

QA: QA

MOL.20020509.0127

SN-M&O-SCI-
024-V1



BOREHOLE SUSPENSION
SEISMIC COMPONENT
OF
GEOTECHNICAL INVESTIGATION
FOR A POTENTIAL WASTE
HANDLING BUILDING

Opened: June 15, 2000.

Closed: March 13, 2002.

3/13/02

John G. Diehl

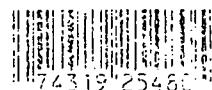


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SN-M#0-SCI-024-V1

BOREHOLE SUSPENSION SEISMIC
COMPONENT OF GEOTECHNICAL ^{9aa}
INVESTIGATION FOR A ^{POTENTIAL} ~~PERMANENT~~ _{3/8/02}
WASTE HANDLING BUILDING.

Opened: June 15, 2000.

This Investigator: John G. Diehl.

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QA: QA

Scientific Notebook SN-M&O-SCI-024-V1

Borehole Suspension Seismic Component of
Geotechnical Investigation for a Potential Waste Handling Building

Date Opened: June 15, 2000

Principal Investigator: Michael J. Luebbers

Lead/Supervisor: David S. Kessel

Responsible Professional: Mark Peters

Work Package Manager: Cliff Howard

Cliff Howard for Mike Luebbers

CH 3-13-02

4-13-00

Initial Entry

The paragraphs below are numbered to correspond with the subparagraph numbers used in Paragraph 5.3.1.a of AP-SIII.1Q, Rev. 0 in listing the required content of all Initial Entries.

1. *Work title and Work Breakdown Structure No.:* This scope of work supports the activity "Soils Report and TDMS Seismic Properties Submittal", the planning for which is documented in Technical Development Plan TDP-WPS-GE-000001, Revision 00. This work supports the task of performing a geotechnical investigation to acquire geotechnical, geologic and geophysical data for use in developing geotechnical recommendations and ground motions for the preliminary design of a potential Waste Handling Building (WHB). This work is in response to Input Request Nos. 00070.R and 00071.Ra. The Work Breakdown Structure number for FY00 and FY01 covering this work is WBS 1.2.22.6T. The work is being performed under Work Package 4201226TM3 (FY00) and 4201226TZC (FY01).

Research Objective: This work supports the task of acquiring seismic velocity data for use in developing the values of geotechnical parameters to be used in developing geotechnical recommendations and ground motions for design of a potential WHB. The recommendations were requested by Input Request Nos. 00070.R and 00071.Ra.

Proposed Approach: Perform suspension seismic logging to acquire data useful to developing some of the needed input. From the raw measurements, interpret the recordings to identify ("pick") the arrival time of the p (compressional) and s (shear) waves at each receiver. Using the p-wave and s-wave arrival times and the receiver-receiver distances, calculate the compressional wave velocities and shear wave velocities, respectively. In addition, calculate the p-wave velocities and s-wave velocities using the source-receiver arrival times. For each depth interval over which both p-wave velocity and s-wave velocity are determined, calculate Poisson's ratio using the theory of elasticity. Present s-wave velocity, p-wave velocity and Poisson's ratio as a function of receiver depth in both tables and graphs. Evaluate sources of error and uncertainty in each of these data sets.

In general, the suspension logging will be performed in accordance with GEOVision's Procedure for OYO P-S Suspension Seismic Velocity Logging Method, Version 1.1, dated 2/22/00. A copy of this procedure will be inserted in this scientific notebook following this initial entry. The GEOVision procedure will be adapted to this specific work and documented in the scientific notebook.

2. *Samples:* No samples will be taken in connection with the suspension seismic effort.
3. *Test Equipment:* The following measuring and test equipment will be used in the field for suspension logging:

- Suspension PS Log 170 System manufactured by OYO Corporation.

The recorder component of this system is the OYO Model 3331 digital recorder. The timing circuit of the OYO Model 3331 digital recorder requires calibration to verify that time is measured to an accuracy of $\pm 0.1\%$ of full scale. The recorder offers sampling rates of 2, 5, 10, 20, 50, 100 and 200 microseconds. Sensitivity is in millivolt range, 12 bits deep. Bechtel calibrated two of these recorders, Serial Nos. 15014 and 12004, on June 6, 2000 at their Las Vegas facility. A copy of the calibration records will be inserted in this scientific notebook following this initial entry and the copy of the

GEOVision logging procedure. Calibration should be repeated upon completion of this work or at intervals not exceeding one year, whichever comes first.

The distance between the receivers in the OYO Model 170 suspension-logging probe needs to be measured to an accuracy of 0.1 inch. This distance can be measured in the field with the probe suspended from a lifting device, as described in the following sentences. Affix a steel rule or measuring tape to the body of the probe at the lower receiver, and note the distance reading at the lower receiver. Lower the probe until the upper receiver is immersed and read the distance at the upper receiver. Calculate the distance between the two receivers as the difference in the distance readings. Similarly, the distance from the source to the first receiver will be measured for use in source-to-receiver calculations.

Knowing the depth of the receiver below ground surface is not important to the calculated velocity, but is important to knowing to what material the measurement applies. Consequently, depth needs to be measured to an accuracy of ± 1 foot. This depth is measured using an electronic depth encoder incorporated into the sheave over which the P-S logging borehole tool cable rides while being lowered into the borehole. Signals from the depth encoder are sent to the PS 170 data logger and converted to meters. Depth accuracy is verified in two ways: first, by confirming the total borehole depth reported by the driller, and secondly by checking the "zero" upon exiting the borehole. The zero is set midway between receivers at ground surface at the time the tool enters the borehole, and should be within ± 1 foot (± 0.3 m) when the tool returns to the surface.

JGD
9-13-00

4. *Relevant procurement activities, such as calibration or analytical services:* Calibrations/verifications will be required, as discussed in Section 3.
5. *Software Programs to be Used:* We will use the following software in this scientific notebook:
 - Microsoft Word for Windows, Version 97 SR-2 or more recent.
 - Microsoft Excel for Windows, Version 97 SR-2 or more recent.
 - Grapher version 2.02 or more recent.
 - PSLOG, Version 1.0 (1991) or more recent.

Section 2.1.1 of AP-SI.1Q exempts Microsoft Word, Microsoft Excel and Grapher from the qualification requirement. However, any software routines, macros, or software applications used within these programs for quality-affecting work will be documented in the AMR in accordance with Section 5.1 of AP-SI.1Q. In particular, Excel spreadsheets used to calculate s-wave velocity, p-wave velocity and Poisson's ratio, and to plot these parameters versus the depth at which they were measured will be verified.

Section 2.1.3 of AP-SI.1Q exempts software such as PSLOG that is embedded in the test equipment. The use of the PSLOG software is as previously described on pages 183 through 191 in Scientific Notebook SN-M&O-SCI-015-V1, a copy of which will be included after this initial entry. PSLOG is used to graphically display the data that is digitally recorded by the OYO suspension seismic logger in order to facilitate "picking" the wave arrivals. PSLOG can also be used to digitally filter the raw records to remove high frequency waves ("noise"). The filter is applied simultaneously and equally to

||*

* THE COPY OF THE PAGES 183-191 IS PROVIDED ON P. 64.

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Ab

records to remove high frequency waves ("noise"). The filter is applied simultaneously and equally to all receiver channels, thereby ensuring that any phase effects from the filters have no influence on the velocity calculation.

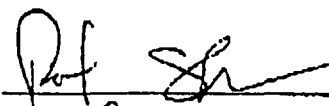
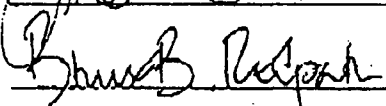
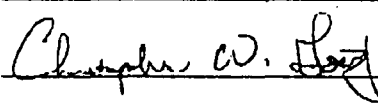
6. *Applicable Standards and Criteria:* Beyond those identified in the Development Plan referenced in Item 1 above, no standards or criteria apply to the work documented in this scientific notebook.

7a. *Any special training/qualifications including procedures, processes or skills:* The operators of the OYO suspension seismic logging equipment, Robert Steller and/or John Diehl, have been selected based on their experience in operating this type of equipment and in interpreting the data acquired with this type of equipment. Bruce Redpath has been selected based on his experience in interpreting this type of data. Other than these requirements, no special training/qualifications, procedures, processes or skills are required beyond those documented in the technical qualifications of the personnel identified in Item 8a of this Initial Entry as having authority to contribute original material to this scientific notebook. Personnel performing evaluations reported herein shall have academic education involving specialized course work in relevant subject matter or equivalent on-the-job learning/training. It is the responsibility of the Principal Investigator and Investigators to consider the background of staff before assigning the staff member to a task.

7b. *Environmental conditions:* Not applicable.

7c. *Accuracy, precision, or representativeness of results; and pertinent potential sources of error:* There are no predefined standards for the accuracy and precision of the results. The accuracy and precision of the data being acquired/developed and described herein will be assessed and the implications for the seismic velocities will be described at appropriate locations in the scientific notebook. The scientific notebook will address the representivity of the seismic velocities after they are developed. No potential sources of error have been identified, other than those inherent in the limited accuracy of the measuring equipment.

8a. *Personnel who may contribute original material to this scientific notebook and examples of their signatures/initials (space is left to add additional signatures if needed):*

Name	Signature	Initials	Date
Robert Steller		R.S.	06-27-00
John Diehl		JD	6-27-00
Bruce Redpath		BR	29 June 00
Michael Luebbers		ML	06-26-00
Christopher Goetz		CG	07-19-00

9-13-00

records to remove high frequency waves ("noise"). The filter is applied simultaneously and equally to all receiver channels, thereby ensuring that any phase effects from the filters have no influence on the velocity calculation.

See facing page

6. *Applicable Standards and Criteria:* Beyond those identified in the Development Plan referenced in Item 1 above, no standards or criteria apply to the work documented in this scientific notebook.

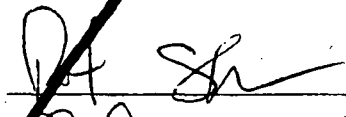
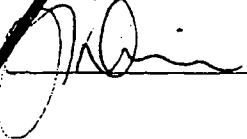
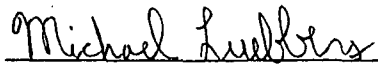
7-13-00

7a. *Any special training/qualifications including procedures, processes or skills:* The operators of the OYO suspension seismic logging equipment, Robert Steller and/or John Diehl, have been selected based on their experience in operating this type of equipment and in interpreting the data acquired with this type of equipment. Bruce Redpath has been selected based on his experience in interpreting this type of data. Other than these requirements, no special training/qualifications, procedures, processes or skills are required beyond those documented in the technical qualifications of the personnel identified in Item 8a of this Initial Entry as having authority to contribute original material to this scientific notebook. Personnel performing evaluations reported herein shall have academic education involving specialized course work in relevant subject matter or equivalent on-the-job learning/training. It is the responsibility of the Principal Investigator and Investigators to consider the background of staff before assigning the staff member to a task.

7b. *Environmental conditions:* Not applicable.

7c. *Accuracy, precision, or representativeness of results; and pertinent potential sources of error:* There are no predefined standards for the accuracy and precision of the results. The accuracy and precision of the data being acquired/developed and described herein will be assessed and the implications for the seismic velocities will be described at appropriate locations in the scientific notebook. The scientific notebook will address the representativity of the seismic velocities after they are developed. No potential sources of error have been identified, other than those inherent in the limited accuracy of the measuring equipment.

8a. *Personnel who may contribute original material to this scientific notebook and examples of their signatures/initials (space is left to add additional signatures if needed):*

Name	Signature	Initials	Date
Robert Steller		RS	06-27-00
John Diehl		JD	6-27-00
Bruce Redpath			
Michael Luebbbers		ML	06-26-00
Christopher Goetz			

9-14-00 incomplete

JLD signed

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Name	Signature	Initials	Date
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

In addition, other individuals may document checks or reviews that they have performed of this scientific notebook. These individuals are not known at this time and do not need to be explicitly identified in the Initial Entry.

8b: Investigator who is responsible for this scientific notebook: Michael J. Luebbers

9. Additional relevant information: None

10. Full citations of all works referenced in this scientific notebook that are related to methodologies in the scientific investigation, and quality status, as appropriate: References related to methodologies used in this scientific notebook will be cited in the entry where they are first used.

11. Provisions for controls of electronically managed data: The completed Supplement V form will be inserted after this initial entry. All data acquired or developed under this scientific notebook will be prepared for submittal to the Technical Data Management System (TDMS) and then submitted to the TDMS. Data submitted to the TDMS will meet TDMS requirements for submitted data. All data acquired in the field will be transferred whenever possible and as soon as practical to electronic format stored on a storage unit in the office. While at the site and in transit between the site and the office, all data will be stored/handled in such manner as to minimize the chance of theft or destruction. In the office, all project data will be backed-up on a separate storage medium to guard against loss until the data can be transferred to the TDMS. Offsite dual-storage will be used whenever practical. Access to stored data will be limited to employees of the companies involved in data acquisition, development and submittal. The scientific notebook will describe how the storage and transfer media are identified as to source, physical and logical format, and date acquired/developed, as appropriate. The acquisition and development of the data will be described herein. If data is transcribed (copied) by manual means (for example, from hand-written notes in a scientific notebook to an electronic data format), the correctness of the transcription shall be verified and documented by a person independent of the original transcription process.

Several staff may access data from the same scientific notebook or the same electronic file stored on a shared file server (local area network); such use by multiple staff requires no special means to verify that each staff member sees the same data because the source is identical. Electronic files transmitted to project associates who are not accessing data from the same source will be manually verified to ensure that the data received is the same as the source data. This may be done by one of several techniques:

- The originating person sends both an electronic and a printed version of the file and the receiving person verifies that the electronic data received matches the printed data. The

9-14-00
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9-14-00

Correct on facing page 5b

In addition, other individuals may document check or reviews that they have performed of this scientific notebook. These individuals are not known at this time and do not need to be explicitly identified in the Initial Entry.

8b: Investigator who is responsible for this scientific notebook: Michael J. Luebbers

9. Additional relevant information: None

10. Full citations of all works referenced in this scientific notebook that are related to methodologies in the scientific investigation, and quality status, as appropriate: References related to methodologies used in this scientific notebook will be cited in the entry where they are first used.

11. Provisions for controls of electronically managed data: The completed Supplement V form will be inserted after this initial entry. All project data will be backed-up on a separate storage medium to guard against loss until the data can be transferred to the Technical Data Management System (TDMS). Offsite dual storage will be used whenever practical.

Electronic files transmitted to project associates in another office will be manually verified to ensure that the data received is the same as the source data. This may be done by one of several techniques:

- The originating person sends both an electronic and a printed version of the file and the receiving person verifies that the electronic data received matches the printed data. The receiving person provides a statement that the check and been performed and that the data has been found to be unaltered. The statement will be inserted in this scientific notebook.
- In the case of TDMS, the originating person can view the data actually posted on the Automated Technical Data Tracking system (ATDT), thus verifying that the data has not only been received correctly, but also has been processed correctly. This is the preferred method because it has been observed that data can be received intact but improperly processed. Manual verification will be recorded in the scientific notebook.

12. There are no special QA verifications, witnesses, or hold points.

Initial Entry Prepared by:

Michael J. Luebbers

Date

Compliance Review by:

9-14-00

9-14-00

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receiving person provides a statement that the check and been performed and that the data has been found to be unaltered. The statement will be inserted in this scientific notebook.

- In the case of TDMS, the originating person can view the data actually posted on the Automated Technical Data Tracking system (ATDT), thus verifying that the data has not only been received correctly, but also has been processed correctly. This is the preferred method because it has been observed that data can be received intact but improperly processed. Manual verification will be recorded in the scientific notebook.

12. There are no special QA verifications, witnesses, or hold points.

Initial Entry Prepared by:

Michael Luebbers
Michael J. Luebbers

July 6, 2000
Date

Compliance Review by:

Jon A. Zischloft
Jon A. Zischloft

7-21-2000
Date

Approved by Lead/Supervisor:

David S. Kessel
David S. Kessel

7/17/00
Date

JB
9-14-00

JB
9-14-00

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Jon A. Zeisloft

Date

9-14-00

Approved by Lead/Supervisor:

JGD

David S. Kessel

Date

correct on facing
page 66

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9-14-00 JGD

incomplete / obsolete

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Cross References to Other Scientific Notebooks

This scientific notebook is related to concurrent scientific notebooks for the geotechnical studies or ground motion studies for a potential Waste Handling Building. These scientific notebooks are:

- SN-USGS-SCI-122-V1, "Collection and Processing of Geotechnical Data from Test Pits and Drill Holes for the Waste Handling Building Foundation", which will be used to document collection and processing of geotechnical data from planned boreholes UE-25 RF#14 through RF#28 and planned test pits TP-WHB-1 through TP-WHB-4.
- SN M&O SCI 020 V1, "Crosshole Seismic Velocity Measurements in North Ramp of Exploratory Studies Facility", which will be used to document crosshole measurements performed using planned boreholes in the walls of the Experimental Studies Facility (ESF) North Ramp tunnel.
- SN-M&O-SCI-022-V1, "SASW Measurements at Waste Handling Building Site", which will be used to document spectral analysis of surface waves (SASW) logging performed at a potential site for a waste handling building in the vicinity of the ESF North Portal.
- SN-M&O-SCI-025-V1, "Downhole Seismic Component of Geotechnical Investigation for a Potential Waste Handling Building", which will be used to document downhole seismic logging performed using planned boreholes UE-25 RF#14 through RF#28.
- SN-M&O-SCI-026-V1, "Development of Geotechnical Parameters for Geotechnical Investigation of a Potential Waste Handling Building", which will be used to document process leading to selection of values for geotechnical parameters needed to perform geotechnical evaluations for foundations for a potential waste handling building.
- SN-M&O-SCI-027-V1, "Foundation Evaluations for Geotechnical Investigation of a Potential Waste Handling Building", which will be used to document evaluations performed to develop geotechnical recommendations for preliminary design of foundations for a potential waste handling building, as requested in Input Request No. 00071.Ra.

Michael Luebbers
Michael Luebbers

July 6, 2000
Date

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Cross References to Other Scientific Notebooks

This scientific notebook is related to concurrent scientific notebooks for the geotechnical studies or ground motion studies for a potential Waste Handling Building. These scientific notebooks are:

- SN-____-____-V1, "____", which will be used to document drilling and sampling of planned boreholes UE-25 RF#14 through RF#28.
- SN-M&O-SCI-020-V1, "Crosshole Seismic Velocity Measurements in North Ramp of Exploratory Studies Facility", which will be used to document crosshole measurements performed using planned boreholes in the walls of the Experimental Studies Facility (ESF) North Ramp tunnel.
- SN-M&O-SCI-022-V1, "SASW Measurements at Waste Handling Building Site", which will be used to document spectral analysis of surface waves (SASW) logging performed at a potential site for a waste handling building in the vicinity of the ESF North Ramp tunnel.
- SN-M&O-SCI-025-V1, "Downhole Seismic Component of Preliminary Geotechnical Investigation for a Potential Waste Handling Building", which will be used to document downhole seismic logging performed using planned boreholes UE-25 RF#14 through RF#28.
- SN-M&O-SCI-026-V1, "Development of Geotechnical Parameters for Geotechnical Investigation of a Potential Waste Handling Building", which will be used to document process leading to selection of values for geotechnical parameters needed to perform geotechnical evaluations for foundations for a potential waste handling building.
- SN-M&O-SCI-027-V1, "Foundation Evaluations for Geotechnical Investigation of a Potential Waste Handling Building", which will be used to document evaluations performed to develop geotechnical recommendations for preliminary design of foundations for a potential waste handling building, as requested in Input Request No. 00071.

Michael Luebbers

Date

✓ 9-14-00

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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT PROCESS CONTROL EVALUATION FOR SUPPLEMENT V

 QA QA
Page: 1 Of: 1

A. Process/Work Activity Identification: (check one)

- ☐ Process Procedure (identify process procedure number including revision and ICN level being evaluated)
- ☒ Work Activity (identify by work package number, work planning document, technical product, etc.)
WBS 1.2.22.6T, Work Package 4201226TM3 (FY00) and 4201226TZC (FY01).

B1. Work Activities/Processes/Process Functions Evaluation

	Yes	No
1. Will, or does, the work activity/process/process function depend on a form of electronic media to store, maintain, retrieve, modify, update, or transmit quality-affecting information?	x	
2. Will, or does, the work activity/process function manage, control, or use an electronic database, spreadsheet, set of files, or other holding system for information that is intended to be used to support the licensing position?	x	
3. Will, or does, the work activity/process function transfer data electronically from one location to another? (The method may be File Transfer Protocol, electronic download, tape to tape, disk to disk, etc.)	x	

If the answers in Section B1 are all "No," process in accordance with Section 5.1.b(6), otherwise proceed to B2.

B2. Work Activities/Processes/Process Functions Compliance Evaluation

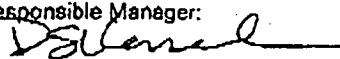
	Yes	No	N/A
1. Does the process procedure or work activity document provide adequate controls to protect data from damage and destruction for its prescribed lifetime?	x		
2. Does the process procedure or work activity document provide adequate controls to ensure the data are readily retrievable?	x		
3. Does the process procedure or work activity document describe how data will be stored with respect to media, conditions, location, retention time, security, and access?	x		
4. Does the process procedure or work activity document describe how the storage and transfer media are identified as to source, physical and logical format, and date prepared?	x		
5. Does the process procedure or work activity document provide adequate controls to ensure completeness and accuracy of the data input and any subsequent changes?	x		
6. Does the process procedure or work activity document provide adequate access controls to maintain data security and integrity?	x		
7. Does the process procedure or work activity document provide adequate controls to ensure that data transfers are error free or within a defined permissible error rate? (e.g., copying raw data from notebook to electronic data form, electronic media to another electronic media, File Transfer Protocols, etc.)	x		

If a "No" answer is given for any question in section B2, proceed to Section C, otherwise process in accordance with Section 5.1.b(6). Mark "N/A" for those items that are not applicable to the specific process or work activity.

C. Results of Evaluation

Provide a summary of the "as-is condition," proposed remedial actions, and expected completion date of document revision, for each item in B2 that was indicated as "No."

Responsible Manager:



Date:

7/17/00

9-14-00

OTHER REFERENCED DOCUMENTS

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT			
SCIENTIFIC NOTEBOOK			
COMPLIANCE REVIEW WORKSHEET			
SN: <u>SN-M&O-SCI-024-V1</u>		Local ID: <u>N/A</u>	Investigator: <u>MIKE LUEBZERS</u>
Title: <u>BORER SUSPENSION SEISMIC COMPONENT OF GEOTECHNICAL INVESTIGATION FOR A POTENTIAL WASTE HANDLING BUILDING</u>			
Reviewed By: <u>JON ZEISLOFT</u>	Reviewer Organization: <u>M&O/ART/DSD</u>	Date: <u>7-14-00</u>	
Review Accepted By: <u>Discinel</u>	Acceptance Date: <u>7/14/00</u>	Record Submittal Date:	
Applicable Implementing Document (Include Rev. No.): <u>AP-SIII.1Q, R.O</u>			
Requirements/Criteria	R	NA	Comments (See Note)
1. Notebook Initiation Includes:			
a. Unique Identifier and Start Date	✓		
b. Use of Bound Book	✓		
c. Space for Table of Contents	✓		
d. Continuous Pagination	✓		
e. Reference any Preceding Notebook	✓		
f. Legible and Reproducible	✓		
2. Initial Entry Includes Following: (or a Referenced Planning Document)			
a. Objective and Description of Work	✓		
b. ID of Scientific Approach or Technical Methods Used to Collect, Analyze, or Study Results	✓		
c. ID of Applicable Standards and Criteria	✓		
d. Equipment to be Used	✓		
e. ID of M&TE and Calibration Requirements	✓		
f. Special Training/Qualification Requirements	✓		
g. ID of Prerequisites, Special Controls, Environmental Conditions, Processes or Skills	✓		
h. Accuracy, Precision, and Representativeness of Results	✓		
i. Identification of Software	✓		<u>9-15-00</u> <u>93</u> <u>NONE</u>
j. Identification of Samples	✓		<u>9-15-00</u> <u>93</u> <u>NONE</u>
k. List of Related Procedures to be Used	✓		<u>93</u> <u>11</u>
l. ID of QA Program Verifications	✓		<u>93</u> <u>11</u>
m. List of All SN Users/Signature/Initials	✓		
n. Designated Owner of SN	✓		
o. Planning Coordinated with Organizations Providing Input to or Using the Results	✓		
p. Provisions for control of any electronically managed data	✓		

AP-SIII.1Q.1

END OF INITIAL ENTRY COMPLIANCE REVIEW.
PAGE 2 WAS NOT USED. 93 7-17-00

Rev. 05/15/2000

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29-14-00

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 Model 170 Suspension P-S Logging system, manufactured by OYO Corporation, is currently the only commercially available suspension system. As shown in Figure 1, the System 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

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9-14-00
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 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 borehole must be between 10 and 20 cm in diameter, or 4 to 8 inches.

