# ATTACHMENT D – GEOPHYSICAL TEST DATA (DOWNHOLE) FIELD ELECTRICAL RESISTIVITY

MACTEC

# Vogtle Units 3 & 4 COL Project

## Attachment D

## GEOPHYSICAL TEST DATA (DOWNHOLE)

## FIELD ELECTRICAL RESISTIVITY

## Consists of:

**GEOVision Report dated May 18, 2007**
**(Boring Geophysical Logging)**

**GEOVision Report dated May 7, 2007**
**(Four Electrode Wenner Resistivity Tests)**

## Volume 1 of 1

**Job No. 6141-06-0286**

**MACTEC ENGINEERING**
**AND CONSULTING, INC.**

**May 31, 2007**

MACTEC

May 31, 2007

Mr. Tom McCallum
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**Subject:** **Geotechnical Data Report Attachment D – Geophysical Test Data (Downhole and Field Electrical Resistivity)**
**Vogtle Units 3 & 4 COL Project**
**Vogtle Electric Generating Plant**
**Burke County, Georgia**
**MACTEC Project Number 6141-06-0286**

Dear Mr. McCallum:

MACTEC Engineering & Consulting, Inc. is pleased to submit Attachment D of the Final Data Report for the geotechnical exploration and laboratory testing for the Vogtle Units 3 & 4 COL Project located adjacent to the existing Vogtle Electric Generating Plant near Waynesboro, Burke County, Georgia.

It has been a pleasure to perform the work described in the attached report. If you have any questions, or if we may be of further service, we hope that you will contact us at your convenience.

Sincerely,

MACTEC ENGINEERING & CONSULTING, INC.

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DCN VGCOL 324
Revision 0, 5/31/07

ATTACHMENT D

This Attachment is one of a number of attachments that are part of the following report which was prepared by MACTEC Engineering & Consulting Inc.:

Geotechnical Data Report
Vogtle Units 3 & 4 COL Project
Vogtle Electric Generating Plant
Burke County, Georgia
Subsurface Investigation and Laboratory Testing
SNC Subcontract No. 7074425
MACTEC Job No. 6141-06-0286

For background and a description of scope of work contained in the report, please refer to the above referenced report. The report was addressed as follows:

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The following list shows other Attachments to the above report and their included information:

Survey Data and Test Locations..... See Attachment A

Geotechnical Boring Logs.....See Attachment B

Cone Penetrometer Test Results.....See Attachment C

ReMi Seismic Shear Wave Velocity Measurements .....See Attachment E

Laboratory Testing Data (Geotechnical).....See Attachment F

Resonant Column Torsional Shear (RCTS) Test Results.....See Attachment G

# ATTACHMENT D

# GEOPHYSICAL TEST DATA (DOWNHOLE)

# FIELD ELECTRICAL RESISTIVITY

## CONSISTS OF:

**GEOVision Report dated May 18, 2007**
**(Boring Geophysical Logging)**

**GEOVision Report dated May 7, 2007**
**(Four Electrode Wenner Resistivity Tests)**

**Volume 1 of 1**

# GEOVision Report dated May 18, 2007

# Boring Geophysical Logging

GEOVision
geophysical services

# FINAL REPORT

# BORING GEOPHYSICAL LOGGING
# BORINGS B-3001, B-3002, B-3003, B-4001, B-4002 AND B-4003

# VOGTLE UNITS 3 & 4 COL PROJECT
# VOGTLE ELECTRIC GENERATING PLANT

**Report 6517-01 vol 1 of 2 rev B**

**May 18, 2007**

# FINAL REPORT

# BORING GEOPHYSICAL LOGGING BORINGS B-3001, B-3002, B-3003, B-4001, B-4002 AND B-4003

# VOGTLE UNITS 3 & 4 COL PROJECT VOGTLE ELECTRIC GENERATING PLANT

**Report 6517-01 vol 1 of 2 rev B**

**May 18, 2007**

**Prepared for:**

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# TABLE OF CONTENTS

**TABLE OF CONTENTS** ..... - 3 -

**TABLE OF FIGURES** ..... - 4 -

**TABLE OF TABLES** ..... - 5 -

**INTRODUCTION** ..... - 6 -

**SCOPE OF WORK** ..... - 7 -

**INSTRUMENTATION** ..... - 8 -

SUSPENSION INSTRUMENTATION ..... - 8 -
CALIPER / NATURAL GAMMA INSTRUMENTATION ..... - 11 -
RESISTIVITY / SPONTANEOUS POTENTIAL / NATURAL GAMMA INSTRUMENTATION ..... - 13 -
BORING DEVIATION INSTRUMENTATION ..... - 14 -

**MEASUREMENT PROCEDURES** ..... - 16 -

SUSPENSION MEASUREMENT PROCEDURES ..... - 16 -
CALIPER / NATURAL GAMMA MEASUREMENT PROCEDURES ..... - 16 -
RESISTIVITY / SPONTANEOUS POTENTIAL MEASUREMENT PROCEDURES ..... - 19 -
BORING DEVIATION MEASUREMENT PROCEDURES ..... - 20 -

**DATA ANALYSIS** ..... - 24 -

SUSPENSION ANALYSIS ..... - 24 -
CALIPER / NATURAL GAMMA ANALYSIS ..... - 26 -
RESISTIVITY / NATURAL GAMMA / SPONTANEOUS POTENTIAL ANALYSIS ..... - 26 -
BORING DEVIATION ANALYSIS ..... - 27 -

**RESULTS** ..... - 27 -

SUSPENSION RESULTS ..... - 27 -
CALIPER/ NATURAL GAMMA RESULTS ..... - 28 -
RESISTIVITY / SPONTANEOUS POTENTIAL RESULTS ..... - 28 -
BORING DEVIATION RESULTS ..... - 29 -

**SUMMARY** ..... - 29 -

DISCUSSION OF SUSPENSION RESULTS ..... - 29 -
DISCUSSION OF CALIPER / NATURAL GAMMA RESULTS ..... - 30 -
DISCUSSION OF RESISTIVITY / SPONTANEOUS POTENTIAL RESULTS ..... - 30 -
DISCUSSION OF BORING DEVIATION RESULTS ..... - 31 -
QUALITY ASSURANCE ..... - 32 -
SUSPENSION DATA RELIABILITY ..... - 32 -

# Table of Figures

Figure 1. Example Calibration Curve for Caliper Probe ..... - 18 -
Figure 2: Concept illustration of P-S logging system ..... - 33 -
Figure 3: Example of filtered (1400 Hz lowpass) record ..... - 34 -
Figure 4. Example of unfiltered record ..... - 35 -
Figure 5: Boring B-3001, Suspension R1-R2 P- and $S_H$-wave velocities ..... - 36 -
Figure 6. Boring B-3001, Upper Section, Caliper, Natural gamma, Resistivity and SP logs ..... - 39 -
Figure 7. Boring B-3001, Lower Section, Caliper, Natural gamma, Resistivity and SP logs ..... - 40 -
Figure 8. Boring B-3001, Deviation Projection (dimensions in feet) ..... - 41 -
Figure 9. Boring B-3002, Suspension R1-R2 P- and $S_H$-wave velocities ..... - 42 -
Figure 10. Boring B-3002, Caliper, Natural gamma, Resistivity and SP logs ..... - 44 -
Figure 11. Boring B-3002, Deviation Projection (dimensions in feet) ..... - 45 -
Figure 12. Boring B-3003, Suspension R1-R2 P- and $S_H$-wave velocities ..... - 46 -
Figure 13. Boring B-3003, Caliper, Natural gamma, Resistivity and SP logs ..... - 48 -
Figure 14. Boring B-3003, Deviation Projection (dimensions in feet) ..... - 49 -
Figure 15. Boring B-4001, Suspension R1-R2 P- and $S_H$-wave velocities ..... - 50 -
Figure 16. Boring B-4001, Caliper, Natural gamma, Resistivity and SP logs ..... - 53 -
Figure 17. Boring B-4001, Deviation Projection (dimensions in feet) ..... - 54 -
Figure 18. Boring B-4002, Suspension R1-R2 P- and $S_H$-wave velocities ..... - 55 -
Figure 19. Boring B-4002, Caliper, Natural gamma, Resistivity and SP logs ..... - 57 -
Figure 20. Boring B-4002, Deviation Projection (dimensions in feet) ..... - 58 -
Figure 21: Boring B-4003, Suspension R1-R2 P- and $S_H$-wave velocities ..... - 59 -
Figure 22. Boring B-4003, Caliper, Natural gamma, Resistivity and SP logs ..... - 61 -
Figure 23. Boring B-4003, Deviation Projection (dimensions in feet) ..... - 62 -

# Table of Tables

Table 1 Boring locations and logging dates ..... - 7 -
Table 2. Logging dates and depth ranges ..... - 22 -
Table 3. Boring Bottom Depths and After Survey Depth Error (ASDE) ..... - 23 -
Table 4. Boring Deviation Data Summary ..... - 31 -
Table 5. Boring B-3001, Suspension R1-R2 depths and P- and $S_H$-wave velocities ..... - 37 -
Table 6. Boring B-3002, Suspension R1-R2 depths and P- and $S_H$-wave velocities ..... - 43 -
Table 7. Boring B-3003, Suspension R1-R2 depths and P- and $S_H$-wave velocities ..... - 47 -
Table 8. Boring B-4001, Suspension R1-R2 depths and P- and $S_H$-wave velocities ..... - 51 -
Table 9. Boring B-4002, Suspension R1-R2 depths and P- and $S_H$-wave velocities ..... - 56 -
Table 10. Boring B-4003, Suspension R1-R2 depths and P- and SH-wave velocities ..... - 60 -

# APPENDICES

**APPENDIX A** **SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS ..... - 63 -**

**APPENDIX B** **CALIPER, NATURAL GAMMA, RESISTIVITY, AND SPONTANEOUS POTENTIAL LOGS ..... - 78 -**

**APPENDIX C** **GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION PROCEDURES AND CALIBRATION RECORDS ..... - 113 -**

**APPENDIX D** **BORING GEOPHYSICAL LOGGING FIELD DATA LOGS ..... - 132 -**

**APPENDIX E** **BORING GEOPHYSICAL LOGGING FIELD MEASUREMENT PROCEDURES ..... - 234 -**

# INTRODUCTION

Boring geophysical measurements were collected in six partially cased borings located at the Vogtle Electric Generating Plant, located in Burke County, Georgia. Geophysical data acquisition was performed between January 9 and February 16, 2007 by Rob Steller of **GEO***Vision*. Data analysis and report preparation was performed by Rob Steller and reviewed by John Diehl of **GEO***Vision*. The work was performed under subcontract with MACTEC Engineering and Consulting, Inc., (MACTEC) with Matt Cooke serving as the point of contact for MACTEC.

This report describes the field measurements, data analysis, and results of this work.

# SCOPE OF WORK

This report presents the results of boring geophysical measurements collected between January 9 and February 16, 2007, in six partially cased borings, as detailed below. The purpose of these studies was to supplement stratigraphic information obtained during MACTEC's soil sampling program and to acquire shear wave velocities and compressional wave velocities as a function of depth, as a component of the Vogtle Combined Operating License (COL) Application Project.

| BORING DESIGNATION | DATES LOGGED | ELEVATION – FEET [1] NGVD 1929 | COORDINATES – FEET [1] GEORGIA EAST STATE PLANE NAD 1927 | |
|---|---|---|---|---|
| | | | NORTHING | EASTING |
| B-3001 | 2/12/2007, 2/13/2007 | 218.40 | 1142599.50 | 621799.64 |
| B-3002 | 2/15/2007 | 218.89 | 1142599.97 | 621872.49 |
| B-3003 | 2/16/2007 | 218.29 | 1142599.85 | 621727.30 |
| B-4001 | 1/9/2007, 1/10/2007, 2/13/2007 | 218.88 | 1142599.53 | 621000.20 |
| B-4002 | 2/15/2007 | 219.06 | 1142600.19 | 621072.22 |
| B-4003 | 2/14/2007 | 218.99 | 1142599.93 | 620927.13 |

[1] Survey data provided by MACTEC

Table 1 Boring locations and logging dates

An OYO/Robertson Suspension Logging System was used to obtain in-situ horizontal shear and compressional wave velocity measurements at 1.6 foot intervals. The acquired data were analyzed and a profile of velocity versus depth was produced for both compressional and horizontally polarized shear waves.

A detailed reference for the velocity measurement techniques used in this study is:

> Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.

A Robertson ELXG Combination Electrical probe was used to obtain resistivity, spontaneous potential and natural gamma data at 0.05 foot intervals.

A Robertson 3ACS Caliper probe was used to obtain caliper and natural gamma data at 0.05 foot intervals.

A Robertson High Resolution Acoustic Televiewer probe was used to obtain boring deviation data at 0.04 foot intervals.

# INSTRUMENTATION

## Suspension Instrumentation

Suspension soil velocity measurements were performed in all borings using the PS suspension logging system, manufactured by OYO Corporation, and their subsidiary, Robertson Geologging. This system directly determines the average velocity of a 3.3 foot high segment of the soil column surrounding the boring of interest by measuring the elapsed time between arrivals of a wave propagating upward through the soil column. The receivers that detect the wave, and the source that generates the wave, are moved as a unit in the boring producing relatively constant amplitude signals at all depths.

| |
|---|
| Winch GEOVision 4-conductor |
| Sheave - Measuring wheel GEOVision S/N 102 |
| |
| OYO PS telemetry unit M/N 3403 S/N 160024 |
| Robertson Micrologger II S/N 5310 |
| |
| OYO PS Logger Borehole Probe, includes: |
| Isolation tube, 1m Model 3387B S/N 28068 |
| Weight Model 3302W S/N 12007 |
| OYO PS 170 Source Model 3304 S/N 19043 |
| Receiver/Sensor S/N 30086, 12008 |
| Driver Model 3386A S/N 27073 |

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear-wave source ($S_H$) and compressional-wave source (P), joined to two biaxial receivers by a flexible isolation cylinder, as shown in Figure 1. The separation of the two receivers is 3.3 feet, allowing average wave velocity in the region between the receivers to be determined by inversion of the wave travel time between the two receivers. The total length of the probe as used in these surveys is 19 feet, with the center point of the receiver pair 12.1 feet above the bottom end of the probe.

The probe receives control signals from, and sends the digitized receiver signals to, instrumentation on the surface via an armored 4 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28 foot circumference sheave fitted with a digital rotary encoder.

The entire probe is suspended in the boring by the cable, therefore, source motion is not coupled directly to the boring walls; rather, the source motion creates a horizontally propagating impulsive pressure wave in the fluid filling the boring and surrounding the source. This pressure wave is converted to P and $S_H$-waves in the surrounding soil and rock as it passes through the casing and grout annulus and impinges upon the wall of the boring. These waves propagate through the soil and rock surrounding the boring, in turn causing a pressure wave to be generated in the fluid surrounding the receivers as the soil waves pass their location. Separation of the P and $S_H$-waves at the receivers is performed using the following steps:

1. Orientation of the horizontal receivers is maintained parallel to the axis of the source, maximizing the amplitude of the recorded $S_H$ -wave signals.
2. At each depth, $S_H$-wave signals are recorded with the source actuated in opposite directions, producing $S_H$-wave signals of opposite polarity, providing a characteristic $S_H$-wave signature distinct from the P-wave signal.
3. The 6.3 foot separation of source and receiver 1 permits the P-wave signal to pass and damp significantly before the slower $S_H$-wave signal arrives at the receiver. In faster soils or rock, the isolation cylinder is extended to allow greater separation of the P- and $S_H$-wave signals.
4. In saturated soils, the received P-wave signal is typically of much higher frequency than the received $S_H$-wave signal, permitting additional separation of the two signals by low pass filtering.
5. Direct arrival of the original pressure pulse in the fluid is not detected at the receivers because the wavelength of the pressure pulse in fluid is significantly greater than the dimension of the fluid annulus surrounding the probe (meter versus centimeter scale), preventing significant energy transmission through the fluid medium.

In operation, a distinct, repeatable pattern of impulses is generated at each depth as follows:

1. The source is fired in one direction producing dominantly horizontal shear with some vertical compression, and the signals from the horizontal receivers situated parallel to the axis of motion of the source are recorded.
2. The source is fired again in the opposite direction and the horizontal receiver signals are recorded.
3. The source is fired again and the vertical receiver signals are recorded. The repeated source pattern facilitates the picking of the P and $S_H$-wave arrivals; reversal of the source changes the polarity of the $S_H$-wave pattern but not the P-wave pattern.

The data from each receiver during each source activation is recorded as a different channel on the recording system. The Suspension PS system has six channels (two simultaneous recording channels), each with a 1024 sample record. The recorded data are displayed as six channels with a common time scale. Data are stored on disk for further processing. Up to 8 sampling sequences can be summed to improve the signal to noise ratio of the signals.

Review of the displayed data on the recorder or computer screen allows the operator to set the gains, filters, delay time, pulse length (energy), sample rate, and summing number to optimize the quality of the data before recording. Verification of the calibration of the Suspension PS digital recorder is performed every twelve months using a NIST traceable frequency source and counter, as outlined in Appendix C.

## Caliper / Natural Gamma Instrumentation

Caliper and natural gamma data were collected using a Model 3ACS 3-leg caliper probe, serial number 5368, manufactured by Robertson Geologging, Ltd. With the short arm configuration used in these surveys, the probes permitted measurement of boring diameters between 1.6 and 16 inches. With this tool, caliper measurements were collected concurrent with measurement of natural gamma emission from the boring walls. The probe was 6.82 feet long, and 1.5 inches in diameter.

This probe is useful in the following studies:

- Measurement of boring diameter and volume
- Location of hard and soft formations
- Location of fissures, caving, pinching and casing damage
- Bed boundary identification
- Strata correlation between borings

The probe receives control signals from, and sends the digitized measurement values to, a Robertson Micrologger II, S/N 5310, on the surface via an armored 4 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28 foot circumference sheave fitted with a digital rotary encoder. The probe and depth data are transmitted by USB link from the Micrologger unit to a laptop computer where it is displayed and stored on hard disk.

The caliper consists of three arms, each with a toothed quadrant at their base, pivoted in the lower probe body. A toothed rack engages with each quadrant, thus constraining the arms to move together. Linear movement of the rack is converted to opening and closing of the arms. Springs hold the arms open in the operating position. A motor drive is provided to retract the arms, allowing the probe to be lowered into the boring. The rack is coupled to a potentiometer which converts movement into a voltage sensed by the probe's microprocessor.

Natural gamma measurements rely upon small quantities of radioactive material contained in all rocks to emit gamma radiation as they decay. Trace amounts of Uranium and Thorium are present in a few minerals, where potassium-bearing minerals such as feldspar, mica and clays will include traces of a radioactive isotope of Potassium. These emit gamma radiation as they decay with an extremely long half-life. This radiation is detected by scintillation - the production of a tiny flash of light when gamma rays strike a crystal of sodium iodide. The light is converted into an electrical pulse by a photomultiplier tube. Pulses above a threshold value of 60 KeV are counted by the probe's microprocessor. The measurement is useful because the radioactive elements are concentrated in certain rock types e.g. clay or shales, and depleted in others e.g. sandstone or coal.

## Resistivity / Spontaneous Potential / Natural Gamma Instrumentation

Resistivity, spontaneous potential and natural gamma data were collected using a Model ELXG electric log probe, S/N 5490, manufactured by Robertson Geologging, Ltd. This probe measures Single Point Resistance (SPR), short normal (16") resistivity, long normal (64") resistivity, Spontaneous Potential (SP) and natural gamma. The probe is 8.20 feet long, and 1.73 inches in diameter.

This probe is useful in the following studies:

- Bed boundary identification
- Strata correlation between borings
- Strata geometry and type (shale indication)

The probe receives control signals from, and sends the digitized measurement values to, a Robertson Micrologger II, S/N 5310, on the surface via an armored 4 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28 foot circumference sheave fitted with a digital rotary encoder. The probe and depth data are transmitted by USB link from the Micrologger unit to a laptop computer where it is displayed and stored on hard disk.

The resistivity section of the probe operates by driving an alternating current into the formation from the central SPR/DRIVE electrode. The current returns via the logging cable armor. To ensure adequate penetration of the formation the logging cable is insulated for approximately 30 feet from the cablehead. Voltages are measured between the 16" and 64" electrodes and the remote earth connection at surface, as noted below:

- Single Point Resistance (SPR): The current flowing to the cable armor is measured along with the voltage at the SPR electrode. The voltage divided by current gives resistance.

- Spontaneous Potential (SP): This is the DC bias of the 16" electrode with respect to the voltage return at the surface (ground stake).

Data quality depends upon good grounding at the surface. This is achieved with a metal stake driven into the mud-pit.

## Boring Deviation Instrumentation

Boring deviation data were collected using a High Resolution Acoustic Televiewer probe (HiRAT), serial numbers 4727 and 5174, manufactured by Robertson Geologging, Ltd. The probe is 7.58 feet long, and 1.9 inches in diameter.

In this application, this probe is useful in the following studies:

- Measurement of boring inclination and deviation from vertical
- Determination of need to correct soil and geophysical log depths to true vertical depths

The probe receives control signals from, and sends the digitized measurement values to, a Robertson Micrologger II, S/N 5310, on the surface via an armored 4 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28 foot circumference sheave fitted with a digital rotary encoder. The probe and depth data are transmitted by USB link from the Micrologger unit to a laptop computer where it is displayed and stored on hard disk.

The probe contains a fluxgate magnetometer to monitor magnetic north, and all raw televiewer data are referenced to magnetic north. A three-axis accelerometer is enclosed in the probe, providing boring dip data that, when processed with the orientation data, allows boring deviation data to be obtained.

The data are presented on a computer screen for operator review during the logging run, and stored on hard disk for later processing.

# MEASUREMENT PROCEDURES

## Suspension Measurement Procedures

All six borings were logged as partially cased borings, filled with bentonite or polymer based drilling mud. Measurements followed the **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.3. These procedures were supplied and approved in advance of the work, and included in the MACTEC work plan, as presented in Appendix E. In each boring, the probe was positioned with the top of the probe at the top of the casing, and the electronic depth counter was set to 6.6 feet, the distance between the mid-point of the receiver and the top of the probe, minus the height of the casing stick-up, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the boring, and then returned to the surface, stopping at 1.6 foot intervals to collect data, as summarized in Table 2.

At each measurement depth the measurement sequence of two opposite horizontal records and one vertical record was performed, and the gains were adjusted as required. The data from each depth were viewed on the computer display, checked, and recorded on disk before moving to the next depth.

Upon completion of the measurements, the probe zero depth indication at the depth reference point was verified prior to removal from the boring.

## Caliper / Natural Gamma Measurement Procedures

All six borings were logged as partially cased borings, filled with bentonite or polymer based drilling mud. Measurements followed the ASTM D6167 Conducting Borehole Geophysical Logging – Mechanical Caliper.

Prior to and following each logging run, the caliper tool was verified, using the manufacturer's supplied three point calibration jig, and a PVC coupling provided by MACTEC with an inside diameter traceable to NIST. The three point jig is a circular plate with a series of holes in the top surface into which the tips of the caliper arms fit. This has circles of diameters from 2" to 12", with NIST traceable calibration as documented in Appendix C. The calibration jig is placed over a bucket with the probe standing upright with its nose section passing through the jig's central hole. The caliper probe arms are opened under program control, and a log is recorded as the tips of the arms are placed in the holes on the calibration jig and inside the PVC coupling. The measured dimensions, as displayed on the recording computer screen was recorded on the field log sheet, as well as in the digital files, and compared with the calibration jig dimensions. These files are presented in LAS 2.0 format in the boring specific sub-directories of the data directory on volume 2 of 2 (CD-R) of this report. If the verification records did not fall within +/- 0.05 inches of the calibration jig values, the caliper tool was re-calibrated, using the three point calibration jig, and the log repeated. As with the verification, the tips of the caliper arms are placed in the holes marked with the required diameter. During calibration, the value of the current calibration point, as stamped on the jig, is entered via the control computer. The system counts for 15 seconds to make an average of the response. The procedure is repeated for the second and third required openings.

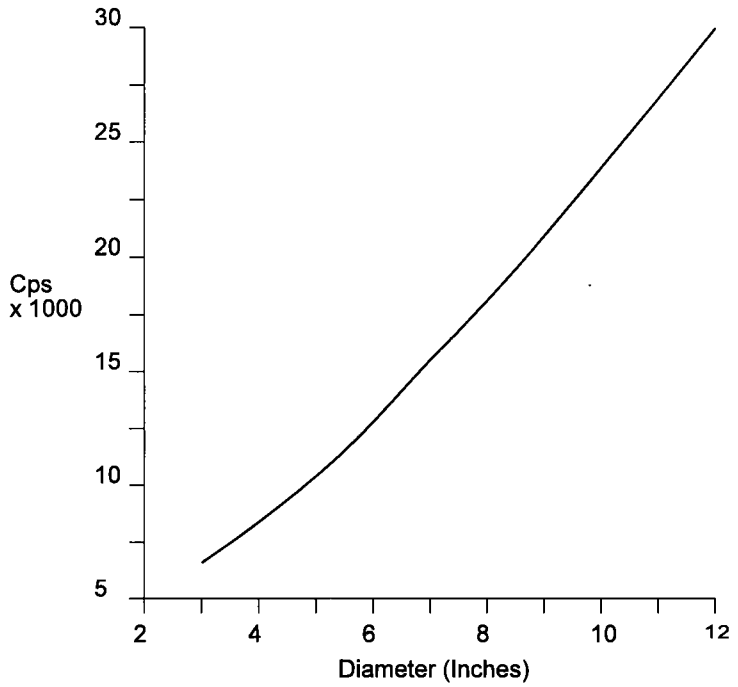



Figure 1. Example Calibration Curve for Caliper Probe

The computation and generation of the calibration coefficient file is entirely automatic. The calibration file is simply the set of coefficients of a quadratic curve which fits the three data points. Figure 1 shows the response of a caliper probe using data gathered during calibration.

Natural gamma was not calibrated in the field, as it is a qualitative measurement, not a quantitative value, and is used only to assist in picking transitions between stratigraphic units, as described in ASTM D6274, Conducting Borehole Geophysical Logging - Gamma,.

In each boring, the probe was positioned with the top of the probe at the top of the mud box, and the electronic depth counter was set to 6.82 feet, the specified length of the probe, minus the height of the mud box, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the boring, where the caliper legs were opened, and data collection begun. The probe was then returned to the surface at 10 feet/minute, collecting data continuously at 0.05 foot spacing, as summarized in Table 2.

Upon completion of the measurements, the probe zero depth indication at the depth reference point was verified prior to removal from the boring, as summarized in Table 3.

## Resistivity / Spontaneous Potential Measurement Procedures

All six borings were logged as partially cased borings, filled with bentonite or polymer based drilling mud. The probe was connected to the logging cable using a 32.8 foot long insulating cable section or "yoke". The probe head was insulated by wrapping all exposed metal of the cablehead and probe with self-amalgamating insulation tape. The 32.8 foot insulating yoke was checked for any damage, and repaired with self-amalgamating insulation tape as needed.

The reference ground stake was driven firmly into the mud pit, and connected to the ground socket on the winch switch box.

This sonde was not calibrated in the field, as it is used to provide qualitative measurements, not quantitative values, and is used only to assist in picking transitions between stratigraphic units, as described in ASTM D5753, Planning and Conducting Borehole Geophysical Surveys. A functional test is performed prior to each logging run by applying fixed resistance values across the probe electrodes, as well as a 100 millivolt signal across the SP electrodes, and recording the resultant output of the system. These functional checks are presented in LAS 2.0 format in the boring specific sub-directories of the data directory on volume 2 of 2 (CD-R) of this report.

In each boring, the probe was positioned with the top of the probe at the top of the casing or mud box, and the electronic depth counter was set to 8.2 feet, the specified length of the probe, minus the height of the casing stick-up or mud box, as verified with a tape measure. When logging on smaller drill rigs, the depth was zeroed to the top of the yoke, and 32.8 feet was added to the zero depth, as recorded in the field logs. The probe was lowered to the bottom of the boring, where data collection was begun. The probe was then returned to the surface at 10 feet/minute, collecting data continuously at 0.05 foot spacing, as summarized in Table 2. The natural gamma data collected in

these logs is redundant with the data collected in the caliper / natural gamma logs, and the caliper / natural data may be used to verify the natural gamma data collected in these logs.

Normally, when the un-insulated section of the logging cable leaves the boring fluid, the log is terminated, as the electrical measurements do not function under these conditions. However, in these surveys, the log was continued, in order to collect as much natural gamma data as possible before the yoke connector reached the measuring wheel.

Upon completion of the measurements, the probe zero depth indication at the depth reference point was verified prior to removal from the boring, as summarized in Table 3.

## Boring Deviation Measurement Procedures

All six borings were logged as partially cased borings, filled with bentonite or polymer based drilling mud. Although the High Resolution Acoustic Televiewer (HiRAT) cannot image in the soft soils at this site, this instrument was used in order to provide a deviation log for each boring. Measurements followed ASTM D5753, Planning and Conducting Borehole Geophysical Surveys.

Prior to use, the HiRAT probe tiltmeter and compass functions were checked by comparison with a Brunton surveyors' compass.

In each boring, the HiRAT probe was positioned with the top of the probe at the top of the casing, and the electronic depth counter was set to 4.71 feet, the specified length of the probe, minus the height of the casing stick-up, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the boring, and data collection begun. The probe was then returned to the surface at 10.0 feet/minute, collecting data continuously at 0.04 foot intervals, as summarized in Table 2.

Upon completion of the measurements, the probe zero depth indication at grade was verified prior to removal from the boring. The log was reviewed in the field, and the data processed with Robertson Geologging RGLDIP software, version 6.2, to produce a boring deviation plot and data in ASCII format. These files are presented in the boring specific sub-directories of the data directory on volume 2 of 2 (CD-R) of this report, and summarized in Table 4.

| BORING NUMBER | TOOL AND RUN NUMBER | DEPTH RANGE (FEET) | OPEN HOLE (FEET) | DEPTH TO BOTTOM OF CASING (FEET) | SAMPLE INTERVAL (FEET) | DATE LOGGED |
|---|---|---|---|---|---|---|
| B-3001 | ELOG/GAMMA 1 | 262.0 – 20.0 | 262.0 | 95.0 | 0.05 | 2/12/2007 |
| B-3001 | SUSPENSION 1 | 98.4 – 237.9 | - | 95.0 | 1.6 | 2/12/2007 |
| B-3001 | CALIPER/GAMMA 1 | 245.0 - 0 | - | 95.0 | 0.05 | 2/12/2007 |
| B-3001 | DEVIATION 1 | 247.0 - 0 | - | 95.0 | 0.04 | 2/12/2007 |
| B-3001 | ELOG/GAMMA 2 | 405.0 – 240.0 | 405.0 | 275.0 | 0.05 | 2/13/2007 |
| B-3001 | ELOG/GAMMA 3 | 404.0 – 240.0 | - | 275.0 | 0.05 | 2/13/2007 |
| B-3001 | SUSPENSION 2 | 277.2 – 394.0 | 406.1 | 275.0 | 1.6 | 2/13/2007 |
| B-3001 | CALIPER/GAMMA 2 | 400.0 - 240.0 | - | 275.0 | 0.05 | 2/13/2007 |
| B-3001 | DEVIATION 2 | 402.0 – 240.0 | - | 275.0 | 0.04 | 2/13/2007 |
| B-3002 | ELOG/GAMMA 1 | 248.0 – 25.0 | 248.0 | 95.5 | 0.05 | 2/15/2007 |
| B-3002 | ELOG/GAMMA 2 | 248.0 – 25.0 | 248.0 | 95.5 | 0.05 | 2/15/2007 |
| B-3002 | SUSPENSION 1 | 96.8 – 236.2 | 248.3 | 95.5 | 1.6 | 2/15/2007 |
| B-3002 | CALIPER/GAMMA 1 | 245.0 - 0 | - | 95.5 | 0.05 | 2/15/2007 |
| B-3002 | DEVIATION 1 | 246.0 - 0 | - | 95.5 | 0.04 | 2/15/2007 |
| B-3003 | ELOG/GAMMA 1 | 249.0 – 20.0 | 249.0 | 97.0 | 0.05 | 2/16/2007 |
| B-3003 | SUSPENSION 1 | 98.4 – 236.2 | 248.3 | 97.0 | 1.6 | 2/16/2007 |
| B-3003 | CALIPER/GAMMA 1 | 245.0 - 0 | - | 97.0 | 0.05 | 2/16/2007 |
| B-3003 | DEVIATION 1 | 248.0 - 0 | 248.0 | 97.0 | 0.04 | 2/16/2007 |
| B-4001 | ELOG/GAMMA 1 | 399.2 – 340.0 | 399.2 | 97.5 | 0.05 | 1/9/2007 |
| B-4001 | ELOG/GAMMA 2 | 340.0 - 319.6 | - | 97.5 | 0.05 | 1/9/2007 |
| B-4001 | ELOG/GAMMA 3 | 330.0 – 288.6 | - | 97.5 | 0.05 | 1/9/2007 |
| B-4001 | ELOG/GAMMA 4 | 300.0 - 0 | - | 97.5 | 0.05 | 1/9/2007 |
| B-4001 | CALIPER/GAMMA 1 | 395.0 – 343.3 | - | 97.5 | 0.05 | 1/9/2007 |
| B-4001 | ELOG/GAMMA 5 | 399.5 – 111.5 | 399.5 | 97.5 | 0.05 | 1/10/2007 |
| B-4001 | ELOG/GAMMA 6 | 0 – 61.9 | - | 97.5 | 0.05 | 1/10/2007 |
| B-4001 | DEVIATION 1 | 399.0 - 0 | - | 97.5 | 0.04 | 1/10/2007 |
| B-4001 | SUSPENSION 1 | 8.2 – 385.5 | - | 97.5 | 1.6 | 1/10/2007 |
| B-4001 | ELOG/GAMMA 7 | 399.5 – 20.0 | 399.5 | 97.5 | 0.05 | 2/13/2007 |
| B-4001 | CALIPER/GAMMA 1 | 397.0 - 0 | - | 97.5 | 0.05 | 2/13/2007 |
| B-4002 | ELOG/GAMMA 1 | 250.7 – 20.0 | 250.7 | 96.0 | 0.05 | 2/15/2007 |
| B-4002 | ELOG/GAMMA 2 | 250.0 – 20.0 | 250.07 | 96.0 | 0.05 | 2/15/2007 |
| B-4002 | SUSPENSION 1 | 98.4 – 236.2 | - | 96.0 | 1.6 | 2/15/2007 |
| B-4002 | CALIPER/GAMMA 1 | 247.0 - 0 | - | 96.0 | 0.05 | 2/15/2007 |
| B-4002 | DEVIATION 1 | 248.0 - 0 | - | 96.0 | 0.04 | 2/15/2007 |
| B-4003 | ELOG/GAMMA 1 | 250.8 – 20.0 | 250.8 | 96.0 | 0.05 | 2/14/2007 |
| B-4003 | SUSPENSION 1 | 3.3 – 211.6 | - | 96.0 | 1.6 | 2/14/2007 |
| B-4003 | SUSPENSION 2 | NO DATA | - | 96.0 | | 2/14/2007 |
| B-4003 | SUSPENSION 3 | 167.3 – 237.9 | - | 96.0 | 1.6 | 2/14/2007 |
| B-4003 | CALIPER/GAMMA 1 | 247.0 - 0 | - | 96.0 | 0.05 | 2/14/2007 |
| B-4003 | DEVIATION 1 | 250.0 - 0 | 250.0 | 96.0 | 0.04 | 2/14/2007 |
| B-4003 | DEVIATION 2 | 250.0 – 0 | 250.0 | 96.0 | 0.04 | 2/14/2007 |

- PROBE DID NOT TOUCH BOTTOM OF BORING

Table 2. Logging dates and depth ranges

| BORING NUMBER | TOOL AND RUN NUMBER | TOOL HIT BOTTOM DEPTH (FEET) | DRILLER DEPTH (FEET) | STARTING DEPTH REF. (FEET) | ENDING DEPTH REF. (FEET) | ASDE (FEET) |
|---|---|---|---|---|---|---|
| B-3001 | ELOG/GAMMA 1 | 262.0 | 420.0 | 38.7 | 38.4 | 0.3 |
| B-3001 | SUSPENSION 1 | - | | 5.9 | 5.9 | 0 |
| B-3001 | CALIPER/GAMMA 1 | - | | 4.5 | 4.5 | 0 |
| B-3001 | DEVIATION 1 | - | | 2.4 | 2.5 | 0.1 |
| B-3001 | ELOG/GAMMA 2 | 405.0 | | 38.7 | 38.5 | -0.2 |
| B-3001 | ELOG/GAMMA 3 | - | | 38.7 | 38.5 | -0.2 |
| B-3001 | SUSPENSION 2 | 406.1 | | 5.9 | 5.8 | -0.1 |
| B-3001 | CALIPER/GAMMA 2 | - | | 4.5 | 4.5 | 0 |
| B-3001 | DEVIATION 2 | - | | 2.4 | 2.2 | -0.2 |
| B-3002 | ELOG/GAMMA 1 | 248.0 | 250.0 | 39.5 | 39.5 | 0 |
| B-3002 | ELOG/GAMMA 2 | 248.0 | | 39.5 | 39.5 | 0 |
| B-3002 | SUSPENSION 1 | 248.3 | | 6.6 | 6.6 | 0 |
| B-3002 | CALIPER/GAMMA 1 | - | | 5.3 | 5.3 | 0 |
| B-3002 | DEVIATION 1 | - | | 3.2 | 3.2 | 0 |
| B-3003 | ELOG/GAMMA 1 | 249.0 | 250.0 | 39.5 | 39.4 | -0.1 |
| B-3003 | SUSPENSION 1 | 248.3 | | 6.6 | 6.6 | 0 |
| B-3003 | CALIPER/GAMMA 1 | - | | 5.3 | 5.3 | 0 |
| B-3003 | DEVIATION 1 | 248.0 | | 3.2 | 3.2 | 0 |
| B-4001 | ELOG/GAMMA 1 | 399.2 | 400.0 | 6.2 | 6.5 | 0.3 |
| B-4001 | ELOG/GAMMA 2 | - | | 6.2 | 6.5 | 0.3 |
| B-4001 | ELOG/GAMMA 3 | - | | 6.2 | 6.5 | 0.3 |
| B-4001 | ELOG/GAMMA 4 | - | | 6.2 | 6.5 | 0.3 |
| B-4001 | CALIPER/GAMMA 1 | - | | 4.8 | 4.8 | 0 |
| B-4001 | ELOG/GAMMA 5 | 399.5 | | 6.2 | 6.0 | -0.2 |
| B-4001 | ELOG/GAMMA 6 | - | | 6.2 | 6.0 | -0.2 |
| B-4001 | DEVIATION 1 | - | | 2.7 | 2.5 | -0.2 |
| B-4001 | SUSPENSION 1 | - | | 5.9 | 5.9 | -0.1 |
| B-4001 | ELOG/GAMMA 7 | 399.5 | | 38.8 | 38.7 | -0.1 |
| B-4001 | CALIPER/GAMMA 1 | - | | 4.6 | 4.6 | 0 |
| B-4002 | ELOG/GAMMA 1 | 250.7 | 250.0 | 38.6 | 38.4 | -0.2 |
| B-4002 | ELOG/GAMMA 2 | 250.0 | 250.0 | 38.6 | 38.4 | -0.2 |
| B-4002 | SUSPENSION 1 | - | | 5.8 | 5.7 | -0.1 |
| B-4002 | CALIPER/GAMMA 1 | - | | 4.4 | 4.4 | 0 |
| B-4002 | DEVIATION 1 | - | | 2.3 | 2.3 | 0 |
| B-4003 | ELOG/GAMMA 1 | 250.8 | 250.0 | 38.5 | 38.5 | 0 |
| B-4003 | SUSPENSION 1 | - | | 5.7 | 5.6 | -0.1 |
| B-4003 | SUSPENSION 2 | - | | 5.7 | 5.7 | 0 |
| B-4003 | SUSPENSION 3 | - | | 5.7 | 5.7 | 0 |
| B-4003 | CALIPER/GAMMA 1 | - | | 4.3 | 4.3 | 0 |
| B-4003 | DEVIATION 1 | 250.0 | | 2.2 | 2.2 | 0 |
| B-4003 | DEVIATION 2 | 250.0 | | 2.2 | 2.1 | -0.1 |

- PROBE DID NOT TOUCH BOTTOM OF BORING

Table 3. Boring Bottom Depths and After Survey Depth Error (ASDE)

# DATA ANALYSIS

## Suspension Analysis

Using the proprietary OYO program PSLOG.EXE version 1.0, included in volume 2 of 2 (CD-R) of this report, the recorded digital waveforms were analyzed to locate the most prominent first minima, first maxima, or first break on the vertical axis records, indicating the arrival of P-wave energy. The difference in travel time between receiver 1 and receiver 2 (R1-R2) arrivals was used to calculate the P-wave velocity for that 3.3 foot segment of the soil column. When observable, P-wave arrivals on the horizontal axis records were used to verify the velocities determined from the vertical axis data. The time picks were then transferred into an EXCEL template (EXCEL version 2003 SP2) to complete the velocity calculations based upon the arrival time picks made in PSLOG. The PSLOG pick files and the EXCEL analysis files are included in the boring specific directories on volume 2 of 2 (CD-R) of this report.

The P-wave velocity over the 6.3 foot interval from source to receiver 1 (S-R1) was also picked using PSLOG, and calculated and plotted in EXCEL, for quality assurance of the velocity derived from the travel time between receivers. In this analysis, the depth values as recorded were increased by 4.8 feet to correspond to the mid-point of the 6.3 foot S-R1 interval. Travel times were obtained by picking the first break of the P-wave signal at receiver 1 and subtracting 0.3 milliseconds, the calculated and experimentally verified delay from source trigger pulse (beginning of record) to source impact. This delay corresponds to the duration of acceleration of the solenoid before impact.

As with the P-wave records, using PSLOG, the recorded digital waveforms were analyzed to locate the presence of clear $S_H$-wave pulses, as indicated by the presence of opposite polarity pulses on each pair of horizontal records. Ideally, the $S_H$-wave signals from the 'normal' and 'reverse' source pulses are very nearly inverted images of each other. Digital FFT - IFFT lowpass filtering was used to remove the higher frequency P-wave signal from the $S_H$-wave signal. Different filter cutoffs

were used to separate P- and $S_H$-waves at different depths, ranging from 600 Hz in the slowest zones to 2000 Hz in the regions of highest velocity. At each depth, the filter frequency was selected to be at least twice the fundamental frequency of the $S_H$-wave signal being filtered.

Generally, the first maxima were picked for the 'normal' signals and the first minima for the 'reverse' signals, although other points on the waveform were used if the first pulse was distorted. The absolute arrival time of the 'normal' and 'reverse' signals may vary by +/- 0.2 milliseconds, due to differences in the actuation time of the solenoid source caused by constant mechanical bias in the source or by boring inclination. This variation does not affect the R1-R2 velocity determinations, as the differential time is measured between arrivals of waves created by the same source actuation. The final velocity value is the average of the values obtained from the 'normal' and 'reverse' source actuations.

As with the P-wave data, $S_H$-wave velocity calculated from the travel time over the 6.3 foot interval from source to receiver 1 was calculated and plotted for verification of the velocity derived from the travel time between receivers. In this analysis, the depth values were increased by 4.8 foot to correspond to the mid-point of the 6.3 foot S-R1 interval. Travel times were obtained by picking the first break of the $S_H$-wave signal at the near receiver and subtracting 0.3 milliseconds, the calculated and experimentally verified delay from the beginning of the record at the source trigger pulse to source impact.

These data and analysis were reviewed by John Diehl and Tony Martin as a component of **GEO***Vision*'s in-house QA-QC program.

Figure 2 shows an example of R1 - R2 measurements on a sample filtered suspension record. In Figure 2, the time difference over the 3.3 foot interval of 1.88 milliseconds for the horizontal signals is equivalent to an $S_H$-wave velocity of 1745 feet/second. Whenever possible, time differences were determined from several phase points on the $S_H$-waveform records to verify the data obtained from the first arrival of the $S_H$-wave pulse. Figure 3 displays the same record before filtering of the $S_H$-waveform record with a 1400 Hz FFT - IFFT digital lowpass filter, illustrating

the presence of higher frequency P-wave energy at the beginning of the record, and distortion of the lower frequency $S_H$-wave by residual P-wave signal.

## Caliper / Natural Gamma Analysis

No analysis is required with the caliper or natural gamma data, however depths to identifiable boring features were compared to verify compatible depth readings on all logs. Using Robertson Geologging Winlogger software version 1.5, build 401J, these data were combined with the resistivity, ELOG based natural gamma and spontaneous potential (SP) logs, and converted to LAS 2.0 and PDF formats for transmittal to the client.

## Resistivity / Natural Gamma / Spontaneous Potential Analysis

No analysis is required with the resistivity, natural gamma or spontaneous potential data, however depths to identifiable boring features were compared to verify compatible depth readings on all logs. Using Robertson Geologging Winlogger software version 1.5, build 401J, these data were combined with the caliper and caliper-based natural gamma logs, and converted to LAS 2.0 and PDF formats for transmittal to the client.

### Boring Deviation Analysis

The collected deviation data were processed with Robertson Geologging's RGLDIP program, version 6.2, to extract the deviation values and produce an ASCII file and plots of deviation data as presented in the boring specific sub-directories in the data directory on volume 2 of 2 (CD-R) of this report, and summarized in Table 4.

## RESULTS

### Suspension Results

Suspension R1-R2 P- and $S_H$-wave velocities are plotted in Figures 5, 9, 12, 15, 18 and 21 The suspension velocity data presented in these figures are presented in Tables 5 – 10. The PSLOG and EXCEL analysis files for each boring are included in the boring specific directories on volume 2 of 2 (CD-R) of this report, along with the raw and filtered waveforms.

P- and $S_H$-wave velocity data from R1-R2 analysis and quality assurance analysis of S-R1 data are plotted together in Figures A-1 through A-6 to aid in visual comparison. It should be noted that R1-R2 data are an average velocity over a 3.3 foot segment of the soil column; S-R1 data are an average over 6.3 feet, creating a significant smoothing relative to the R1-R2 plots. S-R1 data are presented in Tables A-1 through A-6, and included in the EXCEL analysis files for each boring on volume 2 of 2 (CD-R) of this report.

Calibration procedures and records for the suspension PS measurement system are presented in Appendix C, and **GEO***Vision* standard field log sheets for all borings are reproduced in Appendix D.

The **GEO***Vision* standard field procedures are reproduced in Appendix E.

## Caliper/ Natural Gamma Results

Caliper and natural gamma data are presented in combined log plots with resistivity and spontaneous potential as single page logs in Figures 6, 7, 10, 13, 16, 19 and 22, as well as multi-page logs in Appendix B. On these plots, the following acronyms are used:

- NGAM: Natural gamma data collected with the caliper probe.
- SP: Spontaneous (self) potential.
- EGAM: Natural gamma data collected with the ELOG probe.
- CALP: Caliper (borehole diameter)
- SHN: Short normal resistivity (16 inch resistivity)
- LON: Long normal resistivity (64 inch resistivity)
- SPR: Single point resistance

LAS 2.0 data and Acrobat files of the plots for each boring are included in the boring specific sub-directories in the data directory on volume 2 of 2 (CD-R) of this report.

## Resistivity / Spontaneous Potential Results

Resistivity and spontaneous potential data are presented in combined log plots with caliper and natural gamma data as single page logs in Figures 6, 7, 10, 13, 16, 19 and 22, as well as multi-page logs in Appendix B. LAS 2.0 data and Acrobat files for each boring are included in the boring specific sub-directories in the data directory on volume 2 of 2 (CD-R) of this report.

### Boring Deviation Results

Boring deviation data are presented graphically in Figures 8, 11, 14, 17, 20 and 23, and summarized in Table 4. Deviation data plots in Acrobat format and deviation data at 1.0 foot stations are presented in ASCII format in the boring specific sub-directories of the data directory on volume 2 of 2 (CD-R) of this report.

## SUMMARY

### Discussion of Suspension Results

Suspension PS velocity data are ideally collected in an uncased fluid filled boring, drilled with rotary mud (rotary wash) methods. Below approximately 96 feet, the borings at this site were generally good for collection of suspension PS velocity data. The upper 96 feet of these borings were cased with 6 inch casing to prevent collapse and fluid loss. In B-3001, drill rod was placed to 275 feet as a temporary casing through a persistently collapsing zone between 262 and 270 feet. Data collection was performed in the top 96 feet of B-4001, to evaluate if valid velocity data could be obtained through the 6 inch casing. Review of the data indicated poor casing coupling, and the data was not interpretable. No further velocity data was collected in the cased sections of the borings.

Suspension PS velocity data quality is judged based upon 5 criteria:

1. Consistent data between receiver to receiver (R1 – R2) and source to receiver (S – R1) data.
2. Consistent relationship between P-wave and $S_H$ -wave (excluding transition to saturated soils)
3. Consistency between data from adjacent depth intervals.
4. Clarity of P-wave and $S_H$-wave onset, as well as damping of later oscillations.
5. Consistency of profile between adjacent borings, if available.

These data show excellent correlation between R1 – R2 and S – R1 data, as well as excellent correlation between P-wave and $S_H$-wave velocities. P-wave and $S_H$-wave onsets are generally clear, and later oscillations are well damped.

## Discussion of Caliper / Natural Gamma Results

Caliper and natural gamma data were collected for the entire depth of each boring, as natural gamma data can be collected through PVC casing without attenuation, and through steel casing with some attenuation. The caliper logs for these borings show boring erosion extending beyond 12 inches in diameter in a number of areas. Natural gamma data were collected with this tool in all the borings, as well as with the ELOG probe, and the comparison between the two data sets provides an almost exact match, verifying the performance of the natural gamma measuring systems.

## Discussion of Resistivity / Spontaneous Potential Results

These electrical methods provide clear demarcation of different lithologic units at this site. All three resistivity logs show the same structure, and match very closely with the structure indicated by the natural gamma logs. The electrical data are not valid above about 97 feet, as the electrodes move into casing at this depth. This is also the case for B-3001 lower section above 275 feet, where drill rod was placed as a temporary casing. The natural gamma data remains valid, though attenuated, inside the casing, and agrees well with gamma data from the caliper probe. The comparison between the two data sets provides an almost exact match, verifying the performance of the natural gamma measuring systems.

## Discussion of Boring Deviation Results

All six borings were inclined at 4.9 degrees, or less, from vertical, and the maximum error in depth value was 1.9 feet in 397 feet, or 0.5 percent, as presented in Table 4. This error is only slightly more than the 0.4 percent after survey depth error (ASDE) required by ASTM D5753, Planning and Conducting Borehole Geophysical Surveys, and probably less than cumulative depth errors from other causes, so no adjustment of log depth is indicated.

| BORING NUMBER | MEAN DEVIATION AND AZIMUTH (DEGREES) | SURVEY DEPTH (FEET) | VERTICAL DEPTH (FEET) | DEPTH ERROR (FEET) | HORIZONTAL OFFSET (FEET) |
|---|---|---|---|---|---|
| B-3001 | 0.8 – N106.8 | 401.9 | 401.7 | 0.2 | 5.4 |
| B-3002 | 1.0 – N252.4 | 245.9 | 245.7 | 0.2 | 4.5 |
| B-3003 | 1.3 – N105.3 | 247.9 | 247.8 | 0.1 | 5.8 |
| B-4001 | 4.9 – N278.5 | 398.9 | 397.0 | 1.9 | 34.0 |
| B-4002 | 1.8 – N37.4 | 248.8 | 248.5 | 0.3 | 7.8 |
| B-4003 | 2.6 – N120.1 | 249.8 | 249.3 | 0.5 | 11.5 |

Table 4. Boring Deviation Data Summary

## Quality Assurance

These boring geophysical measurements were performed using industry-standard or better methods for measurements and analyses. All work was performed under **GEO***Vision* quality assurance procedures, which include:

- Use of NIST-traceable calibrations, where applicable, for field and laboratory instrumentation
- Use of standard field data logs
- Use of independent verification of velocity data by comparison of receiver-to-receiver and source-to-receiver velocities
- Independent review of calculations and results by a registered professional engineer, geologist, or geophysicist.

## Suspension Data Reliability

P- and $S_H$-wave velocity measurement using the Suspension Method gives average velocities over a 3.3 foot interval of depth. This high resolution results in the scatter of values shown in the graphs. Individual measurements are very reliable with estimated precision of +/- 5%. Standardized field procedures and quality assurance checks contribute to the reliability of these data.

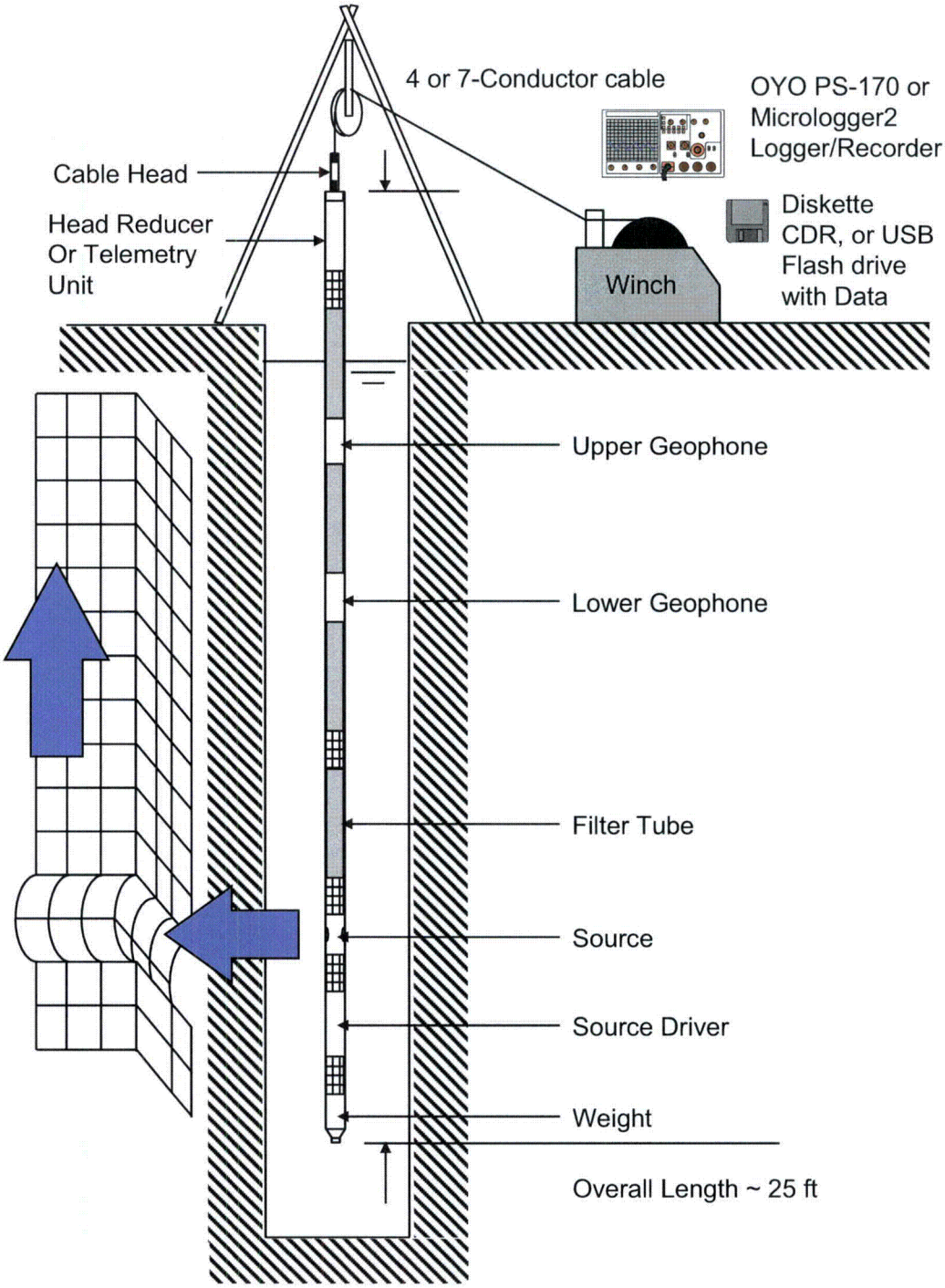



Figure 2: Concept illustration of P-S logging system

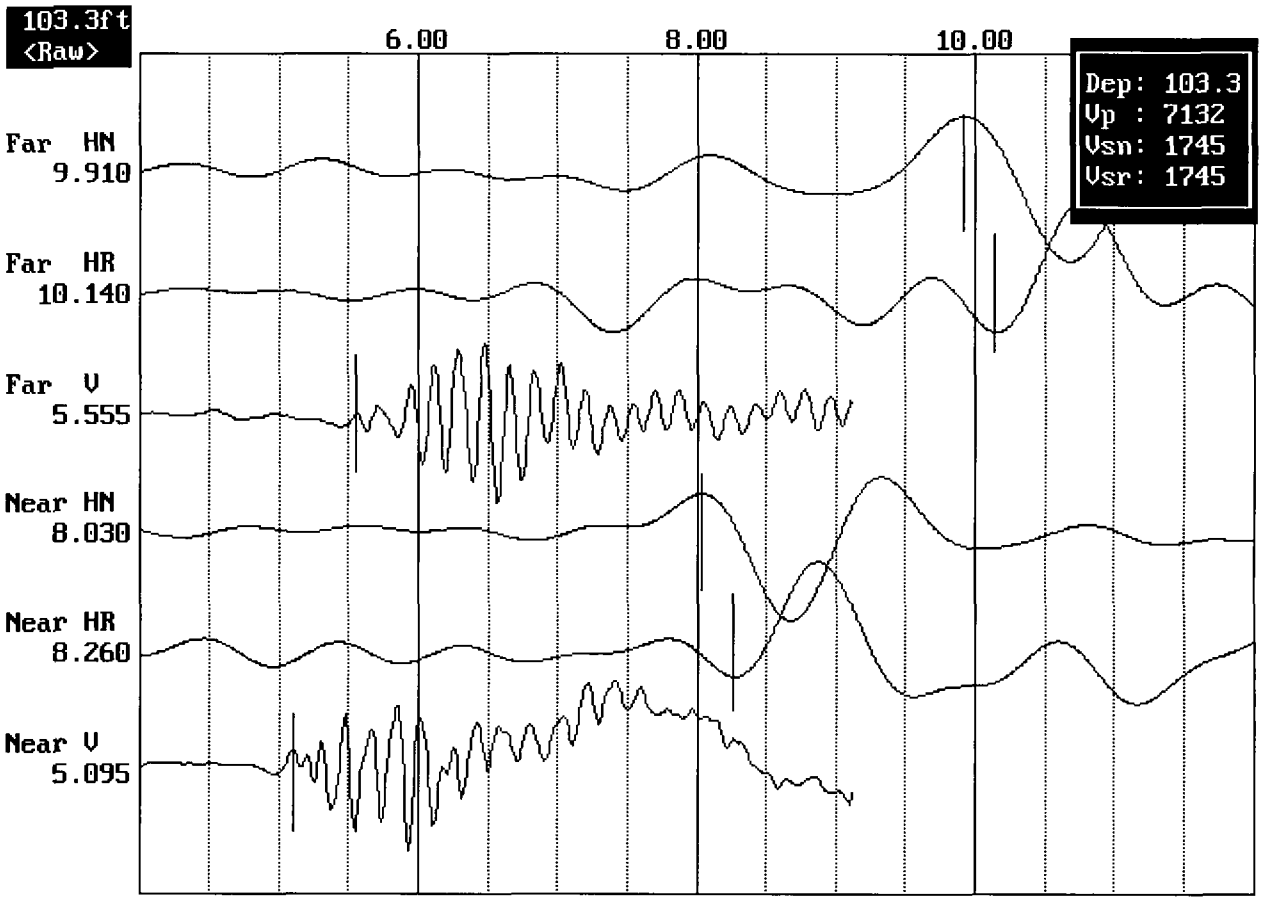



Figure 3: Example of filtered (1400 Hz lowpass) record

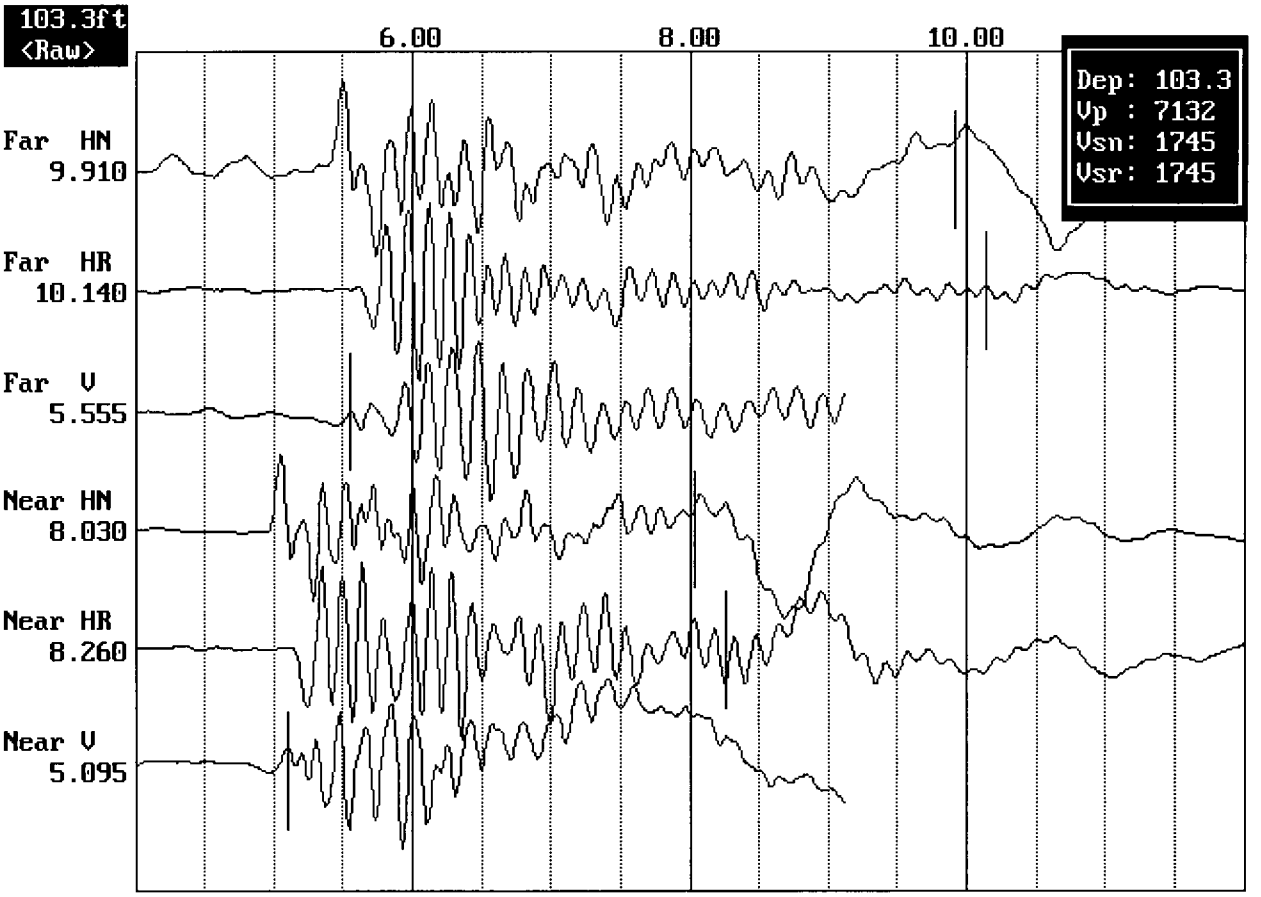



Figure 4. Example of unfiltered record

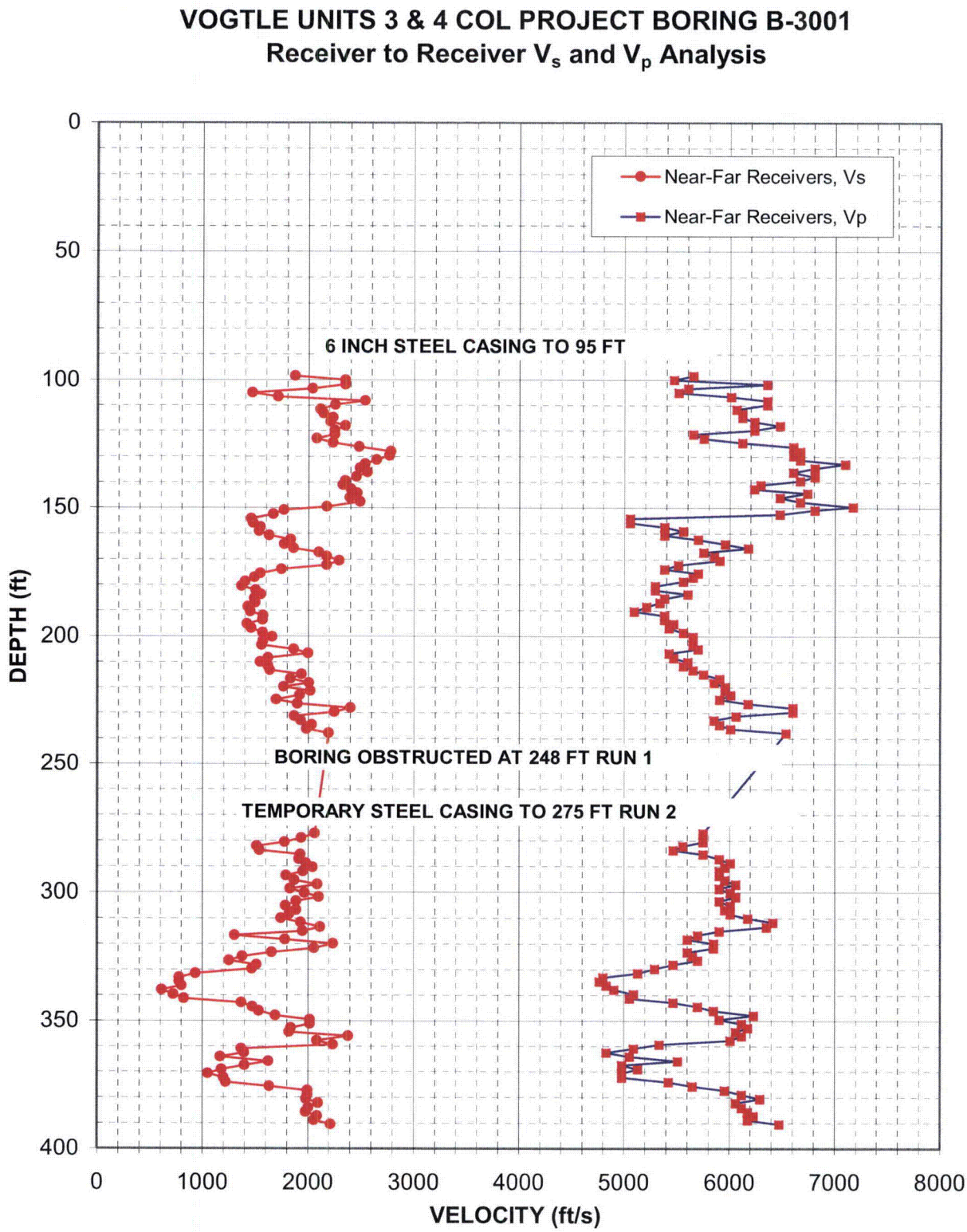



Figure 5: Boring B-3001, Suspension R1-R2 P- and $S_H$-wave velocities

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 98.4 | 1870 | 5650 |
| 100.1 | 2350 | 5460 |
| 101.7 | 2350 | 6350 |
| 103.4 | 2040 | 5600 |
| 105.0 | 1470 | 5510 |
| 106.6 | 1710 | 6010 |
| 108.3 | 2530 | 6350 |
| 109.9 | 2250 | 6350 |
| 111.6 | 2110 | 6060 |
| 113.2 | 2140 | 6120 |
| 114.8 | 2230 | 6120 |
| 116.5 | 2210 | 6230 |
| 118.1 | 2350 | 6470 |
| 119.8 | 2240 | 6230 |
| 121.4 | 2240 | 5650 |
| 123.0 | 2080 | 5750 |
| 124.7 | 2230 | 6120 |
| 126.3 | 2480 | 6600 |
| 128.0 | 2780 | 6670 |
| 129.6 | 2770 | 6600 |
| 131.2 | 2650 | 6670 |
| 132.9 | 2530 | 7090 |
| 134.5 | 2490 | 6800 |
| 136.2 | 2550 | 6600 |
| 137.8 | 2450 | 6800 |
| 139.4 | 2350 | 6670 |
| 141.1 | 2320 | 6290 |
| 142.7 | 2400 | 6230 |
| 144.4 | 2460 | 6730 |
| 146.0 | 2390 | 6470 |
| 147.6 | 2490 | 6670 |
| 149.6 | 2170 | 7170 |
| 150.9 | 1770 | 6800 |
| 152.6 | 1670 | 6470 |
| 154.2 | 1460 | 5050 |
| 155.8 | 1470 | 5050 |
| 157.5 | 1540 | 5380 |
| 159.1 | 1530 | 5560 |
| 160.8 | 1630 | 5380 |
| 162.4 | 1830 | 5700 |
| 164.0 | 1770 | 5950 |
| 165.7 | 1860 | 6170 |
| 167.3 | 2100 | 5750 |
| 169.0 | 2170 | 5850 |
| 170.6 | 2290 | 5900 |
| 172.2 | 2170 | 5510 |
| 173.9 | 1750 | 5380 |
| 175.5 | 1540 | 5700 |
| 177.2 | 1490 | 5650 |
| 178.8 | 1400 | 5560 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 180.5 | 1370 | 5290 |
| 182.1 | 1500 | 5290 |
| 183.7 | 1550 | 5600 |
| 185.4 | 1490 | 5380 |
| 187.0 | 1490 | 5330 |
| 188.7 | 1420 | 5210 |
| 190.3 | 1450 | 5090 |
| 191.9 | 1570 | 5380 |
| 193.6 | 1560 | 5380 |
| 195.2 | 1420 | 5460 |
| 196.9 | 1460 | 5420 |
| 198.5 | 1560 | 5560 |
| 200.1 | 1660 | 5650 |
| 201.8 | 1570 | 5650 |
| 203.4 | 1560 | 5650 |
| 205.1 | 1860 | 5700 |
| 206.7 | 2000 | 5420 |
| 208.3 | 1620 | 5460 |
| 210.0 | 1540 | 5600 |
| 211.6 | 1620 | 5560 |
| 213.3 | 1630 | 5650 |
| 214.9 | 1940 | 5750 |
| 216.5 | 1830 | 5900 |
| 218.2 | 2010 | 5850 |
| 219.8 | 1770 | 5950 |
| 221.5 | 2020 | 5950 |
| 223.1 | 1920 | 6010 |
| 224.7 | 1700 | 5900 |
| 226.4 | 1900 | 6170 |
| 228.0 | 2400 | 6600 |
| 229.7 | 2240 | 6600 |
| 231.3 | 1870 | 6060 |
| 232.9 | 1930 | 5850 |
| 234.6 | 2030 | 5900 |
| 236.2 | 1980 | 6010 |
| 237.9 | 2190 | 6540 |
| 277.2 | 2060 | 5750 |
| 278.9 | 1940 | 5750 |
| 280.5 | 1780 | 5750 |
| 282.2 | 1510 | 5560 |
| 283.8 | 1540 | 5460 |
| 285.4 | 1930 | 5750 |
| 287.1 | 1920 | 5900 |
| 288.7 | 1980 | 6010 |
| 290.4 | 2040 | 5950 |
| 292.0 | 1960 | 5900 |
| 293.6 | 1790 | 5900 |
| 295.3 | 1870 | 5950 |
| 296.9 | 2090 | 6060 |
| 298.6 | 1830 | 5900 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 300.2 | 1970 | 6010 |
| 301.8 | 2100 | 6060 |
| 303.5 | 1890 | 5900 |
| 305.1 | 1790 | 6010 |
| 306.8 | 1890 | 5950 |
| 308.4 | 1820 | 6010 |
| 310.0 | 1750 | 6170 |
| 311.7 | 1930 | 6410 |
| 313.3 | 2120 | 6350 |
| 315.0 | 1950 | 5900 |
| 316.6 | 1300 | 5700 |
| 318.2 | 1780 | 5600 |
| 319.9 | 2240 | 5850 |
| 321.5 | 2060 | 5850 |
| 323.2 | 1660 | 5600 |
| 324.8 | 1380 | 5650 |
| 326.4 | 1250 | 5700 |
| 328.1 | 1520 | 5460 |
| 329.7 | 1470 | 5290 |
| 331.4 | 930 | 5130 |
| 333.0 | 780 | 4800 |
| 334.7 | 780 | 4760 |
| 336.3 | 800 | 4830 |
| 337.9 | 620 | 4900 |
| 339.6 | 720 | 5090 |
| 341.2 | 830 | 5050 |
| 342.9 | 1370 | 5460 |
| 344.5 | 1470 | 5700 |
| 346.1 | 1540 | 5850 |
| 347.8 | 1690 | 6230 |
| 349.4 | 2020 | 5900 |
| 351.1 | 2020 | 6120 |
| 352.7 | 1840 | 6170 |
| 354.3 | 1820 | 6060 |
| 356.0 | 2380 | 6120 |
| 357.6 | 2080 | 6010 |
| 359.3 | 2240 | 5330 |
| 360.9 | 1370 | 5090 |
| 362.5 | 1390 | 4830 |
| 364.2 | 1170 | 5050 |
| 365.8 | 1630 | 5510 |
| 367.5 | 1400 | 4980 |
| 369.1 | 1180 | 5130 |
| 370.7 | 1050 | 4980 |
| 372.4 | 1200 | 4980 |
| 374.0 | 1220 | 5420 |
| 375.7 | 1630 | 5650 |
| 377.3 | 2000 | 5950 |
| 378.9 | 2000 | 6120 |
| 380.6 | 1980 | 6290 |

Table 5. Boring B-3001, Suspension R1-R2 depths and P- and $S_H$-wave velocities

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 382.2 | 2100 | 6060 |
| 383.9 | 2010 | 6120 |
| 385.5 | 1980 | 6170 |
| 387.1 | 2090 | 6230 |
| 388.8 | 2060 | 6170 |
| 390.4 | 2210 | 6470 |
| | | |

Table 5, continued. Boring B-3001, Suspension R1-R2 depths and P- and $S_H$-wave velocities

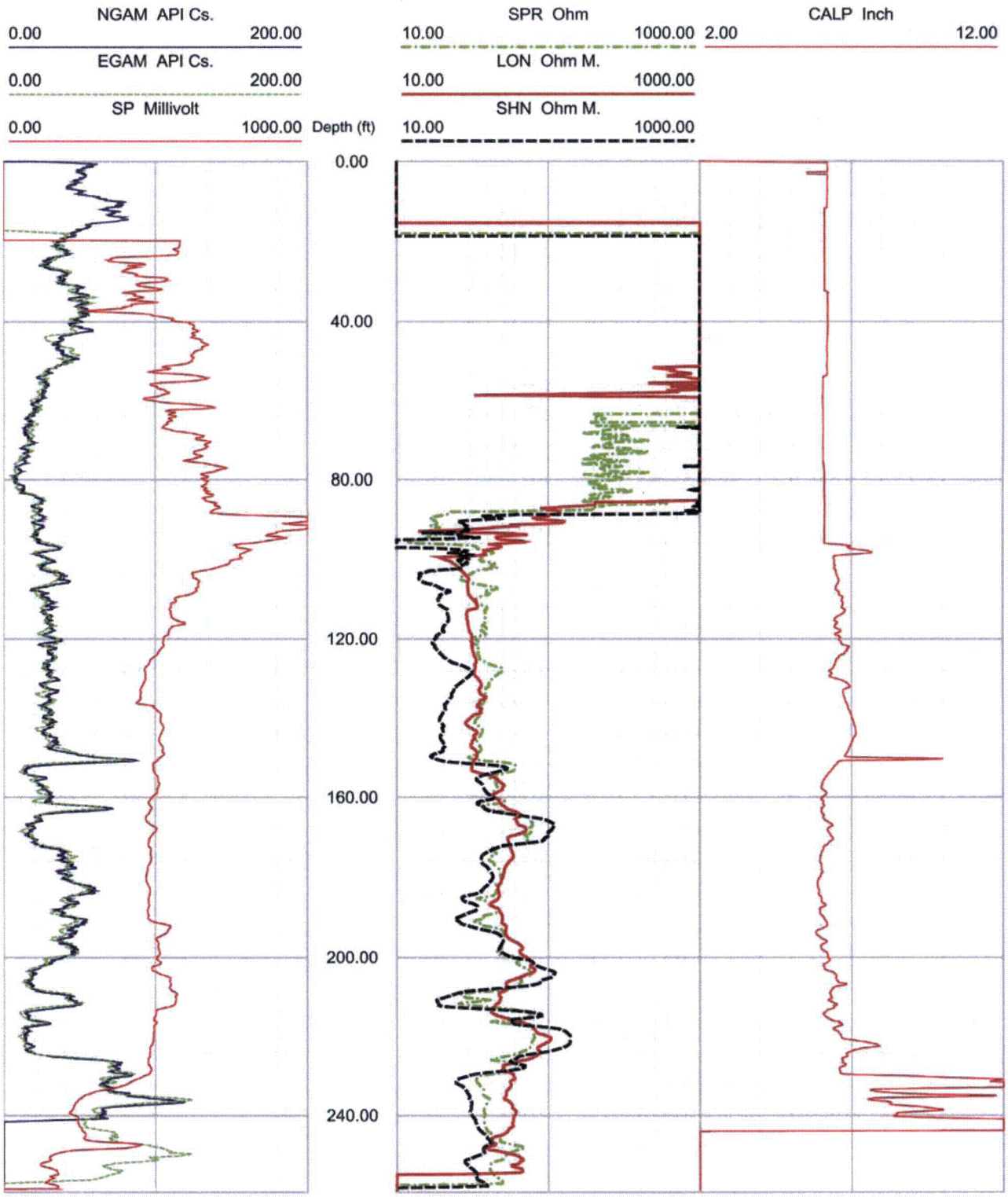



Figure 6. Boring B-3001, Upper Section, Caliper, Natural gamma, Resistivity and SP logs

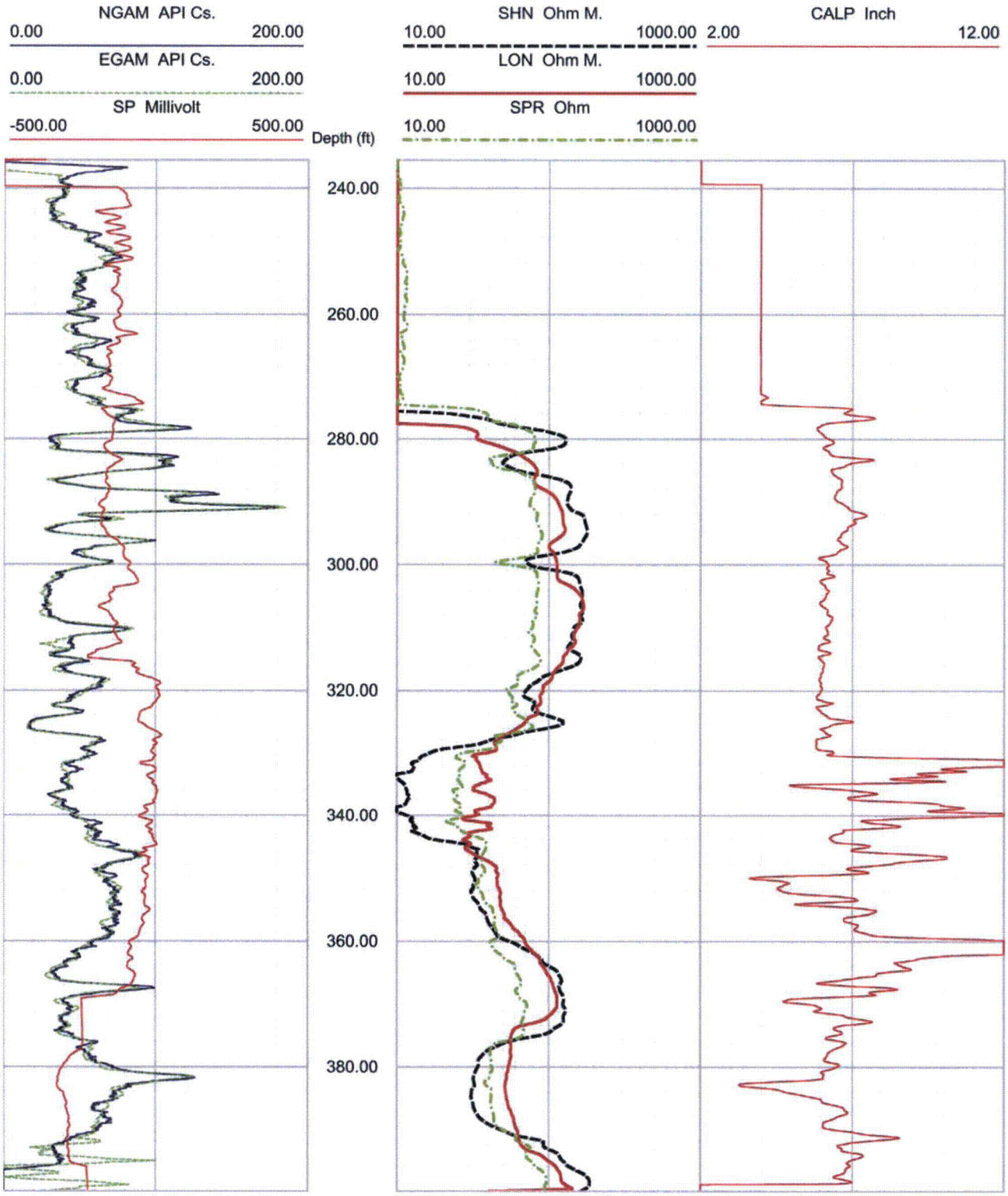



Figure 7. Boring B-3001, Lower Section, Caliper, Natural gamma, Resistivity and SP logs

Deviated borehole in orthographic projection, viewed from N45

Borehole: B-3001 Sonde: BHTV
Zone from: 0.080 to 401.920ft
North ref is true
Mean deviation: 0.77 to N106.79
End coordinates .....
North: -1.561
East : 5.165
Down : 401.711
Azimuth of end: N106.81
Distance start-end: 5.396ft
Viewpoint: N45
Data extrapolated to the surface from 0.080ft

Figure 8. Boring B-3001, Deviation Projection (dimensions in feet)

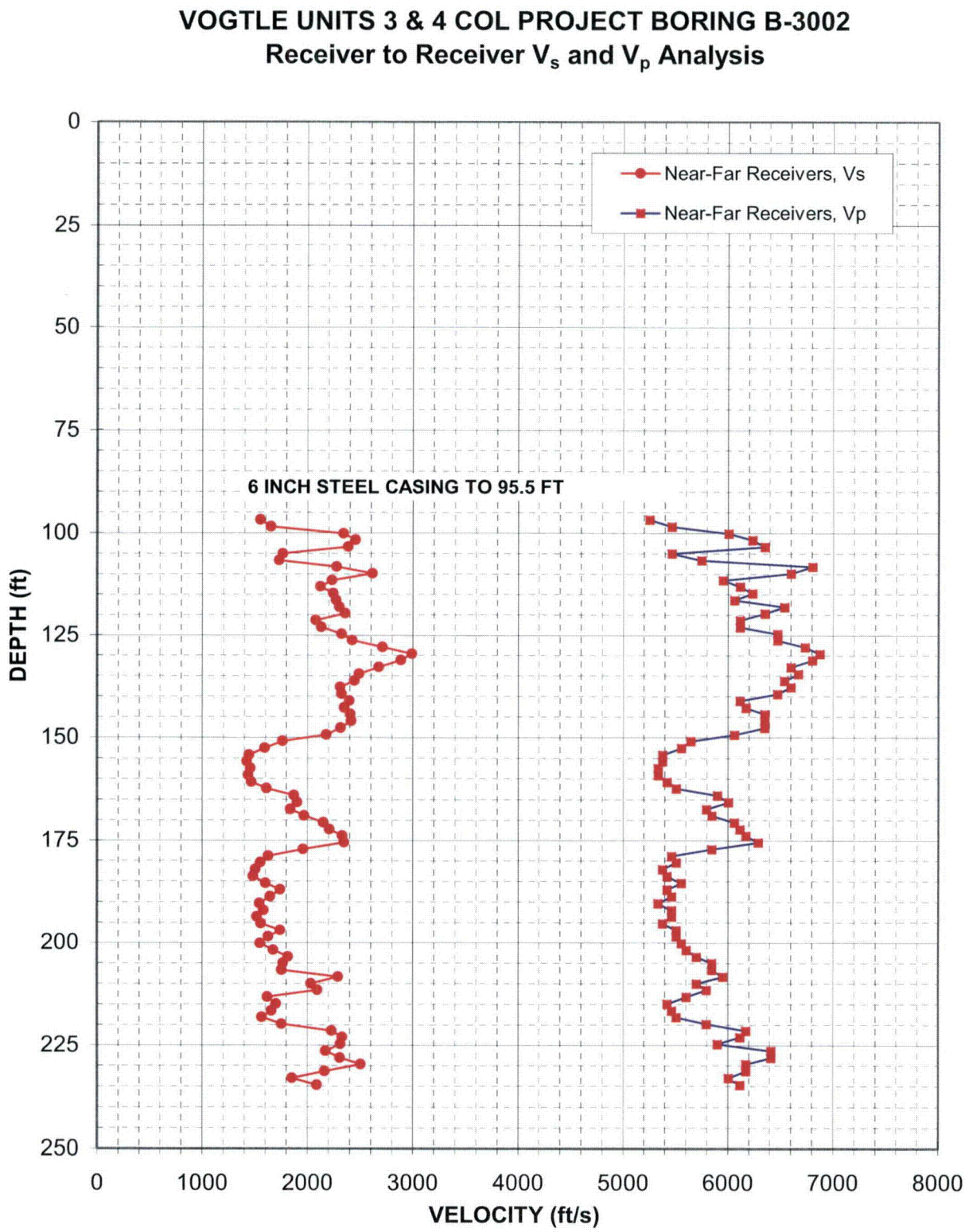



Figure 9. Boring B-3002, Suspension R1-R2 P- and $S_H$-wave velocities

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 96.8 | 1550 | 5250 |
| 98.4 | 1650 | 5460 |
| 100.1 | 2340 | 6010 |
| 101.7 | 2450 | 6230 |
| 103.4 | 2380 | 6350 |
| 105.0 | 1760 | 5460 |
| 106.6 | 1730 | 5750 |
| 108.3 | 2280 | 6800 |
| 109.9 | 2610 | 6600 |
| 111.6 | 2230 | 5950 |
| 113.2 | 2120 | 6120 |
| 114.8 | 2240 | 6230 |
| 116.5 | 2270 | 6060 |
| 118.1 | 2300 | 6540 |
| 119.8 | 2360 | 6350 |
| 121.4 | 2080 | 6120 |
| 123.0 | 2130 | 6120 |
| 124.7 | 2320 | 6470 |
| 126.3 | 2420 | 6470 |
| 128.0 | 2710 | 6730 |
| 129.6 | 2990 | 6870 |
| 131.2 | 2890 | 6800 |
| 132.9 | 2680 | 6600 |
| 134.5 | 2490 | 6670 |
| 136.2 | 2440 | 6540 |
| 137.8 | 2310 | 6600 |
| 139.4 | 2320 | 6470 |
| 141.1 | 2400 | 6120 |
| 142.7 | 2350 | 6170 |
| 144.4 | 2410 | 6350 |
| 146.0 | 2420 | 6350 |
| 147.6 | 2310 | 6350 |
| 149.3 | 2180 | 6060 |
| 150.9 | 1760 | 5650 |
| 152.6 | 1590 | 5560 |
| 154.2 | 1440 | 5380 |
| 155.8 | 1420 | 5380 |
| 157.5 | 1460 | 5330 |
| 159.1 | 1440 | 5330 |
| 160.8 | 1470 | 5420 |
| 162.4 | 1610 | 5510 |
| 164.0 | 1870 | 5900 |
| 165.7 | 1900 | 6010 |
| 167.3 | 1840 | 5800 |
| 169.0 | 1970 | 5850 |
| 170.6 | 2150 | 6060 |
| 172.2 | 2210 | 6120 |
| 173.9 | 2330 | 6170 |
| 175.5 | 2350 | 6290 |
| 177.2 | 1960 | 5850 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 178.8 | 1630 | 5460 |
| 180.5 | 1550 | 5510 |
| 182.1 | 1500 | 5380 |
| 183.7 | 1480 | 5420 |
| 185.4 | 1600 | 5560 |
| 187.0 | 1740 | 5420 |
| 188.7 | 1650 | 5460 |
| 190.3 | 1550 | 5330 |
| 191.9 | 1580 | 5460 |
| 193.6 | 1520 | 5460 |
| 195.2 | 1560 | 5380 |
| 196.9 | 1740 | 5510 |
| 198.5 | 1630 | 5510 |
| 200.1 | 1550 | 5560 |
| 201.8 | 1680 | 5600 |
| 203.4 | 1820 | 5700 |
| 205.1 | 1770 | 5850 |
| 206.7 | 1750 | 5850 |
| 208.3 | 2290 | 5950 |
| 210.0 | 2030 | 5700 |
| 211.6 | 2100 | 5800 |
| 213.3 | 1620 | 5600 |
| 214.9 | 1700 | 5420 |
| 216.5 | 1660 | 5460 |
| 218.2 | 1560 | 5510 |
| 219.8 | 1750 | 5800 |
| 221.5 | 2230 | 6170 |
| 223.1 | 2330 | 6120 |
| 224.7 | 2310 | 5900 |
| 226.4 | 2170 | 6410 |
| 228.0 | 2310 | 6410 |
| 229.7 | 2510 | 6170 |
| 231.3 | 2160 | 6170 |
| 232.9 | 1860 | 6010 |
| 234.6 | 2090 | 6120 |
| | | |

Table 6. Boring B-3002, Suspension R1-R2 depths and P- and $S_H$-wave velocities

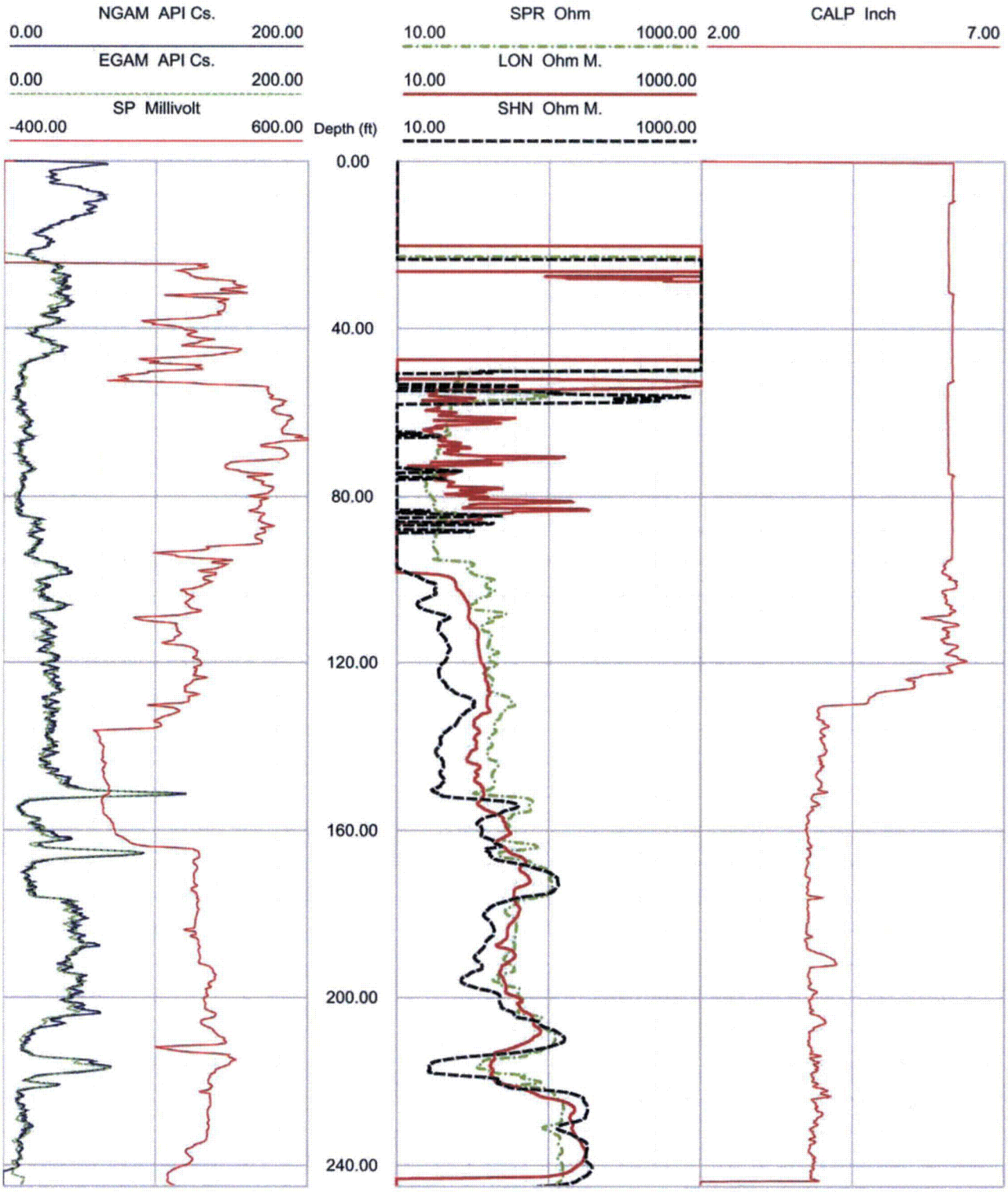



Figure 10. Boring B-3002, Caliper, Natural gamma, Resistivity and SP logs

Deviated borehole in orthographic projection, viewed from N45

Borehole: B-3002 Sonde: BHTV
Zone from: 0.032 to 245.872ft
North ref is true
Mean deviation: 1.05 to N252.35
End coordinates .....
North: -1.361
East : -4.290
Down : 245.742
Azimuth of end: N252.40
Distance start-end: 4.501ft
Viewpoint: N45
Data extrapolated to the surface from 0.032ft

Figure 11. Boring B-3002, Deviation Projection (dimensions in feet)

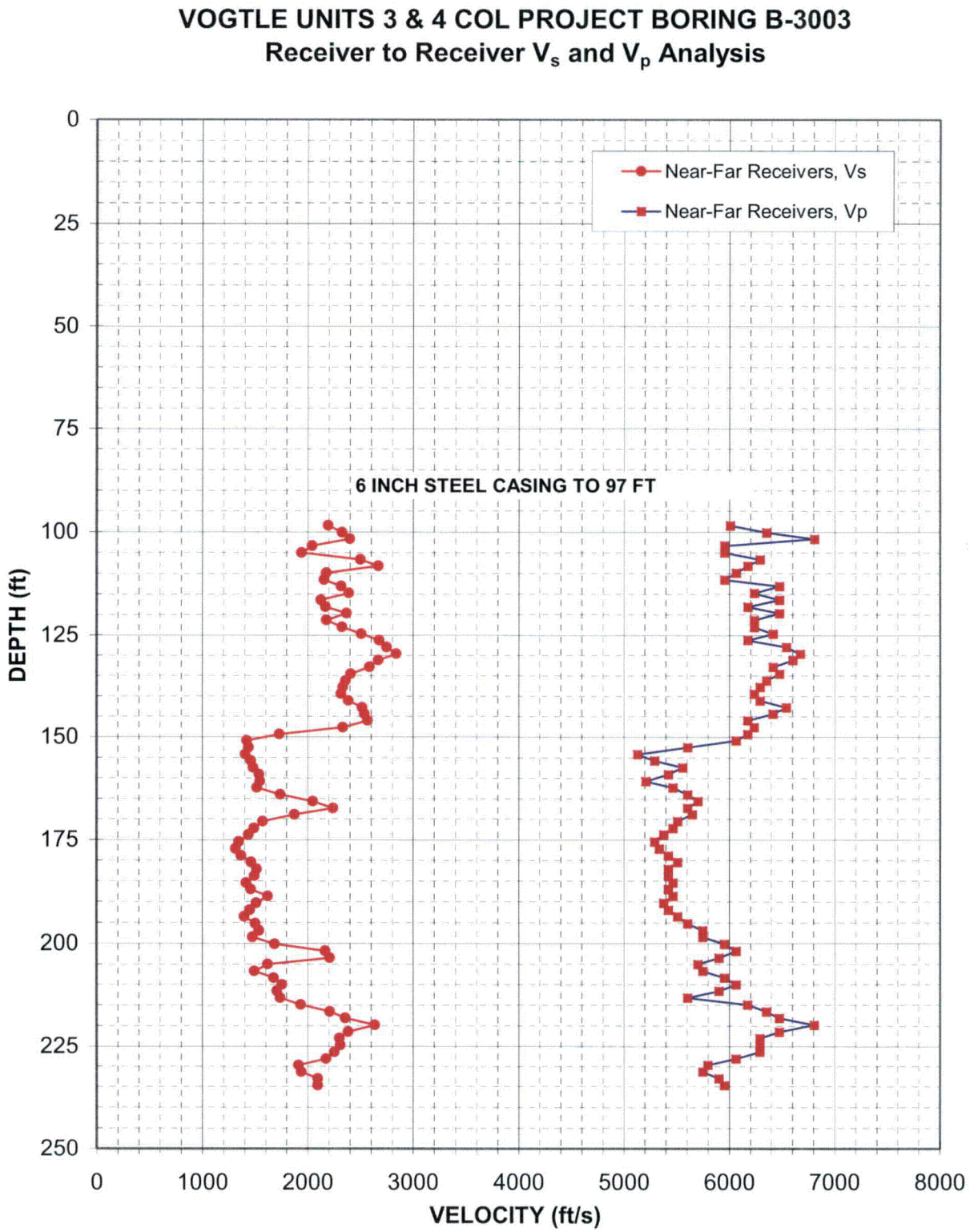



Figure 12. Boring B-3003, Suspension R1-R2 P- and $S_H$-wave velocities

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 98.4 | 2190 | 6010 |
| 100.1 | 2320 | 6350 |
| 101.7 | 2400 | 6800 |
| 103.4 | 2040 | 5950 |
| 105.0 | 1940 | 5950 |
| 106.6 | 2500 | 6290 |
| 108.3 | 2670 | 6170 |
| 109.9 | 2170 | 6060 |
| 111.6 | 2150 | 5950 |
| 113.2 | 2310 | 6470 |
| 114.8 | 2390 | 6230 |
| 116.5 | 2120 | 6470 |
| 118.1 | 2160 | 6170 |
| 119.8 | 2360 | 6470 |
| 121.4 | 2170 | 6230 |
| 123.0 | 2320 | 6230 |
| 124.7 | 2510 | 6410 |
| 126.3 | 2680 | 6170 |
| 128.0 | 2740 | 6540 |
| 129.6 | 2840 | 6670 |
| 131.2 | 2670 | 6600 |
| 132.9 | 2580 | 6410 |
| 134.5 | 2410 | 6470 |
| 136.2 | 2360 | 6350 |
| 137.8 | 2330 | 6290 |
| 139.4 | 2310 | 6230 |
| 141.1 | 2380 | 6290 |
| 142.7 | 2520 | 6540 |
| 144.4 | 2530 | 6410 |
| 146.0 | 2560 | 6170 |
| 147.6 | 2330 | 6230 |
| 149.3 | 1730 | 6170 |
| 150.9 | 1420 | 6060 |
| 152.6 | 1440 | 5600 |
| 154.2 | 1410 | 5130 |
| 155.8 | 1460 | 5290 |
| 157.5 | 1480 | 5560 |
| 159.1 | 1540 | 5420 |
| 160.8 | 1540 | 5210 |
| 162.4 | 1520 | 5460 |
| 164.0 | 1740 | 5600 |
| 165.7 | 2040 | 5700 |
| 167.3 | 2240 | 5600 |
| 169.0 | 1870 | 5650 |
| 170.6 | 1570 | 5510 |
| 172.2 | 1490 | 5460 |
| 173.9 | 1440 | 5380 |
| 175.5 | 1340 | 5290 |
| 177.2 | 1310 | 5330 |
| 178.8 | 1370 | 5420 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 180.5 | 1460 | 5510 |
| 182.1 | 1520 | 5420 |
| 183.7 | 1490 | 5420 |
| 185.4 | 1410 | 5460 |
| 187.0 | 1460 | 5420 |
| 188.7 | 1620 | 5460 |
| 190.3 | 1510 | 5380 |
| 191.9 | 1450 | 5420 |
| 193.6 | 1390 | 5510 |
| 195.2 | 1500 | 5600 |
| 196.9 | 1540 | 5750 |
| 198.5 | 1470 | 5750 |
| 200.1 | 1680 | 5950 |
| 201.8 | 2160 | 6060 |
| 203.4 | 2210 | 5900 |
| 205.1 | 1620 | 5700 |
| 206.7 | 1490 | 5750 |
| 208.3 | 1680 | 5950 |
| 210.0 | 1750 | 6060 |
| 211.6 | 1710 | 5900 |
| 213.3 | 1740 | 5600 |
| 214.9 | 1930 | 6170 |
| 216.5 | 2210 | 6350 |
| 218.2 | 2360 | 6470 |
| 219.8 | 2640 | 6800 |
| 221.5 | 2380 | 6470 |
| 223.1 | 2300 | 6290 |
| 224.7 | 2310 | 6290 |
| 226.4 | 2250 | 6290 |
| 228.0 | 2170 | 6060 |
| 229.7 | 1910 | 5800 |
| 231.3 | 1940 | 5750 |
| 232.9 | 2100 | 5900 |
| 234.6 | 2100 | 5950 |
| | | |

Table 7. Boring B-3003, Suspension R1-R2 depths and P- and $S_H$-wave velocities

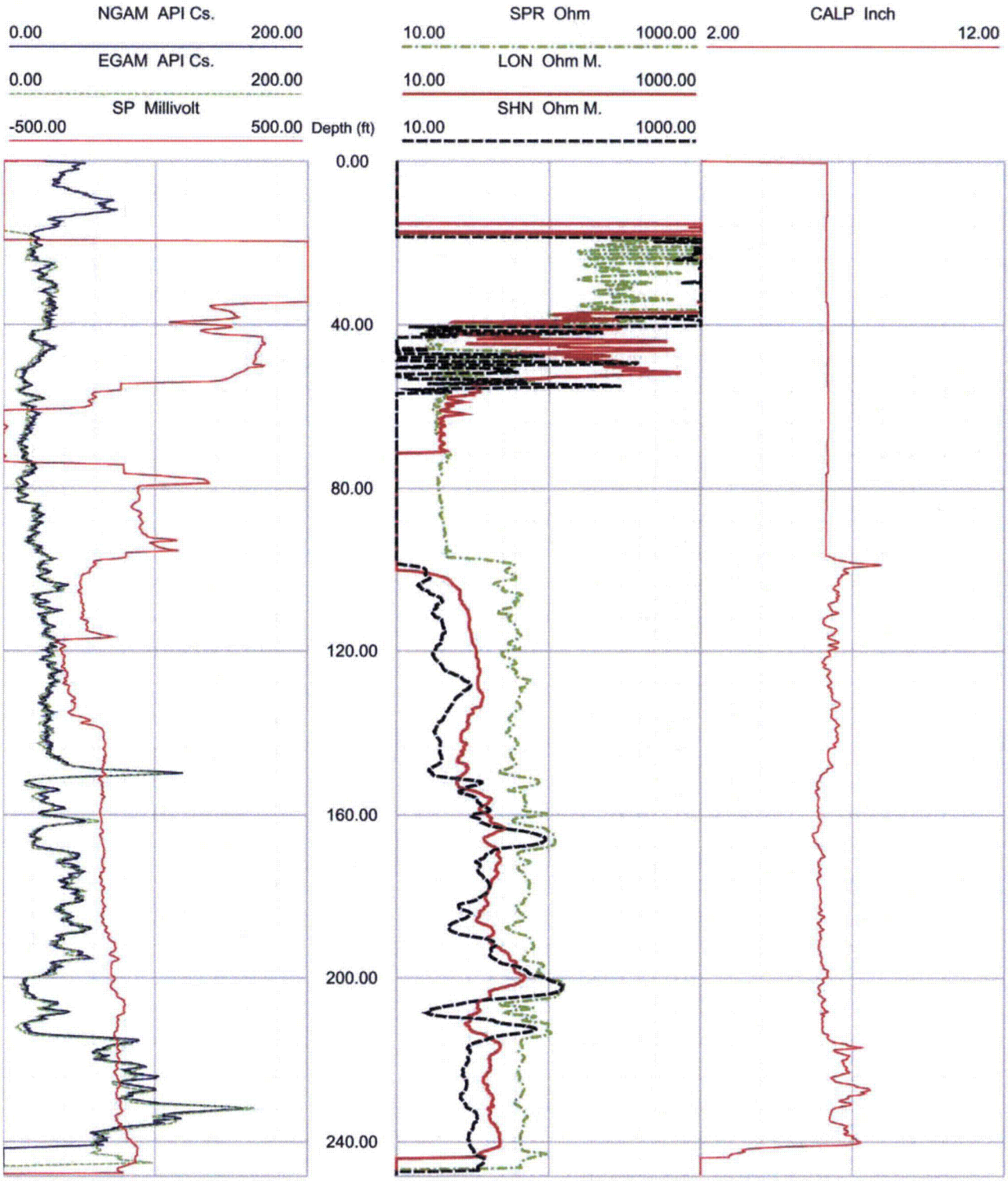
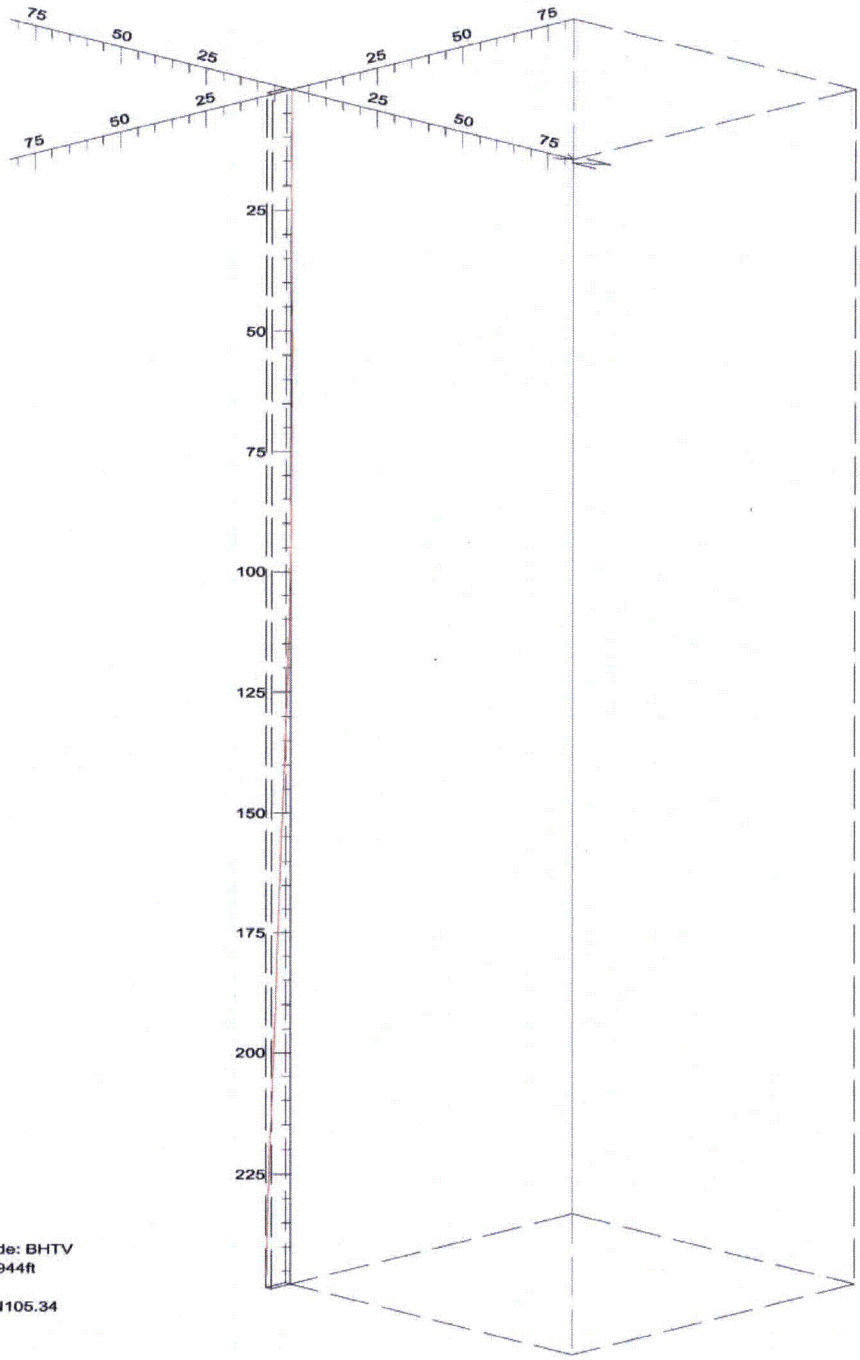



Figure 13. Boring B-3003, Caliper, Natural gamma, Resistivity and SP logs

Deviated borehole in orthographic projection, viewed from N45




Borehole: B-3003 Sonde: BHTV
Zone from: 0.024 to 247.944ft
North ref is true
Mean deviation: 1.34 to N105.34
End coordinates .....
North: -1.526
East : 5.595
Down : 247.779
Azimuth of end: N105.25
Distance start-end: 5.800ft
Viewpoint: N45
Data extrapolated to the surface from 0.024ft

Figure 14. Boring B-3003, Deviation Projection (dimensions in feet)

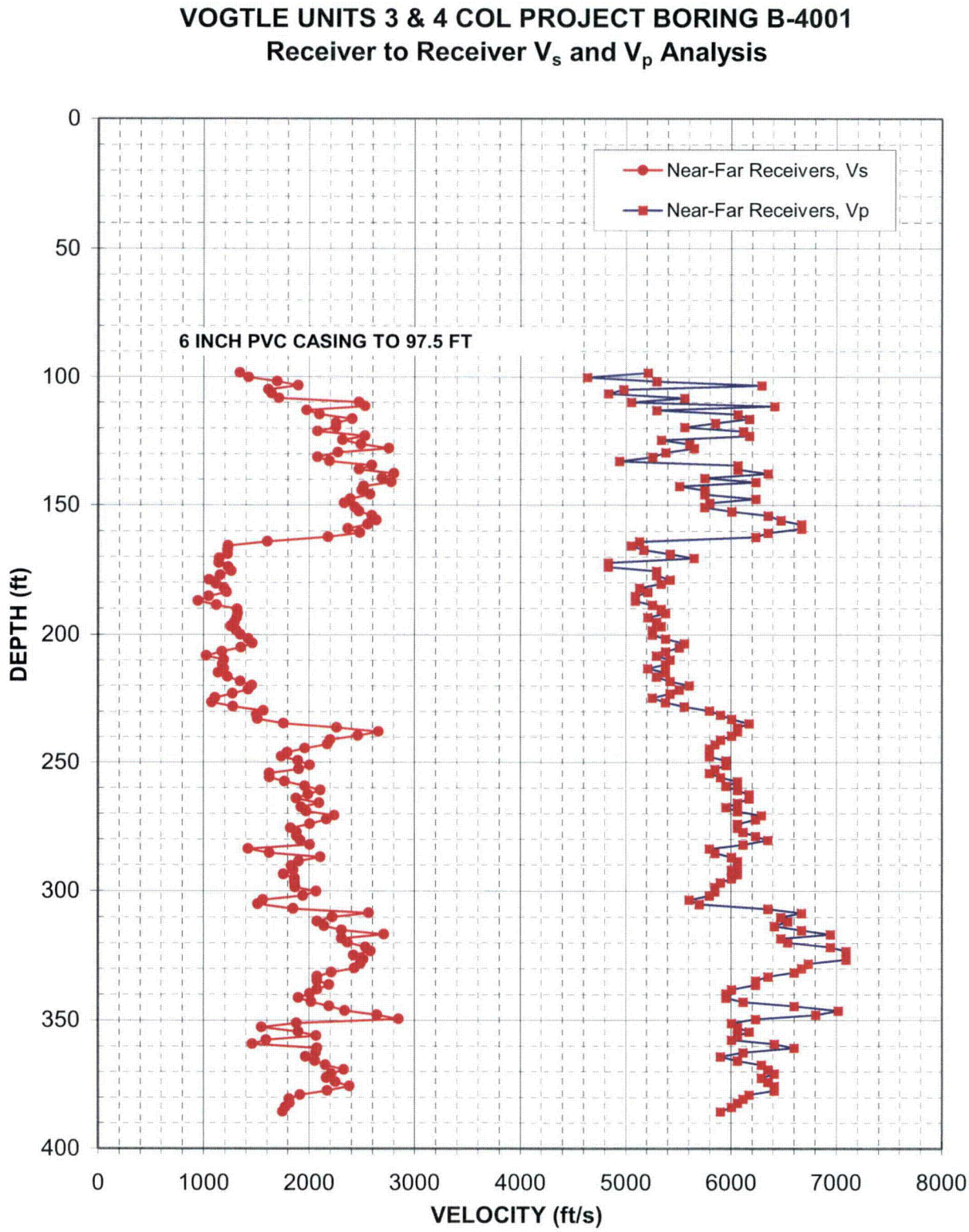



Figure 15. Boring B-4001, Suspension R1-R2 P- and $S_H$-wave velocities

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 98.4 | 1340 | 5210 |
| 100.1 | 1420 | 4630 |
| 101.7 | 1690 | 5290 |
| 103.4 | 1890 | 6290 |
| 105.0 | 1610 | 4980 |
| 106.6 | 1640 | 4830 |
| 108.3 | 1710 | 5560 |
| 109.9 | 2470 | 5050 |
| 111.6 | 2530 | 6410 |
| 113.2 | 1970 | 5290 |
| 114.8 | 2100 | 6060 |
| 116.5 | 2410 | 6170 |
| 118.1 | 2250 | 5850 |
| 119.8 | 2250 | 5560 |
| 121.4 | 2080 | 6120 |
| 123.0 | 2530 | 6170 |
| 124.7 | 2310 | 5330 |
| 126.3 | 2490 | 5600 |
| 128.0 | 2750 | 5650 |
| 129.6 | 2270 | 5380 |
| 131.2 | 2080 | 5250 |
| 132.9 | 2190 | 4940 |
| 134.5 | 2590 | 6060 |
| 136.2 | 2470 | 6060 |
| 137.8 | 2800 | 6350 |
| 139.4 | 2690 | 5750 |
| 141.1 | 2780 | 6230 |
| 142.7 | 2520 | 5510 |
| 144.4 | 2500 | 5750 |
| 146.0 | 2570 | 5750 |
| 147.6 | 2390 | 6230 |
| 149.3 | 2330 | 5800 |
| 150.9 | 2430 | 5750 |
| 152.6 | 2470 | 6010 |
| 154.2 | 2590 | 6350 |
| 155.8 | 2640 | 6470 |
| 157.5 | 2550 | 6670 |
| 159.1 | 2360 | 6670 |
| 160.8 | 2480 | 6350 |
| 162.4 | 2180 | 6230 |
| 164.0 | 1600 | 5130 |
| 165.7 | 1230 | 5050 |
| 167.3 | 1230 | 5170 |
| 169.0 | 1230 | 5420 |
| 170.6 | 1150 | 5650 |
| 172.2 | 1150 | 4830 |
| 173.9 | 1230 | 4830 |
| 175.5 | 1260 | 5290 |
| 177.2 | 1160 | 5290 |
| 178.8 | 1050 | 5420 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 180.5 | 1120 | 5330 |
| 182.1 | 1190 | 5130 |
| 183.7 | 1220 | 5210 |
| 185.4 | 1050 | 5090 |
| 187.0 | 950 | 5090 |
| 188.7 | 1120 | 5250 |
| 190.3 | 1320 | 5330 |
| 191.9 | 1320 | 5380 |
| 193.6 | 1310 | 5210 |
| 195.2 | 1290 | 5290 |
| 196.9 | 1260 | 5330 |
| 198.5 | 1310 | 5250 |
| 200.1 | 1350 | 5250 |
| 201.8 | 1420 | 5380 |
| 203.4 | 1460 | 5560 |
| 205.1 | 1360 | 5510 |
| 206.7 | 1170 | 5380 |
| 208.3 | 1030 | 5290 |
| 210.0 | 1190 | 5420 |
| 211.6 | 1180 | 5380 |
| 213.3 | 1190 | 5210 |
| 214.9 | 1140 | 5380 |
| 216.5 | 1230 | 5290 |
| 218.2 | 1350 | 5420 |
| 219.8 | 1460 | 5600 |
| 221.5 | 1420 | 5510 |
| 223.1 | 1270 | 5420 |
| 224.7 | 1110 | 5250 |
| 226.4 | 1080 | 5380 |
| 228.0 | 1280 | 5560 |
| 229.7 | 1560 | 5800 |
| 231.3 | 1500 | 5900 |
| 232.9 | 1510 | 6010 |
| 234.6 | 1760 | 6170 |
| 236.2 | 2260 | 6060 |
| 237.9 | 2660 | 6060 |
| 239.5 | 2460 | 6010 |
| 241.1 | 2200 | 5900 |
| 242.8 | 2170 | 5850 |
| 244.4 | 1960 | 5800 |
| 246.1 | 1790 | 5800 |
| 247.7 | 1740 | 5800 |
| 249.3 | 1890 | 5950 |
| 251.0 | 2010 | 5950 |
| 252.6 | 1900 | 5850 |
| 254.3 | 1620 | 5800 |
| 255.9 | 1620 | 5900 |
| 257.6 | 1770 | 6060 |
| 259.2 | 1960 | 5950 |
| 260.8 | 2110 | 6060 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 262.5 | 1990 | 6170 |
| 264.1 | 1880 | 6170 |
| 265.8 | 2100 | 6060 |
| 267.4 | 1930 | 5950 |
| 269.0 | 1970 | 6060 |
| 270.7 | 2240 | 6290 |
| 272.3 | 2160 | 6230 |
| 274.0 | 2010 | 6060 |
| 275.6 | 1830 | 6060 |
| 277.2 | 1880 | 6120 |
| 278.9 | 1880 | 6230 |
| 280.5 | 1920 | 6350 |
| 282.2 | 2010 | 6120 |
| 283.8 | 1420 | 5800 |
| 285.4 | 1620 | 5850 |
| 287.1 | 2110 | 6010 |
| 288.7 | 1900 | 6060 |
| 290.4 | 1830 | 6060 |
| 292.0 | 1850 | 6010 |
| 293.6 | 1760 | 6060 |
| 295.3 | 1860 | 6010 |
| 296.9 | 1860 | 5900 |
| 298.6 | 1870 | 5850 |
| 300.2 | 2070 | 5850 |
| 301.8 | 1940 | 5800 |
| 303.5 | 1560 | 5600 |
| 305.1 | 1520 | 5700 |
| 306.8 | 1850 | 6350 |
| 308.4 | 2560 | 6670 |
| 310.0 | 2220 | 6470 |
| 311.7 | 2080 | 6540 |
| 313.3 | 2140 | 6410 |
| 315.0 | 2310 | 6670 |
| 316.6 | 2710 | 6940 |
| 318.2 | 2310 | 6470 |
| 319.9 | 2360 | 6540 |
| 321.5 | 2530 | 6940 |
| 323.2 | 2580 | 7090 |
| 324.8 | 2420 | 7090 |
| 326.4 | 2520 | 7090 |
| 328.1 | 2490 | 6730 |
| 329.7 | 2430 | 6670 |
| 331.4 | 2210 | 6600 |
| 333.0 | 2080 | 6350 |
| 334.7 | 2080 | 6230 |
| 336.3 | 2190 | 6230 |
| 337.9 | 2080 | 6010 |
| 339.6 | 2010 | 5950 |
| 341.2 | 1900 | 5950 |
| 342.9 | 2020 | 6120 |

Table 8. Boring B-4001, Suspension R1-R2 depths and P- and $S_H$-wave velocities

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 344.5 | 2190 | 6600 |
| 346.1 | 2340 | 7020 |
| 347.8 | 2650 | 6800 |
| 349.4 | 2850 | 6230 |
| 351.1 | 1880 | 6010 |
| 352.7 | 1550 | 6060 |
| 354.3 | 1900 | 6170 |
| 356.0 | 2070 | 6060 |
| 357.6 | 1590 | 6010 |
| 359.3 | 1460 | 6410 |
| 360.9 | 2080 | 6600 |
| 362.5 | 2060 | 6120 |
| 364.2 | 1970 | 5900 |
| 365.8 | 2060 | 6060 |
| 367.5 | 2160 | 6290 |
| 369.1 | 2330 | 6350 |
| 370.7 | 2210 | 6410 |
| 372.4 | 2160 | 6290 |
| 374.0 | 2250 | 6350 |
| 375.7 | 2380 | 6410 |
| 377.3 | 2170 | 6410 |
| 378.9 | 1920 | 6170 |
| 380.6 | 1810 | 6120 |
| 382.2 | 1820 | 6060 |
| 383.9 | 1780 | 6010 |
| 385.5 | 1750 | 5900 |
| | | |

Table 8, continued. Boring B-4001, Suspension R1-R2 depths and P- and $S_H$-wave velocities

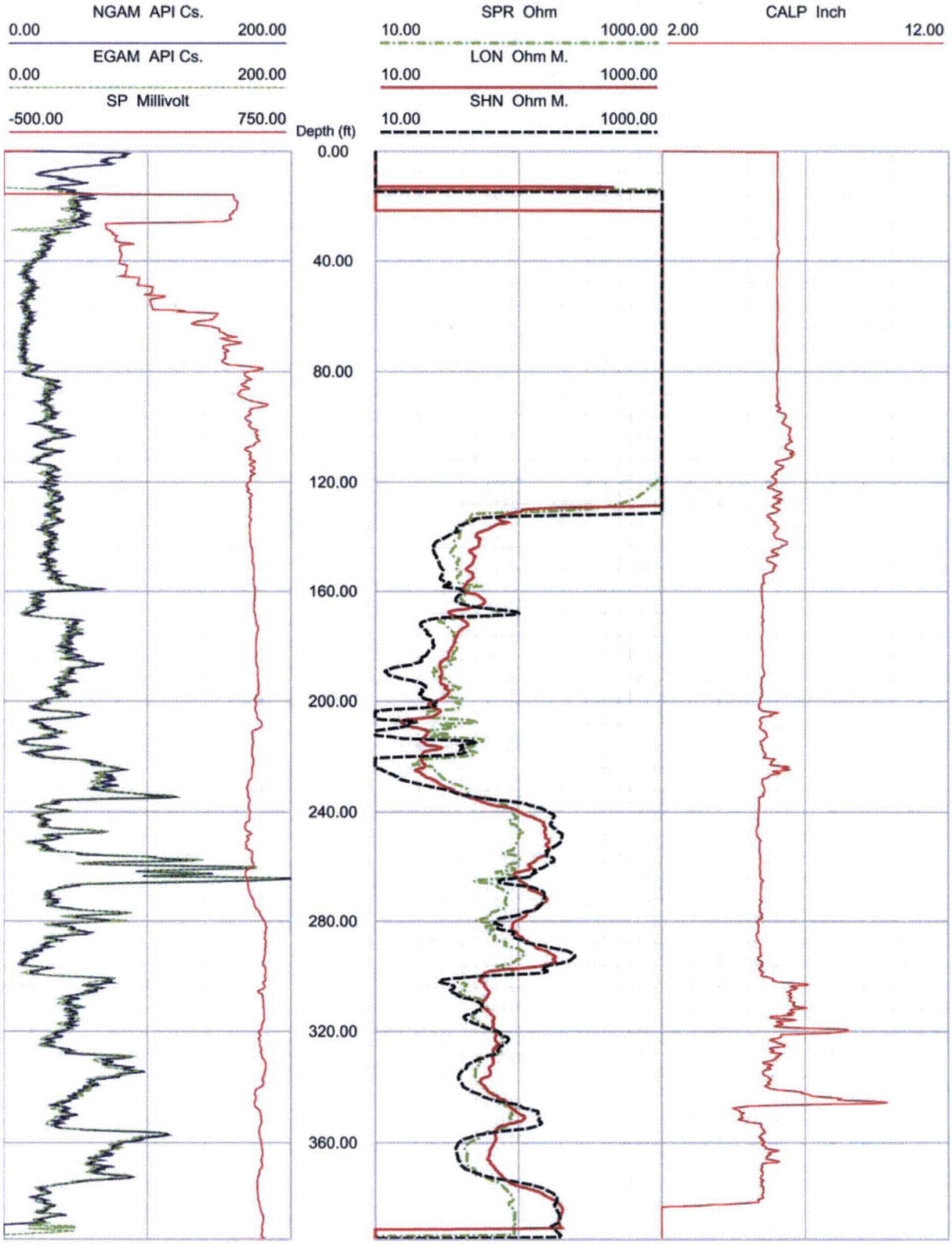
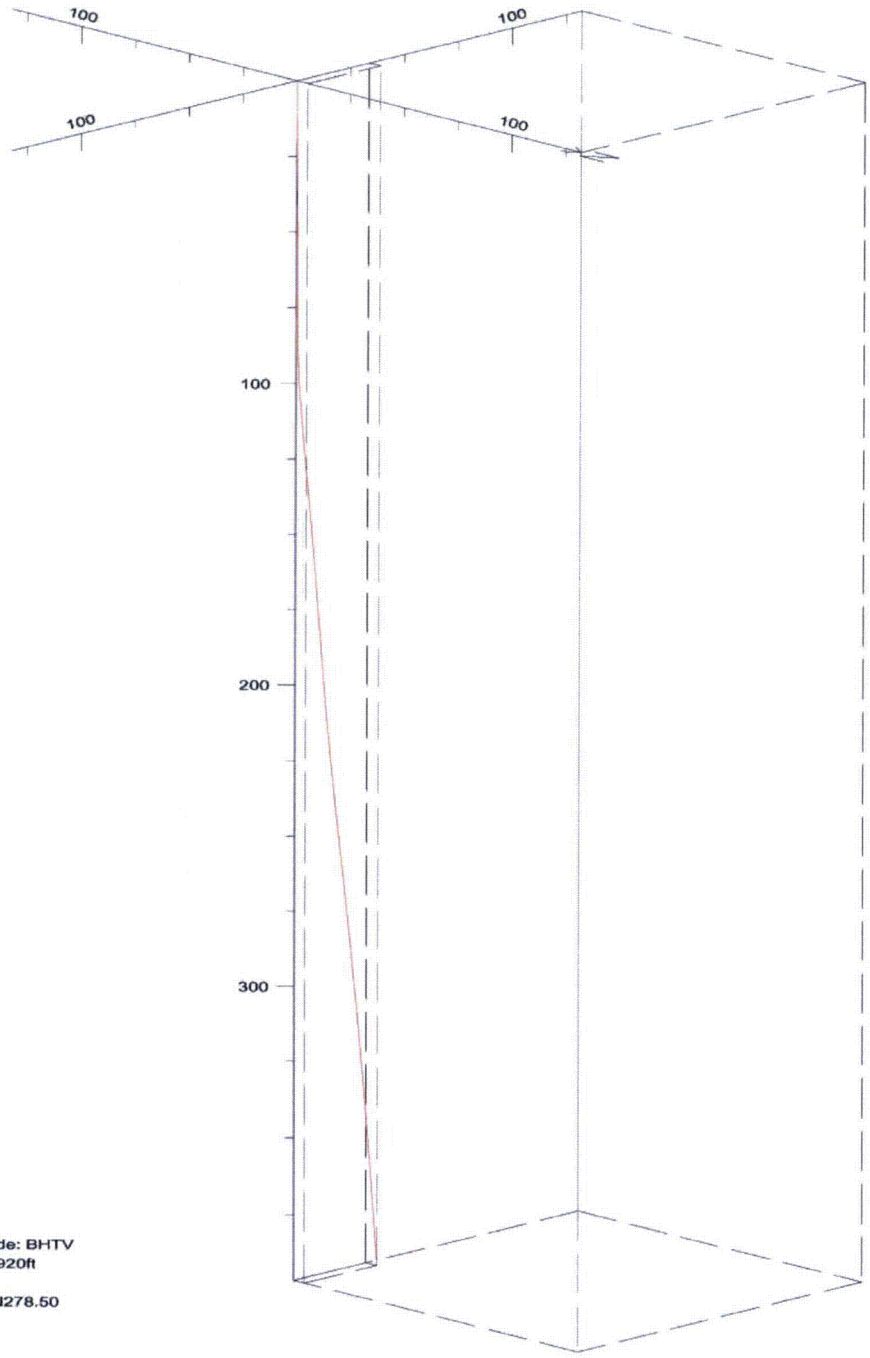



Figure 16. Boring B-4001, Caliper, Natural gamma, Resistivity and SP logs

Deviated borehole in orthographic projection, viewed from N45




Borehole: B-4001 Sonde: BHTV
Zone from: 0.120 to 398.920ft
North ref is true
Mean deviation: 4.90 to N278.50
End coordinates .....
North: 5.025
East : -33.639
Down : 396.983
Azimuth of end: N278.50
Distance start-end: 34.012ft
Viewpoint: N45
Data extrapolated to the surface from 0.120ft

Figure 17. Boring B-4001, Deviation Projection (dimensions in feet)

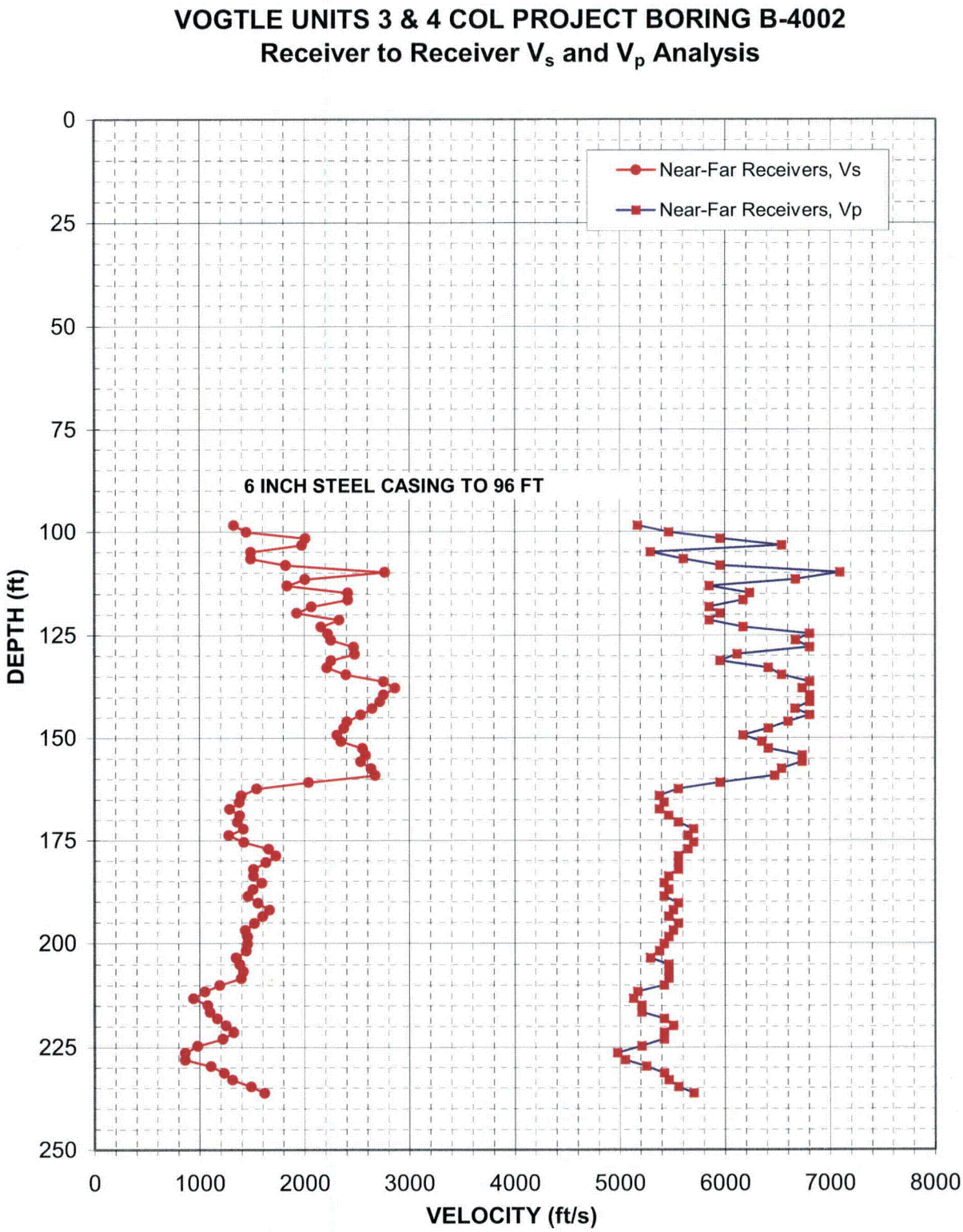



Figure 18. Boring B-4002, Suspension R1-R2 P- and $S_H$-wave velocities

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 98.4 | 1330 | 5170 |
| 100.1 | 1440 | 5460 |
| 101.7 | 2010 | 5950 |
| 103.4 | 1970 | 6540 |
| 105.0 | 1490 | 5290 |
| 106.6 | 1490 | 5600 |
| 108.3 | 1820 | 5950 |
| 109.9 | 2770 | 7090 |
| 111.6 | 2000 | 6670 |
| 113.2 | 1830 | 5850 |
| 114.8 | 2420 | 6230 |
| 116.5 | 2420 | 6170 |
| 118.1 | 2060 | 5850 |
| 119.8 | 1930 | 5950 |
| 121.4 | 2330 | 5850 |
| 123.0 | 2160 | 6170 |
| 124.7 | 2220 | 6800 |
| 126.3 | 2250 | 6670 |
| 128.0 | 2470 | 6800 |
| 129.6 | 2480 | 6120 |
| 131.2 | 2250 | 5950 |
| 132.9 | 2210 | 6410 |
| 134.5 | 2400 | 6540 |
| 136.2 | 2750 | 6800 |
| 137.8 | 2860 | 6730 |
| 139.4 | 2750 | 6800 |
| 141.1 | 2720 | 6800 |
| 142.7 | 2650 | 6670 |
| 144.4 | 2530 | 6800 |
| 146.0 | 2410 | 6600 |
| 147.6 | 2370 | 6410 |
| 149.3 | 2310 | 6170 |
| 150.9 | 2350 | 6350 |
| 152.6 | 2550 | 6410 |
| 154.2 | 2580 | 6730 |
| 155.8 | 2530 | 6730 |
| 157.5 | 2640 | 6540 |
| 159.1 | 2680 | 6470 |
| 160.8 | 2040 | 5950 |
| 162.4 | 1540 | 5560 |
| 164.0 | 1390 | 5380 |
| 165.7 | 1380 | 5420 |
| 167.3 | 1290 | 5380 |
| 169.0 | 1380 | 5460 |
| 170.6 | 1360 | 5560 |
| 172.2 | 1420 | 5700 |
| 173.9 | 1280 | 5650 |
| 175.5 | 1420 | 5700 |
| 177.2 | 1660 | 5650 |
| 178.8 | 1730 | 5560 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 180.5 | 1630 | 5560 |
| 182.1 | 1520 | 5560 |
| 183.7 | 1520 | 5460 |
| 185.4 | 1590 | 5420 |
| 187.0 | 1510 | 5460 |
| 188.7 | 1460 | 5420 |
| 190.3 | 1560 | 5560 |
| 191.9 | 1670 | 5510 |
| 193.6 | 1600 | 5460 |
| 195.2 | 1520 | 5560 |
| 196.9 | 1440 | 5510 |
| 198.5 | 1460 | 5460 |
| 200.1 | 1460 | 5420 |
| 201.8 | 1440 | 5380 |
| 203.4 | 1350 | 5290 |
| 205.1 | 1380 | 5460 |
| 206.7 | 1420 | 5460 |
| 208.3 | 1390 | 5460 |
| 210.0 | 1190 | 5420 |
| 211.6 | 1050 | 5170 |
| 213.3 | 940 | 5130 |
| 214.9 | 1080 | 5210 |
| 216.5 | 1100 | 5210 |
| 218.2 | 1170 | 5420 |
| 219.8 | 1250 | 5510 |
| 221.5 | 1330 | 5420 |
| 223.1 | 1220 | 5420 |
| 224.7 | 980 | 5210 |
| 226.4 | 860 | 4980 |
| 228.0 | 870 | 5050 |
| 229.7 | 1110 | 5250 |
| 231.3 | 1230 | 5420 |
| 232.9 | 1310 | 5460 |
| 234.6 | 1490 | 5560 |
| 236.2 | 1620 | 5700 |
| | | |

Table 9. Boring B-4002, Suspension R1-R2 depths and P- and $S_H$-wave velocities

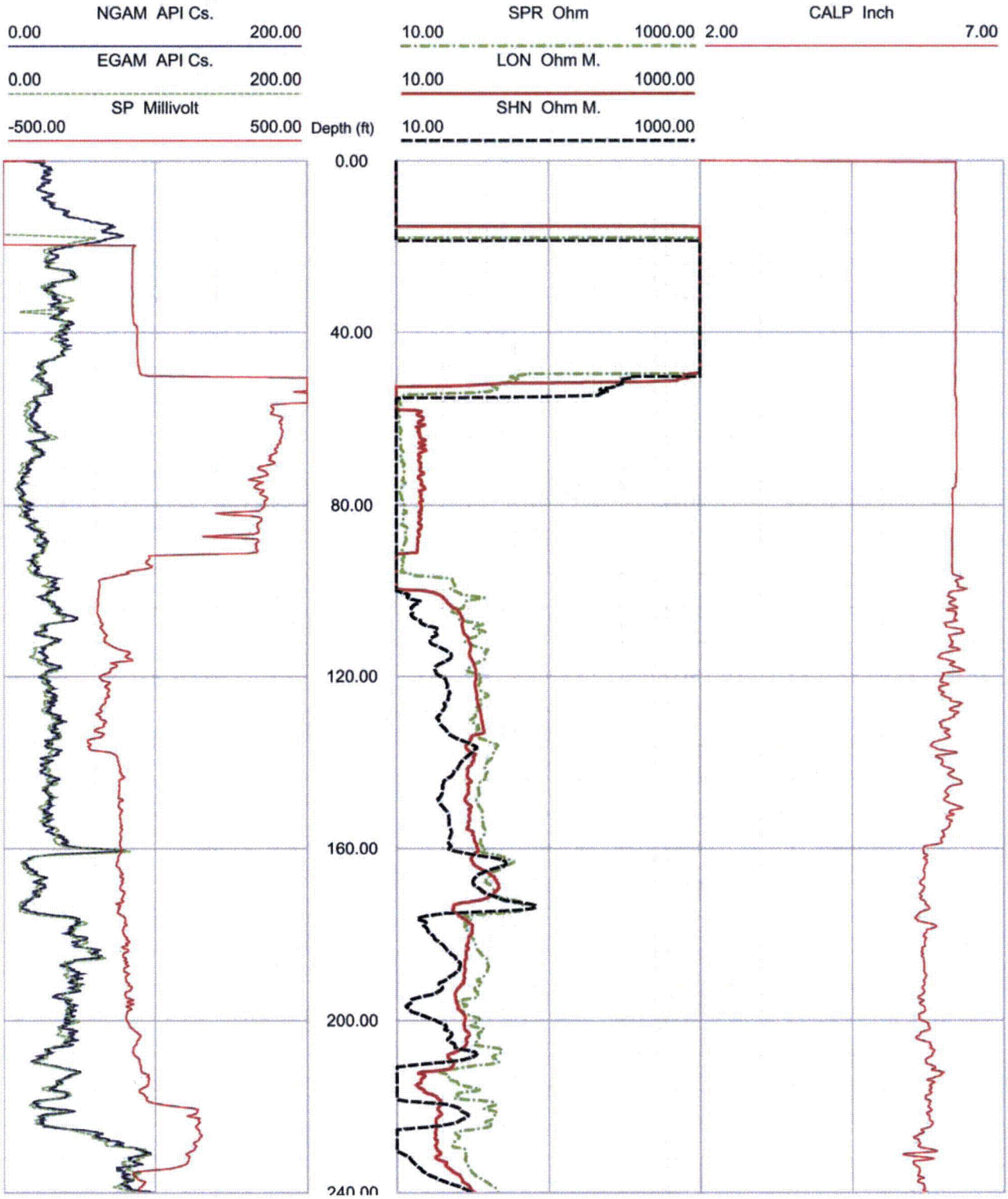



Figure 19. Boring B-4002, Caliper, Natural gamma, Resistivity and SP logs

Deviated borehole in orthographic projection, viewed from N45

Borehole: B-4002 Sonde: BHTV
Zone from: 0.016 to 248.816ft
North ref is true
Mean deviation: 1.79 to N37.39
End coordinates .....
North: 6.159
East : 4.704
Down : 248.479
Azimuth of end: N37.37
Distance start-end: 7.750ft
Viewpoint: N45
Data extrapolated to the surface from 0.016ft

Figure 20. Boring B-4002, Deviation Projection (dimensions in feet)

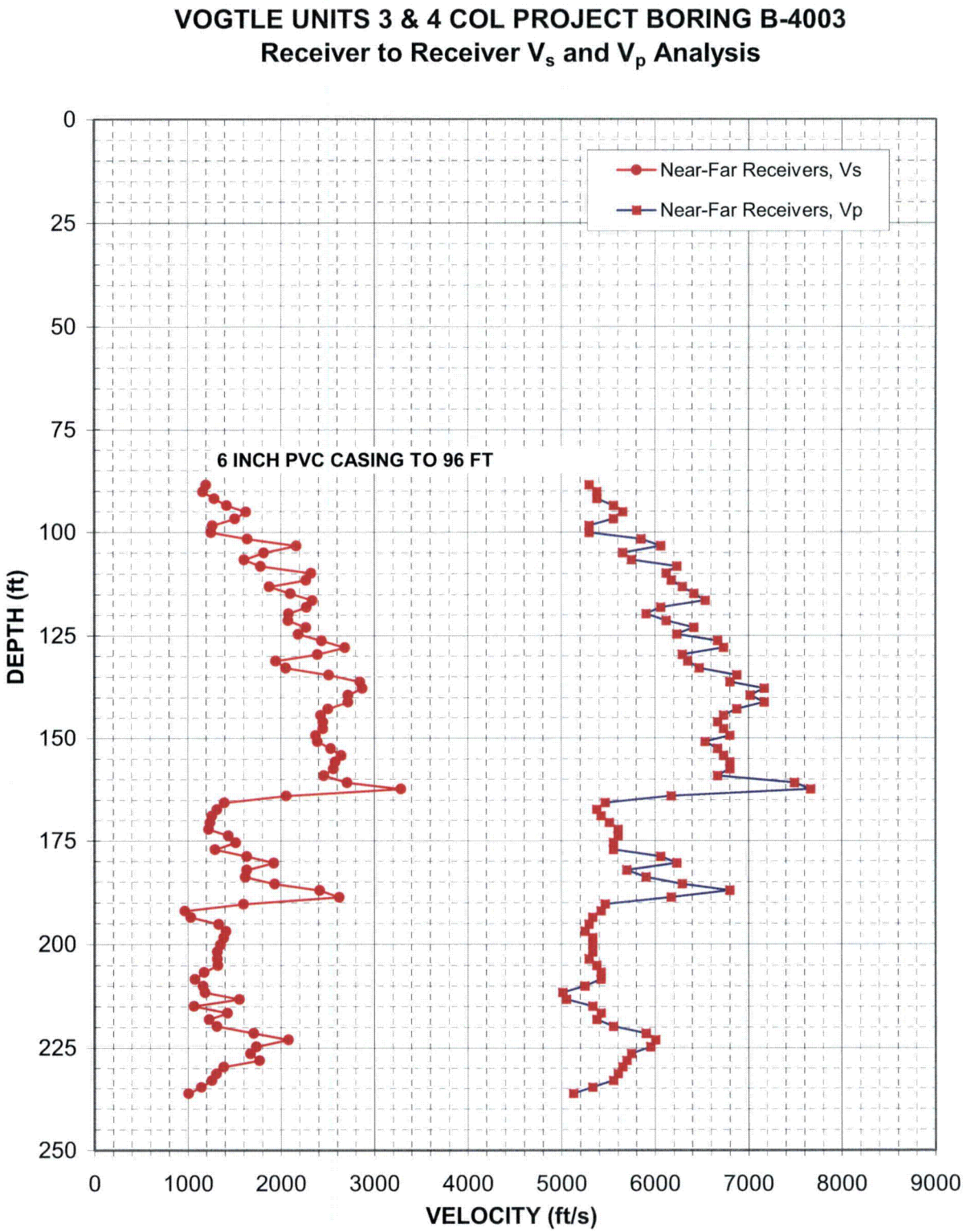



Figure 21: Boring B-4003, Suspension R1-R2 P- and $S_H$-wave velocities

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 85.3 | - | - |
| 86.9 | - | - |
| 88.6 | 1200 | 5290 |
| 90.2 | 1170 | 5380 |
| 91.9 | 1290 | 5380 |
| 93.5 | 1420 | 5560 |
| 95.1 | 1630 | 5650 |
| 96.8 | 1510 | 5560 |
| 98.4 | 1270 | 5290 |
| 100.1 | 1250 | 5290 |
| 101.7 | 1640 | 5850 |
| 103.4 | 2160 | 6060 |
| 105.0 | 1820 | 5650 |
| 106.6 | 1610 | 5750 |
| 108.3 | 1780 | 6230 |
| 109.9 | 2320 | 6120 |
| 111.6 | 2270 | 6170 |
| 113.2 | 1880 | 6290 |
| 114.8 | 2100 | 6410 |
| 116.5 | 2340 | 6540 |
| 118.1 | 2280 | 6060 |
| 119.8 | 2080 | 5900 |
| 121.4 | 2080 | 6120 |
| 123.0 | 2270 | 6410 |
| 124.7 | 2190 | 6230 |
| 126.3 | 2430 | 6670 |
| 128.0 | 2690 | 6730 |
| 129.6 | 2390 | 6290 |
| 131.2 | 1940 | 6350 |
| 132.9 | 2050 | 6470 |
| 134.5 | 2520 | 6870 |
| 136.2 | 2850 | 6800 |
| 137.8 | 2870 | 7170 |
| 139.4 | 2720 | 7020 |
| 141.1 | 2720 | 7170 |
| 142.7 | 2510 | 6870 |
| 144.4 | 2420 | 6730 |
| 146.0 | 2450 | 6670 |
| 147.6 | 2450 | 6730 |
| 149.3 | 2370 | 6800 |
| 150.9 | 2390 | 6540 |
| 152.6 | 2530 | 6670 |
| 154.2 | 2650 | 6730 |
| 155.8 | 2580 | 6800 |
| 157.5 | 2560 | 6800 |
| 159.1 | 2460 | 6670 |
| 160.8 | 2710 | 7490 |
| 162.4 | 3280 | 7660 |
| 164.0 | 2060 | 6170 |
| 165.7 | 1390 | 5460 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 167.3 | 1320 | 5380 |
| 169.0 | 1260 | 5420 |
| 170.6 | 1240 | 5510 |
| 172.2 | 1230 | 5600 |
| 173.9 | 1440 | 5600 |
| 175.5 | 1520 | 5560 |
| 177.2 | 1300 | 5560 |
| 178.8 | 1630 | 6060 |
| 180.5 | 1930 | 6230 |
| 182.1 | 1630 | 5700 |
| 183.7 | 1620 | 5900 |
| 185.4 | 1930 | 6290 |
| 187.0 | 2420 | 6800 |
| 188.7 | 2620 | 6170 |
| 190.3 | 1600 | 5460 |
| 191.9 | 970 | 5420 |
| 193.6 | 1040 | 5330 |
| 195.2 | 1330 | 5290 |
| 196.9 | 1410 | 5250 |
| 198.5 | 1390 | 5330 |
| 200.1 | 1360 | 5330 |
| 201.8 | 1320 | 5330 |
| 203.4 | 1320 | 5290 |
| 205.1 | 1330 | 5380 |
| 206.7 | 1180 | 5420 |
| 208.3 | 1080 | 5420 |
| 210.0 | 1170 | 5250 |
| 211.6 | 1190 | 5010 |
| 213.3 | 1560 | 5050 |
| 214.9 | 1070 | 5330 |
| 216.5 | 1430 | 5420 |
| 218.2 | 1230 | 5380 |
| 219.8 | 1320 | 5560 |
| 221.5 | 1710 | 5900 |
| 223.1 | 2080 | 6010 |
| 224.7 | 1740 | 5950 |
| 226.4 | 1680 | 5750 |
| 228.0 | 1770 | 5700 |
| 229.7 | 1390 | 5650 |
| 231.3 | 1310 | 5600 |
| 232.9 | 1260 | 5560 |
| 234.6 | 1150 | 5330 |
| 236.2 | 1010 | 5130 |
| | | |

Table 10. Boring B-4003, Suspension R1-R2 depths and P- and SH-wave velocities

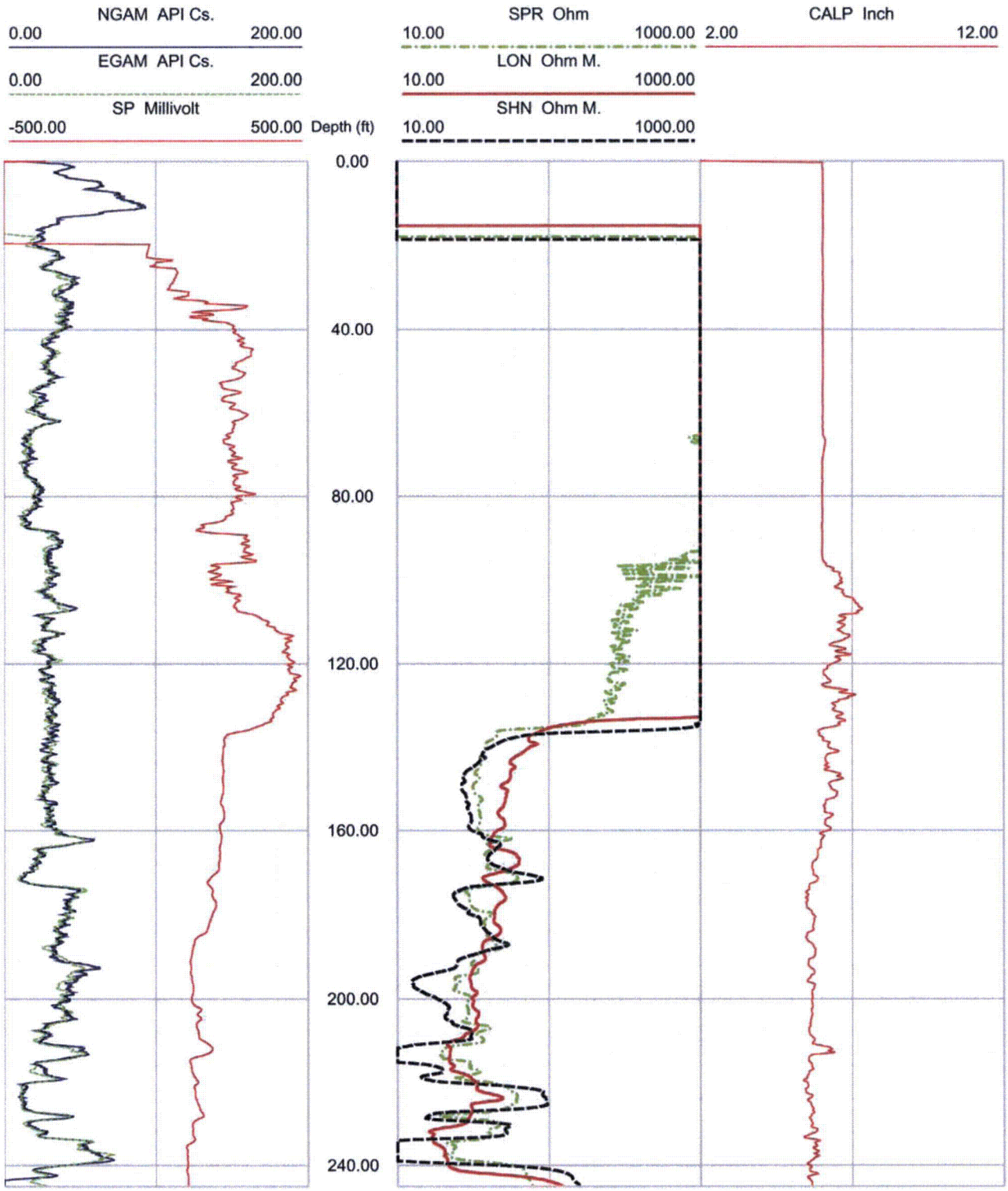



Figure 22. Boring B-4003, Caliper, Natural gamma, Resistivity and SP logs

Deviated borehole in orthographic projection, viewed from N45

Borehole: B-4003 Sonde: BHTV
Zone from: 0.080 to 249.840ft
North ref is true
Mean deviation: 2.64 to N120.14
End coordinates .....
North: -5.784
East : 9.961
Down : 249.295
Azimuth of end: N120.14
Distance start-end: 11.519ft
Viewpoint: N45
Data extrapolated to the surface from 0.080ft

Figure 23. Boring B-4003, Deviation Projection (dimensions in feet)

# APPENDIX A

# SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS

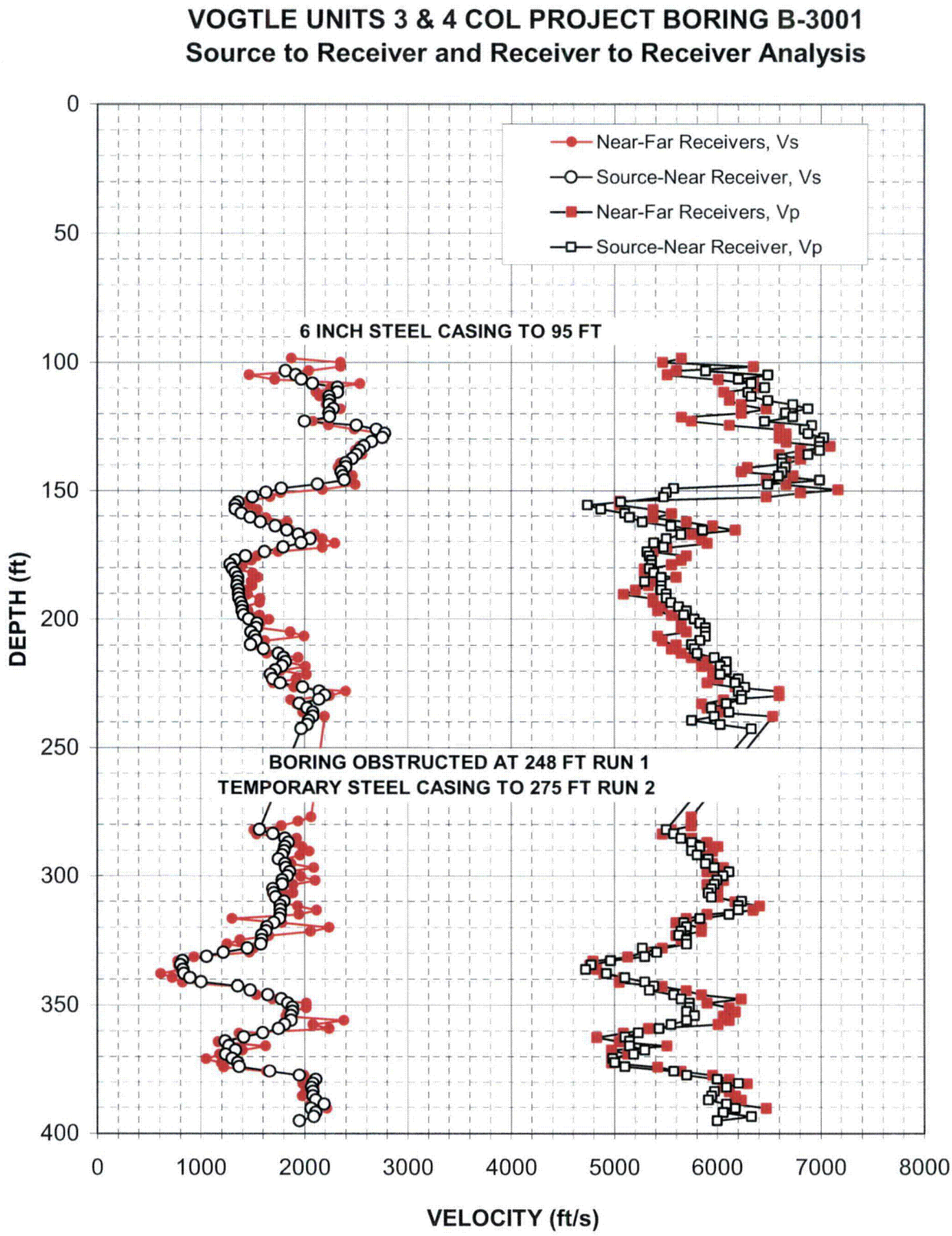



Figure A-1. Boring B-3001, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and $S_H$-wave data

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 103.3 | 1820 | 5890 |
| 104.9 | 1920 | 6490 |
| 106.5 | 1970 | 6210 |
| 108.2 | 2080 | 6330 |
| 109.8 | 2320 | 6460 |
| 111.5 | 2320 | 6300 |
| 113.1 | 2240 | 6330 |
| 114.7 | 2240 | 6490 |
| 116.4 | 2240 | 6730 |
| 118.0 | 2280 | 6880 |
| 119.7 | 2240 | 6660 |
| 121.3 | 2240 | 6730 |
| 122.9 | 2000 | 6460 |
| 124.6 | 2500 | 6920 |
| 126.2 | 2690 | 6840 |
| 127.9 | 2780 | 6880 |
| 129.5 | 2750 | 7030 |
| 131.1 | 2650 | 6990 |
| 132.8 | 2570 | 6990 |
| 134.4 | 2530 | 6990 |
| 136.1 | 2500 | 6880 |
| 137.7 | 2460 | 6630 |
| 139.3 | 2400 | 6630 |
| 141.0 | 2400 | 6660 |
| 142.6 | 2350 | 6630 |
| 144.3 | 2370 | 6590 |
| 145.9 | 2380 | 6990 |
| 147.6 | 2130 | 6490 |
| 149.2 | 1780 | 5580 |
| 150.8 | 1630 | 5500 |
| 152.5 | 1500 | 5480 |
| 154.4 | 1360 | 5060 |
| 155.8 | 1340 | 4740 |
| 157.4 | 1340 | 4870 |
| 159.0 | 1390 | 5100 |
| 160.7 | 1480 | 5150 |
| 162.3 | 1570 | 5280 |
| 164.0 | 1720 | 5550 |
| 165.6 | 1830 | 5860 |
| 167.2 | 1940 | 5650 |
| 168.9 | 2060 | 5500 |
| 170.5 | 1970 | 5390 |
| 172.2 | 1790 | 5480 |
| 173.8 | 1610 | 5320 |
| 175.4 | 1430 | 5340 |
| 177.1 | 1330 | 5360 |
| 178.7 | 1280 | 5360 |
| 180.4 | 1310 | 5340 |
| 182.0 | 1340 | 5390 |
| 183.6 | 1360 | 5460 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 185.3 | 1360 | 5300 |
| 186.9 | 1350 | 5460 |
| 188.6 | 1360 | 5460 |
| 190.2 | 1360 | 5500 |
| 191.8 | 1370 | 5500 |
| 193.5 | 1390 | 5550 |
| 195.1 | 1400 | 5630 |
| 196.8 | 1400 | 5700 |
| 198.4 | 1410 | 5680 |
| 200.0 | 1470 | 5780 |
| 201.7 | 1540 | 5830 |
| 203.3 | 1540 | 5890 |
| 205.0 | 1490 | 5890 |
| 206.6 | 1520 | 5890 |
| 208.2 | 1540 | 5830 |
| 209.9 | 1480 | 5750 |
| 211.5 | 1610 | 5780 |
| 213.2 | 1750 | 5810 |
| 214.8 | 1800 | 5970 |
| 216.4 | 1820 | 6090 |
| 218.1 | 1790 | 6030 |
| 219.7 | 1720 | 6090 |
| 221.4 | 1670 | 6030 |
| 223.0 | 1700 | 6210 |
| 224.7 | 1770 | 6180 |
| 226.3 | 1980 | 6270 |
| 227.9 | 2150 | 6210 |
| 229.6 | 2200 | 6240 |
| 231.2 | 2140 | 6240 |
| 232.9 | 1950 | 6090 |
| 234.5 | 2030 | 5940 |
| 236.1 | 2080 | 6120 |
| 237.8 | 2080 | 5970 |
| 239.4 | 2040 | 5750 |
| 241.1 | 2030 | 6030 |
| 242.7 | 1970 | 6330 |
| 282.1 | 1570 | 5500 |
| 283.7 | 1700 | 5580 |
| 285.3 | 1810 | 5650 |
| 287.0 | 1850 | 5750 |
| 288.6 | 1810 | 5830 |
| 290.3 | 1800 | 5750 |
| 291.9 | 1790 | 5810 |
| 293.5 | 1750 | 5920 |
| 295.2 | 1810 | 5890 |
| 296.8 | 1820 | 5970 |
| 298.5 | 1860 | 6120 |
| 300.1 | 1830 | 6060 |
| 301.8 | 1790 | 6000 |
| 303.4 | 1790 | 5970 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 305.0 | 1700 | 5940 |
| 306.7 | 1710 | 5920 |
| 308.3 | 1720 | 5940 |
| 310.0 | 1800 | 6240 |
| 311.6 | 1770 | 6210 |
| 313.2 | 1770 | 6210 |
| 314.9 | 1770 | 6120 |
| 316.5 | 1760 | 5830 |
| 318.2 | 1710 | 5680 |
| 319.8 | 1640 | 5700 |
| 321.4 | 1630 | 5650 |
| 323.1 | 1590 | 5630 |
| 324.7 | 1590 | 5700 |
| 326.4 | 1580 | 5700 |
| 328.0 | 1450 | 5280 |
| 329.6 | 1220 | 5410 |
| 331.3 | 1060 | 5300 |
| 332.9 | 820 | 4960 |
| 334.6 | 810 | 4780 |
| 336.2 | 830 | 4720 |
| 337.8 | 840 | 4930 |
| 339.5 | 900 | 5100 |
| 341.1 | 1000 | 5300 |
| 342.8 | 1360 | 5390 |
| 344.4 | 1480 | 5340 |
| 346.0 | 1650 | 5580 |
| 347.7 | 1780 | 5650 |
| 349.3 | 1840 | 5730 |
| 351.0 | 1880 | 5730 |
| 352.6 | 1880 | 5700 |
| 354.2 | 1870 | 5780 |
| 355.9 | 1870 | 5700 |
| 357.5 | 1810 | 5550 |
| 359.2 | 1750 | 5430 |
| 360.8 | 1600 | 5230 |
| 362.4 | 1410 | 5100 |
| 364.1 | 1240 | 5150 |
| 365.7 | 1270 | 5150 |
| 367.4 | 1340 | 5300 |
| 369.0 | 1240 | 5190 |
| 370.6 | 1300 | 4980 |
| 372.3 | 1360 | 5000 |
| 373.9 | 1370 | 5100 |
| 375.6 | 1670 | 5580 |
| 377.2 | 1950 | 5700 |
| 378.9 | 2110 | 6000 |
| 380.5 | 2080 | 6210 |
| 382.1 | 2070 | 6090 |
| 383.8 | 2080 | 5970 |
| 385.4 | 2080 | 5940 |

Table A-1. Boring B-3001, S - R1 quality assurance analysis P- and $S_H$-wave data

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 387.1 | 2110 | 5920 |
| 388.7 | 2190 | 6090 |
| 390.3 | 2060 | 6180 |
| 392.0 | 2110 | 6060 |
| 393.6 | 2090 | 6330 |
| 395.3 | 1950 | 6000 |
| | | |

Table A-1, continued. Boring B-3001, S - R1 quality assurance analysis P- and $S_H$-wave data

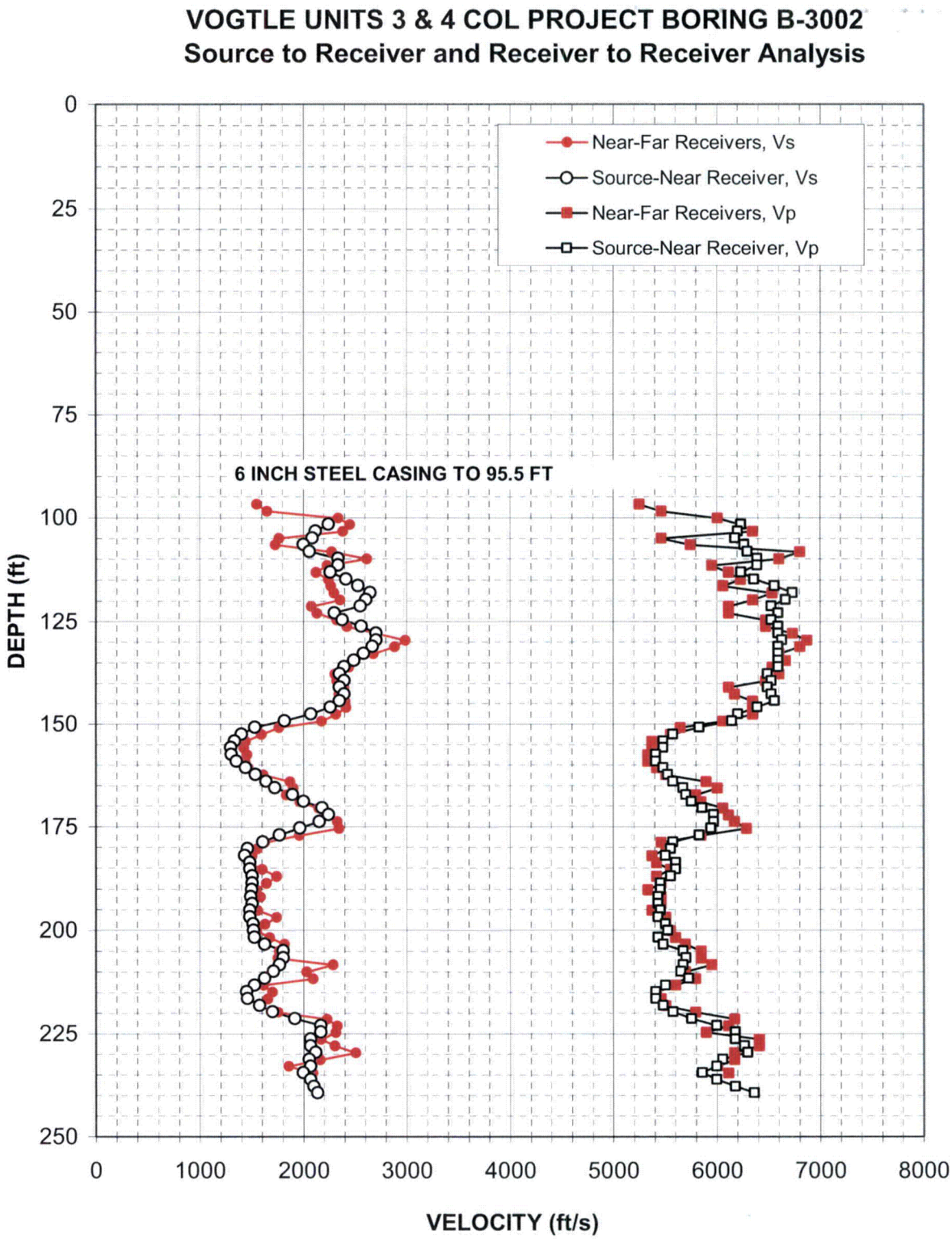



Figure A-2. Boring B-3002, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and $S_H$-wave data

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 101.6 | 2240 | 6240 |
| 103.3 | 2120 | 6210 |
| 104.9 | 2090 | 6180 |
| 106.5 | 2000 | 6270 |
| 108.2 | 2060 | 6300 |
| 109.8 | 2340 | 6390 |
| 111.5 | 2340 | 6390 |
| 113.1 | 2260 | 6240 |
| 114.7 | 2420 | 6360 |
| 116.4 | 2530 | 6560 |
| 118.0 | 2650 | 6730 |
| 119.7 | 2600 | 6660 |
| 121.3 | 2550 | 6530 |
| 122.9 | 2300 | 6590 |
| 124.6 | 2380 | 6530 |
| 126.2 | 2560 | 6590 |
| 127.9 | 2710 | 6590 |
| 129.5 | 2710 | 6630 |
| 131.1 | 2670 | 6590 |
| 132.8 | 2580 | 6590 |
| 134.4 | 2490 | 6590 |
| 136.1 | 2400 | 6590 |
| 137.7 | 2350 | 6490 |
| 139.3 | 2400 | 6530 |
| 141.0 | 2350 | 6490 |
| 142.6 | 2400 | 6530 |
| 144.3 | 2350 | 6560 |
| 145.9 | 2260 | 6390 |
| 147.6 | 2080 | 6210 |
| 149.2 | 1820 | 6150 |
| 150.8 | 1530 | 5830 |
| 152.5 | 1400 | 5580 |
| 154.1 | 1340 | 5480 |
| 155.8 | 1300 | 5480 |
| 157.4 | 1300 | 5410 |
| 159.0 | 1350 | 5410 |
| 160.7 | 1440 | 5480 |
| 162.3 | 1540 | 5530 |
| 164.0 | 1640 | 5580 |
| 165.6 | 1720 | 5680 |
| 167.2 | 1900 | 5700 |
| 168.9 | 2000 | 5750 |
| 170.5 | 2180 | 5860 |
| 172.2 | 2240 | 5970 |
| 173.8 | 2150 | 5970 |
| 175.4 | 1970 | 5940 |
| 177.1 | 1770 | 5830 |
| 178.7 | 1610 | 5580 |
| 180.4 | 1460 | 5550 |
| 182.0 | 1440 | 5500 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 183.6 | 1480 | 5600 |
| 185.3 | 1480 | 5600 |
| 186.9 | 1510 | 5550 |
| 188.6 | 1510 | 5460 |
| 190.2 | 1500 | 5460 |
| 191.8 | 1490 | 5430 |
| 193.5 | 1510 | 5430 |
| 195.1 | 1480 | 5460 |
| 196.8 | 1480 | 5430 |
| 198.4 | 1520 | 5500 |
| 200.0 | 1520 | 5530 |
| 201.7 | 1530 | 5430 |
| 203.3 | 1630 | 5480 |
| 205.0 | 1800 | 5680 |
| 206.6 | 1800 | 5700 |
| 208.2 | 1770 | 5680 |
| 209.9 | 1710 | 5650 |
| 211.5 | 1630 | 5730 |
| 213.2 | 1530 | 5500 |
| 214.8 | 1450 | 5410 |
| 216.4 | 1460 | 5410 |
| 218.1 | 1580 | 5480 |
| 219.7 | 1700 | 5580 |
| 221.4 | 1920 | 5750 |
| 223.0 | 2170 | 6000 |
| 224.7 | 2170 | 6180 |
| 226.3 | 2070 | 6180 |
| 227.9 | 2070 | 6270 |
| 229.6 | 2120 | 6300 |
| 231.2 | 2060 | 6060 |
| 232.9 | 2070 | 6000 |
| 234.5 | 2000 | 5860 |
| 236.1 | 2070 | 6000 |
| 237.8 | 2100 | 6180 |
| 239.4 | 2140 | 6360 |
| | | |

Table A-2. Boring B-3002, S - R1 quality assurance analysis P- and $S_H$-wave data