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 Model 170 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.

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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.

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. Final printed data is verified by the operator prior to moving the probe.

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

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- 13a
9-14-00
J6D
- 2) Paper output records for each measurement as backup showing depth and ID number
 - 3) List of record ID numbers (for data on diskette) and corresponding depth
 - 4) Diskettes 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

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JED
9-14-00
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, PSLOG automatically calculates both V_s and V_p for each depth. The program allows spreadsheet output for presentation in either charts or tables or both.

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

Anthony Martin

Date 6/20/00

QA Review

[Signature]

Date 6/20/00

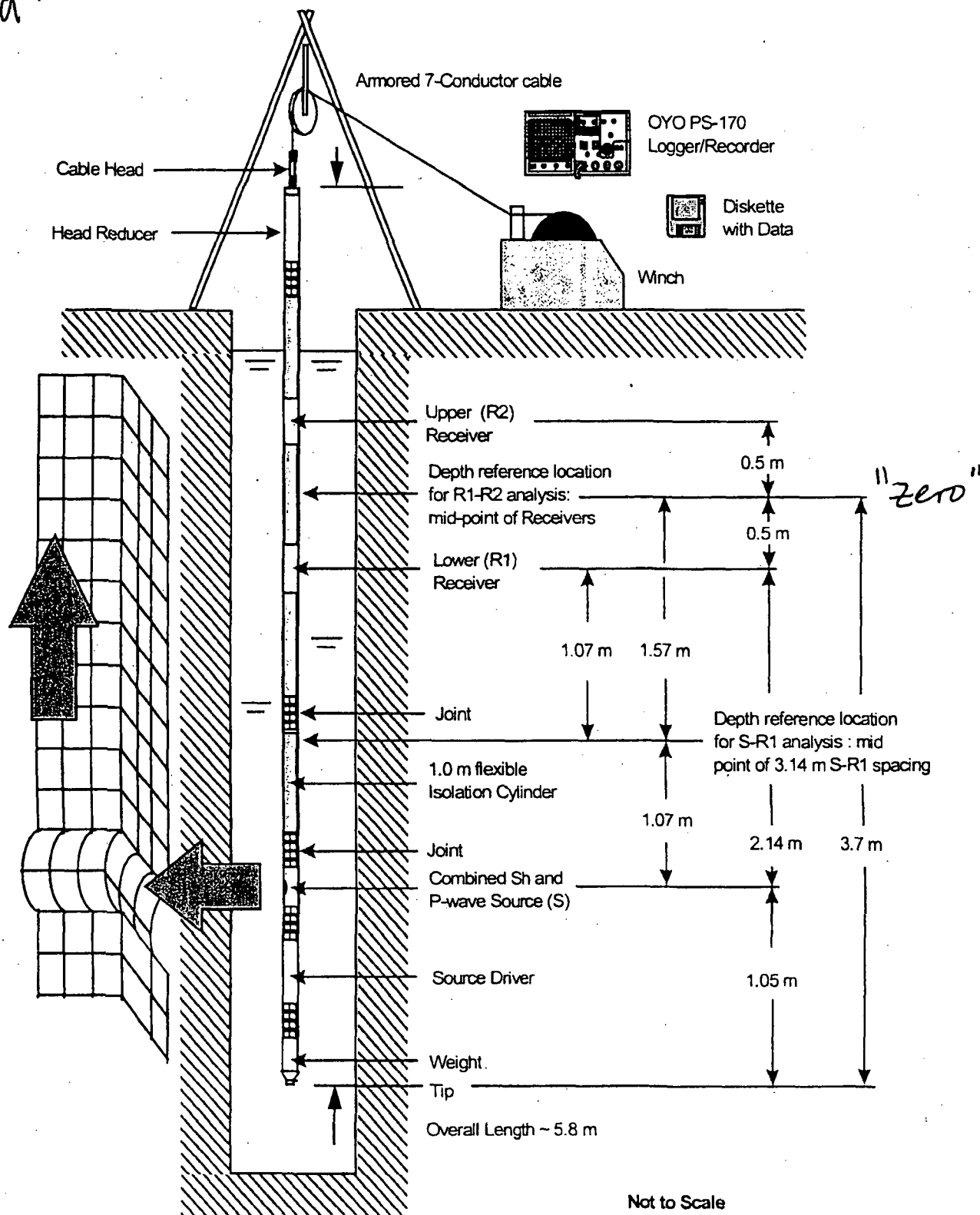
References:

1. Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.
2. The P-S Velocity Logging Method, R.L. Nigbor and T. Imai, XIII ICSMFE, 1994, New Delhi, India / XIII CIMSTF, 1994, New Delhi, India
3. "Standard test Methods for Crosshole Seismic Testing", ASTM Standard D4428/D4428M-91, July 1991, Philadelphia, PA

Job
9-14-00

DIAGRAM SHOWS DIMENSIONS

page
146



15a

OYO SUSPENSION P-S VELOCITY LOGGING SETUP

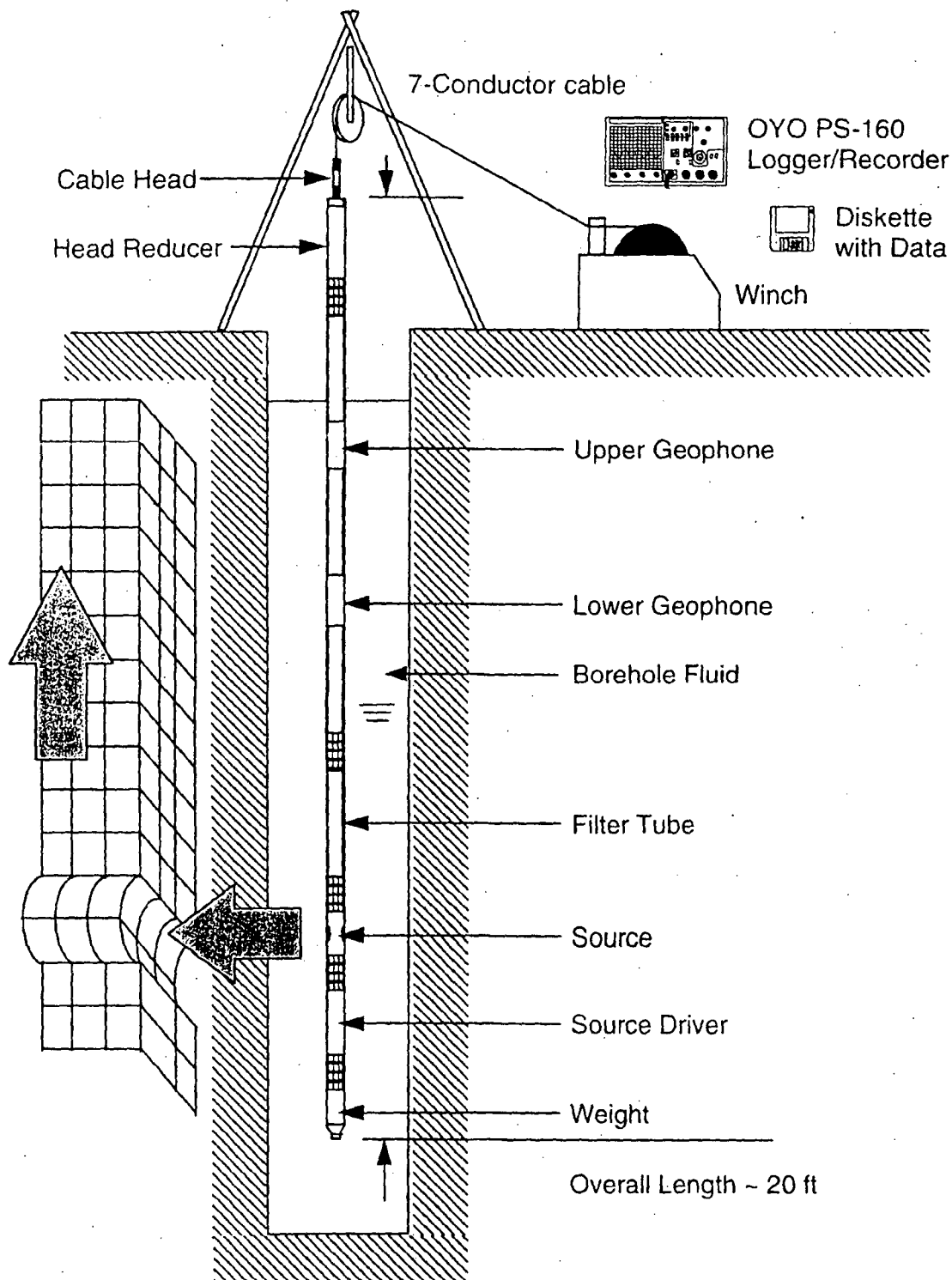


Figure 1. Suspension PS logging method setup

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16a

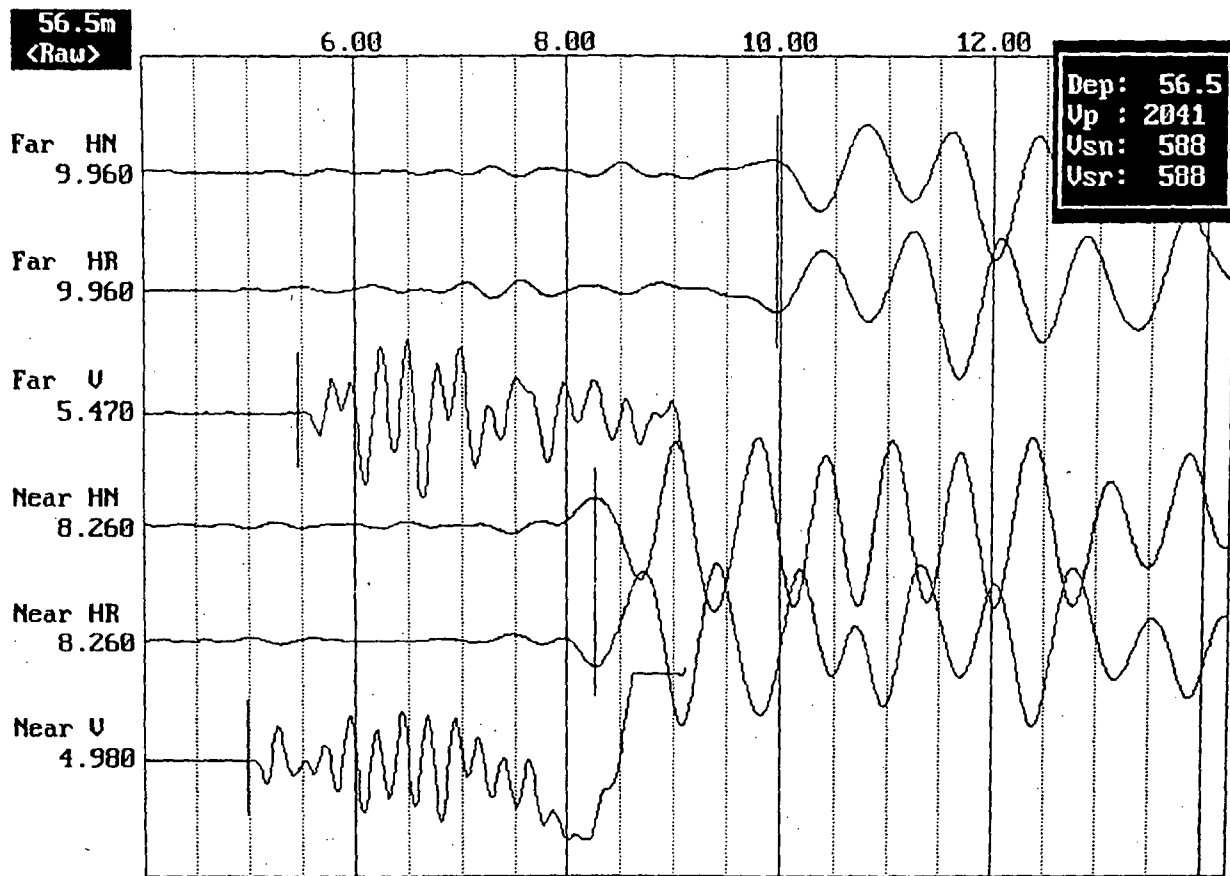


Figure 2. Sample suspension method waveform data showing horizontal normal and reversed (HR and HN), and vertical (V) waveforms received at the near (bottom 3 channels) and far (top 3 channels) geophones. The arrivals in milliseconds for each pick are shown on the left. The box in the upper right corner shows the depth in the borehole and the velocities calculated based on the picks.

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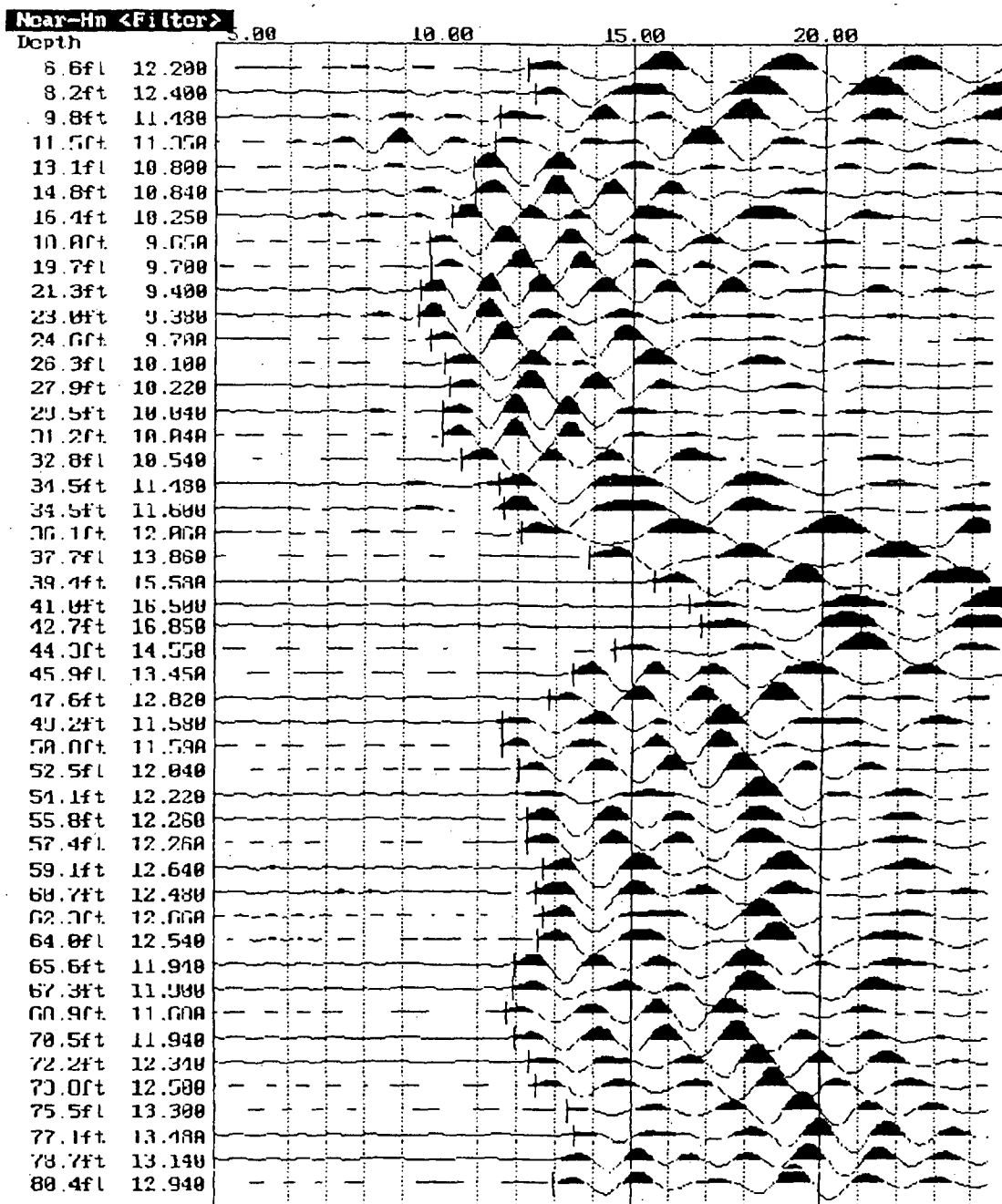


Figure 3. Sample composite waveform plot for normal shear waves received at the near geophone in a single borehole

17b

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18a

gaa 3/2/02

Bechtel Nevada

Standards and Calibration Laboratory
P.O. Box 98521, M/S NLY064 Las Vegas, NV 89193-8521

CALIBRATION REPORT

Report No. 1000018203

Company YUCCA MOUNTAIN PROJECT Instrument SEISMIC RECORDER Inst Id 006852
Department YMP M&O Manufacturer OYO Interval 12 Month
Chg # E0260240 WI10255 Model Number 3331 Cal Date 06/06/2000
Requestor: J. DIEHL Serial 12004 Next Cal 06/06/2000

gaa 3/2/02

STATEMENT of TRACEABILITY and COMPLIANCE

This certifies the above instrument has been calibrated using standards and instruments which are traceable to the National Institute of Standards and Technology (NIST), Sandia PSL, other National Laboratories, an accepted value of a natural physical constant, a ratio calibration technique, or participation in National Measurement Assurance Systems. This calibration complies with the Bechtel Nevada Quality Management Process Description, PD-0001.002, ANSI / NCSL Z540-1-1994 and TRW MPO A08252CCOX.

User Location	ESCL	Humidity:	40.0	Temperature:	75.0
Cal Procedure	MAN OY001 REV 1.2	Accuracy:	ACCURACY CERTIFIED TO: SEE DATA SHEETS SOURCE OF SPECIFICATION: MANUFACTURER		

Measurement Standards:

Instrument Type	Mfr. Model	Inst Id	Cal Date	Cal Due
COUNTER	HP 5335A	002032	11/30/1999	11/30/2000
FUNCTION GENERATOR	HP 3325B	001757	03/06/2000	03/06/2001

A test uncertainty ratio of at least 4:1 is maintained unless otherwise stated.

Test Results Summary:

Condition

VISUAL INSPECTION: OK; AS FOUND : PASS; AS LEFT : PASS

Calibration Notes

Calibrated By: O. Brabham

O. BRABHAM/MET. TECH.

Reviewed By: C.E. Tunley

C.E. TUNLEY/MANAGER

Reviewed Date: 06/06/2000

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Page 1 of 4

gaa 3/2/02

081
JBD 9-14-00
DGA 3/8/02

Bechtel Nevada

Standards and Calibration Laboratory
P.O. Box 98521, M/S NLY064 Las Vegas, NV 89193-8521

CALIBRATION REPORT

Report No. 1000018202

Company YUCCA MOUNTAIN PROJECT Instrument SEISMIC RECORDER Inst Id 006851
Department YMP M&O Manufacturer OYO Interval 12 Mont
Chg # E0260240 WI10255 Model Number 3331 Cal Date 06/06/2000
Requestor: J. DIEHL Serial 15014 Next Cal 06/06/2000

STATEMENT of TRACEABILITY and COMPLIANCE

This certifies the above instrument has been calibrated using standards and instruments which are traceable to the National Institute of Standards and Technology (NIST), Sandia PSL, other National Laboratories, an accepted value of a natural physical constant, a ratio calibration technique, or participation in National Measurement Assurance Systems. This calibration complies with the Bechtel Nevada Quality Management Process Description, PD-0001.002, ANSI / NCSL Z540-1-1994 and TRW MPO A08252CCOX.

User Location ESCL Humidity: 40.0 Temperature: 75.0

Cal Procedure MAN OY001 REV 1.2

Accuracy:

ACCURACY CERTIFIED TO: SEE DATA SHEETS
SOURCE OF SPECIFICATION: MANUFACTURER

Measurement Standards:

Instrument Type	Mfr. Model	Inst Id	Cal Date	Cal Due
COUNTER	HP 5335A	002032	11/30/1999	11/30/2000
FUNCTION GENERATOR	HP 3325B	001757	03/06/2000	03/06/2001

A test uncertainty ratio of at least 4:1 is maintained unless otherwise stated.

Test Results Summary:

Condition

VISUAL INSPECTION: OK; AS FOUND : PASS; AS LEFT : PASS

Calibration Notes

Calibrated By: O. Brabham

O. BRABHAM/MET. TECH.

Reviewed By: Chris R. Tunley

C. E. TUNLEY/MANAGER

Reviewed Date: 06/06/2000

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gao 3/2/02

Additional cross reference

- SN-M#0-SCI-015-VI

This notebook includes some documentation regarding software for data analysis and should be referenced here.

In particular, there is an attachment I regarding documentation of the spreadsheet used for analysis of data in this geotechnical investigation that should be referenced.

Attachment I will be included as a supplemental submitter with this Notebook. It includes procedures and hand calculation verification.

JH
6-8-01
NOTE: only "Rev 04" is available

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JSD
9-14-00

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9-14-00 JSD
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20a

9-14-00

JGD

9-13-00 Wed

1120 Arrive N. Portal Pad ESF
Check in with Chris Goetz.

1130 - 1330 Check in with Ranch
Control. Tool box Safety Meeting.
TCO Field Test Manager - Dick Kovack
Review documents.

1330 Begin set-up equipment.
Open borehole. RF-28
Note: Water down -30'

Mike LaOrange (Dynatec)
says no water avail until
tomorrow morning.

1345 Decided to set up & check
equipment. Proceed to log
bottom section. (per procedure,
P-S log equipment will not work
when water is not present).

1415 Discovered problem with
probe - non oper. "Monitor"
test fail - no signal.
"Measure" test fail, no source.

1415 - 1515 Trouble shooting. Did not
locate fault.

1515 - 1530 Finish catalogue equipment
for property pass.

JGD
9-13-00

p. 206

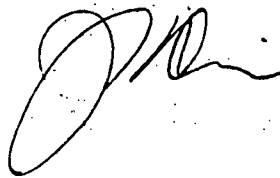
SS 100
9-14-10

1545 Obtain property pass from
Loretta Camp. Sign out.

1600 Depart pad.

1800 Dinner

1900 Assemble & Test equipment.
Replace batteries in Reducer
& wt. Reset system.
Reset all parameters. Test OK

 9-13-00

9-14-00 Thurs.

0730 Arrive on-site. Complete Tool-box
Safety Briefing.

0800 Arrive on borehole RF-28.

0800-0900 Assemble and Test
Equipment OK.

0905 Enter borehole, set "zero"
at ground level.
Continue to bottom of borehole
reach bottom at 24.7m.
This means tip at $3.7 + 24.7 = 28.4m$
or 93.5 ft. Difference between
 $93.5 ft - 99.8 ft$ due to sloughing.

and settling of material to bottom
of borehole.

See "Logging Field Notes"
following for more data.

0940 Reached top of water - cannot
collect more data without water.

1250 Received water to top off borehole.

1255 Commence logging again.

1335 Complete logging, check "zero" OK

1345 Cleanup site. Notify Dynatek
ready to move to next borehole.
(Need water).

NOTE: From -65 ft to -25 ft, signal
low. Will review digital data and
comment possible reasons later. See
page 51a (9-26-00)
JBD

1350 Move to RF.20 p. 24



geophysical services

a division of Blackhawk Geometrics

21a

NOTE: BLANK SPACES P. 21a TO 23 ARE INTENTIONAL
JGD 9-14-00

P-S SUSPENSION VELOCITY FIELD LOG

SITE: YUCCA MTN PROJ ESF NPP DATE: 9-14-00
CLIENT: TRW JOB: 0296
AUTHOR: JOHN DIEHL (JGD) PAGE 1 OF 4

CONTACT: CHRIS GOETZ OFFICE PHONE: 714 835 6886
URS W-C PHONE: _____

CONTACT: _____ OFFICE PHONE: _____

CONTACT: _____ PHONE: _____

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CONTACT: _____ PHONE: _____

EA#: _____

BOREHOLE DESIGNATION: RE 28 LOCATION: see map p. 23b

COUNTY: _____ RANGE: _____ TOWNSHIP: _____ SECTION: _____

BOREHOLE CONSTRUCTION: CASED _____ UNCASD X

DIAMETERS AND DEPTH RANGES: 8.5" 0 TO TD; _____ TO _____

BOREHOLE TOTAL DEPTH AS DRILLED: 99.75 ft

CONDUCTOR CASING?: YES X DEPTH TO BOTTOM OF CASING 5'; NO _____

DEPTH TO BEDROCK: 10-15 ft DEPTH TO WATER TABLE: > 1000 ft

BOREHOLE FLUID: WATER _____; FRESH WATER MUD _____; SALT WATER MUD _____

OTHER: _____

DEPTH TO BOREHOLE FLUID: 68 ft TIME SINCE LAST CIRCULATION: > 1 wk

(at start - filled later)



geophysical services

a division of Blackhawk Geometrics

22a

9-14-00
JGD

JGD
9-14-00

SITE: YMP ESF NPP RF28 DATE: 9-14-00
CLIENT: TRW JOB: 0240
AUTHOR: JGD PAGE 2 OF 4

LOGGING CREW: JOHN DIETZ, CHRIS GOETZ
VEHICLE(S) USED AND MILEAGE: RED ; BLUE ; WHITE RIENTA VAN
MOBILIZED FROM: DEPARTURE TIME:
ARRIVED ON SITE: 0800
STANDBY TIME: 3 HRS CAUSE: NO WATER IN BOREHOLE
LOGGING STARTED: 0921 LOGGING COMPLETED: 1335
STANDBY TIME: CAUSE:
LOGGING STARTED: ~~JGD 9-14-00~~ LOGGING COMPLETED: ~~JGD 9-14-00~~
DEMOLIBIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES X; NO ; STORED WITH NEW
WINCH COMPROBE HAND GREY WHITE TRK
INSTRUMENT 12004 (15014)
GEOPHONE HYPROPHONE 26066

MAINTENANCE PERFORMED ON SITE: WIT SIN 19037
DRIVER 2044
SOURCE 21050
IM 150 4053
EQUIPMENT PROBLEMS OR FAILURES: Reducer 20034

SUGGESTIONS, ADDITIONS, CHANGES: NONE

COMMENTS: NONE - SEE SN

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GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESP NPP RF-28 DATE: 9-14-00
 CLIENT: TRW JOB: 0290 TRW
 AUTHOR: J60 PAGE 3 OF 4

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	NO. IN FILE	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------	----------------------	--------------------------------------

0.5	1.64	1335	hrs	CHECK ZERO - OK J60.	
1.0	3.28		J60 9-14-00		
1.5	4.92				no water, in conductor casing.
2.0	6.56	053			
2.5	8.20	052			
3.0	9.84	051			
3.5	11.48	050			
4.0	13.12	049			
4.5	14.76	048			
5.0	16.40	047			
5.5	18.04	046			
6.0	19.69	045			
6.5	21.33	044			
7.0	22.97	043			near H normal row
7.5	24.61	042			
8.0	26.25	041			
8.5	27.89	040			
9.0	29.53	039			
9.5	31.17	038			
10.0	32.81	037			
10.5	34.45	036			
11.0	36.09	034, 35			reduce gain for H-035
11.5	37.73	033			
12.0	39.37	032			
12.5	41.01	031			
13.0	42.65	030			
13.5	44.29	029			
14.0	45.93	028			
14.5	47.57	027			
15.0	49.21	026			
15.5	50.85	025			
16.0	52.49	024			
16.5	54.13	023			
17.0	55.77	022			
17.5	57.41	021			
18.0	59.06	020			
18.5	60.70	019			low signal near H +

20-1-1-6

J60

23⁵

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF-28 DATE: 9-14-00
 CLIENT: TRW JOB: 0290 TRW
 AUTHOR: JGD PAGE 4 OF 4

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

19.0	62.34	018		low signal near H +
19.5	63.98	017		
20.0	65.62	016		far H low +
20.5	67.26	011, 015		011 - no signal - no water
21.0	68.90	010, 014		010 - no signal on far.
21.5	70.54	009, 013		
22.0	72.18	008, 012		012 - water added.
22.5	73.82	007		
23.0	75.46	006		
23.5	77.10	005		
24.0	78.74	002, 003, 004		pulse width 0.8, 0.4, 1.6 *
24.5	80.38	001		@ 24.7' touch bottom
25.0	82.02			(probe tip @ ~ 37')
25.5	83.66			pulse width 0.8ms
26.0	85.30			
26.5	86.94			* use 1.6 msec - best
27.0	88.58			
27.5	90.22			R = 20
28.0	91.86			
28.5	93.50			
29.0	95.14			+ possible washout.
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			
36.5	119.75			
37.0	121.39			

JGD
9-14-00

JGD
9-14-00

map provided by Chris Goetz (source USBR)



9-14-00
1355 hr

J60
RF-20

Thursday

~~29~~
p. 24
J60
9-14-00

arrive at borehole
No water. Also
in road - block traffic.
Move to RF-21

J60
9-14-00

+3 1400 hr RF-21 no water

↓

1530 wait for water, added two
loads = 3200 gal.

1535 enter bore hole TD* found @ 40.7m
= 132.9 ft, TIP @ 44.4m ~ 146ft

1620 last recording - no more water
@ 31.5 m (103.4 ft)

1635 complete cleanup, pack equipment

1700 Depart site

J60 9-14-00

* TD = Total
Depth

9-14-00
complete taping in
initial pages

J60 9-14-00

NOTE: BLANK
SPACE ARE INTENTIONAL
P. 24a TO P. 26a

P-S SUSPENSION VELOCITY FIELD LOG

SITE: YULCA MTN PROJ ESF NPP DATE: 9-14-00
CLIENT: TRW JOB: 0290
AUTHOR: JOHN DIEHL (JGD) PAGE 1 OF 5
CONTACT: CHRIS GOETZ OFFICE PHONE: 714 835 6886
VRS W-C PHONE: _____
CONTACT: _____ OFFICE PHONE: _____
PHONE: _____
CONTACT: _____ PHONE: _____
PHONE: _____
CONTACT: _____ PHONE: _____
PHONE: _____
DRILLER: 04 NATEL MIKE PHONE: _____
COMPANY: LAGRANGE PHONE: _____

DIRECTIONS TO SITE: _____

GENERAL SITE CONDITIONS/LOCATION: CLEAR, SUNNY

EA#: _____
BOREHOLE DESIGNATION: RF-21 LOCATION: See map p. 236

COUNTY: _____ RANGE: _____ TOWNSHIP: _____ SECTION: _____
BOREHOLE CONSTRUCTION: CASED _____ UNCASD X
DIAMETERS AND DEPTH RANGES: 8.5" 0 TO TD TO _____
BOREHOLE TOTAL DEPTH AS DRILLED: 192.0 ft
CONDUCTOR CASING?: YES X DEPTH TO BOTTOM OF CASING 5'; NO _____
DEPTH TO BEDROCK: _____ DEPTH TO WATER TABLE: > 1000'
BOREHOLE FLUID: WATER _____; FRESH WATER MUD X; SALT WATER MUD _____
OTHER: _____
DEPTH TO BOREHOLE FLUID: _____ TIME SINCE LAST CIRCULATION: _____

P.25
J60
9-14-00

25

J60
9-14-00



geophysical services
a division of Blackhawk Geometrics

SITE: YMP ESF NPP RF 21 DATE: 9-14-00
CLIENT: TRW JOB: 0290
AUTHOR: J60 PAGE 2 OF 5

LOGGING CREW: JOHN DIETZ, CHRIS GEOTZ
VEHICLE(S) USED AND MILEAGE: RED ; BLUE ; WHITE RENTAL VAN
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:
9-13-00

BATTERIES CHANGED BEFORE LOGGING: YES X; NO ; STORED WITH NEW
WINCH COMPROBE HAND Grey WHITE TRK
INSTRUMENT 12004 (15014)
GEOPHONE HYDRO PHONE 26066

MAINTENANCE PERFORMED ON SITE: WT SIN 19037
DRIVER 2044
SOURCE 21050
IM ISO 24053
EQUIPMENT PROBLEMS OR FAILURES: Reducer 20034

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS:

Log 25a
9-14-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF-21

DATE: 9-14-00

CLIENT: TRW

JOB: 0290

AUTHOR: JGD

PAGE 3 OF 5

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

0.5	1.64			ZERO CHECK OK.
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			

JGD 9-14-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF-21 DATE: 9-14-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JGD PAGE 4 OF 5

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

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	019		
32.0	104.99	018		
32.5	106.63	017		
33.0	108.27	016		
33.5	109.91	015		
34.0	111.55	014		
34.5	113.19	013		
35.0	114.83	012		
35.5	116.47	011		
36.0	118.11	010		
36.5	119.75	009		
37.0	121.39	008		

JGD 9-14-00

JGD 9-14-00

← → UNABLE TO LOG - NO WATER - X

9-14-00 26a

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF-21 DATE: 9-14-00
 CLIENT: TRW JOB: 0290 TRW
 AUTHOR: JLD PAGE 5 OF 5

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

37.5	123.03	007		
38.0	124.67	006		
38.5	126.31	005		
39.0	127.95	004		
39.5	129.59	003		
40.0	131.23	002		
40.5	132.87	001	JLD	40.7 m probe @
41.0	134.51		9-14-00	bottom of borehole.
41.5	136.15			
42.0	137.80			
42.5	139.44			tip of probe @
43.0	141.08			40.7 + 3.7
43.5	142.72			= 44.4 m
44.0	144.36			≈ 145 ft.
44.5	146.00			
45.0	147.64			
45.5	149.28			
46.0	150.92	* From JLD		
46.5	152.56		9-14-00	
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			
54.5	178.81			
55.0	180.45			
55.5	182.09			

JLD
9-14-00

9-15-00 Friday JGD

0715 Arrive on-site
Toolbox Safety Briefing

0730 Met with Ivan Wong. Reviewed
Status. Check with drillers RF-16
not ready. Lost circulation
9-14-00 at 4pm. Will recirculate

VAD
9-15-00

0800-
0830 Looked at RF-24, -22, -21
All dry except -21 as left
previous day. Informed by
driller Mike LaOrange RF-16
will be ready 2 hrs.

0830-1130 Waiting. RF-16 still losing
water. Requested by driller
we start logging collect data
as possible. He will top
later.

1200-1330 Waiting for driller to move
off borehole.

1330 Access. Set-up quad-pod.
Begin logging. See Field
Notes following.

1800 No water @ ~~1800~~ 77 ft.

C 1830 Depart site.

[Signature]

9-15-00

Jlg 9-15-00

BLANK SPACES
INTENTIONAL p.27a → 32
JGD 9-15-00

P-S SUSPENSION VELOCITY FIELD LOG

SITE: YUCCA MTN PROJ ESF NPP DATE: 9-15-00
CLIENT: TRW JOB: 0290
AUTHOR: JGD PAGE 1 OF 10

CONTACT: CHRIS GOETZ OFFICE PHONE: 714 835 6886
PHONE: _____

CONTACT: _____ OFFICE PHONE: _____

CONTACT: _____ PHONE: _____

CONTACT: _____ PHONE: _____

CONTACT: _____ PHONE: _____

CONTACT: _____ PHONE: _____

CONTACT: _____ PHONE: _____

CONTACT: _____ PHONE: _____

DRILLER: MIKE LMORANGE

COMPANY: DYNATEC

DIRECTIONS TO SITE: _____

GENERAL SITE CONDITIONS/LOCATION: _____

EA#: _____
BOREHOLE DESIGNATION: RF-16 LOCATION: See map p-236

COUNTY: _____ RANGE: _____ TOWNSHIP: _____ SECTION: _____

BOREHOLE CONSTRUCTION: CASED _____ UNCASD _____

DIAMETERS AND DEPTH RANGES: 8.5" 0 TO TD : _____ TO _____

BOREHOLE TOTAL DEPTH AS DRILLED: 451.3 ft

CONDUCTOR CASING?: YES ☒ DEPTH TO BOTTOM OF CASING 5 ft NO _____

DEPTH TO BEDROCK: _____ DEPTH TO WATER TABLE: > 1000'

BOREHOLE FLUID: WATER _____; FRESH WATER MUD ☒; SALT WATER MUD _____

OTHER: _____

DEPTH TO BOREHOLE FLUID: ? TIME SINCE LAST CIRCULATION: 4 hrs



geophysical services
a division of Blackhawk Geometrics

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JGD 9-15-00

~~028~~
JGD
9-15-00

SITE: YMP ESF NPP RI#16 DATE: 9-15-00
CLIENT: TRW JOB: 0290
AUTHOR: JGD PAGE 2 OF 10

LOGGING CREW: _____
VEHICLE(S) USED AND MILEAGE: RED _____; BLUE _____; WHITE _____
MOBILIZED FROM: _____ DEPARTURE TIME: _____
ARRIVED ON SITE: 0830 hrs
STANDBY TIME: 5 hrs CAUSE: Driller
LOGGING STARTED: _____ LOGGING COMPLETED: _____
STANDBY TIME: _____ CAUSE: _____
LOGGING STARTED: _____ LOGGING COMPLETED: _____
DEMOLIBIZED TO: _____ ARRIVAL TIME: _____
ADDITIONAL DEMOB TIME: _____ REASON: _____

BATTERIES CHANGED BEFORE LOGGING: YES _____; NO X TEST OK
WINCH _____ COMPROBE _____ HAND _____ WHITE TRK _____
INSTRUMENT _____ 12004 _____ 15014
GEOPHONE JGD 9-15-00 26066

MAINTENANCE PERFORMED ON SITE: reducer SN 20034
COMPONENTS USED 1M 24053
TODAY: source 21050
driver 20044
EQUIPMENT PROBLEMS OR FAILURES: Wt 19037
X

SUGGESTIONS, ADDITIONS, CHANGES: _____

COMMENTS: * FEED BUTTON STUCK ON PRINTER
UNIT. EXCH. WITH UNIT FROM
SN 12004. REPAIR LATER

28a

JGD
9-15-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: REF #16 DATE: 9-15-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JGD PAGE 3 OF 10

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

0.5	1.64			
1.0	3.28			"zero check" = OK
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			

"zero check" = OK

no water
no data

JGD

9-15-00

29

J60
9-15-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

ITE: YMP ESF NPP RF #16 DATE: 9-15-00
 LIENT: TRW JOB: 0290 TRW
 UTHOR: J60 PAGE 4 OF 10

EPH ETERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
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	232		far H no water
24.0	78.74	231		
24.5	80.38	230		
25.0	82.02	229		
25.5	83.66	228		
26.0	85.30	227		
26.5	86.94	226		
27.0	88.58	225		printer feed button stuck -
27.5	90.22	224		switch to unit from S/N 2004
28.0	91.86	223		
28.5	93.50	221, 222		reduce gain near H (222)
29.0	95.14	220		reduce gain for H
29.5	96.78	219		
30.0	98.43	218		
30.5	100.07	217		
31.0	101.71	216		
31.5	103.35	215		
32.0	104.99	214		
32.5	106.63	213		
33.0	108.27	212		
33.5	109.91	211		
34.0	111.55	210		incr. gain
34.5	113.19	209		
35.0	114.83	208		
35.5	116.47	207		
36.0	118.11	206		
36.5	119.75	205		
37.0	121.39	204		reduce gain

J60
9-15-00

J60
9-15-00

29a

← p. 29a JGD 9-15-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF # 16 DATE: 9-15-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JGD PAGE 5 OF 10

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

37.5	123.03	203		
38.0	124.67	202		
38.5	126.31	200 201	JGD	
39.0	127.95	199, 200	10-4-01	reduce gain - near H
39.5	129.59	198		
40.0	131.23	197		
40.5	132.87	196		
41.0	134.51	195		
41.5	136.15	194		
42.0	137.80	193		
42.5	139.44	192		
43.0	141.08	190 191	JGD	
43.5	142.72	190	10-4-01	
44.0	144.36	189		
44.5	146.00	188		
45.0	147.64	187		
45.5	149.28	186		
46.0	150.92	185		
46.5	152.56	183 184	JGD	
47.0	154.20	182, 183	10-4-01	repeat, lower gain for H
47.5	155.84	181		
48.0	157.48	180		
48.5	159.12	179		
49.0	160.76	178		
49.5	162.40	177		
50.0	164.04	176		
50.5	165.68	175		
51.0	167.32	174		
51.5	168.96	173		
52.0	170.60	172		
52.5	172.24	171		
53.0	173.88	170		
53.5	175.52	169		
54.0	177.17	168		
54.5	178.81	167		
55.0	180.45	166		
55.5	182.09	165		

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JOB 9-15-00
~~130~~
Joy
9-15-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESP NPP RF #16 DATE: 9-15-00
 CLIENT: TRW JOB: 0290
 AUTHOR: J60 PAGE 6 OF 10

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

56.0	183.73	164		
56.5	185.37	163		
57.0	187.01	162		
57.5	188.65	161		
58.0	190.29	160		
58.5	191.93	159		
59.0	193.57	158		
59.5	195.21	157		
60.0	196.85	156		sw. back to R=20
60.5	198.49	155		
61.0	200.13	154		
61.5	201.77	153		
62.0	203.41	152		
62.5	205.05	151		
63.0	206.69	150		
63.5	208.33	149		
64.0	209.97	148		
64.5	211.61	147		
65.0	213.25	146		
65.5	214.90	145		
66.0	216.54	144		
66.5	218.18	143		
67.0	219.82	142		
67.5	221.46	140, 141		140 pulse width 0.8
68.0	223.10	139		141 " " 1.6
68.5	224.74	138		
69.0	226.38	137		
69.5	228.02	136		
70.0	229.66	135		
70.5	231.30	134		
71.0	232.94	133		
71.5	234.58	132		
72.0	236.22	131		
72.5	237.86	130		
73.0	239.50	129		
73.5	241.14	128		
74.0	242.78	127		1605

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GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: KMP ESF WPP RF #16

DATE: 9-15-00

CLIENT: TRW

JOB: 0290

AUTHOR: JGD

PAGE 7 OF 10

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

74.5	244.42	126		
75.0	246.06	125		
75.5	247.70	124		
76.0	249.34	123		↑
76.5	250.98	122		R=10
77.0	252.62	120 121	JGD 9-15-00	120 R=10, 121 R=20
77.5	254.27	120 119		
78.0	255.91	119 118		
78.5	257.55	118 117		
79.0	259.19	116		
79.5	260.83	115		
80.0	262.47	114		
80.5	264.11	113		
81.0	265.75	112		
81.5	267.39	111		
82.0	269.03	110, 110		repeat on new disk
82.5	270.67	109		
83.0	272.31	108		
83.5	273.95	107		
84.0	275.59	106		
84.5	277.23	105		
85.0	278.87	104		
85.5	280.51	103		
86.0	282.15	102		
86.5	283.79	101		
87.0	285.43	100		
87.5	287.07	099		
88.0	288.71	098		
88.5	290.35	097		
89.0	291.99	096		
89.5	293.64	095		
90.0	295.28	094		
90.5	296.92	093		
91.0	298.56	092		
91.5	300.20	090, 091		noisy (crane @ surface)
92.0	301.84	089		
92.5	303.48	088		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: 4MP ESF NPP RF #16 DATE: 9-15-00
 CLIENT: TRW JOB: 0290 TRW
 AUTHOR: JBD PAGE: 8 OF 10

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
93.0	305.12	087		
93.5	306.76	086		
94.0	308.40	085		
94.5	310.04	084		
95.0	311.68	083		
95.5	313.32	084 082		
96.0	314.96	080 081		
96.5	316.60	079		
97.0	318.24	078		
97.5	319.88	077		
98.0	321.52	076		
98.5	323.16	075		
99.0	324.80	074		
99.5	326.44	073		
100.0	328.08	072		
100.5	329.72	071		
101.0	331.36	070		
101.5	333.01	069		
102.0	334.65	068		
102.5	336.29	067		
103.0	337.93	066		
103.5	339.57	065		
104.0	341.21	064		
104.5	342.85	063		
105.0	344.49	062		
105.5	346.13	070 061		
106.0	347.77	060		
106.5	349.41	059		
107.0	351.05	058		
107.5	352.69	057		
108.0	354.33	056		
108.5	355.97	055		
109.0	357.61	054		
109.5	359.25	053		
110.0	360.89	052		
110.5	362.53	051		
111.0	364.17	050		

JBD
9-15-00

reduce gain for H
 > 15 min break
 1442 m: 45 min
 40 minutes

out of water?
 low signal - near H

← good S₁ - wave form

incr. gain - far H
 incr gain - near H

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF #16 DATE: 9-15-00
 CLIENT: TRW JOB: 0290 TRW
 AUTHOR: JGD PAGE: 9 OF 10

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

111.5	365.81	049		
112.0	367.45	048		
112.5	369.09	047		
113.0	370.73	046		
113.5	372.38	045		
114.0	374.02	044		
114.5	375.66	042, 043		043 - reduce gain H near
115.0	377.30	041		
115.5	378.94	040		
116.0	380.58	039		Pause to fix wrap.
116.5	382.22	038		1357
117.0	383.86	037		
117.5	385.50	036		
118.0	387.14	035		
118.5	388.78	034		
119.0	390.42	033		
119.5	392.06	032		
120.0	393.70	031		
120.5	395.34	030		
121.0	396.98	029		
121.5	398.62	028		
122.0	400.26	027		1347 1347 hr
122.5	401.90	026		
123.0	403.54	025		
123.5	405.18	024		P ~ 4500 S ~ 2000 for
124.0	406.82	023		
124.5	408.46	022		
125.0	410.10	021		
125.5	411.75	020		
126.0	413.39	019		
126.5	415.03	017, 018		
127.0	416.67	016, 017		Lower gain 017 near H
127.5	418.31	015		
128.0	419.95	013, 014		Lower gain 014 for H
128.5	421.59	012		
129.0	423.23	011		
129.5	424.87	010		

p.32 JGD
9-15-00

JGD 9-15-00

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JGD
9-15-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YUCCA MTN PROJ EBF NPP DATE: 9-15-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JGD RF#16 PAGE 10 OF 10

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

130.0	426.51	009		
130.5	428.15	008		
131.0	429.79	007		
131.5	431.43	006		
132.0	433.07	005		
132.5	434.71	004		P-wave ~ 4500 f/s
133.0	436.35	003		
133.5	437.99	002		
134.0	439.63	133.9 m - 001		T.D.
134.5	441.27			
135.0	442.91			TIP of probe @
135.5	444.55			133.9 + 3.7 = 137.6 m
136.0	446.19			451.8 ft.
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			
140.5	460.96			JGD
141.0	462.60			9-15-00
141.5	464.24			
142.0	465.88			
142.5	467.52			
143.0	469.16			
143.5	470.80			
144.0	472.44			
144.5	474.08			
145.0	475.72			
145.5	477.36			
146.0	479.00			
146.5	480.64			
147.0	482.28			
147.5	483.92			
148.0	485.56			

~~32a~~

p. 32a
JOD 9-16-00

9-16-00 Saturday

JGD

0930 Arrive on-site. Toolbox
Safety briefing. Check in
with TCO.

1000 Set up P-S Suspension logger
@ RF-16 AGAIN.

NOTE: Desire to test

- ① other pulse width.
- ② stacking.