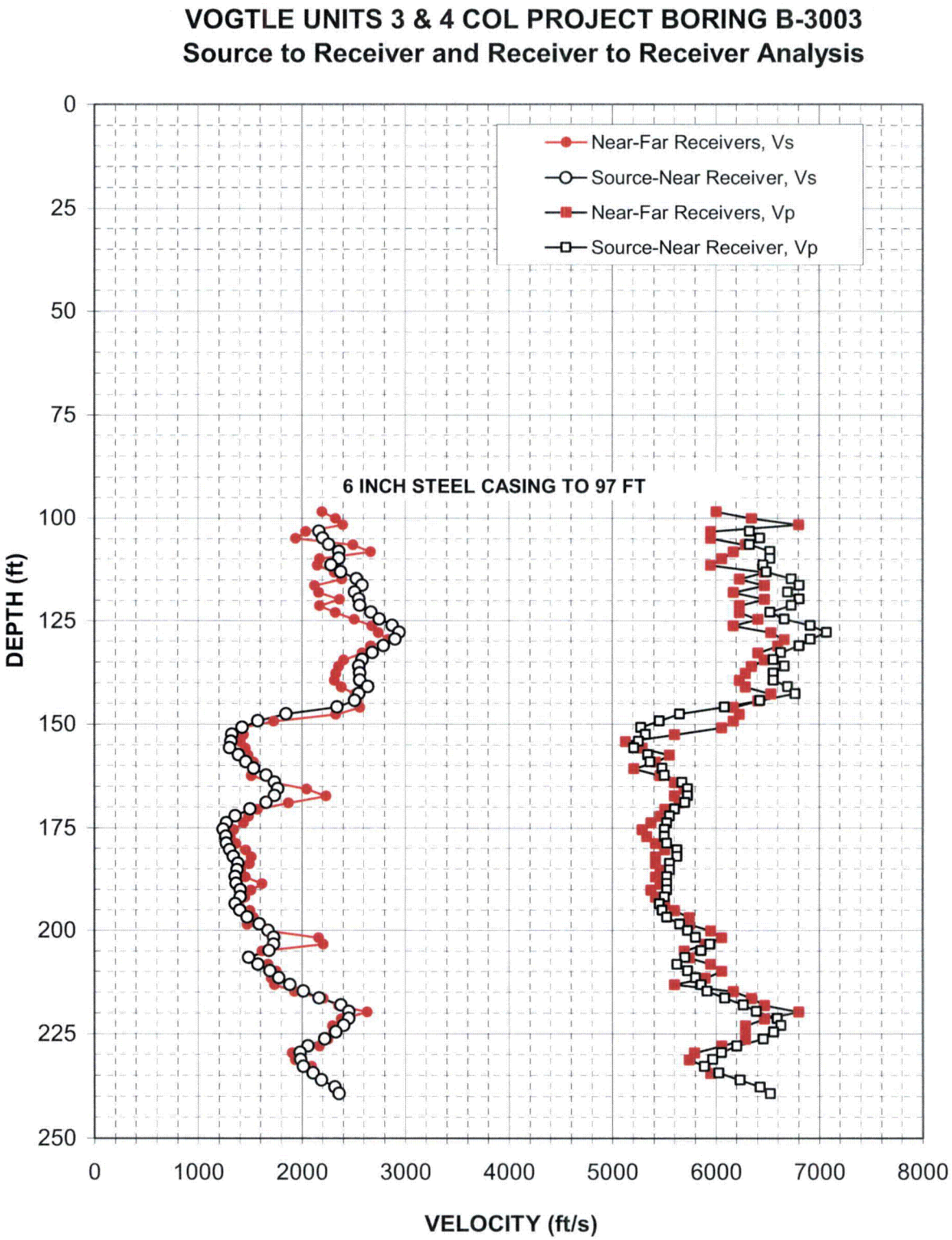



Figure A-3. Boring B-3003, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and $S_H$-wave data

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 103.3 | 2170 | 6330 |
| 104.9 | 2210 | 6430 |
| 106.5 | 2260 | 6330 |
| 108.2 | 2360 | 6530 |
| 109.8 | 2360 | 6530 |
| 111.5 | 2290 | 6460 |
| 113.1 | 2380 | 6490 |
| 114.7 | 2530 | 6730 |
| 116.4 | 2580 | 6810 |
| 118.0 | 2510 | 6700 |
| 119.7 | 2550 | 6810 |
| 121.3 | 2560 | 6730 |
| 122.9 | 2670 | 6530 |
| 124.6 | 2750 | 6660 |
| 126.2 | 2880 | 6920 |
| 127.9 | 2940 | 7070 |
| 129.5 | 2900 | 6920 |
| 131.1 | 2790 | 6810 |
| 132.8 | 2680 | 6630 |
| 134.4 | 2580 | 6560 |
| 136.1 | 2550 | 6660 |
| 137.7 | 2560 | 6560 |
| 139.3 | 2560 | 6560 |
| 141.0 | 2640 | 6700 |
| 142.6 | 2550 | 6770 |
| 144.3 | 2510 | 6430 |
| 145.9 | 2340 | 6090 |
| 147.6 | 1850 | 5650 |
| 149.2 | 1580 | 5460 |
| 150.8 | 1420 | 5280 |
| 152.5 | 1320 | 5320 |
| 154.1 | 1320 | 5250 |
| 155.8 | 1300 | 5210 |
| 157.4 | 1390 | 5340 |
| 159.0 | 1460 | 5360 |
| 160.7 | 1540 | 5480 |
| 162.3 | 1660 | 5500 |
| 164.0 | 1740 | 5680 |
| 165.6 | 1770 | 5730 |
| 167.2 | 1740 | 5730 |
| 168.9 | 1660 | 5700 |
| 170.5 | 1500 | 5600 |
| 172.2 | 1360 | 5550 |
| 173.8 | 1270 | 5530 |
| 175.4 | 1240 | 5500 |
| 177.1 | 1270 | 5500 |
| 178.7 | 1270 | 5530 |
| 180.4 | 1300 | 5630 |
| 182.0 | 1340 | 5630 |
| 183.6 | 1380 | 5550 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 185.3 | 1380 | 5550 |
| 186.9 | 1360 | 5530 |
| 188.6 | 1360 | 5530 |
| 190.2 | 1410 | 5530 |
| 191.8 | 1410 | 5500 |
| 193.5 | 1360 | 5460 |
| 195.1 | 1400 | 5480 |
| 196.8 | 1470 | 5530 |
| 198.4 | 1590 | 5650 |
| 200.0 | 1670 | 5730 |
| 201.7 | 1730 | 5810 |
| 203.3 | 1730 | 5940 |
| 205.0 | 1680 | 5860 |
| 206.6 | 1490 | 5700 |
| 208.2 | 1570 | 5630 |
| 209.9 | 1690 | 5730 |
| 211.5 | 1780 | 5810 |
| 213.2 | 1880 | 5860 |
| 214.8 | 2020 | 5920 |
| 216.4 | 2170 | 6090 |
| 218.1 | 2380 | 6270 |
| 219.7 | 2450 | 6390 |
| 221.4 | 2450 | 6590 |
| 223.0 | 2410 | 6630 |
| 224.7 | 2330 | 6560 |
| 226.3 | 2220 | 6460 |
| 227.9 | 2060 | 6210 |
| 229.6 | 1980 | 6060 |
| 231.2 | 1990 | 5970 |
| 232.9 | 2020 | 5890 |
| 234.5 | 2110 | 6030 |
| 236.1 | 2190 | 6240 |
| 237.8 | 2320 | 6430 |
| 239.4 | 2360 | 6530 |
| | | |

Table A-3. Boring B-3003, S - R1 quality assurance analysis
P- and $S_H$-wave data

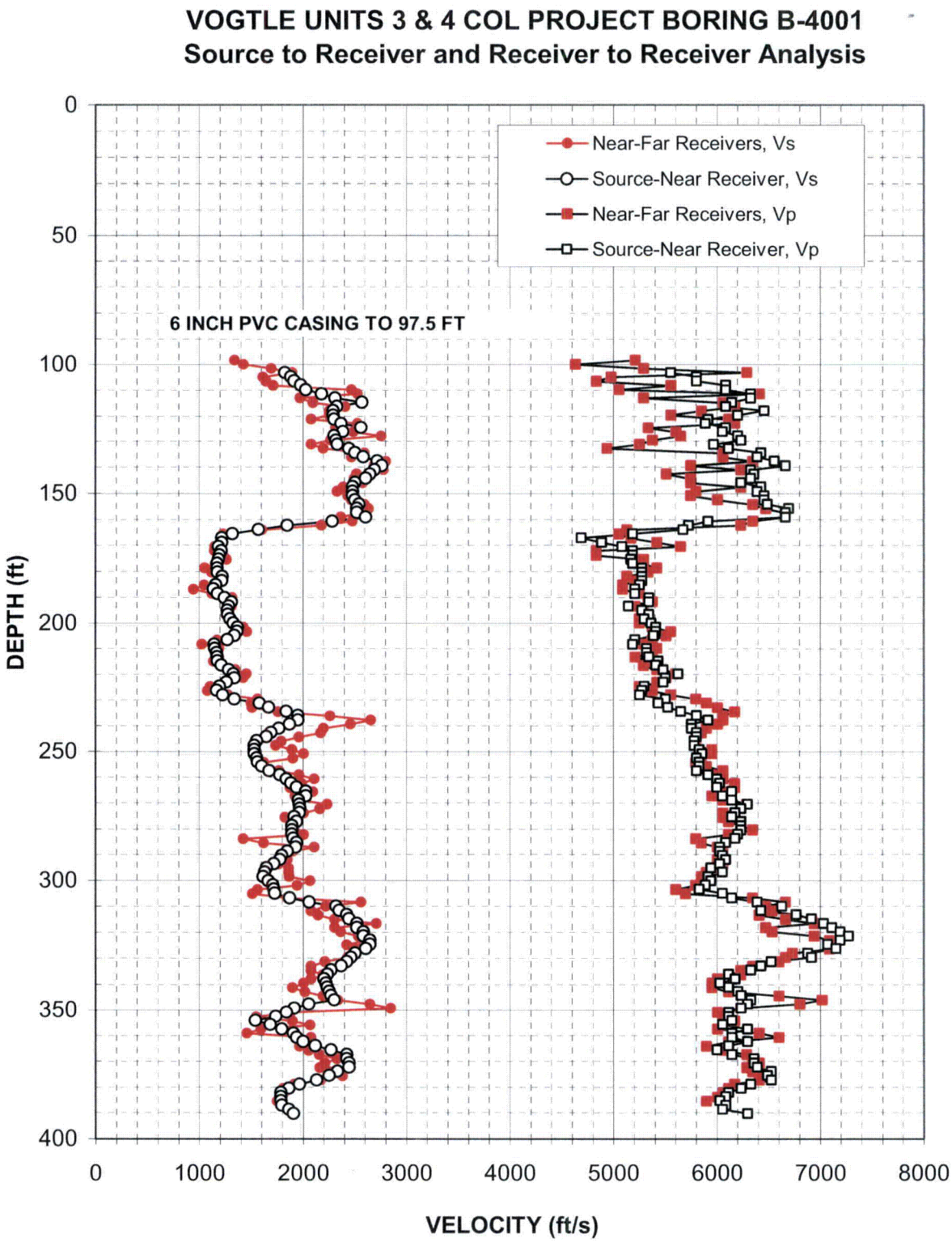



Figure A-4. Boring B-4001, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and $S_H$-wave data

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 103.3 | 1830 | 5550 |
| 104.9 | 1880 | 5810 |
| 106.5 | 1920 | 5810 |
| 108.2 | 1980 | 6090 |
| 109.8 | 2030 | 6090 |
| 111.5 | 2180 | 6330 |
| 113.1 | 2310 | 6330 |
| 114.7 | 2570 | 6150 |
| 116.4 | 2330 | 6090 |
| 118.0 | 2290 | 6460 |
| 119.7 | 2290 | 6210 |
| 121.3 | 2300 | 5920 |
| 122.9 | 2370 | 5890 |
| 124.6 | 2560 | 6090 |
| 126.2 | 2390 | 6060 |
| 127.9 | 2300 | 6210 |
| 129.5 | 2320 | 6240 |
| 131.1 | 2340 | 5970 |
| 132.8 | 2440 | 6120 |
| 134.4 | 2500 | 6430 |
| 136.1 | 2580 | 6390 |
| 137.7 | 2720 | 6560 |
| 139.3 | 2760 | 6660 |
| 141.0 | 2690 | 6330 |
| 142.6 | 2650 | 6360 |
| 144.3 | 2600 | 6330 |
| 145.9 | 2500 | 6240 |
| 147.6 | 2480 | 6430 |
| 149.2 | 2480 | 6390 |
| 150.8 | 2480 | 6460 |
| 152.5 | 2500 | 6460 |
| 154.1 | 2540 | 6490 |
| 155.8 | 2520 | 6700 |
| 157.4 | 2520 | 6660 |
| 159.0 | 2600 | 6660 |
| 160.7 | 2290 | 5920 |
| 162.3 | 1850 | 5730 |
| 164.0 | 1570 | 5680 |
| 165.6 | 1320 | 5190 |
| 167.2 | 1220 | 4690 |
| 168.9 | 1220 | 4890 |
| 170.5 | 1190 | 5080 |
| 172.2 | 1210 | 5190 |
| 173.8 | 1190 | 5190 |
| 175.4 | 1190 | 5170 |
| 177.1 | 1170 | 5190 |
| 178.7 | 1170 | 5280 |
| 180.4 | 1180 | 5280 |
| 182.0 | 1220 | 5280 |
| 183.6 | 1220 | 5280 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 185.3 | 1160 | 5250 |
| 186.9 | 1140 | 5210 |
| 188.6 | 1180 | 5210 |
| 190.2 | 1250 | 5340 |
| 191.8 | 1310 | 5340 |
| 193.5 | 1290 | 5150 |
| 195.1 | 1270 | 5280 |
| 196.8 | 1280 | 5340 |
| 198.4 | 1300 | 5300 |
| 200.0 | 1330 | 5360 |
| 201.7 | 1370 | 5410 |
| 203.3 | 1360 | 5410 |
| 205.0 | 1340 | 5390 |
| 206.6 | 1270 | 5210 |
| 208.2 | 1150 | 5190 |
| 209.9 | 1150 | 5320 |
| 211.5 | 1170 | 5320 |
| 213.2 | 1170 | 5340 |
| 214.8 | 1180 | 5430 |
| 216.4 | 1210 | 5410 |
| 218.1 | 1290 | 5480 |
| 219.7 | 1330 | 5630 |
| 221.4 | 1340 | 5500 |
| 223.0 | 1260 | 5480 |
| 224.7 | 1190 | 5300 |
| 226.3 | 1170 | 5280 |
| 227.9 | 1230 | 5250 |
| 229.6 | 1340 | 5500 |
| 231.2 | 1580 | 5430 |
| 232.9 | 1670 | 5530 |
| 234.5 | 1840 | 5650 |
| 236.1 | 1950 | 5810 |
| 237.8 | 1950 | 5920 |
| 239.4 | 1870 | 5750 |
| 241.1 | 1770 | 5750 |
| 242.7 | 1690 | 5810 |
| 244.3 | 1650 | 5810 |
| 246.0 | 1560 | 5780 |
| 247.6 | 1530 | 5780 |
| 249.3 | 1530 | 5830 |
| 250.9 | 1530 | 5860 |
| 252.5 | 1560 | 5810 |
| 254.2 | 1560 | 5830 |
| 255.8 | 1600 | 5830 |
| 257.5 | 1670 | 5810 |
| 259.1 | 1780 | 5920 |
| 260.7 | 1840 | 6000 |
| 262.4 | 1880 | 6030 |
| 264.0 | 1940 | 6000 |
| 265.7 | 2030 | 6150 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 267.3 | 2030 | 6060 |
| 268.9 | 1960 | 6150 |
| 270.6 | 1970 | 6300 |
| 272.2 | 1970 | 6240 |
| 273.9 | 1970 | 6180 |
| 275.5 | 1920 | 6150 |
| 277.1 | 1940 | 6240 |
| 278.8 | 1900 | 6240 |
| 280.4 | 1900 | 6240 |
| 282.1 | 1900 | 6210 |
| 283.7 | 1910 | 6180 |
| 285.3 | 1940 | 6090 |
| 287.0 | 1930 | 6030 |
| 288.6 | 1850 | 6030 |
| 290.3 | 1800 | 6060 |
| 291.9 | 1780 | 6090 |
| 293.5 | 1720 | 6030 |
| 295.2 | 1650 | 5940 |
| 296.8 | 1630 | 6060 |
| 298.5 | 1610 | 5920 |
| 300.1 | 1670 | 5940 |
| 301.8 | 1710 | 5890 |
| 303.4 | 1720 | 5830 |
| 305.0 | 1730 | 6060 |
| 306.7 | 1870 | 6150 |
| 308.3 | 2060 | 6390 |
| 310.0 | 2320 | 6630 |
| 311.6 | 2350 | 6430 |
| 313.2 | 2430 | 6770 |
| 314.9 | 2440 | 6920 |
| 316.5 | 2520 | 7030 |
| 318.2 | 2520 | 7110 |
| 319.8 | 2580 | 7190 |
| 321.4 | 2580 | 7280 |
| 323.1 | 2650 | 7190 |
| 324.7 | 2650 | 7070 |
| 326.4 | 2600 | 7150 |
| 328.0 | 2500 | 6880 |
| 329.6 | 2460 | 6920 |
| 331.3 | 2430 | 6530 |
| 332.9 | 2370 | 6430 |
| 334.6 | 2270 | 6330 |
| 336.2 | 2240 | 6120 |
| 337.8 | 2210 | 6180 |
| 339.5 | 2220 | 6030 |
| 341.1 | 2240 | 6120 |
| 342.8 | 2250 | 6210 |
| 344.4 | 2270 | 6240 |
| 346.0 | 2300 | 6330 |
| 347.7 | 2060 | 6300 |

Table A-4. Boring B-4001, S - R1 quality assurance analysis P- and $S_H$-wave data

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 349.3 | 1920 | 6240 |
| 351.0 | 1840 | 6120 |
| 352.6 | 1740 | 6120 |
| 354.2 | 1540 | 6150 |
| 355.9 | 1680 | 6060 |
| 357.5 | 1800 | 6300 |
| 359.2 | 1910 | 6150 |
| 360.8 | 1940 | 6150 |
| 362.4 | 2000 | 6300 |
| 364.1 | 2120 | 6120 |
| 365.7 | 2270 | 6000 |
| 367.4 | 2430 | 6150 |
| 369.0 | 2430 | 6360 |
| 370.6 | 2440 | 6360 |
| 372.3 | 2440 | 6390 |
| 373.9 | 2340 | 6530 |
| 375.6 | 2250 | 6490 |
| 377.2 | 2130 | 6530 |
| 378.9 | 1970 | 6330 |
| 380.5 | 1860 | 6240 |
| 382.1 | 1790 | 6120 |
| 383.8 | 1790 | 6090 |
| 385.4 | 1790 | 6030 |
| 387.1 | 1800 | 6090 |
| 388.7 | 1860 | 6060 |
| 390.3 | 1910 | 6300 |
| | | |

Table A-4, continued. Boring B-4001, S - R1 quality assurance analysis P- and $S_H$-wave data

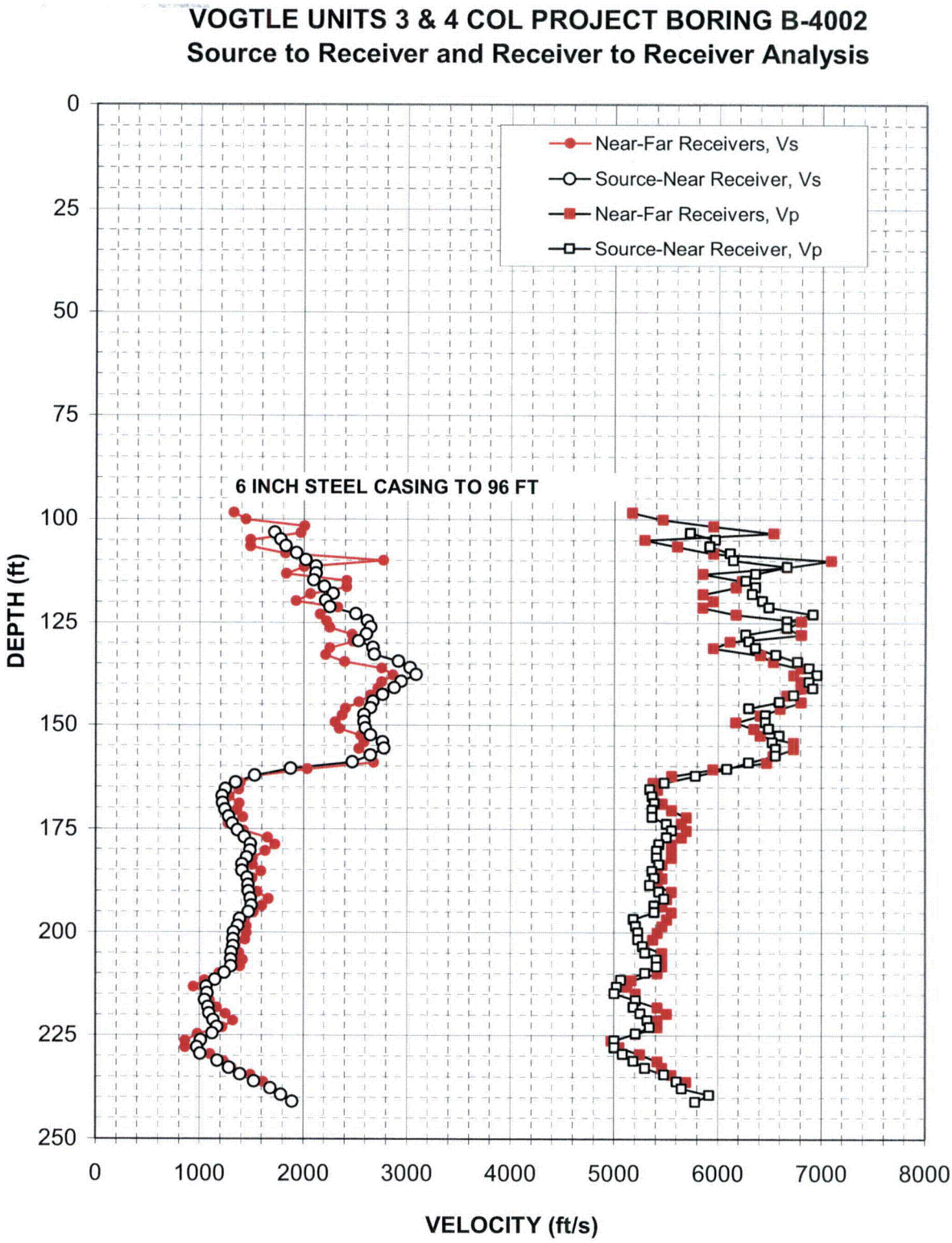



Figure A-5. Boring B-4002, R 1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and $S_H$-wave data

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 103.3 | 1720 | 5730 |
| 104.9 | 1780 | 5970 |
| 106.5 | 1830 | 5920 |
| 108.2 | 1930 | 6120 |
| 109.8 | 2020 | 6150 |
| 111.5 | 2120 | 6660 |
| 113.1 | 2120 | 6360 |
| 114.7 | 2100 | 6270 |
| 116.4 | 2200 | 6360 |
| 118.0 | 2290 | 6330 |
| 119.7 | 2210 | 6430 |
| 121.3 | 2250 | 6490 |
| 122.9 | 2500 | 6920 |
| 124.6 | 2620 | 6660 |
| 126.2 | 2650 | 6660 |
| 127.9 | 2600 | 6270 |
| 129.5 | 2530 | 6300 |
| 131.1 | 2670 | 6360 |
| 132.8 | 2680 | 6560 |
| 134.4 | 2920 | 6770 |
| 136.1 | 3030 | 6880 |
| 137.7 | 3090 | 6960 |
| 139.3 | 2940 | 6880 |
| 141.0 | 2880 | 6920 |
| 142.6 | 2760 | 6730 |
| 144.3 | 2670 | 6590 |
| 145.9 | 2650 | 6300 |
| 147.6 | 2580 | 6460 |
| 149.2 | 2580 | 6460 |
| 150.8 | 2600 | 6490 |
| 152.5 | 2650 | 6590 |
| 154.1 | 2760 | 6530 |
| 155.8 | 2780 | 6560 |
| 157.4 | 2650 | 6560 |
| 159.0 | 2470 | 6300 |
| 160.7 | 1880 | 6090 |
| 162.3 | 1530 | 5780 |
| 164.0 | 1350 | 5480 |
| 165.6 | 1250 | 5340 |
| 167.2 | 1220 | 5360 |
| 168.9 | 1220 | 5390 |
| 170.5 | 1250 | 5360 |
| 172.2 | 1280 | 5360 |
| 173.8 | 1320 | 5500 |
| 175.4 | 1360 | 5550 |
| 177.1 | 1430 | 5500 |
| 178.7 | 1490 | 5430 |
| 180.4 | 1490 | 5410 |
| 182.0 | 1460 | 5410 |
| 183.6 | 1410 | 5430 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 185.3 | 1410 | 5360 |
| 186.9 | 1460 | 5390 |
| 188.6 | 1470 | 5340 |
| 190.2 | 1470 | 5430 |
| 191.8 | 1490 | 5480 |
| 193.5 | 1500 | 5390 |
| 195.1 | 1470 | 5390 |
| 196.8 | 1390 | 5190 |
| 198.4 | 1370 | 5210 |
| 200.0 | 1330 | 5230 |
| 201.7 | 1320 | 5230 |
| 203.3 | 1320 | 5280 |
| 205.0 | 1310 | 5300 |
| 206.6 | 1300 | 5410 |
| 208.2 | 1300 | 5410 |
| 209.9 | 1240 | 5300 |
| 211.5 | 1150 | 5060 |
| 213.2 | 1070 | 5020 |
| 214.8 | 1080 | 5000 |
| 216.4 | 1050 | 5210 |
| 218.1 | 1080 | 5190 |
| 219.7 | 1100 | 5250 |
| 221.4 | 1130 | 5320 |
| 223.0 | 1170 | 5340 |
| 224.7 | 1120 | 5210 |
| 226.3 | 1010 | 5000 |
| 227.9 | 980 | 5000 |
| 229.6 | 1010 | 5080 |
| 231.2 | 1170 | 5190 |
| 232.9 | 1290 | 5300 |
| 234.5 | 1390 | 5480 |
| 236.1 | 1530 | 5600 |
| 237.8 | 1680 | 5650 |
| 239.4 | 1790 | 5920 |
| 241.1 | 1900 | 5780 |
| | | |

Table A-5. Boring B-4002, S - R1 quality assurance analysis P- and $S_H$-wave data

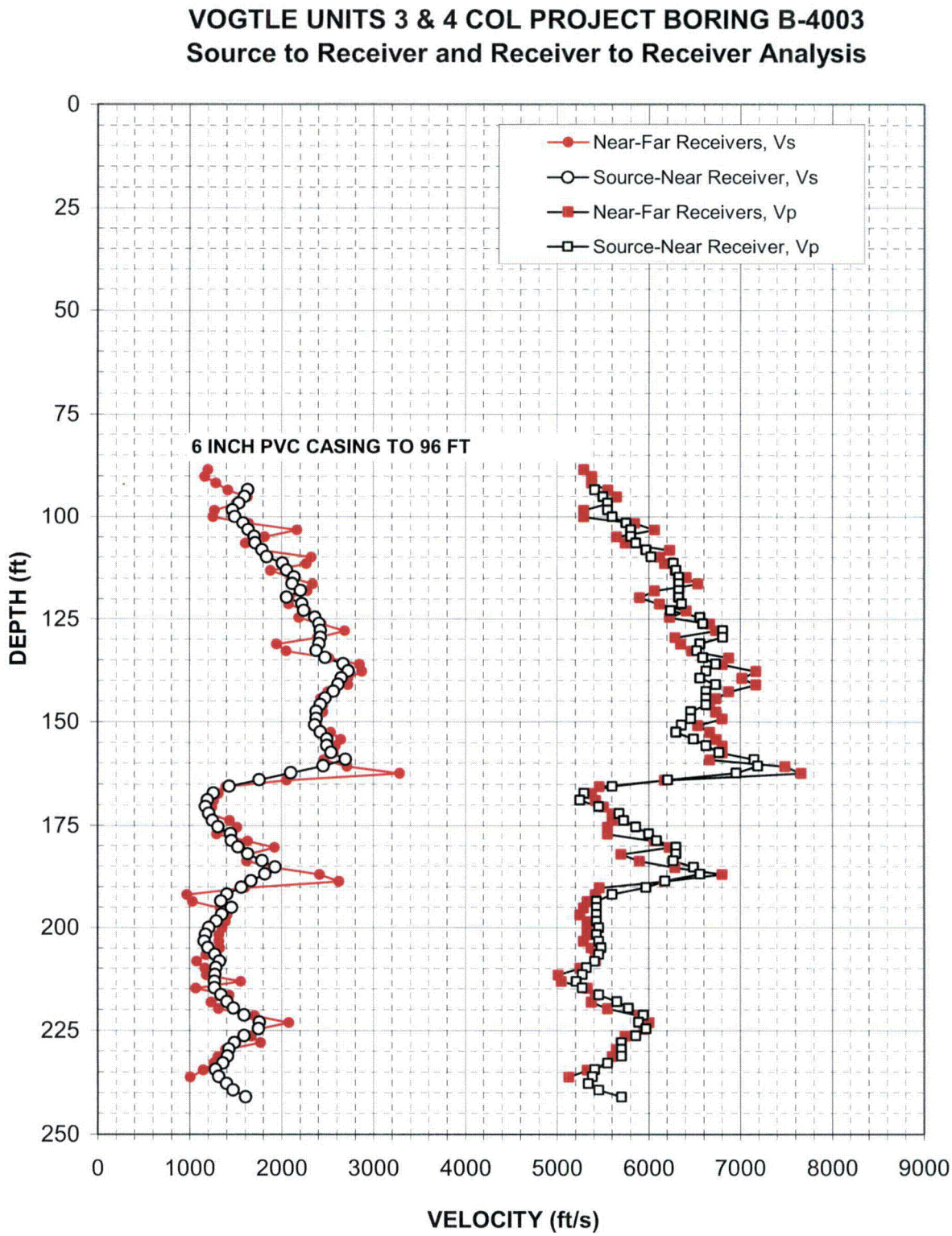



Figure A-6. Boring B-4003, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and $S_H$-wave data

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 90.1 | - | - |
| 91.8 | - | - |
| 93.4 | 1630 | 5410 |
| 95.1 | 1600 | 5500 |
| 96.7 | 1540 | 5550 |
| 98.3 | 1470 | 5550 |
| 100.0 | 1490 | 5600 |
| 101.6 | 1580 | 5750 |
| 103.3 | 1640 | 5810 |
| 104.9 | 1700 | 5810 |
| 106.5 | 1710 | 5860 |
| 108.2 | 1790 | 5970 |
| 109.8 | 1840 | 6030 |
| 111.5 | 2010 | 6270 |
| 113.1 | 2060 | 6300 |
| 114.7 | 2140 | 6330 |
| 116.4 | 2120 | 6330 |
| 118.0 | 2210 | 6330 |
| 119.7 | 2060 | 6330 |
| 121.3 | 2220 | 6360 |
| 122.9 | 2240 | 6240 |
| 124.6 | 2360 | 6560 |
| 126.2 | 2410 | 6590 |
| 127.9 | 2430 | 6810 |
| 129.5 | 2430 | 6810 |
| 131.1 | 2410 | 6560 |
| 132.8 | 2380 | 6530 |
| 134.4 | 2470 | 6590 |
| 136.1 | 2670 | 6730 |
| 137.7 | 2730 | 6630 |
| 139.3 | 2650 | 6560 |
| 141.0 | 2620 | 6730 |
| 142.6 | 2560 | 6630 |
| 144.3 | 2470 | 6630 |
| 145.9 | 2430 | 6630 |
| 147.6 | 2380 | 6460 |
| 149.2 | 2380 | 6460 |
| 150.8 | 2360 | 6360 |
| 152.5 | 2430 | 6300 |
| 154.1 | 2490 | 6490 |
| 155.8 | 2490 | 6630 |
| 157.4 | 2540 | 6770 |
| 159.0 | 2690 | 7150 |
| 160.7 | 2450 | 7190 |
| 162.3 | 2100 | 6960 |
| 164.0 | 1760 | 6210 |
| 165.6 | 1430 | 5600 |
| 167.2 | 1260 | 5300 |
| 168.9 | 1200 | 5250 |
| 170.5 | 1180 | 5460 |

| Depth (feet) | $V_s$ (feet/sec) | $V_p$ (feet/sec) |
|---|---|---|
| 172.2 | 1210 | 5680 |
| 173.8 | 1250 | 5730 |
| 175.4 | 1310 | 5860 |
| 177.1 | 1450 | 6000 |
| 178.7 | 1460 | 6090 |
| 180.4 | 1530 | 6300 |
| 182.0 | 1630 | 6300 |
| 183.6 | 1790 | 6270 |
| 185.3 | 1930 | 6490 |
| 186.9 | 1820 | 6560 |
| 188.6 | 1670 | 6180 |
| 190.2 | 1560 | 5970 |
| 191.8 | 1410 | 5600 |
| 193.5 | 1340 | 5430 |
| 195.1 | 1460 | 5430 |
| 196.8 | 1350 | 5430 |
| 198.4 | 1290 | 5430 |
| 200.0 | 1210 | 5460 |
| 201.7 | 1180 | 5430 |
| 203.3 | 1160 | 5460 |
| 205.0 | 1200 | 5480 |
| 206.6 | 1280 | 5460 |
| 208.2 | 1320 | 5410 |
| 209.9 | 1290 | 5320 |
| 211.5 | 1280 | 5280 |
| 213.2 | 1270 | 5210 |
| 214.8 | 1270 | 5280 |
| 216.4 | 1340 | 5460 |
| 218.1 | 1410 | 5650 |
| 219.7 | 1480 | 5780 |
| 221.4 | 1590 | 5940 |
| 223.0 | 1760 | 5890 |
| 224.7 | 1750 | 5970 |
| 226.3 | 1590 | 5860 |
| 227.9 | 1490 | 5700 |
| 229.6 | 1430 | 5700 |
| 231.2 | 1410 | 5700 |
| 232.9 | 1360 | 5550 |
| 234.5 | 1280 | 5410 |
| 236.1 | 1310 | 5390 |
| 237.8 | 1400 | 5340 |
| 239.4 | 1470 | 5460 |
| 241.1 | 1610 | 5700 |
| | | |

Table A-6. Boring B-4003, S - R1 quality assurance analysis P- and $S_H$-wave data

# APPENDIX B

# CALIPER, NATURAL GAMMA, RESISTIVITY, AND SPONTANEOUS POTENTIAL LOGS

ROBERTSON GEOLOGGING LIMITED

VOGTLE COL

B3001CALUP01

ROBERTSON GEOLOGGING TECHNOLOGY

REMARKS ( C:\Data\PS\Vogtle\B-3001 12-13 Feb 2007 bor..

| | |
|---|---|
| COMPANY | GEOVISION |
| WELL | B-3001 |
| FIELD | |
| COUNTRY | |
| STATE | |
| COUNTY | |
| LAT.: | |
| LONG.: | |

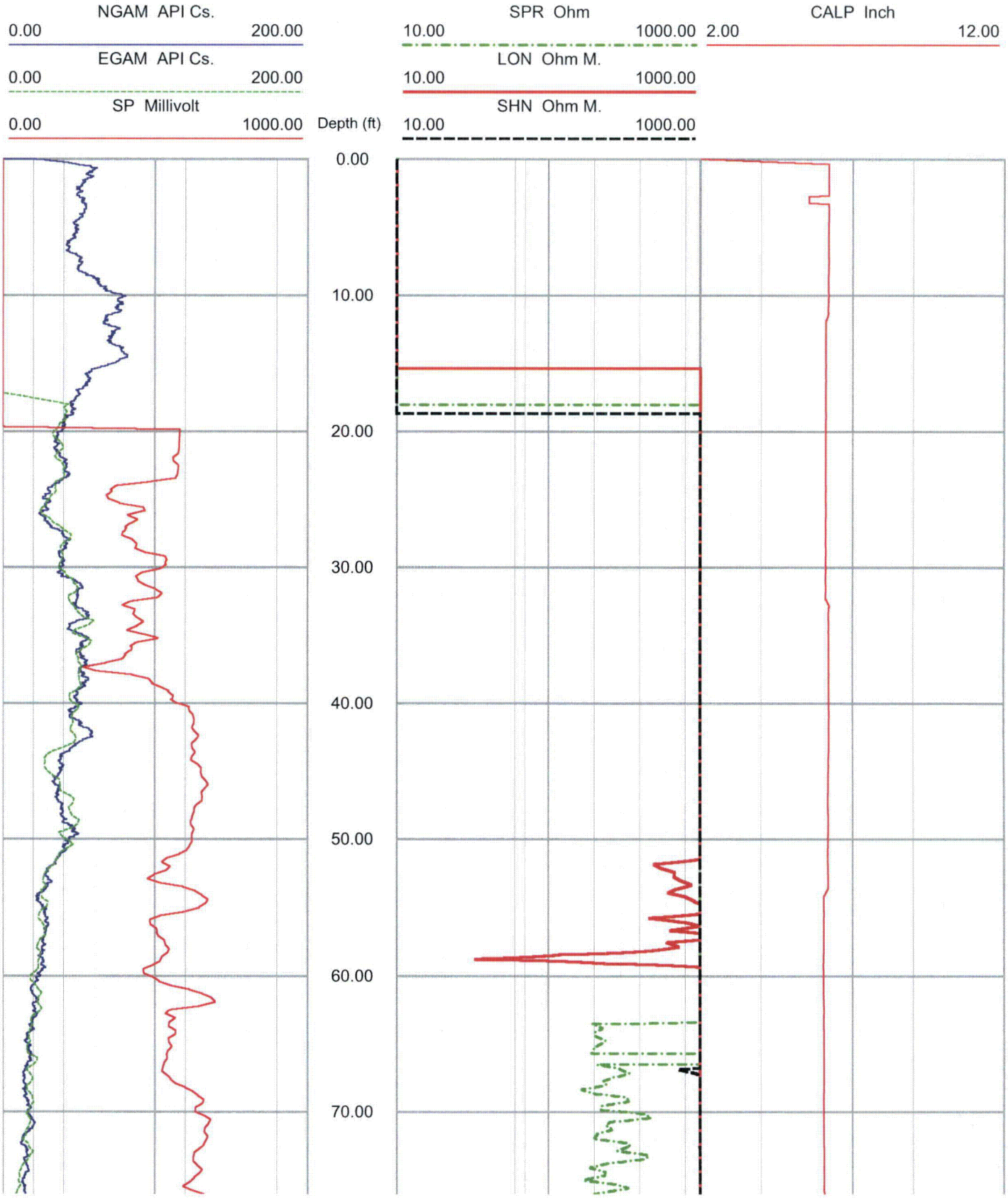
OTHER SERVICES

| | | | |
|---|---|---|---|
| Perm. Da.. | Elev | KB | 0.00 |
| Log. Da.. | | DF | 0.00 |
| Drill Datum | | GL | 0.00 |

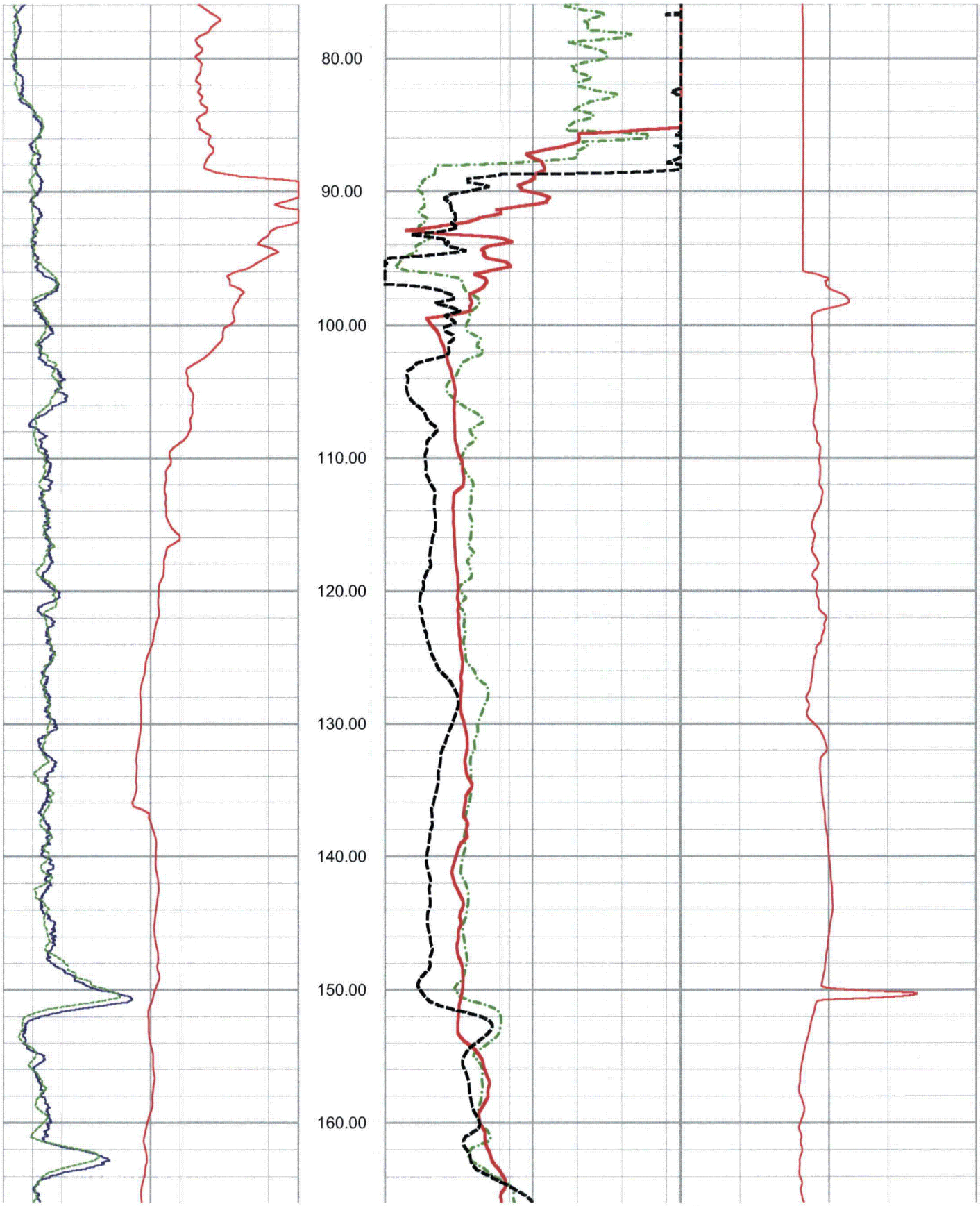
| | | | |
|---|---|---|---|
| DATE | 12 Feb 07 | 15 Dec 06 | 15 Dec 06 |
| RUN# | 5 | 0 | 0 |
| TYPE OF LOG | CALIPER | | |
| DEPTH DRILLER | 420.00 | 0.00 | 0.00 |
| DEPTH LOGGER | 248.00 | 0.00 | 0.00 |
| LOG DEEPEST | 245.00 | 0.00 | 0.00 |
| LOG SHALLOW | 0.00 | 0.00 | 0.00 |
| FLUID IN HOLE | DRILLING MUD | | |
| SALINITY | | | |
| DENSITY | | | |
| LEVEL | | | |
| MAX TEMP °C | 0.00 | 0.00 | 0.00 |
| RIG TIME | | | |
| RECORDED BY | R. STELLER | | |
| WITNESSED BY | | | |

| RUN# | BIT RECORD SIZE | FROM | TO | CASING RECORD SIZE | WEIGHT | FROM | TO |
|---|---|---|---|---|---|---|---|
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

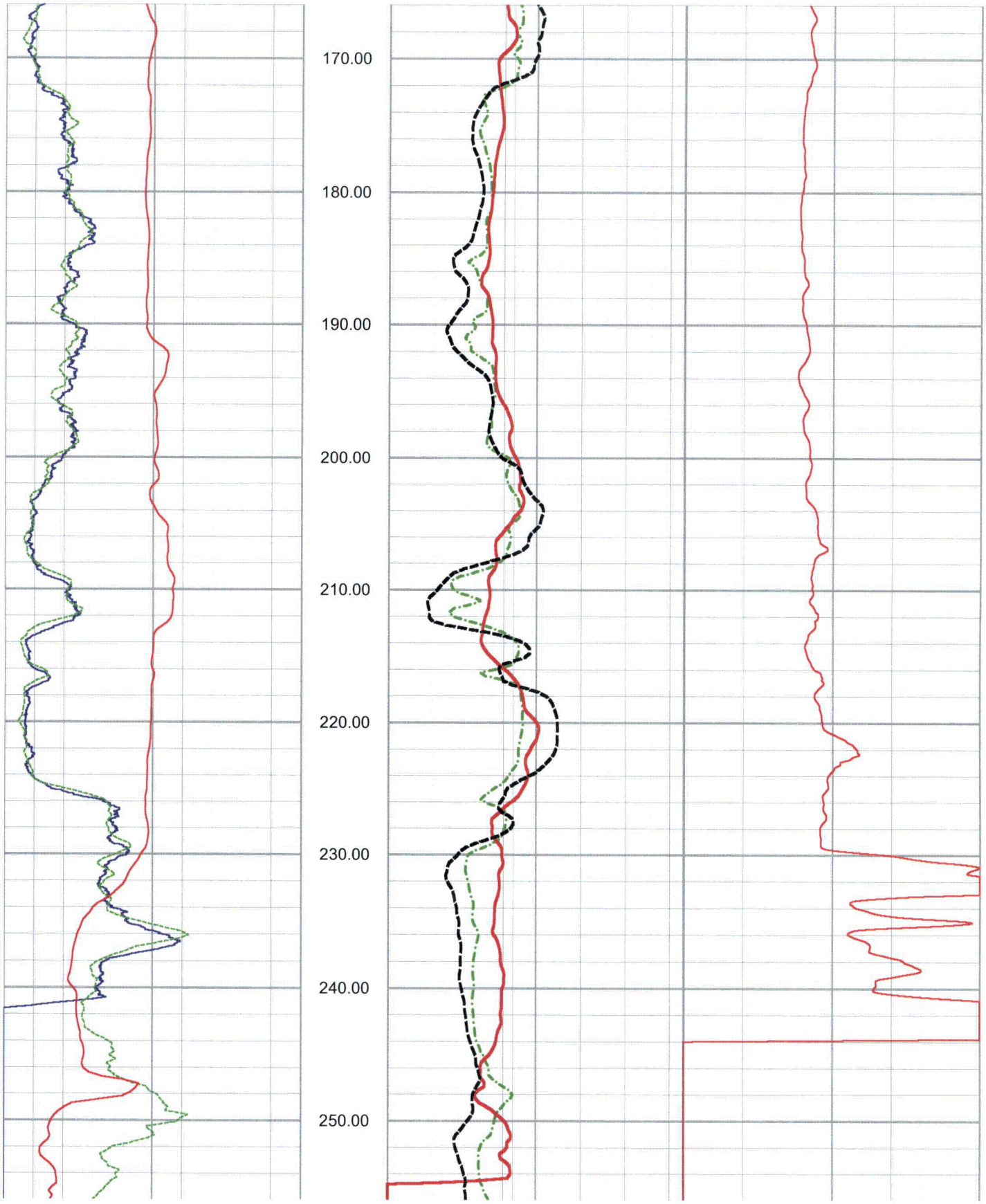
VOGTLE Units 3 & 4 Boring B-3001 ELOG, Caliper and Gamma, Upper Section, rev 1 Sheet 1 of 5



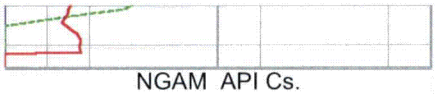

VOGTLE Units 3 & 4 Boring B-3001 ELOG, Caliper and Gamma, Upper Section, rev 1 Sheet 2 of 5




VOGTLE Units 3 & 4 Boring B-3001 ELOG, Caliper and Gamma, Upper Section, rev 1 Sheet 3 of 5




VOGTLE Units 3 & 4 Boring B-3001 ELOG, Caliper and Gamma, Upper Section, rev 1 Sheet 4 of 5

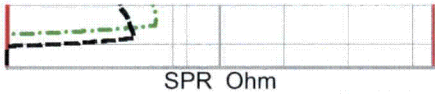


NGAM API Cs.
0.00 200.00

EGAM API Cs.
0.00 200.00

SP Millivolt
0.00 1000.00

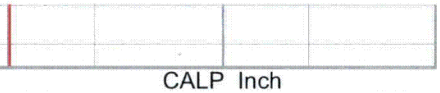
Depth (ft)



SPR Ohm
10.00 1000.00

LON Ohm M.
10.00 1000.00

SHN Ohm M.
10.00 1000.00



CALP Inch
2.00 12.00

VOGTLE Units 3 & 4 Boring B-3001 ELOG, Caliper and Gamma, Upper Section, rev 1 Sheet 5 of 5

ROBERTSON GEOLOGGING LIMITED

VOGTLE COL

B3001CALUP02

ROBERTSON GEOLOGGING TECHNOLOGY

REMARKS ( C:\Data\PS\Vogtle\B-3001 12-13 Feb 2007 bor..

| | |
|---|---|
| COMPANY | GEOVISION |
| WELL | B-3001 |
| FIELD | |
| COUNTRY | |
| STATE | |
| COUNTY | |
| LAT.: | |
| LONG.: | |

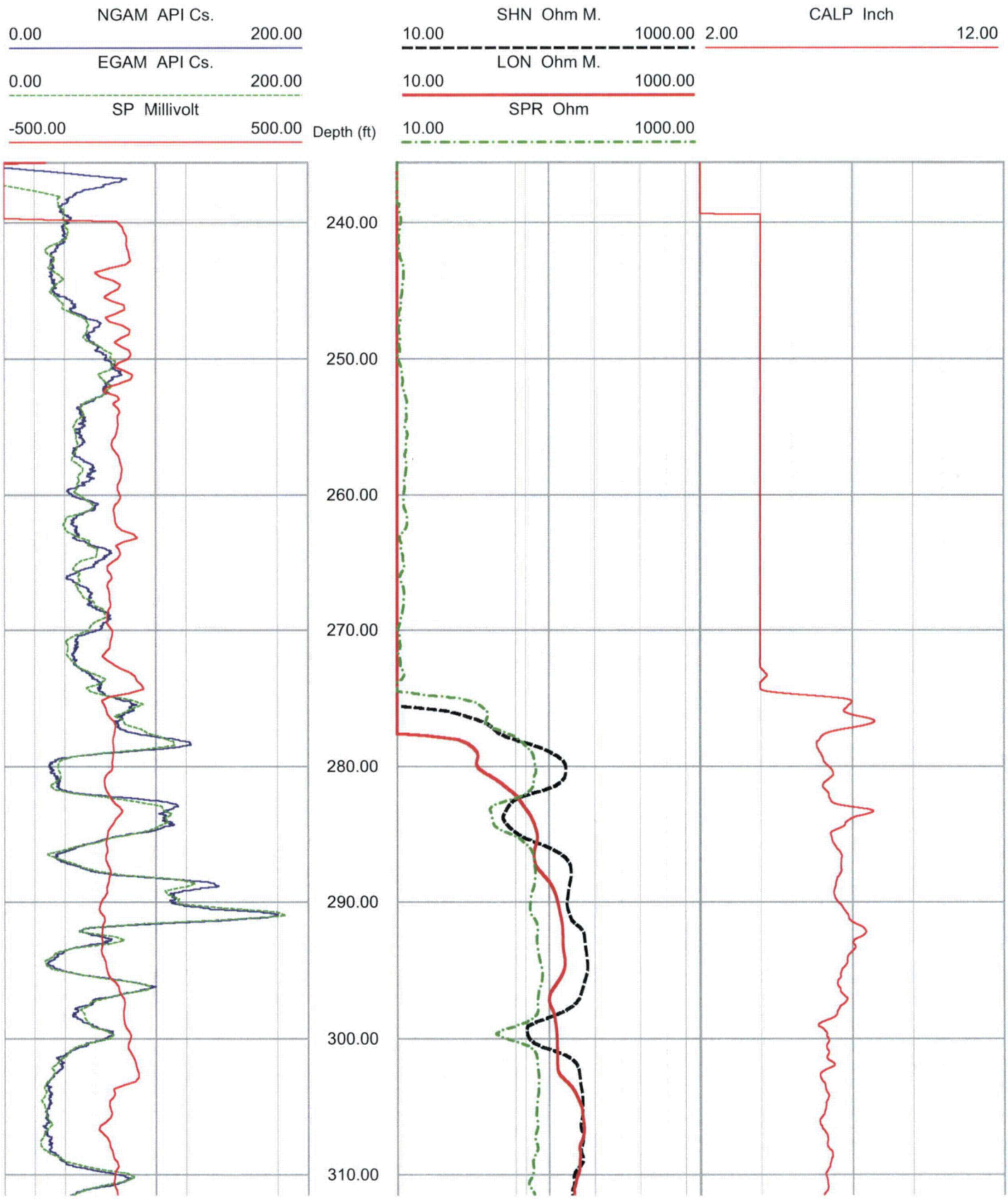
OTHER SERVICES

| | | | |
|---|---|---|---|
| Perm. Da.. | Elev | KB | 0.00 |
| Log. Da.. | | DF | 0.00 |
| Drill Datum | | GL | 0.00 |

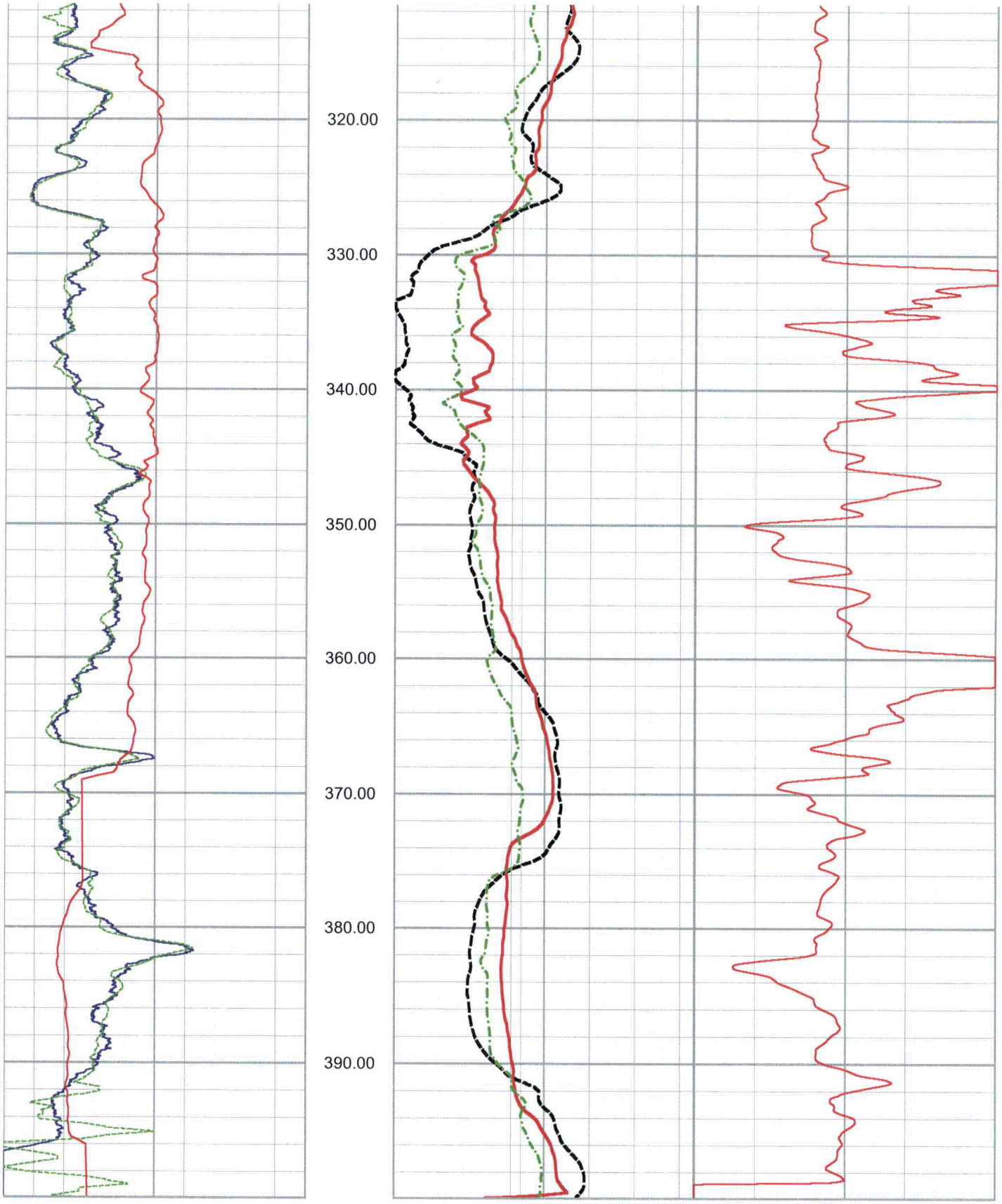
| | | | |
|---|---|---|---|
| DATE | 13 Feb 07 | 15 Dec 06 | 15 Dec 06 |
| RUN# | 6 | 0 | 0 |
| TYPE OF LOG | CALIPER | | |
| DEPTH DRILLER | 420.00 | 0.00 | 0.00 |
| DEPTH LOGGER | 404.00 | 0.00 | 0.00 |
| LOG DEEPEST | 400.00 | 0.00 | 0.00 |
| LOG SHALLOW | 240.00 | 0.00 | 0.00 |
| FLUID IN HOLE | DRILLING MUD | | |
| SALINITY | | | |
| DENSITY | | | |
| LEVEL | | | |
| MAX TEMP °C | 0.00 | 0.00 | 0.00 |
| RIG TIME | | | |
| RECORDED BY | R. STELLER | | |
| WITNESSED BY | | | |

| RUN# | BIT RECORD SIZE | FROM | TO | CASING RECORD SIZE | WEIGHT | FROM | TO |
|---|---|---|---|---|---|---|---|
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

VOGTLE Units 3 & 4 COL Boring B-3001 ELOG, Caliper and Gamma, Lower Section, rev 1 Sheet 1 of 4




VOGTLE Units 3 & 4 COL Boring B-3001 ELOG, Caliper and Gamma, Lower Section, rev 1 Sheet 2 of 4




VOGTLE Units 3 & 4 COL Boring B-3001 ELOG, Caliper and Gamma, Lower Section, rev 1 Sheet 3 of 4

| NGAM API Cs. | | Depth (ft) | SHN Ohm M. | | CALP Inch | |
|---|---|---|---|---|---|---|
| 0.00 | 200.00 | | 10.00 | 1000.00 | 2.00 | 12.00 |
| EGAM API Cs. | | | LON Ohm M. | | | |
| 0.00 | 200.00 | | 10.00 | 1000.00 | | |
| SP Millivolt | | | SPR Ohm | | | |
| -500.00 | 500.00 | | 10.00 | 1000.00 | | |

VOGTLE Units 3 & 4 COL Boring B-3001 ELOG, Caliper and Gamma, Lower Section, rev 1 Sheet 4 of 4

ROBERTSON GEOLOGGING LIMITED

VOGTLE COL

B3002CALUP01

ROBERTSON GEOLOGGING TECHNOLOGY

REMARKS ( C:\Data\PS\Vogtle\B-3002 15 Feb 2007 boring ..

| | |
|---|---|
| COMPANY | GEOVISION |
| WELL | B-3002 |
| FIELD | |
| COUNTRY | |
| STATE | |
| COUNTY | |
| LAT.: | |
| LONG.: | |

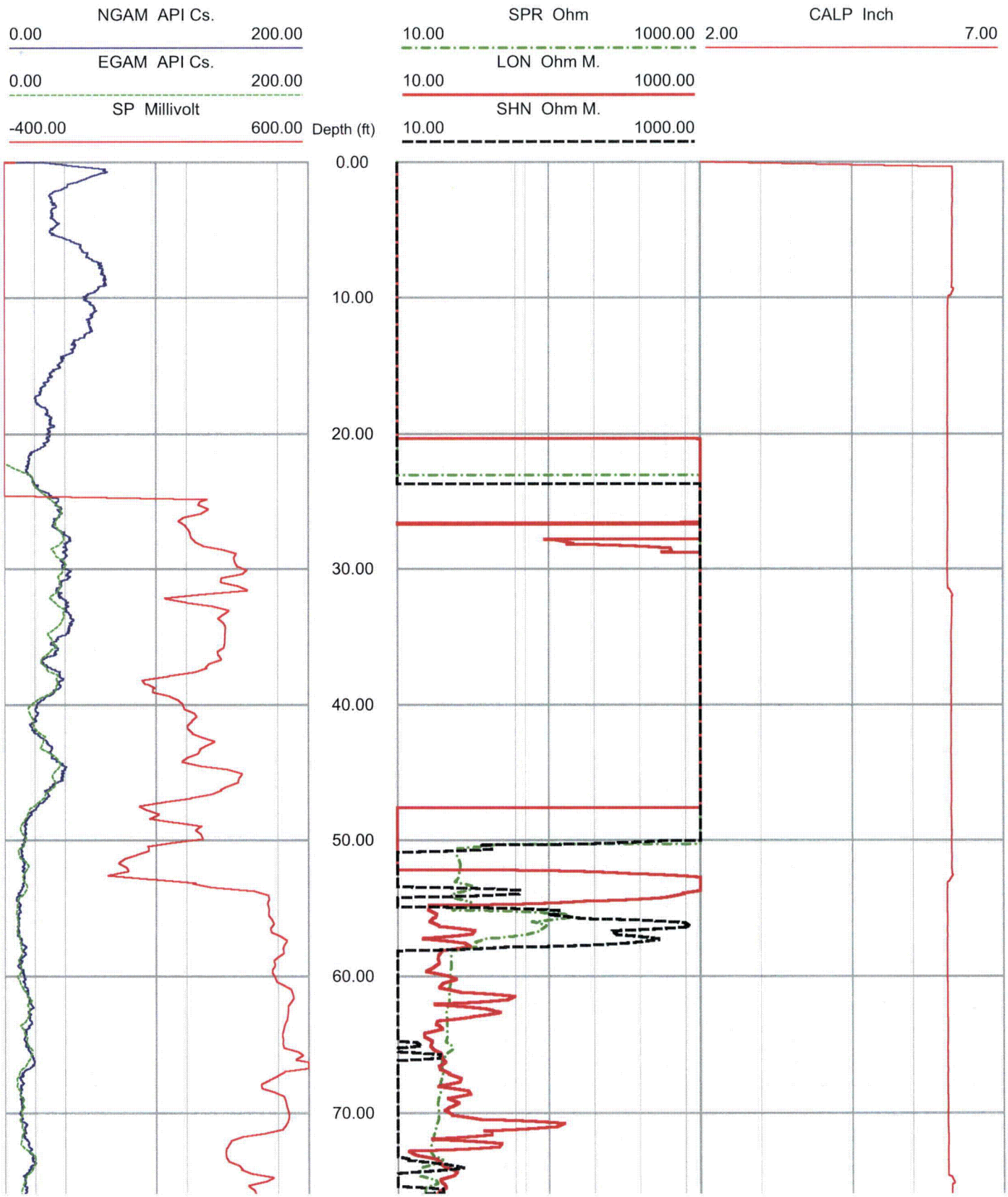
OTHER SERVICES

| | | | |
|---|---|---|---|
| Perm. Da.. | Elev | KB | 0.00 |
| Log. Da.. | | DF | 0.00 |
| Drill Datum | | GL | 0.00 |

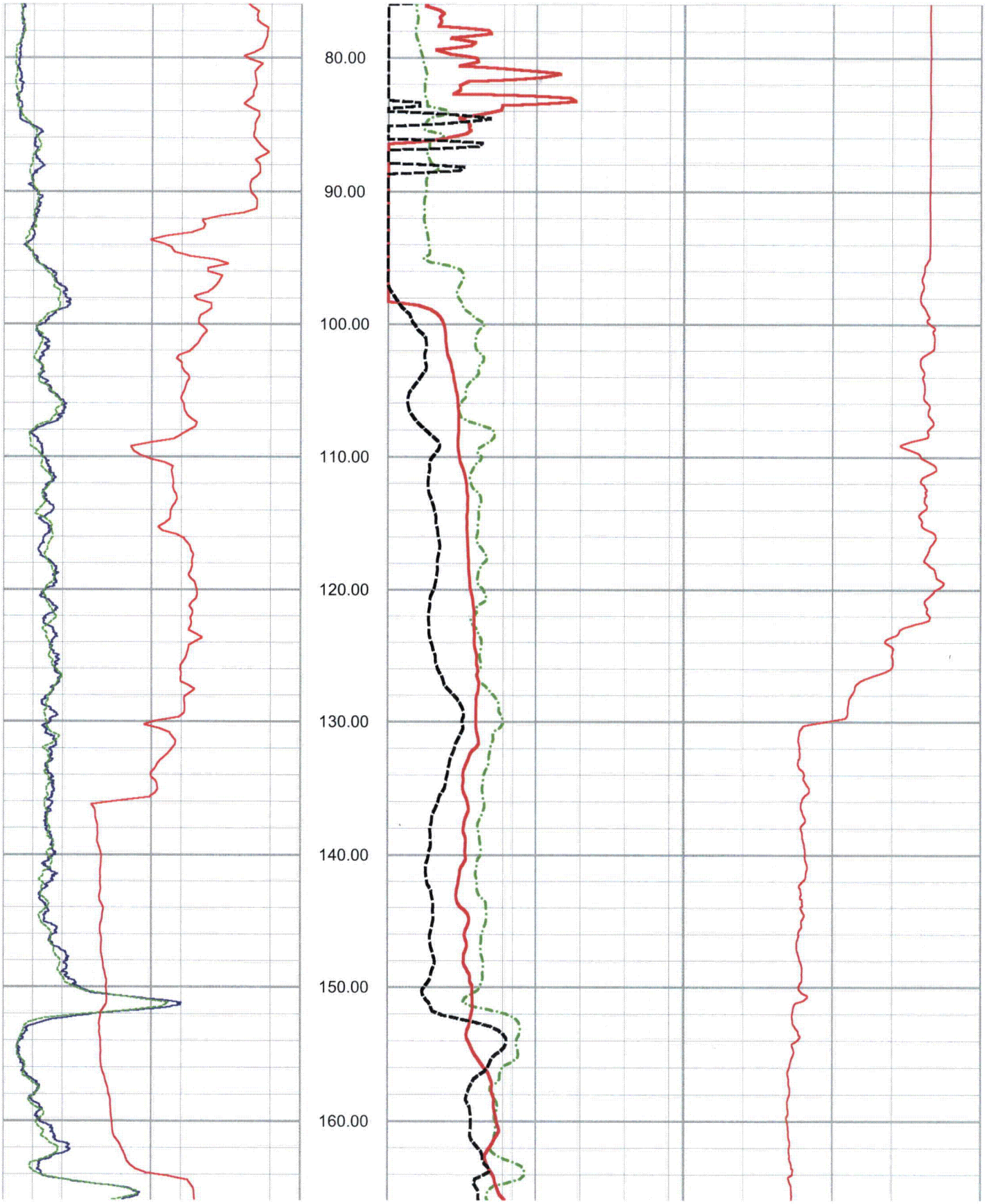
| | | | |
|---|---|---|---|
| DATE | 15 Feb 07 | 15 Dec 06 | 15 Dec 06 |
| RUN# | 6 | 0 | 0 |
| TYPE OF LOG | CALIPER | | |
| DEPTH DRILLER | 250.00 | 0.00 | 0.00 |
| DEPTH LOGGER | 250.00 | 0.00 | 0.00 |
| LOG DEEPEST | 245.00 | 0.00 | 0.00 |
| LOG SHALLOW | 0.00 | 0.00 | 0.00 |
| FLUID IN HOLE | DRILLING MUD | | |
| SALINITY | | | |
| DENSITY | | | |
| LEVEL | | | |
| MAX TEMP °C | 0.00 | 0.00 | 0.00 |
| RIG TIME | | | |
| RECORDED BY | R. STELLER | | |
| WITNESSED BY | | | |

| RUN# | BIT RECORD SIZE | FROM | TO | CASING RECORD SIZE | WEIGHT | FROM | TO |
|---|---|---|---|---|---|---|---|
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

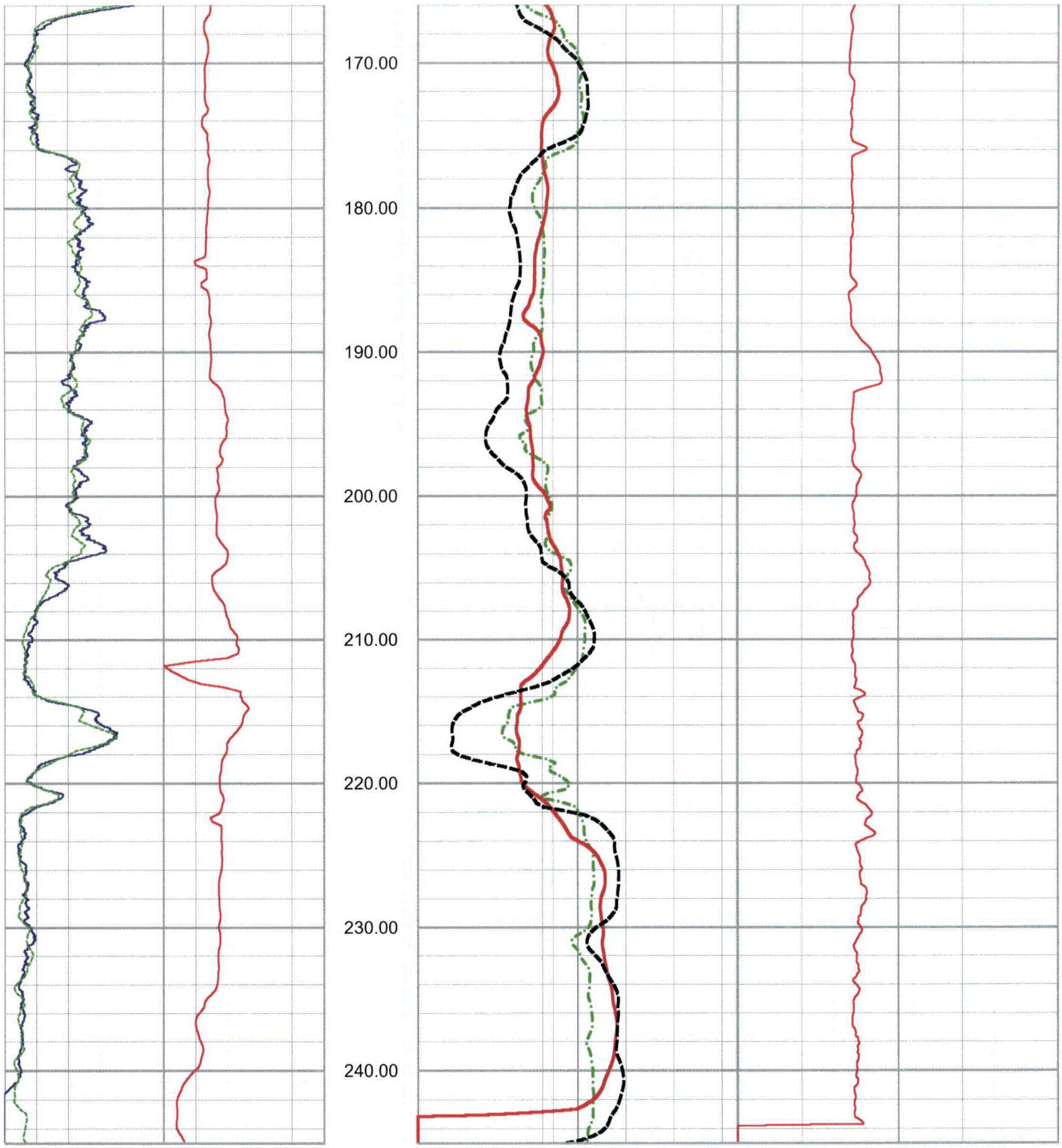
VOGTLE Units 3 & 4 Boring B-3002 ELOG, Caliper and Gamma rev 1 Sheet 1 of 5




VOGTLE Units 3 & 4 Boring B-3002 ELOG, Caliper and Gamma rev 1 Sheet 2 of 5




VOGTLE Units 3 & 4 Boring B-3002 ELOG, Caliper and Gamma rev 1 Sheet 3 of 5




VOGTLE Units 3 & 4 Boring B-3002 ELOG, Caliper and Gamma rev 1 Sheet 4 of 5

| NGAM API Cs. | | Depth (ft) | SPR Ohm | | CALP Inch | |
|---|---|---|---|---|---|---|
| 0.00 | 200.00 | | 10.00 | 1000.00 | 2.00 | 7.00 |
| EGAM API Cs. | | | LON Ohm M. | | | |
| 0.00 | 200.00 | | 10.00 | 1000.00 | | |
| SP Millivolt | | | SHN Ohm M. | | | |
| -400.00 | 600.00 | | 10.00 | 1000.00 | | |

ROBERTSON GEOLOGGING LIMITED

VOGTLE COL

B3003CALUP01

ROBERTSON GEOLOGGING TECHNOLOGY

REMARKS ( C:\Data\PS\Vogtle\B-3003 16 Feb 2007 boring ..

| | |
|---|---|
| COMPANY | GEOVISION |
| WELL | B-3003 |
| FIELD | |
| COUNTRY | |
| STATE | |
| COUNTY | |
| LAT.: | |
| LONG.: | |

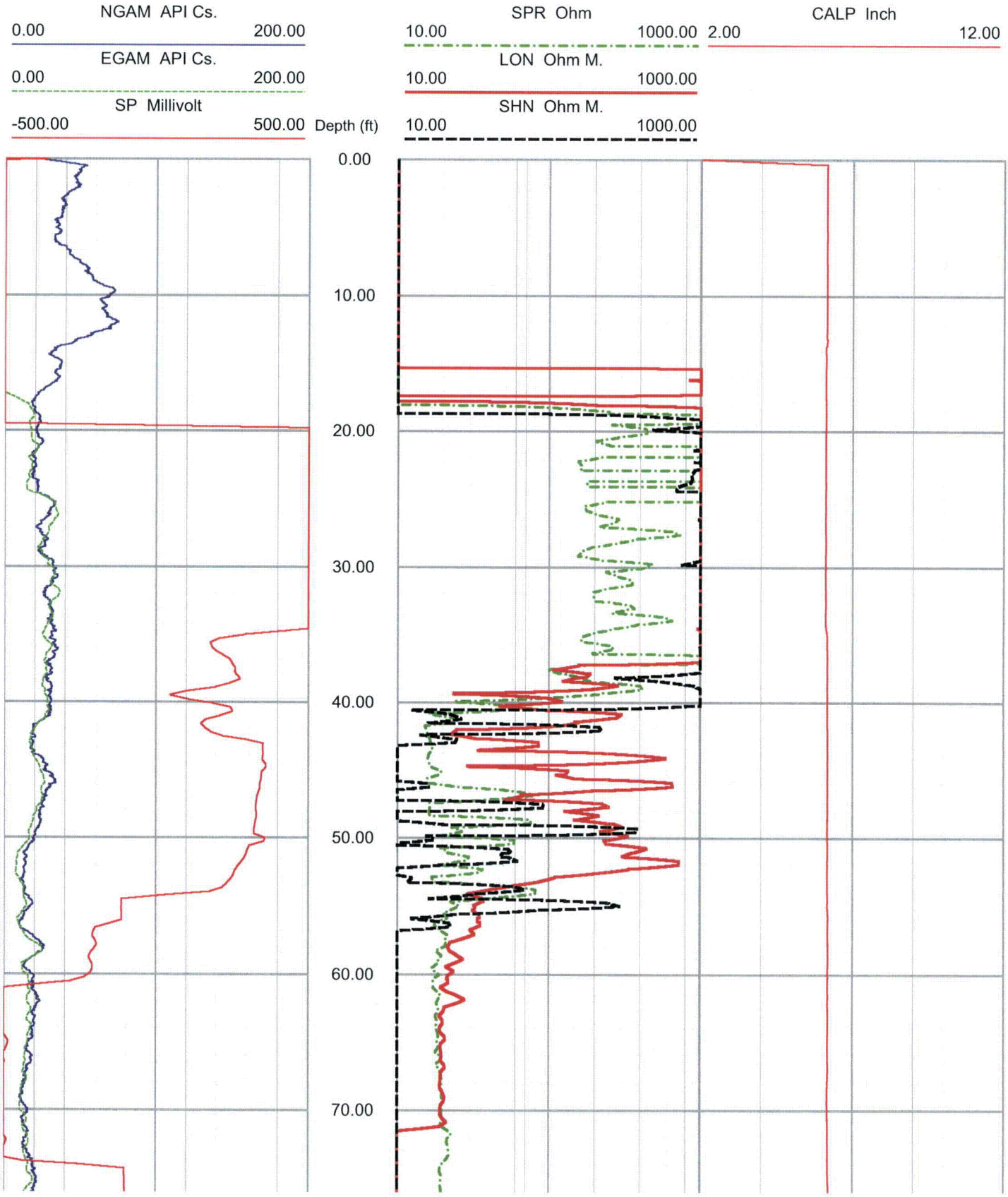
OTHER SERVICES

| | | | |
|---|---|---|---|
| Perm. Da.. | Elev | KB | 0.00 |
| Log. Da.. | | DF | 0.00 |
| Drill Datum | | GL | 0.00 |

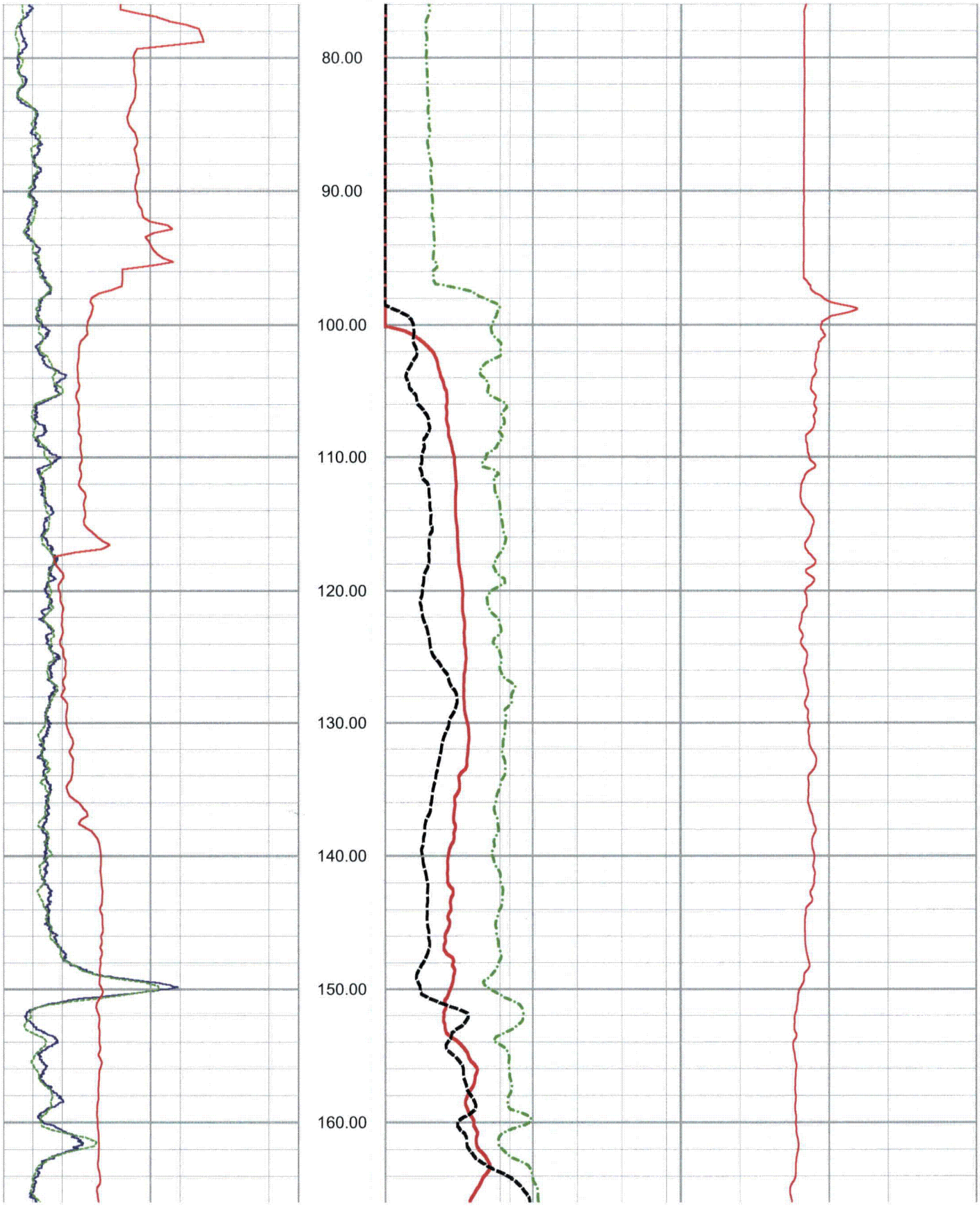
| | | | |
|---|---|---|---|
| DATE | 16 Feb 07 | 15 Dec 06 | 15 Dec 06 |
| RUN# | 5 | 0 | 0 |
| TYPE OF LOG | CALIPER | | |
| DEPTH DRILLER | 250.00 | 0.00 | 0.00 |
| DEPTH LOGGER | 250.00 | 0.00 | 0.00 |
| LOG DEEPEST | 245.00 | 0.00 | 0.00 |
| LOG SHALLOW | 0.00 | 0.00 | 0.00 |
| FLUID IN HOLE | DRILLING MUD | | |
| SALINITY | | | |
| DENSITY | | | |
| LEVEL | | | |
| MAX TEMP °C | 0.00 | 0.00 | 0.00 |
| RIG TIME | | | |
| RECORDED BY | R. STELLER | | |
| WITNESSED BY | | | |

| RUN# | BIT RECORD SIZE | FROM | TO | CASING RECORD SIZE | WEIGHT | FROM | TO |
|---|---|---|---|---|---|---|---|
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

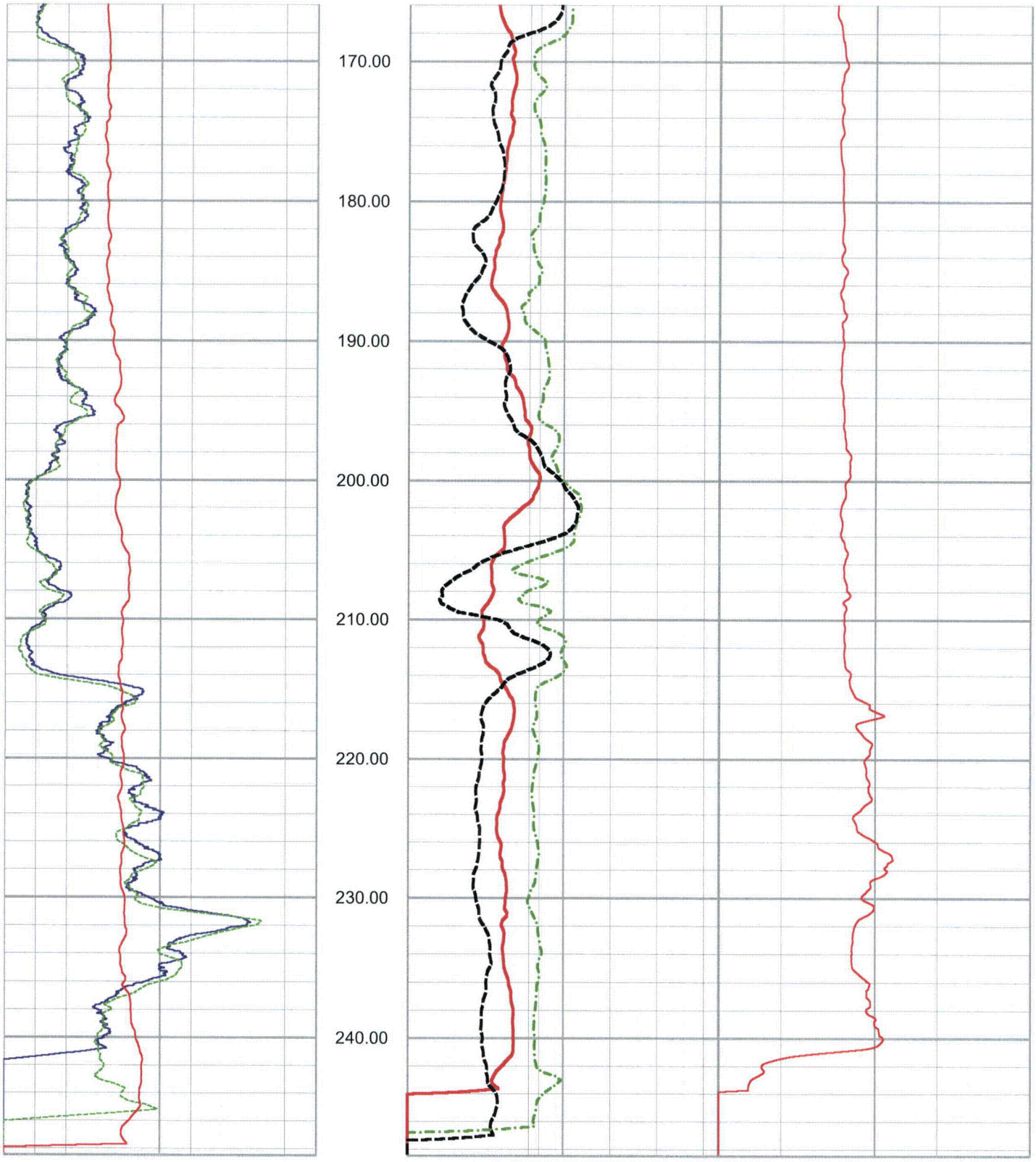
VOGTLE Units 3 & 4 COL Boring B-3003 ELOG, Caliper and Gamma rev 1 Sheet 1 of 5




VOGTLE Units 3 & 4 COL Boring B-3003 ELOG, Caliper and Gamma rev 1 Sheet 2 of 5




VOGTLE Units 3 & 4 COL Boring B-3003 ELOG, Caliper and Gamma rev 1 Sheet 3 of 5




VOGTLE Units 3 & 4 COL Boring B-3003 ELOG, Caliper and Gamma rev 1 Sheet 4 of 5

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| NGAM API Cs. | | | SPR Ohm | | | CALP Inch | |
| 0.00 | 200.00 | Depth (ft) | 10.00 | 1000.00 | 2.00 | | 12.00 |
| EGAM API Cs. | | | LON Ohm M. | | | | |
| 0.00 | 200.00 | | 10.00 | 1000.00 | | | |
| SP Millivolt | | | SHN Ohm M. | | | | |
| -500.00 | 500.00 | | 10.00 | 1000.00 | | | |