To see if measureable, observable
improvement in quality of data.

See facing page 33 and 33b. JGD
33a 9-16-00

PULSE
WIDTH
* 4

JGD 9-16-00

Suspension 170 1.42

ID NO. : 001

HOLE NO. : 16

DEPTH : 131.0 [m]

DATE : 16/09/00 09:59:49 AM

H-SAMPLE RATE: 20 [μSEC]

V-SAMPLE RATE: 10 [μSEC]

PULSE WIDTH : 0.4 [mSEC]

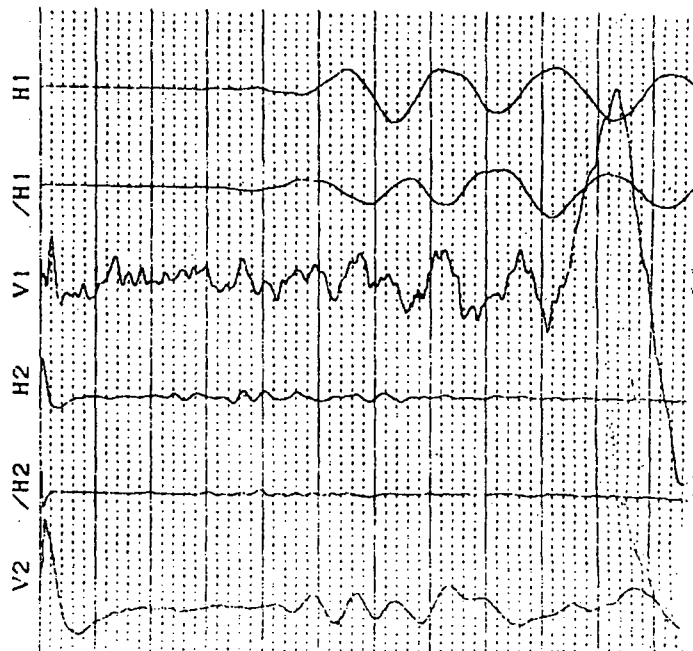
DELAY TIME : 4 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	: X	50	X	50	X	500
LCF [Hz]	: 5	5	5	5	5	5
ICF [Hz]	: 20K	20K	20K	20K	20K	20K
STACK	: 3	3	3	3	3	3

TRACE SIZE : 1

H-TIME SCALE: 0.20 [mSEC/LINE]

V-TIME SCALE: 0.10 [mSEC/LINE]



108 9-16-00

p. 33 JGD 9-16-00 33

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF-16

DATE: 9-16-00 JGD

CLIENT: Trw

JOB: 0290

AUTHOR: JGD

PAGE 1 OF 1

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
--------------	------------	---------------------	-------------------	-----------------------------------

130.0	426.51			
130.5	428.15			
131.0	429.79	001, 002, 003		stack = 3,
131.5	431.43			001 - pulse width .4
132.0	433.07			002 - .8
132.5	434.71	132.7 - T.D.		003 1.6
133.0	436.35			
133.5	437.99			
134.0	439.63			sloughing & settling
134.5	441.27			of bentonite to
135.0	442.91			bottom reduced
135.5	444.55			total depth.
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			
140.5	460.96			
141.0	462.60			
141.5	464.24			
142.0	465.88	THIS TEST WAS PERFORMED TO EVALUATE IF PULSE WIDTH CHOSEN FOR YESTERDAY'S MEASUREMENT WAS THE BEST		
142.5	467.52			
143.0	469.16			
143.5	470.80			
144.0	472.44			
144.5	474.08			
145.0	475.72			X pulse width .4
145.5	477.36			see p. 32a
146.0	479.00			
146.5	480.64			pulse width .8
147.0	482.28			and 1.6 see
147.5	483.92			p. 33a
148.0	485.56			

JGD
9-16-00

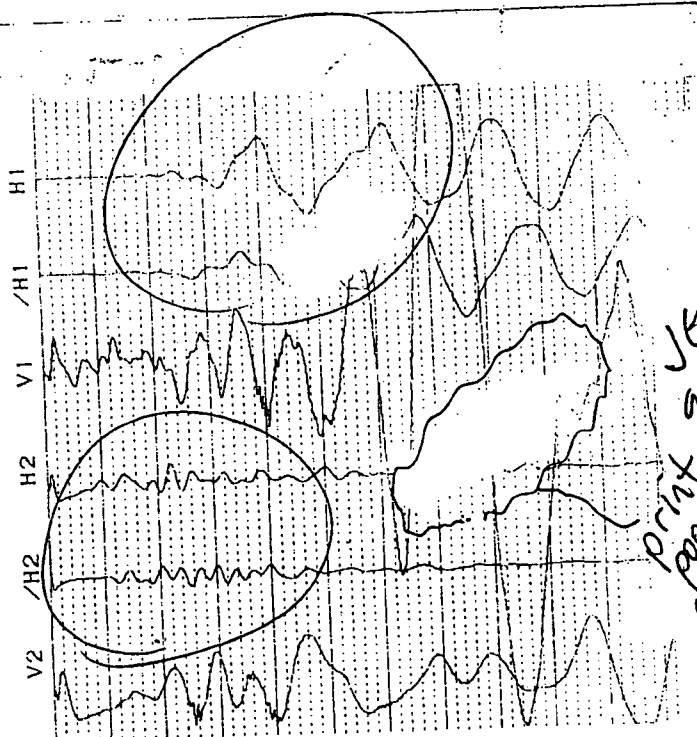
*** PULSE WIDTH 1.6**

Suspension 170 1.42

ID NO. : 003
HOLE NO. : 16
DEPTH : 131.0 [m]
DATE : 16/09/00 10:04:24 AM
H-SAMPLE RATE: 20 [μSEC]
V-SAMPLE RATE: 10 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 4 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	: X	50	X	50	X	500
LCF [Hz]	:	5		5		5
HCF [Hz]	:	20K		20K		20K
STACK	:	3		3		3

TRACE SIZE : 1
H-TIME SCALE: 0.20 [mSEC/LINE]
V-TIME SCALE: 0.10 [mSEC/LINE]



Print person
9-16-00

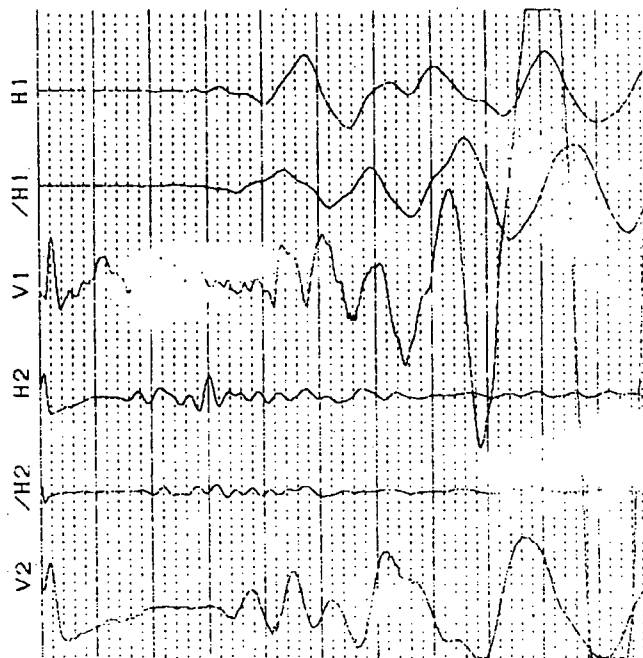
*** PULSE WIDTH 0.8**

Suspension 170 1.4

ID NO. : 002
HOLE NO. : 16
DEPTH : 131.0 [m]
DATE : 16/09/00 10:03:24 AM
H-SAMPLE RATE: 20 [μSEC]
V-SAMPLE RATE: 10 [μSEC]
PULSE WIDTH : 0.8 [mSEC]
DELAY TIME : 4 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	: X	50	X	50	X	500
LCF [Hz]	:	5		5		5
HCF [Hz]	:	20K		20K		20K
STACK	:	3		3		3

TRACE SIZE : 1
H-TIME SCALE: 0.20 [mSEC/LINE]
V-TIME SCALE: 0.10 [mSEC/LINE]



9-16-00

CONCLUSION: The pulse width used, 1.6 msec, is the best choice. Provides higher frequency content, more amplitude of response. But "stacking" does not significantly improve results.

9-16-00, cont.

1015 hr Move to RF-²⁰~~21~~ ^{JOD}
9-16-00

Set up equipment.

1050 in borehole

1105 Begin logging - see pages following.

1225 Complete. Move to RF-26.
(cased bore hole).

go to page 366.

JOD
9-16-00

35

JGD 9-16-00



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16 JGD 9-16-00

SITE: YMP ESF NPP DATE: 9-17-00
CLIENT: TRW JOB: 0290
AUTHOR: JGD PAGE 2 OF 4

LOGGING CREW: John
VEHICLE(S) USED AND MILEAGE: RED _____; BLUE _____; WHITE JGD 9-16-00
MOBILIZED FROM: _____ DEPARTURE TIME: 1230
ARRIVED ON SITE: 1100 hr
STANDBY TIME: 0 CAUSE: _____
LOGGING STARTED: 1108 LOGGING COMPLETED: 1220
STANDBY TIME: _____ CAUSE: _____
LOGGING STARTED: _____ LOGGING COMPLETED: _____
DEMOBILIZED TO: _____ ARRIVAL TIME: _____
ADDITIONAL DEMOB TIME: _____ REASON: _____

9-13-00 TEST etc

BATTERIES CHANGED BEFORE LOGGING: YES _____; NO X; STORED WITH NEW _____
WINCH _____ COMPROBE _____ HAND _____ WHITE TRK _____
INSTRUMENT _____ 12004 _____ 15014 _____
GEOPHONE JGD 9-16-00 _____ 26066 _____

MAINTENANCE PERFORMED ON SITE: Reducer 20034
IM 24053
Modules used. Source 21050
Driver 20044
EQUIPMENT PROBLEMS OR FAILURES: Wt 19037

SUGGESTIONS, ADDITIONS, CHANGES: _____

COMMENTS: _____

35a

9-16-00

J609-16-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF #20

DATE: 9-17-00

CLIENT: TRW

JOB: 0290

AUTHOR: JGD

PAGE 3 OF 4

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			

CASING JGD 9-16-00

Zero check OK.

066

1220 hr

065

Chris holding cable centered

064

062 063

JGD 9-16-00

061 062

060

059

058

057

056

055

054

053

052

051

050

049

048

047

046

044, 45

043

042

041

040

039

038

037

036

035

034

033

032

031

repeat, lower gain for H

lowest gain - still clipped

clipped

9-5-01

JGD

16 JHS 35
9-16-00
D NOTES

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: 9-17-00
CLIENT: _____ JOB: 0290
AUTHOR: _____ PAGE 4 OF 4

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
19.0	62.34	030		
19.5	63.98	029		
20.0	65.62	028		good record
20.5	67.26	027		
21.0	68.90	026		
21.5	70.54	025		
22.0	72.18	024		
22.5	73.82	023		
23.0	75.46	022		
23.5	77.10	021		change paper
24.0	78.74	020		1132
24.5	80.38	019		
25.0	82.02	018		
25.5	83.66	017		
26.0	85.30	016		
26.5	86.94	015		
27.0	88.58	014		
27.5	90.22	013		
28.0	91.86	012		
28.5	93.50	011		
29.0	95.14	010		
29.5	96.78	009		
30.0	98.43	008		1122
30.5	100.07	007		
31.0	101.71	006		
31.5	103.35	005		
32.0	104.99	004		
32.5	106.63	002, 003		
33.0	108.27	32.9 m TD - 001		1108 hr
33.5	109.91			
34.0	111.55	+3.7 = 36.6 m ~ 120 ft TD		
34.5	113.19			
35.0	114.83			
35.5	116.47			
36.0	118.11			
36.5	119.75			
37.0	121.39			

36a

9-16-00 cont.

RF-28 logging.

1245 Arrive on borehole. Set up equipment.

1300 Begin access borehole. See log, pages. following.

1600 Complete logging. Clean up.

1615 Complete clean up.

1630 Depart site.

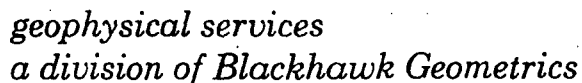
[Signature]

9-16-00

[Signature]
9-16-00

~~87~~

JEP
9-16-00



BLANK SPACES
INTENTIONAL

p. 37 - 40

✓
9-16-00

SITE: YUCCA MTN PROJ ESF NPP DATE: 9-16-00
CLIENT: TRW JOB: 6290
AUTHOR: JLD PAGE 1 OF

CONTACT: CHRIS GOETZ OFFICE PHONE:

CONTACT: _____ OFFICE PHONE: _____

CONTACT: _____ PHONE: _____

CONTACT: _____ PHONE: _____

DRILLER: MIKE LA ORANGE

COMPANY: DYNATEC PHONE: _____

DIRECTIONS TO SITE: _____

GENERAL SITE CONDITIONS/LOCATION: _____

EA#: _____
BOREHOLE DESIGNATION: RF-26 LOCATION: SEE map p. 23B

COUNTY: RANGE: TOWNSHIP: SECTION:

BOREHOLE CONSTRUCTION: CASED ☒ UNCASD

DIAMETERS AND DEPTH RANGES: _____ 0 TO _____ ; _____ TO _____

BOREHOLE TOTAL DEPTH AS DRILLED: 260'

CONDUCTOR CASING?: YES ☒ DEPTH TO BOTTOM OF CASING 5' : 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:

372



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108 9-16-00

SITE: YMP ESF UPP RF #26 DATE: 9-16-00
CLIENT: TRW JOB: 0290
AUTHOR: JGD PAGE 2 OF 7

LOGGING CREW: OIEHL T GOETZ
VEHICLE(S) USED AND MILEAGE: RED _____; BLUE _____; WHITE RENTAL
MOBILIZED FROM: _____ DEPARTURE TIME: _____
ARRIVED ON SITE: _____
STANDBY TIME: _____ CAUSE: _____
LOGGING STARTED: _____ LOGGING COMPLETED: 1600
STANDBY TIME: _____ CAUSE: _____
LOGGING STARTED: _____ LOGGING COMPLETED: _____
DEMOBILIZED TO: _____ ARRIVAL TIME: _____
ADDITIONAL DEMOB TIME: _____ REASON: _____

1615
complete
clean-up

BATTERIES CHANGED BEFORE LOGGING: YES _____; NO X; STORED WITH NEW _____
WINCH _____ COMPROBE _____ HAND _____ WHITE TRK _____
INSTRUMENT _____ 12004 _____ (15014) _____
GEOPHONE 100 9-16-00 _____ 26066 _____

MAINTENANCE PERFORMED ON SITE: Redmar 20034
IM 150 24053
MODULES USED Source 21050
Driver 20044
EQUIPMENT PROBLEMS OR FAILURES: WT 19037

SUGGESTIONS, ADDITIONS, CHANGES: _____

COMMENTS: _____

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YAMP ESF NPP RF #26

DATE: 9-16-00 100 4-16-00 38 160 9-16-00

CLIENT: TRW

JOB: 0290

AUTHOR: J60

PAGE 3 OF 7

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
0.5	1.64	J60 4-16-00	<u>ZERO</u>	<u>CHECK OK</u>
1.0	3.28			
1.5	4.92	152		
2.0	6.56	151		
2.5	8.20	150		
3.0	9.84	149		
3.5	11.48	148		
4.0	13.12	147		
4.5	14.76	146		
5.0	16.40	145		
5.5	18.04	144		
6.0	19.69	143		
6.5	21.33	142		
7.0	22.97	141		
7.5	24.61	140		
8.0	26.25	139		
8.5	27.89	138		
9.0	29.53	137		
9.5	31.17	136		
10.0	32.81	135		
10.5	34.45	134		
11.0	36.09	133		
11.5	37.73	132		
12.0	39.37	131		
12.5	41.01	130		
13.0	42.65	129		
13.5	44.29	128		
14.0	45.93	127		
14.5	47.57	126		
15.0	49.21	125		
15.5	50.85	124		
16.0	52.49	123		
16.5	54.13	122		
17.0	55.77	121		
17.5	57.41	120		
18.0	59.06	119		
18.5	60.70	118		

19m 4-16-00 J60
see (19m) for #153
(jumped from 19.5 → 18.5)

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF#26 DATE: 9-16-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JLD PAGE: 54 OF 67

"4 of 7" JLD 9-16-00

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

19.0	62.34	118 153	JLD 9-16-00	1555 pm
19.5	63.98	117		
20.0	65.62	116		
20.5	67.26	115		
21.0	68.90	114		
21.5	70.54	113		
22.0	72.18	112		
22.5	73.82	111		
23.0	75.46	110		
23.5	77.10	109		
24.0	78.74	108		
24.5	80.38	107		
25.0	82.02	106		
25.5	83.66	105		
26.0	85.30	104		
26.5	86.94	103		
27.0	88.58	102		
27.5	90.22	101		
28.0	91.86	100		
28.5	93.50	099		
29.0	95.14	098		
29.5	96.78	097		
30.0	98.43	096		
30.5	100.07	095		
31.0	101.71	094		
31.5	103.35	093		
32.0	104.99	092		
32.5	106.63	091		
33.0	108.27	090		
33.5	109.91	089		
34.0	111.55	088		
34.5	113.19	087		
35.0	114.83	086		
35.5	116.47	085		
36.0	118.11	084		
36.5	119.75	083	JLD 9-16-00	
37.0	121.39	084 082		

JLD 9-16-00

JGD
9-16-00

p. 39

JGD 9-16-00

JGD 9-16-00
39

JGD

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP RT # 26 DATE: 9-17-00 9-16-00 JGD
CLIENT: TRW JOB: 0290 9-16-00
AUTHOR: JGD PAGE 45 OF 67

" 5 of 7 " JGD 9-16-00

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
37.5	123.03	083 81		
38.0	124.67	082 80		
38.5	126.31	081 79		
39.0	127.95	080 78		
39.5	129.59	079 77		
40.0	131.23	078 76		
40.5	132.87	077 75		
41.0	134.51	076 74		
41.5	136.15	075 73		
42.0	137.80	074 72		
42.5	139.44	073 71		
43.0	141.08	070		
43.5	142.72	069		
44.0	144.36	068		
44.5	146.00	067		
45.0	147.64	066		
45.5	149.28	065		
46.0	150.92	064		
46.5	152.56	063		
47.0	154.20	062		
47.5	155.84	061		
48.0	157.48	060		
48.5	159.12	059		
49.0	160.76	058		
49.5	162.40	057		
50.0	164.04	056		
50.5	165.68	055		
51.0	167.32	054		
51.5	168.96	053		
52.0	170.60	052		
52.5	172.24	051		
53.0	173.88	050		
53.5	175.52	049		
54.0	177.17	048		
54.5	178.81	047		
55.0	180.45	046		
55.5	182.09	045		

ringing - casing?

unsupported casing?
in part clipped H1 (for)

39a p 39a JVD 9-16-00 16 JVD 9-16-00 GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Ymp ESF NAP RF #26 DATE: 9-17-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JVD PAGE 36 OF 47
 "6 of 7" JVD 9-16-00

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

56.0	183.73	044		
56.5	185.37	043		
57.0	187.01	042		1400 hr
57.5	188.65	041		
58.0	190.29	040		
58.5	191.93	039		
59.0	193.57	038		
59.5	195.21	037		
60.0	196.85	035, 036		unsupported casing?
60.5	198.49	034		high ampl. ringing
61.0	200.13	033		
61.5	201.77	032		change pipe
62.0	203.41	031		
62.5	205.05	030		
63.0	206.69	029		
63.5	208.33	028		
64.0	209.97	027		
64.5	211.61	026		
65.0	213.25	025		
65.5	214.90	024		
66.0	216.54	023		
66.5	218.18	022		1340
67.0	219.82	021		
67.5	221.46	020		
68.0	223.10	019		
68.5	224.74	018		
69.0	226.38	017	JVD 9-16-00	
69.5	228.02	015, 016		switch to R=10, back.
70.0	229.66	014, 015		
70.5	231.30	013		
71.0	232.94	012		
71.5	234.58	011		
72.0	236.22	010		
72.5	237.86	009		
73.0	239.50	008		
73.5	241.14	007		
74.0	242.78	006		

p.40 JSD 9-16-00 JSD 9-16-00 -16-00 JSD 9-16-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF# 26

DATE: 9-77-00

CLIENT: TRW

JOB: 0290

AUTHOR: JSD

PAGE 67 OF 67

"7 of 7" JSD 9-16-00

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

74.5	244.42	005		
75.0	246.06	004		
75.5	247.70	003		
76.0	249.34	002		
76.5	250.98	76.7 touch bottom.	001	1317
77.0	252.62			
77.5	254.27	probe tip @ 76.7 + 3.7 = 80.4 m.		
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			
90.5	296.92			
91.0	298.56			
91.5	300.20			
92.0	301.84			
92.5	303.48			

JSD
9-16-00

40a

9-18-00 MONDAY

JGO

0800 Arrive on-site

0800-0845 Set up logging truck,
Tool box safety briefing.
Obtain water.

0900-1000 Set-up on RF-24, wait for water.

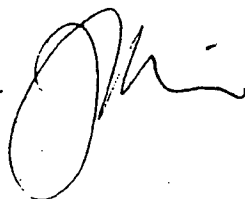
1045- Receive water to fill the
borehole.

1050 Begin logging @ 50.3m.
Note: shd have been 73m.
Difference lost to caving
plus settling of bentonite in
borehole.

1159 Last depth logged, 17.5m,
57.4 ft. No water. Unable
to fill above 55 ft.

1200-1215 Clean up, pack equipment
Depart site. Move to
RF-22.

1230 Depart. Stop at current
drilling operations.



9-18-00



geophysical services
a division of Blackhawk Geometrics

BLANKS
INTENTIONAL
P-41-43

JGD
9-18-00

41

JGD
9-18-00

JGD
9-18-00

P-S SUSPENSION VELOCITY FIELD LOG

SITE: YUCCA MTN PROJECT ESF NPP DATE: 9-18-00
CLIENT: TRW JOB: 0290 TRW
AUTHOR: JGD PAGE 1 OF

CONTACT: <u>CARL GOETZ</u>	OFFICE	PHONE: _____
		PHONE: _____
CONTACT: _____	OFFICE	PHONE: _____
		PHONE: _____
CONTACT: _____		PHONE: _____
		PHONE: _____
CONTACT: _____		PHONE: _____
		PHONE: _____
DRILLER: <u>MIKE LA ORANGE</u>		PHONE: _____
COMPANY: _____		PHONE: _____

DIRECTIONS TO SITE: _____

GENERAL SITE CONDITIONS/LOCATION: SUNNY, CLEAR

EA#: _____
BOREHOLE DESIGNATION: RF #24 LOCATION: see map 23b

COUNTY: _____ RANGE: _____ TOWNSHIP: _____ SECTION: _____
BOREHOLE CONSTRUCTION: CASED _____ UNCASD X
DIAMETERS AND DEPTH RANGES: _____ 0 TO _____ TO _____
BOREHOLE TOTAL DEPTH AS DRILLED: 267 ft → 253 (bentonite fin)
CONDUCTOR CASING?: YES X DEPTH TO BOTTOM OF CASING 5 ft; NO _____
DEPTH TO BEDROCK: _____ DEPTH TO WATER TABLE: > 1000 ft
BOREHOLE FLUID: WATER X; FRESH WATER MUD _____; SALT WATER MUD _____
OTHER: _____
DEPTH TO BOREHOLE FLUID: ⊕ TIME SINCE LAST CIRCULATION: > 3 wks

1511a p.41a J60 9-18-00



geophysical services
a division of Blackhawk Geometrics

SITE: YMP ESF NPP RF #24 DATE: 9-18-00
CLIENT: TRW JOB: 0290
AUTHOR: J60 PAGE 2 OF

LOGGING CREW: DIEHL & GOETZ
VEHICLE(S) USED AND MILEAGE: RED ; BLUE ; WHITE RENTAL
MOBILIZED FROM: DEPARTURE TIME:
ARRIVED ON SITE: 0900
STANDBY TIME: CAUSE: WAIT FOR WATER.
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 X; STORED WITH NEW
WINCH COMPROBE HAND WHITE TRK
INSTRUMENT 12004 15014
GEOPHONE J60 9-18-00 hydro 26066

MAINTENANCE PERFORMED ON SITE: redner 20034 } SW of
1m iso 24053 } clements
source 21050 } used this
driver 20044 } test
EQUIPMENT PROBLEMS OR FAILURES: wt 19037

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS:

J60 9-18-00

P-42 JGD 9-18-00

JGD 9-18-00 42

JGD 9-18-00

JGD 9-18-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP R-#24 DATE: 9-18-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JGD PAGE 3 OF 5

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	066		
18.0	59.06	065		
18.5	60.70	064		

ZERO CHECK - OK.