VOGTLE Units 3 & 4 COL Boring B-3003 ELOG, Caliper and Gamma rev 1 Sheet 5 of 5

ROBERTSON GEOLOGGING LIMITED

VOGTLE COL

B4001CALUP02

ROBERTSON GEOLOGGING TECHNOLOGY

REMARKS ( C:\Data\PS\Vogtle\B-4001 9-10 Jan 13 Feb 20..

| | |
|---|---|
| COMPANY | GEOVISION |
| WELL | B-4001 |
| FIELD | |
| COUNTRY | |
| STATE | |
| COUNTY | |
| LAT.: | |
| LONG.: | |

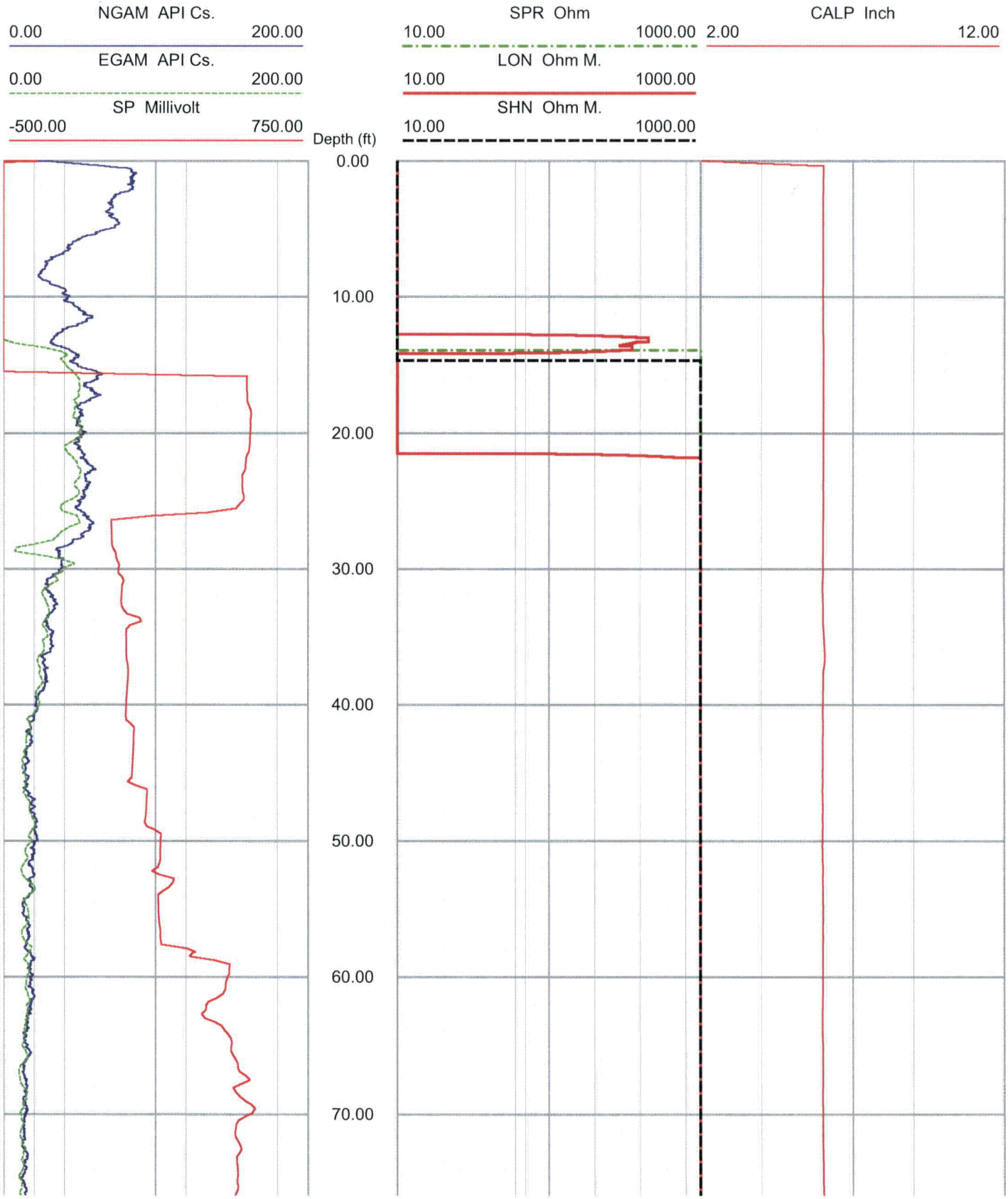
OTHER SERVICES

| | | | |
|---|---|---|---|
| Perm. Da.. | Elev | KB | 0.00 |
| Log. Da.. | | DF | 0.00 |
| Drill Datum | | GL | 0.00 |

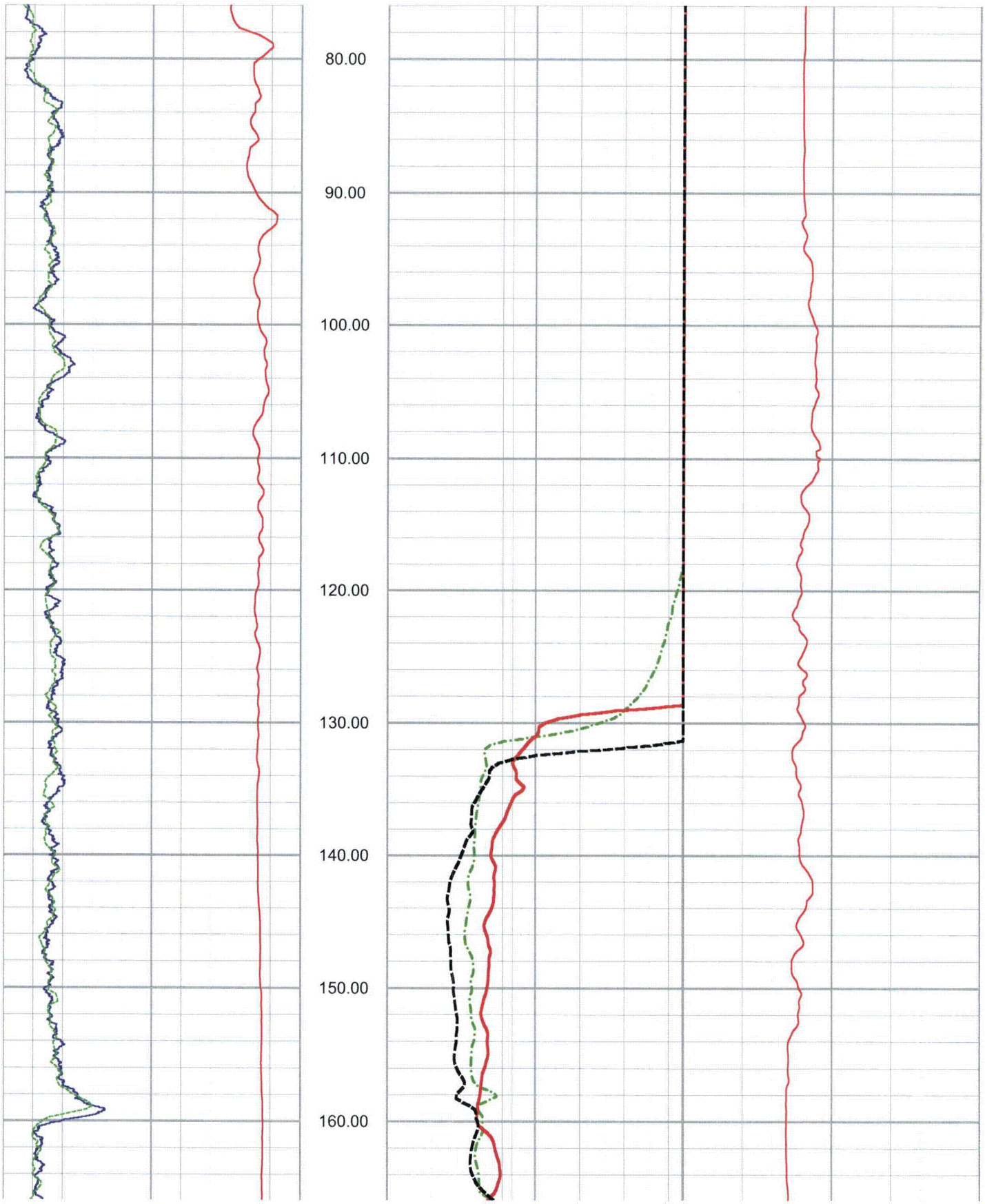
| | | | |
|---|---|---|---|
| DATE | 13 Feb 07 | 15 Dec 06 | 15 Dec 06 |
| RUN# | 4 | 0 | 0 |
| TYPE OF LOG | CALIPER | | |
| DEPTH DRILLER | 400.00 | 0.00 | 0.00 |
| DEPTH LOGGER | 400.00 | 0.00 | 0.00 |
| LOG DEEPEST | 400.00 | 0.00 | 0.00 |
| LOG SHALLOW | 0.00 | 0.00 | 0.00 |
| FLUID IN HOLE | DRILLING MUD | | |
| SALINITY | | | |
| DENSITY | | | |
| LEVEL | | | |
| MAX TEMP °C | 0.00 | 0.00 | 0.00 |
| RIG TIME | | | |
| RECORDED BY | R. STELLER | | |
| WITNESSED BY | | | |

| RUN# | BIT RECORD SIZE | FROM | TO | CASING RECORD SIZE | WEIGHT | FROM | TO |
|---|---|---|---|---|---|---|---|
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

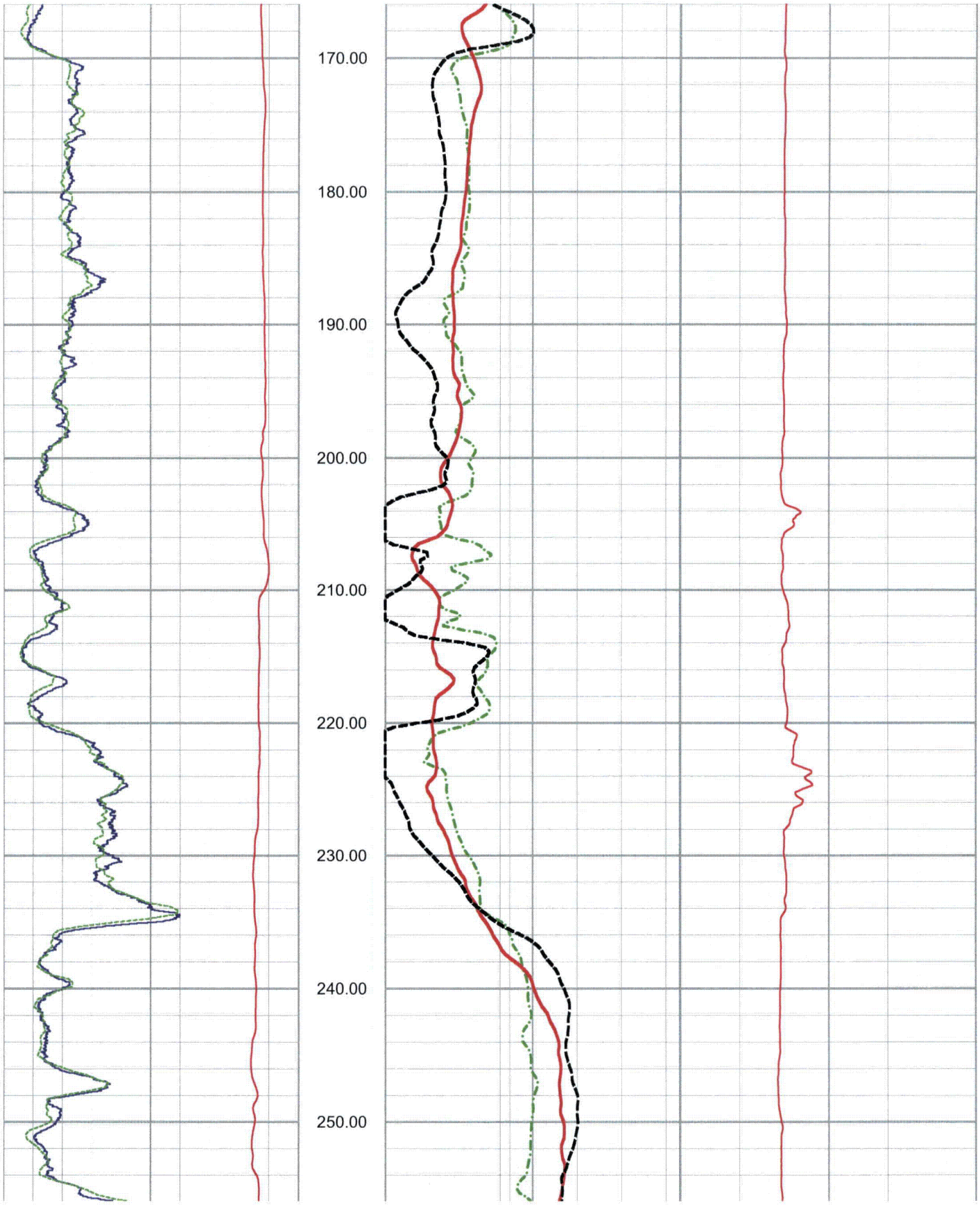
VOGTLE Units 3 & 4 COL Boring B-4001 ELOG, Caliper and Gamma rev 1 Sheet 1 of 6



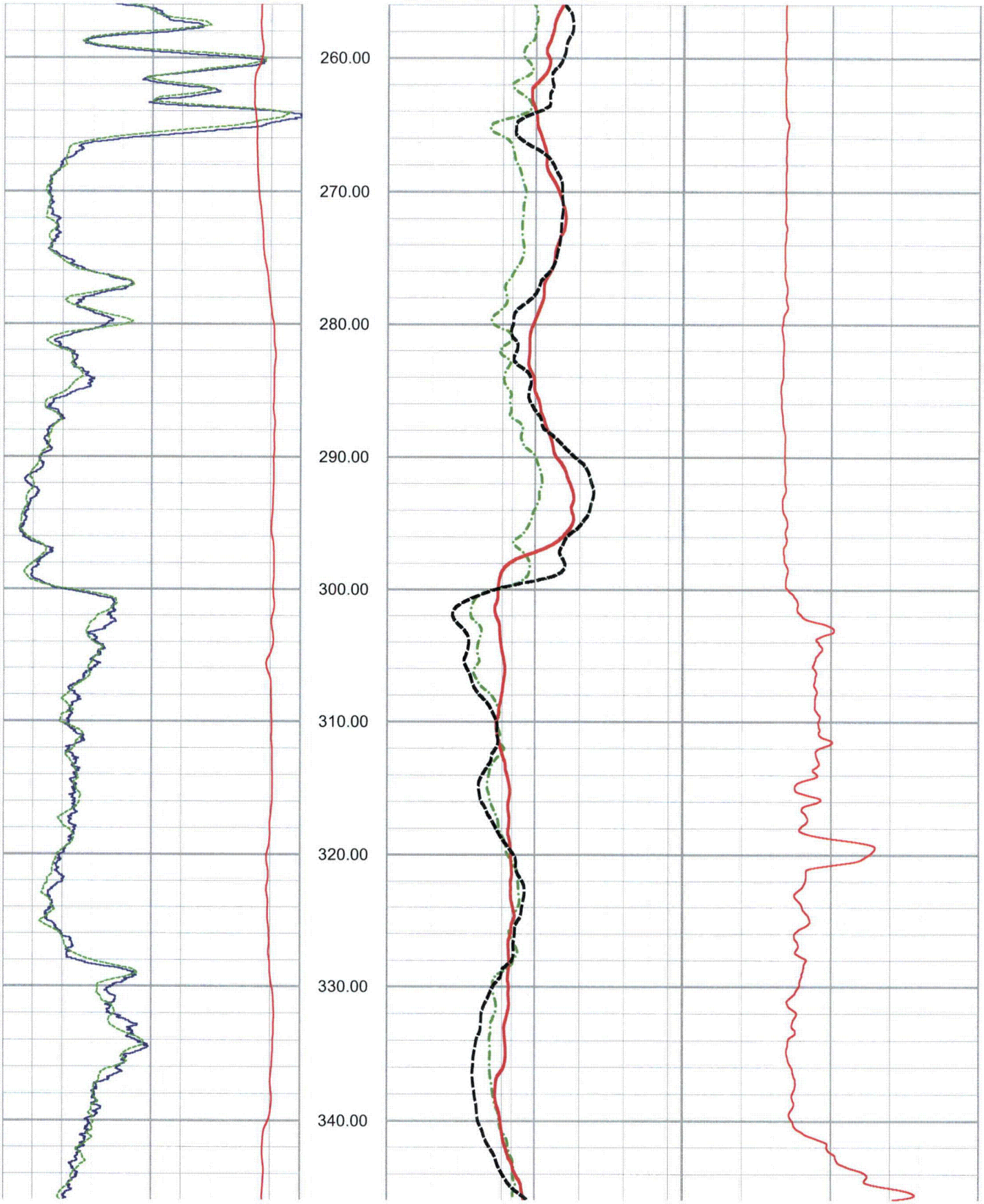

VOGTLE Units 3 & 4 COL Boring B-4001 ELOG, Caliper and Gamma rev 1 Sheet 2 of 6



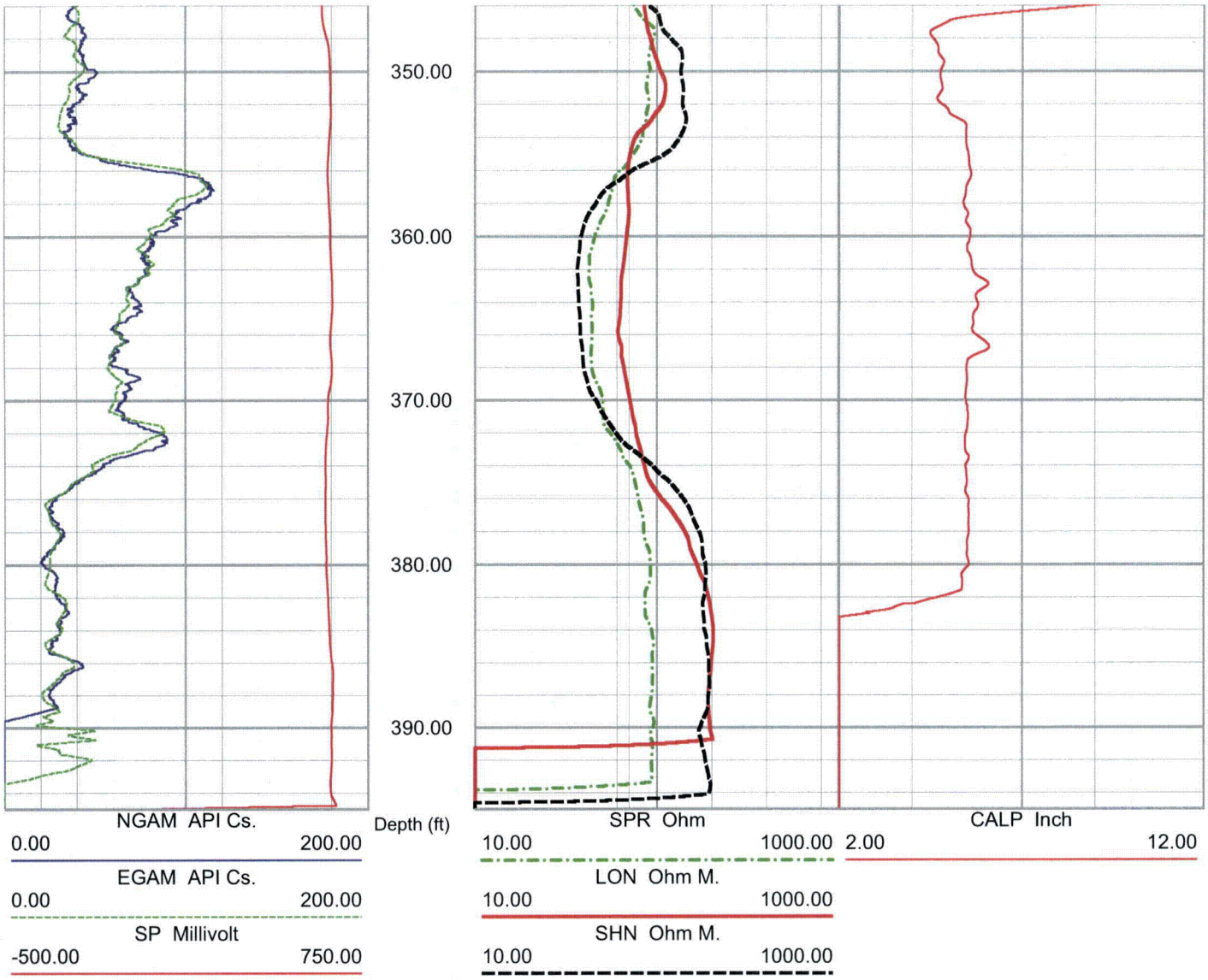

VOGTLE Units 3 & 4 COL Boring B-4001 ELOG, Caliper and Gamma rev 1 Sheet 3 of 6




VOGTLE Units 3 & 4 COL Boring B-4001 ELOG, Caliper and Gamma rev 1 Sheet 4 of 6




VOGTLE Units 3 & 4 COL Boring B-4001 ELOG, Caliper and Gamma rev 1 Sheet 5 of 6




VOGTLE Units 3 & 4 COL Boring B-4001 ELOG, Caliper and Gamma rev 1 Sheet 6 of 6

ROBERTSON GEOLOGGING LIMITED

VOGTLE COL

B4002CALUP01

ROBERTSON GEOLOGGING TECHNOLOGY

REMARKS ( C:\Data\PS\Vogtle\B-4002 15 Feb 2007 boring ..

| | |
|---|---|
| COMPANY | GEOVISION |
| WELL | B-4002 |
| FIELD | |
| COUNTRY | |
| STATE | |
| COUNTY | |
| LAT.: | |
| LONG.: | |

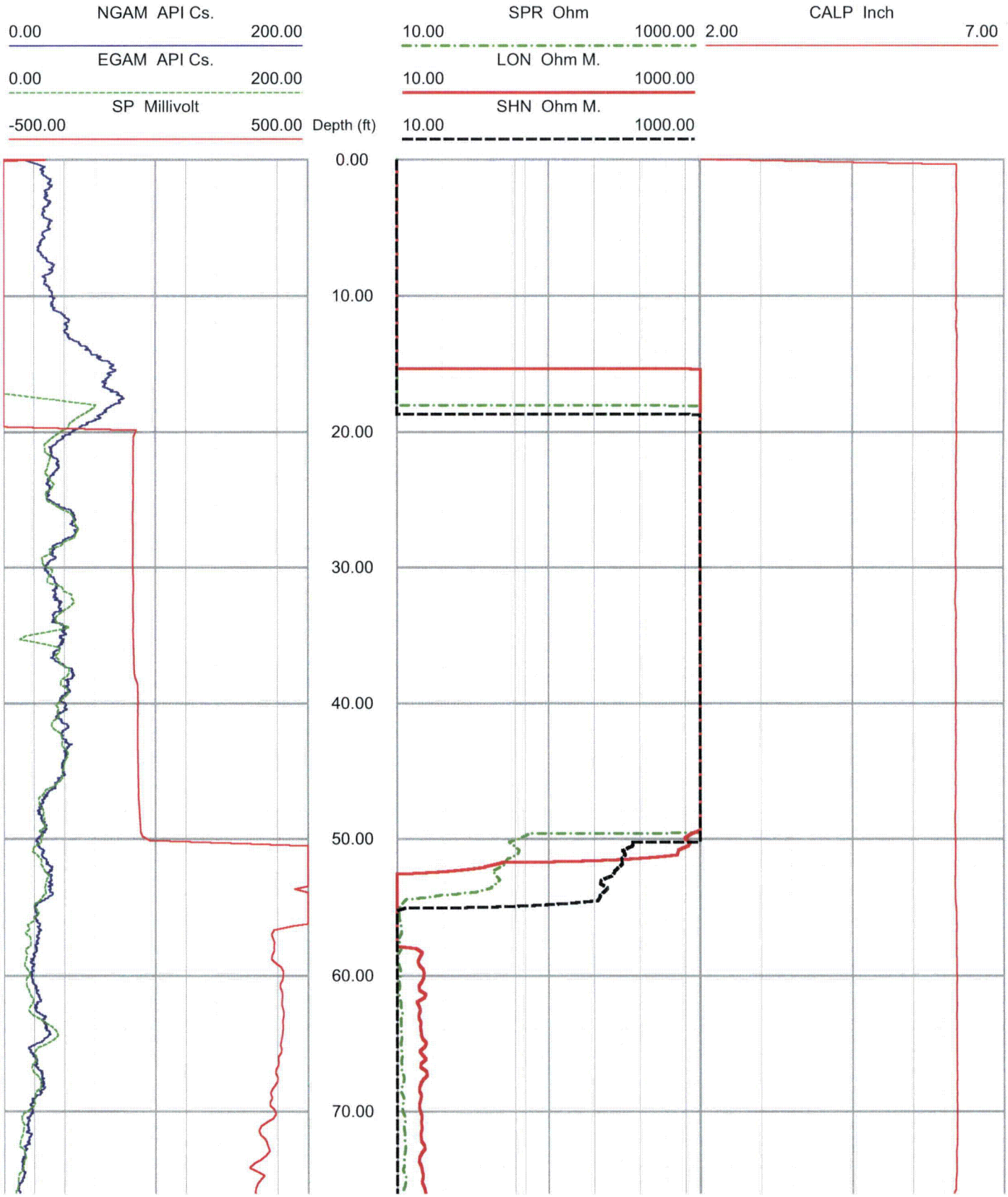
OTHER SERVICES

| | | | |
|---|---|---|---|
| Perm. Da.. | Elev | KB | 0.00 |
| Log. Da.. | | DF | 0.00 |
| Drill Datum | | GL | 0.00 |

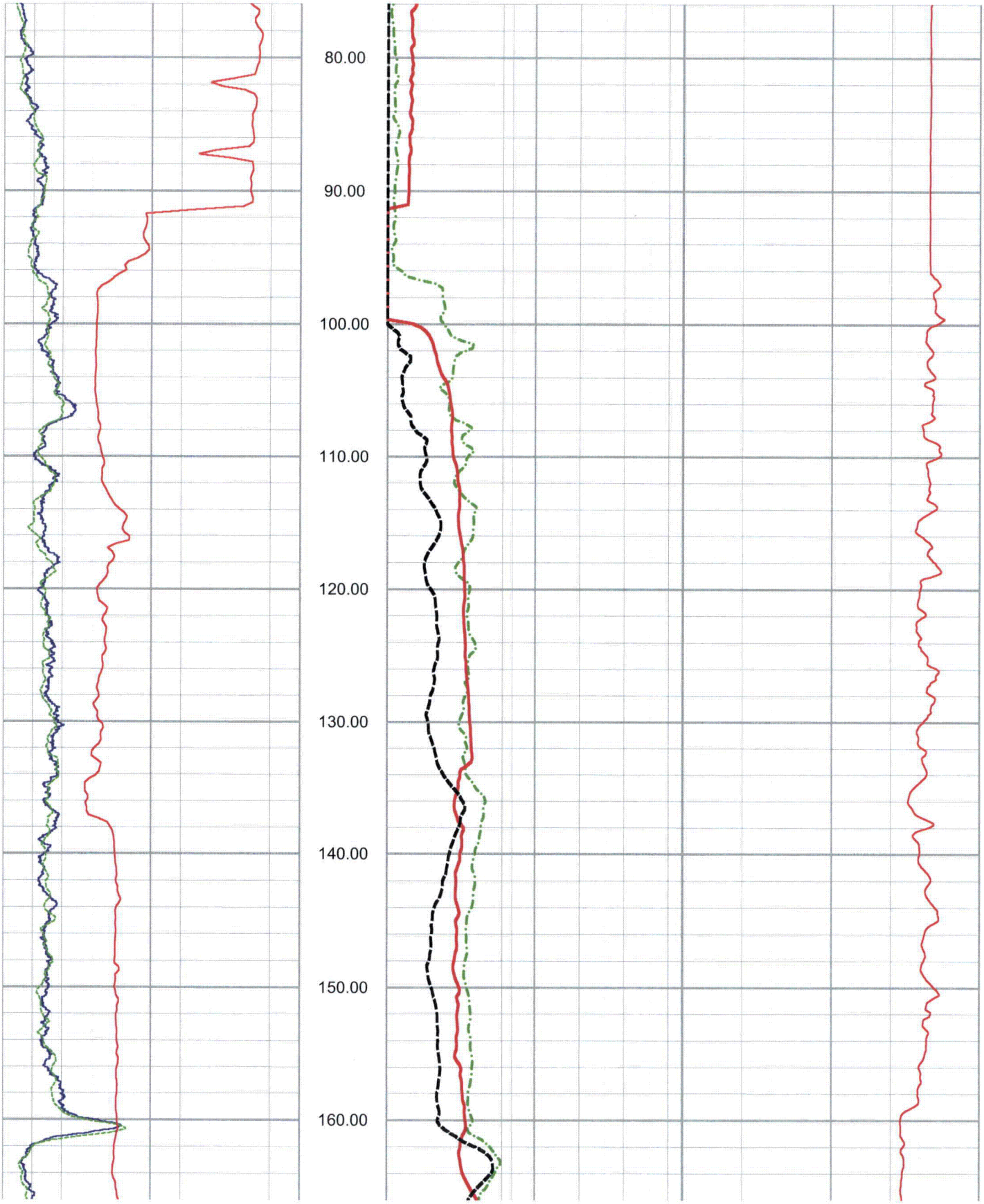
| | | | |
|---|---|---|---|
| DATE | 15 Feb 07 | 15 Dec 06 | 15 Dec 06 |
| RUN# | 6 | 0 | 0 |
| TYPE OF LOG | CALIIPER | | |
| DEPTH DRILLER | 250.00 | 0.00 | 0.00 |
| DEPTH LOGGER | 250.50 | 0.00 | 0.00 |
| LOG DEEPEST | 247.00 | 0.00 | 0.00 |
| LOG SHALLOW | 0.00 | 0.00 | 0.00 |
| FLUID IN HOLE | DRILLING MUD | | |
| SALINITY | | | |
| DENSITY | | | |
| LEVEL | | | |
| MAX TEMP °C | 0.00 | 0.00 | 0.00 |
| RIG TIME | | | |
| RECORDED BY | R. STELLER | | |
| WITNESSED BY | | | |

| RUN# | BIT RECORD SIZE | FROM | TO | CASING RECORD SIZE | WEIGHT | FROM | TO |
|---|---|---|---|---|---|---|---|
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

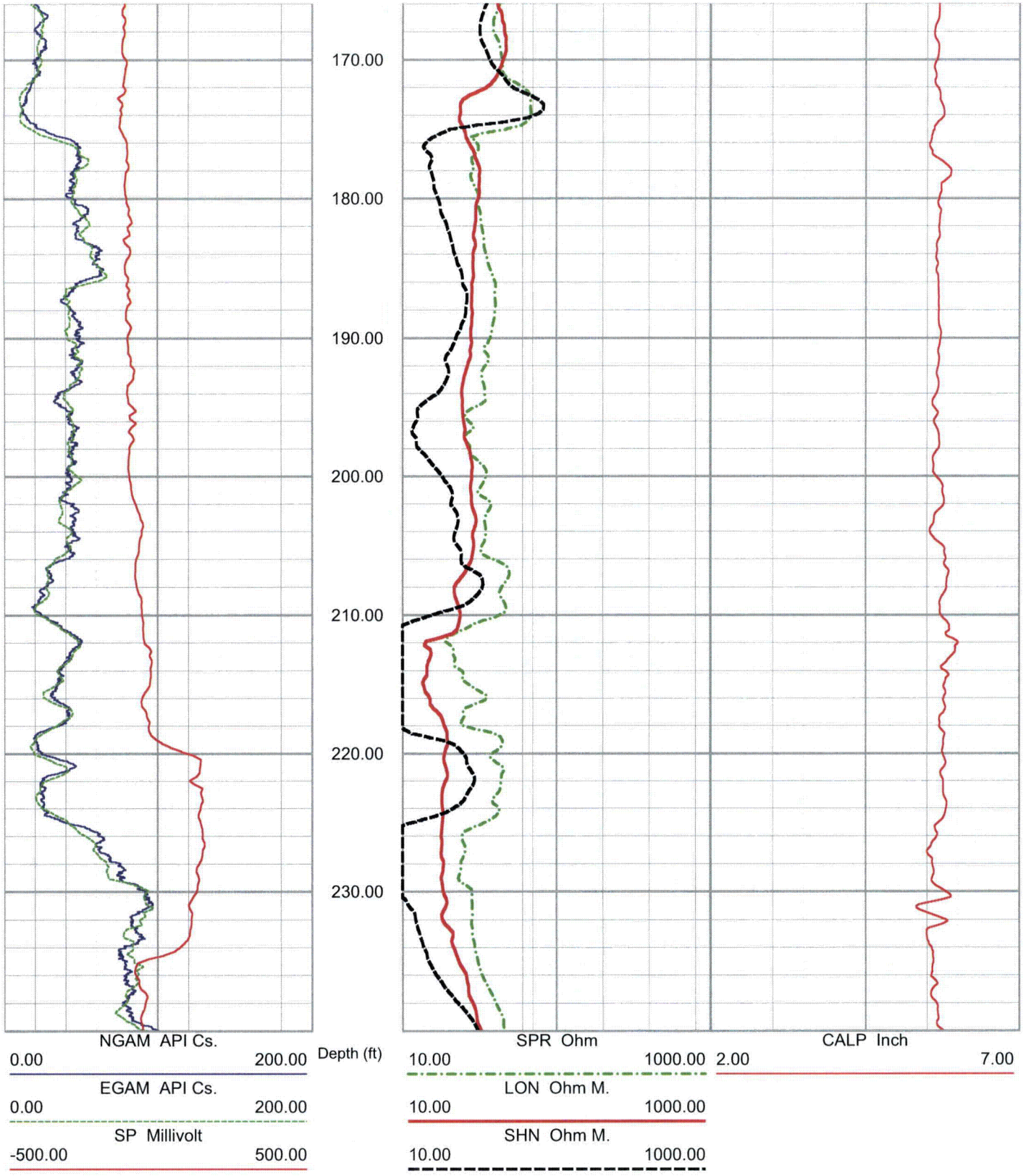
VOGTLE Units 3 & 4 COL Boring B-4002 ELOG, Caliper and Gamma rev 1 Sheet 1 of 4




VOGTLE Units 3 & 4 COL Boring B-4002 ELOG, Caliper and Gamma rev 1 Sheet 2 of 4




VOGTLE Units 3 & 4 COL Boring B-4002 ELOG, Caliper and Gamma rev 1 Sheet 3 of 4




VOGTLE Units 3 & 4 COL Boring B-4002 ELOG, Caliper and Gamma rev 1 Sheet 4 of 4

ROBERTSON GEOLOGGING LIMITED

VOGTLE COL

B4003CALUP01

ROBERTSON GEOLOGGING TECHNOLOGY

REMARKS ( C:\Data\PS\Vogtle\B-4003 14 Feb 2007 boring ..

| | |
|---|---|
| COMPANY | GEOVISION |
| WELL | B-4003 |
| FIELD | |
| COUNTRY | |
| STATE | |
| COUNTY | |
| LAT.: | |
| LONG.: | |

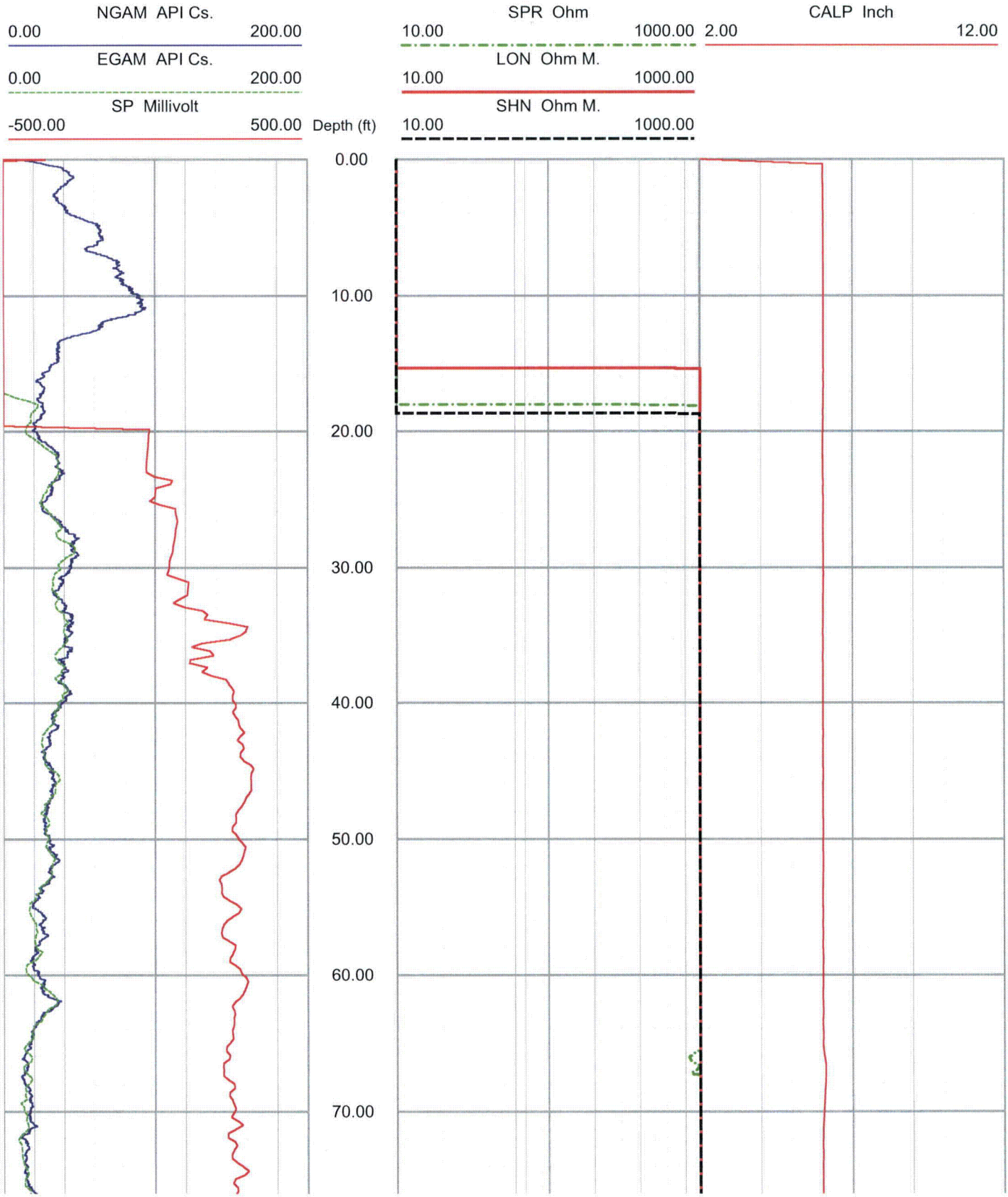
OTHER SERVICES

| | | | |
|---|---|---|---|
| Perm. Da.. | Elev | KB | 0.00 |
| Log. Da.. | | DF | 0.00 |
| Drill Datum | | GL | 0.00 |

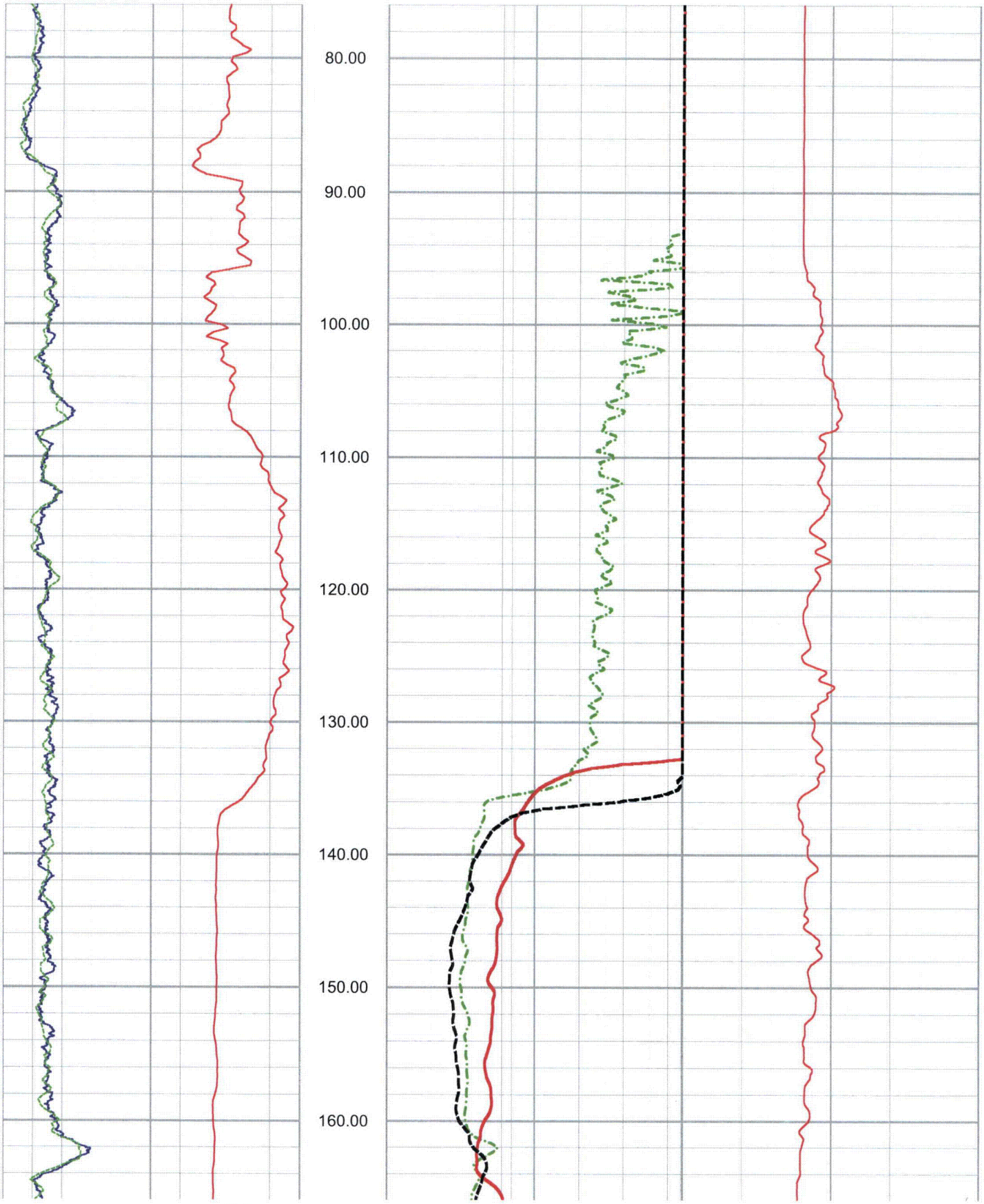
| | | | |
|---|---|---|---|
| DATE | 14 Feb 07 | 15 Dec 06 | 15 Dec 06 |
| RUN# | 7 | 0 | 0 |
| TYPE OF LOG | ELOG | | |
| DEPTH DRILLER | 250.00 | 0.00 | 0.00 |
| DEPTH LOGGER | 250.00 | 0.00 | 0.00 |
| LOG DEEPEST | 247.00 | 0.00 | 0.00 |
| LOG SHALLOW | 0.00 | 0.00 | 0.00 |
| FLUID IN HOLE | DRILLING MUD | | |
| SALINITY | | | |
| DENSITY | | | |
| LEVEL | | | |
| MAX TEMP °C | 0.00 | 0.00 | 0.00 |
| RIG TIME | | | |
| RECORDED BY | R. STELLER | | |
| WITNESSED BY | | | |

| RUN# | BIT RECORD SIZE | FROM | TO | CASING RECORD SIZE | WEIGHT | FROM | TO |
|---|---|---|---|---|---|---|---|
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

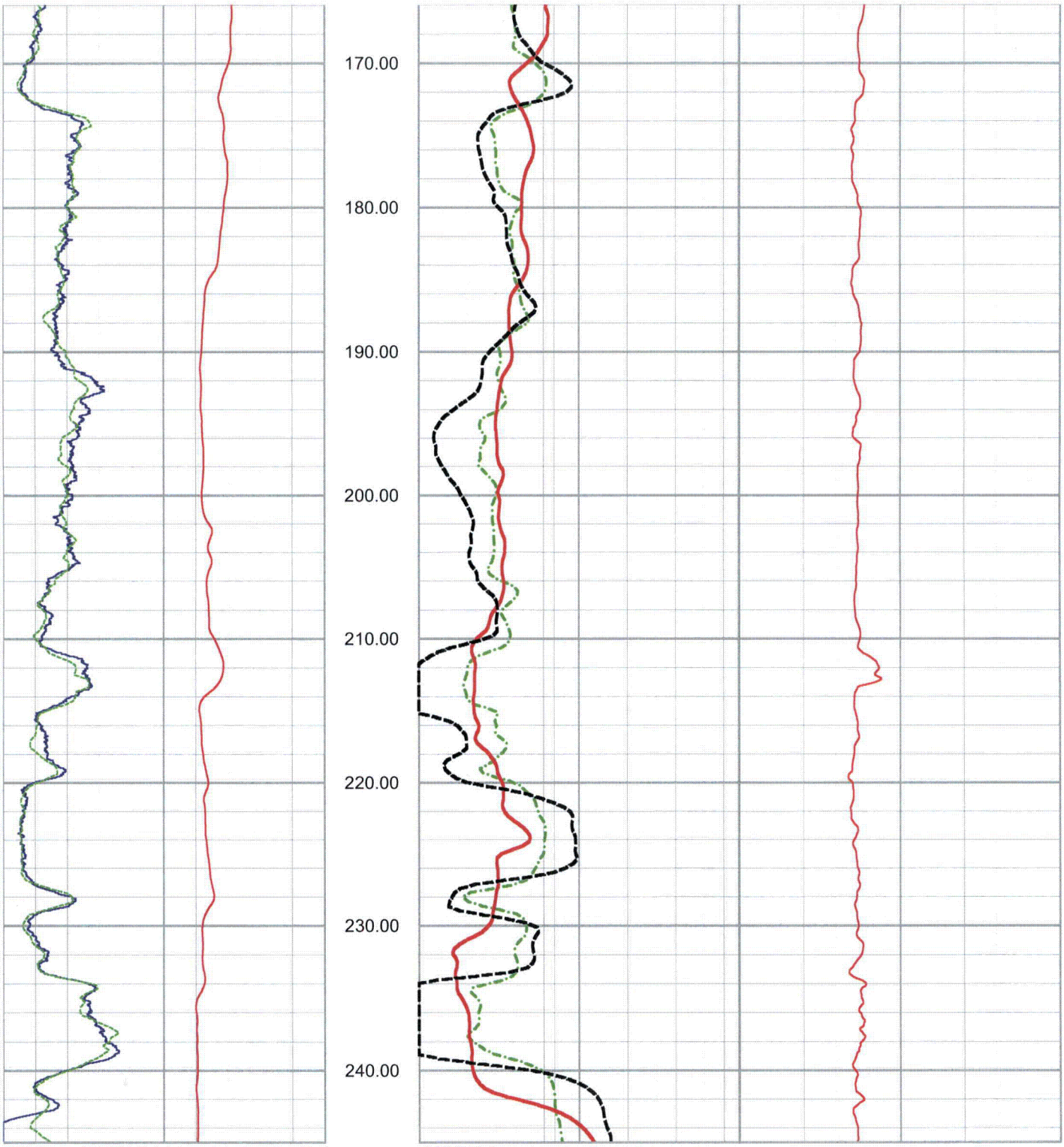
VOGTLE Units 3 & 4 COL Boring B-4003 ELOG, Caliper and Gamma rev 1 Sheet 1 of 5




VOGTLE Units 3 & 4 COL Boring B-4003 ELOG, Caliper and Gamma rev 1 Sheet 2 of 5




VOGTLE Units 3 & 4 COL Boring B-4003 ELOG, Caliper and Gamma rev 1 Sheet 3 of 5




VOGTLE Units 3 & 4 COL Boring B-4003 ELOG, Caliper and Gamma rev 1 Sheet 4 of 5

| NGAM API Cs. | | Depth (ft) | SPR Ohm | | CALP Inch | |
|---|---|---|---|---|---|---|
| 0.00 | 200.00 | | 10.00 | 1000.00 | 2.00 | 12.00 |
| EGAM API Cs. | | | LON Ohm M. | | | |
| 0.00 | 200.00 | | 10.00 | 1000.00 | | |
| SP Millivolt | | | SHN Ohm M. | | | |
| -500.00 | 500.00 | | 10.00 | 1000.00 | | |

VOGTLE Units 3 & 4 COL Boring B-4003 ELOG, Caliper and Gamma rev 1 Sheet 5 of 5

# APPENDIX C

# BORING GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION PROCEDURES AND CALIBRATION RECORDS

# CALIBRATION PROCEDURE FOR

# GEOVision SEISMIC RECORDER/LOGGER

Reviewed 4/6/06

## Objective

The timing/sampling accuracy of seismic recorders or data loggers is required for several GEOVision field procedures including Seismic Refraction, Downhole Seismic Velocity Logging, and P-S Suspension Logging. This procedure describes the method for measuring the timing accuracy of a seismic data logger, such as the OYO Model 170, OYO/Robertson Model 3403, Geometrics Strataview or Geometrics Geode. The objective of this procedure is to verify that the timing accuracy of the recorder is accurate to within 1%.

## Frequency of Calibration

The calibration of each GEOVision seismic data logger is twelve (12) months. In the case of rented seismic data loggers, calibration must be performed prior to use.

## Test Equipment Required

The following equipment is required. Item #2 must have current NIST traceable calibration.

1. Function generator, Krohn Hite 5400B or equivalent
2. Frequency counter, HP 5315A or equivalent
3. Test cables, from item 1 to item 2, and from item 1 to subject data logger.

## Procedure

This procedure is designed to be performed using the accompanying Seismograph Calibration Data Sheet with the same revision number. All data must be entered and the procedure signed by the technician performing the test.

1. Record all identification data on the form provided.
2. Connect function generator to data logger (such as OYO Model 170) using test cable
3. Connect the function generator to the frequency counter using test cable.

4. Set up generator to produce a 100.0 Hz, 0.25 volt (amplitude is approximate, modify as necessary to yield less than full scale waveforms on logger display) peak square wave or sine wave. Verify frequency using the counter and initial space on the data sheet.

5. Initialize data logger and record a data record of at least 0.1 second using a 100 microsecond or less sample period.

6. Measure the recorded square wave frequency by measuring the duration of 9 cycles of data. This measurement can be made using the data logger display device, or by printing out a paper tape. If a paper tape can be printed, the resulting printout must be attached to this procedure. Record the data in the space provided.

7. Repeat steps 5 and 6 three more times using separate files.

**Criteria**

The duration for 9 cycles in any file must be 90.0 milliseconds plus or minus 0.9 milliseconds, corresponding to an average frequency for the nine cycles of 100.0 Hz plus or minus 1 Hz (obtained by dividing 9 cycles by the duration in milliseconds).

If the results are outside this range, the data logger must be marked with a GEOVision REJECT tag until it can be repaired and retested.

If results are acceptable affix label indicating the initials of the person performing the calibration, the date of calibration, and the due date for the next calibration (12 months).

**Procedure Approval**

Approved by:

| | |
|---|---|
| John G. Diehl | President |
| Name | Title |
| | April 6, 2006 |
| Signature | Date |

Client Approval (if required):

| | |
|---|---|
| | |
| Name | Title |
| | |
| Signature | Date |

TEST NUMBER
501203

EDISON ESI
A SOUTHERN CALIFORNIA EDISON Company

# Calibration Report

**METROLOGY**
7300 Fenwick Lane
Westminster, CA 92683
866-723-2257
edisonmetrology.com

**GEOVision Geophysical Services**
1151 Pomona Road, Unit P
Corona, CA 92882
P.O. No.: 6162-060414-01

| | | | |
|---|---|---|---|
| **Manufacturer:** | Oyo | **Calibration Date:** | 04/21/2006 |
| **Model Number:** | 3403 | **Calibration Due Date:** | 04/21/2007 |
| **Description:** | Unit, Suspension Telemetry, | **Calibration Interval:** | 12 Months |
| **Asset Number:** | 160023 | **Condition As Found:** | In Tolerance |
| **Serial Number:** | 160023 | **Condition As Left:** | In Tolerance |

**Remarks:**
The UUT (unit under test) was calibrated using the customer's procedure. The UUT was operated by the customer's personnel and data collection was observed by SCE personnel. The UUT was found to be in tolerance to customer supplied specifications. The reference standards used are in compliance with ISO/IEC 17025:1999 and laboratory accreditation criteria established by NIST/NVLAP under the specific scope of accreditation for lab code 105014-0. Frequency is accredited.
Please see attached data.

## Standards Utilized

| I.D. No. | Mfg. | Model No. | Description | Cal. Date | Due Date |
|---|---|---|---|---|---|
| S1-01252 | Hewlett Packard | 5335A OPT 010,203040 | Counter, Universal | 12/09/2005 | 06/09/2006 |
| S1-03355 | Hewlett Packard | 3325B OPT 001, 002 | Generator, Function, Synthesizer | 11/03/2005 | 11/03/2006 |
| S1-03686 | Fluke | 910 | Standard, Frequency, Controlled, Gps | 01/16/2006 | 01/16/2007 |

**Procedure:** Customer
**Temperature:** 23° C
**Humidity:** 40% RH
**Test No.:** 501203

| Calibration Performed By: | | | Quality Reviewer: |
|---|---|---|---|
| Branson, Craig A CAB | Metrologist | 714-895-0714 | 04-21-06 |
| Name | Title | Phone | Name / Date |

This report may not be reproduced, except in full, without written permission of this laboratory. This report may not be used to claim product endorsement by NVLAP or any agency of the US Government. The results stated in this report relate only to the items tested or calibrated. Measurements reported herein are traceable to SI units via national standards maintained by NIST and were performed in compliance with MIL-STD-45662A, ANSI/NCSL Z540-1-1994, 10CFR50, Appendix B, and ISO 9002-94.

Page 2 of 2

GEOVision geophysical services

## SEISMOGRAPH CALIBRATION DATA SHEET REV 4/6/06

**INSTRUMENT DATA**

| | | | |
|---|---|---|---|
| SYSTEM MFR: | OYO | MODEL NO.: | 3403 |
| SERIAL NO.: | 160023 | CALIBRATION DATE: | 4/21/2006 |
| BY: | ROBERT STELLER | DUE DATE: | 4/21/2007 |
| COUNTER MFR: | HEWLETT PACKARD | MODEL NO.: | 5335A |
| SERIAL NO.: | 2626A09881 | CALIBRATION DATE: | 12/9/2005 |
| BY: | SCE #S1-01252 | DUE DATE: | 6/9/2006 |
| FCTN GEN MFR: | HEWLETT PACKARD | MODEL NO.: | 3325B |
| SERIAL NO.: | 2847A14447 | CALIBRATION DATE: | 11/3/2005 |
| BY: | SCE #S1-03355 | DUE DATE: | 11/3/2006 |

**SYSTEM SETTINGS:**

| | |
|---|---|
| GAIN: | 2 |
| FILTER: | 10 KHZ |
| RANGE: | 100 MILLISEC, 100 MICROSECOND SAMPLE RATE |
| DELAY: | 0 |
| STACK: 1 (STD) | 1 |
| PULSE: | 1.6 |
| DISPLAY: | NA |
| SYSTEM: DATE = CORRECT DATE & TIME | 4/21/2006. 11:07AM |

**PROCEDURE:**

SET FREQUENCY TO 100.0HZ SQUAREWAVE WITH AMPLITUDE APPROXIMATELY 0.25 VOLT PEAK. RECORD BOTH ON DISK AND PAPER TAPE, IF AVAILABLE. ANALYZE AND PRINT WAVEFORMS FROM ANALYSIS UTILITY. ATTACH PAPER COPIES OF PRINTOUT AND PAPER TAPES, IF AVAILABLE, TO THIS FORM. AVERAGE FREQUENCY MUST BE BETWEEN 99.0 AND 101.0 HZ.

AS FOUND 100.0 AS LEFT 100.0

| WAVEFORM | FILE NO | FREQUENCY | TIME FOR 9 CYCLES Hn | TIME FOR 9 CYCLES Hr | TIME FOR 9 CYCLES V | AVERAGE FREQ. |
|---|---|---|---|---|---|---|
| SQUARE | 305 | 100.0 | 90.0 | 90.0 | 90.0 | 100.0 |
| SQUARE | 306 | 100.0 | 90.0 | 90.0 | 90.0 | 100.0 |
| SINE | 307 | 100.0 | 90.0 | 90.0 | 90.0 | 100.0 |
| SINE | 308 | 100.0 | 90.1 | 90.0 | 90.0 | 100.0 |

CALIBRATED BY: ROBERT STELLER 4/21/2006 Robt Steller
NAME DATE SIGNATURE

Seismic recorder/Logger Calibration Data Sheet Rev 1.30 4-6-06

TEST NUMBER
501204

EDISON ESI

A SOUTHERN CALIFORNIA EDISON Company

# Calibration Report

**METROLOGY**
7300 Fenwick Lane
Westminster, CA 92683
800-723-2257
edison@metrology.com

**GEOVision Geophysical Services**
1151 Pomona Road, Unit P
Corona, CA 92882
P.O. No.: 6162-060414-01

| | | | |
|---|---|---|---|
| **Manufacturer:** | Oyo | **Calibration Date:** | 04/21/2006 |
| **Model Number:** | 3403 | **Calibration Due Date:** | 04/21/2007 |
| **Description:** | Unit, Suspension Telemetry, | **Calibration Interval:** | 12 Months |
| **Asset Number:** | 160024 | **Condition As Found:** | In Tolerance |
| **Serial Number:** | 160024 | **Condition As Left:** | In Tolerance |

**Remarks:**
The UUT (unit under test) was calibrated using the customer's procedure. The UUT was operated by the customer's personnel and data collection was observed by SCE personnel. The UUT was found to be in tolerance to customer supplied specifications. The reference standards used are in compliance with ISO/IEC 17025:1999 and laboratory accreditation criteria established by NIST/NVLAP under the specific scope of accreditation for lab code 105014-0. Frequency is accredited.
Please see attached data.

## Standards Utilized

| I.D. No. | Mfg. | Model No. | Description | Cal. Date | Due Date |
|---|---|---|---|---|---|
| S1-01252 | Hewlett Packard | 5335A OPT 010,203040 | Counter, Universal | 12/09/2005 | 06/09/2006 |
| S1-03355 | Hewlett Packard | 3325B OPT 001, 002 | Generator, Function, Synthesizer | 11/03/2005 | 11/03/2006 |
| S1-03686 | Fluke | 910 | Standard, Frequency, Controlled, Gps | 01/16/2006 | 01/16/2007 |

**Procedure:** Customer
**Temperature:** 23° C
**Humidity:** 40% RH
**Test No.:** 501204

| Calibration Performed By: | | | Quality Reviewer: | |
|---|---|---|---|---|
| Branson, Craig A CAB | Metrologist | 714-895-0714 | | 04-21-06 |
| Name | Title | Phone | Name | Date |

This report may not be reproduced, except in full, without written permission of this laboratory. This report may not be used to claim product endorsement by NVLAP or any agency of the US Government. The results stated in this report relate only to the items tested or calibrated. Measurements reported herein are traceable to SI units via national standards maintained by NIST and were performed in compliance with MIL-STD-45662A, ANSI/NCSL Z540-1-1994, 10CFR50, Appendix B, and ISO 9002-94.

page 2 of 2

GEOVision geophysical services

## SEISMOGRAPH CALIBRATION DATA SHEET REV 4/6/06

**INSTRUMENT DATA**

| | | | |
|---|---|---|---|
| SYSTEM MFR: | OYO | MODEL NO.: | 3403 |
| SERIAL NO.: | 160024 | CALIBRATION DATE: | 4/21/2006 |
| BY: | ROBERT STELLER | DUE DATE: | 4/21/2007 |
| COUNTER MFR: | HEWLETT PACKARD | MODEL NO.: | 5335A |
| SERIAL NO.: | 2626A09881 | CALIBRATION DATE: | 12/9/2005 |
| BY: | SCE #S1-01252 | DUE DATE: | 6/9/2006 |
| FCTN GEN MFR: | HEWLETT PACKARD | MODEL NO.: | 3325B |
| SERIAL NO.: | 2847A14447 | CALIBRATION DATE: | 11/3/2005 |
| BY: | SCE #S1-03355 | DUE DATE: | 11/3/2006 |

**SYSTEM SETTINGS:**

| | |
|---|---|
| GAIN: | 2 |
| FILTER: | 10 KHZ |
| RANGE: | 100 MILLISEC, 100 MICROSECOND SAMPLE RATE |
| DELAY: | 0 |
| STACK: 1 (STD) | 1 |
| PULSE: | 1.6 |
| DISPLAY: | NA |
| SYSTEM: DATE = CORRECT DATE & TIME | 4/21/2006, 11:30AM |

**PROCEDURE:**

SET FREQUENCY TO 100.0HZ SQUAREWAVE WITH AMPLITUDE APPROXIMATELY 0.25 VOLT PEAK. RECORD BOTH ON DISK AND PAPER TAPE, IF AVAILABLE. ANALYZE AND PRINT WAVEFORMS FROM ANALYSIS UTILITY. ATTACH PAPER COPIES OF PRINTOUT AND PAPER TAPES, IF AVAILABLE, TO THIS FORM. AVERAGE FREQUENCY MUST BE BETWEEN 99.0 AND 101.0 HZ.

AS FOUND 100.0 AS LEFT 100.0

| WAVEFORM | FILE NO | FREQUENCY | TIME FOR 9 CYCLES Hn | TIME FOR 9 CYCLES Hr | TIME FOR 9 CYCLES V | AVERAGE FREQ. |
|---|---|---|---|---|---|---|
| SQUARE | 401 | 100.0 | 90.0 | 90.0 | 90.0 | 100.0 |
| SQUARE | 402 | 100.0 | 90.0 | 90.0 | 90.0 | 100.0 |
| SINE | 403 | 100.0 | 89.9 | 90.0 | 90.1 | 100.0 |
| SINE | 404 | 100.0 | 90.0 | 90.1 | 90.1 | 99.9 |

CALIBRATED BY: ROBERT STELLER 4/21/2006 Robert Steller
NAME DATE SIGNATURE

Seismic recorder/Logger Calibration Data Sheet Rev 1.30 4-6-06

**United States Department of Commerce**
**National Institute of Standards and Technology**

NVLAP®

# Certificate of Accreditation to ISO/IEC 17025:1999

**NVLAP LAB CODE: 105014-0**

## Southern California Edison Company

Westminster, CA

*is recognized by the National Voluntary Laboratory Accreditation Program for conformance with criteria set forth in NIST Handbook 150:2001 and all requirements of ISO/IEC 17025:1999.*
*Accreditation is granted for specific services, listed on the Scope of Accreditation, for:*

## CALIBRATION LABORATORIES

2006-04-01 through 2007-03-31

*Effective dates*

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

*For the National Institute of Standards and Technology*

NVLAP-01C (REV. 2005-05-19)

**National Voluntary Laboratory Accreditation Program**

# SCOPE OF ACCREDITATION TO ISO/IEC 17025:1999

**Southern California Edison Company**
7300 Fenwick Lane
Westminster, CA 92683
Ms. Jennifer E. Smith
Phone: 714-895-0133 Fax: 714-895-0781
E-mail: Jennifer.Smith@sce.com
URL: http://www.edisonmetrology.com

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 105014-0**

***NVLAP Code:*** 20/A01 ANSI/NCSL Z540-1-1994; Part 1 Compliant

**DIMENSIONAL**

***NVLAP Code:*** 20/D03
Gage Blocks

| *Nominal Length in in* | *Best Uncertainty (±) in µin* [note 1] |
|---|---|
| 0.01 to < 0.05 | 1.9 |
| 0.05 to < 0.1 | 1.7 |
| 0.1 to < 1.0 | 1.2 |
| 1.0 | 1.4 |
| 2.0 | 1.8 |
| 3.0 | 2.2 |
| 4.0 | 2.9 |
| 5.0 | 5.4 |
| 6.0 | 5.6 |
| 7.0 | 5.8 |
| 8.0 | 6.0 |
| 10.0 | 6.8 |
| 12.0 | 7.2 |
| 16.0 | 8.1 |
| 20.0 | 9.4 |

2006-04-01 through 2007-03-31

*Effective dates*

*For the National Institute of Standards and Technology*

# National Voluntary Laboratory Accreditation Program

## CALIBRATION LABORATORIES

**NVLAP LAB CODE 105014-0**

| *Nominal Length in mm* | *Best Uncertainty (±) in nm* [note 1] |
|---|---|
| 0.5 to < 1.0 | 52 |
| 1.0 to < 2.5 | 44 |
| 2.5 to < 25.0 | 39 |
| 25.0 | 44 |
| 50.0 | 47 |
| 75.0 | 60 |
| 100.0 | 80 |

***NVLAP Code:*** 20/D11
Spherical Diameter; Ring Gages

| *Range in inches* | *Best Uncertainty (±) in µin* [note 1] | *Remarks* |
|---|---|---|
| 0.040 to 0.825 | 6 | Comparison to gage blocks |
| > 0.825 to 1.510 | 7 | Comparison to gage blocks |
| > 1.510 to 2.510 | 8 | Comparison to gage blocks |
| > 2.510 to 4.510 | 12 | Comparison to gage blocks |
| > 4.510 to 6.510 | 14 | Comparison to gage blocks |
| > 6.510 to 9.010 | 16 | Comparison to gage blocks |
| > 9.010 to 12.010 | 19 | Comparison to gage blocks |
| > 12.010 to 13.25 | 31 | Comparison to gage blocks |

## ELECTROMAGNETICS - DC/LOW FREQUENCY

***NVLAP Code:*** 20/E02
AC Current

| *Range* | *Best Uncertainty (±) in ppm* [note 1] *Frequency in Hz* | | | |
|---|---|---|---|---|
| | *10* | *20* | *40* | *400 to 10 k* |
| 10 mA | 270 | 199 | 127 | 116 |
| 20 mA | 270 | 199 | 127 | 116 |
| 30 mA | 270 | 199 | 127 | 116 |
| 50 mA | 286 | 208 | 141 | 130 |
| 100 mA | 270 | 199 | 127 | 116 |

2006-04-01 through 2007-03-31

*Effective dates*

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**CALIBRATION LABORATORIES** **NVLAP LAB CODE 105014-0**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 200 mA | | 270 | | 199 | 127 | | 116 |
| 300 mA | | 270 | | 199 | 127 | | 116 |
| 500 mA | | 270 | | 208 | 141 | | 130 |
| | ***10*** | ***20*** | ***40*** | ***400 to 5 k*** | ***10 k*** | | |
| 1A | 270 | 199 | 127 | 116 | 130 | | |
| | ***10*** | ***20*** | ***40*** | ***400 to 10 k*** | | | |
| 2A | 271 | 200 | 129 | 118 | | | |
| 3A | 271 | 200 | 129 | 118 | | | |
| | ***10*** | ***20*** | ***40*** | ***400 to 5 k*** | ***10 k*** | | |
| 5A | 286 | 209 | 142 | 132 | 148 | | |
| | ***10*** | ***20*** | ***40*** | ***400*** | ***1 k*** | ***5 k*** | ***10 k*** |
| 10A | 273 | 233 | 132 | 121 | 121 | 143 | 143 |
| | | | | | | | ***400 to 10 k*** |
| 20A | | | | | | | 144 |

***NVLAP Code:*** 20/E05
DC Current

| ***Range*** | ***Best Uncertainty (±) in ppm*** [note 1] |
|---|---|
| 10 nA | 2.9 |
| 100 nA | 2.3 |
| 1 µA | 2.0 |
| 10 µA | 2.0 |
| 100 µA | 2.0 |
| 1 mA | 1.9 |
| 10 mA | 1.9 |
| 100 mA | 1.9 |
| 1 A | 10.4 |
| 10 A | 10.4 |
| 30 A | 20.6 |

2006-04-01 through 2007-03-31

*Effective dates*

*For the National Institute of Standards and Technology*

# National Voluntary Laboratory Accreditation Program

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 105014-0**

DC Resistance

| *Nominal Value in Ω* | *Best Uncertainty (±) in ppm* [note 1] | *Remarks* |
|---|---|---|
| 100 μ | 8.20 | Automated DC Resistance Calibration System |
| 1 m | 5.50 | Automated DC Resistance Calibration System |
| 10 m | 3.70 | Automated DC Resistance Calibration System |
| 100 m | 2.10 | Automated DC Resistance Calibration System |
| 1 | 0.40 | Automated DC Resistance Calibration System |
| 10 | 0.40 | Automated DC Resistance Calibration System |
| 25 | 0.50 | Automated DC Resistance Calibration System |
| 100 | 0.50 | Automated DC Resistance Calibration System |
| 1 k | 0.50 | Automated DC Resistance Calibration System |
| 10 k | 0.50 | Automated DC Resistance Calibration System |
| 100 k | 1.50 | Automated DC Resistance Calibration System |
| 1 M | 2.30 | Automated DC Resistance Calibration System |
| 10 M | 3.30 | Automated DC Resistance Calibration System |
| 100 M | 4.00 | Automated DC Resistance Calibration System |

***NVLAP Code:*** 20/E06
DC Voltage

| *Range* | *Best Uncertainty (±) in ppm* [notes 1,2] | *Remarks* |
|---|---|---|
| 1.018 V | 0.80 | Automated DC Calibration System |
| 10.00 V | 0.20 | Automated DC Calibration System |
| 1.000 V | 0.80 | Automated DC Calibration System |
| 1 mV to 100 mV | 1.3 [note 6] | Ratiometric Measurement Techniques performed by voltage transfer utilizing a high precision voltage |
| 100 mV | 0.7 | Ratiometric Measurement Techniques performed by voltage transfer utilizing a high precision voltage |
| 1.0 V | 0.3 | Ratiometric Measurement Techniques performed by voltage transfer utilizing a high precision voltage |

2006-04-01 through 2007-03-31

*Effective dates*

*For the National Institute of Standards and Technology*

# National Voluntary Laboratory Accreditation Program

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 105014-0**

| | | |
|---|---|---|
| 10.0 V | 0.3 | Ratiometric Measurement Techniques performed by voltage transfer utilizing a high precision voltage |
| 20.0 V | 0.5 | Ratiometric Measurement Techniques performed by voltage transfer utilizing a high precision voltage |
| 100.0 V | 0.3 | Ratiometric Measurement Techniques performed by voltage transfer utilizing a high precision voltage |
| 1000.0 V | 0.7 | Ratiometric Measurement Techniques performed by voltage transfer utilizing a high precision voltage |

***NVLAP Code:*** 20/E09
LF AC Voltage

***Best Uncertainty (±) in ppm*** *notes 1,3,4*
***Frequency in Hz***

| *Range* | *10* | *20* | *40* | *100* | *1k* | *10k* | *20k* | *50k* | *100k* | *300k* | *500k* | *800k* | *1M* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 mV | 448 | 912 | 889 | 969 | 379 | 865 | 1073 | 405 | 1131 | 1265 | 2116 | 2595 | 2938 |
| 10 mV | 119 | 230 | 102 | 177 | 245 | 169 | 180 | 220 | 343 | 243 | 676 | 425 | 488 |
| 20 mV | 83 | 70 | 67 | 67 | 66 | 76 | 76 | 165 | 261 | 361 | 521 | 372 | 442 |
| 30 mV | 134 | 111 | 80 | 78 | 62 | 63 | 71 | 133 | 219 | 345 | 535 | 688 | 791 |
| 100 mV | 36 | 72 | 23 | 42 | 34 | 35 | 34 | 43 | 77 | 169 | 220 | 287 | 225 |
| 190 mV | 36 | 31 | 22 | 20 | 21 | 26 | 21 | 42 | 80 | 136 | 124 | 264 | 215 |
| 300 mV | 46 | 61 | 30 | 32 | 34 | 19 | 28 | 36 | 59 | 116 | 143 | 189 | 205 |
| 1 V | 120 | 36 | 18 | 10 | 13 | 12 | 11 | 25 | 14 | 87 | 102 | 104 | 98 |
| 1.9 V | 36 | 22 | 22 | 9 | 9 | 9 | 8 | 18 | 11 | 94 | 101 | 85 | 89 |
| 3 V | 26 | 34 | 25 | 17 | 14 | 14 | 13 | 27 | 14 | 100 | 108 | 95 | 97 |
| 10 V | 20 | 42 | 19 | 10 | 10 | 9 | 10 | 11 | 16 | 80 | 100 | 111 | 100 |
| 19 V | 26 | 23 | 20 | 11 | 9 | 9 | 10 | 11 | 16 | 98 | 109 | 82 | 82 |
| 30 V | 30 | 37 | 26 | 19 | 15 | 16 | 19 | 37 | 44 | 118 | | | |
| 100 V | 140 | 46 | 20 | 16 | 15 | 19 | 11 | 40 | 22 | | | | |
| 190 V | 47 | 27 | 20 | 20 | 13 | 13 | 13 | 41 | 26 | | | | |
| 300 V | | | 37 | 29 | 18 | 27 | 22 | 29 | 46 | | | | |
| 500 V | | | 33 | 25 | 17 | 20 | 19 | 38 | 52 | | | | |

2006-04-01 through 2007-03-31

*Effective dates*

*For the National Institute of Standards and Technology*

# National Voluntary Laboratory Accreditation Program

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 105014-0**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 700 V | 29 | 23 | 18 | 17 | 19 | 44 | 54 |
| 1000 V | 22 | 23 | 21 | 19 | 22 | | |

**TIME AND FREQUENCY**

***NVLAP Code:*** 20/F01
**Frequency Dissemination**

| *Range* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|
| 10 MHz | $1.2 \times 10^{-12}$ | GPS Receiver |

**MECHANICAL**

***NVLAP Code:*** 20/M05
Flow Rate

| *Nominal Flow Rate* | *Best Uncertainty (±) in percent* [notes 1, 5] |
|---|---|
| (0.8 to 30) L/s | 0.3 |
| (0.1 to 800) mL/s | 0.4 |
| (0.006 to 0.1) mL/s | 0.7 |

***NVLAP Code:*** 20/M06
Force

| *Nominal Force in lb* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|
| 2 to 200 | 0.025 % | Dead Weight |
| > 200 to 300 | 0.086 lb | Proving Ring |
| > 300 to 500 | 0.14 lb | Proving Ring |
| > 500 to 1000 | 0.28 lb | Proving Ring |
| > 1000 to 2000 | 0.55 lb | Proving Ring |
| > 2000 to 5000 | 0.84 lb | Proving Ring |
| > 5000 to 10 000 | 1.7 lb | Proving Ring |
| > 10 000 to 20 000 | 5.5 lb | Proving Ring |
| > 20 000 to 35 000 | 5.8 lb | Proving Ring |
| > 35 000 to 50 000 | 13 lb | Proving Ring |

2006-04-01 through 2007-03-31

*Effective dates*

*For the National Institute of Standards and Technology*

# National Voluntary Laboratory Accreditation Program

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 105014-0**

| | | |
|---|---|---|
| > 50 000 to 60 000 | 16 lb | Proving Ring |
| > 60 000 to 100 000 | 26 lb | Proving Ring |
| > 100 000 to 300 000 | 113 lb | Proving Ring |

***NVLAP Code:*** 20/M08
Mass

| *Range* | *Best Uncertainty (±) in mg* [notes 1,2] | *Remarks* |
|---|---|---|
| 10 kg | 2.3 | Echelon I |
| 5 kg | 0.93 | Echelon I |
| 3 kg | 0.65 | Echelon I |
| 2 kg | 0.43 | Echelon I |
| 1 kg | 0.052 | Echelon I |
| 500 g | 0.043 | Echelon I |
| 300 g | 0.041 | Echelon I |
| 200 g | 0.034 | Echelon I |
| 100 g | 0.020 | Echelon I |
| 50 g | 0.013 | Echelon I |
| 30 g | 0.013 | Echelon I |
| 20 g | 0.0095 | Echelon I |
| 10 g | 0.0073 | Echelon I |
| 5 g | 0.0048 | Echelon I |
| 3 g | 0.0038 | Echelon I |
| 2 g | 0.0029 | Echelon I |
| 1 g | 0.0030 | Echelon I |
| 500 mg | 0.0017 | Echelon I |
| 300 mg | 0.0013 | Echelon I |
| 200 mg | 0.0010 | Echelon I |
| 100 mg | 0.0009 | Echelon I |
| 50 mg | 0.0007 | Echelon I |
| 30 mg | 0.0007 | Echelon I |
| 20 mg | 0.0005 | Echelon I |
| 10 mg | 0.0005 | Echelon I |
| 5 mg | 0.0006 | Echelon I |
| 3 mg | 0.0006 | Echelon I |

2006-04-01 through 2007-03-31

*Effective dates*

*For the National Institute of Standards and Technology*

# National Voluntary Laboratory Accreditation Program

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 105014-0**

| | | |
|---|---|---|
| 2 mg | 0.0005 | Echelon I |
| 1 mg | 0.0005 | Echelon I |
| 30 kg | 56 | Echelon II |
| 20 kg | 22 | Echelon II |

**THERMODYNAMIC**

***NVLAP Code:*** 20/T05
Pressure

| *Range* | *Best Uncertainty (±) in ppm* [note 1] | *Remarks* |
|---|---|---|
| > 1.5 to 50 | 20 | Gas |
| > 50 to 1450 | 45 | Gas |
| > 1450 to 16 000 | 90 | Gas |
| > 1000 to 10 000 | 60 | Oil |
| > 10 000 to 30 000 | 110 | Oil |
| > 30 000 to 50 000 | 210 | Oil |

1. Represents an expanded uncertainty using a coverage factor, k = 2, at an approximate level of confidence of 95 %.
2. Approximate value. Actual value determined by the test statistics.
3. All ACV measurements performed via AC/DC transfer system.
4. Uncertainties listed are representative of the laboratory's accredited capabilities within the stated ranges. Accreditation is not limited to only those fixed values shown.
5. Dependent upon principle of operation of device being calibrated and its performance relative to standards at the time of the test.
6. The equation: uncert. = $(A + B/mVDC^2)^{0.5}$ (where A = 0.16 and B = 0.013333) is provided in order for potential customers to calculate approximate uncertainties for values down to 1 mV. Example: uncertainty at 1 mVDC would calculate to approximately ±115.47 ppm.
7. The laboratory maintains Echelon II capability for ranges 20 kg to 1 mg and separate Echelon III for all ranges.
8. Avoirdupois mass calibration services are available by comparison to equivalent metric standards. Uncertainties may be appropriately larger.

2006-04-01 through 2007-03-31

*Effective dates*

*For the National Institute of Standards and Technology*

# Calibration Report

MICRO PRECISION CALIBRATION INC.
12686 Hoover Street, Garden Grove, CA 92841
Ph. (714) 901-5659 Fax (714) 901-5649

Customer: **GEOVISION**
**Corona CA 92882**
Account#: **15214**
Cust PO#:
Page 1 of 2

MPC Ctrl#: **AM6766**
Report#: **199974**
Print Date: **041006**
MPC Job#: **L25384**

Instrument: **Caliper Calibration Plate**

Mfg: **Robertson Geo Logging**
Model: **N/A**
Size:
Res.:

Serial#: **201**
Cust Ctrl#:
Location:
Department:

Work Performed: **Inspected, cleaned, and calibrated.**
Parts Replaced: **None**

Calibration Condition as Received: **In tolerance**
Calibration Condition as Returned: **In tolerance**

Functions/Parameters Tested

| Actual Values (inch) | As Measured |
|---|---|
| 1.969 | 1.965 |
| 3.937 | 3.939 |
| 8.000 | 7.995 |
| 12.00 | 11.9965 |

Unless noted otherwise, Pass/Fail criteria is based on published manufacturer specifications and, unless noted otherwise, this instrument meets these specifications.
Services provided comply with ISO 17025:1999, ISO 9001:2000, MPC QM rev.3, MPC CSD rev.2 and customer purchase order requirements as required.

Calibration standards used for performance testing:

| MPC# | Instrument | Due Date | Traceability |
|---|---|---|---|
| K3263 | Pratt & Whitney C Super Micrometer | 060706 | 192068 |
| I2111 | Mitutoyo 516-126 Gage Block Set | 082406 | 397060 |

Environmental: 69 Deg / 40% Rh
Accuracy Ratio: 4:1
Cal Procedure: 33K6-4-552-1
Technician: CHRIS SPANGLER

Cal Int.: **12**
Cal Date: **040606**
Due Date: **040607**
Quality Approval: QC 32

Form Cert 04-25-05

All standards used are either traceable to the National Institute of Standards and Technology or have intrinsic accuracy. All services performed have used proper manufacturer and industrial service techniques and are warranted for no less than (30) days. This report may not be reproduced in part without written permission of Micro Precision's Quality Assurance Manager.

# GEOVision Borehole Geophysics depth wheel verification

Performed by Robert Steller on September 23, 2006

| | Depth reading in #1 | Depth reading out | Depth reading in #2 |
|---|---|---|---|
| Depth wheel<br>S/N 101<br>500 pulse/revolution<br>Circumference = 983mm<br>(3225.07 millifeet) | 100.1 feet<br>(30.51 m) | 99.95 feet<br>(30.46 m) | 100.05 feet<br>(30.50 m) |
| | | | |
| Depth wheel<br>S/N 102<br>500 pulse/revolution<br>Circumference = 994mm<br>(3261.15 millifeet) | 100.00 feet<br>(30.48) m | 100.05 feet<br>(30.50 m) | 100.00 feet<br>(30.48) m |
| | | | |
| Aries winch<br>200 pulse/revolution<br>Circumference = 305.9mm<br>(1003.51 millifeet) | 100.05 feet<br>(30.50) m | 100.05 feet<br>(30.50 m) | 100.00 feet<br>(30.48) m |
| | | | |
| Depth wheel<br>S/N 103<br>500 pulse/revolution<br>Circumference = 1000mm<br>(3.281 feet) | | | |
| | | | |
| Comprobe winch<br>500 pulse/revolution<br>Circumference = 1000mm<br>(3.281 feet) | | | |

All measurements taken with a Stanley 100ft flexible stainless steel tape model number 34-130, and a Keeson 300 foot fiberglass tape, both marked in feet, inches and 1/8ths of inches. Enough cable was spooled off of the winch to allow the cable and tape measures to be laid flat on the parking lot surface side-by-side. A permanent marker was used to mark a 100.0 foot interval on the cable, and the marks were also tagged with electrical tape for visibility. The cable was then spooled back onto the winch. When the first mark was at the top of the measuring wheel, a matching permanent mark was placed, and the recording system (Robertson Micrologger) was set to 0.0 feet depth. The cable was spooled in to the second mark, and the distance was recorded. The recording system was set to 0.0 feet again, and the cable spooled out to the first mark again, and the distance was recorded. The process was repeated one more time to spool the cable back onto the winch, and the distance was recorded.

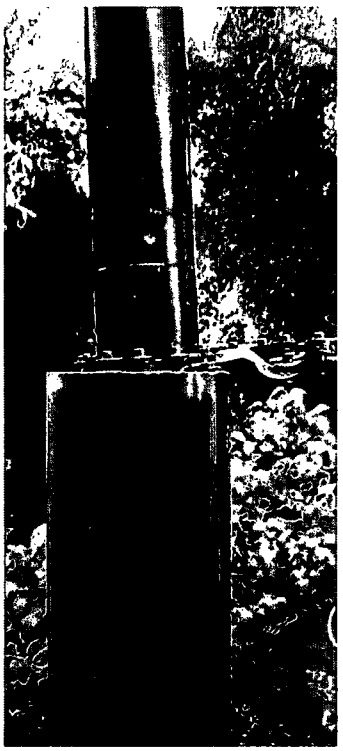
Estimated accuracy is of these measurements is +/- 0.1 foot or +/- 0.03m.

# GEOVision Suspension PS probe Receiver 1–Receiver 2 (R1-R2) spacing verification

Performed by Robert Steller on September 23, 2006

| | R2 center to R1 center hanging dry | R2 center to R1 center hanging submerged | R1 bottom to source center hanging submerged with 1m isolation tube S/N 280068 |
|---|---|---|---|
| Receiver S/N 30086 | 40.2in<br>1.02m | 40.0in<br>1.02m | 76.0in<br>1.93m |
| | | | |
| Receiver S/N 20042 | 39.8in<br>1.01m | 39.6in<br>1.01m | 75.7in<br>1.92m |
| | | | |
| Receiver S/N 12008 | 40.2in<br>1.02m | 40.0in<br>1.02m | 76.0in<br>1.93m |
| | | | |
| | | | |
| | | | |

All measurements taken with a Lufkin 3.7m flexible steel tape model number HV1034DM, marked in mm and 100th of feet. Probe suspended in 3-inch diameter clear PVC pipe, using chain clamp placed between bottom and center of Receiver 2 hard section (See Figure). Probe "bounced" to establish unrestricted hanging length before measurement. Probe allowed to relax for 5 minutes prior to each measurement. Water level set to submerge bottom of Receiver 2 hard section.. Estimated accuracy due to hysterisis in rubber section approximately +/- 0.01' or +/- 0.003m.