JGD 9-18-00

UNABLE TO FILL
PAST THIS LEVEL

NO WATER
1159 hr

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP

DATE: 9-18-00

CLIENT: TRW

JOB: 0290

AUTHOR: Jkm

PAGE 4 OF 5

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

19.0	62.34	063		
19.5	63.98	062		
20.0	65.62	061		
20.5	67.26	060		
21.0	68.90	059		
21.5	70.54	058		
22.0	72.18	057		
22.5	73.82	056		
23.0	75.46	055		
23.5	77.10	054		
24.0	78.74	053		1138 22/20 min
24.5	80.38	052		
25.0	82.02	051		
25.5	83.66	050		
26.0	85.30	049		
26.5	86.94	048		
27.0	88.58	047		
27.5	90.22	046		
28.0	91.86	045		
28.5	93.50	044		
29.0	95.14	043		
29.5	96.78	042		
30.0	98.43	041		
30.5	100.07	040		
31.0	101.71	039		
31.5	103.35	038		
32.0	104.99	037		
32.5	106.63	036		
33.0	108.27	035		low signal on next.
33.5	109.91	034		cavity?
34.0	111.55	033		
34.5	113.19	032		
35.0	114.83	031		1158
35.5	116.47	030		
36.0	118.11	029		
36.5	119.75	028		
37.0	121.39	027		

P. 43 JGD
9-18-00

~~CHB~~
JGD
9-18-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: 4 MD ESE NPP REF #24 DATE: 9-18-00
CLIENT: _____ JOB: 0290
AUTHOR: _____ PAGE 5 OF 5

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
37.5	123.03	026		
38.0	124.67	025		
38.5	126.31	024		
39.0	127.95	023		
39.5	129.59	022		
40.0	131.23	021		
40.5	132.87	020		
41.0	134.51	019		
41.5	136.15	018		
42.0	137.80	017		
42.5	139.44	016		
43.0	141.08	015		
43.5	142.72	014		
44.0	144.36	013		
44.5	146.00	012		
45.0	147.64	011		
45.5	149.28	010		
46.0	150.92	009		
46.5	152.56	008		
47.0	154.20	007		
47.5	155.84	006		
48.0	157.48	005		
48.5	159.12	004		
49.0	160.76	003		
49.5	162.40	002		
50.0	164.04	50.3 TO 001	TR	OF PROBE IS AT
50.5	165.68			$50.3 + 3.7 = 54.0m$
51.0	167.32			$= 177.2 ft.$
51.5	168.96			
52.0	170.60			
52.5	172.24			
53.0	173.88			
53.5	175.52			
54.0	177.17			
54.5	178.81			
55.0	180.45			
55.5	182.09			

JGD
9-18-00

43a

9-18-00

Monday Evening

JGD

Email to Ivan Wong & Mike Luebbers

John Diehl

From: John Diehl <jdiehl@geovision.com>
To: <Michael_Luebbers@urscorp.com>; <Ivan_Wong@urscorp.com>
Cc: Rob Steller <rsteller@interserv.com>
Sent: Monday, September 18, 2000 10:33 PM
Attach: Summary of Progress OYO P-S Log.xls
Subject: Re: Continuing OYO surveys in the week of Sept. 11

see p. 44

Here is progress to date. Before your conference call, I hope we will have logged RF-22 on Tuesday AM.

Some thoughts:

1. There has been significant loss in accessibility of boreholes due to a combination of collapse and inability of these boreholes to hold water.
2. In the opinion of the driller, which based on my experience I have to agree, the dry mudcake on the borehole walls is good for perhaps one filling with freshwater fluid. If this takes too long, or if the hole requires filling again, the mudcake is easily worn away by the flow of fresh water and the borehole will no longer hold water. In the case of RF-21, we were not even able to get the borehole full once. The worst aspect of this is two parts: 1) the possibility of large washouts that will result in grout bulbs in the cased borehole (we will see what the caliper log shows), thereby affecting the Downhole logging, and 2) the deposition of material in the bottom of the borehole, reducing the available depth for logging.
3. The OYO P-S logging method is best and most successfully applied in recently circulated boreholes, with the driller available to top off the borehole with fresh mud. This was the case in RF-16. However, by the time we could access this borehole, about 5 hrs had elapsed, and the borehole was already losing fluid. The driller could not wait and continue to supply mud so we were limited in logging the top.
4. If a borehole cannot be logged fresh with the driller waiting, the next best answer (to avoid losing an unacceptable amount of borehole) seems to be to case the borehole. RF-26 provided much better data than RF-13. I believe the reason is that it was drilled using the rotary mud method rather than rotary air, leaving a smoother wall. Unfortunately we lost about 20ft due to unsupported casing (no grout), so we must be very careful with grouting these boreholes.
5. I recommend that the incomplete boreholes be relogged using the OYO P-S Suspension method after casing.

**OYO P-S SUSPENSION LOGGING
SUMMARY OF PROGRESS THROUGH 9-18-00**

Borehole #	OYO P-S Logged	Depth as Drilled	Depth as logged	Deepest meas't	Shallow meas't	Lost due to water	Lost due to collapse	Total Lost	Comments
RF-28	9-14-00	99.75	91.9	80.4	4.9	0	8	8	Uncased
RF-21	9-14-00	192	145	132.9	103.4	98	47	145	Uncased
RF-16	9-15-00	451.8	451.8	439.6	77.1	72	0	72	Uncased
RF-20	9-16-00	160	120	108.3	6.6	0	40	40	Uncased
RF-26	9-16-00	264	264	251	4.9	0	0	0	Cased
RF-24	9-18-00	253	177.2	164	57.4	52	76	128	Uncased
RF-22	sched 9-19-00	505.4	401 *	388.5	96.8	92	104	196	Uncased.

NOTES:

1. RF-16 logged within 5 hrs after last circulation
2. RF-21 took 3,200 gal water

9-19-00
JGD

* 3. RF-22 Depth before add water was 405.5 ft.

jgd 9/19/00 7:32

P. 44

9-18-00
JGD

~~44~~

9-18-00
JGD

~~44a~~ p. 44a JED
9-19-00

9-19-00 Tuesday

0715 Arrive on-site. Observe water truck not available (at borehole RF-22). Are told by Mike LaOrange (Dynatec) possibly 1-2 hrs.

0820 Complete Toolbox Safety Briefing, updating this notebook.

0820 - 0930 Wait for water truck and hose. Test depth of borehole before add water.

0930 Fill borehole with water

0934 Begin logging.

NOTE: TD before add water
= 405.5 ft
TD after = 401 ft.

TD as drilled = 505.4 ft.

~~09~~ 1217 Out of water @ 96.8 ft.

1217 - 1300 Wait for water, add

1304 Unable to log above 96.8 ft
Due to water loss.

1305 - 1400 Pack & update This SN.

1400 Conference call.



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45
JGD
9-19-00
BLANK SPACES
ARE INTENTIONAL
P. 45 - 49 JGD
9-19-00

P-S SUSPENSION VELOCITY FIELD LOG

SITE: YUCCA MTN PROJECT EST INPP DATE: 9-19-00
CLIENT: TRW JOB: 0290
AUTHOR: JGD PAGE 1 OF

CONTACT: <u>CHRIS GOETZ, URS</u>	OFFICE	PHONE: _____
		PHONE: _____
CONTACT: _____	OFFICE	PHONE: _____
		PHONE: _____
CONTACT: _____		PHONE: _____
		PHONE: _____
CONTACT: _____		PHONE: _____
		PHONE: _____
DRILLER: _____		PHONE: _____
COMPANY: _____		PHONE: _____

DIRECTIONS TO SITE: _____

GENERAL SITE CONDITIONS/LOCATION: CLEAR

EA#: _____
BOREHOLE DESIGNATION: RF #22 LOCATION: See map. 23b

COUNTY: _____ RANGE: _____ TOWNSHIP: _____ SECTION: _____
BOREHOLE CONSTRUCTION: CASED _____ UNCASD ☒
DIAMETERS AND DEPTH RANGES: 3.5 0 TO TD; _____ TO _____
BOREHOLE TOTAL DEPTH AS DRILLED: 505.43
CONDUCTOR CASING?: YES ☒ DEPTH TO BOTTOM OF CASING 5 ft; NO _____
DEPTH TO BEDROCK: _____ DEPTH TO WATER TABLE: > 1000'
BOREHOLE FLUID: WATER _____; FRESH WATER MUD ☒; SALT WATER MUD _____
OTHER: _____
DEPTH TO BOREHOLE FLUID: N/A - dry TIME SINCE LAST CIRCULATION: 8-14-00 ~ 4 wks

24 45a
J6D 9-19-00



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J6D 9-19-00

SITE: YMP ESF NAP/RF#22 DATE: 9-19-00
CLIENT: TRW JOB: 0290
AUTHOR: J6D PAGE 2 OF 9

LOGGING CREW: DIEM & GOETZ
VEHICLE(S) USED AND MILEAGE: RED ; BLUE ; WHITE RENTAL
MOBILIZED FROM: DEPARTURE TIME:
ARRIVED ON SITE:
STANDBY TIME: CAUSE:
LOGGING STARTED: 0934 LOGGING COMPLETED: 1217
STANDBY TIME: 40 min CAUSE: no water
LOGGING STARTED: 1300 LOGGING COMPLETED: to 1303
DEMOLIBIZED TO: ARRIVAL TIME: J6D 9-19-00
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES ; NO ; STORED WITH NEW
WINCH COMPROBE HAND GREY WHITE TRK
INSTRUMENT 12004 (15014)
GEOPHONE J6D 9-19-00 hydro 26066

MAINTENANCE PERFORMED ON SITE:
EQUIP USED reducer 20034
 IM iso 24053 SIN
 source 21050
 Driver 20044
EQUIPMENT PROBLEMS OR FAILURES: Wt 19037

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS:

JGD misc
9-19-00 marks

46

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YUCCA MTN PROJ ESF NPP DATE: 9-19-00
CLIENT: TRW JOB: 0290
AUTHOR: JGD 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			
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			

448a

p. 46a

J60
9-19-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

J60
9-19-00

SITE: YMP EST NPP RE #22

DATE: 9-19-00

CLIENT: TRW

JOB: 0290

AUTHOR: J60

PAGE 4 OF 9

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

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	186		
29.5	96.78	184, 185		
30.0	98.43	182		
30.5	100.07	181		
31.0	101.71	180		
31.5	103.35	179		
32.0	104.99	178		
32.5	106.63	177		
33.0	108.27	176		
33.5	109.91	175		
34.0	111.55	174		
34.5	113.19	173		
35.0	114.83	172		
35.5	116.47	171		
36.0	118.11	170		
36.5	119.75	169		
37.0	121.39	168		

added water - still no measurement
for 4 out of water

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF #22 DATE: 9-19-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JLD PAGE 5 OF 9

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
37.5	123.03	167		
38.0	124.67	165		
38.5	126.31	165		
39.0	127.95	164		
39.5	129.59	163		
40.0	131.23	162		
40.5	132.87	160, 161		nan out water for H (160)
41.0	134.51	159		
41.5	136.15	158		
42.0	137.80	157		
42.5	139.44	156		
43.0	141.08	155		
43.5	142.72	154		
44.0	144.36	153		
44.5	146.00	152		
45.0	147.64	151		
45.5	149.28	150		
46.0	150.92	149		
46.5	152.56	148		
47.0	154.20	147		
47.5	155.84	146		
48.0	157.48	145		
48.5	159.12	144		
49.0	160.76	143		
49.5	162.40	152 142	JLD 9-19-00	
50.0	164.04	141		
50.5	165.68	140		
51.0	167.32	139		
51.5	168.96	138		
52.0	170.60	137		
52.5	172.24	136		
53.0	173.88	134 135	JLD 9-19-00	
53.5	175.52	133 134		
54.0	177.17	132 133		
54.5	178.81	131 132		
55.0	180.45	130 131		
55.5	182.09	129 130		check other pulse width. OK

Job 9-19-00
 47a
 Job 9-19-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESP NPP RF #22 DATE: 9-19-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JBD PAGE 6 OF 9

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
56.0	183.73	128 129	JBD 9-19-00	
56.5	185.37	127 128		
57.0	187.01	136 127		
57.5	188.65	125 126		
58.0	190.29	124, 125		← Reduce gain
58.5	191.93	123		
59.0	193.57	122		
59.5	195.21	121		
60.0	196.85	120		
60.5	198.49	119		
61.0	200.13	118		
61.5	201.77	117		
62.0	203.41	116		↑ inc. gains all dr.
62.5	205.05	115		
63.0	206.69	114		
63.5	208.33	113		← stop here. fix 69.5m.
64.0	209.97	111	JBD 9-19-00	
64.5	211.61	110		
65.0	213.25	109		
65.5	214.90	108		
66.0	216.54	107		
66.5	218.18	106		
67.0	219.82	105		
67.5	221.46	104		
68.0	223.10	103		
68.5	224.74	102		
69.0	226.38	101		
69.5	228.02	112		← avoid dupe. #.
70.0	229.66	100		change diskettes
70.5	231.30	099		
71.0	232.94	098		
71.5	234.58	097		
72.0	236.22	096		
72.5	237.86	095		increase gain A1 & H2
73.0	239.50	094		
73.5	241.14	093		
74.0	242.78	092		

JRD 9-19-00
GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Ymp Est RF # 22 DATE: 9-19-00
 CLIENT: TRW JOB: 0290
 AUTHOR: JRD PAGE 7 OF 9

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

74.5	244.42	091		
75.0	246.06	090		
75.5	247.70	089		
76.0	249.34	088		
76.5	250.98	087		
77.0	252.62	086		
77.5	254.27	085		
78.0	255.91	084		
78.5	257.55	083		
79.0	259.19	082		
79.5	260.83	081		
80.0	262.47	080		
80.5	264.11	079		
81.0	265.75	078		
81.5	267.39	077		
82.0	269.03	076		
82.5	270.67	075		
83.0	272.31	074		
83.5	273.95	073		
84.0	275.59	072		
84.5	277.23	071		
85.0	278.87	070		
85.5	280.51	069		
86.0	282.15	068		
86.5	283.79	067		
87.0	285.43	066		
87.5	287.07	065		
88.0	288.71	064		
88.5	290.35	063		
89.0	291.99	062		
89.5	293.64	061		
90.0	295.28	060		
90.5	296.92	059		
91.0	298.56	058		
91.5	300.20	057		
92.0	301.84	056		
92.5	303.48	055		

8A 48a J60 9-19-00 p.48a J60 9-19-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESF NPP RF #22

DATE: 9-19-00

CLIENT: TRW

JOB: 0290

AUTHOR: J60

PAGE 8 OF 9

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
93.0	305.12	054		
93.5	306.76	053		
94.0	308.40	052		
94.5	310.04	051		
95.0	311.68	050		
95.5	313.32	049		
96.0	314.96	048		
96.5	316.60	047		
97.0	318.24	046		
97.5	319.88	045		
98.0	321.52	044		
98.5	323.16	043		
99.0	324.80	042		
99.5	326.44	041		
100.0	328.08	040		
100.5	329.72	039		
101.0	331.36	038		
101.5	333.01	037		
102.0	334.65	036		
102.5	336.29	035		
103.0	337.93	034		
103.5	339.57	033		
104.0	341.21	032		
104.5	342.85	031		
105.0	344.49	030		
105.5	346.13	029		
106.0	347.77	028		
106.5	349.41	027		
107.0	351.05	026		
107.5	352.69	029, 025		R=10, R=20
108.0	354.33	022, 023		R=20, R=10, reduce gain clipped
108.5	355.97	021		
109.0	357.61	020		
109.5	359.25	019		
110.0	360.89	018		
110.5	362.53	017		
111.0	364.17	016		

p. 49 JGD
9-19-00JGD 9-19-00
misc marks49 JGD
9-19-00

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: YMP ESP NPP RF#22

DATE: 9-19-00

CLIENT: TRW

JOB: 0290

AUTHOR: JGD

PAGE 9 OF 9

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
-----------------	---------------	------------------------	----------------------	--------------------------------------

111.5	365.81	015		
112.0	367.45	014		
112.5	369.09	013		
113.0	370.73	012		
113.5	372.38	011		
114.0	374.02	010		
114.5	375.66	009		
115.0	377.30	008		
115.5	378.94	007		
116.0	380.58	006		
116.5	382.22	005		
117.0	383.86	004		
117.5	385.50	003		
118.0	387.14	002		
118.5	388.78	118.4 -	001	TIP OF PROBE AFTER ADD WATER IS AT $118.4 + 3.7 = 122.1 \text{ m}$ ~ 401 ft
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			TIP OF PROBE, PRIOR TO ADD WATER, IS AT $119.9 + 3.7 = 123.6 \text{ m}$ ~ 405.5 ft. ↑
124.0	406.82			
124.5	408.46			
125.0	410.10			
125.5	411.75			
126.0	413.39			123.6 JGD 9-19-00
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			

~~PD~~ 100 9-19-00
49a

1515 Depart site

Phi
9-19-00

100
9-19-00

9-25-00 Jgd



**OYO P-S SUSPENSION LOGGING
SUMMARY OF PROGRESS THROUGH 9-19-00**

Borehole #	OYO P-S Logged	Depth as Drilled	Depth as logged	Deepest meas't	Shallow meas't	Lost due to water	Lost due to collapse	Total Lost	Comments
RF-28	9-14-00	99.75	91.9	80.4	4.9	0	8	8	Uncased
RF-21	9-14-00	192	145	132.9	103.4	98	47	145	Uncased
RF-16	9-15-00	451.8	451.8	439.6	77.1	72	0	72	Uncased
RF-20	9-16-00	160	120	108.3	6.6	0	40	40	Uncased
RF-26	9-16-00	264	264	251	4.9	0	0	0	Cased
RF-24	9-18-00	253	177.2	164	57.4	52	76	128	Uncased
RF-22	9-19-00	505.4	401	388.5	96.8	92	104	196	Uncased

NOTES:

1. RF-16 logged within 5 hrs after last circulation
2. RF-21 took 3,200 gal water
3. RF-22 Depth before adding water was 405.5 ft

jgd

9/25/00

9-25-00
Emailed two summary report to M. Lucibors
Jgd
9-25-00

50

~~50a~~
50a

JGD
9-26-00

RE:

Data

Processing

see p. 63a +

68a. JGD

11-7-00

9-26-00 Review data

RF-16 Data will be difficult to interpret

- far receiver P-wave arrival is difficult to see - may be visible in horizontal records - Noisy
- generally noisy, with poor signal-to-noise ratio (S/N)
- overall, expect to recover data, but processing will be time consuming.

RF-20 Data will be difficult to interpret

- noisy, poor S/N
- offset between normal and reverse (N & R) could be due to size of borehole as well as source.
- very large slow arrivals late in record caused use of long record lengths in the field but may result in lower resolution in picking. Look like S₄ wave but NOT.

- overall, data probably recoverable but processing very time consuming.

RF-21 Lost most of this borehole due to collapse or water (see p. 50). Recommend wait until next phase and log cased borehole.

RF-22 Lost 196 ft of SDS due to collapse or loss of water. However, available data looks very good. Recommend processing.

RF-23 24 Data will be difficult to interpret.

- Near V ok, but far V uninterpretable over most of the borehole much 100-9200
- poor S/N ratio, noisy + low signal, probably due to size of borehole
- near SH arrival visible on normal, low signal on reverse, but far SH not interpretable.

100
9-26-00

JGD
9-26-00

~~R~~ p. 51a

RF-24 cont.

- recommend relog this borehole as cased hole

RF-26 This is a cased borehole which was ^{JGD} ~~was~~ ⁹⁻²⁶⁻⁰⁰ ~~over~~ able to log with water available. Data is actually reasonably good throughout. Expect to recover data from this borehole.

RF-28 Data will be very difficult to interpret.

- noisy poor SN
- far V not interpretable 55-81 ft. and near V 84-81 ft.
- S₄ arrival very weak and far S₄ not interpretable
- recommend relog this borehole cased

JGD
9-26-00

9-27-00

OVERALL

1. Data from these large bore holes was not very good in general

- the overall coverage is poor due to loss from collapse and lack of available water. The problem is that the mud-cake from rotary mud drilling begins to degrade shortly after drilling is concluded. Once fresh water is added this washes away more mudcake. The slough falls to the bottom. Once the mud-cake is gone there is further loss of water into formation and it is no longer possible to keep water in the borehole.
- there were later arrivals that, in the field, appeared to be S_4 arrivals. These pushed the range of recording out which reduced the resolution. This is a minor problem.
- There is weak signal, primarily due to the size of borehole and losses in the disturbed

JOB 9-27-00

9-27-00

P. 52a

OVERALL REVIEW, cont.

Zone at the borehole wall. Signal-to-noise ratio (S/N) was low. Very often far receiver data is not interpretable.

2. We still need to measure R1 - R2 distance in the field using the suspension in water test agreed on (email from M. Neubers, J. Diehl to R. Steller).

From: "Robert Steller" <rsteller@interserv.com>
To: "John G. Diehl" <geovisn.jdiehl@pe.net>
Sent: Thursday, June 08, 2000 12:19 AM
Subject: Re: OYO spacings
John,

I agree completely!

Rob

-----Original Message-----

From: John G. Diehl <geovisn.jdiehl@pe.net>
To: Rob Steller <rsteller@interserv.com>
Date: Wednesday, June 07, 2000 8:11 PM
Subject: Fw: OYO spacings

>Rob,

>

>I think its stupid to worry about spacing in air and I'll tell Mike that.

>Why bother when you can measure directly?

>

>But I agree that we need to measure it in the field. I don't want to look

>stupid 5 years from now sitting on the stand and having someone ask why, if

>distance and time are all thats important we only calibrated time. I think

>a steel tape is adequate. Just log it in the SN. Tape the tip of the tape

>to the middle of the source, lower into the borehole, measure to the first

>receiver while making sure the water is topped up. Repeat for the distance

>form R1 to R2.

>

>John

>

>----- Original Message -----

>From: <Michael Luebbers@urscorp.com>

>To: John Diehl <jdiehl@geovision.com>

>Cc: Rob Steller <rsteller@interserv.com>

>Sent: Tuesday, June 06, 2000 2:52 PM

>Subject: OYO spacings

>

9-27-00

53

From: <Michael_Luebbers@urscorp.com>
To: "John Diehl" <jdiehl@geovision.com>
Cc: "Rob Steller" <rsteller@interserv.com>
Sent: Tuesday, June 06, 2000 2:52 PM
Subject: OYO spacings
John,

I gave some thought to our conversation yesterday about how to measure the S-R1 and R1-R2 OYO spacings appropriate for operation in a liquid-filled borehole. We discussed lowering the OYO probe just to the point where the first receiver is at the liquid surface and measuring the S-R1 distance, and then lowering the device further until the second receiver is at the liquid surface and measuring the R1-R2 distance. We also discussed that it is better to make these measurements with the probe immersed in the fluid rather than hanging in air because the connections between the source section and the first receiver section and between the first receiver section and the second receiver section are flexible in order to isolate the receivers from the seismic waves generated by the source. Since the connections are flexible, the spacings depend on the buoyant weights of the two lower sections of the probe.

I think the approach we discussed will work. I also think it would be good to check the spacings by measuring the probe while it is hanging freely in the air. This should give slightly larger spacings than are measured when the probe is suspended in the liquid. While the probe is hanging in the air we could also apply a force to the base of the probe equal to the estimated buoyant force on the section below the lower flexible connection and measure the S-R1 spacing. Then we could apply a force to the base of the probe equal to the estimated buoyant force on the section below the second flexible connection and measure the S-R2 spacing. By subtraction we would get the R1-R2 spacing. I think simulating the buoyant force would result in measurement in air that is closer to the measurement in the liquid. However, this assumes that the simulated buoyant force is not so large that it causes some unusual deformation of the flexible connection. I am assuming that the buoyant weight of the lower section of the probe is not negative.

JSD
9-27-00

As for the precision with which the spacings should be measured, an error in the spacing is translated directly into an error in velocity. Hence, if we use a spacing of 1,000 mm in the calculation and the actual distance is 1,010 mm (1 percent greater than used), then the real velocity will be 1 percent higher than the calculated velocity. Of course, the spacing is only one source of error and the various sources of error have to be considered together. Obviously, if we want the velocity to be accurate to within 5 percent, the spacing cannot be in error by 5 percent.

Mike

Michael Luebbers
URS Corporation

62

J60 9-27-00

9-27-00 cont OVERALL REVIEW. P. 53a

p. 53a

3. There are still more boreholes to be logged in the field.

RF-14, 15, 17, 18, 19, 25 and 29. These will probably be cased. Since we got reasonably good results in RF-26, ^{J60 9-27-00} ~~at~~ and since these results to date are not very good anyway, one strategy is to wait and see what we get from these boreholes when cased.

4. However, M. Cutler and I. Wong are anxious to get some results. Possibly, we could analyze the data we have that appears to have good potential for results.

RF-16, 22, and 26.

J60.
9-27-00

54

9-28-00

Sent data to Rob Steller.
Asked for overall review.

From: "Robert Steller" <rsteller@interserv.com>
To: "John Diehl" <jdiehl@geovision.com>
Sent: Thursday, October 05, 2000 2:58 PM
Subject: YMP data status
John,

As it stands now, this is how I view the data sets:

RF-16, uncased: Fair Sh-wave data from 108-131 ft, poor P-wave in same region, remaining sections (77-108 ft, 131-440 ft) not interpretable.

RF-20, uncased: Fair Sh-wave data for entire range 6-108 ft, poor P-wave in same region.

RF-21, uncased: Not interpretable over entire range 103-132 ft.

RF-22, uncased: Good Sh-wave data over entire range 97-389 ft, good P-wave data over 230-389 ft. ((John, I just found the files from 97-230 ft, as they were not in you original .SPS file! Disregard the zip file I just sent to you.))

RF-24, uncased: Not interpretable over entire range 57-164 ft.

RF-26, cased: Fair P- and Sh-wave data in range 82-213 ft, not interpretable over 5-82 ft and 213-251 ft.

RF-28, uncased: Not interpretable over entire range 7-80 ft.

All of the sections where we have good quality data seem to exhibit similar velocity and waveform signatures, indicating that we may have a particular formation which is better suited to these logging efforts. In addition, these data were collected with reducer head S/N 20034, which I subsequently determined was producing intermittent P-wave signals, though I do not see this problem in any of these data sets.

Rob

data ok Joe

Joe
10-5-00

~~42~~ p. 54a

JGD
9-10-5-00

10-5-00

VOD
10-5-00

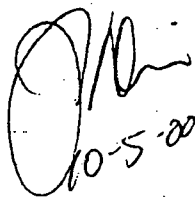
Based on Rob's review,
and my own, we will
process the three benches

RF-16, 22, and 26

Further processing will
await review of data
collected on next field trip.

If new data is better, no
additional analysis will
be performed. If new
data is no better,
a decision will be made
which data to process.

If new data is worse,
data from this September
data set will be fully
analyzed.


10-5-00

10-5-00

need to log following emails.

55

JGD
10-5-00

From: "John G. Diehl" <geovisn.jdiehl@pe.net>
To: "Mike Luebbers" <michael_luebbers@urscorp.com>
Sent: Tuesday, October 03, 2000 12:12 PM
Subject: EQUIPMENT AVAILABILITY

We need to try and schedule completing our logging at YMP this month. Both 7-conductor winches will be tied up throughout November and part of December at the San Francisco Int'l Airport expansion.

I propose we schedule this for the last week of October. Hopefully by that time all the boreholes will be cased and the grout set.

John Diehl
GEOVision Geophysical Services
<http://www.geovision.com>
(909) 549-1234
fax (909) 549-1236

JGD
10-5-00

From: "John G. Diehl" <geovisn.jdiehl@pe.net>
To: <Michael_Luebbers@urscorp.com>
Sent: Tuesday, October 03, 2000 12:45 PM
Subject: Re: EQUIPMENT AVAILABILITY

Yes, absolutely. If we can plan it for that week, end of October, BOTH Rob and I will mob up to YMP. That way, since he is GET trained, we don't need anyone else, and we can work independently. We'll do downhole and P-S in all the boreholes available (within budget limits).

John Diehl
GEOVision Geophysical Services
<http://www.geovision.com>
(909) 549-1234
fax (909) 549-1236

----- Original Message -----

From: <Michael_Luebbers@urscorp.com>
To: John G. Diehl <geovisn.jdiehl@pe.net>; <Mark_Esp@notes.ymp.gov>
Cc: <Ivan_Wong@urscorp.com>
Sent: Tuesday, October 03, 2000 12:17 PM
Subject: Re: EQUIPMENT AVAILABILITY

>
> I should hope that all the holes will be available by then. We may even be
> able to do the work sooner. Mark Esp should comment. I would like to do
> the
> downhole and suspension on the same mobilization if that seems possible.
> By
> the time you mobilize, Ivan should have identified 2 or 3 holes where he
> wants you to do the downhole.
>
> Michael Luebbers, C.E., G.E.
> URS Corporation
> 2020 East First Street, Suite 400
> Santa Ana, CA 92705-4032
> Telephone (direct): 714-648-2780
> Telephone (administrative assistant): 714-648-2723
> Telephone (receptionist): 714-835-6886
> Fax: 714-973-4086
>
>

JGD 10-5-00

JED
10-9-00

22

p. 55a

10-9-00

JED
10-9-00

Received from M. Leubbers ~~with~~
the WHS Data Management
and Supplement V form and
signature program

Does not seem to work. This
is cumbersome to use.

JM
10-9-00

10-10-00

figured out how to do
multiple files - at least there
seems to be a way.

M. Leubbers has backup
copy of diskette (data from
field) - He will send
these to me and we will
try and match his
signatures with the data
we are using for
analysis.

JM
10-10-00

9-5-01 JM

Printouts on next three pages are
only meant to show that the number of
matches equals the ~~at~~ ^{JED} 9-5-01 number of
files. Most of the printouts are cut off.

58

10-18-00

This date M. Luebers made
signature file.

10-26-00

Received raw data diskettes.
Following are log of confirmation that
data used in analysis is same
as original recording.

RF#16 001-110.log

orig files
001-110.

Time : 10/26/00 11:22:59 AM

Total Files 110

Total Matches 110

Total Misses 0

1	SUSPE001.ORG	EFAA9ADD6414F83140BAFA9E3DE4376C	Matched
2	SUSPE002.ORG	391CCD843F11D8358BB0B21BC781F331	Matched
3	SUSPE003.ORG	C795381A717DB0676C1435096A49E476	Matched
4	SUSPE004.ORG	A5AEF09F9F0E5100CCB1DB576E35196E	Matched
5	SUSPE005.ORG	34C852C27DB36FBC68B798983B6F8796	Matched

110 files - most files not shown
RF#16 110-218.log

JLD
9-5-01

JLD
10-28-00

Time : 10/26/00 3:29:37 PM

Total Files 109

Total Matches 109

Total Misses 0

1	SUSPE110.ORG	647825010D674CBC0617A918B4194BE4	Matched
2	SUSPE111.ORG	5201D191813D381728C8A6143E0F226A	Matched
3	SUSPE112.ORG	9263FD8FEF9E4FA4C900A9738C78FF58	Matched
4	SUSPE113.ORG	A4AA0A7E106CFF5BC9AE8893E84E2EEA	Matched

RF#16 219-232.log

JLD
9-5-01

JLD
10-28-00

Time : 10/26/00 3:31:38 PM

Total Files 14

Total Matches 14

Total Misses 0

1	SUSPE219.ORG	9BE131B4AFD24E91CBA3010985C2FA47	Matched
2	SUSPE220.ORG	322180A5BA8AEA1D21234756DB39A4A1	Matched
3	SUSPE221.ORG	EE8367C297324CB28722EC13F488B5FD	Matched
4	SUSPE222.ORG	75FE660D726ADAC9CE477201C9B2C07C	Matched
5	SUSPE223.ORG	7E3E8C9B08787EB566DB5A945281B115	Matched
6	SUSPE224.ORG	031A367A20A8BE10FFDECAE79AB7A093	Matched
7	SUSPE225.ORG	82F1421A86CDA13EA882B3FC0C4A9811	Matched
8	SUSPE226.ORG	E1B2BC176BF5982E0A6CF5CC7F872E99	Matched
9	SUSPE227.ORG	2FD3652014D242F7ED939224RD9D09CD	Matched

JLD
10-28-00

RF-16 TOTAL 233 files

p. 56a

500
10-26-00

500
10-26-00

RF#21 001-019.log

Time : 10/26/00 3:33:14 PM

Total Files 19

Total Matches 19

Total Misses 0

1	SUSPE001.ORG	OE7E9247C69BF51EA7AE6F2A8B4B2196	Matched
2	SUSPE002.ORG	279F0EC3BCC385084557D2D2F0498A4F	Matched
3	SUSPE003.ORG	F71B563A8B9DC5ECBAF76A93134CC5BB	Matched
4	SUSPE004.ORG	166BE5565A819382669EA9ED21C7E13C	Matched
5	SUSPE005.ORG	BBEB485B85CECA69A2929F5DFAB32FA1	Matched
6	SUSPE006.ORG	5686529B696C79CF716D17FE1DF54474	Matched
7	SUSPE007.ORG	32613F9817E6DBAC6A832ED9BF492979	Matched
8	SUSPE008.ORG	BA2CEB77D4050891CF7A877C0829CDEE	Matched

print out cut off - see p. 55a JLD
9-5-01

500
10-26-00

RF#22 001-100.log

Time : 10/26/00 3:36:42 PM

Total Files 100

Total Matches 100

Total Misses 0

1	SUSPE001.ORG	EE5733B12630C9DE841E7DC768FA713F	Matched
2	SUSPE002.ORG	BBBD19C5545127A6B8170146E717C740	Matched
3	SUSPE003.ORG	0663BE99E5345EDFBBA78C09B51F65E6	Matched
4	SUSPE004.ORG	0EAAC0FFFFFA0D4670C6636030C9E1532	Matched
5	SUSPE005.ORG	00C7F8733EA224986FC2284F71EE41A0	Matched
6	SUSPE006.ORG	17374DAC59079FEB5D77EFCA1B1F9DC9	Matched
7	SUSPE007.ORG	778E9A057813FBFD51B55D6CCB30189E	Matched
8	SUSPE008.ORG	B069D4A232AD45873F08A4A24B28E124	Matched

RF#22 101-184.log

Time : 10/26/00 3:38:18 PM

Total Files 84

Total Matches 84

Total Misses 0

1	SUSPE101.ORG	9AB24FFF31661908D6ABB192F2691A82	Matched
2	SUSPE102.ORG	FC6DC20928E2BB4CDA8D719CCF145475	Matched
3	SUSPE103.ORG	C5BA2DC87BF1AF6891127FEEEEE05DF14	Matched
4	SUSPE104.ORG	2BEF86B86520013E43BAD4921216F70C	Matched
5	SUSPE105.ORG	FA968AFA9951EC1551FBB7264E48614D	Matched
6	SUSPE106.ORG	0DA6653A24A8F09650BC402DE06DADA1	Matched
7	SUSPE107.ORG	71F956D74988EACD975107B651D33484	Matched
8	SUSPE108.ORG	1EB2366F46592B177FB3B725DA0442AB	Matched
9	SUSPE109.ORG	72DE56E454FB3949AAEAA87AA37FC64A	Matched

500
10-26-00

RF 22
184 files

57

J62
10-26-00

RF#20 001-066.log

Time : 10/26/00 3:34:36 PM

Total Files 66

Total Matches 66

Total Misses 0

1	SUSPE001.ORG	FED430E27BBC99DC52FF66F5B9BF475B	Matched
2	SUSPE002.ORG	243605DA797581E5A89C79140090E0A6	Matched
3	SUSPE003.ORG	6546F30CB0BD09B6D3D297F6F4F30F13	Matched
4	SUSPE004.ORG	57F4C85100DE6E5223B50C30ED012F05	Matched
5	SUSPE005.ORG	DDF86CA9C01ACA89059FAA974DAA6C33	Matched
6	SUSPE006.ORG	95F78F12203D121CFA1D84DD02FE8C6D	Matched
7	SUSPE007.ORG	FEECCD03D0CC3084C6509CE39B81917A	Matched
8	SUSPE008.ORG	847ECA624A38D9334AB199BFA475A140	Matched
9	SUSPE009.ORG	951B84AB1F70EFF7A61DFB6CC6DF9059	Matched

RF#24 001-066.log

J60
10-26-00

Time : 10/26/00 3:42:17 PM

Total Files 66

Total Matches 66

Total Misses 0

1	SUSPE001.ORG	1E0054AFDFA8951B76D653A70C949321	Matched
2	SUSPE002.ORG	63A171DCE23783022774C14E94526568	Matched
3	SUSPE003.ORG	EA6792B679F81B319A5A94E85EEA0A60	Matched
4	SUSPE004.ORG	1A3898BE8CAAD5B106A2AB2F35D55E10	Matched
5	SUSPE005.ORG	CF08F453668F3CA22F5998A24D1BFA73	Matched
6	SUSPE006.ORG	2A20278CBE8F3006703B7AA3D902279D	Matched
7	SUSPE007.ORG	7661443DBF2E961AE0B3F85D7A82D656	Matched
8	SUSPE008.ORG	CE5BADFE0B0B1A66C834086883047038	Matched
9	SUSPE009.ORG	0D07E886A1B3B237A2A1A000000000	Matched

printouts cut off - see p. 55a J60
9-5-01

RF#26 001-100.log

J60
10-26-00

Time : 10/26/00 3:41:28 PM

Total Files 100

Total Matches 100

Total Misses 0

1	SUSPE001.ORG	2D3762A9CF0E06DB8CC68F3E9BED5079	Matched
2	SUSPE002.ORG	DD13B004B03BDFB041AB82B79164EF53	Matched

RF#26 101-153.log

Time : 10/26/00 3:41:49 PM

Total Files 53

Total Matches 53

Total Misses 0

1	SUSPE101.ORG	D7B3239B4FB31FB34568B5E8F240AEE7	Matched
2	SUSPE102.ORG	DED2962158F72B0AF82D327B8A691AD0	Matched
3	SUSPE103.ORG	6AC7945526E2898B36143B58D86712F0	Matched
4	SUSPE104.ORG	B96AB2CE49E48E08BA2870A7004D228C	Matched
5	SUSPE105.ORG	F047E5812CD9555CCFD677488E21A132	Matched
6	SUSPE106.ORG	D43F75FD20B65055BAB7C0481A5255E6	Matched
7	SUSPE107.ORG	8D75FCDC29E7C8575D3C34AAF8B50FB9	Matched
8	SUSPE108.ORG	F0FD3EA9C6C3CFBFE2962CEC64A0C428	Matched
9	SUSPE109.ORG	C89A778484518AA70B672902119A09AB	Matched

RF 26
153 files

RF#28 001-053.log

Time : 10/26/00 3:40:57 PM

Total Files 53

Total Matches 53

Total Misses 0

1	SUSPE001.ORG	759ADC61B6D9E177E5F116F234787559	Matched
2	SUSPE002.ORG	6982EFD95A78907FB6F1D231CA256C18	Matched
3	SUSPE003.ORG	741B7948A9B7F105D7B91DB528F9CC6C	Matched
4	SUSPE004.ORG	7F2626D4A727F55E7EFD6F74889E1375	Matched
5	SUSPE005.ORG	F21982CF612E485B0021D7AFE1286F88	Matched
6	SUSPE006.ORG	C59DB4F80AE208846A7E568FF4F52DBA	Matched
7	SUSPE007.ORG	A348FE7CE8602775235C082F753FE09	Matched
8	SUSPE008.ORG	94696FE93B33A10C0E47B56A74896A31	Matched
9	SUSPE009.ORG	2F36B83C4551B4DC3BB3106167694E7C	Matched

print out
cut off - see
p. 55a JGD
9-5-01

11-1-00

JGD
10-26-00

From: "John G. Diehl" <geovisn.jdiehl@pe.net>
To: "Ivan Wong" <Ivan_Wong@urscorp.com>; <Michael_Luebbers@urscorp.com>
Sent: Wednesday, November 01, 2000 7:41 PM
Attach: OYO Data Reduction-Rev03-DRAFT-RF-22.xls; OYO Data Reduction-Rev03-DRAFT-RF-16.xls;
DRAFT NOTES ON PROCESSING OF RF-16.pdf; DRAFT NOTES ON PROCESSING OF RF-22.pdf
Subject: Re: OYO template - Rev 3

OK. Using the new REV03 spreadsheet, here are the results for RF-16 and RF-22. Still finishing up RF-26, but after that, as we agreed, we will wait on further processing until we get back in the field. As we agreed, I am giving you spreadsheets instead of PDF files, because you need the numerical data. However, the sheets have been protected so they should be allright.

I'm wondering if there is some automatic way to calculate the beginning time for the downhole travel times. Maybe you can think about this.

John Diehl
GEOVision Geophysical Services
<http://www.geovision.com>
(909) 549-1234
fax (909) 549-1236

NOTE: per discussion with Cliff
Howard, since these are
PRELIMINARY / DRAFT no
need for signature files.

(10-17-00)

JGD
11-1-00

11-1-00

re processing

see p. 63a

& p. 68a

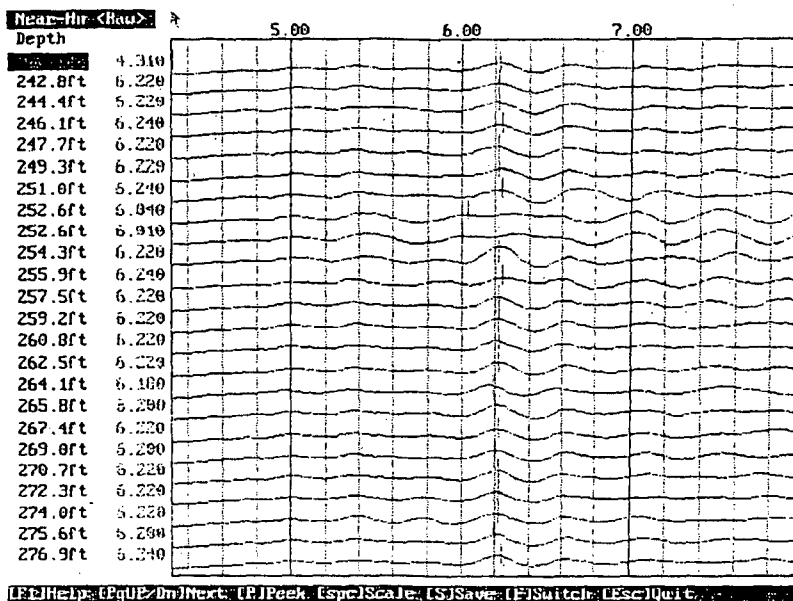
11-7-00

November 1, 2000
jgd

58

DRAFT NOTES ON PROCESSING OF RF-16

1. Large offset between Normal & Reverse could be due to hysteresis in the source, and exacerbated by the large size of the borehole.
2. The large record length used turned out to be non-optimal for the velocity resolution, but was necessitated by the quality of the data. In other words, if in the field the P- and S-wave arrivals are not obvious, it is good practice to collect a longer record length in order to be sure of capturing the data set. But this reduces the accuracy because the sample rate is lower.
3. Data accuracy calculated based on sample interval is compromised by poor quality data, especially noise.
4. There is, by necessity in this borehole, more reliance on source-to-receiver results than on receiver-to-receiver results. Ordinarily, receiver-to-receiver data is preferred because, even though more scattered, these results are more direct and less influenced by source characteristics. However, sometimes for whatever reasons, the far receiver data can be poor or non-existent. In such cases, the source-to receiver data is still better than nothing, and often quite good.
5. The best interpretation is presented in these draft results. However, neither this analyst nor the QA reviewer are content with these results. Here are some comments:
 - On one hand, the results presented are generally consistent with data acquired in RF-13 and RF-22. The source to receiver data for the most part is consistent with available receiver-to-receiver data, and the velocity ratios from vertical to horizontal are quite believable. Further, this interpretation is the most direct, since it looks at the first arrivals on each channel as you should expect.
 - But, the picks between 150ft and 360ft depth are, in our experience, too consistent to represent "real-world", fractured rock, conditions, even for source-to-receiver results. The following figure is a "depth sequential" plot showing the Hn wave arrivals from 4.3 to 8ms. The Vs arrival picks are outlined in blue. The picks are nearly a straight line.



11-1-00

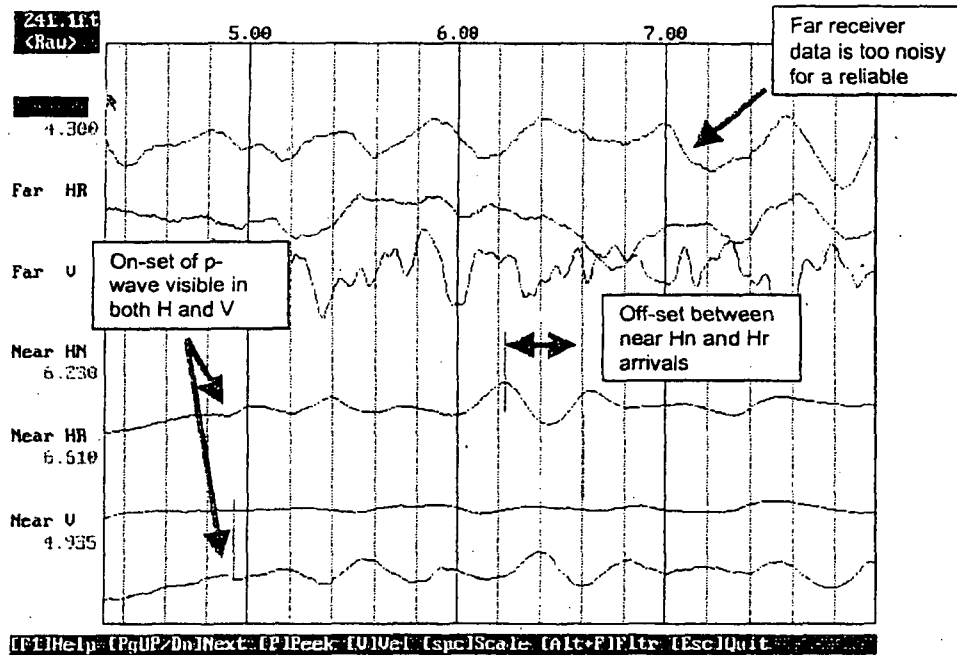
JGD
11-1-00

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p. 58a

JGD
11-1-00

November 1, 2000
jgd

The following figure shows an example from 241.1 ft. The P-wave arrival picked is visible on both near Hn and V. While the near Hr data is poor, the arrival is still visible. The far data is generally too poor for a reliable pick. The offset between near Hn and Hr is not uncommon, particularly in large boreholes (see 1 above).