# APPENDIX D

# BORING GEOPHYSICAL LOGGING FIELD DATA LOGS

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# B-3001 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 2/12, 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL _____ PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420' ; _____, _____ TO _____
BOREHOLE TOTAL DEPTH AS DRILLED: 420'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 95 ON 2/12/07; NO ____
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____; 275' ON 2/13/07

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B3001ELOGTEST01 | Ø | 2/12/07 | 09:30 - 09:33 |
| ELOG/GAMMA | B3001ELOGUP01 | 262.0 - 20.0' | " | 10:44 - 11:08 |
| SUSPENSION PS | B301-001 → 086.DOG | 98.4 - 237.9' | " | 15:30 - 16:20 |
| CALIPER TEST | B3001CALTEST01 | Ø | " | 16:43 - 16:46 |
| CALIPER/GAMMA | B3001CALUP01 | 245.0 - Ø | " | 16:55 - 17:22 |
| CALIPER TEST | B3001CALTEST02 | Ø | " | 17:23 - 17:28 |
| DEVIATION | B3001AKUP01 | 247.0 - Ø | " | 17:52 - 18:12 |
| ELOG TEST | B3001ELOGTEST02 | Ø | 2/13/07 | 13:38 - 13:41 |
| ELOG/GAMMA | B3001ELOGUP02 | 405.0 - 240.0' | " | 13:56 - 14:21 |
| ELOG/GAMMA | B3001ELOGUP03 | 404.0 - 240.0' | " | 14:26 - 14:44 |
| SUSPENSION PS | B301-188 → 257.DOG | 277.2 - 394.0' | " | 15:09 - 15:47 |
| CALIPER TEST | B3001CALTEST03 | Ø | " | 16:06 - 16:09 |
| CALIPER/GAMMA | B3001CALUP02 | 400.0' - 240.0' | " | 16:20 - 16:37 |
| CALIPER TEST | B3001CALTEST04 | Ø | " | 16:45 - 16:48 |
| DEVIATION | B3001AKUP02 | 402.0 - 240.0' | " | 17:07 - 17:18 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

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# B-3001 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL CONTACT: MATT COOKE
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 420
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 95' ; NO ____ 6" STEEL
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: 270'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: 270' TIME SINCE LAST CIRCULATION: 1/2 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:20
ARRIVED ON SITE: 08:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 09:30 LOGGING COMPLETED: 11:08

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SITE: VOGTLE COL B. 3001 DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER ~~5310~~ 5301 ✓ 5772 ____ OTHER ____
ELOG PROBE 5490 ✓ OTHER ____

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | + 32.8' | |
| MINUS CASING STICK-UP | − 2.3' | |
| DEPTH REF. OFFSET AT START | 38.7' | |
| DEPTH REF. OFFSET AT END | 38.35' Run 1 | |
| AFTER SURVEY DEPTH ERROR | .35 | LESS THAN 0.4%? |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3001ELOGTEST01 | Ø | 9:30 | Ø | 9:33 |
| B3001ELOGup01 | 26.20 | 10:44 | 20.0 | 11:08 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# P-S SUSPENSION VELOCITY FIELD LOG

SITE: VOGTLE COL B-3001 DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 6

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 420'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 95' 6" STEEL ; NO ____
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: 270
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: 1/2 HR

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SITE: VOGTLE COL B-3001 DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 6

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:20
ARRIVED ON SITE: 08:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 15:30 LOGGING COMPLETED: 16:20
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES ✓; NO ____; STORED WITH NEW ____

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WINCH | COMPROBE ☐ | | GREY ☐ | OYO ☐ | RG ☐ | OTH ☑ | | |
| INSTRUMENT | OYO 12004 ☐ | 15014 ☐ | 19029 ☐ | | RG 160023 ☐ | 160024 ☑ | | |
| RECEIVER S/N | 12008 ☐ | 20042 ☐ | 26066 ☐ | 11001 ☐ | 23053 ☐ | 30086 ☑ | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: DEPTH ZERO = 2.5m - .71m = 1.79m.
EXIT = 1.79m

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# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3001 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 3 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 0.5 | 1.64 | | | |
| 1.0 | 3.28 | | | |
| 1.5 | 4.92 | | | |
| 2.0 | 6.56 | | | |
| 2.5 | 8.20 | | | |
| 3.0 | 9.84 | | | |
| 3.5 | 11.48 | | | |
| 4.0 | 13.12 | | | |
| 4.5 | 14.76 | | | |
| 5.0 | 16.40 | | | |
| 5.5 | 18.04 | | | |
| 6.0 | 19.69 | | | |
| 6.5 | 21.33 | | | |
| 7.0 | 22.97 | | | |
| 7.5 | 24.61 | | | |
| 8.0 | 26.25 | | | |
| 8.5 | 27.89 | | | |
| 9.0 | 29.53 | | | |
| 9.5 | 31.17 | | | |
| 10.0 | 32.81 | | | |
| 10.5 | 34.45 | | | |
| 11.0 | 36.09 | | | |
| 11.5 | 37.73 | | | |
| 12.0 | 39.37 | | | |
| 12.5 | 41.01 | | | |
| 13.0 | 42.65 | | | |
| 13.5 | 44.29 | | | |
| 14.0 | 45.93 | | | |
| 14.5 | 47.57 | | | |
| 15.0 | 49.21 | | | |
| 15.5 | 50.85 | | | |
| 16.0 | 52.49 | | | |
| 16.5 | 54.13 | | | |
| 17.0 | 55.77 | | | |
| 17.5 | 57.41 | | | |
| 18.0 | 59.06 | | | |
| 18.5 | 60.70 | | | |
| 19.0 | 62.34 | | | |
| 19.5 | 63.98 | | | |
| 20.0 | 65.62 | | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3001 DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 4 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 20.5 | 67.26 | | | |
| 21.0 | 68.90 | | | |
| 21.5 | 70.54 | | | |
| 22.0 | 72.18 | | | |
| 22.5 | 73.82 | | | |
| 23.0 | 75.46 | | | |
| 23.5 | 77.10 | | | |
| 24.0 | 78.74 | | | |
| 24.5 | 80.38 | | | |
| 25.0 | 82.02 | | | |
| 25.5 | 83.66 | | | |
| 26.0 | 85.30 | | | |
| 26.5 | 86.94 | | | |
| 27.0 | 88.58 | | | |
| 27.5 | 90.22 | | | |
| 28.0 | 91.86 | | | |
| 28.5 | 93.50 | | | |
| 29.0 | 95.14 | | | |
| 29.5 | 96.78 | | 6" | STEEL TO 96' |
| 30.0 | 98.43 | 001 | | |
| 30.5 | 100.07 | 2 | | |
| 31.0 | 101.71 | 3 | | |
| 31.5 | 103.35 | 4 | | |
| 32.0 | 104.99 | 5 | | |
| 32.5 | 106.63 | 6 | | |
| 33.0 | 108.27 | 7 | | |
| 33.5 | 109.91 | 8 | | |
| 34.0 | 111.55 | 9 | | |
| 34.5 | 113.19 | 10 | | |
| 35.0 | 114.83 | 11 | | |
| 35.5 | 116.47 | 12 | | |
| 36.0 | 118.11 | 13 | | |
| 36.5 | 119.75 | 14 | | |
| 37.0 | 121.39 | 15 | | |
| 37.5 | 123.03 | 16 | | |
| 38.0 | 124.67 | 17 | | |
| 38.5 | 126.31 | 18 | | |
| 39.0 | 127.95 | 19 | | |
| 39.5 | 129.59 | 20 | | |
| 40.0 | 131.23 | 21 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3001 DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 5 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 40.5 | 132.87 | 22 | | |
| 41.0 | 134.51 | 23 | | |
| 41.5 | 136.15 | 24 | | |
| 42.0 | 137.80 | 25 | | |
| 42.5 | 139.44 | 26 | | |
| 43.0 | 141.08 | 27 | | |
| 43.5 | 142.72 | 28 | | |
| 44.0 | 144.36 | 29 | | |
| 44.5 | 146.00 | 30 | | |
| 45.0 | 147.64 | 31 | | |
| 45.5 | 149.28 | 32 | | |
| 46.0 | 150.92 | 33 | | |
| 46.5 | 152.56 | 34 | | |
| 47.0 | 154.20 | 35 | | |
| 47.5 | 155.84 | 36 | | |
| 48.0 | 157.48 | 37 | | |
| 48.5 | 159.12 | 38 | | |
| 49.0 | 160.76 | 39 | | |
| 49.5 | 162.40 | 40 | | |
| 50.0 | 164.04 | 41 | | |
| 50.5 | 165.68 | 42 | | |
| 51.0 | 167.32 | 43 | | |
| 51.5 | 168.96 | 44 | | |
| 52.0 | 170.60 | 45 | | |
| 52.5 | 172.24 | 46 | | |
| 53.0 | 173.88 | 47 | | |
| 53.5 | 175.52 | 48 | | |
| 54.0 | 177.17 | 49 | | |
| 54.5 | 178.81 | 50 | | |
| 55.0 | 180.45 | 51 | | |
| 55.5 | 182.09 | 52 | | |
| 56.0 | 183.73 | 53 | | |
| 56.5 | 185.37 | 54 | | |
| 57.0 | 187.01 | 55 | | |
| 57.5 | 188.65 | 56 | | |
| 58.0 | 190.29 | 57 | | |
| 58.5 | 191.93 | 58 | | |
| 59.0 | 193.57 | 59 | | |
| 59.5 | 195.21 | 60 | | |
| 60.0 | 196.85 | 61 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3001 DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 6 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 60.5 | 198.49 | 62 | | |
| 61.0 | 200.13 | 63 | | |
| 61.5 | 201.77 | 64 | | |
| 62.0 | 203.41 | 65 | | |
| 62.5 | 205.05 | 66 | | |
| 63.0 | 206.69 | 67 | | |
| 63.5 | 208.33 | 68 | | |
| 64.0 | 209.97 | 69 | | |
| 64.5 | 211.61 | 70 | | |
| 65.0 | 213.25 | 71 | | |
| 65.5 | 214.90 | 72 | | |
| 66.0 | 216.54 | 73 | | |
| 66.5 | 218.18 | 74 | | |
| 67.0 | 219.82 | 75 | | |
| 67.5 | 221.46 | 76 | | |
| 68.0 | 223.10 | 77 | | |
| 68.5 | 224.74 | 78 | | |
| 69.0 | 226.38 | 79 | | |
| 69.5 | 228.02 | 80 | | |
| 70.0 | 229.66 | 81 | | |
| 70.5 | 231.30 | 82 | | |
| 71.0 | 232.94 | 83 | | |
| 71.5 | 234.58 | 84 | HTR @ 71.7 m. | BOTTOM MEASUREMENT! |
| 72.0 | 236.22 | 85 | | DO NOT USE #85 OR #86. |
| 72.5 | 237.86 | 86 | | |
| 73.0 | 239.50 | | | |
| 73.5 | 241.14 | | | |
| 74.0 | 242.78 | | | |
| 74.5 | 244.42 | | | |
| 75.0 | 246.06 | | | |
| 75.5 | 247.70 | | | HOLE OBSTRUCTED @ 248' END. |
| 76.0 | 249.34 | | | |
| 76.5 | 250.98 | | | |
| 77.0 | 252.62 | | | |
| 77.5 | 254.27 | | | |
| 78.0 | 255.91 | | | |
| 78.5 | 257.55 | | | |
| 79.0 | 259.19 | | | |
| 79.5 | 260.83 | | | |
| 80.0 | 262.47 | | | |

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# B-3001 CALIPER FIELD LOG

SITE: VOGTLE COL DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 420' 6" STEEL
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE:
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: 070' TIME SINCE LAST CIRCULATION: ~1.5 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:20
ARRIVED ON SITE: 08:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 16:43 LOGGING COMPLETED: 17:28

*GEOVision Geophysical Services* *1151 Pomona Road, Unit P, Corona, CA 92882* *Ph (951) 549-1234 Fx (951) 549-1236*

SITE:_VOGTLE COL B-3001 DATE: 2/12/07
CLIENT:_MACTEC JOB:_6517
AUTHOR:_R. STELLER PAGE 2 OF 2

WINCH: COMPROBE_____ SILVER ✓ OYO_____ OTHER_____
MICROLOGGER 5310 ~~5301~~ ✓ 5772_____ OTHER_____
CALIPER PROBE 5368 ✓ OTHER_____

| | | |
|---|---|---|
| PROBE OFFSET | 2.08M(6.82 FT) 12 IN MAX | |
| MINUS CASING STICK-UP | -2.3' | |
| DEPTH REF. OFFSET AT START | 4.52' | |
| DEPTH REF. OFFSET AT END | 4.50' | |
| AFTER SURVEY DEPTH ERROR | -0.02' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3001 CALTEST 01 | Ø | 16:43 | Ø | 16:46 |
| B3001 CALUP 01 | 245.0 | 16:55 | Ø | 17:22 |
| B3001 CALTEST 02 | 0 | 17:23 | Ø | 17:28 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| CALIBRATION PLATE S/N 201 | | AS BUILT | | | PVC FITTING |
|---|---|---|---|---|---|
| | | 1.968 IN | 3.937 IN | 8.000 IN | 4.507 IN |
| | FILE NAME | (50 MM) | (100 MM) | (203.2 MM) | (114.3 MM) |
| AS MEAS. | B3001 CALTEST 01 | 1.97 | 3.94 | 8.00 | 4.50 |
| AS MEAS. | B3001 CALTEST 02 | 1.97 | 3.92 | 8.00 | 4.51 |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |

MAINTENANCE PERFORMED ON SITE:_____

EQUIPMENT PROBLEMS OR FAILURES:_____

SUGGESTIONS, ADDITIONS, CHANGES:_____

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# B-3001 ACOUSTIC TELEVIEWER FIELD LOG

SITE: VOGTLE COL B-3001 DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 420'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈2.5 Hr

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SITE: VOGTLE COL B-3001 DATE: 2/12/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:20
ARRIVED ON SITE: 08:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 17:52 LOGGING COMPLETED: 18:12

WINCH: COMPROBE ___ SILVER ✓ OYO ___ OTHER ___
MICROLOGGER 5310 ~~5301~~ ✓ 5772 ___
TELEVIEWER ACOUSTIC #5174 ✓ OTHER ___

PROBE TILT TEST 91.1° BRUNTON TILT 91°
PROBE TILT TEST 68.3° BRUNTON TILT 67°
PROBE TILT TEST 30.4° BRUNTON TILT 26° AFTER LOG
PROBE AZIMUTH TEST 4.60° BRUNTON AZIMUTH 1°
PROBE AZIMUTH TEST 303.8° BRUNTON AZIMUTH 304
PROBE AZIMUTH TEST 24.60° BRUNTON AZIMUTH 20° AFTER LOG

| | | |
|---|---|---|
| PROBE OFFSET | 1.44M(4.72FT) | |
| MINUS CASING STICK-UP | 2.3 | |
| DEPTH REF. OFFSET AT START | 2.42' | |
| DEPTH REF. OFFSET AT END | 2.52 | |
| AFTER SURVEY DEPTH ERROR | +0.1' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3001AuuP01 | 247.0 | 17:52 | ∅ | 18:12 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

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# B-3001 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL CONTACT: MATT COOKE
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 420'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 275' (4" STEEL); NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈1 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 08:20
ARRIVED ON SITE: 09:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 13:38 LOGGING COMPLETED: 14:44

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SITE: VOGTLE COL B - 3001 DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER 5310 ~~5301~~ ✓ 5772 ____ OTHER ____
ELOG PROBE 5490 ✓ OTHER ____

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | +32.8' | |
| MINUS CASING STICK-UP | -2.3 | |
| DEPTH REF. OFFSET AT START | 38.7' | |
| DEPTH REF. OFFSET AT END | 38.5' | |
| AFTER SURVEY DEPTH ERROR | -0.2' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3001ELOG TEST02 | Ø | 13:38 | Ø | 13:41 |
| B3001 ELOG UP02 | 405.0 | 13:56 | 240.0' | 14:21 |
| B3001 ELOG UP03 | 405.0 | 14:26 | 240.0' | 14:44 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: Hung @ 315 ↑

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# P-S SUSPENSION VELOCITY FIELD LOG

SITE: VOGTLE COL B-3001 DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 5

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420 ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 420'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 275' (4" STEEL); NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈24 HR

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SITE: VOGTLE COL B-3001 DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 5

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 08:00
ARRIVED ON SITE: 09:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 15:09 LOGGING COMPLETED: 15:47
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES ____; NO ✓; STORED WITH NEW ____

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WINCH | COMPROBE ☐ | | GREY ☐ | OYO ☐ | RG ☐ | OTH ☑ | | |
| INSTRUMENT | OYO 12004 ☐ | 15014 ☐ | 19029 ☐ | | RG 160023 ☐ | 160024 ☑ | | |
| RECEIVER S/N | 12008 ☐ | 20042 ☐ | 26066 ☐ | 11001 ☐ | 23053 ☐ | 30086 ☑ | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: DEPTH ZERO = 2.5m - .71m = 1.79m
EXM ZERO = 1.78m

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# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3001 DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 3 OF 5

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 80.5 | 264.11 | | | |
| 81.0 | 265.75 | | | |
| 81.5 | 267.39 | | | |
| 82.0 | 269.03 | | | |
| 82.5 | 270.67 | | | |
| 83.0 | 272.31 | | | |
| 83.5 | 273.95 | | | |
| 84.0 | 275.59 | | | STEEL CASE TO 275' |
| 84.5 | 277.23 | 188 | | |
| 85.0 | 278.87 | 189 | | |
| 85.5 | 280.51 | 190 | | |
| 86.0 | 282.15 | 191 | | |
| 86.5 | 283.79 | 192 | | |
| 87.0 | 285.43 | 193 | | |
| 87.5 | 287.07 | 194 | | |
| 88.0 | 288.71 | 195 | | |
| 88.5 | 290.35 | 196 | | |
| 89.0 | 291.99 | 197 | | |
| 89.5 | 293.64 | 198 | | |
| 90.0 | 295.28 | 199 | | |
| 90.5 | 296.92 | 200 | | |
| 91.0 | 298.56 | 201 | | |
| 91.5 | 300.20 | 202 | | |
| 92.0 | 301.84 | 203 | | |
| 92.5 | 303.48 | 204 | | |
| 93.0 | 305.12 | 205 | | |
| 93.5 | 306.76 | 206 | | |
| 94.0 | 308.40 | 207 | | |
| 94.5 | 310.04 | 208 | | |
| 95.0 | 311.68 | 209 | | |
| 95.5 | 313.32 | 210 | | |
| 96.0 | 314.96 | 211 | | |
| 96.5 | 316.60 | 212 | | |
| 97.0 | 318.24 | 213 | | |
| 97.5 | 319.88 | 214 | | |
| 98.0 | 321.52 | 215 | | |
| 98.5 | 323.16 | 216 | | |
| 99.0 | 324.80 | 217 | | |
| 99.5 | 326.44 | 218 | | |
| 100.0 | 328.08 | 219 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3001 DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 4 OF 5

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 100.5 | 329.72 | 220 | | |
| 101.0 | 331.36 | 221 | | |
| 101.5 | 333.01 | 222 | | |
| 102.0 | 334.65 | 223 | | |
| 102.5 | 336.29 | 224 | | |
| 103.0 | 337.93 | 225 | | |
| 103.5 | 339.57 | 226 | | |
| 104.0 | 341.21 | 227 | | |
| 104.5 | 342.85 | 228 | | |
| 105.0 | 344.49 | 229 | | |
| 105.5 | 346.13 | 230 | | |
| 106.0 | 347.77 | 231 | | |
| 106.5 | 349.41 | 232 | | |
| 107.0 | 351.05 | 233 | | |
| 107.5 | 352.69 | 234 | | |
| 108.0 | 354.33 | 235 | | |
| 108.5 | 355.97 | 236 | | |
| 109.0 | 357.61 | 237 | | |
| 109.5 | 359.25 | 238 | | |
| 110.0 | 360.89 | 239 | | |
| 110.5 | 362.53 | 240 | | |
| 111.0 | 364.17 | 241 | | |
| 111.5 | 365.81 | 242 | | |
| 112.0 | 367.45 | 243 | | |
| 112.5 | 369.09 | 244 | | |
| 113.0 | 370.73 | 245 | | |
| 113.5 | 372.38 | 246 | | |
| 114.0 | 374.02 | 247 | | |
| 114.5 | 375.66 | 248 | | |
| 115.0 | 377.30 | 249 | | |
| 115.5 | 378.94 | 250 | | |
| 116.0 | 380.58 | 251 | | |
| 116.5 | 382.22 | 252 | | |
| 117.0 | 383.86 | 253 | | |
| 117.5 | 385.50 | 254 | | |
| 118.0 | 387.14 | 255 | | |
| 118.5 | 388.78 | 256 | | |
| 119.0 | 390.42 | 257 | | |
| 119.5 | 392.06 | | | BOTTOM MEASUREMENT ? |
| 120.0 | 393.70 | | | HIT @ 119.4 m |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL DATE:
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 5 OF 5

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 120.5 | 395.34 | | | |
| 121.0 | 396.98 | | | |
| 121.5 | 398.62 | | | |
| 122.0 | 400.26 | | | |
| 122.5 | 401.90 | | | |
| 123.0 | 403.54 | | | ELOG OBSTRUCTED @ 405' |
| 123.5 | 405.18 | | | |
| 124.0 | 406.82 | | | |
| 124.5 | 408.46 | | | |
| 125.0 | 410.10 | | | |
| 125.5 | 411.75 | | | |
| 126.0 | 413.39 | | | |
| 126.5 | 415.03 | | | |
| 127.0 | 416.67 | | | |
| 127.5 | 418.31 | | | |
| 128.0 | 419.95 | | | |
| 128.5 | 421.59 | | | |
| 129.0 | 423.23 | | | |
| 129.5 | 424.87 | | | |
| 130.0 | 426.51 | | | |
| 130.5 | 428.15 | | | |
| 131.0 | 429.79 | | | |
| 131.5 | 431.43 | | | |
| 132.0 | 433.07 | | | |
| 132.5 | 434.71 | | | |
| 133.0 | 436.35 | | | |
| 133.5 | 437.99 | | | |
| 134.0 | 439.63 | | | |
| 134.5 | 441.27 | | | |
| 135.0 | 442.91 | | | |
| 135.5 | 444.55 | | | |
| 136.0 | 446.19 | | | |
| 136.5 | 447.83 | | | |
| 137.0 | 449.48 | | | |
| 137.5 | 451.12 | | | |
| 138.0 | 452.76 | | | |
| 138.5 | 454.40 | | | |
| 139.0 | 456.04 | | | |
| 139.5 | 457.68 | | | |
| 140.0 | 459.32 | | | |

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# B-3001 CALIPER FIELD LOG

SITE: VOGTLE COL DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 420'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 275' ; NO 4" STEEL
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈3 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 08:20
ARRIVED ON SITE: 09:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 16:06 LOGGING COMPLETED: 16:48

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SITE: VOGTLE COL B-3001 DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER 5310 ~~5304~~ ____ 5772 ____ OTHER ____
CALIPER PROBE 5368 ✓ OTHER ____

| | | |
|---|---|---|
| PROBE OFFSET | 2.08M(6.82 FT) 12 IN MAX | |
| MINUS CASING STICK-UP | 2.3 | |
| DEPTH REF. OFFSET AT START | 4.52' | |
| DEPTH REF. OFFSET AT END | 4.50 | |
| AFTER SURVEY DEPTH ERROR | -0.02 | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3001CALTEST03 | Ø | 16:06 | Ø | 16:09 |
| B3001CALUP02 | 400.0' | 16:20 | 240.0' | 16:37 |
| B3001CALTEST04 | Ø | 16:45 | Ø | 16:48 |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |

CALIBRATION PLATE S/N 201

| | | AS BUILT | | | PVC FITTING |
|---|---|---|---|---|---|
| | | 1.968 IN | 3.937 IN | 8.000 IN | 4.507 IN |
| | FILE NAME | (50 MM) | (100 MM) | (203.2 MM) | (114.3 MM) |
| AS MEAS. | B3001CALTEST03 | 1.97 | 3.96 | 8.02 | 4.49 |
| AS MEAS. | B3001CALTEST04 | 1.96 | 3.93 | 8.00 | 4.50 |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# B-3001 ACOUSTIC TELEVIEWER FIELD LOG

SITE: VOGTLE COL DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 420' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 420'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 275' ; NO ____ 4" STEEL
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈ 70'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈ 70' TIME SINCE LAST CIRCULATION: ≈ 4 HR

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SITE: VOGTLE COL B-3001 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 08:20
ARRIVED ON SITE: ~~08:~~ 09:00 RAS 2/15/07
STANDBY TIME: CAUSE:
LOGGING STARTED: 17:07 LOGGING COMPLETED: 17:18

WINCH: COMPROBE ___ SILVER ✓ OYO ___ OTHER ___
MICROLOGGER 5310 ~~5301~~ ✓ 5772 ___
TELEVIEWER ACOUSTIC #5174 ✓ OTHER ___

PROBE TILT TEST 90.5° BRUNTON TILT 90°
PROBE TILT TEST 13.5° BRUNTON TILT 14°
PROBE TILT TEST 0.6° BRUNTON TILT 0° AFTER LOG
PROBE AZIMUTH TEST 2.3° BRUNTON AZIMUTH 0°
PROBE AZIMUTH TEST 250.0 BRUNTON AZIMUTH 257°
PROBE AZIMUTH TEST 177.2° BRUNTON AZIMUTH 180° AFTER LOG

| | | |
|---|---|---|
| PROBE OFFSET | 1.44M(4.72FT) | |
| MINUS CASING STICK-UP | 2.3 | |
| DEPTH REF. OFFSET AT START | 2.42' | |
| DEPTH REF. OFFSET AT END | 2.22' | |
| AFTER SURVEY DEPTH ERROR | -0.2' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3001 AMUP 02 | 402.0' | 17:07 | 240.0' | 17:18 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

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# B-3002 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL ____ PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250' 6" STEEL
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 95.5' ; NO ____
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B3002ELOGTEST01 | ϕ | 2/15/07 | 08:50 - 08:53 |
| ELOG/GAMMA | B3002ELOGUP01 | 248.0 - 25.0' | " | 09:20 - 09:43 |
| ELOG/GAMMA | B3002ELOGUP01 | 248.0 - 25.0' | " | 09:49 - 10:12 |
| SUSPENSION PS | B302_001→086.ORG | 96.8 - 236.2' | " | 10:25 - 11:04 |
| CALIPER TEST | B3002CALTEST01 | ϕ | " | 11:20 - 11:23 |
| CALIPER/GAMMA | B3002CALUP01 | 245.0 - ϕ' | " | 11:34 - 12:00 |
| CALIPER TEST | B3002CALTEST02 | ϕ | " | 12:05 - 12:08 |
| DEVIATION | B3002ALLUP01 | 246.0 - ϕ | " | 12:23 - 12:36 |
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# B-3002 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE _OFFICE__ PHONE:
_CELL___ CONTACT: MATT COOKE
CONTACT: _OFFICE__ PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3002 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED___ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 95.5' ; NO___ 6" STEEL.
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE:
BOREHOLE FLUID: WATER___; FRESH WATER MUD ✓; SALT WATER MUD ___;
OTHER:
DEPTH TO BOREHOLE FLUID: TIME SINCE LAST CIRCULATION: 1/2 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 08:50 LOGGING COMPLETED: 10:12

*GEOVision Geophysical Services* *1151 Pomona Road, Unit P, Corona, CA 92882* *Ph (951) 549-1234 Fx (951) 549-1236*

SITE: VOGTLE COL B-3002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER ~~5310~~ ~~5301~~ ✓ 5772 ____ OTHER ____
ELOG PROBE 5490 ✓ OTHER ____

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | + 32.8 | |
| MINUS CASING STICK-UP | - 1.5' | |
| DEPTH REF. OFFSET AT START | 39.5' | |
| DEPTH REF. OFFSET AT END | 39.45' | |
| AFTER SURVEY DEPTH ERROR | -0.05 | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3002ELOG TEST01 | Ø | 08:50 | Ø | 08:53 |
| B3002ELOG.UP01 | 248.0' | 09:20 | 25.0' | 09:43 |
| B3002ELOG.UP02 | 248.0' | 09:49 | 25.0' | 10:12 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# P-S SUSPENSION VELOCITY FIELD LOG

SITE: VOGTLE COL B-3002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 6

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3002 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250' 6" STEEL
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 95.5'; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER; FRESH WATER MUD ✓; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈2HR

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SITE: VOGTLE COL B-3002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 6

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 10:25 LOGGING COMPLETED: 11:04
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES ____; NO ✓; STORED WITH NEW ____

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WINCH | COMPROBE ☐ | | GREY ☐ | OYO ☐ | RG ☐ | OTH ☑ | | |
| INSTRUMENT | OYO 12004 ☐ | 15014 ☐ | 19029 ☐ | | RG 160023 ☐ | 160024 ☑ | | |
| RECEIVER S/N | 12008 ☐ | 20042 ☐ | 26066 ☐ | 11001 ☐ | 23053 ☐ | 30086 ☑ | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: DEPTH ZERO @ 2.5m - 0.5m = 2.0m
" " @ EXIT = 2.0 m

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# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 3 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 0.5 | 1.64 | | | |
| 1.0 | 3.28 | | | |
| 1.5 | 4.92 | | | |
| 2.0 | 6.56 | | | |
| 2.5 | 8.20 | | | |
| 3.0 | 9.84 | | | |
| 3.5 | 11.48 | | | |
| 4.0 | 13.12 | | | |
| 4.5 | 14.76 | | | |
| 5.0 | 16.40 | | | |
| 5.5 | 18.04 | | | |
| 6.0 | 19.69 | | | |
| 6.5 | 21.33 | | | |
| 7.0 | 22.97 | | | |
| 7.5 | 24.61 | | | |
| 8.0 | 26.25 | | | |
| 8.5 | 27.89 | | | |
| 9.0 | 29.53 | | | |
| 9.5 | 31.17 | | | |
| 10.0 | 32.81 | | | |
| 10.5 | 34.45 | | | |
| 11.0 | 36.09 | | | |
| 11.5 | 37.73 | | | |
| 12.0 | 39.37 | | | |
| 12.5 | 41.01 | | | |
| 13.0 | 42.65 | | | |
| 13.5 | 44.29 | | | |
| 14.0 | 45.93 | | | |
| 14.5 | 47.57 | | | |
| 15.0 | 49.21 | | | |
| 15.5 | 50.85 | | | |
| 16.0 | 52.49 | | | |
| 16.5 | 54.13 | | | |
| 17.0 | 55.77 | | | |
| 17.5 | 57.41 | | | |
| 18.0 | 59.06 | | | |
| 18.5 | 60.70 | | | |
| 19.0 | 62.34 | | | |
| 19.5 | 63.98 | | | |
| 20.0 | 65.62 | | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 4 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 20.5 | 67.26 | | | |
| 21.0 | 68.90 | | | |
| 21.5 | 70.54 | | | |
| 22.0 | 72.18 | | | |
| 22.5 | 73.82 | | | |
| 23.0 | 75.46 | | | |
| 23.5 | 77.10 | | | |
| 24.0 | 78.74 | | | |
| 24.5 | 80.38 | | | |
| 25.0 | 82.02 | | | |
| 25.5 | 83.66 | | | |
| 26.0 | 85.30 | | | |
| 26.5 | 86.94 | | | |
| 27.0 | 88.58 | | | |
| 27.5 | 90.22 | | | |
| 28.0 | 91.86 | | | |
| 28.5 | 93.50 | | | |
| 29.0 | 95.14 | | | |
| 29.5 | 96.78 | 1 | | STEEL CASING TO 95.5' |
| 30.0 | 98.43 | 2 | | |
| 30.5 | 100.07 | 3 | | |
| 31.0 | 101.71 | 4 | | |
| 31.5 | 103.35 | 5 | | |
| 32.0 | 104.99 | 6 | | |
| 32.5 | 106.63 | 7 | | |
| 33.0 | 108.27 | 8 | | |
| 33.5 | 109.91 | 9 | | |
| 34.0 | 111.55 | 10 | | |
| 34.5 | 113.19 | 11 | | |
| 35.0 | 114.83 | 12 | | |
| 35.5 | 116.47 | 13 | | |
| 36.0 | 118.11 | 14 | | |
| 36.5 | 119.75 | 15 | | |
| 37.0 | 121.39 | 16 | | |
| 37.5 | 123.03 | 17 | | |
| 38.0 | 124.67 | 18 | | |
| 38.5 | 126.31 | 19 | | |
| 39.0 | 127.95 | 20 | | |
| 39.5 | 129.59 | 21 | | |
| 40.0 | 131.23 | 22 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3002 DATE: 2/15/02
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 5 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 40.5 | 132.87 | 23 | | |
| 41.0 | 134.51 | 24 | | |
| 41.5 | 136.15 | 25 | | |
| 42.0 | 137.80 | 26 | | |
| 42.5 | 139.44 | 27 | | |
| 43.0 | 141.08 | 28 | | |
| 43.5 | 142.72 | 29 | | |
| 44.0 | 144.36 | 30 | | |
| 44.5 | 146.00 | 31 | | |
| 45.0 | 147.64 | 32 | | |
| 45.5 | 149.28 | 33 | | |
| 46.0 | 150.92 | 34 | | |
| 46.5 | 152.56 | 35 | | |
| 47.0 | 154.20 | 36 | | |
| 47.5 | 155.84 | 37 | | |
| 48.0 | 157.48 | 38 | | |
| 48.5 | 159.12 | 39 | | |
| 49.0 | 160.76 | 40 | | |
| 49.5 | 162.40 | 41 | | |
| 50.0 | 164.04 | 42 | | |
| 50.5 | 165.68 | 43 | | |
| 51.0 | 167.32 | 44 | | |
| 51.5 | 168.96 | 45 | | |
| 52.0 | 170.60 | 46 | | |
| 52.5 | 172.24 | 47 | | |
| 53.0 | 173.88 | 48 | | |
| 53.5 | 175.52 | 49 | | |
| 54.0 | 177.17 | 50 | | |
| 54.5 | 178.81 | 51 | | |
| 55.0 | 180.45 | 52 | | |
| 55.5 | 182.09 | 53 | | |
| 56.0 | 183.73 | 54 | | |
| 56.5 | 185.37 | 55 | | |
| 57.0 | 187.01 | 56 | | |
| 57.5 | 188.65 | 57 | | |
| 58.0 | 190.29 | 58 | | |
| 58.5 | 191.93 | 59 | | |
| 59.0 | 193.57 | 60 | | |
| 59.5 | 195.21 | 61 | | |
| 60.0 | 196.85 | 62 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 6 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 60.5 | 198.49 | 63 | | |
| 61.0 | 200.13 | 64 | | |
| 61.5 | 201.77 | 65 | | |
| 62.0 | 203.41 | 66 | | |
| 62.5 | 205.05 | 67 | | |
| 63.0 | 206.69 | 68 | | |
| 63.5 | 208.33 | 69 | | |
| 64.0 | 209.97 | 70 | | |
| 64.5 | 211.61 | 71 | | |
| 65.0 | 213.25 | 72 | | |
| 65.5 | 214.90 | 73 | | |
| 66.0 | 216.54 | 74 | | |
| 66.5 | 218.18 | 75 | | |
| 67.0 | 219.82 | 76 | | |
| 67.5 | 221.46 | 77 | | |
| 68.0 | 223.10 | 78 | | |
| 68.5 | 224.74 | 79 | | |
| 69.0 | 226.38 | 80 | | |
| 69.5 | 228.02 | 81 | | |
| 70.0 | 229.66 | 82 | | |
| 70.5 | 231.30 | 83 | | |
| 71.0 | 232.94 | 84 | | |
| 71.5 | 234.58 | 85 | | |
| 72.0 | 236.22 | 86 | | HIT BOTTOM @ ~~8~~ 72.0 m |
| 72.5 | 237.86 | | | BOTTOM MEASUREMENT? |
| 73.0 | 239.50 | | | DO NOT USE # 86. |
| 73.5 | 241.14 | | | |
| 74.0 | 242.78 | | | |
| 74.5 | 244.42 | | | |
| 75.0 | 246.06 | | | |
| 75.5 | 247.70 | | | |
| 76.0 | 249.34 | | | |
| 76.5 | 250.98 | | | T.D. @ 250' |
| 77.0 | 252.62 | | | |
| 77.5 | 254.27 | | | |
| 78.0 | 255.91 | | | |
| 78.5 | 257.55 | | | |
| 79.0 | 259.19 | | | |
| 79.5 | 260.83 | | | |
| 80.0 | 262.47 | | | |

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# B-3002 CALIPER FIELD LOG

SITE: VOGTLE COL DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3002 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 95.5' (6" STEEL); NO ____
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈3HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 11:20 LOGGING COMPLETED: 12:08

*GEOVision Geophysical Services* *1151 Pomona Road, Unit P, Corona, CA 92882* *Ph (951) 549-1234 Fx (951) 549-1236*

SITE: VOGTLE COL B-3002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER 5316 ~~5301~~ ✓ 5772 ____ OTHER ____
CALIPER PROBE 5368 ✓ OTHER ____

| | | |
|---|---|---|
| PROBE OFFSET | 2.08M(6.82 FT) 12 IN MAX | |
| MINUS CASING STICK-UP | -1.5 | |
| DEPTH REF. OFFSET AT START | 5.32' | |
| DEPTH REF. OFFSET AT END | 5.30' | |
| AFTER SURVEY DEPTH ERROR | ____ | LESS THAN 0.4%? |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3002CALTEST01 | Ø | 11:20 | Ø | 11:23 |
| B3002 CALUP01 | 245.0' | 11:34 | Ø | 12:00 |
| B3002 CALTEST02 | Ø | 12:05 | Ø | 12:08 |
| | | | | |
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| | | | | |
| | | | | |
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CALIBRATION PLATE S/N 201

| | | AS BUILT | | | PVC FITTING |
|---|---|---|---|---|---|
| | | 1.968 IN | 3.937 IN | 8.000 IN | 4.507 IN |
| | FILE NAME | (50 MM) | (100 MM) | (203.2 MM) | (114.3 MM) |
| AS MEAS. | B3002CALTEST01 | 1.99 | 3.96 | 7.97 | 4.49 |
| AS MEAS. | B3002 CALTEST02 | 1.98 | 3.93 | 7.99 | 4.51 |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# B-3002 ACOUSTIC TELEVIEWER FIELD LOG

SITE: VOGTLE COL DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3002 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 95.5 ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈ 4HR

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SITE: VOGTLE COL B-3002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME:
ARRIVED ON SITE:
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
RAS 2/15/07

WINCH: COMPROBE ✓ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER 5310 ~~5304~~ ✓ 5772 ____
TELEVIEWER ACOUSTIC #5174 ✓ OTHER ____

PROBE TILT TEST 88.6° BRUNTON TILT 89°
PROBE TILT TEST 16.1° BRUNTON TILT 15°
PROBE TILT TEST 0.6° BRUNTON TILT 0°
PROBE AZIMUTH TEST 351.9° BRUNTON AZIMUTH 350°
PROBE AZIMUTH TEST 224.4° BRUNTON AZIMUTH 227°
PROBE AZIMUTH TEST 353.6 BRUNTON AZIMUTH 350°

| | | |
|---|---|---|
| PROBE OFFSET | 1.44M(4.72FT) | |
| MINUS CASING STICK-UP | 1.5' | |
| DEPTH REF. OFFSET AT START | 3.22' | |
| DEPTH REF. OFFSET AT END | 3.20 | |
| AFTER SURVEY DEPTH ERROR | -0.02 | LESS THAN 0.4%? YES. |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3002AunP01 | 246.0' | 12:23 | Ø | 12:36 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE: 4π Bottom @ 248.5'

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

*GEOVision Geophysical Services* *1151 Pomona Road, Unit P, Corona, CA 92882* *Ph (951) 549-1234 Fx (951) 549-1236*

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# B-3003 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL: PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97' ; NO ____
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓ ; SALT WATER MUD ____;

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B3003 ELOGTEST01 | Ø | 2/16/07 | 09:02 - 09:05 |
| ELOG/GAMMA | B3003 ELOGUP01 | 249.0 - 20.0' | " | 11:03 - 11:26 |
| SUSPENSION PS | B303_001 → 005.026 | 98.4 - 236.2 | " | 11:45 - 12:30 |
| CALIPER TEST | B3003CALTEST01 | Ø | " | 12:49 - 12:52 |
| CALIPER/GAMMA | B3003CALUP01 | 245.0 - Ø | " | 13:02 - 13:27 |
| CALIPER TEST | B3003CALTEST02 | Ø | " | 13:39 - 13:42 |
| DEVIATION | B3003 DEVUP01 | 248.0 - Ø | " | 14:00 - 14:12 |
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# B-3003 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL CONTACT: MATT COOKE
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3003 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: ~~250'~~ 6" 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97' ; NO 6" STEEL
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ~70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ~20' TIME SINCE LAST CIRCULATION: ½ HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 9:02 LOGGING COMPLETED: 11:26

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SITE:_VOGTLE COL B-3003 DATE: 2/16/07
CLIENT:_MACTEC JOB:_6517
AUTHOR:_R. STELLER PAGE 2 OF 2

WINCH: COMPROBE_____ SILVER ✓ OYO_____ OTHER_____
MICROLOGGER 5310 ~~5301~~ ✓ 5772_____ OTHER_____
ELOG PROBE 5490 ✓ OTHER_____

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | 32.8 | |
| MINUS CASING STICK-UP | -1.5 | |
| DEPTH REF. OFFSET AT START | 39.5' | |
| DEPTH REF. OFFSET AT END | 39.4' | |
| AFTER SURVEY DEPTH ERROR | -0.1' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3003ELOGTEST01 | Ø | 9:02 | Ø | 9:05 |
| B3003ELOG01 | 209.0 | 11:03 | 20.0' | 11:26 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE:_____

EQUIPMENT PROBLEMS OR FAILURES:_____

SUGGESTIONS, ADDITIONS, CHANGES:_____

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# P-S SUSPENSION VELOCITY FIELD LOG

SITE: VOGTLE COL B-3003 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 0

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3003 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97' ; NO ____ 6" STEEL
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ~70'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈ 20' TIME SINCE LAST CIRCULATION: ~1 HR

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SITE: VOGTLE COL B-3003 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 6

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 11:45 LOGGING COMPLETED: 12:30
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES ____; NO ✓; STORED WITH NEW ____

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WINCH | COMPROBE ☐ | | GREY ☐ | OYO ☐ | RG ☐ | OTH ☑ | | |
| INSTRUMENT | OYO 12004 ☐ | 15014 ☐ | 19029 ☐ | | RG 160023 ☐ | 160024 ☑ | | |
| RECEIVER S/N | 12008 ☐ | 20042 ☐ | 26066 ☐ | 11001 ☐ | 23053 ☐ | 30086 ☑ | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: DEPTH ZERO = 2.5 m − 0.5 m = 2.00 m
EXIT ZERO = 2.01 m.

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# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3003 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 3 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 0.5 | 1.64 | | | |
| 1.0 | 3.28 | | | |
| 1.5 | 4.92 | | | |
| 2.0 | 6.56 | | | |
| 2.5 | 8.20 | | | |
| 3.0 | 9.84 | | | |
| 3.5 | 11.48 | | | |
| 4.0 | 13.12 | | | |
| 4.5 | 14.76 | | | |
| 5.0 | 16.40 | | | |
| 5.5 | 18.04 | | | |
| 6.0 | 19.69 | | | |
| 6.5 | 21.33 | | | |
| 7.0 | 22.97 | | | |
| 7.5 | 24.61 | | | |
| 8.0 | 26.25 | | | |
| 8.5 | 27.89 | | | |
| 9.0 | 29.53 | | | |
| 9.5 | 31.17 | | | |
| 10.0 | 32.81 | | | |
| 10.5 | 34.45 | | | |
| 11.0 | 36.09 | | | |
| 11.5 | 37.73 | | | |
| 12.0 | 39.37 | | | |
| 12.5 | 41.01 | | | |
| 13.0 | 42.65 | | | |
| 13.5 | 44.29 | | | |
| 14.0 | 45.93 | | | |
| 14.5 | 47.57 | | | |
| 15.0 | 49.21 | | | |
| 15.5 | 50.85 | | | |
| 16.0 | 52.49 | | | |
| 16.5 | 54.13 | | | |
| 17.0 | 55.77 | | | |
| 17.5 | 57.41 | | | |
| 18.0 | 59.06 | | | |
| 18.5 | 60.70 | | | |
| 19.0 | 62.34 | | | |
| 19.5 | 63.98 | | | |
| 20.0 | 65.62 | | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3003 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 4 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 20.5 | 67.26 | | | |
| 21.0 | 68.90 | | | |
| 21.5 | 70.54 | | | |
| 22.0 | 72.18 | | | |
| 22.5 | 73.82 | | | |
| 23.0 | 75.46 | | | |
| 23.5 | 77.10 | | | |
| 24.0 | 78.74 | | | |
| 24.5 | 80.38 | | | |
| 25.0 | 82.02 | | | |
| 25.5 | 83.66 | | | |
| 26.0 | 85.30 | | | |
| 26.5 | 86.94 | | | |
| 27.0 | 88.58 | | | |
| 27.5 | 90.22 | | | |
| 28.0 | 91.86 | | | |
| 28.5 | 93.50 | | | |
| 29.0 | 95.14 | | | |
| 29.5 | 96.78 | | | STEEL CASING |
| 30.0 | 98.43 | 001 | | |
| 30.5 | 100.07 | 2 | | |
| 31.0 | 101.71 | 3 | | |
| 31.5 | 103.35 | 4 | | |
| 32.0 | 104.99 | 5 | | |
| 32.5 | 106.63 | 6 | | |
| 33.0 | 108.27 | 7 | | |
| 33.5 | 109.91 | 8 | | |
| 34.0 | 111.55 | 9 | | |
| 34.5 | 113.19 | 10 | | |
| 35.0 | 114.83 | 11 | | |
| 35.5 | 116.47 | 12 | | |
| 36.0 | 118.11 | 13 | | |
| 36.5 | 119.75 | 14 | | |
| 37.0 | 121.39 | 15 | | |
| 37.5 | 123.03 | 16 | | |
| 38.0 | 124.67 | 17 | | |
| 38.5 | 126.31 | 18 | | |
| 39.0 | 127.95 | 19 | | |
| 39.5 | 129.59 | 20 | | |
| 40.0 | 131.23 | 21 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3003 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 5 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 40.5 | 132.87 | 22 | | |
| 41.0 | 134.51 | 23 | | |
| 41.5 | 136.15 | 24 | | |
| 42.0 | 137.80 | 25 | | |
| 42.5 | 139.44 | 26 | | |
| 43.0 | 141.08 | 27 | | |
| 43.5 | 142.72 | 28 | | |
| 44.0 | 144.36 | 29 | | |
| 44.5 | 146.00 | 30 | | |
| 45.0 | 147.64 | 31 | | |
| 45.5 | 149.28 | 32 | | |
| 46.0 | 150.92 | 33 | | |
| 46.5 | 152.56 | 34 | | |
| 47.0 | 154.20 | 35 | | |
| 47.5 | 155.84 | 36 | | |
| 48.0 | 157.48 | 37 | | |
| 48.5 | 159.12 | 38 | | |
| 49.0 | 160.76 | 39 | | |
| 49.5 | 162.40 | 40 | | |
| 50.0 | 164.04 | 41 | | |
| 50.5 | 165.68 | 42 | | |
| 51.0 | 167.32 | 43 | | |
| 51.5 | 168.96 | 44 | | |
| 52.0 | 170.60 | 45 | | |
| 52.5 | 172.24 | 46 | | |
| 53.0 | 173.88 | 47 | | |
| 53.5 | 175.52 | 48 | | |
| 54.0 | 177.17 | 49 | | |
| 54.5 | 178.81 | 50 | | |
| 55.0 | 180.45 | 51 | | |
| 55.5 | 182.09 | 52 | | |
| 56.0 | 183.73 | 53 | | |
| 56.5 | 185.37 | 54 | | |
| 57.0 | 187.01 | 55 | | |
| 57.5 | 188.65 | 56 | | |
| 58.0 | 190.29 | 57 | | |
| 58.5 | 191.93 | 58 | | |
| 59.0 | 193.57 | 59 | | |
| 59.5 | 195.21 | 60 | | |
| 60.0 | 196.85 | 61 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-3003 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 6 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 60.5 | 198.49 | 62 | | |
| 61.0 | 200.13 | 63 | | |
| 61.5 | 201.77 | 64 | | |
| 62.0 | 203.41 | 65 | | |
| 62.5 | 205.05 | 66 | | |
| 63.0 | 206.69 | 67 | | |
| 63.5 | 208.33 | 68 | | |
| 64.0 | 209.97 | 69 | | |
| 64.5 | 211.61 | 70 | | |
| 65.0 | 213.25 | 71 | | |
| 65.5 | 214.90 | 72 | | |
| 66.0 | 216.54 | 73 | | |
| 66.5 | 218.18 | 74 | | |
| 67.0 | 219.82 | 75 | | |
| 67.5 | 221.46 | 76 | | |
| 68.0 | 223.10 | 77 | | |
| 68.5 | 224.74 | 78 | | |
| 69.0 | 226.38 | 79 | | |
| 69.5 | 228.02 | 80 | | |
| 70.0 | 229.66 | 81 | | |
| 70.5 | 231.30 | 82 | | |
| 71.0 | 232.94 | 83 | | |
| 71.5 | 234.58 | 84 | | |
| 72.0 | 236.22 | 85 | | HIT BOTTOM @ 71.95m. |
| 72.5 | 237.86 | | | BOTTOM MEASUREMENT? |
| 73.0 | 239.50 | | | DO NOT USE #85. |
| 73.5 | 241.14 | | | |
| 74.0 | 242.78 | | | |
| 74.5 | 244.42 | | | |
| 75.0 | 246.06 | | | |
| 75.5 | 247.70 | | | |
| 76.0 | 249.34 | | | |
| 76.5 | 250.98 | | | T.D. @ 250' |
| 77.0 | 252.62 | | | |
| 77.5 | 254.27 | | | |
| 78.0 | 255.91 | | | |
| 78.5 | 257.55 | | | |
| 79.0 | 259.19 | | | |
| 79.5 | 260.83 | | | |
| 80.0 | 262.47 | | | |

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# B-3003 CALIPER FIELD LOG

SITE: VOGTLE COL DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3003 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97' ; NO 6" STEEL
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: 170'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: 250' TIME SINCE LAST CIRCULATION: 23 HC

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 12:49 LOGGING COMPLETED: 13:42

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SITE: VOGTLE COL B-3003 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE____ SILVER ✓ OYO____ OTHER____
MICROLOGGER 5310 ~~5301~~ ✓ 5772____ OTHER____
CALIPER PROBE 5368 ✓ OTHER____

| | | |
|---|---|---|
| PROBE OFFSET | 2.08M(6.82 FT) 12 IN MAX | |
| MINUS CASING STICK-UP | -1.5 | |
| DEPTH REF. OFFSET AT START | 5.32' | |
| DEPTH REF. OFFSET AT END | 5.30' | |
| AFTER SURVEY DEPTH ERROR | -0.02' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3003 CALTEST01 | Ø | 12:49 | Ø | 12:52 |
| B 3003 CALUP01 | 245.0' | 13:02 | Ø | 13:27 |
| B 3003 CALTEST02 | Ø | 13:37 | Ø | ~~13:42~~ 13:42 |
| | | | | |
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EAS 2/16/07

CALIBRATION PLATE S/N 201

| | | AS BUILT | | | PVC FITTING |
|---|---|---|---|---|---|
| | | 1.968 IN | 3.937 IN | 8.000 IN | 4.507 IN |
| | FILE NAME | (50 MM) | (100 MM) | (203.2 MM) | (114.3 MM) |
| AS MEAS. | B 3003 CALTEST 01 | 1.97 | 3.94 | 8.00 | 4.51 |
| AS MEAS. | B3003 CALTEST02 | 1.99 | 3.97 | 8.00 | 4.53 |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |

MAINTENANCE PERFORMED ON SITE:____

EQUIPMENT PROBLEMS OR FAILURES:____

SUGGESTIONS, ADDITIONS, CHANGES:____

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# B-3003 ACOUSTIC TELEVIEWER FIELD LOG

SITE: VOGTLE COL DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-3003 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97' (6" STEEL); NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈20'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈30' TIME SINCE LAST CIRCULATION: ≈4HR

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SITE: VOGTLE COL B-3003 DATE: 2/16/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 14:00 LOGGING COMPLETED: 14:12

WINCH: COMPROBE ✓ SILVER ____ OYO ____ OTHER ____
MICROLOGGER 5310 ~~5301~~ ✓ 5772 ____
TELEVIEWER ACOUSTIC #5174 ✓ OTHER ____

PROBE TILT TEST 91.6° BRUNTON TILT 91°
PROBE TILT TEST 5.6° BRUNTON TILT 5°
PROBE TILT TEST 0.5° BRUNTON TILT 0° AFTER LOG
PROBE AZIMUTH TEST 306° BRUNTON AZIMUTH 21°
PROBE AZIMUTH TEST 207.4 BRUNTON AZIMUTH 216°
PROBE AZIMUTH TEST 123.4 BRUNTON AZIMUTH 120° AFTER LOG

| | | |
|---|---|---|
| PROBE OFFSET | 1.44M(4.72FT) | |
| MINUS CASING STICK-UP | 1.5 | |
| DEPTH REF. OFFSET AT START | 3.22' | |
| DEPTH REF. OFFSET AT END | 3.15 | |
| AFTER SURVEY DEPTH ERROR | -0.07' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B3003AMUP02 | 248.0' | 14:00 | Ø | 14:12 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

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# B-4001 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 1/9/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL ____ PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5'; NO ____
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B4001ELOGTEST01 | Ø | 1/9/07 | 12:45 - 12:50 |
| ELOG/GAMMA | B4001ELOGUP01 | 399.2' - 340.0' | " | 13:50 - 14:05 |
| ELOG/GAMMA | B4001ELOGUP02 | 340.0' - 319.6' | " | 14:08 - 14:18 |
| ELOG/GAMMA | B4001ELOGUP03 | 330.0' - 288.6' | " | 14:25 - 14:30 |
| ELOG/GAMMA | B4001ELOGUP04 | 300.0' - Ø | " | 14:38 - 15:21 |
| ELOG TEST | B4001ELOGTEST02 | Ø | " | 15:31 - 15:35 |
| CALIPER TEST | B4001CALTEST01 | Ø | " | 15:50 - 15:56 |
| CALIPER/GAMMA | B4001CALUP01 | 395.0' - 343.3' | " | 16:20 - 16:27 |
| | | | | |
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# B-4001 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 1/9/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL CONTACT: MATT COOKE
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; 6", TO 400'
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5' ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: Ø TIME SINCE LAST CIRCULATION: ≈ 3 hr

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 06:30
ARRIVED ON SITE: 07:30
STANDBY TIME: CAUSE:
LOGGING STARTED: 12:45 LOGGING COMPLETED: 15:35

*GEOVision Geophysical Services* *1151 Pomona Road, Unit P, Corona, CA 92882* *Ph (951) 549-1234 Fx (951) 549-1236*

SITE: VOGTLE COL B-4001 DATE: 1/9/06
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ____ OYO ____ OTHER RG
MICROLOGGER 5301 ____ 5772 ✓ OTHER ____
ELOG PROBE 5490 ____ OTHER 30800

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | – | |
| MINUS CASING STICK-UP | -2.0' | |
| DEPTH REF. OFFSET AT START | 6.2' | |
| DEPTH REF. OFFSET AT END | 6.5' | |
| AFTER SURVEY DEPTH ERROR | +0.3 | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4001 ELOGTEST01 | 0 | 12:45 | 0 | 12:50 |
| B4001 ELOGUP01 | 349.2' | 13:50 | 340 | 14:05 |
| B4001 ELOGUP02 | 340 | 14:08 | 319.6 | 14:18 |
| B4001 ELOGUP03 | 330 | 14:25 | 289.6 | 14:30 |
| B4001 ELOGREPO4 | 300 | 14:38 | ~~15:31~~ 0 | 15:21 |
| B4001 ELOGTEST02 | 0 | 15:31 | DAS 1/9/06 | 15:35 |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: LONG & SHORT RESITIVITY DATA MISSING. PROBE CURRENT JUMPED FROM 44 mA TO 100 mA - LOST COMM.

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# B-4001 CALIPER FIELD LOG

SITE: VOGTLE COL DATE: 1/9/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5' ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE:
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: TIME SINCE LAST CIRCULATION: ≈ 4 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 06:30
ARRIVED ON SITE: 07:30
STANDBY TIME: CAUSE:
LOGGING STARTED: 15:50 LOGGING COMPLETED: 16:27

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SITE:_VOGTLE COL B-400 DATE: 1/9/07
CLIENT:_MACTEC JOB:_6517
AUTHOR:_R. STELLER PAGE 2 OF 2

WINCH: COMPROBE_____ SILVER_____ OYO_____ OTHER RG
MICROLOGGER 5301___ 5772 ✓ OTHER_____
CALIPER PROBE 5368___ OTHER 2715

| | | |
|---|---|---|
| PROBE OFFSET | 2.08M(6.82 FT) 12 IN MAX | |
| MINUS CASING STICK-UP | 2.0' | |
| DEPTH REF. OFFSET AT START | 4.82' | |
| DEPTH REF. OFFSET AT END | 4.80' | |
| AFTER SURVEY DEPTH ERROR | -0.02' | LESS THAN 0.4%? YES. |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4001CALTEST01 | 0 | 15:50 | 0 | 15:56 |
| B4001CALUP01 | 345 | 16:20 | 343.3 | 16:27 |
| | | | | |
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| CALIBRATION PLATE S/N 201 | | | AS BUILT | | PVC FITTING |
|---|---|---|---|---|---|
| | | 205 1.968 IN | 3.937 IN | 7.87" ~~8.000~~ IN | 4.507 IN |
| | FILE NAME | 52 (~~50~~ MM) | (100 MM) | 200 (~~203~~.2 MM) | (114.3 MM) |
| AS MEAS. | B4001 CALTEST01 | 2.05 | 3.93 | 7.83 | 4.52 |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |

MAINTENANCE PERFORMED ON SITE:_____

EQUIPMENT PROBLEMS OR FAILURES:_____

SUGGESTIONS, ADDITIONS, CHANGES:_____

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# B-4001 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5'; NO ____
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B4001ELOGTEST03 | Ø | 1/10/07 | 09:10 - 09:13 |
| ELOG/GAMMA | B4001ELOGUP05 | 399.5' - 111.5' | " | 09:55 - 10:26 |
| ELOG/GAMMA | B4001ELOGDOWN01 | Ø - 61.9' | " | 10:46 - 10:52 |
| DEVIATION | B4001AMUP01 | 399.0 - Ø | " | 11:40 - 12:00 |
| SUSPENSION PS | B401_001 - 231.DAT | 8.2' - 385.5' | " | 12:35 - 14:43 |
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# B-4001 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 1/18/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL CONTACT: MATT COOKE
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5' ; NO
DEPTH TO BEDROCK: NK DEPTH TO WATER TABLE:
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ∅ TIME SINCE LAST CIRCULATION: 1/2 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 09:00
ARRIVED ON SITE: 07:05
STANDBY TIME: NK CAUSE:
LOGGING STARTED: 09:10 LOGGING COMPLETED: 10:52

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SITE: VOGTLE COL B-4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ____ OYO ____ OTHER RG MINI WINCH
MICROLOGGER 5301 ____ 5772 ✓ OTHER ____
ELOG PROBE 5490 ____ OTHER 3080

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | ⊖ | |
| MINUS CASING STICK-UP | -2.0 | |
| DEPTH REF. OFFSET AT START | 6.2' | |
| DEPTH REF. OFFSET AT END | 6.0' | |
| AFTER SURVEY DEPTH ERROR | -0.2' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4001 ELOG TEST 03 | Ø | 09:10 | Ø | 09:13 |
| B4001 ELOG UP 05 | 3?9.5 | 09:55 | 111.5 | 10:26 |
| B4001 ELOG DOWN 01 | Ø | 10:40 | 61.9 | 10:52 |
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MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# B-4001 ACOUSTIC TELEVIEWER FIELD LOG

SITE: VOGTLE COL DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5'; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈ 70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈ 20' TIME SINCE LAST CIRCULATION: ≈ 2 HR

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SITE:_VOGTLE COL B-4001 DATE: 1/10/07
CLIENT:_MACTEC JOB:_6517
AUTHOR:_R. STELLER PAGE 2 OF 2

LOGGING CREW:_R. STELLER
VEHICLE(S) USED AND MILEAGE: _RENTAL
MOBILIZED FROM:_AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 11:40 LOGGING COMPLETED: 12:00

WINCH: COMPROBE___ SILVER___ OYO___ OTHER RG MINI WINCH
MICROLOGGER 5301___ 5772 ✓
TELEVIEWER ACOUSTIC #5174___ OTHER 4727

PROBE TILT TEST 88.24° BRUNTON TILT 89°
PROBE TILT TEST 0.4° BRUNTON TILT 0° HANGING FREE.
PROBE TILT TEST 0.4° BRUNTON TILT 0° AFTER LOGGING RUNS
PROBE AZIMUTH TEST 192.4 BRUNTON AZIMUTH 191°
PROBE AZIMUTH TEST 83.4° BRUNTON AZIMUTH 83°
PROBE AZIMUTH TEST 114.8° BRUNTON AZIMUTH 114°

| | | |
|---|---|---|
| PROBE OFFSET | 1.44M(4.72FT) | |
| MINUS CASING STICK-UP | 2' | |
| DEPTH REF. OFFSET AT START | 2.72' | |
| DEPTH REF. OFFSET AT END | 2.45' | |
| AFTER SURVEY DEPTH ERROR | -0.27' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| Sgood AuxP 01 | 399 | 11:40 | 8 | 12:00 |
| | | | | |
| | | | | |
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| | | | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

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# P-S SUSPENSION VELOCITY FIELD LOG

SITE: VOGTLE COL B-4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 9

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5'; NO ____
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈ 70'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: Ø TIME SINCE LAST CIRCULATION: ≈ 3 Hr

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SITE: VOGTLE COL B-4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 9

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 10:35 LOGGING COMPLETED: 14:43
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES ✓; NO ____; STORED WITH NEW ____

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WINCH | COMPROBE ☐ | | GREY ☐ | OYO ☐ | RG ☑ | OTH ☐ | | |
| INSTRUMENT | OYO 12004 ☐ | 15014 ☐ | 19029 ☐ | | RG 160023 ☐ | 160024 ☑ | | |
| RECEIVER S/N | 12008 ☑ | 20042 ☐ | 26066 ☐ | 11001 ☐ | 23053 ☐ | 30086 ☐ | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: DEPTH OFFSET = 2.5 m - .7m = 1.8m
" " ON REPT = 1.77m
ASDE = -0.03 m

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# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 3 OF 9

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 0.5 | 1.64 | | | |
| 1.0 | 3.28 | | | |
| 1.5 | 4.92 | | | STEEL TO ≈ 5' |
| 2.0 | 6.56 | | | |
| 2.5 | 8.20 | 1 | | |
| 3.0 | 9.84 | 2 | | |
| 3.5 | 11.48 | 3 | | |
| 4.0 | 13.12 | 4 | | |
| 4.5 | 14.76 | 5 | | |
| 5.0 | 16.40 | 6 | | |
| 5.5 | 18.04 | 7 | | |
| 6.0 | 19.69 | 8 | | |
| 6.5 | 21.33 | 9 | | |
| 7.0 | 22.97 | 10 | | |
| 7.5 | 24.61 | 11 | | |
| 8.0 | 26.25 | 12 | | |
| 8.5 | 27.89 | 13 | | |
| 9.0 | 29.53 | 14 | | |
| 9.5 | 31.17 | 15 | | |
| 10.0 | 32.81 | 16 | | |
| 10.5 | 34.45 | 17 | | |
| 11.0 | 36.09 | 18 | | |
| 11.5 | 37.73 | 19 | | |
| 12.0 | 39.37 | 20 | | |
| 12.5 | 41.01 | 21 | | |
| 13.0 | 42.65 | 22 | | |
| 13.5 | 44.29 | 23 | | |
| 14.0 | 45.93 | 24 | | |
| 14.5 | 47.57 | 25 | | |
| 15.0 | 49.21 | 26 | | |
| 15.5 | 50.85 | 27 | | |
| 16.0 | 52.49 | 28 | | |
| 16.5 | 54.13 | 29 | | |
| 17.0 | 55.77 | 30 | | |
| 17.5 | 57.41 | 31 | | |
| 18.0 | 59.06 | 32 | | |
| 18.5 | 60.70 | 33 | | |
| 19.0 | 62.34 | 34 | | |
| 19.5 | 63.98 | 35 | | |
| 20.0 | 65.62 | 36 | | |

# danawill

## Attachment D–Geophysical Test Data_5–31–08/14/07 02:36 PM

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 4 OF 9

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 20.5 | 67.26 | 37 | | |
| 21.0 | 68.90 | 38 | | |
| 21.5 | 70.54 | 39 | | |
| 22.0 | 72.18 | 40 | | |
| 22.5 | 73.82 | 41 | | |
| 23.0 | 75.46 | 42 | | |
| 23.5 | 77.10 | 43 | | |
| 24.0 | 78.74 | 44 | | |
| 24.5 | 80.38 | 45 | | |
| 25.0 | 82.02 | 46 | | |
| 25.5 | 83.66 | 47 | | |
| 26.0 | 85.30 | 48 | | |
| 26.5 | 86.94 | 49 | | |
| 27.0 | 88.58 | 50 | | |
| 27.5 | 90.22 | 51 | | |
| 28.0 | 91.86 | 52 | | |
| 28.5 | 93.50 | 53 | | |
| 29.0 | 95.14 | 54 | | |
| 29.5 | 96.78 | 55 | | 6" PVC CASE TO 97.5' |
| 30.0 | 98.43 | 56 | | |
| 30.5 | 100.07 | 57 | | |
| 31.0 | 101.71 | 58 | | |
| 31.5 | 103.35 | 59 | | |
| 32.0 | 104.99 | 60 | | |
| 32.5 | 106.63 | 61 | | |
| 33.0 | 108.27 | 62 | | |
| 33.5 | 109.91 | 63 | | |
| 34.0 | 111.55 | 64 | | |
| 34.5 | 113.19 | 65 | | |
| 35.0 | 114.83 | 66 | | |
| 35.5 | 116.47 | 67 | | |
| 36.0 | 118.11 | 68 | | |
| 36.5 | 119.75 | 69 | | |
| 37.0 | 121.39 | 70 | | |
| 37.5 | 123.03 | 71 | | |
| 38.0 | 124.67 | 72 | | |
| 38.5 | 126.31 | 73 | | |
| 39.0 | 127.95 | 74 | | |
| 39.5 | 129.59 | 75 | | |
| 40.0 | 131.23 | 76 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 5 OF 9

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 40.5 | 132.87 | 77 | | |
| 41.0 | 134.51 | 78 | | |
| 41.5 | 136.15 | 79 | | |
| 42.0 | 137.80 | 80 | | |
| 42.5 | 139.44 | 81 | | |
| 43.0 | 141.08 | 82 | | |
| 43.5 | 142.72 | 83 | | |
| 44.0 | 144.36 | 84 | | |
| 44.5 | 146.00 | 85 | | |
| 45.0 | 147.64 | 86 | | |
| 45.5 | 149.28 | 87 | | |
| 46.0 | 150.92 | 88 | | |
| 46.5 | 152.56 | 89 | | |
| 47.0 | 154.20 | 90 | | |
| 47.5 | 155.84 | 91 | | |
| 48.0 | 157.48 | 92 | | |
| 48.5 | 159.12 | 93 | | |
| 49.0 | 160.76 | 94 | | |
| 49.5 | 162.40 | 95 | | |
| 50.0 | 164.04 | 96 | | |
| 50.5 | 165.68 | 97 | | |
| 51.0 | 167.32 | 98 | | |
| 51.5 | 168.96 | 99 | | |
| 52.0 | 170.60 | 100 | | |
| 52.5 | 172.24 | 101 | | |
| 53.0 | 173.88 | 102 | | |
| 53.5 | 175.52 | 103 | | |
| 54.0 | 177.17 | 104 | | |
| 54.5 | 178.81 | 105 | | |
| 55.0 | 180.45 | 106 | | |
| 55.5 | 182.09 | 107 | | |
| 56.0 | 183.73 | 108 | | |
| 56.5 | 185.37 | 109 | | |
| 57.0 | 187.01 | 110 | | |
| 57.5 | 188.65 | 111 | | |
| 58.0 | 190.29 | 112 | | |
| 58.5 | 191.93 | 113 | | |
| 59.0 | 193.57 | 114 | | |
| 59.5 | 195.21 | 115 | | |
| 60.0 | 196.85 | 116 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 6 OF 9

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 60.5 | 198.49 | 117 | | |
| 61.0 | 200.13 | 118 | | |
| 61.5 | 201.77 | 119 | | |
| 62.0 | 203.41 | 120 | | |
| 62.5 | 205.05 | 121 | | |
| 63.0 | 206.69 | 122 | | |
| 63.5 | 208.33 | 123 | | |
| 64.0 | 209.97 | 124 | | |
| 64.5 | 211.61 | 125 | | |
| 65.0 | 213.25 | 126 | | |
| 65.5 | 214.90 | 127 | | |
| 66.0 | 216.54 | 128 | | |
| 66.5 | 218.18 | 129 | | |
| 67.0 | 219.82 | 130 | | |
| 67.5 | 221.46 | 131 | | |
| 68.0 | 223.10 | 132 | | |
| 68.5 | 224.74 | 133 | | |
| 69.0 | 226.38 | 134 | | |
| 69.5 | 228.02 | 135 | | |
| 70.0 | 229.66 | 136 | | |
| 70.5 | 231.30 | 137 | | |
| 71.0 | 232.94 | 138 | | |
| 71.5 | 234.58 | 139 | | |
| 72.0 | 236.22 | 140 | | |
| 72.5 | 237.86 | 141 | | |
| 73.0 | 239.50 | 142 | | |
| 73.5 | 241.14 | 143 | | |
| 74.0 | 242.78 | 144 | | |
| 74.5 | 244.42 | 145 | | |
| 75.0 | 246.06 | 146 | | |
| 75.5 | 247.70 | 147 | | |
| 76.0 | 249.34 | 148 | | |
| 76.5 | 250.98 | 149 | | |
| 77.0 | 252.62 | 150 | | |
| 77.5 | 254.27 | 151 | | |
| 78.0 | 255.91 | 152 | | |
| 78.5 | 257.55 | 153 | | |
| 79.0 | 259.19 | 154 | | |
| 79.5 | 260.83 | 155 | | |
| 80.0 | 262.47 | 156 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 7 OF 9

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 80.5 | 264.11 | 157 | | |
| 81.0 | 265.75 | 158 | | |
| 81.5 | 267.39 | 159 | | |
| 82.0 | 269.03 | 160 | | |
| 82.5 | 270.67 | 161 | | |
| 83.0 | 272.31 | 162 | | |
| 83.5 | 273.95 | 163 | | |
| 84.0 | 275.59 | 164 | | |
| 84.5 | 277.23 | 165 | | |
| 85.0 | 278.87 | 166 | | |
| 85.5 | 280.51 | 167 | | |
| 86.0 | 282.15 | 168 | | |
| 86.5 | 283.79 | 169 | | |
| 87.0 | 285.43 | 170 | | |
| 87.5 | 287.07 | 171 | | |
| 88.0 | 288.71 | 172 | | |
| 88.5 | 290.35 | 173 | | |
| 89.0 | 291.99 | 174 | | |
| 89.5 | 293.64 | 175 | | |
| 90.0 | 295.28 | 176 | | |
| 90.5 | 296.92 | 177 | | |
| 91.0 | 298.56 | 178 | | |
| 91.5 | 300.20 | 179 | | |
| 92.0 | 301.84 | 180 | | |
| 92.5 | 303.48 | 181 | | |
| 93.0 | 305.12 | 182 | | |
| 93.5 | 306.76 | 183 | | |
| 94.0 | 308.40 | 184 | | |
| 94.5 | 310.04 | 185 | | |
| 95.0 | 311.68 | 186 | | |
| 95.5 | 313.32 | 187 | | |
| 96.0 | 314.96 | 188 | | |
| 96.5 | 316.60 | 189 | | |
| 97.0 | 318.24 | 190 | | |
| 97.5 | 319.88 | 191 | | |
| 98.0 | 321.52 | 192 | | |
| 98.5 | 323.16 | 193 | | |
| 99.0 | 324.80 | 194 | | |
| 99.5 | 326.44 | 195 | | |
| 100.0 | 328.08 | 196 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B - 4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 8 OF 9

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 100.5 | 329.72 | 197 | | |
| 101.0 | 331.36 | 198 | | |
| 101.5 | 333.01 | 199 | | |
| 102.0 | 334.65 | 200 | | |
| 102.5 | 336.29 | 201 | | |
| 103.0 | 337.93 | 202 | | |
| 103.5 | 339.57 | 203 | | |
| 104.0 | 341.21 | 204 | | |
| 104.5 | 342.85 | 205 | | |
| 105.0 | 344.49 | 206 | | |
| 105.5 | 346.13 | 207 | | |
| 106.0 | 347.77 | 208 | | |
| 106.5 | 349.41 | 209 | | |
| 107.0 | 351.05 | 210 | | |
| 107.5 | 352.69 | 211 | | |
| 108.0 | 354.33 | 212 | | |
| 108.5 | 355.97 | 213 | | |
| 109.0 | 357.61 | 214 | | |
| 109.5 | 359.25 | 215 | | |
| 110.0 | 360.89 | 216 | | |
| 110.5 | 362.53 | 217 | | |
| 111.0 | 364.17 | 218 | | |
| 111.5 | 365.81 | 219 | | |
| 112.0 | 367.45 | 220 | | |
| 112.5 | 369.09 | 221 | | |
| 113.0 | 370.73 | 222 | | |
| 113.5 | 372.38 | 223 | | |
| 114.0 | 374.02 | 224 | | |
| 114.5 | 375.66 | 225 | | |
| 115.0 | 377.30 | 226 | | |
| 115.5 | 378.94 | 227 | | |
| 116.0 | 380.58 | 228 | | |
| 116.5 | 382.22 | 229 | | |
| 117.0 | 383.86 | 230 | | |
| 117.5 | 385.50 | 231 | | HIT BOTTOM @ 117.7 m. |
| 118.0 | 387.14 | | | BOTTOM MEASUREMENT? |
| 118.5 | 388.78 | | | |
| 119.0 | 390.42 | | | |
| 119.5 | 392.06 | | | |
| 120.0 | 393.70 | | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B - 4001 DATE: 1/10/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 7 OF 9

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 120.5 | 395.34 | | | |
| 121.0 | 396.98 | | | |
| 121.5 | 398.62 | | | |
| 122.0 | 400.26 | | | T.D. @ 400' |
| 122.5 | 401.90 | | | |
| 123.0 | 403.54 | | | |
| 123.5 | 405.18 | | | |
| 124.0 | 406.82 | | | |
| 124.5 | 408.46 | | | |
| 125.0 | 410.10 | | | |
| 125.5 | 411.75 | | | |
| 126.0 | 413.39 | | | |
| 126.5 | 415.03 | | | |
| 127.0 | 416.67 | | | |
| 127.5 | 418.31 | | | |
| 128.0 | 419.95 | | | |
| 128.5 | 421.59 | | | |
| 129.0 | 423.23 | | | |
| 129.5 | 424.87 | | | |
| 130.0 | 426.51 | | | |
| 130.5 | 428.15 | | | |
| 131.0 | 429.79 | | | |
| 131.5 | 431.43 | | | |
| 132.0 | 433.07 | | | |
| 132.5 | 434.71 | | | |
| 133.0 | 436.35 | | | |
| 133.5 | 437.99 | | | |
| 134.0 | 439.63 | | | |
| 134.5 | 441.27 | | | |
| 135.0 | 442.91 | | | |
| 135.5 | 444.55 | | | |
| 136.0 | 446.19 | | | |
| 136.5 | 447.83 | | | |
| 137.0 | 449.48 | | | |
| 137.5 | 451.12 | | | |
| 138.0 | 452.76 | | | |
| 138.5 | 454.40 | | | |
| 139.0 | 456.04 | | | |
| 139.5 | 457.68 | | | |
| 140.0 | 459.32 | | | |

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# B-4001 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6' 0 TO 400' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5' ; NO ____
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B4001ELOGTEST04 | Ø | 2/13/07 | 10:01 – 10:06 |
| ELOG/GAMMA | B4001ELOGUP06 | 399.5 - 20.0' | " | 10:35 - 11:12 |
| CALIPER TEST | B4001CALTEST02 | Ø | " | 11:25 - 11:27 |
| CALIPER/GAMMA | B4001 CALUP 02 | 397.0 - Ø' | " | 11:40 - 12:23 |
| CALIPER TEST | B4001CALTEST05 | Ø | " | 12:30 - 12:33 |
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# B-4001 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL CONTACT: MATT COOKE
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5' ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ~70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ∅ TIME SINCE LAST CIRCULATION: 1/2 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 08:00
ARRIVED ON SITE: 09:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 10:01 LOGGING COMPLETED: 11:12

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SITE: VOGTLE COL B-4001 DATE: 6/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER 5310 ~~5301~~ ✓ 5772 ____ OTHER ____
ELOG PROBE 5490 ✓ OTHER ____

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | 52.8' | |
| MINUS CASING STICK-UP | -2.2 | |
| DEPTH REF. OFFSET AT START | 58.0' | |
| DEPTH REF. OFFSET AT END | 38.7' | |
| AFTER SURVEY DEPTH ERROR | -0.1' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4001 ELOG TEST04 | Ø | 10:01 | Ø | 10:06 |
| B 4001 ELOG u8 06 | 399.5 | 10:33 | 20.0' | 11:12 |
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MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# B-4001 CALIPER FIELD LOG

SITE: VOGTLE COL DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4001 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 400' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 400'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 97.5' ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: 170'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: Ø TIME SINCE LAST CIRCULATION: ≈ 2 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 08:00
ARRIVED ON SITE: 09:00
STANDBY TIME: CAUSE:
LOGGING STARTED: 11:25 LOGGING COMPLETED: 12:33

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SITE: VOGTLE COL B-4001 DATE: 2/13/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER ~~5310~~ ~~5301~~ ✓ 5772 ____ OTHER ____
CALIPER PROBE 5368 ✓ OTHER ____

| | | |
|---|---|---|
| PROBE OFFSET | 2.08M(6.82 FT) 12 IN MAX | |
| MINUS CASING STICK-UP | -2.2' | |
| DEPTH REF. OFFSET AT START | 4.62' | |
| DEPTH REF. OFFSET AT END | 4.60' | |
| AFTER SURVEY DEPTH ERROR | -0.02' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4001CALTEST02 | Ø | 11:25 | Ø | 11:27 |
| B4001 CALUP02 | 397.0 | 11:40 | Ø | 12:23 |
| B4001 CALTEST03 | Ø | 12:30 | Ø | 12:35 |
| | | | | |
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| CALIBRATION PLATE S/N 201 | | AS BUILT | | | PVC FITTING |
|---|---|---|---|---|---|
| | | 1.968 IN | 3.937 IN | 8.000 IN | 4.507 IN |
| | FILE NAME | (50 MM) | (100 MM) | (203.2 MM) | (114.3 MM) |
| AS MEAS. | B4001 CALTEST02 | 1.97 | 3.97 | 8.02 | 4.51 |
| AS MEAS. | B4001 CALTEST03 | 1.95 | 3.93 | 8.00 | 4.49 |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# B-4002 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO ____
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B4002ELOGTEST01 | Ø | 2/15/07 | 13:09 – 13:11 |
| ELOG/GAMMA | B4002ELOGUP01 | 250.7 – 20.0' | " | 13:28 – 13:53 |
| SUSPENSION PS | B402_001 → 085.029 | 98.4 – 236.2 | " | 14:59 – 15:46 |
| CALIPER TEST | B4002CALTEST01 | Ø | " | 16:07 – 16:10 |
| CALIPER/GAMMA | B4002CALUP01 | 247.0 – Ø | " | 16:17 – 16:44 |
| CALIPER TEST | B4002CALTEST02 | Ø | " | 16:50 – 16:53 |
| DEVIATION | B4002ALLUP01 | 248.0 – Ø | " | 17:07 – 17:18 |
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# B-4002 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL CONTACT: MATT COOKE
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4002 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 256'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO ____
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈ 1/2 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 13:09 LOGGING COMPLETED: 14:25

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SITE:_VOGTLE COL B-4002 DATE: 2/15/07
CLIENT:_MACTEC JOB:_6517
AUTHOR:_R. STELLER PAGE 2 OF 2

WINCH: COMPROBE____ SILVER ✓ OYO____ OTHER____
MICROLOGGER ~~5310~~ ~~5301~~ ✓ 5772____ OTHER____
ELOG PROBE 5490 ✓ OTHER____

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | + 32.8 | |
| MINUS CASING STICK-UP | -2.4 | |
| DEPTH REF. OFFSET AT START | 38.6 | |
| DEPTH REF. OFFSET AT END | 38.4' | RUN1 & RUN 2 |
| AFTER SURVEY DEPTH ERROR | -0.2' | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4002 ELOG TEST01 | Ø | 13:09 | Ø | 13:11 |
| B4002 ELOG UP01 | 250.75 | 13:28 | 20.0' | 13:53 |
| B4002 ELOG UP02 | 250.0 | 14:02 | 20.0' | 14:25 |
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MAINTENANCE PERFORMED ON SITE:____

EQUIPMENT PROBLEMS OR FAILURES:____

SUGGESTIONS, ADDITIONS, CHANGES:____

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# P-S SUSPENSION VELOCITY FIELD LOG

SITE: VOGTLE COL B-4002 DATE: 5/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 6

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4002 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO ____
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈ 70'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓ ; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈ 24 HR

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SITE: VOGTLE COL B-4002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 6

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 14:59 LOGGING COMPLETED: 15:40
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES ____; NO ✓; STORED WITH NEW ____

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WINCH | COMPROBE ☐ | | GREY ☐ | OYO ☐ | RG ☐ | OTH ☑ | | |
| INSTRUMENT | OYO 12004 ☐ | 15014 ☐ | 19029 ☐ | | RG 160023 ☐ | 160024 ☑ | | |
| RECEIVER S/N | 12008 ☐ | 20042 ☐ | 26066 ☐ | 11001 ☐ | 23053 ☐ | 30086 ☑ | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: DEPTH ZERO = 2.5m − .73m = 1.77m.
EXIT ZERO = 1.75m

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# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL ~~B-4003~~ B-4002 DATE: 2/15/07
CLIENT: MACTEC RDS 2/15/07 JOB: 6517
AUTHOR: R. STELLER PAGE 3 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 0.5 | 1.64 | | | |
| 1.0 | 3.28 | | | |
| 1.5 | 4.92 | | | |
| 2.0 | 6.56 | | | |
| 2.5 | 8.20 | | | |
| 3.0 | 9.84 | | | |
| 3.5 | 11.48 | | | |
| 4.0 | 13.12 | | | |
| 4.5 | 14.76 | | | |
| 5.0 | 16.40 | | | |
| 5.5 | 18.04 | | | |
| 6.0 | 19.69 | | | |
| 6.5 | 21.33 | | | |
| 7.0 | 22.97 | | | |
| 7.5 | 24.61 | | | |
| 8.0 | 26.25 | | | |
| 8.5 | 27.89 | | | |
| 9.0 | 29.53 | | | |
| 9.5 | 31.17 | | | |
| 10.0 | 32.81 | | | |
| 10.5 | 34.45 | | | |
| 11.0 | 36.09 | | | |
| 11.5 | 37.73 | | | |
| 12.0 | 39.37 | | | |
| 12.5 | 41.01 | | | |
| 13.0 | 42.65 | | | |
| 13.5 | 44.29 | | | |
| 14.0 | 45.93 | | | |
| 14.5 | 47.57 | | | |
| 15.0 | 49.21 | | | |
| 15.5 | 50.85 | | | |
| 16.0 | 52.49 | | | |
| 16.5 | 54.13 | | | |
| 17.0 | 55.77 | | | |
| 17.5 | 57.41 | | | |
| 18.0 | 59.06 | | | |
| 18.5 | 60.70 | | | |
| 19.0 | 62.34 | | | |
| 19.5 | 63.98 | | | |
| 20.0 | 65.62 | | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B- 4002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 4 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 20.5 | 67.26 | | | |
| 21.0 | 68.90 | | | |
| 21.5 | 70.54 | | | |
| 22.0 | 72.18 | | | |
| 22.5 | 73.82 | | | |
| 23.0 | 75.46 | | | |
| 23.5 | 77.10 | | | |
| 24.0 | 78.74 | | | |
| 24.5 | 80.38 | | | |
| 25.0 | 82.02 | | | |
| 25.5 | 83.66 | | | |
| 26.0 | 85.30 | | | |
| 26.5 | 86.94 | | | |
| 27.0 | 88.58 | | | |
| 27.5 | 90.22 | | | |
| 28.0 | 91.86 | | | |
| 28.5 | 93.50 | | | |
| 29.0 | 95.14 | | | |
| 29.5 | 96.78 | | | STEEL TO 96' |
| 30.0 | 98.43 | 001 | | |
| 30.5 | 100.07 | 2 | | |
| 31.0 | 101.71 | 3 | | |
| 31.5 | 103.35 | 4 | | |
| 32.0 | 104.99 | 5 | | |
| 32.5 | 106.63 | 6 | | |
| 33.0 | 108.27 | 7 | | |
| 33.5 | 109.91 | 8 | | |
| 34.0 | 111.55 | 9 | | |
| 34.5 | 113.19 | 10 | | |
| 35.0 | 114.83 | 11 | | |
| 35.5 | 116.47 | 12 | | |
| 36.0 | 118.11 | 13 | | |
| 36.5 | 119.75 | 14 | | |
| 37.0 | 121.39 | 15 | | |
| 37.5 | 123.03 | 16 | | |
| 38.0 | 124.67 | 17 | | |
| 38.5 | 126.31 | 18 | | |
| 39.0 | 127.95 | 19 | | |
| 39.5 | 129.59 | 20 | | |
| 40.0 | 131.23 | 21 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 5 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 40.5 | 132.87 | 22 | | |
| 41.0 | 134.51 | 23 | | |
| 41.5 | 136.15 | 24 | | |
| 42.0 | 137.80 | 25 | | |
| 42.5 | 139.44 | 26 | | |
| 43.0 | 141.08 | 27 | | |
| 43.5 | 142.72 | 28 | | |
| 44.0 | 144.36 | 29 | | |
| 44.5 | 146.00 | 30 | | |
| 45.0 | 147.64 | 31 | | |
| 45.5 | 149.28 | 32 | | |
| 46.0 | 150.92 | 33 | | |
| 46.5 | 152.56 | 34 | | |
| 47.0 | 154.20 | 35 | | |
| 47.5 | 155.84 | 36 | | |
| 48.0 | 157.48 | 37 | | |
| 48.5 | 159.12 | 38 | | |
| 49.0 | 160.76 | 39 | | |
| 49.5 | 162.40 | 40 | | |
| 50.0 | 164.04 | 41 | | |
| 50.5 | 165.68 | 42 | | |
| 51.0 | 167.32 | 43 | | |
| 51.5 | 168.96 | 44 | | |
| 52.0 | 170.60 | 45 | | |
| 52.5 | 172.24 | 46 | | |
| 53.0 | 173.88 | 47 | | |
| 53.5 | 175.52 | 48 | | |
| 54.0 | 177.17 | 49 | | |
| 54.5 | 178.81 | 50 | | |
| 55.0 | 180.45 | 51 | | |
| 55.5 | 182.09 | 52 | | |
| 56.0 | 183.73 | 53 | | |
| 56.5 | 185.37 | 54 | | |
| 57.0 | 187.01 | 55 | | |
| 57.5 | 188.65 | 56 | | |
| 58.0 | 190.29 | 57 | | |
| 58.5 | 191.93 | 58 | | |
| 59.0 | 193.57 | 59 | | |
| 59.5 | 195.21 | 60 | | |
| 60.0 | 196.85 | 61 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 6 OF 6

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 60.5 | 198.49 | 62 | | |
| 61.0 | 200.13 | 63 | | |
| 61.5 | 201.77 | 64 | | |
| 62.0 | 203.41 | 65 | | |
| 62.5 | 205.05 | 66 | | |
| 63.0 | 206.69 | 67 | | |
| 63.5 | 208.33 | 68 | | |
| 64.0 | 209.97 | 69 | | |
| 64.5 | 211.61 | 70 | | |
| 65.0 | 213.25 | 71 | | |
| 65.5 | 214.90 | 72 | | |
| 66.0 | 216.54 | 73 | | |
| 66.5 | 218.18 | 74 | | |
| 67.0 | 219.82 | 75 | | |
| 67.5 | 221.46 | 76 | | |
| 68.0 | 223.10 | 77 | | |
| 68.5 | 224.74 | 78 | | |
| 69.0 | 226.38 | 79 | | |
| 69.5 | 228.02 | 80 | | |
| 70.0 | 229.66 | 81 | | |
| 70.5 | 231.30 | 82 | | |
| 71.0 | 232.94 | 83 | | |
| 71.5 | 234.58 | 84 | | |
| 72.0 | 236.22 | 85 | | HM BOTTOM @ 72.3m ⇒ TIPE 249.5 |
| 72.5 | 237.86 | | | BOTTOM MEAS CEMENT ? |
| 73.0 | 239.50 | | | |
| 73.5 | 241.14 | | | |
| 74.0 | 242.78 | | | |
| 74.5 | 244.42 | | | |
| 75.0 | 246.06 | | | |
| 75.5 | 247.70 | | | |
| 76.0 | 249.34 | | | |
| 76.5 | 250.98 | | | T.D. @ 250 |
| 77.0 | 252.62 | | | |
| 77.5 | 254.27 | | | |
| 78.0 | 255.91 | | | |
| 78.5 | 257.55 | | | |
| 79.0 | 259.19 | | | |
| 79.5 | 260.83 | | | |
| 80.0 | 262.47 | | | |

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# B-4002 CALIPER FIELD LOG

SITE: VOGTLE COL DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4002 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO ____
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈ 70'
BOREHOLE FLUID: WATER ____ ; FRESH WATER MUD ✓ ; SALT WATER MUD ____ ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈ 70' TIME SINCE LAST CIRCULATION: ≈ 3 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 16:07 LOGGING COMPLETED: 16:53

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SITE: VOGTLE COL B-4002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER ~~5310~~ ~~5301~~ ✓ 5772 ____ OTHER ____
CALIPER PROBE 5368 ✓ OTHER ____

| | |
|---|---|
| PROBE OFFSET | 2.08M(6.82 FT) 12 IN MAX |
| MINUS CASING STICK-UP | -2.4 |
| DEPTH REF. OFFSET AT START | 4.42' |
| DEPTH REF. OFFSET AT END | 4.40 |
| AFTER SURVEY DEPTH ERROR | -0.02 LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4002CALTEST01 | Ø | 16:07 | Ø | 16:10 |
| B4002CALUP01 | 247.0 | 16:17 | Ø | 16:44 |
| B4002 CALTEST02 | Ø | 16:50 | Ø | 16:53 |
| | | | | |
| | | | | |
| | | | | |
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| | | | | |

CALIBRATION PLATE S/N 201

| | | AS BUILT | | | PVC FITTING |
|---|---|---|---|---|---|
| | | 1.968 IN | 3.937 IN | 8.000 IN | 4.507 IN |
| | FILE NAME | (50 MM) | (100 MM) | (203.2 MM) | (114.3 MM) |
| AS MEAS. | B4002CALTEST01 | 1.98 | 3.96 | 7.98 | 4.52 |
| AS MEAS. | B4002CALTEST02 | 1.98 | 3.95 | 8.00 | 4.52 |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

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# B-4002 ACOUSTIC TELEVIEWER FIELD LOG

SITE: VOGTLE COL DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4002 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96'; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈70' TIME SINCE LAST CIRCULATION: ≈4 HR

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SITE: VOGTLE COL B-4002 DATE: 2/15/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 07:00
ARRIVED ON SITE: 07:45
STANDBY TIME: CAUSE:
LOGGING STARTED: 17:07 LOGGING COMPLETED: 17:18

WINCH: COMPROBE ___ SILVER ✓ OYO ___ OTHER ___
MICROLOGGER 5310 ~~5301~~ ✓ 5772 ___
TELEVIEWER ACOUSTIC #5174 ✓ OTHER ___

PROBE TILT TEST 90.5° BRUNTON TILT 91°
PROBE TILT TEST 4.1° BRUNTON TILT 4°
PROBE TILT TEST 0.6° BRUNTON TILT 0° AFTER LOG
PROBE AZIMUTH TEST 292.8° BRUNTON AZIMUTH 296°
PROBE AZIMUTH TEST 168.4 BRUNTON AZIMUTH 169°
PROBE AZIMUTH TEST 96.3 BRUNTON AZIMUTH 95° AFTER LOG

| | | |
|---|---|---|
| PROBE OFFSET | 1.44M(4.72FT) | |
| MINUS CASING STICK-UP | -2.4 | |
| DEPTH REF. OFFSET AT START | 2.32' | |
| DEPTH REF. OFFSET AT END | 2.33 | |
| AFTER SURVEY DEPTH ERROR | +0.01 | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4002ANUP01 | 248.0' | 17:07 | Ø | 17:18 |
| | | | | |
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MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

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# B-4003 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL ____ PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO ____ 6" PVC
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B4003ELOGTEST01 | Ø | 12/14/07 | 08:54 - 08:57 |
| ELOG/GAMMA | B4003ELOGUP01 | 250.8 - 20.0' | " | 09:45 - 10:09 |
| SUSPENSION PS | B403_001 → 129.0DAT | 3.3 - 211.6' | " | 10:40 - 12:16 |
| SUSPENSION PS | B403_130 → 173.0DAT | 167.3 - 237.9' | " | 15:20 - 15:44 |
| CALIPER TEST | B4003 CALTEST01 | Ø | " | 16:03 - 16:06 |
| CALIPER/GAMMA | B4003 CALUP01 | 247.0 - Ø' | " | 16:14 - 16:38 |
| CALIPER TEST | B4003CALTEST02 | Ø | " | 16:47 - 16:51 |
| DEVIATION | B4003AUUP01 | 250.0 - Ø | " | 17:08 - 17:22 |
| DEVIATION | B4003AUUP02 | 250.0 - Ø | " | 17:27 - 17:38 |
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# B-4003 BORING GEOPHYSICS FIELD LOG SUMMARY

SITE: VOGTLE COL DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 1

CONTACT: MATT COOKE CELL PHONE: 803-261-5792

BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' 6" PVC ; NO ____
DEPTH TO BEDROCK: NA
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;

LOGGING CREW: R. STELLER

| LOG TYPE | FILE NAME | DEPTH RANGE | DATE | TIMES |
|---|---|---|---|---|
| ELOG TEST | B4003ELOGTEST01 | Ø | 12/14/07 | 08:54 - 08:57 |
| ELOG/GAMMA | B4003ELOGUP01 | 250.8 - 20.0' | " | 09:45 - 10:09 |
| SUSPENSION PS | B403_001 → 129.0RG | 3.3 - 211.6' | " | 10:40 - 12:16 |
| SUSPENSION PS | B403_130 → 178.0RG | 167.3 - 237.9' | " | 15:20 - 15:44 |
| CALIPER TEST | B4003 CALTEST01 | Ø | " | 16:03 - 16:06 |
| CALIPER/GAMMA | B4003 CALUP01 | 247.0 - Ø' | " | 16:14 - 16:38 |
| CALIPER TEST | B4003CALTEST02 | Ø | " | 16:47 - 16:51 |
| DEVIATION | B4003AUXP01 | 250.0 - Ø | " | 17:08 - 17:22 |
| DEVIATION | B4003AUXP02 | 250.0 - Ø | " | 17:27 - 17:38 |
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# B-4003 ELOG FIELD LOG

SITE: VOGTLE COL DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL CONTACT: MATT COOKE
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4003 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: 70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: Ø TIME SINCE LAST CIRCULATION: 1 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 06:45
ARRIVED ON SITE: 07:30
STANDBY TIME: CAUSE:
LOGGING STARTED: 08:54 LOGGING COMPLETED: 10:09

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SITE: VOGTLE COL B - 4003 DATE: 8/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE____ SILVER ✓ OYO____ OTHER____
MICROLOGGER 5310 ~~5304~~ ✓ 5772____ OTHER____
ELOG PROBE 5490 ✓ OTHER____

| | | |
|---|---|---|
| PROBE LENGTH | 2.50M(8.20 FT) | |
| PLUS YOKE 10.0M (32.8 FT) | + 32.8 | |
| MINUS CASING STICK-UP | - 2.5 | |
| DEPTH REF. OFFSET AT START | 38.5' | |
| DEPTH REF. OFFSET AT END | 38.45' | |
| AFTER SURVEY DEPTH ERROR | -0.05 | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4003 ELOG TEST01 | Ø | 08:54 | Ø | 08:57 |
| B4003 ELOG UP 01 | 250.0 | 09:45 | 20.0' | 10:09 |
| | | | | |
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| | | | | |

MAINTENANCE PERFORMED ON SITE:____

EQUIPMENT PROBLEMS OR FAILURES:____

SUGGESTIONS, ADDITIONS, CHANGES:____

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# P-S SUSPENSION VELOCITY FIELD LOG

SITE: VOGTLE COL B-4003 DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 6

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4003 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' 6" PVC ; NO ____
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: Ø TIME SINCE LAST CIRCULATION: ≈2HR

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SITE: VOGTLE COL B-4003 DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 6

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 06:45
ARRIVED ON SITE: 07:30
STANDBY TIME: CAUSE:
LOGGING STARTED: 10:40 LOGGING COMPLETED: 12:16
STANDBY TIME: CAUSE:
RUN 3 LOGGING STARTED: 15:20 LOGGING COMPLETED: 15:44
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES ✓; NO ____; STORED WITH NEW ____

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WINCH | COMPROBE ☐ | | GREY ☐ | OYO ☐ | RG ☐ | OTH ☑ | | |
| INSTRUMENT | OYO 12004 ☐ | 15014 ☐ | 19029 ☐ | RG 160023 ☐ | 160024 ☑ | | | |
| RECEIVER S/N | 12008 ☐ | 20042 ☐ | 26066 ☐ | 11001 ☐ | 23053 ☐ | 30086 ☑ | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES: HIT OBSTACLE @ 51.0 m - SPUDDED & BROKE SHOT CONTROL WIRE IN RECEIVER OR ISOLATION TUBE. REWIRED & DATA COLLECTED TO BOTTOM OF HOLE.