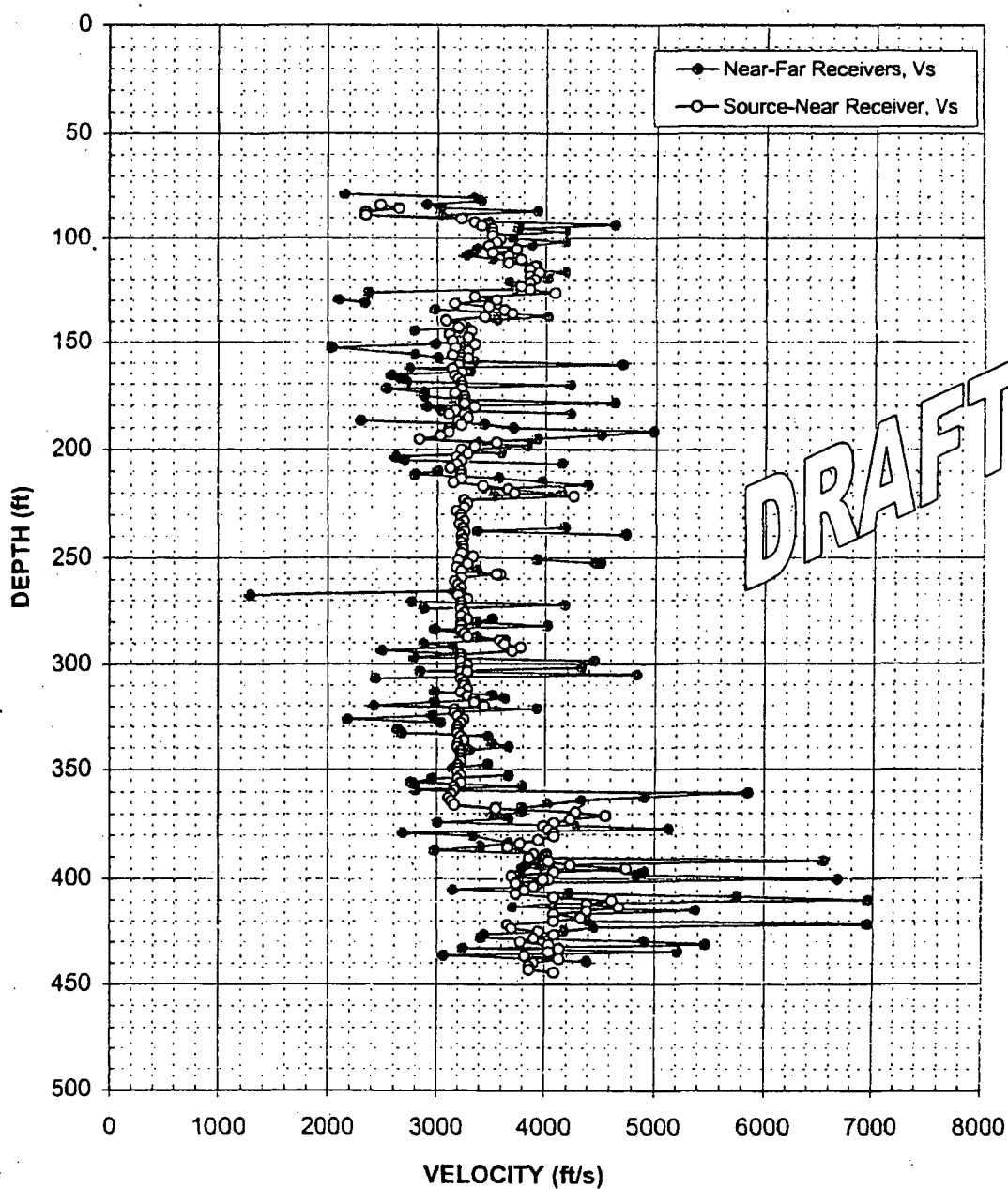
- Even though we have these concerns, here are reasons to believe this data: 1) data above 150ft and below 350ft do not show this response at 6.2ms, 2) the apparatus performed well in subsequent boreholes (see RF-22) so there is no reason to think the equipment malfunctioned, 3) it is possible that when averaged over the distance from source to receiver that a material of consistent properties and consistent fracturing could have very consistent response (consider RF-22); after all, the receiver-to-receiver data shows normally scattered results, 4) alternate "lines of interpretation" lead to much slower velocities in this section that are even less believable, and 5) as stated above, the results are consistent with other data.
 - Nevertheless, we reserve the right to reinterpret this data after repeating these measurements after the borehole has been cased, and (if permitted) conducting downhole measurements in this borehole.
6. We still need to measure r1-r2 in the field with this particular apparatus using the suspension-in-water test we agreed on. This may change the R1-R2 and S-R1 distances measured (now 40 inches and 7.02 ft). This is another reason this data is labeled "draft" and "preliminary".

JGD
11-1-00

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JOD
11-1-00

Yucca Mountain Project Borehole RF-16
Source to Receiver and Receiver to Receiver
Shear Wave Analysis



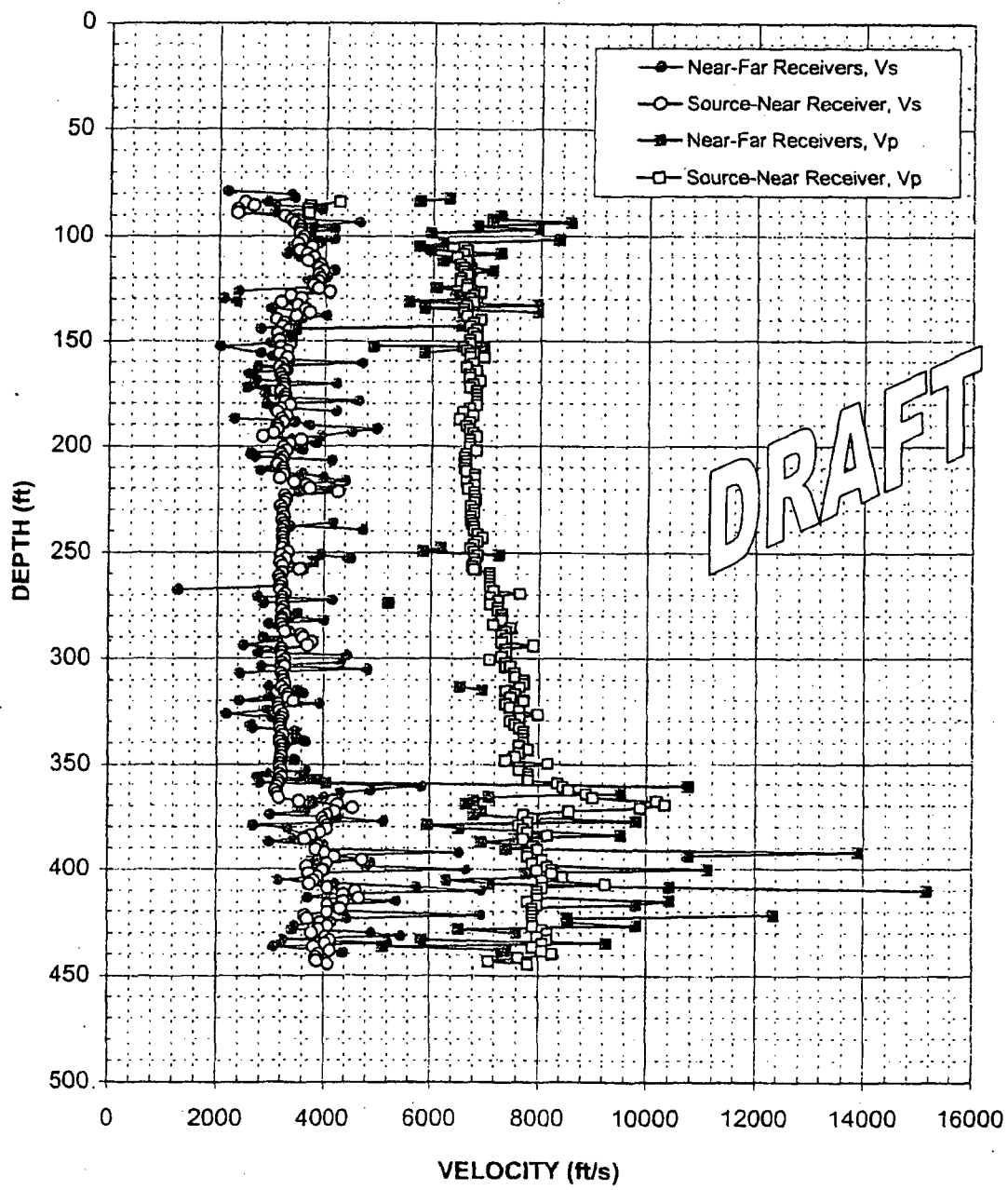
JOD
11-1-00

~~P2~~

p. 59a

JOD
11-1-00

Yucca Mountain Project Borehole RF-16
Source to Receiver and Receiver to Receiver Analysis



60

Y62
11-1-00

November 1, 2000
jgd

DRAFT NOTES ON PROCESSING OF RF-22

1. Large offset between Normal & Reverse could be due to hysteresis in the source, and exacerbated by the large size of the borehole.
2. The large record length used turned out to be non-optimal for the velocity resolution, but was necessitated by the quality of the data. In other words, if in the field the P- and S-wave arrivals are not obvious, it is good practice to collect a longer record length in order to be sure of capturing the data set. But this reduces the accuracy because the sample rate is lower.
3. Data accuracy calculated based on sample interval is compromised by poor quality data, especially noise.
4. We still need to measure r1-r2 in the field with this particular apparatus using the suspension-in-water test we agreed on. This may change the R1-R2 and S-R1 distances measured (now 40 inches and 7.02ft). This is another reason this data is labeled "draft" and "preliminary".

Jgd

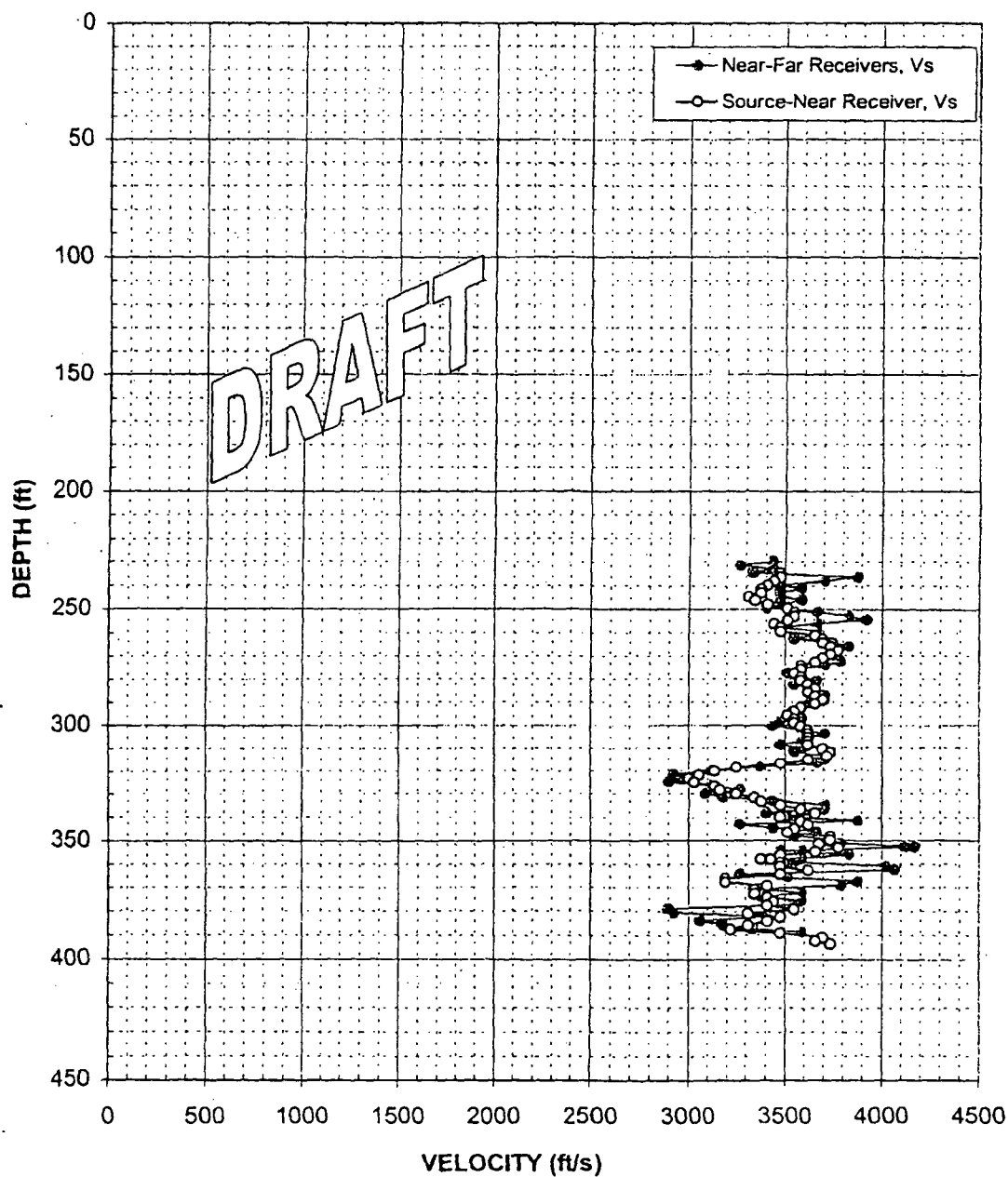
11-1-00

JMD
11-1-00

~~03~~ p. 60a

JMD
11-1-00

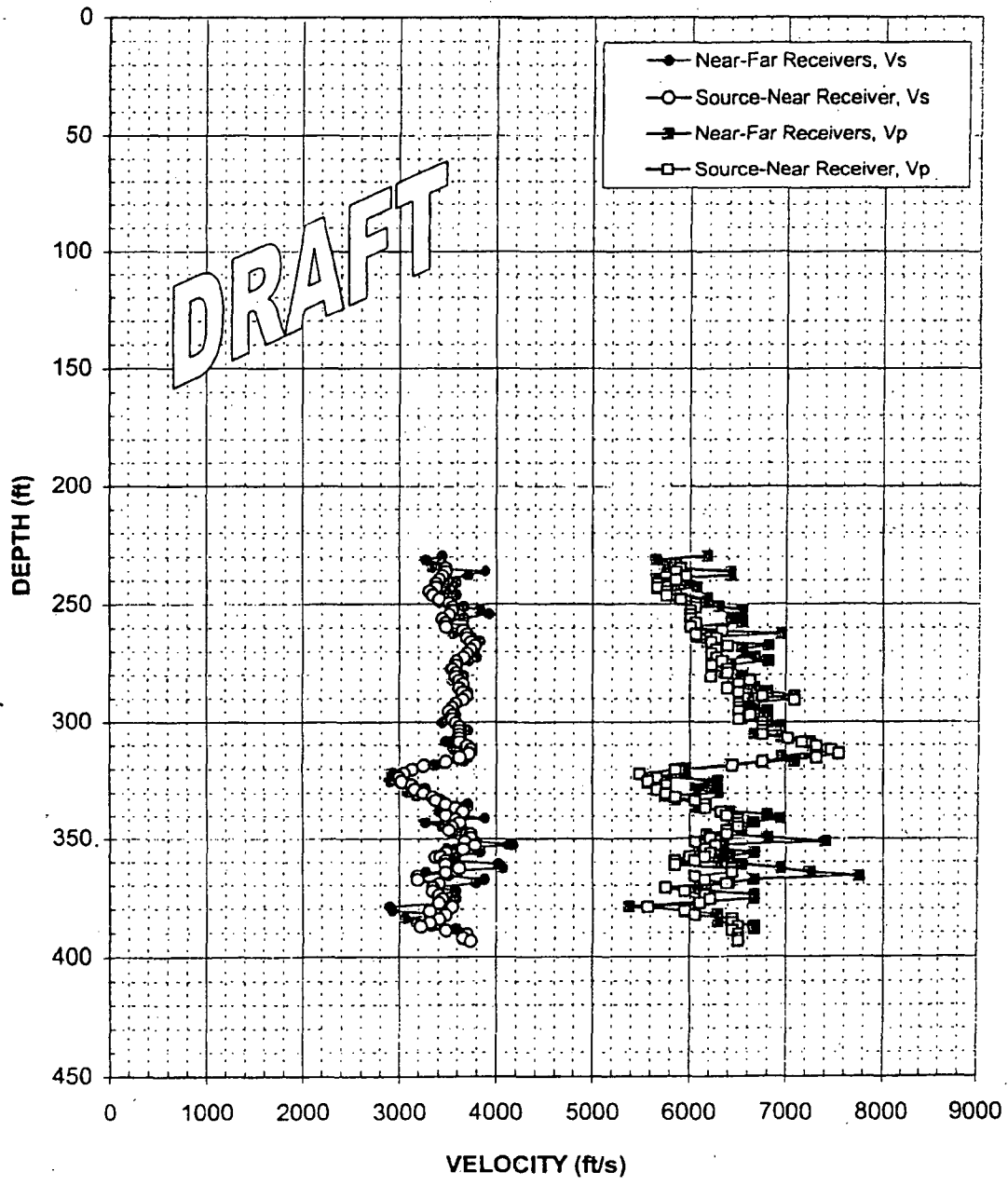
Yucca Mountain Project Borehole RF-22
Source to Receiver and Receiver to Receiver
Shear Wave Analysis



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JOP
11-7-00

Yucca Mountain Project Borehole RF-22
Source to Receiver and Receiver to Receiver Analysis



JGD
11-1-00

~~11~~
p. 61a

11-1-00

NOTE: All these draft results are
in the electronic file referenced in
email this date (see p. 576)

Included are tabular data for
velocity with depth, metric and
standard.

JGD 11-1-00

Page 1 of 1

John Diehl

From: "John G. Diehl" <geovisn.jdiehl@pe.net>
To: <Michael_Luebbers@urscorp.com>
Sent: Monday, November 06, 2000 3:25 PM
Attach: DRAFT NOTES ON PROCESSING OF RF-26.pdf; OYO Data Reduction-Rev031-RF-26-DRAFT.xls
Subject: Re: RF#26 needed ASAP

Here is what I have. Was still refining the P-wave above 80ft, and both P- and S-wave below 200ft. The S-wave data is quite robust down to 210ft, and the P-wave as well between 85ft and 210ft.

Sorry this took longer than expected.

John Diehl
GEOVision Geophysical Services
<http://www.geovision.com>
(909) 549-1234

fax (909) 549-1236

— Original Message —

From: <Michael_Luebbers@urscorp.com>
To: John Diehl <jdiehl@geovision.com>
Sent: Monday, November 06, 2000 9:40 AM
Subject: RF#26 needed ASAP

> I plan on leaving for Yucca Mountain early tomorrow morning. I would like
> to get the promised data for RF#26 early today so I can get it plotted up
> like the others.
>
>

JGD
11-6-00

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JGD
11-5-00November 6, 2000
jgd**DRAFT NOTES ON PROCESSING OF RF-26**

1. Large offset between Normal & Reverse could be due to hysteresis in the source, and exacerbated by the large size of the borehole.
2. The large record length used turned out to be non-optimal for the velocity resolution, but was necessitated by the quality of the data. In other words, if in the field the P- and S-wave arrivals are not obvious, it is good practice to collect a longer record length in order to be sure of capturing the data set. But this reduces the accuracy because the sample rate is lower.
3. Data accuracy calculated based on sample interval is compromised by poor quality data, especially noise.
4. There is, by necessity in this borehole, more reliance on source-to-receiver results than on receiver-to-receiver results. Ordinarily, receiver-to-receiver data is preferred because, even though more scattered, these results are more direct and less influenced by source characteristics. However, sometimes for whatever reasons, the far receiver data can be poor or non-existent. In such cases, the source-to receiver data is still better than nothing, and often quite good.
5. We still need to measure r1-r2 in the field with this particular apparatus using the suspension-in-water test we agreed on. This may change the R1-R2 and S-R1 distances measured (now 40 inches and 7.02ft). This is another reason this data is labeled "draft" and "preliminary".