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: DEPTH REF @ START = 2.5 m - .76 m = 1.74 m
@ EXIT RUN 1 = 1.70 m
@ EXIT RUN 2 = 1.73 m
@ EXIT RUN 3 = 1.72 m

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# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4003 DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 3 OF ~~5~~ 6
RAS 2/14/07

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 0.5 | 1.64 | | | |
| 1.0 | 3.28 | 1 | | |
| 1.5 | 4.92 | 2 | | |
| 2.0 | 6.56 | 3 | | |
| 2.5 | 8.20 | 4 | | |
| 3.0 | 9.84 | 5 | | |
| 3.5 | 11.48 | 6 | | |
| 4.0 | 13.12 | 7 | | |
| 4.5 | 14.76 | 8 | | |
| 5.0 | 16.40 | 9 | | |
| 5.5 | 18.04 | 10 | | |
| 6.0 | 19.69 | 11 | | |
| 6.5 | 21.33 | 12 | | |
| 7.0 | 22.97 | 13 | | |
| 7.5 | 24.61 | 14 | | |
| 8.0 | 26.25 | 15 | | |
| 8.5 | 27.89 | 16 | | |
| 9.0 | 29.53 | 17 | | |
| 9.5 | 31.17 | 18 | | |
| 10.0 | 32.81 | 19 | | |
| 10.5 | 34.45 | 20 | | |
| 11.0 | 36.09 | 21, 22 | | DO NOT USE RECORD 21. |
| 11.5 | 37.73 | 23 | | |
| 12.0 | 39.37 | 24 | | |
| 12.5 | 41.01 | 25 | | |
| 13.0 | 42.65 | 26 | | |
| 13.5 | 44.29 | 27 | | |
| 14.0 | 45.93 | 28 | | |
| 14.5 | 47.57 | 29 | | |
| 15.0 | 49.21 | 30 | | |
| 15.5 | 50.85 | 31 | | |
| 16.0 | 52.49 | 32 | | GOOD SH SIGNAL ✓ |
| 16.5 | 54.13 | 33 | | |
| 17.0 | 55.77 | 34 | | |
| 17.5 | 57.41 | 35 | | |
| 18.0 | 59.06 | 36 | | |
| 18.5 | 60.70 | 37 | | |
| 19.0 | 62.34 | 38 | | |
| 19.5 | 63.98 | 39 | | |
| 20.0 | 65.62 | 40 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4003 DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 4 OF ~~5~~ 6 RAS 2/14/07

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 20.5 | 67.26 | 41 | | |
| 21.0 | 68.90 | 42 | | |
| 21.5 | 70.54 | 43 | | |
| 22.0 | 72.18 | 44 | | |
| 22.5 | 73.82 | 45 | | |
| 23.0 | 75.46 | 46 | | |
| 23.5 | 77.10 | 47 | | |
| 24.0 | 78.74 | 48 | | |
| 24.5 | 80.38 | 49 | | |
| 25.0 | 82.02 | 50 | | |
| 25.5 | 83.66 | 51 | | |
| 26.0 | 85.30 | 52 | | |
| 26.5 | 86.94 | 53 | | |
| 27.0 | 88.58 | 54 | | |
| 27.5 | 90.22 | 55 | | |
| 28.0 | 91.86 | 56 | | |
| 28.5 | 93.50 | 57 | | GOOD RECORDS - TOP OF MARL? |
| 29.0 | 95.14 | 58 | | |
| 29.5 | 96.78 | 59 | | |
| 30.0 | 98.43 | 60 | | |
| 30.5 | 100.07 | 61 | | |
| 31.0 | 101.71 | 62 | | |
| 31.5 | 103.35 | 63 | | |
| 32.0 | 104.99 | 64 | | |
| 32.5 | 106.63 | 65 | | |
| 33.0 | 108.27 | 66 | | |
| 33.5 | 109.91 | 67 | | |
| 34.0 | 111.55 | 68 | | |
| 34.5 | 113.19 | 69 | | |
| 35.0 | 114.83 | 70 | | |
| 35.5 | 116.47 | 71 | | |
| 36.0 | 118.11 | 72 | | |
| 36.5 | 119.75 | 73 | | |
| 37.0 | 121.39 | 74 | | |
| 37.5 | 123.03 | 75 | | |
| 38.0 | 124.67 | 76 | | |
| 38.5 | 126.31 | 77 | | |
| 39.0 | 127.95 | 78 | | |
| 39.5 | 129.59 | 79 | | |
| 40.0 | 131.23 | 80 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-4003 DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE ~~4~~ 5 OF ~~5~~ 6 RAS 2/14/07

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|---|
| 40.5 | 132.87 | 81 | | | |
| 41.0 | 134.51 | 82 | | | |
| 41.5 | 136.15 | 83 | | | |
| 42.0 | 137.80 | 84 | | | |
| 42.5 | 139.44 | 85 | | | |
| 43.0 | 141.08 | 86 | | | |
| 43.5 | 142.72 | 87 | | | |
| 44.0 | 144.36 | 88 | | | |
| 44.5 | 146.00 | 89 | | | |
| 45.0 | 147.64 | 90 | | | |
| 45.5 | 149.28 | 91 | | | |
| 46.0 | 150.92 | 92 | | | |
| 46.5 | 152.56 | 93 | | | |
| 47.0 | 154.20 | 94 | | | |
| 47.5 | 155.84 | 95 | | | |
| 48.0 | 157.48 | 96 | | | |
| 48.5 | 159.12 | 97 | | | |
| 49.0 | 160.76 | 98 | | | |
| 49.5 | 162.40 | 99 | | | |
| 50.0 | 164.04 | 100 | | | |
| 50.5 | 165.68 | 101 | | | |
| 51.0 | 167.32 | 102 | 130 | | HIT OBSTACLE. |
| 51.5 | 168.96 | 103 | 131 | | PROBE FAILURE - |
| 52.0 | 170.60 | 104 | 132 | | SOURCE REVERSAL NOT |
| 52.5 | 172.24 | 105 | 133 | | FUNCTIONAL - DATA CONTINUED |
| 53.0 | 173.88 | 106 | 134 | | AS S/H ARRIVAL IS UNAMBIGIOUS. |
| 53.5 | 175.52 | 107 | 135 | | |
| 54.0 | 177.17 | 108 | 136 | | |
| 54.5 | 178.81 | 109 | 137 | | |
| 55.0 | 180.45 | 110 | 138 | | |
| 55.5 | 182.09 | 111 | 139 | | |
| 56.0 | 183.73 | 112 | 140 | | |
| 56.5 | 185.37 | 113 | 141 | | |
| 57.0 | 187.01 | 114 | 142 | | |
| 57.5 | 188.65 | 115 | 143 | | |
| 58.0 | 190.29 | 116 | 144 | | |
| 58.5 | 191.93 | 117 | 145 | | |
| 59.0 | 193.57 | 118 | 146 | | |
| 59.5 | 195.21 | 119 | 147 | | |
| 60.0 | 196.85 | 120 | 148 | | |

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: VOGTLE COL B-0003 DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 56 OF 56
RAS 2/14/07

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 60.5 | 198.49 | 121 149 | | |
| 61.0 | 200.13 | 122 150 | | |
| 61.5 | 201.77 | 123 151 | | |
| 62.0 | 203.41 | 124 152 | | |
| 62.5 | 205.05 | 125 153 | | |
| 63.0 | 206.69 | 126 154 | | |
| 63.5 | 208.33 | 127 155 | | |
| 64.0 | 209.97 | 128 156 | | |
| 64.5 | 211.61 | 129 157 | | HIT OBSTACLE @ 65 m. => TD @ 225' |
| 65.0 | 213.25 | ~~130~~ 158 | | |
| 65.5 | 214.90 | RAS 159 | | |
| 66.0 | 216.54 | 2/14/07 160 | | |
| 66.5 | 218.18 | 161 | | |
| 67.0 | 219.82 | 162 | | |
| 67.5 | 221.46 | 163 | | |
| 68.0 | 223.10 | 164 | | |
| 68.5 | 224.74 | 165 | | |
| 69.0 | 226.38 | 166 | | |
| 69.5 | 228.02 | 167 | | |
| 70.0 | 229.66 | 168 | | |
| 70.5 | 231.30 | 169 | | |
| 71.0 | 232.94 | 170 | | |
| 71.5 | 234.58 | 171 | | |
| 72.0 | 236.22 | 172 | | |
| 72.5 | 237.86 | 173 | | BOTTOM MEASUREMENT? |
| 73.0 | 239.50 | | | HIT BOTTOM @ 72.5 |
| 73.5 | 241.14 | | | DO NOT USE 173. |
| 74.0 | 242.78 | | | |
| 74.5 | 244.42 | | | |
| 75.0 | 246.06 | | | |
| 75.5 | 247.70 | | | |
| 76.0 | 249.34 | | | |
| 76.5 | 250.98 | | | T.D. @ 250' |
| 77.0 | 252.62 | | | |
| 77.5 | 254.27 | | | |
| 78.0 | 255.91 | | | |
| 78.5 | 257.55 | | | |
| 79.0 | 259.19 | | | |
| 79.5 | 260.83 | | | |
| 80.0 | 262.47 | | | |

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# B-4003 CALIPER FIELD LOG

SITE: VOGTLE COL DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4003 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED ____ UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250 ; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED: 250'
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' 6" PVC ; NO ____
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ____; FRESH WATER MUD ✓; SALT WATER MUD ____;
OTHER:
DEPTH TO BOREHOLE FLUID: Ø TIME SINCE LAST CIRCULATION: ≈1 HR

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 06:45
ARRIVED ON SITE: 07:30
STANDBY TIME: CAUSE:
LOGGING STARTED: 16:03 LOGGING COMPLETED: 16:51

*GEOVision Geophysical Services 1151 Pomona Road, Unit P, Corona, CA 92882 Ph (951) 549-1234 Fx (951) 549-1236*

SITE: VOGTLE COL B-4003 DATE: 12/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

WINCH: COMPROBE ____ SILVER ✓ OYO ____ OTHER ____
MICROLOGGER 5310 ~~5301~~ ✓ 5772 ____ OTHER ____
CALIPER PROBE 5368 ✓ OTHER ____

| | | |
|---|---|---|
| PROBE OFFSET | 2.08M(6.82 FT) 12 IN MAX | |
| MINUS CASING STICK-UP | 2.5 | |
| DEPTH REF. OFFSET AT START | 4.32' | |
| DEPTH REF. OFFSET AT END | 4.30 | |
| AFTER SURVEY DEPTH ERROR | -0.02 | LESS THAN 0.4%? YES |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4003 CALTEST01 | Ø | 16:03 | Ø | 16:06 |
| B4003 CALLUP01 | 247.0' | 16:14 | Ø | 16:38 |
| B4003 CALTEST02 | Ø | 16:47 | Ø | 16:51 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

CALIBRATION PLATE S/N 201

| | | AS BUILT | | | PVC FITTING |
|---|---|---|---|---|---|
| | | 1.968 IN | 3.937 IN | 8.000 IN | 4.507 IN |
| | FILE NAME | (50 MM) | (100 MM) | (203.2 MM) | (114.3 MM) |
| AS MEAS. | B4003 CALTEST01 | 1.97 | 3.93 | 8.00 | 4.53 |
| AS MEAS. | B4003CALTEST02 | 1.97 | 3.43 | 8.00 | 4.51 |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |
| AS MEAS. | | | | | |

MAINTENANCE PERFORMED ON SITE: ____

EQUIPMENT PROBLEMS OR FAILURES: ____

SUGGESTIONS, ADDITIONS, CHANGES: ____

*GEOVision Geophysical Services* *1151 Pomona Road, Unit P, Corona, CA 92882* *Ph (951) 549-1234 Fx (951) 549-1236*

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# B-4003 ACOUSTIC TELEVIEWER FIELD LOG

SITE: VOGTLE COL DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 1 OF 2

CONTACT: MATT COOKE OFFICE PHONE:
CELL PHONE: 803-261-5792
CONTACT: OFFICE PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
CONTACT: PHONE:
PHONE:
DRILLER: PHONE:
COMPANY: PHONE:

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

BOREHOLE DESIGNATION: B-4003 LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED ✓
DIAMETERS AND DEPTH RANGES: 6" 0 TO 250' ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 250' 6" PVC
CONDUCTOR CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 96' ; NO
DEPTH TO BEDROCK: NA DEPTH TO WATER TABLE: ≈70'
BOREHOLE FLUID: WATER ; FRESH WATER MUD ✓ ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ≈30' TIME SINCE LAST CIRCULATION: ≈2 HR

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SITE: VOGTLE COL B-4003 DATE: 2/14/07
CLIENT: MACTEC JOB: 6517
AUTHOR: R. STELLER PAGE 2 OF 2

LOGGING CREW: R. STELLER
VEHICLE(S) USED AND MILEAGE: RENTAL
MOBILIZED FROM: AUGUSTA, GA DEPARTURE TIME: 06:45
ARRIVED ON SITE: 07:30
STANDBY TIME: CAUSE:
LOGGING STARTED: 17:08 LOGGING COMPLETED: 17:38

WINCH: COMPROBE ___ SILVER ✓ OYO ___ OTHER ___
MICROLOGGER 5310 ~~5301~~ ✓ 5772 ___
TELEVIEWER ACOUSTIC #5174 ✓ OTHER ___

PROBE TILT TEST 90.3° BRUNTON TILT 90°
PROBE TILT TEST 24.4° BRUNTON TILT 24°
PROBE TILT TEST 0.5° BRUNTON TILT 0° AFTER LOG
PROBE AZIMUTH TEST 330.1° BRUNTON AZIMUTH 331°
PROBE AZIMUTH TEST 142.9° BRUNTON AZIMUTH 193°
PROBE AZIMUTH TEST 179.1° BRUNTON AZIMUTH 180° AFTER LOG

| | |
|---|---|
| PROBE OFFSET | 1.44M(4.72FT) |
| MINUS CASING STICK-UP | 2.5 |
| DEPTH REF. OFFSET AT START | 2.22 |
| DEPTH REF. OFFSET AT END | 2.20, 2.10 RUN 2 |
| AFTER SURVEY DEPTH ERROR | -0.02, -0.12' LESS THAN 0.4%? YES. |

| LOG NAME | START DEPTH | START TIME | END DEPTH | END TIME |
|---|---|---|---|---|
| B4003AMUP01 | 250.0' | 17:08 | Ø | 17:22 |
| B4003AMUP02 | 250.0' | 17:27 | Ø | 17:38 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

*GEOVision Geophysical Services* *1151 Pomona Road, Unit P, Corona, CA 92882* *Ph (951) 549-1234 Fx (951) 549-1236*

# APPENDIX E

# BORING GEOPHYSICAL LOGGING FIELD MEASUREMENT PROCEDURES

**MACTEC ENGINEERING & CONSULTING, INC.**

**CONTROLLED ISSUE DOCUMENT TRANSMITTAL RECEIPT**

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Date Sent: 10/27/06

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Copy 4 - Cooke

# VOGTLE ELECTRIC GENERATING PLANT UNITS 3 & 4 COL GEOTECHNICAL WORK PLAN REVISION 0

This Work Plan meets the Quality Assurance Program requirements for this project.

Controlled Document

Document Control No.: VGCOL-10
74 pages

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Date: 10/26/06

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## TABLE OF CONTENTS

*1* **INTRODUCTION** ..... **4**
1.1 DEFINITIONS ..... 4
1.2 ACRONYMS/ABBREVIATIONS ..... 5
*2* **SCOPE OF SERVICES** ..... **7**
2.1 PLANNING AND PERMITTING ..... 7
2.2 SURVEYING ..... 7
2.3 UNDERGROUND UTILITY LOCATION AND CLEARING ..... 8
2.4 FIELD EXPLORATION ..... 8
2.5 GEOTECHNICAL SERVICES SCHEDULE ..... 9
2.6 DRILLING AND SAMPLING ..... 9
2.7 CONE PENETRATION TESTS ..... 10
2.8 DOWNHOLE TESTING ..... 10
*2.8.1 P-S Seismic Velocity Logging ..... 10*
*2.8.2 Geophysical Logging ..... 10*
2.9 SURFACE GEOPHYSICAL TESTING ..... 10
*2.9.1 Field Electrical Resistivity Testing ..... 10*
*2.9.2 Refraction Microtremor Testing (ReMi) ..... 11*
2.10 FIELD RECORDS ..... 11
2.11 INSTRUMENTATION ..... 11
2.12 LABORATORY TESTING ..... 11
2.13 REPORTING ..... 13
*3* **ENGINEERING ANALYSES** ..... **14**
*4* **RESPONSIBILITIES** ..... **14**
4.1 PROJECT MANAGEMENT ..... 14
*4.1.1 Project Manager ..... 14*
*4.1.2 Technical Oversight ..... 14*
*4.1.3 Site Coordinator (Site Superintendent) ..... 15*
*4.1.4 Rig Geologist ..... 16*
*4.1.5 Downhole Geophysicist ..... 16*
*4.1.6 Surface Geophysicist ..... 16*
*4.1.7 CPT Supervisor ..... 17*
*4.1.8 Laboratory Services Manager ..... 17*
*4.1.9 Survey Party Chief ..... 17*
*4.1.10 Quality Assurance Representative ..... 17*
4.2 DRILLING SERVICE ..... 18
4.3 CONE PENETRATION TESTING (CPT) SUBCONTRACTOR ..... 18
4.4 DOWNHOLE GEOPHYSICAL SUBCONTRACTOR ..... 19
4.5 TEST PIT EXCAVATION ..... 19
4.6 SITE RESTORATION ..... 19
4.7 PROJECT SURVEY SUBCONTRACTOR ..... 20
*5* **QUALITY ASSURANCE PLAN** ..... **20**
*6* **REFERENCES AND STANDARDS** ..... **20**

## ATTACHMENTS

- ATTACHMENT 1: SURVEY DATA CONTROL ..... 1-1

- ATTACHMENT 2: DRILLING AND SAMPLING PROCEDURES ..... 2-1
- ATTACHMENT 3: CONE PENETRATION TEST PROCEDURES ..... 3-1
- ATTACHMENT 4: DOWNHOLE TEST PROCEDURES ..... 4-1
  - 4.1: P-S LOGGING ..... 4-2
  - 4.3 BOREHOLE GEOPHYSICAL LOGGING ..... 4-24
- ATTACHMENT 5: REFRACTION MICROTREMOR (REMI) TESTING ..... 5-1
- ATTACHMENT 6: ELECTRICAL RESISTIVITY TEST ..... 6-1
- ATTACHMENT 7: FIELD RECORDS AND SAMPLE CONTROL PROCEDURES ..... 7-1
- ATTACHMENT 8: LABORATORY CONTROL AND PROCEDURES ..... 8-1
- ATTACHMENT 9: ORGANIZATION CHART ..... 9-1

# 1 INTRODUCTION

This Work Plan for Subsurface Investigation and Laboratory Testing describes the planned geotechnical activities, based on the Bechtel Technical Specification, to be used for the inputs in preparation of the Combined Construction & Operation License (COL) application at the site of the Vogtle Electric Generating Plant – Units 3 and 4.

The scope of the program is contained in the Technical Specification for Subsurface Investigation, which is Bechtel Specification AR01-0000-XGS-2001, latest Revision.

## 1.1 DEFINITIONS

**Approved Subcontractors List** - a list of potential Subcontractor(s) that adequately meet the requirements of MACTEC's QAPD and QA procedures.

**Client** – Southern Nuclear Operating Company.

**Project Geotechnical Engineer** – Bechtel Power Corporation (BECHTEL)

**CONTRACTOR** – MACTEC Engineering and Consulting, Inc (MACTEC).

**Document Control Center** - A centralized location remote from the Project Site which is responsible for issuing unique document identification numbers and collecting the project records and data for archival and transmittal purposes.

**SNC** – Southern Nuclear Operating Company. SNC is the sponsor and Owner of this project.

**Project Geotechnical Services** - Those services necessary to accomplish the scope of work prescribed by the Specification. These services include drilling, well installation, surface and downhole geophysical testing, and laboratory testing.

**Project Principal** - Individual(s) assigned by MACTEC, having technical authority for MACTEC activities, technical work products, documentation, and quality.

**Quality Assurance (QA)** - Those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

**Rig Geologist** - Individual(s) assigned by MACTEC with responsibility for supervision/ observation of the drilling activities performed by their assigned crew, performing rig safety checks, documentation of work activities, and implementation of the Work Plan.

**Rig Geotechnical Engineer** – Same function as Rig Geologist, except individual is a geotechnical engineer by education or experience rather than a geologist.

**Site Coordinator** – See Site Superintendent.

**Site Superintendent** - Name applied to Site Coordinator function by the Specifications. Individual(s) assigned by MACTEC with responsibility for daily supervision of MACTEC and its

Subcontractor personnel, ongoing coordination of work activities, and implementation of the Work Plan.

**Subcontractor** - A person or firm that may be selected from MACTEC's Approved Subcontractors List.

**Work Instruction** - A written description of the assigned task to be performed in accordance with the Specification. The work instruction also identifies the procedures/methods to utilize in accordance with the Work Plan.

**Work Plan** - This written description of how the scope of work is to be performed. Includes labor, Subcontractors, equipment, and materials supplied by MACTEC.

**Specification** – Bechtel Technical Specification AR01-0000-XGS-2001, Version 1 Issued 9/20/06 Subsurface Investigation and Laboratory Testing. The specification describes the activities, location, type and number of tests (scope of work).

**Subsurface Investigation Location Plan** – Part of Specification consisting of Bechtel Drawings 0-CY-0000-00001, Revision A, and 0-CY-0000-00002, Revision A (SNC Drawings AR01-0000-XG-2004, Version A, and AR01-0000-XG-2005, Version A).

## 1.2 ACRONYMS/ABBREVIATIONS

| | |
|---|---|
| **AP1000** | Nuclear Technology by Westinghouse |
| **ASTM** | American Society for Testing and Materials |
| **COC** | Chain of Custody |
| **COL** | Combined Construction and Operating License |
| **CPT** | Cone Penetration Test or Sounding |
| **DCC** | Document Control Center |
| **Bechtel** | Bechtel Power Corporation |
| **EPA** | Environmental Protection Agency |
| **gINT** | Geotechnical Data Presentation Software |
| **GPS** | Global Positioning System |
| **MACTEC** | MACTEC Engineering and Consulting, Inc. |
| **M&TE** | Measuring and Test Equipment |
| **MSDS** | Material Safety Data Sheet |
| **NIST** | National Institute of Standards and Technology |
| **NRC** | Nuclear Regulatory Commission |
| **OSHA** | Occupational Safety and Health Agency |
| **OW** | Observation Well |
| **PM** | Project Manager |
| **QA** | Quality Assurance |
| **QAPD** | Quality Assurance Project Document |
| **QAR** | Quality Assurance Representative |

| | |
|---|---|
| **SPT** | Standard Penetration Test |
| **SSI** | Soil Structure Interaction |
| **USACE** | US Army Corps of Engineers |
| **WI** | Work Instruction |

# 2 SCOPE OF SERVICES

The scope of services, described in the Specification and in this work plan will consist of field exploration, laboratory testing, and geotechnical testing. One or more Geotechnical Data Report(s) will be prepared to provide the data from which engineering properties of soils can be evaluated.

The following sections describe the scope for implementing the field exploration program, laboratory testing and reporting activities.

## 2.1 PLANNING AND PERMITTING

Working conditions are identified and addressed prior to the start of field activities. The work sequence and schedule are outlined in a separate document from this Work Plan because the sequence and schedule are subject to updates as the work progresses. Planning and Permitting Activities include:

1. Obtaining permits necessary to perform the work, including permission for site access and right of way.
2. Preparing and submitting a Quality Assurance Project Document (QAPD);
3. Establishment of a Document Control Center (DCC);
4. Evaluating resource availability for supervision, labor, equipment, tools, supplies, and materials necessary to perform the scope of work described in the Specification which is the basis for this document;
5. Coordinating exploration efforts and schedule with Bechtel;
6. QA Evaluation of Subcontractors and qualification for site work; and
7. Preparing a Work Activity Schedule.

## 2.2 SURVEYING

Surveying will be performed by the SNC. We understand that test locations identified in the Boring Location Plan of the Specification will initially be field-located using GPS or field measurement methods by SNC Surveyors. The precise locations will be established based on accessibility by the drilling and geophysical testing equipment. If boring or test locations must be relocated due to access limitations, the relocation must be approved by Bechtel and SNC. A field sketch or written description will be prepared indicating the field-located boring or test locations showing distances to the specified points established prior to MACTEC's work. All field-located points will be marked for precise survey location (see below).

After the field exploration, we understand surveying will be performed by SNC to locate the borings, CPTs, test pits, electrical resistivity tests, and other reference points as necessary. The surveying to establish the as-drilled locations and elevations of each test location will be performed under a separate work plan and quality assurance program by others (See Attachment 1).

## 2.3 UNDERGROUND UTILITY LOCATION AND CLEARING

Underground utilities will be evaluated as noted in Attachment 2, Drilling and Sampling Procedures.

Following layout of the boring and CPT locations, access roads will be cleared to the proposed locations and work pads cleared or constructed, as needed. MACTEC understands that SNC can provide a bulldozer and operator for this purpose. Some areas are wooded with planted pine trees. We understand that we have permission to cut these trees to facilitate access to the boring and cone penetration test locations. Specific boring locations may require clearing, construction of roads, and placement of some bridging soils and/or periodic improvements during the course of the investigation. We understand that SNC personnel and equipment will be available for this, as needed.

Borings for the raw water intake structure are located at low elevations in the floodplain of the Savannah River near sensitive wetland areas. MACTEC will make every effort to minimize disturbance in these areas. However, some felling of trees and other hand clearing may be required to provide access to our drilling equipment. MACTEC will coordinate with SNC and Bechtel regarding specific measures required for access into this area. Mechanized (bulldozer) clearing will not be performed in these areas unless specifically authorized by SNC.

## 2.4 FIELD EXPLORATION

The field testing methods may include:

- Standard Penetration Testing (SPT);
- Undisturbed Sampling using Shelby Tube or Pitcher Samplers;
- Seismic borehole velocity measurements (P-S logging);
- Borehole Geophysical Logging
- Cone Penetration Test (CPT) Soundings with pore water pressure measurements, pore pressure dissipation tests (select locations), and downhole seismic tests (select locations);
- Field Electrical Resistivity Testing;
- Refraction Microtremor Testing
- Surveying of the borings and other test locations (by SNC);
- Test Pit Excavation;
- Borehole Sealing/Grouting; and
- Technical Observation and Oversight.

The program contained in the Specification is based upon expected or assumed conditions to be found during the field investigation. Revisions during the program may be made by Bechtel depending on actual site-specific subsurface conditions discovered as part of this program.

The specific number of exploratory borings established in the Specification was configured to:

- Obtain data to meet NRC requirements;
- Meet AP1000 vendor recommendations necessary to perform the SSI analyses; and
- Satisfy NRC Regulatory Guide 1.132 criteria related to boring spacing and depth for safety and non-safety facilities.

The boring locations and depths are presented in the Specification, which presents the detailed scope of the subsurface exploration and field-testing program for the primary structures or site elements. The Specification should be viewed in conjunction with this work plan as it lists the specific locations and depths of borings and CPTs. The types of tests associated with the field test locations are also assigned by the Specification. A Work Instruction will be prepared by the Site Coordinator or Project Principal and supplied to the Rig Geologist or Subcontractor before each activity type.

## 2.5 GEOTECHNICAL SERVICES SCHEDULE

A schedule of geotechnical activities has been developed. The schedule is referenced in this Work Plan rather than included due to its dynamic nature. It is planned that the various geotechnical field data collection tasks will be substantially completed in late February 2007; field activities are scheduled to begin on October 30, 2006. The schedule will be reviewed on an ongoing basis. If inclement weather or other events cause schedule pressure, MACTEC is prepared to mobilize additional resources to the site in order to maintain the project deadlines. Events beyond the control of MACTEC (such as unexpected changed conditions, Client postponement or cease work orders) that cause significant project delays in some activities may cause slippage of the end date even with additional applied resources.

## 2.6 DRILLING AND SAMPLING

MACTEC will supply drill rig(s) mounted on trucks, ATV-carriers or other rigs capable of performing the expected types of drilling required to execute the proposed borings. Both disturbed and undisturbed samples of soil are planned. Disturbed samples (SPT samples) will be obtained at the depths called for in the Specification. The undisturbed samples will be obtained (or attempted) at the depths to be determined by Bechtel based on the exploration results. Recovered samples will be classified, labeled, sealed and handled as in accordance with Attachment 2 (Drilling and Sampling Procedures) of this work plan.

Depths to fluid levels in boreholes will be made during the drilling activities. During mud rotary wash drilling, it is understood that the fluid levels in the boreholes may not reflect the ground-water level.

Boreholes will be abandoned before final demobilization from the borehole site by placement of a bentonite-cement grout mixture. Borings for geophysical logging may be left open for several days after drilling and before geophysical logging. After completion of geophysical logging activities, these borings will also be abandoned as discussed above. A wooden survey stake will be placed for identification of the as-drilled location by the surveyor.

The field records produced, and the samples collected by the Rig Geologist will be controlled following the procedures provided in Attachment 7 (Field Records and Sample Control Procedures).

## 2.7 CONE PENETRATION TESTS

Cone penetration tests (CPTs) will be conducted by a Subcontractor at the depths/locations described in the Specification. The CPTs will be pushed to refusal that is estimated to be encountered near a depth of 120 feet. Based on our previous experience at the site, CPT refusal may occur near the top of the Marl layer at depths shallower than 120 feet. If refusal occurs at a depth that is unacceptable to SNC/Bechtel, we will coordinate regarding how to proceed. It may be necessary to advance CPT probes by drilling through hard zones or obstructions. CPT testing will be performed in accordance with the procedures and controls described in Attachment 3 of this Work Plan. The field records produced by the Subcontractor and collected by the Rig Geologist will be controlled following the procedures provided in Attachment 7.

## 2.8 DOWNHOLE TESTING

Geophysical downhole testing will be conducted by Subcontractors at the depths/locations described in the Specification. The field records produced by the Subcontractor and submitted to the Site Coordinator will be controlled following the procedures provided in Attachment 7.

### 2.8.1 P-S Seismic Velocity Logging

P-S seismic velocity logging will be conducted by a Subcontractor at the boring locations described in the Specification. P-S logging will be performed in accordance with the procedures described in Attachment 4 of this Work Plan. The field records will be controlled following the procedures provided in Attachment 7.

### 2.8.2 Geophysical Logging

Geophysical logging consisting of natural gamma, long-and-short – normal resistivity, three arm caliper, and directional survey will be conducted by a Subcontractor at the boring locations described in the specification. The procedures are described in ASTM D 5753, Standard Guide for Planning and Conducting Borehole Geophysical Logging. The field records will be controlled following the procedures provided in Attachment 7.

## 2.9 SURFACE GEOPHYSICAL TESTING

### 2.9.1 Field Electrical Resistivity Testing

Surface geophysical testing (Electrical Resistivity testing) will be conducted by MACTEC or a Subcontractor at the locations described in the Specification or as determined by Bechtel. Surface geophysical testing will be performed in accordance with the procedures and control described in Attachment 6 of this Work Plan. The field records will be controlled following the procedures provided in Attachment 7.

### 2.9.2 Refraction Microtremor Testing (ReMi)

ReMi testing will be conducted by MACTEC or a Subcontractor at the locations described in the Specification or as determined by Bechtel. ReMi testing will be performed in accordance with the

procedures and control described in Attachment 5 of this Work Plan. The field records will be controlled following the procedures provided in Attachment 7.

## 2.10 FIELD RECORDS

MACTEC will supply a Rig Geologist or Rig Engineer for each drill rig during the drilling and sampling. The Rig Geologist will keep records of drilling conditions as described in Attachment 2. Subcontractors for the cone penetration testing and downhole testing will provide previously qualified individuals to perform the test and create field records of their work in accordance with Attachments 3 and 4. Field recordkeeping will be performed in accordance with the procedures and controls described in Attachment 7 of this Work Plan.

The Site Coordinator will collect and review the field records for conformance to the Specification and to MACTEC's QA requirements.

## 2.11 INSTRUMENTATION

Long-term monitoring instrumentation will not be utilized during the COL phase of this project.

## 2.12 LABORATORY TESTING

Description of Materials to be Sampled and Tested

Based on subsurface information obtained on the site during ESP activities conducted in Fall of 2005, we anticipate the following materials will be encountered during drilling activities at the site:

Coastal Plain Soils – We anticipate that the Coastal Plain soils encountered in this exploration will consist of Paleocene to Eocene aged marine and deltaic sediments. We anticipate that the materials encountered will consist of sands with varying silt and clay content, silts, clays, and marl. The deepest borings currently planned on the site (400 feet) will likely terminate in the Paleocene Black Mingo Formation.

Existing Concrete – Portions of the site may contain concrete slabs of former warehouses used during construction of the existing Vogtle Electric Generating Station.

Existing Man-Made Fill Soil – Due to the site's close proximity to the existing power plant, it is possible that site grading may have left some man-made fill soils that will be encountered.

Alluvial Soil - In some portions of the site, soils washed from higher ground may have settled to form alluvial deposits. Significant amounts of alluvial soil are not expected within the power block areas. Significant amounts of alluvial soils may be encountered within the floodplain of the Savannah River in borings for the new raw water intake structure.

The borings will obtain samples of all the preceding materials except possibly the concrete and alluvial soils.

The following sample types are planned or anticipated for each soil type:

- Coastal Plain Soils, Alluvium
  Existing Fill: SPT samples

  SPT <~30 Push tubes (ASTM D 1586)

  SPT >~30 Pitcher Barrel Samples (EM 1110-1-1804, USACE)

- Existing Concrete: No samples planned.

- Groundwater: No samples planned.

Existing Fill or Coastal Plain Soils in Test Pits:

- Test Pits: Bulk samples of each major soil type encountered as directed by Bechtel, with accompanying sealed jar samples.

Laboratory testing will be performed in accordance with the procedures and controls described in Attachment 8 of this Work Plan.

Number of Laboratory Tests Planned

The laboratory testing will involve tests on disturbed and undisturbed soil samples. Tests for compressibility, static strength and dynamic property tests will be performed. The tests will be performed in general accordance with ASTM procedures or other applicable standards (References and Standards in the Attachment).

The laboratory tests will be performed at MACTEC's Atlanta, Georgia, Charlotte, NC, or Raleigh, NC office (except for tests assigned to a MACTEC-qualified Subcontractor). The number and type of specific laboratory tests will be determined by Bechtel from the results of the field exploration program.

Distribution of Test Types

Based on the Specification it is expected that the types of tests that will be performed are those summarized in Table 8.1 of Attachment 8.

The number of tests for each material type is determined by Bechtel based on conditions encountered; at the time of this revision to the Work Plan, the approximate total number of tests planned is shown in Table 8.1. The total number of tests shown in Table 8.1 in Attachment 8 is subject to some change as the work progresses due to such factors as insufficient volume of sample to perform all the tests assigned to that sample.

Specialized laboratory testing will be performed by Subcontract laboratories or University laboratories. It is expected that the following types of specialized tests may be performed:

- Resonant Column/Torsional Shear
- Chemical Analysis (soil pH, chloride, sulfate)

## 2.13 REPORTING

A data report with Attachments will be developed and issued as a project design basis document. The main elements of the data report will include the following:

1. Introduction
2. Scope of Work
    a. Number of tests or locations
    b. Locations where testing was performed
3. Methodology
    a. How was testing performed (detailed description of field or lab equipment and also of test procedure if not covered by ASTM)
    b. What procedures were used or followed
    c. List of firms who performed the tests
4. QA Procedures
    a. How was quality assurance maintained and documented
5. Results
    a. Data from test or procedure (either in the data report or in an Attachment thereto)
    b. Logs or figures
        - Hard copies (either in the data report or in an Attachment thereto)
        - Electronic Data (either in the data report or in an Attachment thereto)
        - Calibration Reports (Calibration Records will be submitted to Bechtel during the course of the project prior to testing activities as required by the Specification. Copies of these records will be stored in the DCC and will be available upon special request)

# 3 ENGINEERING ANALYSES

Engineering analyses will not be performed as part of this work plan. Engineering analyses utilizing the results in the Geotechnical Data Reports described in Section 2.15 herein will be performed under a separate work plan and quality assurance plan by others.

# 4 RESPONSIBILITIES

## 4.1 PROJECT MANAGEMENT

MACTEC has the project management responsibilities for the geotechnical data collection tasks associated with this work plan.

Attachment 9 presents a chart of the management, staff, and functional groups within the organization that will have direct involvement on this project.

### 4.1.1 Project Manager

The Project Manager (PM) is to function as the lead management authority responsible for the preparation of the Work Plan and the management, scoping, and execution of the assigned project tasks. The PM will provide assistance during project inception and will have lead responsibility for the management and execution of the project.

The Project Manager (PM) is to function as a centralized authority responsible for the management and execution of the geotechnical services associated with this Work Plan.

Specific responsibilities of the PM include:

- Administer procurement of MACTEC Subcontractors and equipment in accordance with the QAPD;
- Preparation and issuance of project documents, including QAPD and Work Plans;
- Provide appropriate, qualified resources to support the project tasks and schedule;
- Coordinate work among different groups for efficient scheduling;
- Provide procurement contract administration for MACTEC activities and Subcontractor services;
- Process and administer scope of work changes; and
- Communicate with Bechtel and SNC personnel on overall program activities.

### 4.1.2 Technical Oversight

The Principal Geotechnical Engineer(s) are responsible for:

- Interfacing with representatives of Bechtel and SNC on technical issues;
- Technical requirements for field, laboratory and geotechnical assessment and functions;
- Establishing QA requirements in conjunction with the project QA Representative;
- Technical direction of geotechnical field and laboratory activities, and engineering oversight;
- Technical review of required technical documents including QAPDs;
- Implementation of QA/QC Program Procedures;

- Establishment of the technical and quality requirements for the project;
- Oversight of laboratory testing;
- Providing Bechtel and SNC with copies of draft and final data reports;
- Establishing that the requested tasks will be performed using the procedures invoked by this document and the associated QAPD;
- Assessing the project technical and quality requirements and in consultation with the Project Manager determining MACTEC's capability to properly perform the requested tasks;
- Evaluating the project staff qualifications, MACTEC's capabilities, and assuring that MACTEC and Subcontractor personnel are documented as qualified to perform the work within the project specific requirements; and
- Evaluating with the QAR and/or Project Manager the following criteria to determine capability:

    1. QA Training;
    2. Technical training and qualifications;
    3. Equipment capability;
    4. Proper procedures in place;
    5. Subcontractor status, as applicable;
    6. Need for a Readiness Review.

- Informing the appropriate project personnel of training to be performed or other necessary special actions to be accomplished in support of the project
- Examining the QAPD and ascertain and document that the client requirements and its invoked documents are adequately addressed by the QAPD.
- Ensuring that any special client requirements which are not invoked in the MACTEC QA Program are listed in the QAPD.

### 4.1.3 Site Coordinator (Site Superintendent)

The Site Coordinator (Site Superintendent) is the on-site technical person in charge of the day-to-day field activities. The Site Coordinator will be responsible for the following:

- Daily supervision of the field drilling crew(s), surface geophysical crew, downhole geophysical Subcontractor(s), cone penetration testing Subcontractor, and other site personnel;
- Coordination of MACTEC activities with Bechtel and SNC site representatives;
- Supervising documentation of the field test results (daily field boring logs and other documents);

- Ongoing coordination of MACTEC work activities, and implementation of the Work Plan;
- Updating Principals and PMs, with periodic progress reports (at least once per work shift, either weekly or 10 days), scheduling impact issues, and the like; and
- Serving as Site Safety Officer for MACTEC.

### 4.1.4 Rig Geologist

The Rig Geologist (or a Rig Geotechnical Engineer) supplied by MACTEC will be assigned as full-time with a drill rig. The duties of this person include:

- Monitoring the conduct of the drilling or testing operations for conformance to specified procedures;
- Documenting sample or test depths and test results;
- Maintaining a field log for the boring, including classification of materials recovered and recovery.
- Placing samples into the sample storage facility; and
- Providing the Site Coordinator with input for progress reports.

### 4.1.5 Downhole Geophysicist

The Downhole Geophysicist is one or more employee(s) of the specialty Downhole Geophysical Subcontractor and will be assigned as full-time with a borehole logging rig. Tests consist of P-S velocity logging and geophysical logging. The duties of this person include:

- Monitoring the conduct of the borehole logging operations for conformance to procedures;
- Documenting test depths, procedures and test results;
- Maintaining a field log and electronic record for the operation;
- Providing the Site Coordinator with input for progress reports;
- Providing a duplicate field log and electronic record to the Site Coordinator; and
- Periodic transmission of reduced data to MACTEC project manager.

### 4.1.6 Surface Geophysicist

The Surface Geophysicist may be a MACTEC employee or a Subcontractor. The duties of the Surface Geophysicist include:

- Monitoring the conduct of or performing the surface geophysics operations for conformance to specified procedures;
- Documenting test locations, procedures and test results;
- Maintaining a field log and electronic record for the test;
- Coordinating transport of duplicates of the data records to the site storage facility and;
- Providing the Site Coordinator with input for progress reports.
- Periodic transmission of data to the MACTEC project manager.

### 4.1.7 CPT Supervisor

The CPT Supervisor is an employee of the Cone Penetration Test (CPT) Subcontractor. The duties of the CPT Supervisor include:

- Performing the CPT test in accordance with the applicable procedures and at the locations and depths assigned by the Site Coordinator or his representative;
- Providing a field log and duplicate electronic record, including calibration data, to the Site Coordinator;
- Providing the Site Coordinator with input for the progress reports; and
- Periodic transmission of reduced data to the MACTEC PM.

### 4.1.8 Laboratory Services Manager

The Laboratory Services Manager is the MACTEC technical person in charge of the day-to-day laboratory testing activities. The Laboratory Services Manager will be responsible for the following:

- Supervision of the MACTEC laboratory staff and other MACTEC Subcontractor laboratories,
- Preparation of periodic progress reports;
- Documentation of the laboratory test results;
- Updating Principal and PM with progress reports, scheduling impact issues, and the like.

### 4.1.9 Survey Party Chief

Surveying will be performed by SNC under a separate quality assurance program. However, the surveyor's duties typically include:

- Locating the as-drilled borings, CPTs, test pits and other reference points as necessary;
- Documenting that the surface elevations will be obtained at the locations referenced to the provided site datum;
- Documenting that horizontal surveying will meet the accuracies required by the Specification;
- Maintaining field notebooks sufficient to reproduce the survey results, if necessary;
- Storage of duplicate field notes at the office trailer/facility for future retrieval;
- Providing the MACTEC Site Coordinator with input for progress reports;
- Providing survey results as Microsoft excel worksheets.

### 4.1.10 Quality Assurance Representative

The MACTEC Quality Assurance Representative (QAR) is responsible for:

- Performing independent surveillance and inspection of activities (performed as a function of this Work Plan) to assure compliance with applicable procedures, codes and standards;
- Providing Quality Oversight over geotechnical laboratory activities; and
- Review of QAPD and Work Plan.

Copies of these QA documents (latest revision) will be available to project personnel for use as appropriate:

*MACTEC QUALITY ASSURANCE MANUAL*
*MACTEC EQUIPMENT CALIBRATION MANUAL*
*OFFICE LABORATORY QUALITY SYSTEM MANUAL;*
*MACTEC Procedure for Quality Assurance Project Document for Nuclear Safety-Related Services*
*MACTEC COL QAPD*
*Description of MT&E used for laboratory testing*
*MACTEC COL Work Plan Number 1*
QAP 11-2, Procedure for Control of Software and Hardware
QAP 18-1, Audit Procedure
QAP 18-2, Qualification of Lead Auditor and Other Audit or Surveillance Personnel
QAP 20-1, Qualification of Personnel
QAP 23-1, Procedure for Preparation of a Work Plan
QAP 24-1, Procedure for Preparation of a Work Instruction

## 4.2 DRILLING SERVICE

The drilling service (MACTEC's drill crew, Subcontractor drill crews, and their drilling manager) will provide services administered by the Project Manager (PM). The Site Coordinator will direct daily drilling operations and set sampling and location priorities to meet the objectives of schedule as set forth in the Work Plan and Specification.

MACTEC will be responsible for:

- Equipment and personnel for field testing activities to include drilling, undisturbed and disturbed sampling, Standard Penetration Tests, casing installation, and borehole abandonment;
- Hammer weight measurement certificate;
- SPT energy measurements; and
- Support activities for the downhole geophysical logging.

## 4.3 CONE PENETRATION TESTING (CPT) SUBCONTRACTOR

The cone penetration testing Subcontractor will be responsible for:

- Supplying equipment that meets the requirements of the specification and the QAPD and that can reach the desired probing locations;
- Performing electric friction-piezocone penetrometer tests (CPT) at locations and to depths directed in the Specification;
- Performing seismic cone soundings at locations and to depths in the Specification;
- Provide field records and duplicate electronic records for storage at the office facility; and
- Submitting a data report of the testing, including electronic files of the CPT logs on a CD.

## 4.4 DOWNHOLE GEOPHYSICAL SUBCONTRACTOR

The downhole geophysical Subcontractor will provide seismic velocity measurement services and borehole geophysical services under contract administered by the PM. The Site Coordinator will coordinate downhole geophysical operations. The Downhole Geophysical Subcontractor will be responsible for:

- Equipment and personnel for field testing activities to perform the required measurements in both open or cased boreholes, as needed;
- Provide field records and duplicate electronic records for storage at the facility;
- Data Reduction and Reporting; and
- Providing results and final logs and a report summarizing the activities.

## 4.5 TEST PIT EXCAVATION

Test pits are to be performed at locations specified by Bechtel (field-located). A MACTEC Subcontractor will provide the backhoe to excavate the pits. MACTEC will document the test pit excavation activity and classify the materials encountered in accordance with Attachment 2. Bechtel will select the materials to be sampled from each test pit. When directed by Bechtel, a Rig Geologist or Rig Engineer of MACTEC will collect and label the samples in accordance with the Specification and Attachment 7. If approved by Bechtel, MACTEC will place the bulk samples in new 5 gallon plastic buckets with lids and with handles for carrying in lieu of plastic-lined canvas bags. A sealed glass jar suitable for moisture content testing and containing the same material will be labeled in accordance with the Specification and Attachment 7 and placed in the bucket. Upon receiving instruction to abandon the test pit either by Bechtel or the Site Coordinator, the MACTEC Subcontractor will backfill the test excavation with the excavated native soils and tamp those materials in-place using the backhoe bucket. The Rig Geologist will be responsible for placing one or more stakes to mark the test pit for later survey location. Density testing of the test pit backfill is not planned.

## 4.6 SITE RESTORATION

After completion of field activities MACTEC will clean up all drilling and sampling equipment, paper, rags, etc. associated with the drilling operations. Small trees that have been cut will be stacked into brush piles. The drill sites will be returned to the same general condition as found prior to drilling. Drill cuttings and drilling fluids will be spread onto the ground and left. Vegetative ground cover will not be re-established nor will wheel ruts and other ground surface irregularities be repaired. MACTEC understands that discharge of drilling fluids may have to be further controlled in wetland areas near the Savannah River floodplain. We anticipate that this control may include but not be limited to: containerizing drilling fluids and wet cuttings in steel drums, or pumping drilling fluids and wet cuttings to higher elevations for discharge into a temporary mud pit or tank. Specific measures for control of cuttings will be coordinated and approved by SNC and Bechtel prior to MACTEC work in this area.

## 4.7 PROJECT SURVEY SUBCONTRACTOR

Surveying will be performed by SNC under a separate work plan and quality assurance program

# 5 QUALITY ASSURANCE PLAN

The MACTEC QA Manual and the QAPD will be applicable to the scope of work delineated in this Work Plan. Attachment 9 presents a chart of the management, staff, and functional groups within the organization that will have direct involvement on this project.

# 6 REFERENCES AND STANDARDS

The codes, standards and regulations of the following organization in effect January 1, 2006, unless otherwise noted, are a part of the project Work Plan and are listed as follows:

1) ASTM D 420-98; "*Standard Guide to Site Characterization for Engineering, Design and Construction Purposes.*"
2) NRC Regulatory Guide 1.132
3) NRC Regulatory Guide 1.138

Additional codes associated with specific procedures are included in Attachments 1 thru 8.

# ATTACHMENT 1

## *SURVEY DATA CONTROLS*

## SURVEY DATA CONTROLS

General

Surveying will be performed by SNC under a separate work plan and quality assurance program. We anticipate that the following general survey activities will take place during the course of the project:

Reference points will be established by others nearby the site prior to the start of the MACTEC's work. The planned coordinates of all the test locations are contained in the Boring Location Plan of the Specification. The Surveyor will field locate the test locations based on the specified coordinates to sub-meter accuracy, and the precise locations for borings, CPT tests, wells, test pits and other test locations will be adjusted by the Site Coordinator, with Bechtel's approval, based on site conditions. These locations will be identified by wooden stakes or wire flag, if appropriate, with the test number identified thereon in accordance with the Specification. After the testing has been done, and when requested by the Site Coordinator, the "as-built" locations will be surveyed to establish their horizontal locations and surface elevations. The survey will establish the northing and easting coordinates of the locations in accordance with the State of Georgia coordinate system per the Specification. A qualified licensed land surveyor will perform the survey.

# ATTACHMENT 2

## *DRILLING AND SAMPLING PROCEDURES*

## DRILLING AND SAMPLING PROCEDURES

General Tasks

Drilling and sampling of soil is anticipated on this site. The borehole designation and location are shown in the Specification. The borings will be initially located by the Surveyor as described in Attachment 1. Test pits will be field-located by Bechtel. Following layout of the boring and CPT locations, access roads will be cleared to the proposed locations and work pads cleared or constructed. Boreholes will be drilled and sampled with truck or all-terrain vehicle mounted drill rigs. A backhoe will be used to excavate the test pits. Groundwater levels will be checked as outlined in the Specification. Boreholes will be abandoned upon completion of drilling or geophysical logging. Survey markers (wooden stakes) will identify the borehole location until a survey of the as-drilled location and elevation is accomplished.

Pre-Mobilization Activities

Drill equipment will be inspected by the MACTEC Rig Geologist or Site Coordinator in conjunction with the drill crew prior to drilling to ensure materials and equipment are suitably clean and in visually good condition. The field inspection will be documented by the Rig Geologist.

Designation of Test Pit/Borehole ID

The designations and names of boreholes and all other test locations will be those contained in the Specification.

Field Borehole Location and Pre-Drilling Activities

The location for a borehole or other test location is derived from the Specification. Prior to drilling, test pit/borehole locations will be marked in the field with a stake and/or flagging. If a survey crew has not located the test pit/borehole prior to start of work, then the locations will be located with a GPS unit or field measurement methods using existing landmarks or survey reference points. Final as-drilled locations will be survey-located as described in Attachment 1. Prior to initiation of drilling or test pit excavation, boring locations will be reviewed by the Site Coordinator in consultation with SNC and screened for possible underground utility conflicts (see below). Some clearing and grading may be required for rig access or to establish a relatively level drilling platform.

MACTEC's utility location subcontractor will locate existing underground utilities within a 10 foot radius of each exploratory boring as outlined in the Specification. Location methods may include survey location from available drawings, use of marking wires and signals, ground penetrating radar (GPR), electromagnetic survey (EM), and hand auger borings. GPR and EM surveys will be conducted and markings placed in accordance with the Specification. We note that available methods for detecting underground utilities have limitations and may not detect all lines, especially deep, small, non-metallic lines. MACTEC will coordinate potential underground obstructions with site drawings to attempt to resolve any uncertainty regarding underground obstructions. If uncertainty then remains, pre-drilling of selected boring locations to depths of 5 to 10 feet utilizing manual hand auger equipment may be performed to verify safe conditions. The use of insulated gloves and shoes during the hand-augering process will be used, if appropriate.

Following the utility detection effort, a report describing the results of the utility detection effort, including a field drawing of known or suspected utility locations in proximity of the planned exploratory points will be prepared and submitted to SNC and Bechtel.

The MACTEC drilling service will provide at the start of work, for each rig that is to perform SPT testing, a signed certificate stating the weight of the SPT hammer measured by a standard traceable to the National Institute of Standards and Technology (NIST), that indicates that the hammer weight falls within the range of 140 ±2 pounds (lbs.).

The certification of Calibration is documentation to ensure that the equipment used was properly calibrated and adequate to perform its function. As a minimum, this certification will include the following:

- Equipment general and unique identification (name and serial or ID number).
- Name and signature of person performing calibration and date performed.
- Acceptance criteria (calibration limits) and, if required, conversion tables or curves.
- Date recalibration is due.
- Calibration equipment used and its traceability to the NIST or a natural physical constant.

Drilling of Boreholes

Hollow stem augers will not be used for drilling in soils below the water table, or for drilling borings in which geophysical and P-S logging will be performed. For all borings used for geotechnical purposes, mud rotary drilling methods and equipment using water with or without bentonite added, as appropriate, will be used. Rotary drilling will be conducted in accordance with ASTM D 5783. The finished hole size will be between approximately 3 and 8 inches in diameter. Drill string advance will be carefully controlled to minimize disturbance to formation soils.

Water losses are anticipated near the top of the Blue Bluff Marl layer (marl). It may be necessary to grout the area of water loss and then drill through the hardened grout or to set steel casing to seal off the zone of water loss. No other zone of water loss is currently identified; although deeper water loss zones may be encountered. The following procedures may be utilized if either shallow or deep water loss zones are encountered, with approval by Bechtel as required:

1. Thicken the drilling fluid
2. Place additives into the drilling fluid
3. Grout the water loss zone and re-drill the grouted zone
4. Set steel or plastic temporary casing

We note that MACTEC's logging contractor, GeoVision, will not be able to perform P-S suspension or geophysical logging through steel casing. Therefore the upper approximately 5 to 10 feet of borings will not be logged, due to near-surface casing routinely installed for mud rotary drilling. If steel casing is required to seal off water losses near the top of the "marl" layer, this section may also be lost to the logging process. If approved by Bechtel and SNC, this may be acceptable since foundations for the ALWR are expected to bear near the top of the 'marl' layer and shallower information may not be necessary. Alternately, if approved by Bechtel and SNC, plastic casing may be set through any water loss zone near the top of the marl, grouted in place, and the boring extended after the grout has hardened. P-S suspension logging and some geophysical logs can be performed through a properly grouted PVC casing. However, in locations with significant loss of circulation, it is sometimes not possible to adequately grout the PVC casing. MACTEC will notify and coordinate with Bechtel and SNC for alternate solutions if such difficulties arise. Solutions may include re-drilling the hole or drilling an offset hole. Drilling and casing installation (if applicable) procedures for the geophysical boreholes will be coordinated with Bechtel prior to the work.

Hammer (SPT) sampling will be performed at close spacing (2.5 ft spacing or two samples every 5 ft, per Bechtel) in the upper 15 ft and thereafter at reasonably constant 5-foot depth intervals (or assigned intervals, if different) in the boreholes. Below the bottom of the Blue Bluff Marl (estimated depth of about 150 feet), SPT will be performed at 10 foot intervals, or as directed by Bechtel. In selected boreholes (150 feet deep or less), the SPT sampling interval at 2.5 ft depth increments will be continued until the borehole termination depth to accomplish continuous sampling. We anticipate that Bechtel may

select at least two boreholes for continuous sampling. SPT testing will be conducted in accordance with ASTM D 1586.

Undisturbed samples will be obtained in accordance with the Specification and at depths and boring locations selected by Bechtel. Samples will be obtained by hydraulic push, or rotary methods (Pitcher, or other rotary sampler approved by Bechtel). Sampling will be coordinated with Bechtel as the hole advances. Undisturbed samples may be obtained between SPT samples, in place of SPT samples, or in offset holes drilled nearby the original hole at depths to be determined by Bechtel. Standard procedures will be followed, but recovery of samples, especially in granular zones below the water table, may be variable. If an undisturbed sample is not recovered, another attempt will be made to recover a sample as soon as possible without interfering with the SPT interval. As previously mentioned, it may also be necessary to drill parallel borings specifically to obtain undisturbed samples. The quantity and quality of undisturbed samples will be coordinated with SNC and Bechtel prior to demobilization of SPT drilling equipment. Undisturbed sampling will be conducted in accordance with ASTM D 1587

Prior to hammer or undisturbed sampling, the borehole bottom will be flushed to remove drill cuttings.

Existing concrete slabs or foundations, if encountered at the boring locations, will be cored or removed by other methods to allow drilling of the borehole. Samples of the existing concrete, if encountered, will not be obtained.

The depth of each sample interval should be established by measurements of the downhole drilling rod length to within 3-inches, and measured from a fixed reference point (such as the top of drill casing or mud tank) with a measuring tape. These measurements will be graphically recorded by the Rig Geologist on the borehole log as the top of each sample. The measurement will be made after the sampler is lightly seated into the bottom of the hole.

Upon retrieval, samples will be inspected and logged by the Rig Geologist/engineer and transferred into suitable containers for storage. Digital photographs of selected samples may be obtained. Sample handling will be performed in accordance with ASTM D 4220 and in accordance with Attachment 7.

Sampling of Boreholes

The on-site soils may be sampled by either hammer drive (SPT) sampling, rotational Pitcher sampling, and/or hydraulic push sampling. The following equipment specified in the following paragraphs is to be used for these techniques.

SPT sampling equipment will meet ASTM specification D1586, and include:

- Delivery system : Automatic-trip hammer; and
- SPT Sampler: 2.0-inch O.D., 1.375-inch I.D., 24-inch to 30-inch interior length, split-spoon sampler. Brass liners will not be used in SPT samplers.

Dimensions are standard for this type of sampler. Drive sampler shoes should be in good condition, i.e. not contain visible deformations, dings, or excessively worn edges.

Equipment for undisturbed sampling will meet ASTM D 1587.

If difficult drilling conditions are encountered, i.e. bridging hole or flowing sands, the sampling program may be modified at the driller's and Rig Geologist/Engineer's joint recommendation and with Bechtel's permission, to allow completion of the hole. If this is necessary, a modification to the Work Instruction may be necessary to document the authorized changes made.

Borehole Logging

Exploratory borings will be logged on Boring Log Sheets that include descriptions of drilling procedures, sampling, geologic materials, and general subsurface information. The following data, as applicable, is to be included on these sheets for the borings:

- Project name and job number;
- Date started and completed;
- Description of drill rig and name of Driller;
- Boring number;
- Type & diameter of boring;
- Elevation of top of hole will not generally be available until the as-built survey is done;
- Boring location if significantly different from the location on the Boring Location Plan in the Specification (may be shown on accompanying sketch with measurements from fixed reference features with a measuring tape and compass); location data to be understood as approximate until provided by the project surveyor (after drilling);
- Sampling method: including all samplers used;
- Sample driving hammer type and drop (ASTM standards for SPT sampling require a 140 lb. hammer with a 30 inch drop);
- Recovery;
- Name of geologist/engineer logging the hole;
- Hammer sample blows per 6-inch drive;
- Description and classification of the soil (see discussion below); and
- Specific notes, as applicable, regarding drilling fluid circulation, casing dimensions, type of grout backfill, etc.

Soil Descriptions/Nomenclature

Descriptive terms and geologic classification of soil material will be based on the following sources:

- ASTM D 2487 standard classification of soils for engineering purposes, D 2488-00 standard practice for description and identification of soils; and
- Munsell soil color charts, 1994.
- Subsurface Stratigraphy established during the Early Site Permit work in 2005.
- Stratigraphy and Depositional Environments of Sediments from Five Cores from Screven and Burke Counties, Georgia (USGS Professional Paper 1603-A).

During drilling, the Rig Geologist will keep records of drilling conditions such as rod drop, water loss or drill chatter as well as standard penetration resistance, sample locations, material types, or any materials or occurrences, which may require additional investigation. Comments from the driller regarding drilling will also be noted. Daily observations will usually include water level at start of day and end of day and drilling progress.

The Daily Field Report for field activities will be kept daily by the Rig Geologist and submitted to the Site Coordinator.

Copies of field records may be submitted to Bechtel as completed on a preliminary basis until the records are finalized.

Well Installation

The installation of ground water monitoring wells is beyond the scope of work for this exploration.

Test Pits

The Specification states that Bechtel (CONTRACTOR) will field-locate the test pits, select the materials to be bulk sampled, and direct the backfilling of the test pits. MACTEC will be responsible for logging the test pit excavation, collection of the bulk samples, the glass jar samples, and labeling and storing the samples in accordance with Attachment 7.

Collection and Transportation of Samples
Samples will be documented and stored in accordance with Attachment 7.

Unexpected Conditions
In the event of a changed condition at the drilling/sampling site-above or below grade (i.e., oil spills, injuries, and encounters with potentially hazardous material) the Site Coordinator will stop the work and notify the Bechtel representative on-site for the purposes of organizational notification. These changes in conditions can include but not be limited to; encounters with unexpected concrete, unexpected metal or unusual material returned in the wash water or drill cuttings. For any of the above, operations will cease regardless of depth of drilling or sampling.

It is anticipated that near-surface concrete and miscellaneous metal may be encountered just below the surface in the former warehouse locations. Such encounters would thus not necessarily be a condition to stop work.

SPT Energy Measurement
An energy measurement will be performed on each SPT drill rig hammer at least once during the 12 month period that includes the work of this rig on the project. An instrumented drill rod of the proper size for the drill rods being used (i.e. "A" or "N" sized, or other) will be used to perform the measurements. The energy measurement does not have to be made prior to the start of work and may be made while the rig is on another project by properly qualified personnel. The SPT energy measurement will be performed in accordance with ASTM D 4633.

Borehole Completion and Restoration
Upon completion of the borings and geophysical logging and extraction of any temporary piezometer casings or drill casings, the boreholes not used as observation wells will be completely backfilled to the ground surface with a bentonite-grout mix installed by the tremie method, and according to local and state requirements for protection of groundwater. Grouting procedures will be documented. For future location by the surveyor, a wooden stake will be placed in the backfill grout at the approximate center of the boreholes and labeled with the specified boring number.

In holes provided with a grouted PVC casing (if required) for the downhole geophysical logging, as approved by Bechtel and SNC, the PVC casing will be left in place and the hole backfilled with grout.

Upon completion of the test pits as directed by Bechtel, the excavations will be completely backfilled to the ground surface with the removed native materials, and compactive effort applied using the backhoe bucket as directed by Bechtel. The test pit will be staked for later survey location.

After completion of field activities MACTEC will clean up all drilling and sampling equipment, paper, rags, etc. associated with the drilling operations. Trees dislocated by bulldozer will be left where deposited by the dozer. Because of the site conditions, the drill sites cannot be returned to the same general condition as found prior to drilling. However, drill cuttings and drilling fluids will be spread onto the ground and left. Vegetative ground cover will not be re-established nor will wheel ruts and other ground surface irregularities be repaired. MACTEC understands that discharge of drilling fluids may have to be further controlled in wetland areas near the Savannah River floodplain. We anticipate that this control may include but not be limited to: containerizing drilling fluids and wet cuttings in steel drums, or pumping drilling fluids and wet cuttings to higher elevations for discharge into a temporary mud pit or

tank. Specific measures for control of cuttings will be coordinated and approved by SNC and Bechtel prior to MACTEC work in this area.

## REFERENCES AND STANDARDS

The codes, standards and regulations of the following organization in effect January 1, 2006, unless otherwise noted, are a part of the project Work Plan and are listed as follows:

**American Society for Testing and Materials (ASTM).**

1) ASTM D 420-98; "*Standard Guide to Site Characterization for Engineering, Design and Construction Purposes.*"
2) ASTM D 1452-80 (2000); "*Standard Practice for Soil Investigation and Sampling by Auger Borings.*"
3) ASTM D 1586-99; "*Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.*"
4) ASTM D 2488-2000; "*Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).*"
5) ASTM D 2487-2000; "*Standard Practice for Classification of Soils for Engineering Purposes.*"
6) ASTM D 4220-95 (2000); "*Practices for Preserving and Transporting Soil Samples.*"
7) D 1587-2000; "*Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.*"
8) ASTM 4750-87 *(2001); "Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well).*"
9) ASTM D 5778-95 (2000); *"Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils."*
10) ASTM D 4633-05; *"Standard Test Method for Energy Measurement for Dynamic Penetrometers."*

MACTEC

**DAILY FIELD REPORT**

| | | |
|---|---|---|
| JOB NAME: | JOB NO.: | PAGE NO.: |
| CLIENT: | CONTRACTOR: | |
| LOCATION: | MACTEC REP.: | DATE: __/__/__ |
| ATTACHMENTS: | REFERENCES: | |

ACTIVITY TYPES: RESISTIVITY, SPT; CPT; DPT; $V_S$; ELOG; MWELL; PIEZ; STEST; SRES; GROUT; CON-CORE, R-CORE, GJACK, PACKER, P-S, TELEV, BSEAL; DELAY; UNAVAIL.

| LOCATION: | ACTIVITY: | EQUIPMENT, PERSONNEL, QUANTITY: |
|---|---|---|
| | | |

| | |
|---|---|
| REVIEWED BY: | DATE: |

MACTEC

**Boring Summary Sheet**

| | | | |
|---|---|---|---|
| | | | BORING NO.: |
| JOB NAME: | JOB NO.: | PAGE NO.: | __/__ |
| LOCATION: | CLIENT: | | MACTEC REP.: |
| CONTRACTOR: | RIG TYPE: | DATE: | __/__/__ |

| DATE STARTED: | DATE FINISHED: | DEPTH ACHIEVED: | EQUIPMENT USED: | NUMBER OF SAMPLES FOR TESTING: | IDENTIFICATION OF SAMPLES FOR TESTING (# AND DEPTH): |
|---|---|---|---|---|---|
| | | | | | |

| FIELD CHECKS: | N/A | ACCEPTABLE | UNACCEPTABLE |
|---|---|---|---|
| 1. CERTIFICATE THAT WEIGHT OF HAMMER MEETS ASTM D 1586-84 REQUIREMENTS. | | | |
| 2. DRILL DEPTH AND INTENDED TEST DEPTH IS ACCEPTABLE. | | | |
| 3. SPLIT SPOON IS PROPERLY CLEANED. | | | |
| 4. DRIVE SHOE IS IN GOOD SHAPE (FREE OF PITS AND SMOOTH). | | | |
| 5. SPLIT SPOON IS PROPERLY ASSEMBLED AND CATCHER IS INSTALLED PROPERLY. | | | |
| 6. TWO FOOT BLEEDER IS IN PLACE (IF WASH DRILLED). | | | |
| 7. DEPTH OF SPLIT SPOON IN PLACE IN BORING. | | | |
| 8. NUMBER OF ROPE TURNS AROUND THE CATHEAD MEETS ASTM D-1586-84 REQUIREMENTS (2). | | | |
| 9. SIX (6) INCH INCREMENTS ARE MARKED ON THE DRILL ROD. | | | |
| 10. THIRTY (30) INCH DROP MARK IS MARKED ON THE HAMMER ROD. | | | |
| 11. HAMMERS FALLS FREELY AND SMOOTHLY. | | | |

ADDITIONAL REMARKS:

| | |
|---|---|
| REVIEWED BY: | DATE: |

MACTEC

**CASING INSTALLATION FIELD LOG**

| | | | |
|---|---|---|---|
| | | | BORING NO.: |
| JOB NAME: | JOB NO.: | PAGE NO.: | __/__ |
| LOCATION: | CLIENT: | | MACTEC REP.: |
| DRILLER: | RIG TYPE: | DATE: | __/__/__ |

| | |
|---|---|
| DATE DRILLED: | |
| SURFACE ELEV.: | GROUNDWATER DEPTH: |
| HOLE DIAMETER: | |
| DRILL METHOD: | NOTES: |
| DRILL MUD: | |
| MISC.: | |
| CASING TYPE: | INSTALLATION DEPTH: |
| CASING DIAMETER: | TOP OF CASING ELEV.: |
| TYPE JOINT: | TOTAL GROUT/BOND: |

**INSTALLATION PROCEDURE**

| NOTES | SKETCH: |
|---|---|
| **GROUT/BOND MIX** | |
| | NOTES: |

| REFERENCES | ATTACHMENTS |
|---|---|
| REVIEWED BY: | DATE: |

# ATTACHMENT 3

## *CONE PENETRATION TEST PROCEDURES*

## CONE PENETRATION TEST PROCEDURES

CPT – The Cone Penetration Test procedure is described on the following page.

## REFERENCES AND STANDARDS

The codes, standards and regulations of the following organization in effect January 1, 2006, unless otherwise noted, are a part of the project Work Plan and are listed as follows:

1) ASTM D 5778-95 (2000); "*Standard Test Method for Performing Electric Friction Cone and Piezocone Penetration Testing of Soils.*"

# Cone Penetration Testing Procedure (CPT)

Gregg In Situ, Inc. carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*. The soundings are conducted using a 20 ton capacity cone with a tip area of 15 $cm^2$ and a friction sleeve area of 225 $cm^2$. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.85.

The cone takes measurements of cone bearing ($q_c$), sleeve friction ($f_s$) and dynamic pore water pressure ($u_2$) at 5-cm intervals during penetration to provide a nearly continuous hydrogeologic log. CPT data reduction and interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored on disk for further analysis and reference. All CPT soundings are performed in accordance with revised (2002) ASTM standards (D 5778-95).

The cone also contains a porous filter element located directly behind the cone tip ($u_2$), *Figure CPT*. It consists of porous plastic and is 5.0mm thick. The filter element is used to obtain dynamic pore pressure as the cone is advanced as well as Pore Pressure Dissipation Tests (PPDT's) during appropriate pauses in penetration. It should be noted that prior to penetration, the element is fully saturated with silicon oil under vacuum pressure to ensure accurate and fast dissipation.

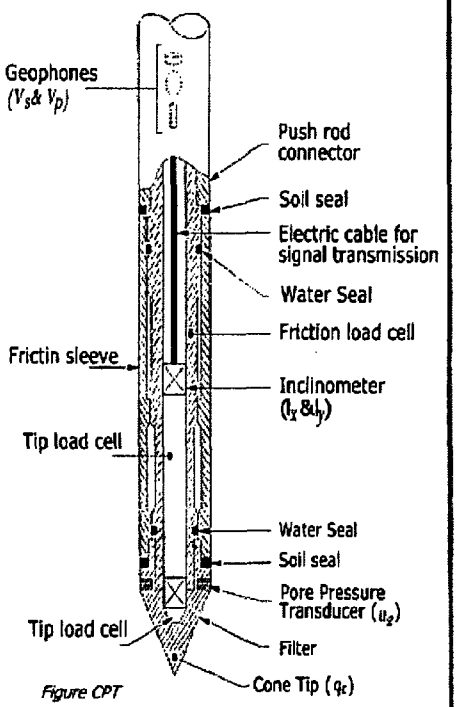


*Figure CPT*

When the soundings are complete, the test holes are grouted using a Gregg In Situ support rig. The grouting procedure consists of pushing a hollow CPT rod with a "knock out" plug to the termination depth of the test hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

GREGG
2726 Walnut Avenue · Signal Hill · California · 90755 · Phone: (562) 427-6899 · Fax: (562) 427-3314
Web Site: www.greggdrilling.com Email: info@greggdrilling.com
Additional locations in: Charleston · Houston · Palo Alto · Salt Lake City · San Francisco · Vancouver

# ATTACHMENT 4

## *DOWNHOLE TEST PROCEDURES*

- **4.1 4.2 P-S Logging**
- **4.2 Borehole Geophysical Logging**

# 4.1 P-S LOGGING TECHNIQUE

4.2 P-S Logging Technique: The Specification includes P-S logging at selected boreholes. A Subcontractor will perform the logging at the selected locations in accordance with the following procedure.

## GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____
CLIENT: _____ JOB: _____
AUTHOR: _____ PAGE _____ OF _____

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 0.5 | 1.64 | | | |
| 1.0 | 3.28 | | | |
| 1.5 | 4.92 | | | |
| 2.0 | 6.56 | | | |
| 2.5 | 8.20 | | | |
| 3.0 | 9.84 | | | |
| 3.5 | 11.48 | | | |
| 4.0 | 13.12 | | | |
| 4.5 | 14.76 | | | |
| 5.0 | 16.40 | | | |
| 5.5 | 18.04 | | | |
| 6.0 | 19.69 | | | |
| 6.5 | 21.33 | | | |
| 7.0 | 22.97 | | | |
| 7.5 | 24.61 | | | |
| 8.0 | 26.25 | | | |
| 8.5 | 27.89 | | | |
| 9.0 | 29.53 | | | |
| 9.5 | 31.17 | | | |
| 10.0 | 32.81 | | | |
| 10.5 | 34.45 | | | |
| 11.0 | 36.09 | | | |
| 11.5 | 37.73 | | | |
| 12.0 | 39.37 | | | |
| 12.5 | 41.01 | | | |
| 13.0 | 42.65 | | | |
| 13.5 | 44.29 | | | |
| 14.0 | 45.93 | | | |
| 14.5 | 47.57 | | | |
| 15.0 | 49.21 | | | |
| 15.5 | 50.85 | | | |
| 16.0 | 52.49 | | | |
| 16.5 | 54.13 | | | |
| 17.0 | 55.77 | | | |
| 17.5 | 57.41 | | | |
| 18.0 | 59.06 | | | |

2 of 22

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____
CLIENT: _____ JOB: _____
AUTHOR: _____ PAGE _____ OF _____

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 18.5 | 60.70 | | | |
| 19.0 | 62.34 | | | |
| 19.5 | 63.98 | | | |
| 20.0 | 65.62 | | | |
| 20.5 | 67.26 | | | |
| 21.0 | 68.90 | | | |
| 21.5 | 70.54 | | | |
| 22.0 | 72.18 | | | |
| 22.5 | 73.82 | | | |
| 23.0 | 75.46 | | | |
| 23.5 | 77.10 | | | |
| 24.0 | 78.74 | | | |
| 24.5 | 80.38 | | | |
| 25.0 | 82.02 | | | |
| 25.5 | 83.66 | | | |
| 26.0 | 85.30 | | | |
| 26.5 | 86.94 | | | |
| 27.0 | 88.58 | | | |
| 27.5 | 90.22 | | | |
| 28.0 | 91.86 | | | |
| 28.5 | 93.50 | | | |
| 29.0 | 95.14 | | | |
| 29.5 | 96.78 | | | |
| 30.0 | 98.43 | | | |
| 30.5 | 100.07 | | | |
| 31.0 | 101.71 | | | |
| 31.5 | 103.35 | | | |
| 32.0 | 104.99 | | | |
| 32.5 | 106.63 | | | |
| 33.0 | 108.27 | | | |
| 33.5 | 109.91 | | | |
| 34.0 | 111.55 | | | |
| 34.5 | 113.19 | | | |
| 35.0 | 114.83 | | | |
| 35.5 | 116.47 | | | |
| 36.0 | 118.11 | | | |

3 of 22

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____
CLIENT: _____ JOB: _____
AUTHOR: _____ PAGE _____ OF _____

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 36.5 | 119.75 | | | |
| 37.0 | 121.39 | | | |
| 37.5 | 123.03 | | | |
| 38.0 | 124.67 | | | |
| 38.5 | 126.31 | | | |
| 39.0 | 127.95 | | | |
| 39.5 | 129.59 | | | |
| 40.0 | 131.23 | | | |
| 40.5 | 132.87 | | | |
| 41.0 | 134.51 | | | |
| 41.5 | 136.15 | | | |
| 42.0 | 137.80 | | | |
| 42.5 | 139.44 | | | |
| 43.0 | 141.08 | | | |
| 43.5 | 142.72 | | | |
| 44.0 | 144.36 | | | |
| 44.5 | 146.00 | | | |
| 45.0 | 147.64 | | | |
| 45.5 | 149.28 | | | |
| 46.0 | 150.92 | | | |
| 46.5 | 152.56 | | | |
| 47.0 | 154.20 | | | |
| 47.5 | 155.84 | | | |
| 48.0 | 157.48 | | | |
| 48.5 | 159.12 | | | |
| 49.0 | 160.76 | | | |
| 49.5 | 162.40 | | | |
| 50.0 | 164.04 | | | |
| 50.5 | 165.68 | | | |
| 51.0 | 167.32 | | | |
| 51.5 | 168.96 | | | |
| 52.0 | 170.60 | | | |
| 52.5 | 172.24 | | | |
| 53.0 | 173.88 | | | |
| 53.5 | 175.52 | | | |
| 54.0 | 177.17 | | | |

4 of 22

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____
CLIENT: _____ JOB: _____
AUTHOR: _____ PAGE _____ OF _____

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 54.5 | 178.81 | | | |
| 55.0 | 180.45 | | | |
| 55.5 | 182.09 | | | |
| 56.0 | 183.73 | | | |
| 56.5 | 185.37 | | | |
| 57.0 | 187.01 | | | |
| 57.5 | 188.65 | | | |
| 58.0 | 190.29 | | | |
| 58.5 | 191.93 | | | |
| 59.0 | 193.57 | | | |
| 59.5 | 195.21 | | | |
| 60.0 | 196.85 | | | |
| 60.5 | 198.49 | | | |
| 61.0 | 200.13 | | | |
| 61.5 | 201.77 | | | |
| 62.0 | 203.41 | | | |
| 62.5 | 205.05 | | | |
| 63.0 | 206.69 | | | |
| 63.5 | 208.33 | | | |
| 64.0 | 209.97 | | | |
| 64.5 | 211.61 | | | |
| 65.0 | 213.25 | | | |
| 65.5 | 214.90 | | | |
| 66.0 | 216.54 | | | |
| 66.5 | 218.18 | | | |
| 67.0 | 219.82 | | | |
| 67.5 | 221.46 | | | |
| 68.0 | 223.10 | | | |
| 68.5 | 224.74 | | | |
| 69.0 | 226.38 | | | |
| 69.5 | 228.02 | | | |
| 70.0 | 229.66 | | | |
| 70.5 | 231.30 | | | |
| 71.0 | 232.94 | | | |
| 71.5 | 234.58 | | | |
| 72.0 | 236.22 | | | |

5 of 22

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____
CLIENT: _____ JOB: _____
AUTHOR: _____ PAGE _____ OF _____

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 72.5 | 237.86 | | | |
| 73.0 | 239.50 | | | |
| 73.5 | 241.14 | | | |
| 74.0 | 242.78 | | | |
| 74.5 | 244.42 | | | |
| 75.0 | 246.06 | | | |
| 75.5 | 247.70 | | | |
| 76.0 | 249.34 | | | |
| 76.5 | 250.98 | | | |
| 77.0 | 252.62 | | | |
| 77.5 | 254.27 | | | |
| 78.0 | 255.91 | | | |
| 78.5 | 257.55 | | | |
| 79.0 | 259.19 | | | |
| 79.5 | 260.83 | | | |
| 80.0 | 262.47 | | | |
| 80.5 | 264.11 | | | |
| 81.0 | 265.75 | | | |
| 81.5 | 267.39 | | | |
| 82.0 | 269.03 | | | |
| 82.5 | 270.67 | | | |
| 83.0 | 272.31 | | | |
| 83.5 | 273.95 | | | |
| 84.0 | 275.59 | | | |
| 84.5 | 277.23 | | | |
| 85.0 | 278.87 | | | |
| 85.5 | 280.51 | | | |
| 86.0 | 282.15 | | | |
| 86.5 | 283.79 | | | |
| 87.0 | 285.43 | | | |
| 87.5 | 287.07 | | | |
| 88.0 | 288.71 | | | |
| 88.5 | 290.35 | | | |
| 89.0 | 291.99 | | | |
| 89.5 | 293.64 | | | |
| 90.0 | 295.28 | | | |

6 OF 22

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____
CLIENT: _____ JOB: _____
AUTHOR: _____ PAGE _____ OF _____

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 90.5 | 296.92 | | | |
| 91.0 | 298.56 | | | |
| 91.5 | 300.20 | | | |
| 92.0 | 301.84 | | | |
| 92.5 | 303.48 | | | |
| 93.0 | 305.12 | | | |
| 93.5 | 306.76 | | | |
| 94.0 | 308.40 | | | |
| 94.5 | 310.04 | | | |
| 95.0 | 311.68 | | | |
| 95.5 | 313.32 | | | |
| 96.0 | 314.96 | | | |
| 96.5 | 316.60 | | | |
| 97.0 | 318.24 | | | |
| 97.5 | 319.88 | | | |
| 98.0 | 321.52 | | | |
| 98.5 | 323.16 | | | |
| 99.0 | 324.80 | | | |
| 99.5 | 326.44 | | | |
| 100.0 | 328.08 | | | |
| 100.5 | 329.72 | | | |
| 101.0 | 331.36 | | | |
| 101.5 | 333.01 | | | |
| 102.0 | 334.65 | | | |
| 102.5 | 336.29 | | | |
| 103.0 | 337.93 | | | |
| 103.5 | 339.57 | | | |
| 104.0 | 341.21 | | | |
| 104.5 | 342.85 | | | |
| 105.0 | 344.49 | | | |
| 105.5 | 346.13 | | | |
| 106.0 | 347.77 | | | |
| 106.5 | 349.41 | | | |
| 107.0 | 351.05 | | | |
| 107.5 | 352.69 | | | |
| 108.0 | 354.33 | | | |

7 of 22

# GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____
CLIENT: _____ JOB: _____
AUTHOR: _____ PAGE _____ OF _____

| DEPTH METERS | DEPTH FEET | UNFILTERED FILE NO. | FILTERED FILE NO. | COMMENTS CASING, WATER, ROCK, ETC |
|---|---|---|---|---|
| 108.5 | 355.97 | | | |
| 109.0 | 357.61 | | | |
| 109.5 | 359.25 | | | |
| 110.0 | 360.89 | | | |
| 110.5 | 362.53 | | | |
| 111.0 | 364.17 | | | |
| 111.5 | 365.81 | | | |
| 112.0 | 367.45 | | | |
| 112.5 | 369.09 | | | |
| 113.0 | 370.73 | | | |
| 113.5 | 372.38 | | | |
| 114.0 | 374.02 | | | |
| 114.5 | 375.66 | | | |
| 115.0 | 377.30 | | | |
| 115.5 | 378.94 | | | |
| 116.0 | 380.58 | | | |
| 116.5 | 382.22 | | | |
| 117.0 | 383.86 | | | |
| 117.5 | 385.50 | | | |
| 118.0 | 387.14 | | | |
| 118.5 | 388.78 | | | |
| 119.0 | 390.42 | | | |
| 119.5 | 392.06 | | | |
| 120.0 | 393.70 | | | |
| 120.5 | 395.34 | | | |
| 121.0 | 396.98 | | | |
| 121.5 | 398.62 | | | |
| 122.0 | 400.26 | | | |
| 122.5 | 401.90 | | | |
| 123.0 | 403.54 | | | |
| 123.5 | 405.18 | | | |
| 124.0 | 406.82 | | | |
| 124.5 | 408.46 | | | |
| 125.0 | 410.10 | | | |
| 125.5 | 411.75 | | | |
| 126.0 | 413.39 | | | |

8 of 22

# CALIBRATION PROCEDURE FOR

# GEOVision SEISMIC RECORDER/LOGGER

Reviewed 4/6/06

## Objective

The timing/sampling accuracy of seismic recorders or data loggers is required for several GEOVision field procedures including Seismic Refraction, Downhole Seismic Velocity Logging, and P-S Suspension Logging. This procedure describes the method for measuring the timing accuracy of a seismic data logger, such as the OYO Model 170, OYO/Robertson Model 3403, Geometrics Strataview or Geometrics Geode. The objective of this procedure is to verify that the timing accuracy of the recorder is accurate to within 1%.

## Frequency of Calibration

The calibration of each GEOVision seismic data logger is twelve (12) months. In the case of rented seismic data loggers, calibration must be performed prior to use.

## Test Equipment Required

The following equipment is required. Item #2 must have current NIST traceable calibration.

1. Function generator, Krohn Hite 5400B or equivalent
2. Frequency counter, HP 5315A or equivalent
3. Test cables, from item 1 to item 2, and from item 1 to subject data logger.

## Procedure

This procedure is designed to be performed using the accompanying Seismograph Calibration Data Sheet with the same revision number. All data must be entered and the procedure signed by the technician performing the test.

1. Record all identification data on the form provided.
2. Connect function generator to data logger (such as OYO Model 170) using test cable
3. Connect the function generator to the frequency counter using test cable.

4. Set up generator to produce a 100.0 Hz, 0.25 volt (amplitude is approximate, modify as necessary to yield less than full scale waveforms on logger display) peak square wave or sine wave. Verify frequency using the counter and initial space on the data sheet.

5. Initialize data logger and record a data record of at least 0.1 second using a 100 microsecond or less sample period.

6. Measure the recorded square wave frequency by measuring the duration of 9 cycles of data. This measurement can be made using the data logger display device, or by printing out a paper tape. If a paper tape can be printed, the resulting printout must be attached to this procedure. Record the data in the space provided.

7. Repeat steps 5 and 6 three more times using separate files.

**Criteria**

The duration for 9 cycles in any file must be 90.0 milliseconds plus or minus 0.9 milliseconds, corresponding to an average frequency for the nine cycles of 100.0 Hz plus or minus 1 Hz (obtained by dividing 9 cycles by the duration in milliseconds).

If the results are outside this range, the data logger must be marked with a GEOVision REJECT tag until it can be repaired and retested.

If results are acceptable affix label indicating the initials of the person performing the calibration, the date of calibration, and the due date for the next calibration (12 months).

**Procedure Approval**

Approved by:

| | |
|---|---|
| John G. Diehl | President |
| Name | Title |
| | April 6, 2006 |
| Signature | Date |

Client Approval (If required):

| | |
|---|---|
| | |
| Name | Title |
| | |
| Signature | Date |

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geophysical services

**OYO P-S Suspension Velocity Logging Procedure REVISION LOG**

| DATE | REVISION NUMBER | REASON FOR CHANGE | APPROVED |
|---|---|---|---|
| | | | |
| 12/7/1998 | 1.00 | NEW GEOVISION PROCEDURE | JGD |
| | | (WAS AGBABIAN PROCEDURE) | |
| | | | |
| 12/8/1998 | 1.10 | MINOR CORRECTIONS TO TEXT | JGD |
| | | | |
| 6/20/2000 | 1.20 | REVIEWED TEXT. | JGD |
| | | REVISED FIELD LOG TO CHANGE LOGO | |
| | | FROM GEOVISION DIV OF AGBABIAN | |
| | | TO GEOVISION DIVISION OF | |
| | | BLACKHAWK GEOMETRICS | |
| | | | |
| 4/6/2006 | 1.30 | - CHANGED TEXT PAGE 1 UNDER | JGD |
| | | INSTRUMENTATION TO REFLECT CURRENT | |
| | | INSTRUMENTS AVAILABLE. | |
| | | - CHANGED THIRD PARAGRAPH P.2 | |
| | | WHISKERS "MAY" BE USED - NOT ALWAYS | |
| | | NECESSARY. | |
| | | - CHANGED FIRST PARAGRAPH UNDER | |
| | | ENVIRONMENTAL CONDITIONS P.2 | |
| | | TO ALLOW 3IN CASING. | |
| | | - CHANGED TEXT P.3 TO ADD PARAGRAPH | |
| | | HOW MICROLOGGER STORES DATA. | |
| | | ADDED SENTENCE TO PARAGRAPH 5 | |
| | | RE DATA VERIFICATION FOR MICRO- | |
| | | LOGGER. | |
| | | - REVISED ITEM 2 UNDER REQUIRED | |
| | | FIELD RECORDS TO STATE THAT | |
| | | PAPER RECORDS NO LONGER | |
| | | REQUIRED. | |
| | | - REVISED ITEM 4 UNDER REQUIRED | |
| | | FIELD RECORDS TO ALLOW CDROM | |
| | | AND USB DRIVES AS ALTERNATE | |
| | | BACKUP STORAGE IN ADDITION | |
| | | TO FLOPPY DISK | |
| | | - REVISED THIRD PARAGRAPH P.5 TO REFLECT | |
| | | THAT VELOCITY CALCS ARE DONE IN EXCEL | |
| | | SPREADSHEET | |
| | | | |

11 of 22

# PROCEDURE FOR

# OYO P-S SUSPENSION SEISMIC VELOCITY LOGGING

## Background

This procedure describes a method for measuring shear and compressional wave velocities in soil and rock. The OYO P-S Suspension Method is applied by generating shear and compressional waves in a borehole using the OYO P-S Suspension Logger borehole tool and measuring the travel time between two receiver geophones or hydrophones located in the same tool.

## Objective

The outcome of this procedure is a plot and table of P and $S_H$ wave velocity versus depth for each borehole. Standard analysis is performed on receiver to receiver data. Data is presented in report format, with ASCII data files and digital records transmitted on diskette.

## Instrumentation

1. OYO Model 170 Digital Logging Recorder or equivalent
2. OYO P-S Suspension Logger probe, including two sets horizontal and vertical geophones, seismic source, and power supply for the source and receivers
3. Winch and winch controller, with logging cable
4. Batteries to operate OYO 170 and winch

The Suspension P-S Logger system, manufactured by OYO Corporation, or the Robertson Digital P-S Suspension Probe with the Robertson Micrologger2 are currently the only commercially available suspension logging systems. As shown in Figure 1, these systems consists of a borehole probe suspended by a cable and a recording/control electronics package on the surface.

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear-wave generator ($S_H$) and compressional-wave generator (P), joined to two biaxial geophones by a flexible isolation cylinder. The separation of the two

geophones is one meter, allowing average wave velocity in the region between the geophones to be determined by inversion of the wave travel time between the two geophones. The total length of the probe is approximately 7 meters; the center point of the geophones is approximately 5 meters above the bottom end of the probe.

The probe receives control signals from, and sends the amplified geophone signals to, the instrumentation package on the surface via an armored 7 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured by a rotary encoder to provide probe depth data.

The entire probe is suspended by the cable and may be centered in the borehole by nylon "whiskers." Therefore, source motion is not coupled directly to the borehole walls; rather, the source motion creates a horizontally propagating pressure wave in the fluid filling the borehole and surrounding the source. This pressure wave produces a horizontal displacement of the soil forming the wall of the borehole. This displacement propagates up and down the borehole wall, in turn causing a pressure wave to be generated in the fluid surrounding the geophones as the soil displacement wave passes their location.

**Environmental Conditions**

The OYO P-S Suspension Logging Method can be used in either cased or uncased boreholes. For best results, the uncased borehole must be between 10 and 20 cm in diameter, or 4 to 8 inches. A cased borehole may be as small as 3 inches, if properly grouted (see below) and the grout annulus does not exceed 1 inch.

Uncased boreholes are preferred because the effects of the casing and grouting are removed. It is recommended that the borehole be drilled using the rotary mud method. This method does little damage to the borehole wall, and the drilling fluid coats and seals the borehole wall reducing fluid loss and wall collapse. The borehole fluid is required for the logging, and must be well circulated prior to logging.

If the borehole must be cased, the casing must be PVC and properly installed and grouted. Any voids in the grout will cause problems with the data. Likewise, large grout bulbs used to fill cavities will also cause problems. The grout must be set before testing. This means the grouting must take place at least 48 hours before testing.

For borehole casing, applicable preparation procedures are presented in ASTM Standard D4428/D4428M-91 Section 4.1 (see ASTM website for copy).

**Calibration**

Calibration of the digital recorder is required. Calibration is limited to the timing accuracy of the recorder. GEOVision's Seismograph Calibration Procedure or equivalent should be used. Calibration must be performed on an annual basis.

**Measurement Procedure**

The entire probe is lowered into the borehole to a specific measurement depth by the winch. A measurement sequence is then initiated by the operator from the instrumentation package control panel. No further operator intervention is then needed to complete the measurement sequence described below.

The system electronics activates the SH-wave source in one direction and records the output of the two horizontally oriented geophone axes which are situated parallel to the axis of motion of the source. The source is then activated in the opposite direction, and the horizontal output signals are again recorded, producing a SH-wave record of polarity opposite to the previous record. The source is finally actuated in the first direction again, and the responses of the vertical geophone axes to the resultant P-wave are recorded during this sampling.

The data from each geophone during each source activation is recorded as a different channel on the recording system. The Model 170 has six channels (two simultaneous recording channels), each with a 12 bit 1024 sample record. The recorded data is displayed on a CRT display and on paper tape output as six channels with a common time scale. Data is stored on 3.5-inch floppy diskettes for further processing. Up to 8 sampling sequences can be stacked (averaged) to improve the signal to noise ratio of the signals.

The Robertson Micrologger2 also stores data digitally, but instead of storing it on floppy disk, data is delivered to an adjacent field computer (laptop PC) via USB cable and stored on hard disk. No paper record is generated.

Review of the displayed data on the CRT or paper tape allows the operator to set the gains, filters, delay time, pulse length (energy), sample rate, and stacking number in order to optimize the quality of the data before recording. In the case of the Model 170, printed data is verified by the operator prior to moving the probe. In the case of the Robertson Micrologger2, storage on the hard disk should be verified from time-to-time, certainly before exiting the borehole.

Typical depth spacing for measurements is 1.0 meters, or 3.3 feet. Alternative spacing is 0.5 meter, or 1.6 feet.

**Required Field Records**

1) Field log for each borehole showing

   a) Borehole identification

   b) Date of test

c) Tester or data recorder

d) Description of measurement

e) Any deviations from test plan and action taken as a result

f) QA Review

2) Paper output records are no longer required, since the Micrologger2 cannot generate them. However, data must be stored in at least 2 places prior to leaving the site

3) List of record ID numbers (for data on diskette) and corresponding depth

4) Diskettes, CDRom, or USB flash drives with backup copies of data on hard disk, labeled with borehole designation, record ID numbers, date, and tester name.

An example Field Log is attached to this procedure.

**Analysis**

Following completion of field work, the recorded digital records are processed by computer using the OYO Corporation software program PSLOG and interactively analyzed by an experienced geophysicist to produce plots and tables of P and $S_H$ wave velocity versus depth.

The digital time series records from each depth are transferred to a personal computer for analysis. Figure 2 shows a sample of the data from a single depth. These digital records are analyzed to locate the first minima on the vertical axis records, indicating the arrival of P-wave energy. The difference in travel time between these arrivals is used to calculate the P-wave velocity for that 1-meter interval. When observable, P-wave arrivals on the horizontal axis records are used to verify the velocities determined from the vertical axis data. In addition, the soil velocity calculated from the travel time from source to first receiver is compared to the velocity derived from the travel time between receivers.

The digital records are studied to establish the presence of clear SH-wave pulses, as indicated by the presence of opposite polarity pulses on each pair of horizontal records. Ideally, the SH-wave signals from the 'normal' and 'reverse' source pulses are very nearly inverted images of each other. Digital FFT – IFFT lowpass filtering are used to remove the higher frequency P-wave signal from the SH-wave signal.

The first maxima are picked for the 'normal' signals and the first minima are picked for the 'reverse' signals. The absolute arrival time of the 'normal' and 'reverse' signals may vary by +/- 0.2 milliseconds, due to differences in actuation time of the solenoid source caused by constant mechanical bias in the source or by borehole inclination. This

variation does not affect the velocity determinations, as the differential time is measured between arrivals of waves created by the same source actuation. The final velocity value is the average of the values obtained from the 'normal' and 'reverse' source actuations.

In Figure 2, the time difference over the 1-meter interval of 1.70 millisecond is equivalent to a SH-wave velocity of 588 m/sec. Whenever possible, time differences are determined from several phase points on the $S_H$ -wave pulse trains to verify the data obtained from the first arrival of the $S_H$ -wave pulse. In addition, the soil velocity calculated from the travel time from source to first receiver is compared to the velocity derived from the travel time between receivers.

Figure 3 is a sample composite plot of the far normal horizontal geophone records for a range of depths. This plot shows the waveforms at each depth, clearly showing the S-wave arrivals. This display format is used during analysis to observe trends in velocity with changing depth.

Once the proper picks are entered in PSLOG, the picks are transferred to an Excel spreadsheet where Vs and Vp are calculated. The spreadsheet allows output for presentation in charts and tables.

Standard analysis is performed on receiver 1 to receiver 2 data, with separate analysis performed on source to receiver data as a quality assurance procedure.

Registered Geophysicist Antony Martin Date 4/10/06

QA Review Date 4/10/06

References:

1. "In Situ P and S Wave Velocity Measurement", Ohya, S. 1986. Proceedings of In-Situ '86, *Use of In-Situ Tests In Geotechnical Engineering*, an ASCE Specialty Conference sponsored by the Geotechnical Engineering Division of ASCE and co-sponsored by the Civil Engineering Dept of Virginia Tech.

2. Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.

3. "Standard test Methods for Crosshole Seismic Testing", ASTM Standard D4428/D4428M-91, July 1991, Philadelphia, PA

## OYO SUSPENSION P-S VELOCITY LOGGING SETUP

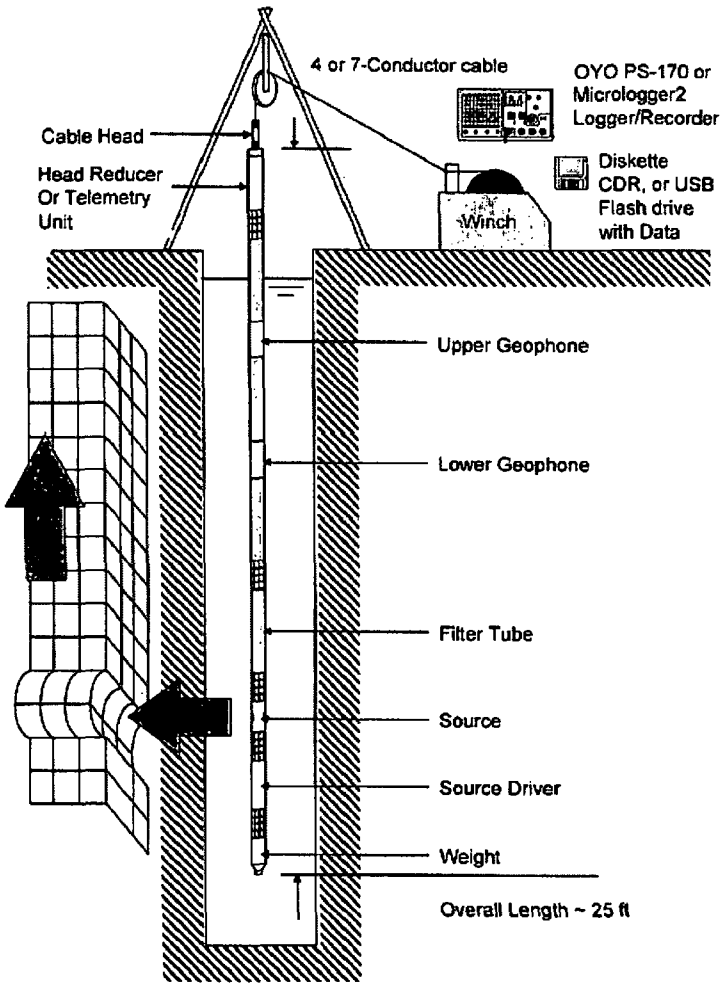


Figure 1. Suspension PS logging method setup

| GE Vision | Procedure for OYO P-S Suspension Seismic Velocity Logging<br>Rev 1.3 4/06/06 Page 6 |
|---|---|

17 of 22

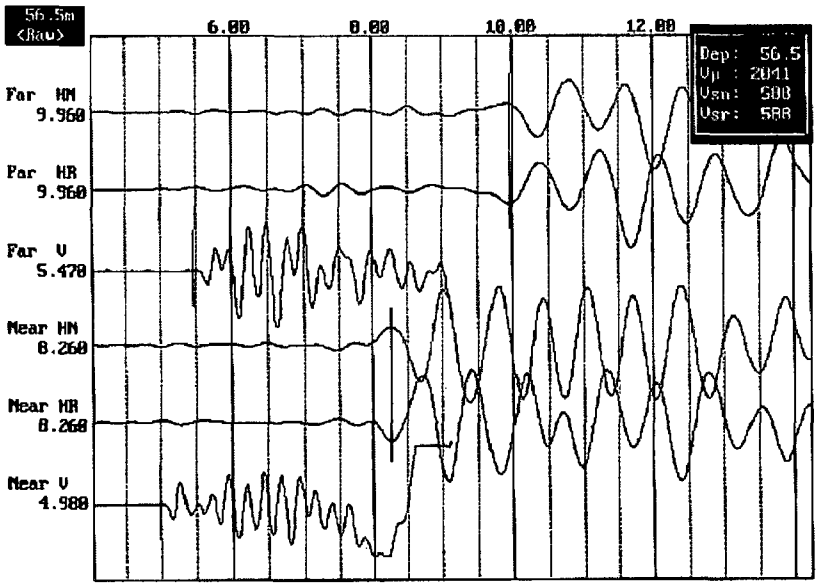


Figure 2. Sample suspension method waveform data showing horizontal normal and reversed (HR and HN), and vertical (V) waveforms received at the near (bottom 3 channels) and far (top 3 channels) geophones. The arrivals in milliseconds for each pick are shown on the left. The box in the upper right corner shows the depth in the borehole and the velocities calculated based on the picks.

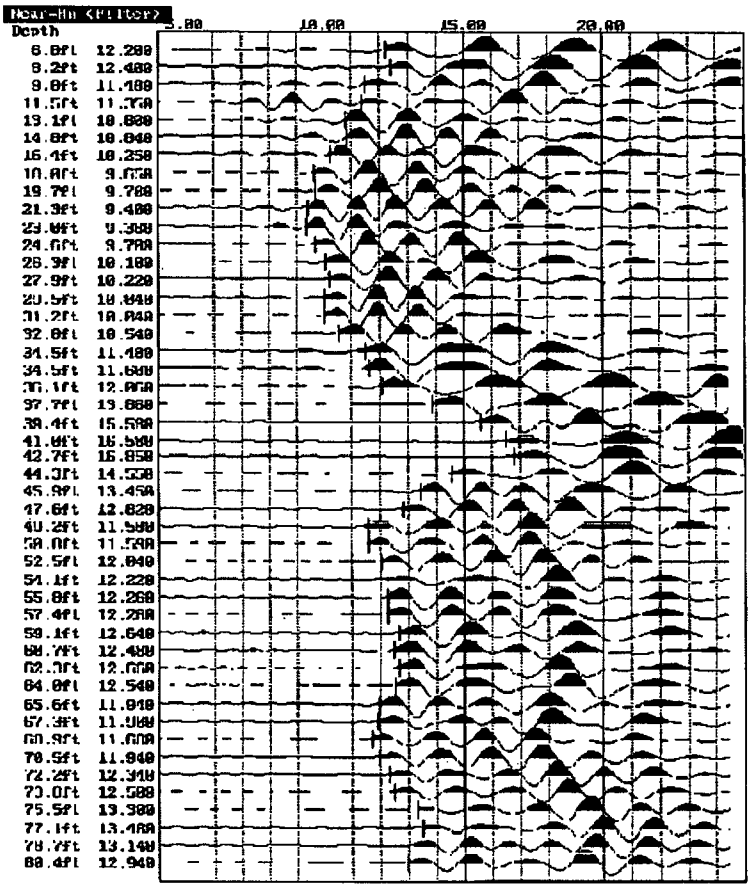


**Figure 3. Sample composite waveform plot for normal shear waves received at the near geophone in a single borehole**

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## P-S SUSPENSION VELOCITY FIELD LOG

SITE:_____ DATE:_____
CLIENT:_____ JOB:_____
AUTHOR:_____ PAGE 1 OF ____

CONTACT:_____ _OFFICE_ PHONE:_____
_____ PHONE:_____
CONTACT:_____ _OFFICE_ PHONE:_____
_____ PHONE:_____
CONTACT:_____ _____ PHONE:_____
_____ PHONE:_____
CONTACT:_____ _____ PHONE:_____
_____ PHONE:_____
DRILLER:_____ _____ PHONE:_____
COMPANY:_____ _____ PHONE:_____

DIRECTIONS TO SITE:_____
_____
_____
_____
_____

GENERAL SITE CONDITIONS/LOCATION:_____
_____

EA#:_____
BOREHOLE DESIGNATION:_____LOCATION:_____
_____
COUNTY:_____RANGE:_____TOWNSHIP:_____SECTION:_____
BOREHOLE CONSTRUCTION: CASED____ UNCASED_____
DIAMETERS AND DEPTH RANGES: _____ 0 TO _____; _____, _____ TO _____
BOREHOLE TOTAL DEPTH AS DRILLED:_____
CONDUCTOR CASING?: YES____ DEPTH TO BOTTOM OF CASING_____; NO____
DEPTH TO BEDROCK:_____ DEPTH TO WATER TABLE:_____
BOREHOLE FLUID: WATER____; FRESH WATER MUD____; SALT WATER MUD ____;
OTHER:_____
DEPTH TO BOREHOLE FLUID:_____ TIME SINCE LAST CIRCULATION:_____

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20 of 22

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SITE:_____ DATE:_____
CLIENT:_____ JOB:_____
AUTHOR:_____ PAGE 2 OF _____

LOGGING CREW:_____
VEHICLE(S) USED AND MILEAGE: _____
MOBILIZED FROM:_____ DEPARTURE TIME:_____
ARRIVED ON SITE:_____
STANDBY TIME:_____ CAUSE:_____
LOGGING STARTED:_____ LOGGING COMPLETED:_____
STANDBY TIME:_____ CAUSE:_____
LOGGING STARTED:_____ LOGGING COMPLETED:_____
DEMOBILIZED TO:_____ ARRIVAL TIME:_____
ADDITIONAL DEMOB TIME:_____ REASON:_____

BATTERIES CHANGED BEFORE LOGGING: YES_____; NO_____; STORED WITH NEW_____

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WINCH | COMPROBE ☐ | | GREY ☐ | OYO ☐ | RG ☐ | OTH ☐ | | |
| INSTRUMENT | OYO 12004 ☐ | 15014 ☐ | 19029 ☐ | | RG 160023 ☐ | 160024 ☐ | | |
| RECEIVER S/N | 12008 ☐ | 20042 ☐ | 26086 ☐ | 11001 ☐ | 23053 ☐ | | | |

MAINTENANCE PERFORMED ON SITE:_____

EQUIPMENT PROBLEMS OR FAILURES:_____

SUGGESTIONS, ADDITIONS, CHANGES:_____

COMMENTS:_____

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21 of 22

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## SEISMOGRAPH CALIBRATION DATA SHEET REVISION LOG

| DATE | REVISION NUMBER | REASON FOR CHANGE | APPROVED |
|---|---|---|---|
| | | | |
| 4/14/1998 | 1.00 | NEW GEOVISION PROCEDURE | JGD |
| | | (WAS AGBABIAN PROCEDURE) | |
| | | | |
| 12/8/1998 | 1.10 | REVISED 0.25MV TO 0.25V BECAUSE | JGD |
| | | TEST APPARATUS INJECTS SIGNAL | |
| | | AFTER GAIN AMPLIFIERS. ALSO | |
| | | CORRECTED SPELLING ERRORS | |
| | | (COORECT AND SEISMOGRAPG) | |
| | | | |
| 2/16/1999 | 1.20 | REVISED "TEST EQUIPMENT | JGD |
| | | REQUIRED" SECTION TO ONLY REQUIRE | |
| | | NIST TRACEABLE CALIBRATION FOR | |
| | | THE FREQUENCY COUNTER. ALSO | |
| | | ADDED INSTRUCTIONS FOR CREATING | |
| | | CALIB. LABEL PER QA PROGRAM. | |
| | | | |
| 7/11/2002 | 1.20 | CHANGED THE LOGO FROM | JGD |
| | | BLACKHAWK GEOMETRICS TO | |
| | | BLACKHAWK GEOSERVICES. NO | |
| | | CHANGES TO PROCEDURE. | |
| | | | |
| 10/10/2005 | 1.21 | CHANGED LOGO TO REMOVE | JGD |
| | | "DIVISION OF BLACKHAWK" AND ADD | |
| | | REV 1.21 AT BOTTOM OF PAGE | |
| | | CHANGED TITLE OF SIGNATURE IN | |
| | | PROCEDURE FROM VP TO PRESIDENT. | |
| | | | |
| 4/6/2006 | 1.30 | CHANGED "RECORD BOTH ON | JGD |
| | | DISKETTE AND PAPER TAPE.." TO | |
| | | "RECORD BOTH ON DISK AND PAPER | |
| | | TAPE, IF AVAILABLE" AND CHANGED | |
| | | "ATTACH ...PAPER TAPES TO THIS | |
| | | FORM" TO "ATTACH...PAPER TAPES, | |
| | | IF AVAILABLE, TO THIS FORM." | |
| | | | |

22 OF 22

# 4.3 BOREHOLE GEOPHYSICAL LOGGING

Borehole Geophysical Logging

Down-hole geophysical logging will be performed in specified boreholes in accordance with the procedures described in ASTM D 5753, Standard Guide for Planning and Conducting Borehole Geophysical Logging. The following down-hole geophysical logs will be required to be performed in the selected boreholes:

- Natural gamma;
- Long- and short-normal resistivity;
- Three-arm caliper; and
- Directional Survey

The capability to log both open and cased holes with a minimum diameter of 4 inches is required.

Geophysical logging will begin after all drilling tools have been removed from the borehole. Where this would require hourly standby charges from the Geophysical Subcontractor to coordinate with drilling operations, grouted PVC casing may be used to maintain holes open, depending on site/borehole conditions and as necessary, awaiting geophysical logging. The PVC casing would be left in place when the hole is completed by grouting.

Prior to beginning logging activities, information on logging rates, plotting, logging order, and instrument sensitivities will be provided to Bechtel.

Data for all logs will be recorded in a digital format so that the logs can be reproduced at any scale required by subsequent data analysis or presentation. The logs will be interpreted by the Geophysical Subcontractor and the logs and the interpretation will be presented in the data report and transmitted to Bechtel. Interpretation of the logs will include, but not be limited to, information on lithology, water quality, water-bearing zones and fracture zones.

# ATTACHMENT 5

## *REFRACTION MICROTREMOR (REMI) TEST PROCEDURES*

**DATA ACQUISITION**

The data gathering process in the field uses standard refraction seismic equipment to measure site characteristics using ambient vibrations (microtremors) as a seismic source. If ambient noise is low at the time of the test, an active source, which may consist of walking or driving back and forth across the array, is used. The equipment used for the survey includes a SeisDAQ ReMi recording unit capable of storing record lengths up to about 100 seconds and 24 10-Hz vertical P-wave geophones. The data is collected from the 24 receivers (10 Hz. Geophones) set along a relatively straight-line array, with evenly spaced intervals between the receivers. Ten unfiltered 30-second records are recorded along each line.

**DATA PROCESSING**

The vibration records collected above are processed using proprietary software that uses the refraction microtremor method as explained in Louie, J. N., 2001, "Faster, Better: Shear-wave velocity to 100 meters depth from refraction micrometer arrays, Bulletin of the Seismological Society of America, v. 91, p. 347-364.

For each location, there are three main processing steps:

Step 1: Creating a velocity spectrum (p-f image) from the data: The distinctive slope of dispersive waves is an integral part of the p-f analysis. Other arrivals that appear in microtremor records, such as body waves and airwaves, cannot have such a slope.

Step 2: Rayleigh-wave dispersion picking: Picking is done along a "lowest-velocity envelope" bounding the energy appearing in the p-f image.

Step 3: Shear wave velocity modeling: The refraction microtremor method interactively forward-models the normal-mode dispersion data picked from the p-f images

# ATTACHMENT 6

## *ELECTRICAL RESISTIVITY TEST*

## FIELD ELECTRICAL RESISTIVITY TESTING

Field Electrical resistivity testing will be performed to determine the in-place electrical resistivity of the foundation materials at the project site. The testing will be performed at the locations shown on the Subsurface Investigation Location Plan of the Specification and at other locations as directed in the field by Bechtel. A Wenner four-electrode resistivity array provided by MACTEC or a Subcontractor will be used for the testing.

The procedure used for the resistivity testing will be in accordance with ASTM G 57. The electrode spacing will be 3, 5, 7.5, 10, 15, 30, 50, 100, 200, and 300 ft, or as approved by Bechtel, to determine the resistivity at increasing depths. The locations shown on the Subsurface Investigation Location Plan of the Specification for the resistivity tests will be the centerpoint of the test. The tests will be conducted in the directions shown on the Subsurface Investigation Location Plan or as directed by Bechtel in the field.

The resistivity data will be interpreted by MACTEC and the results transmitted to Bechtel in the Data Report.

# ATTACHMENT 7

## *FIELD RECORDS AND SAMPLE CONTROL PROCEDURES*

# FIELD RECORDS AND SAMPLE CONTROL PROCEDURES

## Purpose

The purpose of this procedure is to describe the process that will be followed in the field handling of samples, methods of controlling access to the samples and the process for transferring the samples to the laboratories for testing. This procedure also addresses the process that will be followed for controlling field records.

## Definitions

Field Record: A field record is created once the act of data collection begins. Field records include: digital photographs, electronic files, paper documents, field notes and journal entries, maps and additional information related to the samples. Such information includes field data CDs or diskettes test reports, monitoring well installation forms, borehole logs, chain of custody forms, results of in-situ tests, data CD's /diskettes and downhole geophysical logging interpretations.

Field Sample: A field sample is a portion of material (solid, liquid or gas) collected from the subject site. Typical field samples will be soil materials (placed in glass jars), undisturbed soil samples (contained in steel Shelby tubes), and bulk samples (placed in plastic buckets or plastic-lined bags).

Office Facility: The actual location of this facility has not been determined. However, this is typically a secured building (or area of a building) which contains the file storage and data processing equipment (copier, fax, telephone). The office facility will be climate-controlled.

On-Site Storage Facility: This will be one or more rooms at or near the site which may also serve as the office facility. The Storage Facility will also be climate-controlled.

## Processing of Field Records

Field records will be returned to the office facility on a daily basis. Journal originals may remain with the author, however a copy of that day's entries must be created for the office facility. A copy of field records should be maintained at the site in the office facility. These copies will be stored in a secure file cabinet in the office. The originals (or copies of journals, as appropriate) should be transmitted to the Document Control Center (DCC) on a once per work shift basis by the Site Coordinator or his designee. The Site Coordinator is responsible for maintenance of the field records stored at the office facility.

Formal requests for copies of field records will be submitted to the DCC. Field records are considered to be for information only until they have been reviewed and approved by the Principal Geotechnical Engineer. Any copies received directly from the field office facility will be considered as documents for information only.

## Transportation and Storage of Samples

Collected samples will be stored in a manner that will allow future retrieval for examination and laboratory testing. The following procedures will be followed to preserve the sample integrity.

a. ASTM standard D 4220 "Standard practices for preserving and transporting soil samples" will be followed.

b. Samples should be clearly labeled with the job name, job number, borehole number, depth and date collected.

c. SPT sample specimens will be placed in glass sample jars/bottles fitted with moisture-resistant lids and the jars/bottles placed in cardboard boxes.

d. Undisturbed samples will be placed in appropriate padded boxes and kept upright while transported to the Storage Facility in accordance with ASTM 4220. Inside the Storage Facility the samples may be stored upright in appropriate storage racks or kept in their transportation boxes until they are selected to send to the laboratory (see Transportation of Samples to Off-Site Locations).

e. Sample jars, and undisturbed sample tubes, will be clearly marked with the following information in indelible ink:

- Job Name and Project Number
- Date of Sampling
- Borehole Number
- Depth Interval
- Sample Number

Pre-printed adhesive labels will be placed on the sides of the glass sample jars to accommodate the above pertinent information. The above information will be written directly on the sides of the undisturbed sample tubes in indelible ink. Boxes of sample jars (SPT samples) will have the job name, project number, boring number, and range of sample numbers, written on the side of the box in indelible ink.

Field Samples consisting of full boxes of sample jars (SPT samples), and all undisturbed samples will be delivered to the On-Site Storage Facility on a daily basis. Improperly labeled sample containers (e.g., boxes) will not be accepted into the On-Site Storage Facility unless they are only partially filled and scheduled for additional sampling on the following working day.

Partially filled boxes containing sample jars (SPT samples) may be stored in the drill rig cab or truck cab to remain on-site for continued use on the following working day until the box is full and sample container labeling can be properly completed. Boxes of undisturbed samples will be delivered to the Storage Facility on a daily basis.

**Access to Field Records and Samples**

The Site Coordinator will control access to the On-Site Storage Facility and the office facility field records. The general public will not have access to the On-Site Storage Facility or the office facility.

**Transportation of Samples to Off-Site Locations**

If a transfer to an off-site facility (e.g., the testing laboratory of MACTEC or one of its Subcontractors) is requested by Bechtel, the MACTEC Site Coordinator or Project Manager will determine when the transfer can be performed. Samples will be prepared for transportation and documented accordingly using a Chain-of-Custody (COC) form. The parties involved in sample transportation will fill in the COC form to completely document the transportation process. The Site Coordinator or his designee will collect the associated chain of custody forms and arrange for transport of the sample containers. Weather protection of the sample containers will be maintained during the transfer. The Site Coordinator or his designee will retain copies of the chain of custody form after relinquishing control to the testing laboratory or to Bechtel at the off-site facility.

# ATTACHMENT 8

## *LABORATORY CONTROL AND PROCEDURES*

## Laboratory Control and Procedures

The laboratory testing of soil and water samples will be performed in accordance with ASTM procedures or other applicable standards (see attached References & Standards).

The laboratory tests will be performed at MACTEC's Atlanta, GA, Charlotte, NC, or Raleigh, NC office or by a MACTEC-approved Subcontractor. Additional laboratory testing will be performed by subcontract or University laboratories. For soil, this additional testing will include dynamic testing and the chemical analysis tests. The number and type of specific laboratory tests will be determined by Bechtel based on the results of the field exploration program.

## REFERENCES AND STANDARDS

The following standards are to be used for performing the laboratory tests on soil and rock samples:

**American Society for Testing and Materials (ASTM).**

1) ASTM D 1557-02$e_1$; "Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700kN-m/m3))"

2) ASTM D 854-06; "*Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer.*"
3) ASTM D 1883-05; "*Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils.*"
4) ASTM D 2488-1100; "*Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).*"
5) ASTM D 2487-06 (2006); "*Standard Practice for Classification of Soils for Engineering Purposes.*"
6) ASTM D 422-63 (2002); "*Standard Test Method for Particle-Size Analysis of Soils.*"
7) ASTM D 6913-04$e_1$; "*Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis" Use in lieu of D422 except for Hydrometer*
8) ASTM D 1586-99; "*Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.*"
9) ASTM D 2166-00; "*Standard Test Method for Unconfined Compressive Strength of Cohesive Soil.*"
10) ASTM D 2216-05; "*Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*".
11) ASTM D 2435-04; "*Standard Test Methods for One-Dimensional Consolidation Properties of Soils using Incremental Loading.*"
12) ASTM D 2850-03 (2003); "*Standard Test Method for Unconslidated-Undrained Triaxial Compression Test on Cohesive Soils.*"

13) ASTM D 3080-04; "*Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions.*"
14) ASTM D 4015-92 (2000); "*Standard Test Methods for Modulus and Damping of Soils by the Resonant-Column Method.*"
15) Test Procedures and Calibration Documentation Associated with the RCTS and URC Tests at the University of Texas at Austin, DCN: UTSD RCTS GR06-4, April 25, 2006, Geotechnical Engineering Center, University of Texas, Austin, Texas

16) ASTM D 4220-95 (2000); *"Standard Practices for Preserving and Transporting Soil Samples."*
17) ASTM D 4318-05; *"Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils."*
18) ASTM D 4767-04 (2004); *"Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils."*

19) EPA Methods Chemical Analysis of Soil Samples (Corrosion)

- *EPA Method SW-846 9056/300.0 (Chlorides)*
- *EPA Method SW-846 8056/300.0 (Sulfates)*
- *EPA Method SW-846 9045 (pH)*

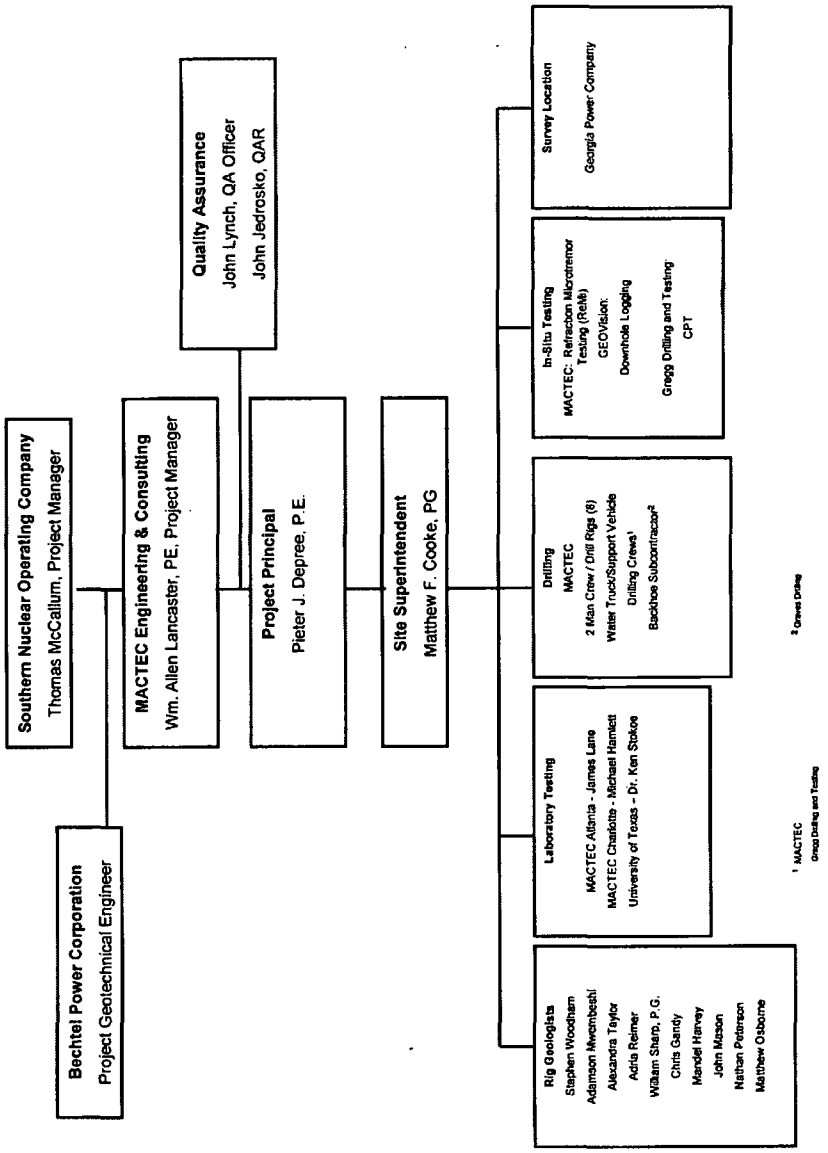
**Table 8.1 - Laboratory Testing Program**

| | Grain Size (Dry) | Grain Size (Hydrometer) | Atterberg Limits | Moisture-Density Mod. Proctor | Moisture Content | Specific Gravity | Triaxial Shear (CU) | Triaxial Shear (UU) | Direct Shear | Consolidation | Corrosion | Unconfined Compression - Soil | Unit Weight - Soil | Resonant Column / Torsional Shear |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Tests in Program | 250 | 50 | 150 | 20 | 600 | 50 | 10 | 30 | 0 | 20 | 50 | 0 | 50 | 20 |
| | | | | | | | | | | | | | | |
| SPT | | | | | | | | | | | | | | |
| Existing Fill | | | | | | | | | | | | | | |
| Coastal Plain Soils | • | • | • | | • | • | | | | | • | | | |
| | | | | | | | | | | | | | | |
| UD Thin-Wall Tube | | | | | | | | | | | | | | |
| Coastal Plain Soils | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| | | | | | | | | | | | | | | |
| Bulk Sample - Test Pits | | | | | | | | | | | | | | |
| Coastal Plain Soils | • | • | • | • | • | • | | | | | • | | | |

*Notes: Dots indicate samples that may be selected by Bechtel for laboratory testing*

# ATTACHMENT 9

## *ORGANIZATION CHART*


Southern Nuclear Operating Company
Thomas McCallum, Project Manager
Bechtel Power Corporation
Project Geotechnical Engineer
MACTEC Engineering & Consulting
Wm. Allen Lancaster, PE, Project Manager
Quality Assurance
John Lynch, QA Officer
John Jedrosko, QAR
Project Principal
Pieter J. Depree, P.E.
Site Superintendent
Matthew F. Cooke, PG
Rig Geologists
Stephen Woodham
Adamson Mwombeshi
Alexandra Taylor
Adria Reimer
William Sharp, P.G.
Chris Gandy
Mandel Harvey
John Mason
Nathan Petersen
Matthew Osborne
Laboratory Testing
MACTEC Atlanta - James Lane
MACTEC Charlotte - Michael Hamlett
University of Texas - Dr. Ken Stokoe
Drilling
MACTEC
2 Man Crew / Drill Rigs (8)
Water Truck/Support Vehicle
Drilling Crews[1]
Backhoe Subcontractor[2]
In-Situ Testing
MACTEC: Refraction Microtremor Testing (ReMi)
GEOVision:
Downhole Logging
Gregg Drilling and Testing
CPT
Survey Location
Georgia Power Company
[1] MACTEC
Gregg Drilling and Testing
[2] Gravel Drilling

# FINAL REPORT

# BORING GEOPHYSICAL LOGGING
# BORINGS B-3001, B-3002, B-3003, B-4001, B-4002 AND B-4003

# VOGTLE UNITS 3 & 4 COL PROJECT
# VOGTLE ELECTRIC GENERATING PLANT

**Report 6517-02 vol 2 of 2 (CD-R) rev B**

**May 18, 2007**

**Prepared for:**

**MACTEC Engineering and Consulting, Inc.**
396 Plasters Avenue
Atlanta, Georgia 30324
404-873-4761
MACTEC Job number 6141-06-0286

**Prepared by**

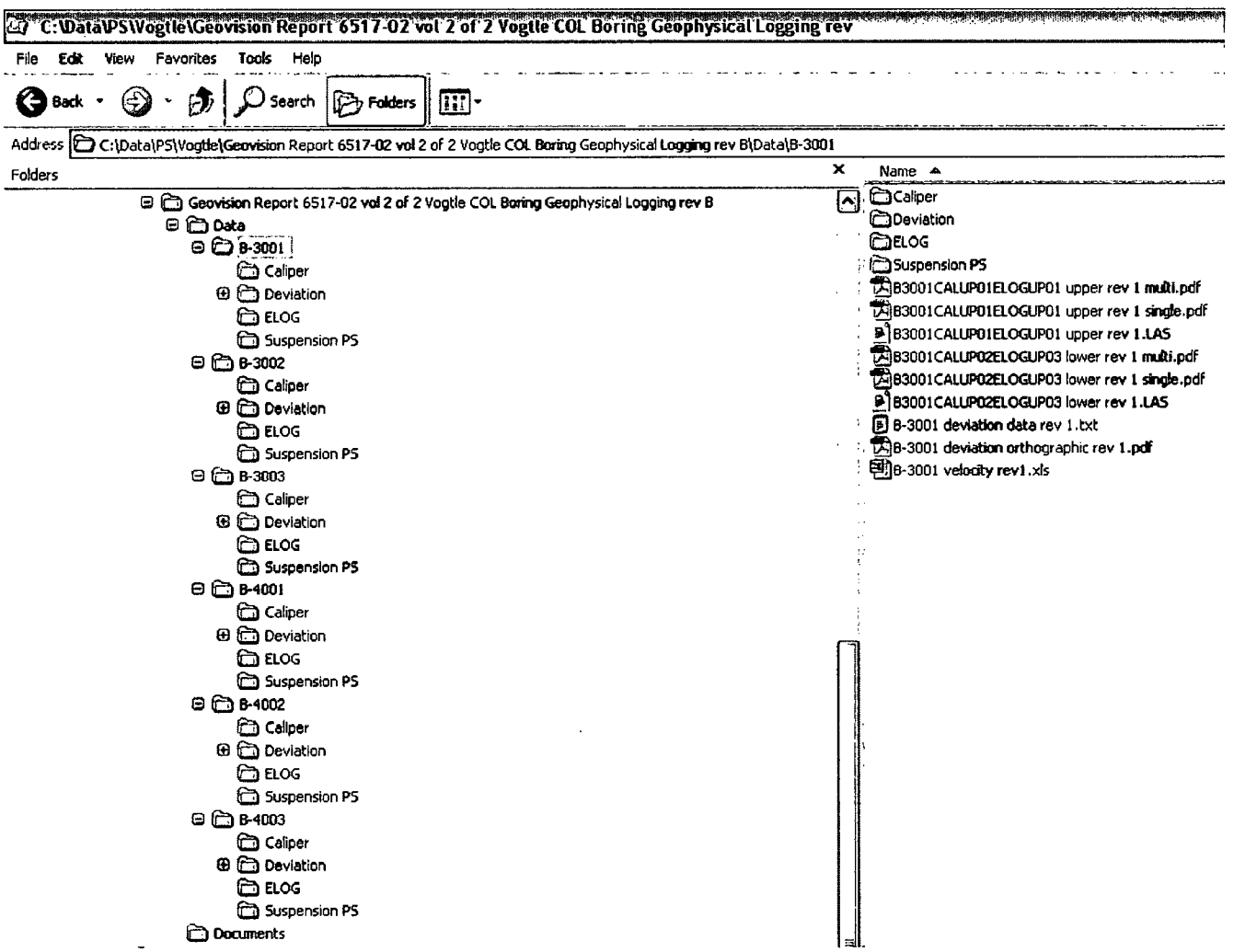
**GEOVision Geophysical Services**
1151 Pomona Road, Unit P
Corona, California 92882
(951) 549-1234

## CONTENTS

The "Data" directory contains boring-specific subdirectories, each containing .XLS, .PDF, .TXT and .LAS files for presentation or further processing, as shown in the Windows Explorer screen grab below. File names and revision level are self explanatory. Each boring-specific subdirectory is further divided by log type, with each sub-directory containing raw data files and intermediate processing steps for those log types.

The PSLOG picking and file viewing program for the Suspension PS data, and directions for its use, are contained in the "Data" directory. It may be run and files viewed directly off the disk.

The "Documents" directory contains the vol 1 of 2 of this report, as well as this vol 2 of 2 cover sheet.



# GEOVision Report dated May 7, 2007

# Four Electrode Wenner Resistivity Tests

GEOVision
geophysical services

May 7, 2007

GEOVision Project Number 7125

Mr. Matt Cooke
MACTEC Engineering and Consulting
720 Gracem Road, Suite 132
Columbia, South Carolina 29210

**Subject:** **GEOVision Report 7125-01 Vogtle COL Resistivity rev 0**
**Four Electrode Wenner Resistivity Tests**
**Vogtle Electric Generating Plant**
**Vogtle Units 3 & 4 COL Geotechnical Data Report Attachment D**
**Project 6141-06-0286**

Dear Mr. Cooke:

A geophysical survey was conducted from March 27, 2007 to March 29, 2007 at the Vogtle Electric Generating Plant near Waynesboro, Georgia. The purpose of the geophysical survey was to measure soil resistivity according to ASTM standard G57-2006. Site conditions consisted of very dry surficial soils with minor to heavy vegetation

## METHODOLOGY

Resistivity equipment used during this investigation included an Advanced Geosciences Supersting R8/IP earth resistivity meter Serial Number SS0609199 coupled to 1/4- inch stainless steel electrode stakes with 20 gauge insulated copper wire. A test resistor rated at 19.82 ohms was used to verify the receiver was operating within calibrated levels. The Supersting transmitter is rated at 200W and is capable of continuous output current between 1mA-1A with an output voltage of 800 V peak to peak. The operator may select a maximum output current, which the instrument will automatically reduce as needed depending on soil conditions and ground impedance. The transmitter then maintains a steady current through the measurement cycle, recording input voltage and writing V/I to internal memory.

## FIELD PROCEDURES

Before conducting the geophysical survey the battery level was checked on the resistivity meter and found to be within acceptable limits. Ambient temperature and soil conditions were recorded on the field log. Electrode spacing was pre-determined based on information provided by the client.

A test resistor rated at 19.82 ohms was connected to the positive and negative current and potential leads on the Supersting R8/IP immediately before the first sounding and immediately after the final sounding, at each of the survey locations. The resistance value across the test resistor and the time of the test measurement was recorded on the field log.

Resistivity measurements (soundings) were made at ten locations (ER-1103, ER-1104, ER-1105, ER-1106, ER-3001, ER-3002, ER-4001, ER-4002, ER-4003 AND ER-4004) at the selected intervals using a surveyor's measuring tape for spatial control.

Resistivity measurements at ten electrode spacings were made on each line. For each resistivity measurement, four stainless steel electrodes were placed at equal distances (*a* spacing) in a straight line. A current was applied from the outer electrodes, and a potential reading (voltage) was measured across the inner electrodes. The Supersting R8/IP displays the resistance value, which was recorded along with the *a* spacing on a field data sheet and later transferred to a spreadsheet. The instrument also displays a calculated apparent resistivity value, which was also recorded on the field log. However, the Supersting R8/IP performs all internal calculations in metric units prior to display, and some rounding errors may occur. It should be noted that resistance values are unitless and are therefore not affected by any rounding errors during unit conversion. The instrument stores output current, resistance values, and apparent resistivity values in internal memory as well as geometry of the measurement. Two or more measurements were recorded at each station for quality control. If there was significant variation between the first and second measurements the control leads, electrode cable and electrode coupling were field checked to ensure proper survey conditions. After each measurement, the electrodes were moved to the next *a* spacing and another set of measurements was taken. Vegetation, accessibility, and line lengths constrained ER-3001, ER-3002, and ER-4003 to a maximum 200 ft electrode spacing. Data was downloaded at the completion of each field day.

## DATA REDUCTION

Ten spreadsheets were generated from the collected resistivity data. Probe spacing (*a*) and resistance reading (ΔV/I), were entered for each resistivity measurement. A generalized form of the four-electrode array is shown in Figure 1.

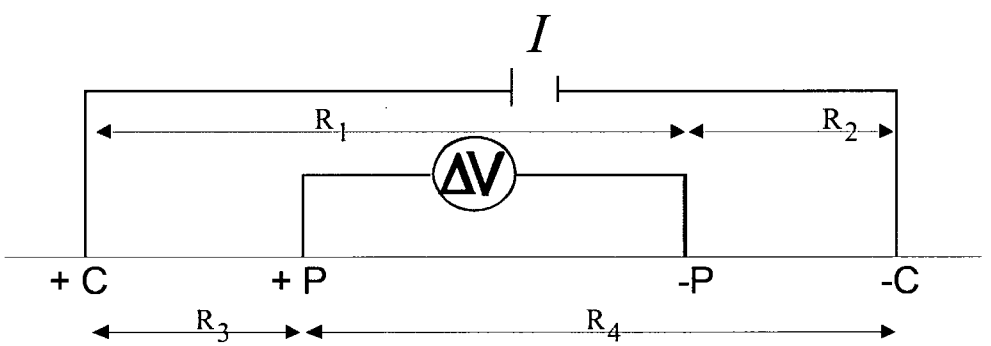



**Figure 1: The generalized form of the four electrode array**

When the material upon which the current is induced is uniform, the resistivity calculated will be constant independent of electrode configuration. However, in a field investigation where subsurface heterogeneities exist, the calculated resistivity values will vary with electrode array. This calculated resistivity is referred to as apparent resistivity ($\rho_a$), and can be calculated using the relationship:

$$\rho_a = \frac{2\pi\Delta V}{I\left\{\left(\frac{1}{R_3}-\frac{1}{R_4}\right)-\left(\frac{1}{R_1}-\frac{1}{R_2}\right)\right\}}$$

For the Wenner array, which was used during this investigation, where $R_1 = R_4$ ; $R_3 = R_2$ and $R_1 = 2R_2 = 2a$, it can be shown that the formula for calculated apparent resistivity can be reduced to the following form:

$$\rho_a = 2\pi a\left(\frac{\Delta V}{I}\right)$$

## RESULTS

Data collected from the ten Wenner resistivity arrays are attached as Tables 1-10. Electrode *a* spacing was converted to meters in order to provide an average soil resistivity in ohm-meters. All calculations were conducted using known geometry and measured unitless resistance values; calculated apparent resistance values may vary from values calculated by the Supersting R8/IP, which are recorded on the daily field logs. According to ASTM Standard G57-2006 data is also presented in the ohm-centimeter unit.

Several readings encountered during measurements at ER-1105 and ER-4001 are considered erroneous and should not be used for design purposes. Coarse gravels, extremely dry soils, and poor contact between the electrode stake and native soils are interpreted as contributing factors. The measurements at these locations were repeated. Wire and electrode contacts were checked to ensure proper testing protocols. It should be noted that two techniques or procedures may typically be employed to overcome extreme contact resistances. The first involves increasing the amount of surface area of the electrode with the soil by driving the electrode stake further into the soil or increasing the diameter of the electrode stake, both in contradiction with standard ASTM G57-2006. The second technique entails pouring a sodium-chloride solution in a shallow excavation around the electrode stakes. However, neither of these field procedures are covered in the published standard, and were therefore not used in this project.

All completed data processing forms are retained in project files. All files generated during the processing sequence were archived on CD-ROM.

## SUMMARY

Four-electrode soil resistivity measurements were made at the Vogtle Electric Generating Plant according to ASTM standard G57-2006. Soil resistivity values were made at ten locations, using electrode spacings determined by the client. Field measurements and calculated values were consistent and repeatable at all locations, as summarized in Tables 1-10.

If you have any questions concerning this investigation, please call us at 951-549-1234.

Sincerely,
**GEO***Vision* Geophysical Services

Vincent Romano

JB Shawver

Submitted by:
Vincent John Romano
Staff Geophysicist

Reviewed and Approved by:
JB Shawver
Senior Project Geophysicist

Attachments:

Table 1: Resistivity Soundings ER-1103
Table 2: Resistivity Soundings ER-1104
Table 3: Resistivity Soundings ER-1105
Table 4: Resistivity Soundings ER-1106
Table 5: Resistivity Soundings ER-3001
Table 6: Resistivity Soundings ER-3002
Table 7: Resistivity Soundings ER-4001
Table 8: Resistivity Soundings ER-4002
Table 9: Resistivity Soundings ER-4003
Table 10: Resistivity Soundings ER-4004
Applied Technical Services, Incorporated Certificate of Calibration
Applied Technical Services, Incorporated Calibration Data Sheet

**TABLE #1 ELECTRICAL RESISTIVITY SOUNDING ER-1103**

Job Number 7125 Date 28-Mar-07

19.82 ohm Test Resistor Reading

19.83 ohm at 0810 19.83 ohm at 0855

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 842.265 | 18.850 | 15876.321 | 4839.103 | 483910.271 | 838.952 | 15813.873 | 4820.068 | 482006.8 |
| 5.0 | 418.706 | 31.416 | 13154.037 | 4009.350 | 400935.046 | 418.042 | 13133.177 | 4002.992 | 400299.2 |
| 7.5 | 207.763 | 47.124 | 9790.601 | 2984.175 | 298417.510 | 207.561 | 9781.082 | 2981.274 | 298127.4 |
| 10.0 | 133.799 | 62.832 | 8406.839 | 2562.405 | 256240.456 | 134.007 | 8419.908 | 2566.388 | 256638.8 |
| 15.0 | 88.277 | 94.248 | 8319.940 | 2535.918 | 253591.756 | 88.470 | 8338.054 | 2541.439 | 254143.9 |
| 30.0 | 54.207 | 188.496 | 10217.816 | 3114.390 | 311439.046 | 54.373 | 10249.088 | 3123.922 | 312392.2 |
| 50.0 | 38.985 | 314.159 | 12247.405 | 3733.009 | 373300.896 | 39.053 | 12268.799 | 3739.530 | 373953.0 |
| 100.0 | 9.3450 | 628.319 | 5871.637 | 1789.675 | 178967.486 | 9.430 | 5925.044 | 1805.953 | 180595.3 |
| 200.0 | 0.4837 | 1256.637 | 607.835 | 185.268 | 18526.821 | 0.483 | 606.956 | 185.000 | 18500.0 |
| 300.0 | 0.1975 | 1884.956 | 372.279 | 113.471 | 11347.056 | 0.239 | 450.239 | 137.233 | 13723.3 |

**TABLE #2 ELECTRICAL RESISTIVITY SOUNDING ER-1104**

Job Number 7125 Date 28-Mar-07

19.82 ohm Test Resistor Reading

19.81 ohm at 0945 19.81 ohm at 1030

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 171.443 | 18.850 | 3231.624 | 984.999 | 98499.912 | 171.443 | 3231.624 | 984.999 | 98499.9 |
| 5.0 | 169.746 | 31.416 | 5332.728 | 1625.415 | 162541.545 | 170.053 | 5342.373 | 1628.355 | 162835.5 |
| 7.5 | 159.804 | 47.124 | 7530.586 | 2295.323 | 229532.264 | 159.709 | 7526.109 | 2293.958 | 229395.8 |
| 10.0 | 146.189 | 62.832 | 9185.326 | 2799.687 | 279968.729 | 146.148 | 9182.750 | 2798.902 | 279890.2 |
| 15.0 | 116.037 | 94.248 | 10936.230 | 3333.363 | 333336.278 | 116.048 | 10937.266 | 3333.679 | 333367.9 |
| 30.0 | 49.719 | 188.496 | 9371.830 | 2856.534 | 285653.365 | 49.759 | 9379.256 | 2858.797 | 285879.7 |
| 50.0 | 14.542 | 314.159 | 4568.535 | 1392.490 | 139248.961 | 14.538 | 4567.122 | 1392.059 | 139205.9 |
| 100.0 | 0.912 | 628.319 | 572.915 | 174.624 | 17462.439 | 0.912 | 573.032 | 174.660 | 17466.0 |
| 200.0 | 0.056 | 1256.637 | 70.572 | 21.510 | 2151.023 | 0.057 | 71.646 | 21.838 | 2183.8 |
| 300.0 | 0.054 | 1884.956 | 102.117 | 31.125 | 3112.529 | 0.054 | 101.876 | 31.052 | 3105.2 |

**TABLE #3 ELECTRICAL RESISTIVITY SOUNDING ER-1105**

Job Number 7125 Date 27-Mar-07

19.82 ohm Test Resistor Reading

19.82 ohm at 1300 19.81 ohm at 1420

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | *2428.000* | *18.850* | *45766.722* | *13949.697* | *1394969.680* | *2428.000* | *45766.722* | *13949.697* | *1394969.7* |
| 5.0 | *1240.000* | *31.416* | *38955.749* | *11873.712* | *1187371.227* | *1240.000* | *38955.749* | *11873.712* | *1187371.2* |
| 7.5 | 647.000 | 47.124 | 30489.157 | 9293.095 | 929309.496 | 646.200 | 30451.458 | 9281.604 | 928160.4 |
| 10.0 | 426.000 | 62.832 | 26766.369 | 8158.389 | 815838.940 | 426.200 | 26778.936 | 8162.220 | 816222.0 |
| 15.0 | 227.500 | 94.248 | 21441.370 | 6535.330 | 653532.953 | 227.200 | 21413.096 | 6526.712 | 652671.2 |
| 30.0 | 73.740 | 188.496 | 13899.663 | 4236.617 | 423661.714 | 73.880 | 13926.052 | 4244.661 | 424466.1 |
| 50.0 | 22.650 | 314.159 | 7115.707 | 2168.868 | 216886.760 | 22.660 | 7118.849 | 2169.825 | 216982.5 |
| 100.0 | 2.230 | 628.319 | 1401.150 | 427.071 | 42707.062 | 2.211 | 1389.212 | 423.432 | 42343.2 |
| 200.0 | 0.404 | 1256.637 | 507.556 | 154.703 | 15470.298 | 0.410 | 514.593 | 156.848 | 15684.8 |
| 300.0 | 0.123 | 1884.956 | 232.604 | 70.898 | 7089.755 | 0.128 | 240.332 | 73.253 | 7325.3 |

** Note: Italicied values are considered erroneous and interpreted as being caused by difficulty overcoming high contact resistance*

**TABLE #4 ELECTRICAL RESISTIVITY SOUNDING ER-1106**

Job Number 7125 Date 27-Mar-07

19.82 ohm Test Resistor Reading

19.81 ohm at 1515 19.81 ohm at 1615

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 934.800 | 18.850 | 17620.565 | 5370.748 | 537074.817 | 934.200 | 17609.255 | 5367.301 | 536730.1 |
| 5.0 | 497.500 | 31.416 | 15629.423 | 4763.848 | 476384.827 | 497.100 | 15616.857 | 4760.018 | 476001.8 |
| 7.5 | 282.500 | 47.124 | 13312.499 | 4057.650 | 405764.966 | 282.600 | 13317.211 | 4059.086 | 405908.6 |
| 10.0 | 199.900 | 62.832 | 12560.087 | 3828.315 | 382831.465 | 199.700 | 12547.521 | 3824.484 | 382448.4 |
| 15.0 | 107.800 | 94.248 | 10159.911 | 3096.741 | 309674.076 | 101.700 | 9584.999 | 2921.508 | 292150.8 |
| 30.0 | 33.500 | 188.496 | 6314.601 | 1924.690 | 192469.046 | 33.480 | 6310.831 | 1923.541 | 192354.1 |
| 50.0 | 11.680 | 314.159 | 3669.380 | 1118.427 | 111842.709 | 11.660 | 3663.097 | 1116.512 | 111651.2 |
| 100.0 | 1.903 | 628.319 | 1195.690 | 364.446 | 36444.636 | 1.921 | 1207.000 | 367.894 | 36789.4 |
| 200.0 | 0.379 | 1256.637 | 475.637 | 144.974 | 14497.420 | 0.382 | 479.658 | 146.200 | 14620.0 |
| 300.0 | 0.054 | 1884.956 | 101.788 | 31.025 | 3102.486 | 0.055 | 103.786 | 31.634 | 3163.4 |

**TABLE #5 ELECTRICAL RESISTIVITY SOUNDING ER-3001**

Job Number 7125 Date 28-Mar-07

19.82 ohm Test Resistor Reading

19.82 ohm at 1150 19.82 ohm at 1225

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 126.810 | 18.8496 | 2390.3122 | 728.5672 | 72856.7154 | 126.764 | 2389.4451 | 728.3029 | 72830.2869 |
| 5.0 | 71.6531 | 31.4159 | 2251.0485 | 686.1196 | 68611.9591 | 71.5757 | 2248.6169 | 685.3784 | 68537.8441 |
| 7.5 | 40.8731 | 47.1239 | 1926.0995 | 587.0751 | 58707.5116 | 40.8587 | 1925.4209 | 586.8683 | 58686.8283 |
| 10.0 | 30.0764 | 62.8319 | 1889.7559 | 575.9976 | 57599.7612 | 30.0909 | 1890.6670 | 576.2753 | 57627.5304 |
| 15.0 | 16.3815 | 94.2478 | 1543.9200 | 470.5868 | 47058.6817 | 16.3681 | 1542.6571 | 470.2019 | 47020.1878 |
| 30.0 | 4.6420 | 188.4956 | 874.9964 | 266.6989 | 26669.8898 | 4.6410 | 874.8079 | 266.6414 | 26664.1445 |
| 50.0 | *2.0568* | *314.159* | *646.153* | *196.948* | *19694.754* | *2.0577* | *646.4361* | *197.0337* | *19703.3722* |
| 100.0 | 0.8117 | 628.3185 | 510.0062 | 155.4499 | 15544.9875 | 0.8129 | 510.7601 | 155.6797 | 15567.9689 |
| 200.0 | 0.1708 | 1256.6371 | 214.6336 | 65.4203 | 6542.0324 | 0.1708 | 214.6336 | 65.4203 | 6542.0324 |
| 300.0 | NA | NA | NA | NA | NA | NA | NA | NA | NA |

**TABLE #6 ELECTRICAL RESISTIVITY SOUNDING ER-3002**

Job Number 7125 Date 28-Mar-07

19.82 ohm Test Resistor Reading

19.81 ohm at 1305 19.81 ohm at 1335

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 377.128 | 18.850 | 7108.695 | 2166.730 | 216673.034 | 375.625 | 7080.364 | 2158.095 | 215809.5 |
| 5.0 | 311.754 | 31.416 | 9794.041 | 2985.224 | 298522.362 | 310.257 | 9747.011 | 2970.889 | 297088.9 |
| 7.5 | 230.066 | 47.124 | 10841.605 | 3304.521 | 330452.115 | 229.889 | 10833.264 | 3301.979 | 330197.9 |
| 10.0 | 173.354 | 62.832 | 10892.153 | 3319.928 | 331992.825 | 173.229 | 10884.299 | 3317.534 | 331753.4 |
| 15.0 | 88.775 | 94.248 | 8366.809 | 2550.203 | 255020.336 | 88.750 | 8364.519 | 2549.505 | 254950.5 |
| 30.0 | 57.478 | 188.496 | 10834.367 | 3302.315 | 330231.494 | 57.477 | 10834.235 | 3302.275 | 330227.5 |
| 50.0 | 31.486 | 314.159 | 9891.744 | 3015.004 | 301500.366 | 31.486 | 9891.744 | 3015.004 | 301500.4 |
| 100.0 | 5.621 | 628.319 | 3531.483 | 1076.396 | 107639.606 | 5.623 | 3533.035 | 1076.869 | 107686.9 |
| 200.0 | 0.501 | 1256.637 | 629.450 | 191.856 | 19185.621 | 0.507 | 637.241 | 194.231 | 19423.1 |
| 300.0 | NA | NA | NA | NA | NA | NA | NA | NA | NA |

**TABLE #7 ELECTRICAL RESISTIVITY SOUNDING ER-4001**

Job Number 7125 Date 28-Mar-07

19.82 ohm Test Resistor Reading

19.82 ohm at1425 19.81 ohm at 1500

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 39.110 | 18.850 | 737.206 | 224.700 | 22470.043 | 39.110 | 737.206 | 224.700 | 22470.0 |
| 5.0 | 34.280 | 31.416 | 1076.938 | 328.251 | 32825.069 | 34.230 | 1075.367 | 327.772 | 32777.2 |
| 7.5 | 32.980 | 47.124 | 1554.146 | 473.704 | 47370.367 | 33.020 | 1556.031 | 474.278 | 47427.8 |
| 10.0 | 34.330 | 62.832 | 2157.018 | 657.459 | 65745.894 | 34.330 | 2157.018 | 657.459 | 65745.9 |
| 15.0 | 32.960 | 94.248 | 3106.407 | 946.833 | 94683.280 | 32.970 | 3107.349 | 947.120 | 94712.0 |
| 30.0 | 28.030 | 188.496 | 5283.531 | 1610.420 | 161042.010 | 28.010 | 5279.761 | 1609.271 | 160927.1 |
| 50.0 | 16.370 | 314.159 | 5142.787 | 1567.522 | 156752.153 | 16.340 | 5133.362 | 1564.649 | 156464.9 |
| 100.0 | 2.895 | 628.319 | 1818.982 | 554.426 | 55442.576 | 2.891 | 1816.469 | 553.660 | 55366.0 |
| 200.0 | 0.468 | 1256.637 | 587.980 | 179.216 | 17921.645 | 0.468 | 587.603 | 179.102 | 17910.2 |
| 300.0 | *-0.040* | *1884.956* | *-74.588* | *-22.734* | *-2273.433* | *-0.040* | *-75.700* | *-23.073* | *-2307.3* |

** Note: Italicied values are considered erroneous and interpreted as being caused by difficulty overcoming high contact resistance*

**TABLE #8 ELECTRICAL RESISTIVITY SOUNDING ER-4002**

Job Number 7125 Date 29-Mar-07

19.82 ohm Test Resistor Reading

19.82 ohm at 1120 19.84 ohm at 1150

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 67.933 | 18.850 | 1280.497 | 390.296 | 39029.563 | 67.942 | 1280.678 | 390.351 | 39035.1 |
| 5.0 | 51.935 | 31.416 | 1631.599 | 497.311 | 49731.129 | 51.853 | 1629.010 | 496.522 | 49652.2 |
| 7.5 | 50.012 | 47.124 | 2356.769 | 718.343 | 71834.331 | 49.973 | 2354.936 | 717.785 | 71778.5 |
| 10.0 | 45.430 | 62.832 | 2854.426 | 870.029 | 87002.903 | 45.327 | 2847.998 | 868.070 | 86807.0 |
| 15.0 | 37.232 | 94.248 | 3509.062 | 1069.562 | 106956.198 | 37.211 | 3507.064 | 1068.953 | 106895.3 |
| 30.0 | 20.163 | 188.496 | 3800.561 | 1158.411 | 115841.086 | 20.193 | 3806.197 | 1160.129 | 116012.9 |
| 50.0 | 8.311 | 314.159 | 2610.978 | 795.826 | 79582.599 | 8.288 | 2603.752 | 793.624 | 79362.4 |
| 100.0 | 0.834 | 628.319 | 524.143 | 159.759 | 15975.888 | 0.835 | 524.646 | 159.912 | 15991.2 |
| 200.0 | 0.358 | 1256.637 | 450.127 | 137.199 | 13719.883 | 0.358 | 449.499 | 137.007 | 13700.7 |
| 300.0 | 0.040 | 1884.956 | 75.606 | 23.045 | 2304.458 | 0.040 | 76.096 | 23.194 | 2319.4 |

**TABLE #9 ELECTRICAL RESISTIVITY SOUNDING ER-4003**

Job Number 7125 Date 29-Mar-07

19.82 ohm Test Resistor Reading

19.83 ohm at 0915 19.83 ohm at 0945

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 71.668 | 18.850 | 1350.908 | 411.757 | 41175.679 | 71.617 | 1349.947 | 411.464 | 41146.4 |
| 5.0 | 55.649 | 31.416 | 1748.274 | 532.874 | 53287.401 | 55.648 | 1748.218 | 532.857 | 53285.7 |
| 7.5 | 48.325 | 47.124 | 2277.238 | 694.102 | 69410.227 | 48.287 | 2275.481 | 693.567 | 69356.7 |
| 10.0 | 45.240 | 62.832 | 2842.494 | 866.392 | 86639.223 | 45.186 | 2839.126 | 865.366 | 86536.6 |
| 15.0 | 36.179 | 94.248 | 3409.743 | 1039.290 | 103928.976 | 36.147 | 3406.812 | 1038.396 | 103839.6 |
| 30.0 | 17.868 | 188.496 | 3368.095 | 1026.595 | 102659.542 | 17.857 | 3365.946 | 1025.940 | 102594.0 |
| 50.0 | 7.135 | 314.159 | 2241.526 | 683.217 | 68321.723 | 7.139 | 2242.783 | 683.600 | 68360.0 |
| 100.0 | 2.285 | 628.319 | 1435.708 | 437.604 | 43760.375 | 2.283 | 1434.451 | 437.221 | 43722.1 |
| 200.0 | 0.536 | 1256.637 | 672.929 | 205.109 | 20510.880 | 0.535 | 672.803 | 205.071 | 20507.1 |
| 300.0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

**TABLE #10 ELECTRICAL RESISTIVITY SOUNDING ER-4004**

Job Number 7125 Date 29-Mar-07

19.82 ohm Test Resistor Reading

19.84 ohm at 0745 19.84 ohm at 0815

| A-Spacing [ft.] | Resistance Reading [Ohm] | Geometric Multiplier [2(pi)A] | Calculated Magnitude [Ohm-ft.] | Converted Magnitude [Ohm-m] | Calculated to Ohm-cm [Ohm-cm] | Repeat Resistance [Ohm] | Repeat Magnitude [Ohm-ft.] | Repeat Conversion [Ohm-m] | Repeat Calculation to Ohm-cm [Ohm-cm] |
|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 41.796 | 18.850 | 787.830 | 240.131 | 24013.070 | 41.835 | 788.579 | 240.359 | 24035.9 |
| 5.0 | 35.448 | 31.416 | 1113.638 | 339.437 | 33943.688 | 35.412 | 1112.498 | 339.089 | 33908.9 |
| 7.5 | 33.188 | 47.124 | 1563.967 | 476.697 | 47669.699 | 33.156 | 1562.444 | 476.233 | 47623.3 |
| 10.0 | 31.249 | 62.832 | 1963.445 | 598.458 | 59845.808 | 31.237 | 1962.685 | 598.226 | 59822.6 |
| 15.0 | 26.802 | 94.248 | 2526.048 | 769.939 | 76993.938 | 26.772 | 2523.239 | 769.083 | 76908.3 |
| 30.0 | 25.238 | 188.496 | 4757.270 | 1450.016 | 145001.583 | 25.214 | 4752.802 | 1448.654 | 144865.4 |
| 50.0 | 15.509 | 314.159 | 4872.296 | 1485.076 | 148507.583 | 15.476 | 4861.835 | 1481.887 | 148188.7 |
| 100.0 | 6.831 | 628.319 | 4292.044 | 1308.215 | 130821.498 | 6.830 | 4291.416 | 1308.023 | 130802.3 |
| 200.0 | 1.285 | 1256.637 | 1614.779 | 492.185 | 49218.452 | 1.281 | 1609.752 | 490.652 | 49065.2 |
| 300.0 | 0.433 | 1884.956 | 816.374 | 248.831 | 24883.088 | 0.435 | 820.710 | 250.152 | 25015.2 |

# CERTIFICATE OF CALIBRATION

ACCREDITED
CERT. # 1858-03

## Accredited Calibration

**Certificate Number:** M505659-1

Manufacturer: **Advanced Geosciences, Inc**
Model No: **Super Sting**
Customer PO No.:

Description: **Auto Resistivity Meter**
Serial No: **SS0609199**
Customer Asset No.: **SS0609199**

**Customer:**
GeoVision
1151 Pomona Road
Suite P
Corona, CA 92882

**Location of Calibration:**
Applied Technical Services, Inc.
1049 Triad Court
Marietta, GA 30062

Calibration Procedure: **ATS-1032 Rev. 2: Calibration of Resistance Bridges / MicroOhm Meters**

Date of Calibration: **March 26, 2007**
Temperature: **70° F**
Condition Received: **In Tolerance**

*Next Calibration Due: **March 26, 2008**
Humidity: **40 %**
Condition Returned: **In Tolerance**

This instrument has been calibrated using primary or secondary standards whose calibration is traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST). Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements.

The reported expanded measurement uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a confidence level of approximately 95%. ATS maintains, wherever possible, at least a 4:1 Test Uncertainty Ratio. Statements of compliance, where applicable, are based on test results falling within specified limits with no reduction by the uncertainty of the measurement, unless otherwise allowed by procedure.

All calibrations are performed in accordance with the ATS Quality Manual QM1, Rev. 7 dated July 7, 2006. Applied Technical Services, Inc.'s Quality System complies with the applicable requirements of ANSI/NCSL Z540-1, ISO 9001-2000, 10CFR 50 Appendix B, 10CFR Part 21 and ISO/IEC 17025. ATS is an ISO/IEC 17025 Accredited Calibration Laboratory through A2LA.

The reported data is valid only at the time of the test and related only to the item calibrated. *Calibration due dates appearing on this Certificate of Calibration and calibration label are determined by the client and do not imply continued conformance to specifications.

This certificate shall not be reproduced except in full, without the permission of Applied Technical Services, Inc.

Notes:

Calibration Equipment Used::

| Model: | Desc.: | ID No.: | Cal Due Date: |
|---|---|---|---|
| Guildline 9211A | Master Shunt Box | ATS-02014 | 4/25/2007 |

**Calibrated by:** Jeff L. Cook
Electrical Lab Supervisor



**Applied Technical Services, Inc. 1049 Triad Court, Marietta, GA 30062 (770) 423-1400 www.atslab.com**

APPLIED TECHNICAL SERVICES, INCORPORATED

# Calibration Data Sheet

Page 2 of 2

Customer: Geovision — Purchase Order No:

Item Name: Automatic Resistivity Meter — Asset No: SS0609199 — ATS Reference No: M505659-1

Manufacturer: Advanced Geosciences — Model No Super Sting — Proc. No: 1032 — Rev: 1

Serial No: SS0609199 — Calibration Date: 03-26-07 — Calibration Due Date: 3/26/2008

Reason For Service: ■ Initial Calibration ☐ Due For Calibration ☐ Repair and Calibration

Equipment Used: ATS-02014 Due: 04-25-07 Guidlind Resistance Standard
Due:
Due:
Due:
Due:

Calibrated By: Jeff L Cook

Customer Instrument Under Test

| UNCERTAINTY (SEE NOTE) | Function And Range | Applied | TOLERANCE | | AS FOUND READING | AS CALIBRATED READING |
|---|---|---|---|---|---|---|
| 0.001 | Restance m ohms | 999.99 | 989.9901 | 1009.9899 | 998.1 | 998.1 |
| 0.001 | Restance m ohms | 99.99 | 98.9901 | 100.9899 | 99.98 | 99.98 |
| 0.001 | Restance m ohms | 10.00 | 9.9000 | 10.1000 | 10.01 | 10.01 |
| 0.001 | Restance m ohms | 1.00 | 0.9900 | 1.0100 | 1.003 | 1.003 |
| 0.001 | Restance u ohms | 333.33 | 329.9997 | 336.6663 | 332.9 | 332.9 |

* Indicates out of tolerance readings

Remarks:

ATS-563, 08/06

**Vogtle ESP Application Supplement 2-S1**

**Part 2, Section 3.8 (New)**

(Pages 3.8-1 through 3.8-2)

## 3.8 Design of Category I Structures

### 3.8.5 Foundations

This section of the DCD Revision 15, along with references to other DCD Revision 15 sections necessary to support the scope of the LWA-2 request, is incorporated by reference.

Materials incorporated by reference in this application include the following documents:

- Westinghouse document APP-GW-GL-700, *AP1000 Design Control Document* (DCD), Revision 15 as modified by the following Technical Reports:
  - APP-GW-GLN-105, "Building and Structure Configuration, Layout, and General Arrangement Design Updates," (Technical Report 105)
  - APP-GW-GLR-005, "Containment Vessel Design Adjacent to Large Penetrations," (Technical Report 9)
  - APP-GW-GLR-021, "AP1000 As-Built COL Information Items," (Technical Report 6)
  - APP-GW-GLR-044, "Nuclear Island Basemat and Foundation," (Technical Report 85)
  - APP-GW-GLR-045, "Nuclear Island: Evaluation of Critical Sections," (Technical Report 57)
  - APP-GW-GLR-130, "Editorial Format Changes Related to "Combined License applicant" and "Combined License Information Items," (Technical Report 130)
  - APP-GW-S2R-010, "Extension of Nuclear Island Seismic Analysis to Soil Sites," (Technical Report 03)

The scope of the LWA-2 foundation work includes: placing the mud mats, water proofing membrane, concrete forms, reinforcing bars, embedments, drains and other items necessary to prepare the Nuclear Island base slab for the first concrete pour.

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**Vogtle ESP Application Supplement 2-S1**

**Part 2, Section 13.7 (New)**

(Pages 13.7-1 through 13.7-2)

## 13.7 Fitness for Duty

A Fitness for Duty (FFD) program is implemented and maintained to meet the requirements contained in 10 CFR Part 26. The FFD program complies with the FFD requirements contained in 10 CFR Part 26 at the new plant construction site during both the construction and operating phases of the nuclear unit. This program will be implemented at the new plant construction site prior to construction of safety- or security-related structures, systems, and components.

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**Vogtle ESP Application Supplement 2-S1**

**Part 2, Appendix 17.1A**

(Pages 17.1A-1 through last page of appendix)

# Appendix

## 17.1A Nuclear Development Quality Assurance Manual

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SOUTHERN COMPANY

*Energy to Serve Your World®*

# Quality Assurance Manual

Title: Nuclear Development Quality Assurance Manual

Process/Program Owner: **Quality Assurance Manager**

| | Version Number | Effective Date |
|---|---|---|
| | **5.0** | **August 10, 2007** |

Revision Summary

Version 5.0:
Revised to reflect the addition of construction activities and appropriate oversight during that time.

Prepared By/Date:

**Original signed by John M. Giddens, Jr.** / **08-07-07**
Nuclear Development Quality Assurance Project Engineer

| Reviewed By/Date: | Approved By/Date: |
|---|---|
| **Original signed by W. D. Drinkard** / **08/07/07** | **Original signed by J. A. Miller** / **08-10-07** |
| SNC QA Manager | Senior Vice President Nuclear Development |

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## SOUTHERN NUCLEAR OPERATING COMPANY, INC

## POLICY STATEMENT

Southern Nuclear Operating Company, Inc. (SNC) shall design, procure and construct nuclear plants in a manner that will ensure the health and safety of the public and workers. These activities shall be performed in compliance with the requirements of the Code of Federal Regulations (CFR), the applicable Nuclear Regulatory Commission (NRC) Facility Operating Licenses, and applicable laws and regulations of the state and local governments.

The SNC Nuclear Development Quality Assurance Program (NDQAP) described in the SNC Nuclear Development Quality Assurance Manual (NDQAM) and associated implementing documents provides for control of SNC activities that affect the quality of safety related nuclear plant structures, systems, and components and includes all planned and systematic activities necessary to provide adequate confidence that such structures, systems, and components will perform satisfactorily in service. The NDQAP may also be applied to certain equipment and activities that are not safety related, but support safe plant operations, or where other NRC guidance establishes program requirements.

The NDQAM is the top-level policy document that establishes the manner in which quality is to be achieved and presents SNC's overall philosophy regarding achievement and assurance of quality. Implementing documents assign more detailed responsibilities and requirements and define the organizational interfaces involved in conducting activities within the scope of the NDQAM. Compliance with the NDQAM and implementing documents is mandatory for personnel directly or indirectly associated with implementation of the SNC NDQAP.

Signed **Original signed by J. B. Beasley, Jr.**
J. Barnie Beasley
President and Chief Executive Officer
Southern Nuclear Operating Company, Inc.

July 2006

## TABLE OF CONTENTS

**POLICY STATEMENT** ..... **1**
**PART I INTRODUCTION** ..... **4**
**SECTION 1 GENERAL** ..... 4
1.1 Scope / Applicability ..... 4
1.2 Responsibilities ..... 5
1.3 Interfaces with Owners ..... 5
1.4 NQA-1-1994 Commitment ..... 5
**PART II QUALITY ASSURANCE PROGRAM DETAILS** ..... **6**
**SECTION 1 ORGANIZATION** ..... 6
1.1 President and CEO ..... 6
1.2 Nuclear Development ..... 6
1.3 Engineering ..... 8
1.4 Corporate Services ..... 9
1.5 Executive Vice President ..... 10
1.6 Vice President and General Counsel ..... 13
1.7 Westinghouse Electric Company, LLC ..... 13
1.8 Bechtel Power Corporation, Inc. ..... 13
1.9 Tetra Tech NUS, Inc. ..... 13
1.10 NQA-1-1994 Commitment ..... 14
Figure II.1-1 ..... 15
Figure II.1-2 ..... 16
Figure II.1-3 ..... 17
**SECTION 2 QUALITY ASSURANCE PROGRAM** ..... 18
2.1 Responsibilities ..... 19
2.2 Delegation of Work ..... 19
2.3 ESP and COL Identification of Site Specific Safety Related Design Basis Activities ..... 19
2.4 Periodic Review of the Quality Assurance Program ..... 19
2.5 Issuance and Revision to NDQAM ..... 20
2.6 Personnel Qualifications ..... 20
2.7 NQA-1-1994 Commitment / Exceptions ..... 20
**SECTION 3 DESIGN CONTROL** ..... 22
3.1 Design Verification ..... 22
3.2 Design Records ..... 23
3.3 Computer Application and Digital Equipment Software ..... 23
3.4 NQA-1-1994 Commitment ..... 23
**SECTION 4 PROCUREMENT DOCUMENT CONTROL** ..... 24
4.1 Reviewer Qualification ..... 24
4.2 NQA-1-1994 Commitment ..... 24
**SECTION 5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS** ..... 26
5.1 Procedure Adherence ..... 26
5.2 NQA-1-1994 Commitment ..... 26
**SECTION 6 DOCUMENT CONTROL** ..... 27
6.1 Changes to Documents ..... 27

6.2 NQA-1-1994 Commitment ..... 27
**SECTION 7 CONTROL OF PURCHASED MATERIAL, EQUIPMENT, AND SERVICES** .. 28
7.1 Acceptance of Item or Service ..... 28
7.2 NQA-1-1994 Commitment ..... 29
**SECTION 8 IDENTIFICATION AND CONTROL OF MATERIALS, PARTS, AND COMPONENTS** ..... 30
8.1 NQA-1-1994 Commitment ..... 30
**SECTION 9 CONTROL OF SPECIAL PROCESSES** ..... 31
9.1 NQA-1-1994 Commitment ..... 31
**SECTION 10 INSPECTION** ..... 32
10.1 NQA-1-1994 Commitment / Exceptions ..... 32
**SECTION 11 TEST CONTROL** ..... 33
11.1 NQA-1-1994 Commitment ..... 33
11.2 NQA-1-1994 Commitment for Computer Program Testing ..... 33
**SECTION 12 CONTROL OF MEASURING AND TEST EQUIPMENT** ..... 34
12.1 NQA-1-1994 Commitment / Exceptions ..... 34
**SECTION 13 HANDLING, STORAGE, AND SHIPPING** ..... 35
13.1 Housekeeping ..... 35
13.2 NQA-1-1994 Commitment / Exceptions ..... 35
**SECTION 14 INSPECTION, TEST, AND OPERATING STATUS** ..... 37
14.1 NQA-1-1994 Commitment ..... 37
**SECTION 15 NONCONFORMING MATERIALS, PARTS, OR COMPONENTS** ..... 38
15.1 NQA-1-1994 Commitment ..... 38
**SECTION 16 CORRECTIVE ACTION** ..... 39
16.1 Authority to Stop Work ..... 39
16.2 10 CFR Part 21 Reporting Program ..... 39
16.3 10 CFR 50.55(e) Reporting Program ..... 39
16.4 NQA-1-1994 Commitment ..... 39
**SECTION 17 QUALITY ASSURANCE RECORDS** ..... 40
17.1 Record Retention ..... 40
17.2 Electronic Records ..... 40
17.3 NQA-1-1994 Commitment / Exceptions ..... 40
**SECTION 18 AUDITS** ..... 41
18.1 Performance of Audits ..... 41
18.2 NQA-1-1994 Commitment ..... 42
**PART III REGULATORY COMMITMENTS** ..... **43**
**NRC Regulatory Guides and Quality Assurance Standards** ..... 43
Regulatory Guides: ..... 43
Standards: ..... 45

# PART I INTRODUCTION

## SECTION 1 GENERAL

This Southern Nuclear Operating Company, Inc. (SNC) Nuclear Development Quality Assurance Manual (NDQAM) is the top-level policy document that establishes the quality assurance policy and assigns major functional responsibilities for plants designed and constructed by SNC. The NDQAM describes the methods and establishes quality assurance program and administrative control requirements that meet 10CFR50, Appendix B. The NDQAM is based on the requirements of ASME NQA–1-1994, "Quality Assurance Requirements for Nuclear Facility Applications," Parts I and II, except as specified in this NDQAM.

The Nuclear Development Quality Assurance Program (NDQAP) is defined by the NRC approved regulatory document that describes the quality assurance program elements (the NDQAM), along with the associated corporate, site, and supplier implementing documents. Certain common program elements, procedures and organizations described in the NDQAM exist for currently operating SNC nuclear plants. Procedures and instructions that control Nuclear Development activities that are not addressed by existing SNC procedures and instructions will be developed prior to commencement of those activities. Corporate Policies and Guidelines establish high level responsibilities and authority for carrying out important administrative functions which are outside the scope of the NDQAP. Nuclear fleet wide procedures establish practices for certain activities which are common to all SNC organizations performing those activities such that the activity is controlled and carried out in a manner that meets NDQAP requirements. Site or organization specific procedures establish detailed implementation requirements and methods, and may be used to implement Corporate Policies and Guidelines and nuclear fleet wide procedures or be unique to particular functions or work activities.

### 1.1 Scope / Applicability

This NDQAM applies to activities affecting the quality and performance of safety-related structures, systems, and components, including, but not limited to:

| | | |
|---|---|---|
| Designing | Receiving | Testing |
| Constructing | Storing | Licensing |
| Procuring | Erecting | ESP Application Development |
| Fabricating | Installing | COL Application Development |
| Cleaning | Repairing | |
| Handling | Training | |
| Shipping | Inspecting | |

This manual is initiated for the development of ESP and COL applications as well as LWA activities and will be revised as the Nuclear Development organization and related activities evolve. The NDQAM applies to these activities until turnover to SNC Operations. It does not apply to SNC's operating units at Plants Farley, Hatch and Vogtle.

Safety related systems, structures, and components, under the control of the NDQAM, are identified by design documents. The technical aspects of these items are considered when determining program applicability, including, as appropriate, the item's design safety function.

The NDQAP may be applied to certain activities where regulations other than 10CFR50 establish QA program requirements for activities within their scope.

The policy of SNC is to assure a high degree of availability and reliability of its nuclear plants while ensuring the health and safety of its workers and the public. To this end, selected elements of the Quality Assurance Program are also applied to certain equipment and activities that are not safety related or important to safety, but support safe, economic, and reliable plant operations, or where other NRC guidance establishes program requirements. These include, but may not be limited to security and fire protection. Implementing documents establish program element applicability.

## 1.2 Responsibilities

SNC personnel engaged in activities described in this NDQAM shall comply with the requirements of the Nuclear Development Quality Assurance Program. Contractors, suppliers or other organizations supporting SNC, are required to comply with the NDQAP established by this NDQAM, or with their own programs determined by SNC to include sufficient controls to meet the applicable requirements of 10CFR50, Appendix B. All facilities shall be designed and constructed in compliance with the applicable Code of Federal Regulations and the applicable laws and regulations of the state and local governments in which the facility is located.

Quality assurance personnel have the authority to stop work actions when they perceive that work is not progressing in a manner that meets the quality assurance program.

## 1.3 Interfaces with Owners

Agreements exist between Southern Nuclear Operating Company, Inc. and the nuclear power plant owner organizations to establish responsibilities and authorities for the design and construction of said facilities.

## 1.4 NQA-1-1994 Commitment

- In establishing, implementing, and maintaining the NDQAM, SNC commits as described in this NDQAM to compliance with ASME NQA-1-1994. NDQAM revisions are reviewed by the SNC QA Manager and approved by the SNC Senior Vice President Nuclear Development. Changes to this NDQAM will be governed by and made in accordance with Part II, Section 2.5.

# PART II QUALITY ASSURANCE PROGRAM DETAILS

## SECTION 1 ORGANIZATION

This Section describes the SNC organizational structure, functional responsibilities, levels of authority and interfaces for establishing, executing, and verifying NDQAP implementation. The organizational structure includes corporate and onsite functions for nuclear development. Implementing documents assign more specific responsibilities and duties, and define the organizational interfaces involved in conducting activities and duties within the scope of this NDQAM. Management gives careful consideration to the timing, extent and effects of organizational structure changes.

The SNC Nuclear Development (ND) organization is responsible for new nuclear plant licensing, engineering, procurement, construction, startup and operations development activities. There are several organizations within SNC which implement and support the NDQAP. These organizations include, but are not limited to Nuclear Development, Engineering, Corporate Services, Fleet Operations Support, General Counsel, and Quality Assurance.

Design, engineering and environmental services are provided to the SNC Nuclear Development Organization by three primary contractors in accordance with their Quality Assurance Programs. These three contractors are Bechtel Power Corporation, Inc. (Bechtel), Westinghouse Electric Company LLC (Westinghouse), and Tetra Tech NUS, Inc. (TtNUS).

The following sections describe the reporting relationships, functional responsibilities and authorities for organizations implementing and supporting the Nuclear Development QA Program during the application development stage. Conceptual position descriptions necessary to support the construction phase, including activities performed under a Limited Work Authorization (LWA) are also provided; however, they are noted as construction phase. Likewise the Engineering Procurement Construction Contractor organizations are described. The Southern Nuclear Organization, the Nuclear Development Organization and the Vogtle Deployment Construction Organization are shown in Figures II.1-1, II.1-2 and II.1-3, respectively.

### 1.1 President and CEO

The SNC President and Chief Executive Officer (President/CEO) is responsible for all aspects of design and construction of Southern Company's nuclear plants. The President/CEO is also responsible for all technical and administrative support activities provided by SNC and contractors. The President/CEO directs the Chief Nuclear Officer/Executive Vice President, the Senior Vice President – Nuclear Development, the Vice President and General Counsel, the Vice President Corporate Services, and the Vice President Engineering in fulfillment of their responsibilities. The President/CEO reports to the SNC Board of Directors with respect to all matters.

### 1.2 Nuclear Development

Southern Nuclear Operating Company, Nuclear Development (ND) organization is responsible for new nuclear plant licensing, engineering, procurement, construction, startup and operational development activities.

### 1.2.1 Senior Vice President – Nuclear Development

The Senior Vice President – Nuclear Development (SVPND) reports to the President/CEO and is responsible for the administration of the Nuclear Development QA Program described in this manual. The SVPND also directs the planning and development of the Nuclear Development staff, and organization resources. The SVPND is also responsible for establishing and managing the Westinghouse contract for the development of new nuclear generation.

#### 1.2.1.1 Nuclear Technology and Start-up Director

The Nuclear Technology and Start-up Director (NTSD) reports to the Senior Vice President – Nuclear Development and is responsible for new plant standardized design and support for construction, start-up and operations development, including initial operations staffing and training.

#### 1.2.1.2 Vogtle Deployment Director

The Vogtle Deployment Director (VDD) reports to the Senior Vice President – Nuclear Development and is responsible for the effective implementation of the NDQAP for Vogtle site new nuclear plant licensing, procurement, and construction activities. The VDD is responsible for ESP and COL license applications and the supporting site specific engineering activities. The VDD is responsible for the planning and oversight of new Vogtle nuclear plant construction and procurement activities.

##### 1.2.1.2.1 Vogtle Deployment Licensing Manager

The Vogtle Licensing Manager (VDLM) reports to the Vogtle Deployment Director and is responsible for the effective implementation of the NDQAP for the Vogtle site new nuclear plant licensing activities. The VDLM has overall authority for all activities supporting development of the ESP and COL applications including licensing and license engineering activities. The VDLM and his staff are responsible for managing the principal contractors and all contractor-related activities, such as collecting and analyzing data, conducting testing for site suitability, and developing application content. The VDLM and his staff are responsible for coordinating actions of the principal contractors (Bechtel and TtNUS), Southern Company and SNC resources supporting development of license applications. The VDLM and his staff are also the primary interface with the NRC staff during the ESP and COL review process. During construction, the VDLM will oversee: FSAR maintenance, performance of design changes and environmental reviews, NRC interface, the corrective action program, ITAAC readiness, the NRC Construction Inspection Program, NRC inspection activities, and environmental permits.

##### 1.2.1.2.2 Construction Interface Manager

During construction, the Construction Interface Manager (CIM) will report to the Vogtle Deployment Director and be responsible for the effective implementation of the NDQAP for the Vogtle site new nuclear plant construction activities. The CIM has overall authority for all activities supporting construction activities and will serve as the interface with the EPC contractor. The CIM and his staff are responsible for coordinating actions of the principal contractors (Westinghouse and SHAW Stone & Webster). During construction, the CIM will oversee: 1) administrative activities including document control, FFD, industrial safety, Information Technology and invoice management; 2) engineering activities including the design

authority, configuration control and existing unit interfaces; and 3) project management activities including schedule and cost tracking, offsite fabrication and security.

#### 1.2.1.2.4 Engineering, Procurement and Construction (EPC) Contractor

During construction, the Consortium of Westinghouse and SHAW Stone & Webster will serve as the Engineering, Procurement and Construction (EPC) Contractor to SNC. Each of the Consortium members has a Quality Assurance Program that meets the requirements of 10 CFR 50, Appendix B and NQA-1 (1994). The scope of each member of the Consortium is established through a Division of Responsibility (DOR). Subcontractors performing work within the scope of 10 CFR 50, Appendix B and which provide materials, services, or both that are nuclear safety related or important to nuclear safety, will maintain appropriate quality assurance programs at each site where work is been performed. As between SNC and the EPC Contractor, the EPC Contractor shall be responsible for the performance of work by subcontractors performing 10 CFR 50, Appendix B work under the applicable DOR scope. SNC will provide oversight of this responsibility through audits of the EPC Contractor and surveillances of the subcontractors.

The EPC Contactor will also be responsible to perform the quality control and inspection functions and activities. The persons performing quality control functions for the EPC Contractor will have sufficient authority and organizational freedom to identify quality problems; to initiate, recommend, or provide solutions; and to verify implementation of solutions. The persons performing these functions will have the requisite independence from cost and schedule when contrary to safety considerations.

### 1.2.1.3 Business Services Project Manager

The Business Services Project Manager (BSPM) reports to the Senior Vice President – Nuclear Development and is responsible for the effective implementation of the NDQAP involving contract negotiations, budgets, financials, and supply chain issues as related to new nuclear plant development. In this capacity, the BSPM will serve as liaison with related groups within SNC.

## 1.3 Engineering

The Engineering organization is responsible for support of the Nuclear Development organization by providing engineering, licensing, training, and document control support where applicable.

### 1.3.1 Vice President Engineering

The Vice President Engineering reports to the President/CEO and is responsible for the administration of Nuclear Licensing and Probabilistic Risk Assessment (PRA) Services, Engineering Administrative Services, Plant Support, and Nuclear Fuel activities supporting the NDQAP. For the purposes of this program, the description of the responsibilities of the Vice President Engineering will be limited to those activities that support Nuclear Development.

#### 1.3.1.1 Nuclear Licensing and PRA Services

The Manager – Nuclear Licensing and PRA Services reports to the Vice President Engineering and has responsibility for providing specialized engineering and technical services in the areas of licensing and regulatory support. PRA Services will specifically support the Nuclear Development organization in the completion of the Westinghouse AP1000 PRA models for the new nuclear plants. Nuclear Licensing performs both plant specific and generic licensing activities for the SNC operating units. Nuclear Licensing will support Nuclear Development through licensing activities addressing impacts to the existing Vogtle Units and through support of industry efforts related to new nuclear generation. Nuclear Licensing will also support Nuclear Development licensing activities after issuance of the COL.

#### 1.3.1.2 Engineering Administrative Services

The Engineering Administrative Services Manager reports to the Vice President Engineering. The Engineering Administrative Services department includes the Document Services and the Technical Training sections.

The Document Services section is responsible for control and management of engineering documents. This includes record scanning, database indexing, and creating and distributing compact disks (CDs). Document Services will provide document control services for Nuclear Development.

The Technical Training section is responsible for developing, coordinating, tracking and administering technical training for corporate organizations. Technical Training will be responsible for maintaining records of staff training as well as the development of curriculum for initial and ongoing staff training. Technical Training will provide support for Nuclear Development.

#### 1.3.1.3 Nuclear Fuel

The Nuclear Fuel Manager reports to the Vice President Engineering. The Nuclear Fuel department is comprised of the Core Analysis, Nuclear Fuel Services and Fuel Performance sections. Nuclear Fuel will provide fuel design and procurement for Nuclear Development.

## 1.4 Corporate Services

The Corporate Services organization is responsible for supporting the Nuclear Development organization through performing activities related to procurement, safety and health and information technology where applicable.

### 1.4.1 CFO and Vice President Corporate Services

The Chief Financial Officer (CFO) and Vice President Corporate Services, reports to the SNC President and Chief Executive Officer and is responsible for managing the overall Corporate Services organization including assuring that Supply Chain Management, Safety and Health and Information Technology support Nuclear Development activities in accordance with the NDQAP. For the purposes of this program, the description of the responsibilities of the CFO and Vice President Corporate Services will be limited to those activities that support Nuclear Development.

#### 1.4.1.1 Supply Chain Management

The Supply Chain General Manager reports to the CFO and Vice President Corporate Services and is responsible for the effective management of the Supply Chain Management organization supporting Nuclear Development activities. The Supply Chain Management Department is responsible for the preparation of procurement documents for purchasing materials and services for SNC. In support of this effort, Supply Chain Management is responsible for preparing, with appropriate input from engineering, procurement documents for purchasing certain materials, components, equipment, and services which will include provisions for material identification and control. Supply Chain Management is also responsible for the review of these specifications for adequacy of identification, control, technical, and quality requirements. Similarly, Supply Chain Management reviews and approves information included in procurement documents to verify inclusion of adequate technical and quality requirements.

#### 1.4.1.2 Safety and Health

Safety and Health reports to the CFO and Vice President Corporate Services and is responsible for coordinating the overall Fitness-for-Duty (FFD) program among SNC management, the corporate staff, the staff at each of the SNC nuclear plants and the Nuclear Development organization. In this capacity, Safety and Health administers the FFD program's random selection process; performs drug and alcohol testing at the corporate office and at each SNC nuclear plant pursuant to 10 CFR 26; "Fitness for Duty Programs;" ensures that testing procedures are in place; trains the FFD staff; and maintains associated training records.

In addition, Safety and Health develops policies and procedures to ensure a safe and healthy workplace and compliance with standards established by the Occupational Safety and Health Administration.

#### 1.4.1.3 Southern Company Services (SCS) Information Technology (IT)

The SCS IT Group Manager is responsible for SNC IT activities and reports administratively to the Regional Chief Information Officer – Generation and functionally to the SNC CFO and Vice President Corporate Services. The SCS IT Group Manager shall provide support to the Nuclear Development organization including but not limited to applications, servers, tape backup, voice and data, network infrastructure hardware, and emergency communication hardware. The IT Group Manager will provide support to Engineering or Corporate Services under this QAP and associated SNC procedures for software control, SyncPowr disaster prevention/recovery, and emergency planning. The IT Group Manager is also responsible for maintaining controls for SNC software applications which are not required to be maintained under the SNC program described herein.

### 1.5 Executive Vice President

The Executive Vice President is the Chief Nuclear Officer (CNO) and is responsible for the safe, reliable, and efficient operation of the SNC nuclear plants. The CNO directs the Vice Presidents – Nuclear Plant Site (Vogtle, Hatch and Farley), the Vice President – Fleet Operations Support, and the Quality Assurance Manager. For the purposes of this program, the description of the responsibilities of the Executive Vice President will be limited to those activities that support Nuclear Development. The Executive Vice President will support Nuclear Development through

the Vice President – Nuclear Plant Site (Vogtle), the Nuclear Fleet Security and Emergency Planning organization, and the Quality Assurance organization.

### 1.5.1 Vice President – Nuclear Plant Site

The Vice Presidents – Nuclear Plant Site report to the Executive Vice President and are responsible for the overall safe and efficient operation of their operating plant, and for the implementation of quality assurance requirements in the areas specified by the operations Quality Assurance program.

For the purposes of this program, the description of the duties of the Vice Presidents' – Nuclear Plant Site and their staff will be limited to those site activities that support Nuclear Development.

#### 1.5.1.1 Nuclear Plant Site Organization

The Nuclear Plant Site Organization is responsible for operations and maintenance of the respective nuclear plant site. The Nuclear Plant Site Organization is responsible for operations quality inspection activities of operations on-site work, including any that support Nuclear Development ESP and COL application development, as well as controlling interfaces between the operating units and any preconstruction or construction activities.

### 1.5.2 Vice President – Fleet Operations Support

The Vice President – Fleet Operations Support report to the Executive Vice President and is responsible for Fleet Improvement, Fleet Integration and Nuclear Fleet Security and Emergency Planning. For the purposes of this program, the description of responsibilities of the Vice President – Fleet Operations Support will be limited to those activities that support Nuclear Development.

#### 1.5.2.1 Nuclear Fleet Security and Emergency Planning

The Nuclear Fleet Security and Emergency Planning (NFSEP) Manager reports to the Vice President – Fleet Operations Support and is responsible for management of the NFSEP organization and the overall coordination of fleet security activities and programs, the corporate emergency planning programs (including the common Emergency Operations Facility) and the Access Authorization program. The Nuclear Fleet Security and Emergency Planning Manager will also have responsibility for site emergency response communication. The NFSEP organization is responsible for providing information and support concerning emergency plans and security to the Nuclear Development organization.

For the Access Authorization Program, the Nuclear Fleet Security and Emergency Planning Manager shall assure compliance with 10 CFR 73.56 (Access Authorization), NRC Order EA-02-261, dated January 7, 2003 (Compensatory Measures Related to Access Authorization Program); and 10 CFR 73.57 (Criminal History Check and Pre-Access Suitable Inquiries.)

### 1.5.3 Quality Assurance

The SNC Quality Assurance Organization is responsible for independently planning and performing activities to verify the development and effective implementation of the SNC quality assurance programs including but not limited to nuclear development, engineering, licensing, document control, corrective action program and procurement that support new nuclear plant generation.

#### 1.5.3.1 Quality Assurance Manager

The Quality Assurance Manager reports to the Executive Vice President for the operations activities and to the Senior Vice President – Nuclear Development for the new reactor activities and is responsible for developing and maintaining the SNC quality assurance programs, evaluating compliance to the programs and managing the QA organization resources.

##### 1.5.3.1.1 Nuclear Development Quality Assurance Project Engineer

The Nuclear Development Quality Assurance Project Engineer (NDQAPE) reports administratively to the SNC QA Manager and functionally to the Senior Vice President – Nuclear Development, and is responsible for the development and verification of implementation of the NDQAP described in this manual. The NDQAPE is responsible for assuring compliance with regulatory requirements and procedures through audits and technical reviews; for monitoring organization processes to ensure conformance to commitments and licensing document requirements; for ensuring that vendors providing quality services, parts and materials to SNC are meeting the requirements of 10CFR50 Appendix B through NUPIC or SNC vendor audits. The NDQAPE has sufficient independence from other nuclear development priorities to bring forward issues affecting safety and quality and makes judgments regarding quality in all areas necessary regarding Southern Nuclear's Nuclear Development activities. The NDQAPE may make recommendations to the Nuclear Development management regarding improving the quality of work processes. If the NDQAPE disagrees with any actions taken by the ND organization and is unable to obtain resolution, the NDQAPE shall inform the QA Manager and bring the matter to the attention of the Senior Vice President – Nuclear Development who will determine the final disposition.

###### 1.5.3.1.1.1 Quality Assurance Coordinator

During construction, the Quality Assurance Coordinator (QAC) will report to the Nuclear Development Quality Assurance Project Engineer and have a matrix reporting relationship to the Vogtle Deployment Director. The QAC will be responsible for ensuring that appropriate vendor, construction and design audits and surveillances have been performed to satisfy the regulatory requirements. Additionally, the QAC will ensure that construction procedure approval is performed in accordance with the regulatory requirements.

##### 1.5.3.1.2 Quality Assurance Supervisor (Corporate)

The Quality Assurance Supervisor (Corporate) reports to the Quality Assurance Manager and is responsible for supporting evaluations of the quality programs of suppliers and contractors performing Nuclear Development activities within the scope of the NDQAP. This is accomplished by scheduling and conducting triennial external audits, annual supplier quality assurance program evaluations, reviewing audits conducted by external organizations (e.g.,

other utilities and the Nuclear Procurement Issues Committee), and maintenance of the Qualified Suppliers List. In addition, the Quality Assurance Supervisor is responsible to the Quality Assurance Manager for assuring compliance with the corporate Quality Assurance program, administration of the internal audit program, and supervising and interfacing with corporate Quality Assurance personnel.

#### 1.5.3.1.3 Quality Assurance Supervisor (Site)

The Quality Assurance Supervisor (Site) reports to the Quality Assurance Manager and is primarily responsible for operations quality assurance activities for the existing units. He and his staff may also support Nuclear Development activities by performing oversight of onsite work which supports ESP/COL development.

## 1.6 Vice President and General Counsel

The Vice President and General Counsel reports to the President/CEO and is responsible for managing the various functions associated with general counsel, compliance officer, and external affairs. Reporting to this position is the Manager of Environmental Affairs.

### 1.6.1 Environmental Affairs

The Environmental Affairs Manager reports to the Vice President and General Counsel and is responsible for managing environmental issues such as radiological environmental, non-radiological environmental, dose and shielding calculations, and low level radioactive waste functions supporting the Nuclear Development organization. Environmental Affairs is responsible for providing various licensing, engineering and environmental related services in support of the Nuclear Development organization.

## 1.7 Westinghouse Electric Company, LLC

Westinghouse Electric Company, LLC (Westinghouse) provides engineering services for plant design and licensing of Westinghouse AP-1000 plants on Southern Company sites. These engineering services for new nuclear generation include site specific engineering and design necessary to support development of ESP and COL applications, preconstruction and construction activities.

## 1.8 Bechtel Power Corporation, Inc.

Bechtel Power Corporation, Inc (Bechtel) provides engineering services for the development of the ESP and COL applications. These engineering services include site specific license engineering, and design activities necessary to support development of the ESP and COL applications, and planning and support for preconstruction and construction of new nuclear generation.

## 1.9 Tetra Tech NUS, Inc.

Tetra Tech NUS, Inc (TtNUS) provides environmental services to the Nuclear Development organization in support of the development of the ESP and COL applications. These environmental services include site specific investigation and analysis necessary to support

development of the ESP and COL applications, and planning and support for preconstruction and construction of new nuclear generation.

### 1.10 NQA-1-1994 Commitment

In establishing its organizational structure, SNC commits to compliance with NQA-1-1994, Basic Requirement 1 and Supplement 1S-1.

## Figure II.1-1

## SNC Organization

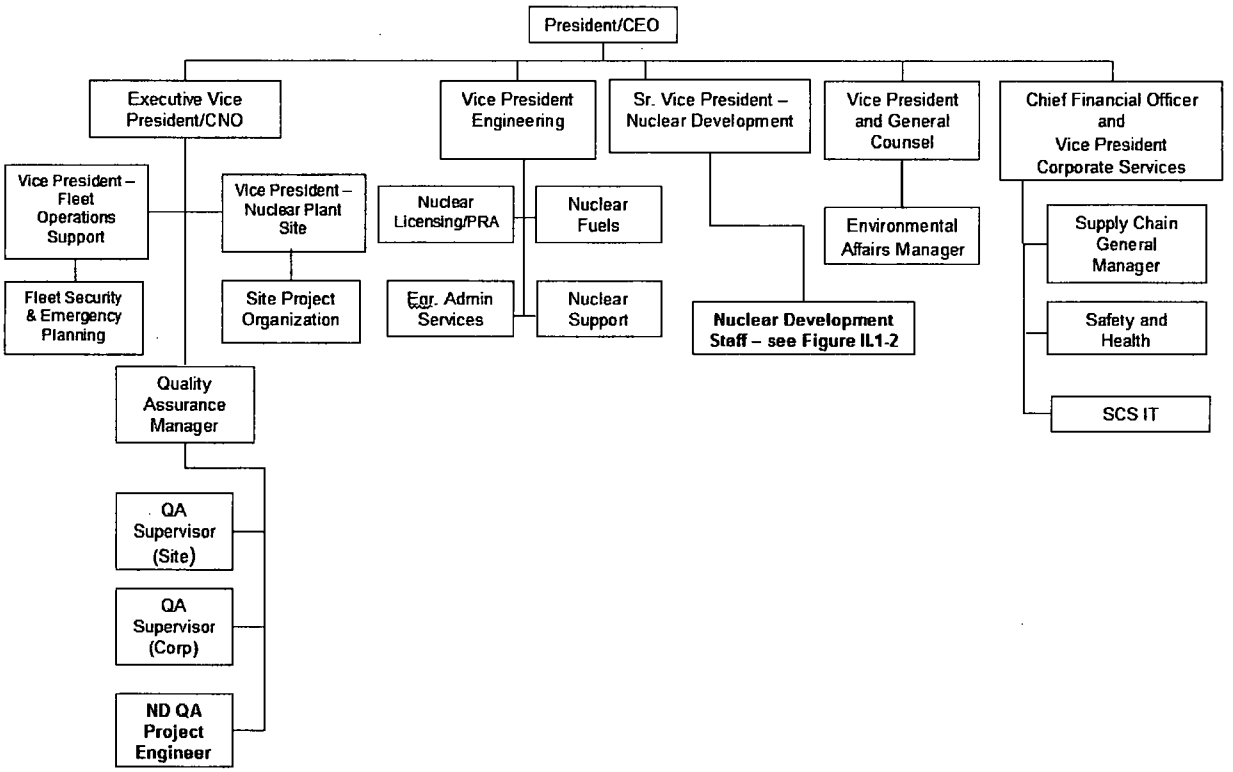


**Figure II.1-2**

## Nuclear Development Organization

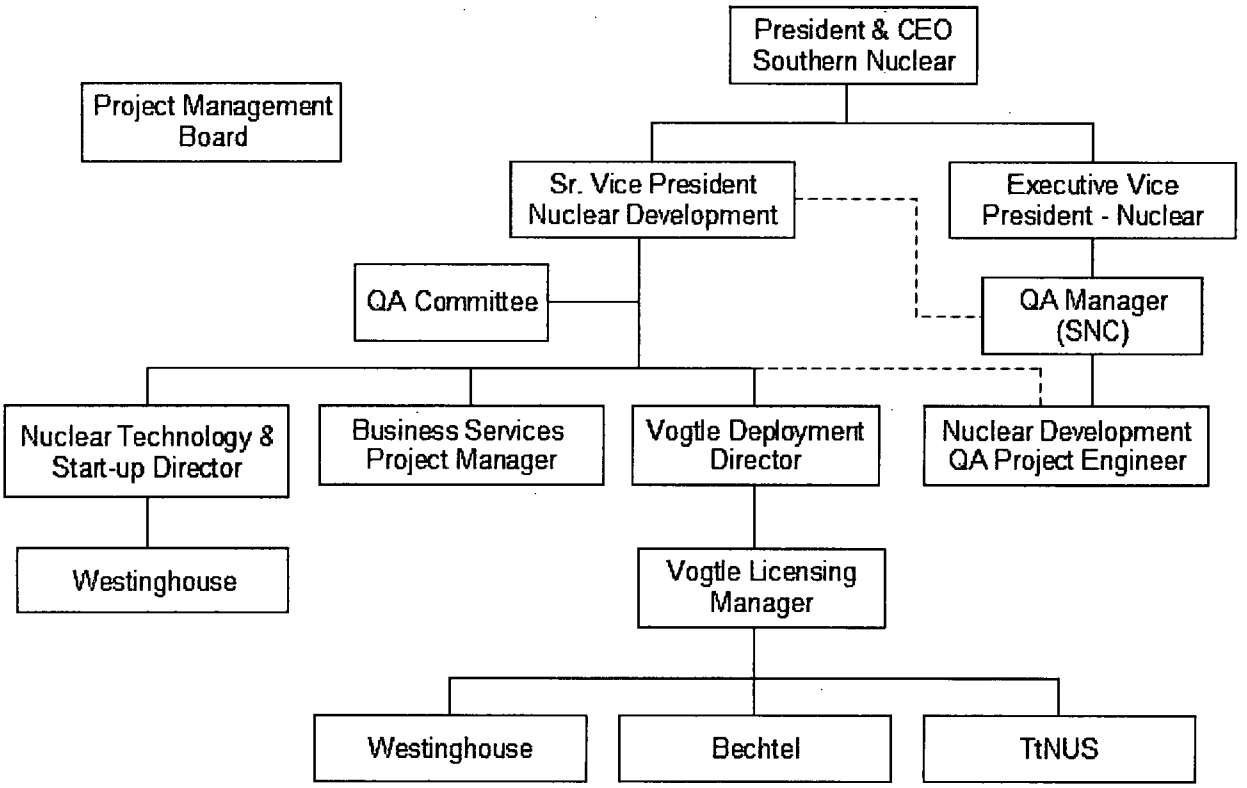
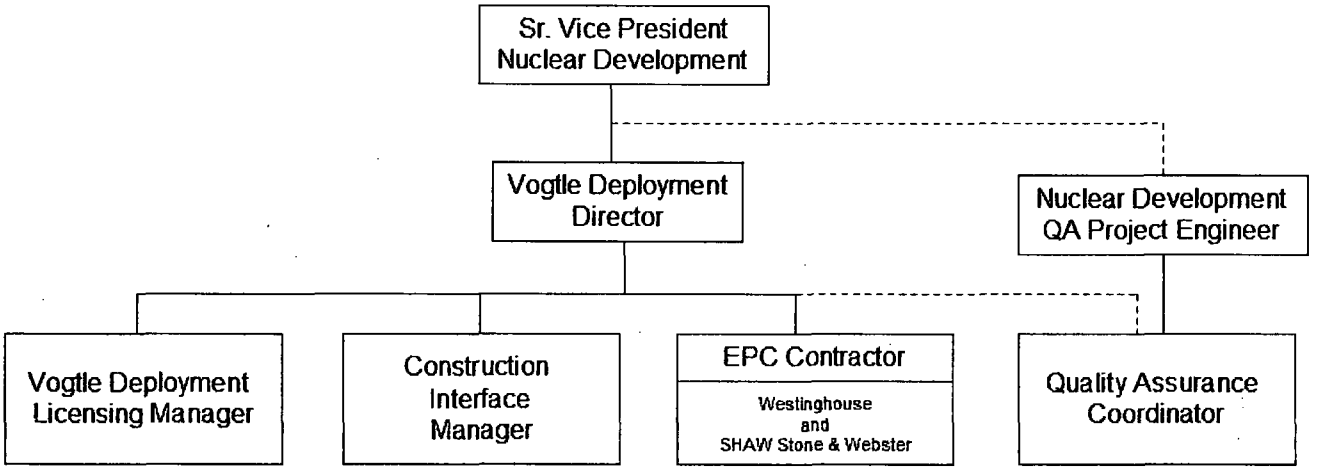


**Figure II.1-3**

**Nuclear Development Construction Organization**



## SECTION 2 QUALITY ASSURANCE PROGRAM

SNC has established the necessary measures and governing procedures to implement the NDQAP as described in the NDQAM. SNC is committed to meeting this NDQAP in all aspects of work that are important to the safety and reliability of the nuclear plants as described and to the extent delineated in this NDQAM. Further, SNC ensures through the systematic process described herein that its suppliers of safety related equipment or services meet the applicable requirements of 10CFR 50, Appendix B. Senior management is regularly apprised of audit results evaluating the adequacy of implementation of the NDQAP through the audit functions described in the Audit Section of this NDQAM.

The objective of the NDQAP is to assure that SNC nuclear generating plants are designed and constructed in accordance with governing regulations and license requirements. The program is based on the requirements of ASME NQA-1-1994, "Quality Assurance Requirements for Nuclear Facility Applications," as further described in this manual. The NDQAP applies to those quality-related activities that involve the functions of safety-related structures, systems, and components (SSCs) associated with the design, licensing and construction of new nuclear power plants as described in the ESP Site Safety Analysis Report and COL Final Safety Analysis Report. Examples of ESP/COL program safety-related activities include, but are not limited to, site specific engineering related to safety related SSCs, site geotechnical investigations, site engineering analysis, seismic analysis, and meteorological analysis. Cost and scheduling functions do not prevent proper implementation of the NDQAP.

Delegated responsibilities may be performed under a supplier's or principal contractor's Quality Assurance Program that has been approved by the SNC Quality Assurance organization. Periodic audits and assessments of supplier QA programs are performed to assure compliance with the approved program and implementing procedures. In addition, routine interfaces with project personnel assure that quality expectations are met.

For the ESP and COL applications, this Quality Assurance Program applies to those Nuclear Development and SNC activities that can affect either directly or indirectly the safety-related site characteristics or analysis of those characteristics. In addition, this QAP applies to engineering activities that are used to characterize the site or analyze that characterization.

New nuclear plant construction will be the responsibility of SNC's Nuclear Development organization. Detailed engineering specifications and construction procedures will be developed to implement the NDQAP and Westinghouse QA programs prior to commencement of preconstruction (ESP) and/or construction (COL) activities. Examples of Limited Work Authorization (LWA) activities that could impact safety-related SSCs would include impacts of construction to existing facilities and for construction of new plants, the design interface between non safety-related and safety-related SSCs and the placement of seismically designed backfill.

In general, the program requirements specified herein are detailed in implementing procedures that are either SNC implementing procedures, or supplier implementing procedures governed by a supplier quality program.

## 2.1 Responsibilities

Personnel who work directly or indirectly for SNC are responsible for the achievement of acceptable quality in the work covered by this NDQAM. This includes those activities delineated in Part I, Section 1.1 of this NDQAM. SNC personnel performing verification activities are responsible for verifying the achievement of acceptable quality. Activities governed by the NDQAP are performed as directed by documented instructions, procedures and drawings that are of a detail appropriate for the activity's complexity and effect on safety. Instructions, procedures and drawings specify quantitative or qualitative acceptance criteria as applicable or appropriate for the activity, and verification is against these criteria. Provisions are established to designate or identify the proper documents to be used in an activity, and to ascertain that such documents are being used. The Quality Assurance Manager is responsible to verify that processes and procedures comply with NDQAM and other applicable requirements, that such processes or procedures are implemented, and that management appropriately ensures compliance.

## 2.2 Delegation of Work

SNC retains and exercises the responsibility for the scope and implementation of an effective NDQAP. Positions identified in the Organization Section of this NDQAM may delegate all or part of the activities of planning, establishing, and implementing the program for which they are responsible to others, but retain the responsibility for the program's effectiveness. Decisions affecting safety are made at the level appropriate for its nature and effect, and with any necessary technical advice or review.

## 2.3 ESP and COL Identification of Site Specific Safety Related Design Basis Activities

ESP site specific safety-related design basis activities are defined as those activities, including sampling, testing, data collection and supporting engineering calculations and reports that will be used to determine the bounding physical parameters of the site. The development of the SNC ESP and COL applications will involve site testing, data collection and calculations that may create or bound safety-related design basis data. Site testing and data collection of information pertaining to the physical characteristics of the site that have the potential to affect safety-related design will be considered safety related. In addition, calculations and other engineering data that bounds or characterizes the site will be classified as safety related. The ND organization will develop an ESP application Quality Criteria Document (QCD) identifying the sections of the application that include safety-related design basis activities. In addition the QCD will identify those sections of the application and supporting analysis that will be treated with appropriate quality requirements. The ND organization will develop annotated outlines for the COL application that will identify the sections safety classification and the regulatory requirements applicable to the section content.

## 2.4 Periodic Review of the Quality Assurance Program

Reviews of the status and adequacy of the Nuclear Development Quality Assurance Program and its implementation will be conducted on an ongoing basis via senior management review of quality assurance audit reports. The senior management review will also include reviews by the SNC Nuclear Development Quality Assurance Committee.

## 2.5 Issuance and Revision to NDQAM

Administrative control of the NDQAM will be the responsibility of the ND Quality Assurance Project Engineer. Changes to the NDQAM are evaluated by the ND Quality Assurance Project Engineer to ensure that such changes do not degrade previously approved quality assurance controls specified in the NDQAP. This manual shall be revised as appropriate to incorporate additional QA commitments that may be established during the ESP and COL application development process. New revisions to the manual will be reviewed, at a minimum, by the SNC Quality Assurance Manager and approved by the Senior Vice President - Nuclear Development.

## 2.6 Personnel Qualifications

Personnel assigned to implement elements of the NDQAP shall be capable of performing their assigned tasks. To this end SNC establishes and maintains formal indoctrination and training programs for personnel performing, verifying, or managing activities within the scope of the NDQAP to assure that suitable proficiency is achieved and maintained. Plant and support staff minimum qualification requirements are as delineated in each site's Technical Specifications. Other qualification requirements may be established but will not reduce those required by Technical Specifications. Sufficient managerial depth is provided to cover absences of incumbents. When required by code, regulation, or standard, specific qualification and selection of personnel is conducted in accordance with those requirements as established in the applicable SNC procedures. Indoctrination includes the administrative and technical objectives, requirements of the applicable codes and standards, and the NDQAP elements to be employed. Training for positions identified in 10 CFR 50.120 is accomplished according to programs accredited by the National Nuclear Accrediting Board of the National Academy of Nuclear Training that implement a systematic approach to training. Records of personnel training and qualification are maintained.

The minimum qualifications of the Quality Assurance Manager and the Nuclear Development Quality Assurance Project Engineer are that each holds an engineering or related science degree and has a minimum of five year's experience in the areas of engineering, field construction, or plant operations. Two of these five years must involve working under a nuclear quality assurance program.

## 2.7 NQA-1-1994 Commitment / Exceptions

- In establishing qualification and training programs, SNC commits to compliance with NQA-1-1994, Basic Requirement 2 and Supplements 2S-1, 2S-2, 2S-3 and 2S-4, with the following clarifications and exceptions:
    - NQA-1-1994, Supplement 2S-1
        - SNC Supplement 2S-1 will include use of the guidance provided in Appendix 2A-1 the same as if it were part of the Supplement. The following two alternatives may be applied to the implementation of this Supplement and Appendix:
            - (1) In lieu of being certified as Level I, II, or III in accordance with NQA-1-1994, personnel performing independent quality verification inspections, examinations, measurements, or tests of

material, products, or activities will be required to possess qualifications equal to or better than those required for performing the task being verified; and the verification is within the skills of these personnel and/or is addressed by procedures. These individuals will not be responsible for the planning of quality verification inspections and tests (i.e., establishing hold points and acceptance criteria in procedures, and determining who will be responsible for performing the inspections), evaluating inspection training programs, nor certifying inspection personnel.

- (2) A qualified engineer may be used to plan inspections, evaluate the capabilities of an inspector, or evaluate the training program for inspectors. For the purpose of these functions, a qualified engineer is one who has a baccalaureate in engineering in a discipline related to the inspection activity (such as electrical, mechanical, civil) and has a minimum of five years engineering work experience with at least two years of this experience related to nuclear facilities.

- NQA-1-1994, Supplement 2S-2

  - In lieu of Supplement 2S-2, for qualification of nondestructive examination personnel, SNC will follow the applicable standard cited in the version(s) of Section III of the ASME Boiler and Pressure Vessel Code approved by the NRC for use at SNC sites.

- NQA-1-1994, Supplement 2S-3

  – The requirement that prospective Lead Auditors have participated in a minimum of five (5) audits in the previous three (3) years is replaced by the following, "The prospective lead auditor shall demonstrate his/her ability to properly implement the audit process, as implemented by SNC, to effectively lead an audit team, and to effectively organize and report results, including participation in at least one nuclear audit within the year preceding the date of qualification."

# SECTION 3 DESIGN CONTROL

SNC has established and implements a process to control the design, design changes and temporary modifications (e.g. temporary bypass lines, electrical jumpers and lifted wires, and temporary setpoints) of items that are subject to the provisions of this NDQAM. The design process includes provisions to control design inputs, outputs, changes, interfaces, records and organizational interfaces within SNC and with suppliers. These provisions assure that design inputs (such as design bases and the performance, regulatory, quality, and quality verification requirements) are correctly translated into design outputs (such as analyses, specifications, drawings, procedures, and instructions) so that the final design output can be related to the design input in sufficient detail to permit verification. Design change processes and the division of responsibilities for design related activities are detailed in SNC and supplier procedures. The design control program includes interface controls necessary to control the development, verification, approval, release, status, distribution and revision of design inputs and outputs. Design changes and disposition of nonconforming items as "use as is" or "repair" are reviewed and approved by the SNC design organization or by other organizations so authorized by SNC.

In addition, temporary design changes (temporary modifications), such as temporary bypass lines, electrical jumpers and lifted wires, and temporary trip-point settings, are controlled by procedures that include requirements for appropriate installation and removal verifications and status tracking.

## 3.1 Design Verification

SNC design processes provide for design verification to ensure that items and activities subject to the provisions of this NDQAM are suitable for their intended application, consistent with their effect on safety. Design changes are subjected to these controls, which include verification measures commensurate with those applied to original plant design.

Design verifications are performed by competent individuals or groups other than those who performed the original design but who may be from the same organization. The verifier shall not have taken part in the selection of design inputs, the selection of design considerations, or the selection of a singular design approach, as applicable. This verification may be performed by the originator's supervisor provided the supervisor did not specify a singular design approach; rule out certain design considerations, did not establish the design inputs used in the design, or if the supervisor is the only individual in the organization competent to perform the verification. If the verification is performed by the originator's supervisor, the justification of the need is documented and approved in advance by management.

The extent of the design verification required is a function of the importance to safety of the item under consideration, the complexity of the design, the degree of standardization, the state-of-the-art, and the similarity with previously proven designs. This includes design inputs, design outputs and design changes. Design verification procedures are established and implemented to assure that an appropriate verification method is used, the appropriate design parameters to be verified are chosen, the acceptance criteria are identified, and the verification is satisfactorily accomplished and documented. Verification methods may include, but are not limited to, design reviews, alternative calculations and qualification testing. Testing used to verify the acceptability of a specific design feature demonstrates acceptable performance under conditions that simulate the most adverse design conditions expected for item's intended use.

SNC normally completes design verification activities before the design outputs are used by other organizations for design work, and before they are used to support other activities such as procurement, manufacture or construction. When such timing cannot be achieved, the design verification is completed before relying on the item to perform its intended design or safety function.

### 3.2 Design Records

SNC maintains records sufficient to provide evidence that the design was properly accomplished. These records include the final design output and any revisions thereto, as well as record of the important design steps (e.g., calculations, analyses and computer programs) and the sources of input that support the final output.

Plant design drawings reflect the properly reviewed and approved configuration of the plant.

### 3.3 Computer Application and Digital Equipment Software

The NDQAP shall govern the development, procurement, testing, maintenance, and use of computer application and digital equipment software when used in safety-related applications and designated non-safety-related applications. SNC and suppliers shall be responsible for developing, approving, and issuing procedures, as necessary, to control the use of such computer application and digital equipment software. The procedures shall require that the application software be assigned a proper quality classification and that the associated quality requirements be consistent with this classification. Each application software and revision thereto shall be approved by designated SNC and supplier management and listed in a software register for identifying active quality related applications. This NDQAP shall also be applicable to the administrative functions associated with the maintenance and security of computer hardware where such functions are considered essential in order to comply with other NDQAP requirements such as QA records.

### 3.4 NQA-1-1994 Commitment

In establishing its program for design control and verification, SNC commits to compliance with NQA-1-1994, Basic Requirement 3, and Supplement 3S-1.

# SECTION 4 PROCUREMENT DOCUMENT CONTROL

SNC has established the necessary measures and governing procedures to assure that purchased items (components, spares and replacement parts necessary for plant design and construction) and services are subject to quality and technical requirements at least equivalent to those specified for original equipment or specified by properly reviewed and approved revisions to the original requirements to assure the items are suitable for the intended service, and are of acceptable quality, consistent with their effect on safety. Procurement document changes shall be subject to the same degree of control as utilized in the preparation of the original documents. These controls include provisions such that:

- Where original technical or quality assurance requirements cannot be determined, an engineering evaluation is conducted and documented by qualified staff to establish appropriate requirements and controls to assure that interfaces, interchangeability, safety, fit and function, as applicable, are not adversely affected or contrary to applicable regulatory requirements.

- Applicable technical, regulatory, administrative, quality and reporting requirements (such as specifications, codes, standards, tests, inspections, special processes, and 10CFR21) are invoked for procurement of items and services. Applicable design bases and other requirements necessary to assure adequate quality shall be included or referenced in documents for procurement of items and services. To the extent necessary, procurement documents shall require suppliers to have a quality assurance program consistent with the applicable requirements of this NDQAM.

## 4.1 Reviewer Qualification

Reviews required by this Section shall be performed by personnel who have access to pertinent information and who have an adequate understanding of the requirements and intent of the procurement documents.

## 4.2 NQA-1-1994 Commitment

In establishing controls for procurement, SNC commits to compliance with NQA-1-1994, Basic Requirements 4 and Supplements 4S-1, with the following clarifications and exceptions:

- NQA-1-1994, Supplement 4S-1

  - Section 2.3 of this Supplement 4S-1 includes a requirement that procurement documents require suppliers to have a documented quality assurance program that implements NQA-1-1994, Part 1. In lieu of this requirement, SNC may require suppliers to have a documented supplier quality assurance program that is determined to meet the applicable requirements of 10 CFR 50, Appendix B, as appropriate to the circumstances of the procurement.

  - With regard to service performed by a supplier, SNC procurement documents may allow the supplier to work under the SNC quality assurance program, including implementing procedures, in lieu of the supplier having its own quality assurance program.

- Section 3 of this supplement 4S-1 requires procurement documents to be reviewed prior to bid or award of contract. The quality assurance review of procurement documents is satisfied through review of the applicable procurement specification, including the technical and quality procurement requirements, prior to bid or award of contract. Procurement document changes (e.g., scope, technical or quality requirements) will also receive the quality assurance review.

# SECTION 5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

SNC has established the necessary measures and governing procedures to ensure that activities affecting quality are prescribed by and performed in accordance with instructions, procedures or drawings of a type appropriate to the circumstances and which, where applicable, include quantitative or qualitative acceptance criteria to implement the NDQAP as described in the NDQAM. Such documents are prepared and controlled according to Part II, Section 6 of this NDQAM. In addition, means are provided for dissemination to the staff of instructions of both general and continuing applicability, as well as those of short-term applicability. Provisions are included for reviewing, updating, and canceling such procedures.

## 5.1 Procedure Adherence

The SNC policy is that procedures are followed, and the requirements for use of procedures have been established in administrative procedures. Where procedures cannot be followed as written, provisions are established for making changes in accordance with Part II, Section 6 of this NDQAM. Requirements are established to identify the manner in which procedures are to be implemented, including identification of those tasks that require (1) the written procedure to be present and followed step-by-step while the task is being performed, (2) the user to have committed the procedure steps to memory, (3) verification of completion of significant steps, by initials or signatures or use of check-off lists. Procedures that are required to be present and referred to directly are those developed for extensive or complex jobs where reliance on memory cannot be trusted, tasks that are infrequently performed, and tasks where steps must be performed in a specified sequence.

Administrative procedures prescribe the methods whereby procedures can be temporarily revised without undue delay when the need arises. These temporary procedure revisions may not change intent of the approved procedure. Such revisions are documented and approved by the appropriate management within 14 days of implementation. In cases of emergency, personnel are authorized to depart from approved procedures when necessary to prevent injury to personnel or damage to the plant. Such procedures are logged describing the prevailing conditions and reasons for the action taken.

## 5.2 NQA-1-1994 Commitment

In establishing procedural controls, SNC commits to compliance with NQA-1-1994, Basic Requirement 5.

# SECTION 6 DOCUMENT CONTROL

SNC has established the necessary measures and governing procedures to control the preparation of, issuance of, and changes to documents that specify quality requirements or prescribe how activities affecting quality are controlled to assure that correct documents are being employed. Such documents, including changes thereto, shall be reviewed for adequacy and approved for release by authorized personnel. The control system shall be documented and shall provide for (a) through (f) below:

(a) identification of documents to be controlled and their specified distribution;

(b) a method to identify the correct document (including revision) to be used and control of superseded documents;

(c) identification of assignment of responsibility for preparing, reviewing, approving, and issuing documents;

(d) review of documents for adequacy, completeness, and correctness prior to approval and issuance.

(e) a method for providing feedback from users to continually improve procedures and work instructions.

(f) coordinating and controlling interface documents and procedures.

## 6.1 Changes to Documents

Changes to documents, other than those defined in implementing procedures as minor changes, are considered as major changes and shall be reviewed and approved by the same organizations that performed the original review and approval unless other organizations are specifically designated. The reviewing organization shall have access to pertinent background data or information upon which to base their approval. Minor changes to documents, such as inconsequential editorial corrections, shall not require that the revised documents receive the same review and approval as the original documents. To avoid a possible omission of a required review, the type of minor changes that do not require such a review and approval and the persons who can authorize such a decision shall be clearly delineated in implementing procedures.

Prior to issuance or use, documents including revisions thereto, shall be approved by the designated authority. A listing of all controlled documents identifying the current approved revision, or date, is maintained so personnel can readily determine the appropriate document for use.

## 6.2 NQA-1-1994 Commitment

In establishing provisions for document control, SNC commits to compliance with NQA-1-1994, Basic Requirement 6 and Supplement 6S-1.

# SECTION 7 CONTROL OF PURCHASED MATERIAL, EQUIPMENT, AND SERVICES

SNC has established the necessary measures and governing procedures to control the procurement of items and services to assure conformance with specified requirements. Such control shall provide for the following as appropriate: source evaluation and selection, evaluation of objective evidence of quality furnished by the Supplier, source inspection, audit, and examination of items or services upon delivery or completion.

## 7.1 Acceptance of Item or Service

SNC establishes and implements measures to assure the quality of purchased items and services, whether purchased directly or through contractors, at intervals and to a depth consistent with the item's or service's importance to safety, complexity, quantity and the frequency of procurement. Verification actions include testing, as appropriate, during design, fabrication and construction activities. Verifications occur at the appropriate phases of the procurement process, including, as necessary, verification of activities of suppliers below the primary contractor/supplier.

Measures to assure the quality of purchased items and services include the following, as applicable:

- Items are inspected, identified, and stored to protect against damage, deterioration, or misuse.

- Prospective suppliers of safety-related items and services are evaluated to assure that only qualified suppliers are used. Qualified suppliers are audited on a triennial basis. SNC may utilize audits conducted by outside organizations for supplier qualification provided that the scope and adequacy of the audits meet SNC requirements. Documented annual evaluations are performed for qualified suppliers to assure they continue to provide acceptable products and services. Industry programs, such as those applied by ASME, Nuclear Procurement Issues Committee (NUPIC), or other established utility groups, are used as input or the basis for supplier qualification whenever appropriate. The results of the reviews are promptly considered for effect on a supplier's continued qualification and adjustments made as necessary (including corrective actions, adjustments of supplier audit plans, and input to third party auditing entities, as warranted). In addition, results are reviewed periodically to determine if, as a whole, they constitute a significant condition adverse to quality requiring additional action.

- Provisions are made for accepting purchased items and services, such as source verification, receipt inspection, pre- and post-installation tests, certificates of conformance, and document reviews. Acceptance actions are completed to ensure that procurement, inspection, and test requirements, as applicable, have been satisfied before relying on the item to perform its intended safety function.

- Controls are imposed for the selection, determination of suitability for intended use (critical characteristics), evaluation, receipt and acceptance of commercial-grade services or "off-the-shelf" items to assure they will perform satisfactorily in service in safety related applications.

## 7.2 NQA-1-1994 Commitment

In establishing procurement verification controls, SNC commits to compliance with NQA-1-1994, Basic Requirement 7 and Supplement 7S-1, with the following clarifications and exceptions:

- NQA-1-1994, Supplement 7S-1

  - SNC considers that other 10 CFR 50 licensees, Authorized Nuclear Inspection Agencies, National Institute of Standards and Technology, or other State and Federal agencies which may provide items or services to SNC plants are not required to be evaluated or audited.

  - When purchasing commercial grade calibration services from a calibration laboratory, procurement source evaluation and selection measures need not be performed provided each of the following conditions are met:

    (1) The purchase documents impose any additional technical and administrative requirements, as necessary, to comply with the SNC QA program and technical provisions. At a minimum, the purchase document shall require that the calibration certificate/report include identification of the laboratory equipment/standard used.

    (2) The purchase documents require reporting as-found calibration data when calibrated items are found to be out-of-tolerance.

    (3) A documented review of the supplier's accreditation shall be performed and shall include a verification of each of the following:

      - The calibration laboratory holds an accreditation by the National Voluntary Laboratory Accreditation Program (NVLAP) or by the American Association for Laboratory Accreditation (A2LA) as recognized by NVLAP through a Mutual Recognition Arrangement (MRA).

      - The accreditation is based on ANS/ISO/IEC 17025.

      - The published scope of accreditation for the calibration laboratory covers the necessary measurement parameters, ranges, and uncertainties.

  - For Section 8.1, SNC considers documents that may be stored in approved electronic media under SNC control and not physically located on the plant site but which are accessible from the respective nuclear facility site as meeting the NQA-1 requirement for documents to be available at the site.

  - In lieu of the requirements of Section 10, Commercial Grade Items, controls for commercial grade items and services are established in SNC documents using the guidance of EPRI NP-5652 as discussed in Generic Letter 89-02 and Generic Letter 91-05.

# SECTION 8 IDENTIFICATION AND CONTROL OF MATERIALS, PARTS, AND COMPONENTS

SNC has established the necessary measures and governing procedures to identify and control items to prevent the use of incorrect or defective items. This includes controls for consumable materials and items with limited shelf life. The identification of items is maintained throughout fabrication, erection, installation and use so that the item can be traced to its documentation, consistent with the item's effect on safety. Identification locations and methods are selected so as not to affect the function or quality of the item.

## 8.1 NQA-1-1994 Commitment

In establishing provisions for identification and control of items, SNC commits to compliance with NQA-1-1994, Basic Requirement 8 and Supplement 8S-1.

# SECTION 9 CONTROL OF SPECIAL PROCESSES

SNC has established the necessary measures and governing procedures to assure that special processes that require interim process controls to assure quality, such as welding, heat treating, and nondestructive examination, are controlled. These provisions include assuring that special processes are accomplished by qualified personnel using qualified procedures and equipment. Special processes are performed in accordance with applicable codes, standards, specifications, criteria or other specially established requirements. Special processes are those where the results are highly dependent on the control of the process or the skill of the operator, or both, and for which the specified quality cannot be fully and readily determined by inspection or test of the final product.

## 9.1 NQA-1-1994 Commitment

In establishing measures for the control of special processes, SNC commits to compliance with NQA-1-1994, Basic Requirement 9 and Supplement 9S-1.

# SECTION 10 INSPECTION

SNC has established the necessary measures and governing procedures to implement inspections that assure items, services and activities affecting safety meet established requirements and conform to applicable documented specifications, instructions, procedures, and design documents. Inspection may also be applied to items, services and activities affecting plant reliability and integrity. Types of inspections may include those verifications related to procurement, such as source, in-process, final, and receipt inspection, as well as construction and installation activities. Inspections are carried out by properly qualified persons independent of those who performed or directly supervised the work. Inspection results shall be documented.

## 10.1 NQA-1-1994 Commitment / Exceptions

- In establishing inspection requirements, SNC commits to compliance with NQA-1-1994, Basic Requirement 10, Supplement 10S-1 and Subpart 2.4, with the clarification that follows below. In addition, SNC commits to compliance with the requirements of Subparts 2.5 and 2.8 for establishing appropriate inspection requirements.

  - Subpart 2.4 commits SNC to IEEE 336-1985. IEEE 336-1985 refers to IEEE 498-1985. Both IEEE 336 -1985 and IEEE 498-1985 use the definition of "Safety Systems Equipment" from IEEE 603- 1980. SNC commits to the definition of Safety Systems Equipment in IEEE 603-1980, but does not commit to the balance of that standard.

  - An additional exception to Subpart 2.4 is contained in Section 12 of this NDQAM.

# SECTION 11 TEST CONTROL

SNC has established the necessary measures and governing procedures to demonstrate that items subject to the provisions of this NDQAM will perform satisfactorily in service, that the plant can be operated safely and as designed, and that the coordinated operation of the plant as a whole is satisfactory. These programs include criteria for determining when testing is required, such as proof tests before installation, pre-operational tests, post-maintenance tests, post-modification tests, in-service tests, and operational tests (such as surveillance tests required by Plant Technical Specifications), to demonstrate that performance of plant systems is in accordance with design. Programs also include provisions for establishing and adjusting test schedules and maintaining status for periodic or recurring tests. Tests are performed according to applicable procedures that include, consistent with the effect on safety, (1) instructions and prerequisites to perform the test, (2) use of proper test equipment, (3) acceptance criteria, and (4) mandatory verification points as necessary to confirm satisfactory test completion. Test results are documented and evaluated by the organization performing the test and reviewed by a responsible authority to assure that the test requirements have been satisfied. If acceptance criteria are not met, retesting is performed as needed to confirm acceptability following correction of the system or equipment deficiencies that caused the failure.

## 11.1 NQA-1-1994 Commitment

In establishing provisions for testing, SNC commits to compliance with NQA-1-1994, Basic Requirement 11 and Supplement 11S-1.

## 11.2 NQA-1-1994 Commitment for Computer Program Testing

SNC establishes and implements provisions to assure that computer software used in applications affecting safety is prepared, documented, verified and tested, and used such that the expected output is obtained and configuration control maintained. To this end SNC commits to compliance with the requirements of NQA-1-1994, Supplement 11S-2 and Subpart 2.7 to establish the appropriate provisions.

# SECTION 12 CONTROL OF MEASURING AND TEST EQUIPMENT

SNC has established the necessary measures and governing procedures to control the calibration, maintenance, and use of measuring and test equipment that is not installed as plant equipment and that provides information important to safe plant operation. The provisions of such procedures cover equipment such as indicating and actuating instruments and gages, tools, reference and transfer standards, and nondestructive examination equipment.

The provisions of this NDQAM Section are intended to assure that:

- Measuring and test equipment is calibrated at specified intervals on the basis of the item's required accuracy, intended use, frequency of use, and stability characteristics or other conditions affecting its performance. Alternatively, equipment may be calibrated immediately before and after use if a defined interval is not appropriate.

- Measuring and test equipment is labeled, tagged or otherwise controlled to indicate its calibration status and provide traceability to calibration test data or records.

- Calibrations are performed against standards that have an accuracy of at least four times the required accuracy of the equipment being calibrated. When this is not possible, the standards have an accuracy that ensures the equipment being calibrated will be within the required tolerance.

- Where possible, calibration standards are traceable to appropriate national standards. Calibration standards have greater accuracy than the standards being calibrated, except where the same accuracy as the instruments being calibrated can be shown to be adequate for the service requirements.

- Measuring and test equipment found out of calibration is tagged or segregated and not used until it is successfully re-calibrated. An evaluation is performed to determine the acceptability of any items measured, inspected or tested with an out-of-calibration device from the time of the previous calibration.

## 12.1 NQA-1-1994 Commitment / Exceptions

In establishing provisions for control of measuring and test equipment, SNC commits to compliance with NQA-1-1994, Basic Requirement 12, Supplement 12S-1 and Subpart 2.16 for establishing appropriate requirements for calibration and control of measuring and test equipment, with the following clarifications and exceptions:

- NQA-1-1994, Subpart 2.16 (ANSI/IEEE 498-1985)

  - Section 5.5 of ANSI/IEEE 498-85 requires all M&TE to be labeled. SNC plants may not label certain M&TE, such as installed instrumentation, but will provide other means of identification so that appropriate controls can be implemented. This exception also applies to labeling and tagging of items requiring calibration as discussed in Section 7.2.1 of ANSI/IEEE 336-85 (NQA-1, Subpart 2.4).

# SECTION 13 HANDLING, STORAGE, AND SHIPPING

SNC has established the necessary measures and governing procedures to control the handling, storage, packaging, shipping, cleaning, and preservation of items to prevent inadvertent damage or loss, and to minimize deterioration. These provisions include specific procedures, when required to maintain acceptable quality of the items important to safety. Items are appropriately marked and labeled during packaging, shipping, handling and storage to identify, maintain, and preserve the item's integrity and indicate the need for special controls. Special controls (such as containers, shock absorbers, accelerometers, inert gas atmospheres, specific moisture content levels and temperature levels) are provided when required to maintain acceptable quality.

## 13.1 Housekeeping

Housekeeping practices during construction and pre-operational activities are established to account for conditions or environments that could affect the quality of structures, systems and components within the plant. This includes control of cleanness of facilities and materials, fire prevention and protection, disposal of combustible material and debris, control of access to work areas, protection of equipment, radioactive contamination control and storage of solid radioactive waste. Housekeeping practices help assure that only proper materials, equipment, processes and procedures are used and that the quality of items is not degraded. Necessary procedures or work instructions, such as for electrical bus and control center cleaning, cleaning of control consoles, and radioactive decontamination are developed and used.

## 13.2 NQA-1-1994 Commitment / Exceptions

In establishing provisions for handling, storage and shipping, SNC commits to compliance with NQA-1-1994, Basic Requirement 13 and Supplement 13S-1. SNC also commits to compliance with the requirements of NQA-1-1994, Subpart 2.2, with the clarifications and exceptions shown below.

In addition, SNC commits to compliance with the requirements of NQA-1-1994, Subpart 2.1, to establish appropriate provisions for the cleaning of fluid systems and associated components; and Subpart 2.3, to establish appropriate provisions for housekeeping; with the following clarifications and exceptions:

- NQA-1-1994, Subpart 2.1
  - Subpart 2.1, sections 3.1 and 3.2, establish criteria for classifying items into cleanness classes and requirements for each class. Instead of using the cleanness level system of Subpart 2.1, SNC plants may establish cleanness requirements on a case-by-case basis, consistent with the other provisions of Subpart 2.1. SNC establishes appropriate cleanliness controls for work on safety related equipment to minimize introduction of foreign material and maintain system/component cleanliness throughout maintenance or modification activities, including documented verification of absence of foreign materials prior to system closure.

- NQA -1-1994, Subpart 2.2

  - Subpart 2.2, sections 3.2 and 3.5: For items in storage, as determined by facility management, the packaging requirements described under section 3, Packaging, may include alternate methods of affording required protection such as maintaining a storage atmosphere free from harmful contaminants in concentrations that could produce damage to the stored items, or utilizing storage practices that obviate the need for capping all openings.

  - Subpart 2.2, section 6.6, "Storage Records:" This section requires written records be prepared containing information on personnel access. As an alternative to this requirement, SNC documents establish controls for storage areas that describe those authorized to access areas and the requirements for recording access of personnel. However, these records of access are not considered quality records and will be retained in accordance with the administrative controls of the applicable plant.

  - Subpart 2.2, section 7.1 refers to Subpart 2.15 for requirements related to handling of items. The scope of Subpart 2.15 includes hoisting, rigging and transporting of items for nuclear power plants. This scope exceeds the scope of the NRC's original endorsement of ANSI N45.2.2 in Regulatory Guide 1.38, and establishes requirements for which there is no NRC regulatory position. In lieu of compliance with Subpart 2.15, SNC establishes and implements controls over hoisting, rigging and transport activities to the extent necessary to protect the integrity of the items involved, as well as potentially affected nearby structures and components. For re-rating of lifting equipment to allow "special lifts," SNC performs dynamic load testing over the full range of the lift using test loads at least 110% of the lift weight. Dynamic tests include raising, lowering and traversing the load. Where required, SNC complies with applicable hoisting, rigging and transportation regulations and codes.

- NQA-1-1994, Subpart 2.3 requires a written record of the entry and exit of all personnel be established and maintained for Zones I, II, and III. The following exceptions are taken:

  - Instead of the five-level zone designation in Subpart 2.3, section 2.2, SNC bases its control over housekeeping activities on a consideration of what is necessary and appropriate for the activity involved. The controls are effected through procedures or instructions which, in the case of maintenance or modification work, are developed on a case-by-case basis. Factors considered in developing the procedures and instructions include cleanliness control, personnel safety, fire prevention and protection, radiation control, and security. The procedures and instructions make use of standard janitorial and work practices to the extent possible.

# SECTION 14 INSPECTION, TEST, AND OPERATING STATUS

SNC has established the necessary measures and governing procedures to identify the inspection, test, and operating status of items and components subject to the provisions of this NDQAM in order to maintain personnel and reactor safety and avoid unauthorized operation of equipment. Where necessary to preclude inadvertent bypassing of inspections or tests, or to preclude inadvertent operation, these measures require the inspection, test or operating status be verified before release, fabrication, receipt, installation, test or use. These measures also establish the necessary authorities and controls for the application and removal of status indicators or labels.

## 14.1 NQA-1-1994 Commitment

In establishing measures for control of inspection, test and operating status, SNC commits to compliance with NQA-1-1994, Basic Requirement 14.

# SECTION 15 NONCONFORMING MATERIALS, PARTS, OR COMPONENTS

SNC has established the necessary measures and governing procedures to control items, including services, which do not conform to specified requirements to prevent inadvertent installation or use. Controls provide for identification, documentation, evaluation, segregation when practical, and disposition of nonconforming items, and for notification to affected organizations. These controls require that an individual discovering a nonconforming condition to identify, describe, and document the nonconformance in accordance with Section 16, Corrective Action, of this NDQAM. Controls are provided to address conditional release of nonconforming items for use on an at risk basis prior to resolution and disposition of the nonconformance, including maintaining identification of the item and documenting the basis for such release. Conditional release of nonconforming items for installation requires the approval of the designated management. Nonconformances are corrected or resolved prior to depending on the item to perform its intended safety function. Nonconformances are evaluated for impact on operability of quality structures, systems, and components to assure that the final condition does not adversely affect safety, operation, or maintenance of the item or service. Nonconformances to design requirements dispositioned repair or use-as-is, shall be subject to design control measures commensurate with those applied to the original design. Nonconformance dispositions are reviewed for adequacy, analysis of quality trends, and reports provided to the designated management. Significant trends are reported to management in accordance with SNC procedures, regulatory requirements, and industry standards.

## 15.1 NQA-1-1994 Commitment

In establishing measures for nonconforming materials, parts, or components, SNC commits to compliance with NQA-1-1994, Basic Requirement 15, and Supplement 15S-1.

# SECTION 16 CORRECTIVE ACTION

SNC has established the necessary measures and governing procedures to promptly identify, control, document, classify, and correct conditions adverse to quality. These procedures apply to all Nuclear Development activities. SNC procedures assure that corrective action is documented and initiated following the determination of a condition adverse to quality in accordance with regulatory guidance and applicable quality standards. When complex issues arise where it cannot be readily determined if a condition adverse to quality exists, SNC documents establish the requirements for documentation and timely evaluation of the issue. Results of evaluations of conditions adverse to quality are analyzed to identify trends. Significant conditions adverse to quality and significant adverse trends are documented and reported to responsible management.

## 16.1 Authority to Stop Work

Quality assurance and inspection personnel have the authority, and the responsibility, to stop work in progress which is not being done in accordance with approved procedures or where safety or SSC integrity may be jeopardized. This extends to off-site work performed by suppliers furnishing safety-related materials and services to SNC.

## 16.2 10 CFR Part 21 Reporting Program

SNC has in-place the necessary measures and governing procedures that implement a program to identify, evaluate and report defects and non-compliances in accordance with 10 CFR Part 21. Such a reporting program applies to safety-related activities and services performed by SNC and/or SNC suppliers / sub-suppliers providing input to the ESP and COL application development.

## 16.3 10 CFR 50.55(e) Reporting Program

SNC will establish the necessary measures and governing procedures that implement a reporting program which conforms to the requirements of 10 CFR 50.55(e). Such a reporting program will be in-place when SNC applies for a COL.

## 16.4 NQA-1-1994 Commitment

In establishing provisions for corrective action, SNC commits to compliance with NQA-1-1994, Basic Requirement 16.

# SECTION 17 QUALITY ASSURANCE RECORDS

SNC has established the necessary measures and governing procedures to ensure that sufficient records of items and activities affecting quality are developed, reviewed, approved, issued, used, and revised to reflect completed work. The provisions of such procedures establish the scope of the records retention program for SNC and include requirements for records administration, including receipt, preservation, retention, storage, safekeeping, retrieval, and final disposition.

## 17.1 Record Retention

Records of activities for design, engineering, procurement, manufacturing, construction, inspection and test, installation, pre-operation, startup and audits include the appropriate content requirements of NQA-1-1994, Parts I and II. Such records and their retention times are based on Regulatory Position C.2, Table 1, of Regulatory Guide 1.28, Revision 3. This table addresses design, construction, and initial start-up records. In all cases where state, local, or other agencies have more restrictive requirements for record retention, those requirements will be met.

## 17.2 Electronic Records

When using electronic records storage and retrieval systems, SNC complies with NRC guidance in RIS 2000-18, October 2000, "Guidance on Managing Quality Assurance Records in Electronic Media" including NIRMA guidelines; TG 11-1998, TG15-1998, TG16-1998, and TG21-1998. SNC will also meet the NRC Regulatory Position C.2 of Regulatory Guide 1.28, Revision 3, August 1985 except that the reference to ASME NQA-1 will be to the 1994 edition.

## 17.3 NQA-1-1994 Commitment / Exceptions

In establishing provisions for records, SNC commits to compliance with NQA-1-1994, Basic Requirement 17 and Supplement 17S-1, with the following clarifications and exceptions:

- NQA-1-1994, Supplement 17S-1
  - Supplement 17S-1, section 4.2(b) requires records to be firmly attached in binders or placed in folders or envelopes for storage in steel file cabinets or on shelving in containers. For hard-copy records maintained by SNC, the records are suitably stored in steel file cabinets or on shelving in containers, except that methods other than binders, folders or envelopes may be used to organize the records for storage.

# SECTION 18 AUDITS

SNC has established the necessary measures and governing procedures to implement audits to verify that activities covered by this NDQAM are performed in conformance with the requirements established. The audit programs are themselves reviewed for effectiveness as a part of the overall audit process.

## 18.1 Performance of Audits

Internal audits of selected aspects of licensing, design and construction phase activities are performed with a frequency commensurate with safety significance and in a manner which assures that audits of safety-related activities are completed. During the early portions of nuclear development activities, audits will focus on areas including, but not limited to, site investigation, procurement, and corrective action. The audits are scheduled on a formal preplanned audit schedule. The audit system is reviewed periodically and revised as necessary to assure coverage commensurate with current and planned activities. Additional audits may be performed as deemed necessary by management. The scope of the audit is determined by the quality status and safety importance of the activities being performed. These audits are conducted by trained personnel not having direct responsibilities in the area being audited and in accordance with preplanned and approved audit plans or checklists, under the direction of the QA Manager.

The Quality Assurance organization is responsible for conducting periodic internal and external audits. Internal audits are conducted to determine the adequacy of programs and procedures, and to determine if they are meaningful and comply with the overall Quality Assurance program. External audits determine the adequacy of supplier and contractor Quality Assurance programs.

The results of each audit are reported in writing to the Senior Vice President Nuclear Development, the Nuclear Technology Startup Director, the Vogtle Deployment Director, and the Vogtle Licensing Manager as appropriate. Additional internal distribution is made to other concerned management levels in accordance with approved procedures.

Management responds to all audit findings and initiates corrective action where indicated. Where corrective action measures are indicated, documented follow-up of applicable areas through inspections, review, re-audits, or other appropriate means is conducted to verify implementation of assigned corrective action.

Audit schedule changes reflecting more frequent audits are required by one or more of the following conditions:

- When significant changes are made in functional areas of the NDQAP, such as significant reorganization or procedure revisions.
- When there is evidence that the performance or reliability of safety-related items is in jeopardy due to deficiencies or nonconformances in the NDQAP.
- When a systematic, independent assessment of NDQAP effectiveness is necessary.
- When it is necessary to verify implementation of required corrective actions.

## 18.2 NQA-1-1994 Commitment

In establishing the independent audit program, SNC commits to compliance with NQA-1-1994, Basic Requirement 18 and Supplement 18S-1.

# PART III REGULATORY COMMITMENTS

## NRC Regulatory Guides and Quality Assurance Standards

This section identifies the NRC Regulatory Guides and the other quality assurance standards which have been selected to supplement and support the SNC NDQAP. Southern Nuclear commits to compliance with these standards to the extent described herein. Commitment to a particular Regulatory Guide or other QA standard does not constitute a commitment to the Regulatory Guides or QA standards that may be referenced therein.

**Regulatory Guides:**

**Regulatory Guide 1.8**, Revision 2, April 1987 – Qualification and Training of Personnel for Nuclear Power Plants

Regulatory Guide 1.8 defines the requirements for selection and training of nuclear power plant operations phase personnel.

Southern Nuclear meets the requirement of this regulatory guide for the selection and training of nuclear power plant personnel.

Personnel who complete an accredited program which has been endorsed by the NRC shall meet the requirements of the accredited program in lieu of other guidance given in the guide.

**Regulatory Guide 1.26**, Revision 3, February 1976 – Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants

Regulatory Guide 1.26 defines classification of systems and components.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide for ND with the exception of Criteria C.1, C.1.a, C.1.b, and C.3. Refer to the Westinghouse AP1000 Design Control Document, Appendix 1A for a detailed discussion of these exceptions.

**Regulatory Guide 1.28**, Revision 3, August, 1985 – Quality Assurance Program Requirements (Design and Construction)

Southern Nuclear meets the requirements of this regulatory guide for Construction Activities conducted by Southern Nuclear, except that ASME NQA-1-1994 edition (as modified by the exceptions to NQA-1-1994 as shown in this NDQAM) will be used in place of ANSI/ASME NQA-1-1983 and the ANSI/ASME NQA-1a-1983 Addenda.

**Regulatory Guide 1.29**, Revision 3, September 1978 – Seismic Design Classification

Regulatory Guide 1.29 defines systems required to withstand a safe shutdown earthquake (SSE).

SNC commits to the applicable regulatory position guidance provided in this regulatory guide for ND with the exception of Criteria C.1.d, C.1.g, and C.1.n. Refer to the Westinghouse AP1000 Design Control Document, Appendix 1A for a detailed discussion of these exceptions.

**Regulatory Guide 1.54**, Revision 1, July 2000- Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants

Regulatory Guide 1.54 defines requirements and guidelines for protective coatings applied to various materials.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide for ND with the exception of Criteria C.1 and C.2. Refer to the Westinghouse AP1000 Design Control Document, Appendix 1A for a detailed discussion of these exceptions.

**Regulatory Guide 1.97**, Revision 3, May 1983 – Instrumentation for Light-Water Nuclear Power Plants to Assess Plant and Environs Condition During and Following an Accident

Regulatory Guide 1.97 describes an acceptable method to provide instrumentation to monitor plant variables and systems during and following an accident.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide for ND.

**Regulatory Guide 1.143**, Revision 2, November 2001 – Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants

Regulatory Guide 1.143 furnishes design guidance acceptable to the NRC regarding seismic and quality group classification and quality assurance provisions for radioactive waste management SSCs.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide for ND.

**Regulatory Guide 1.152**, Revision 2, January 2006 - Criteria for Digital Computers in Safety Systems of Nuclear Power Plants

Regulatory Guide 1.152 describes a method acceptable to the NRC regarding use of digital computers in safety systems.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide for ND.

**Regulatory Guide 1.168**, Revision 1, February 2004 - Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants

Regulatory Guide 1.168 describes acceptable methods regarding verification and validation; reviews; and audits of digital computer software used in safety systems.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide.

**Regulatory Guide 1.169**, Revision 0, September 1997 - Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants

Regulatory Guide 1.169 describes acceptable methods regarding configuration management plans for digital computer software used in safety systems.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide.

**Regulatory Guide 1.170**, Revision 0, September 1997 - Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants

Regulatory Guide 1.170 describes acceptable methods regarding software test documentation for digital computer software used in safety systems.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide.

**Regulatory Guide 1.171**, Revision 0, September 1997 - Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants

Regulatory Guide 1.171 describes acceptable methods regarding software unit testing for digital computer software used in safety systems.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide.

**Regulatory Guide 1.172,** Revision 0, September 1997 - Software Requirements Specifications for Digital Computer Software Used in Safety Systems of Nuclear Power Plants

Regulatory Guide 1.172 describes acceptable software requirements specifications for digital computer software used in safety systems.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide.

**Regulatory Guide 1.173**, Revision 0, September 1997 - Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants

Regulatory Guide 1.173 describes acceptable methods regarding development of software life cycle processes for digital computer software used in safety systems.

SNC commits to the applicable regulatory position guidance provided in this regulatory guide.

**Standards:**

**ASME NQA-1-1994 Edition** – Quality Assurance Requirements for Nuclear Facility Applications

SNC commits to NQA-1-1994, Parts I and II, as described in the foregoing sections of this manual.

**Nuclear Information and Records Management Association, Inc. (NIRMA) Technical Guides (TGs)**

SNC commits to NIRMA TGs as described in section 17 of this manual.