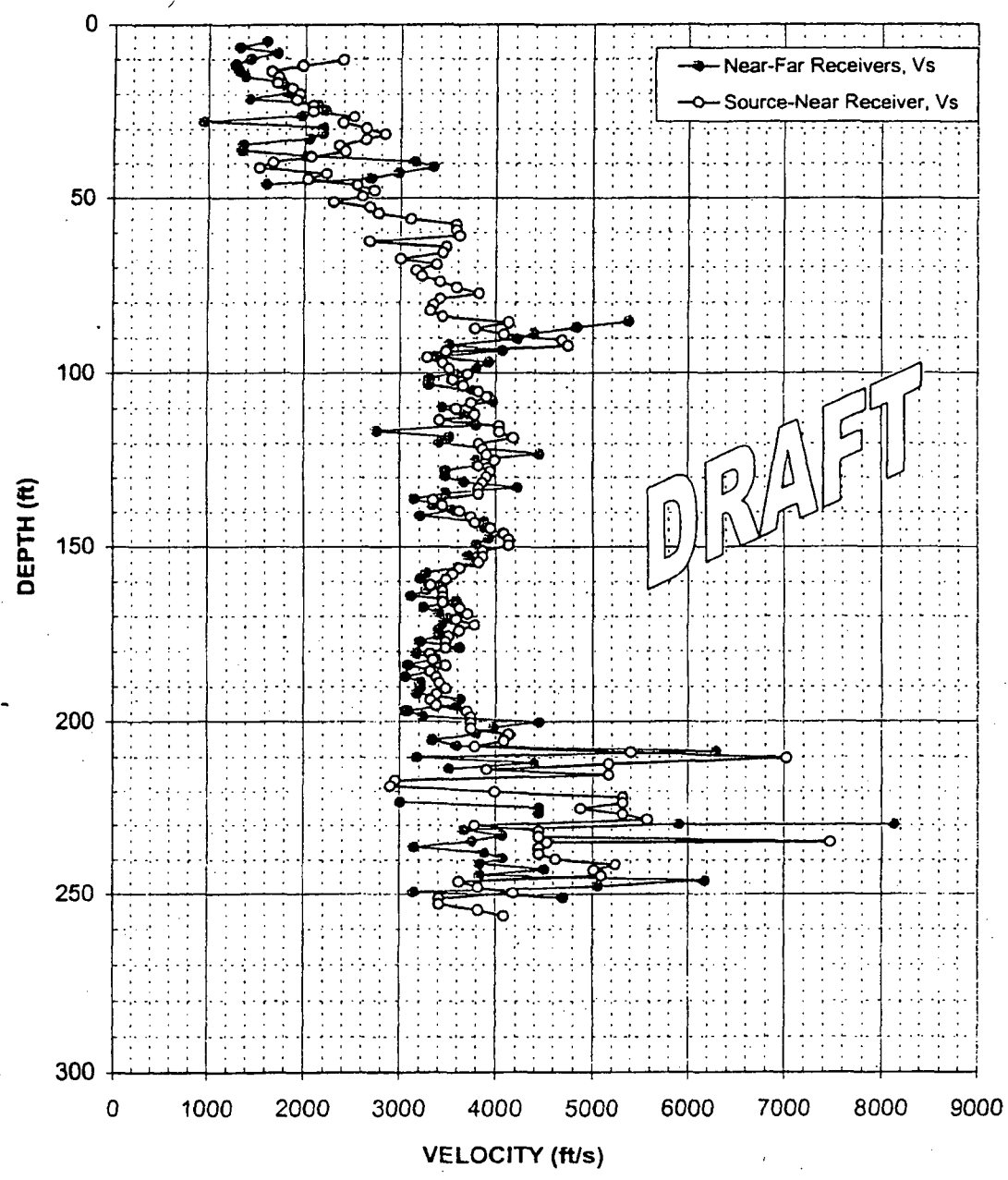
JGD
11-6-00

~~58~~ p62a

JLB
11-6-00

JLB
11-6-00

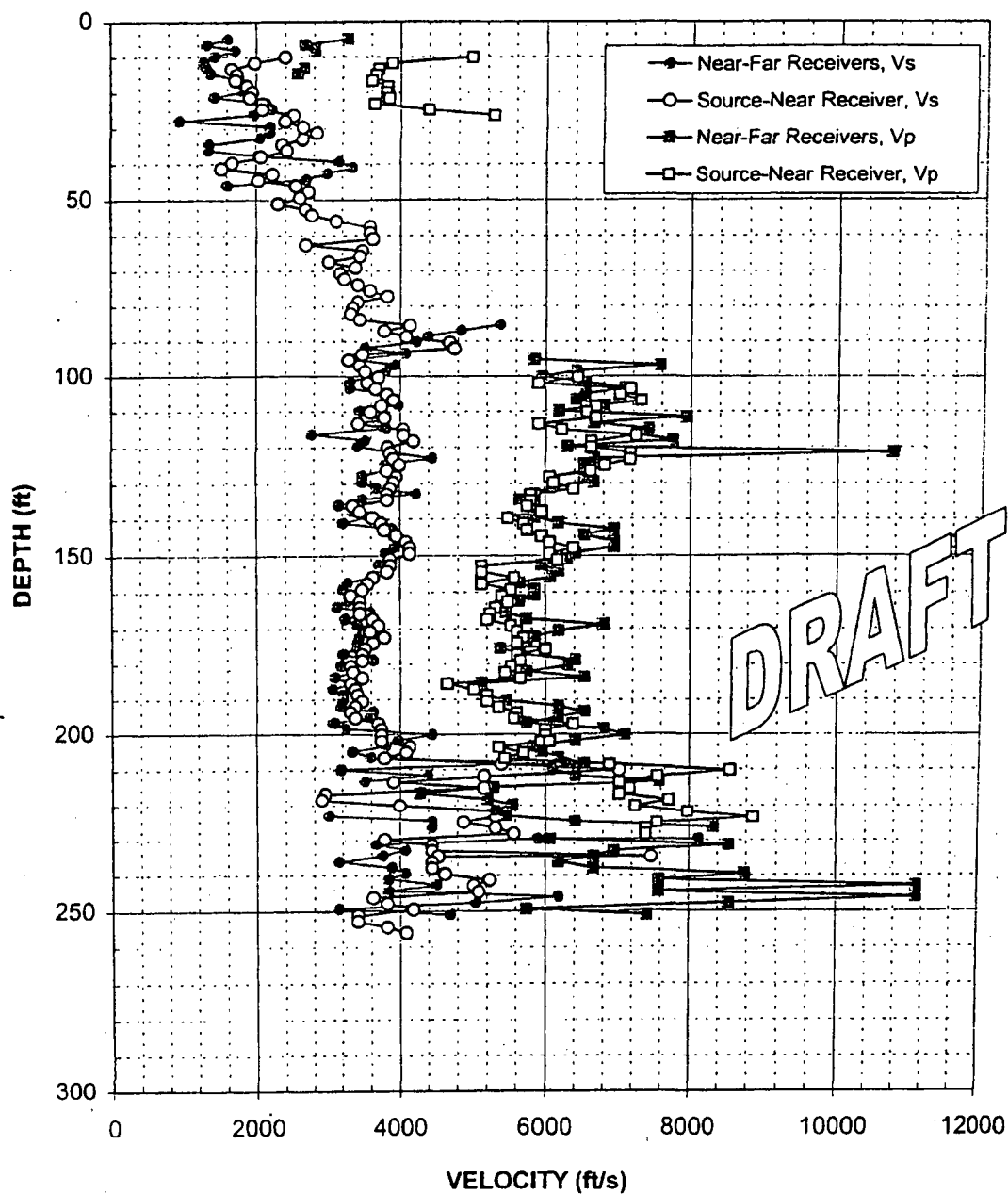
Yucca Mountain Project Borehole RF-26
Source to Receiver and Receiver to Receiver
Shear Wave Analysis



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J60
11-6-00

Yucca Mountain Project Borehole RF-26
Source to Receiver and Receiver to Receiver Analysis



~~28~~ JGD
11-7-00
p. 63a

11-7-00

Comments re:

Data Processing (see also p. 68a
JGD
11-7-00)

1. Software issues are addressed in the initial entry page 4a.
2. The initial entry references p. 183 to 191 of SN-M & O-SCI-015-VI. These pages should have been included following the initial entry, but are reproduced here instead, pages 64-68.

NOTE: most of this information is a reproduction of the procedure already inserted in pages 10-17. However, The Initial Entry requires a copy, so here it is.

JGD 11-7-00

JGD
11-7-00

Job 11-7-00

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183

from

SN-M 40-SCI-015-VI

✓ 60
11-7-00

GE Vision

geophysical services
a division of Blackhawk Geometrics

Memorandum

To: Jon Zeisloft
CC: Mike Leubbers
From: John Diehl
Date: 02/22/00
Re: P-S Suspension Logging Procedures, Yucca Mountain Project

This memorandum confirms our discussion of this date.

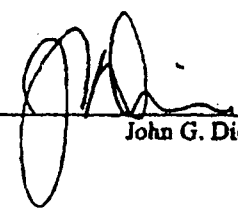
Verification of raw data

The operation of the OYO P-S 170 Suspension Logger ensures that when the operator presses "Enter" to save the file he/she views on the CRT to diskette, only then is the exact same record printed on the paper record. In addition, it is GEOVision's standard procedure for the operator to verify that the printed data on the paper record is what he/she expected (the same as that displayed on the seismograph CRT) prior to moving the probe to the next depth location. This step helps to assure the quality of the data. This procedure has been confirmed and reinforced by adding such a statement to a new version of the OYO P-S Suspension Velocity Logging Method Rev. 1.1 (copy attached, see last sentence, paragraph 4, page 3).

Use of Filtering

Digital filtering is used to assist interpretation of the data. An FFT - IFFT lowpass filter is selected at a frequency at least 10% higher than the maximum frequency of interest in order to remove higher frequency P-wave signal and noise contamination from the S_H-wave signal. This filtering is applied simultaneously and equally to both receiver channels, thereby ensuring that any phase effects by the filter are removed from the velocity calculation, since the elapsed wave travel time is measured between receivers. In other words, if there is a time shift in the waveform because of the filter, it is the same for both receivers, and does not affect the arrival time picks.

Note: The memo reproduced on this page and the procedure it refers to, which are reproduced on pp. 184-191, are part of my entry on p. 182. MK 05-24-00



John G. Diehl, Vice President

64a

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J09 11-7-00

PROCEDURE FOR OYO P-S SUSPENSION SEISMIC VELOCITY LOGGING METHOD

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 Model 170 Suspension P-S Logging system, manufactured by OYO Corporation, is currently the only commercially available suspension system. As shown in Figure 1, the system 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



OYO P-S Suspension Velocity Logging Procedure
Rev 1.1 2/22/00 Page 1

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 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 borehole must be between 10 and 20 cm in diameter, or 4 to 8 inches.

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 Model 170 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.



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Job 11-7-00

URS GEOTECH

PAGE 84

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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.

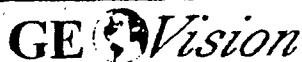
The data from each geophone during each source activation is recorded as a different channel on the recording system. The Model 170 has six channels (two simultaneous recording channels), each with a 12 bit 1024 sample record. The recorded data is displayed on a CRT display and on paper tape output as 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.

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. Final printed data is verified by the operator prior to moving the probe.

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



OYO P-S Suspension Velocity Logging Procedure
Rev 1.1 2/22/00 Page 3

11-7-20

- 2) Paper output records for each measurement as backup showing depth and ID number
- 3) List of record ID numbers (for data on diskette) and corresponding depth
- 4) Diskettes 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

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11-7-00

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, PSLOG automatically calculates both V_s and V_p for each depth. The program allows spreadsheet output for presentation in either charts or tables or both.

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 2/22/00

QA Review [Signature] Date 2/22/00

References:

1. Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.
2. The P-S Velocity Logging Method, R.L. Nigbor and T. Imal, XIII ICSMFE, 1994, New Delhi, India / XIII CIMSTF, 1994, New Delhi, India
3. "Standard test Methods for Crosshole Seismic Testing", ASTM Standard D4428/D4428M-91, July 1991, Philadelphia, PA

OYO SUSPENSION P-S VELOCITY LOGGING SETUP

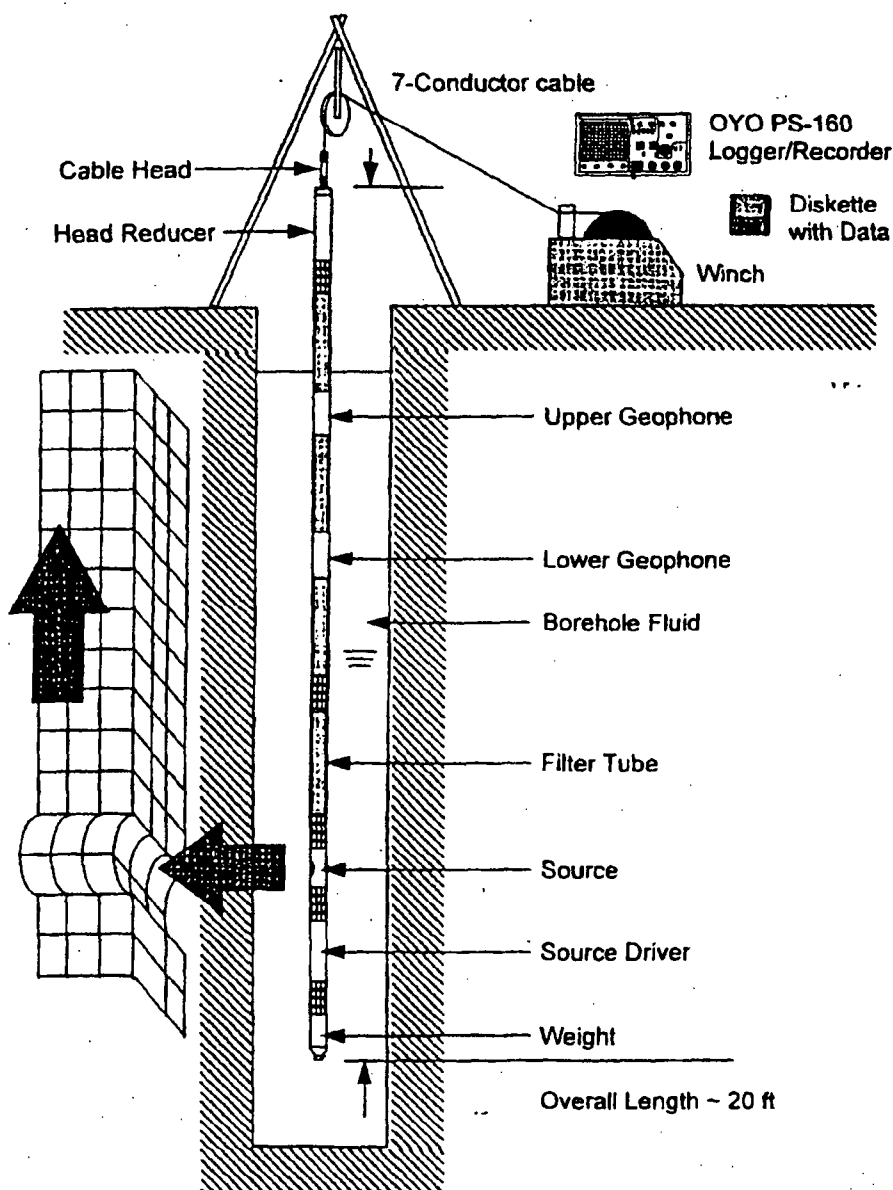


Figure 1. Suspension PS logging method setup

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J60 11-7-00

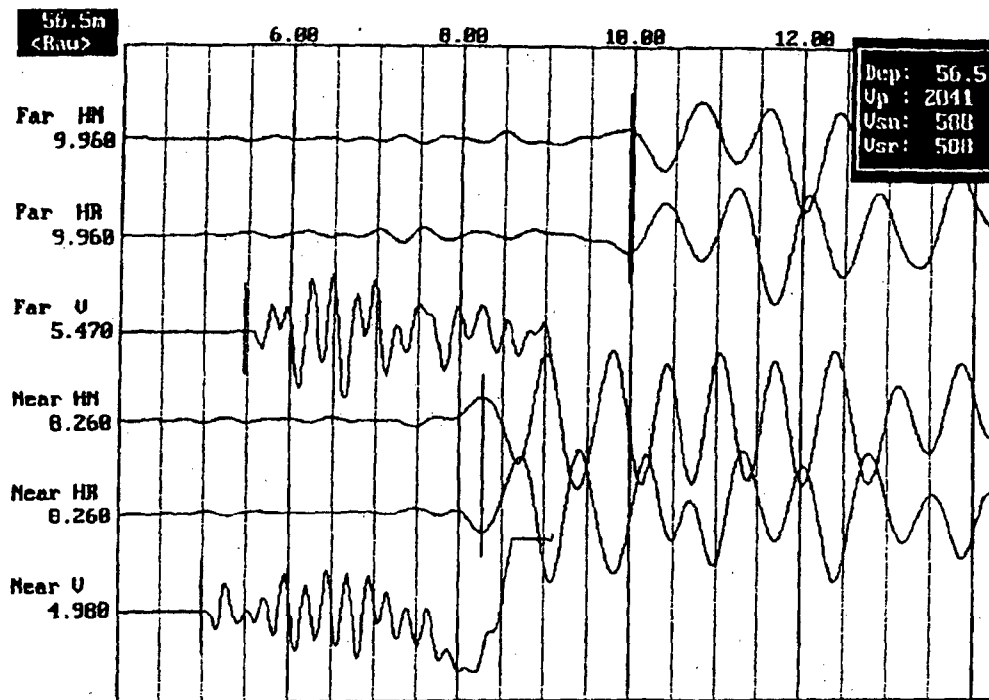


Figure 2. Sample suspension method waveform data showing horizontal normal and reversed (HR and HN), and vertical (V) waveforms received at the near (bottom 3 channels) and far (top 3 channels) geophones. The arrivals in milliseconds for each pick are shown on the left. The box in the upper right corner shows the depth in the borehole and the velocities calculated based on the picks.

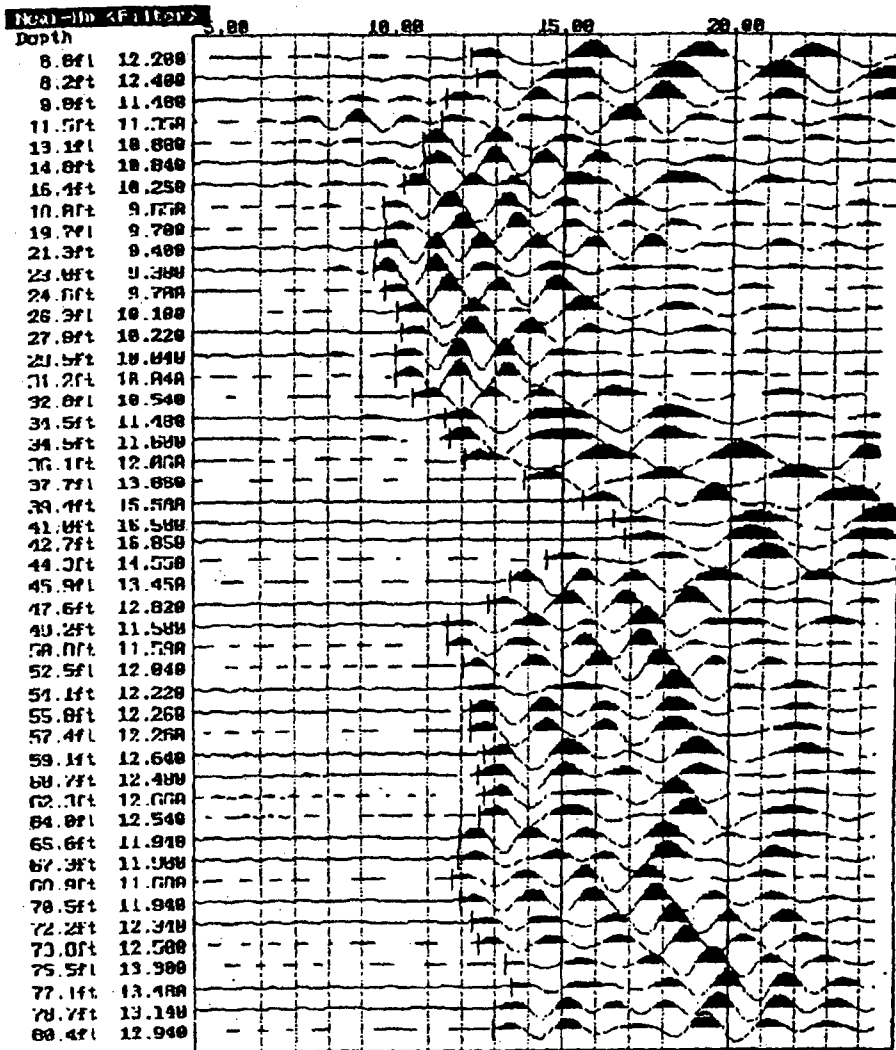


Figure 3. Sample composite waveform plot for normal shear waves received at the near geophone in a single borehole

68a

11-7-00

Further comments on processing of data

1. Initial acquisition procedures to acquire the raw data are fully covered in the field procedure p. 10 of this SN.
2. The raw data is in the form of binary files *.org, one for each measurement depth.
3. These *.org files can only be viewed by proprietary Oyo software. A version of this software is embedded in the test equipment, and is used to view data in the field. The same software also exists separately as PSLOG (p. 4a)
4. PSLOG is used to view the data files and make the arrival picks. It is included on the CDROM accompanying this SN. The operation is very simple but summarized here:

Commands are across the bottom of the screen

- " / " - opens menu
- ← → - arrows pan the menu.
- <Enter> - opens the selected menu.
- <tab> - moves to different fields.

Select the correct directory,
choose the correct *.SPS file.

NOTE: * SPS files are the "pick" files. These are ASCII files that can be opened by almost any program. Columns are labeled Near HR, Far HN etc (reference p. 16a).

* SPS files Titles & Names

sample :

ple: RF14 - RR2.SPS

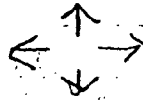
intermediate version
or revision

highest
number is
latest.

means receiver - to - receiver
pick file

Select an *.SAS file and <enter>. First screen is title screen with notes. <Page Down> to see records

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Select a record with  and push "T" to look at trace.

In the Trace view, the vertical white lines are the picks, and the corresponding pick time is on the left.

Move cursor and <enter> to change picks.

<Esc> to go back to table of picks.

Table shows velocities but these are preliminary, since this software assumes exact in spacing between receivers. (See p. 52a).

5. GEOVision used The Excel Spreadsheet

"Oyo Data Reduction - Rev 03. xlt"

provided by URS / Mike Leubbers^{JGD} 11-7-00
(see. p. 19a) Luebbers

Notes on operation of this Spreadsheet are provided in

two places.

- a. in the spreadsheet itself are the procedures for using the program, where to insert the *.SPS files.
- b. I believe Luebbers plans to include a supplement or attachment describing this Excel program. (see p. 19a)

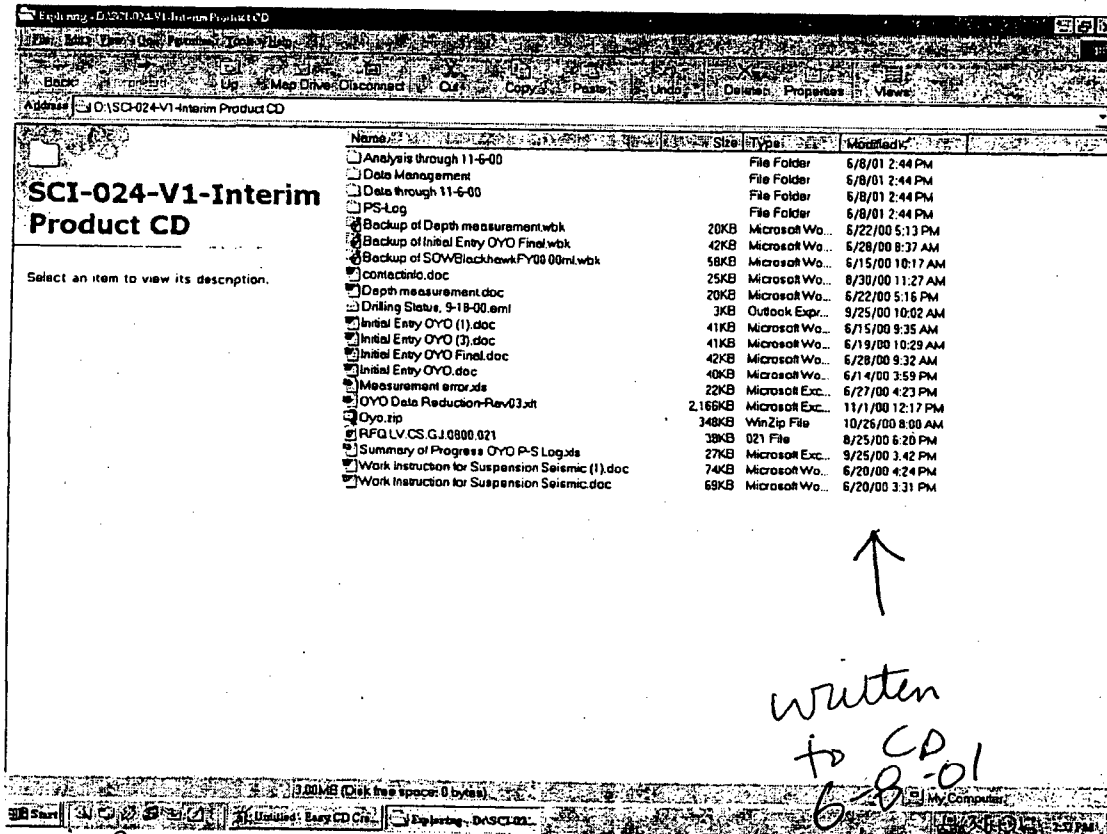
Included with this submittal of this SN is a CDROM containing all the work completed up to this date. Contents include

- analysis results
- data collected
- PS-LOG program
- "OYO Data Reduction - Rev 03. xlt" spreadsheet
- data management results

See next page.

Min 11-7-00

70a



written
to CD
6-8-01
JOD

JOD
6-8-01

END OF SN-M&O-SCI-024-V1
SCIENTIFIC NOTEBOOK

Scientific Notebook Closure Statement

Because this scientific notebook is nearly full, another volume has been opened to continue the work. The continuation volume is it SN-M&O-SCI-024-V2, "Borehole Suspension Seismic Component of Geotechnical Investigation for a Potential Waste Handling Building".

This scientific notebook will be submitted for technical and compliance review as part of the process of closing it out. No more entries will be added except as may be required to respond to review comments.

Michael Luebbers
Michael Luebbers

11-30-00
Date

9-4-01 JMD

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9-4-01 JMD



Cliff_Howard@notes.y
mp.gov

08/20/01 03:33 PM

To: Patricia_Thomas@urscorp.com
cc: Jon_Zeisloft@notes.ymp.gov
Subject: Help with WHB scientific notebooks/records

Patricia,
Work to close out the notebooks associated the WHB started on April 20, 2001 as indicated by the E-mail below. Please include this information as appropriate in the scientific notebooks undergoing closure.
Cliff

----- Forwarded by Cliff Howard/YM/RWDOE on 08/20/2001 03:33 PM

Cliff Howard
04/30/2001 02:46 PM

To: Jose Archuleta/YM/RWDOE@CRWMS
cc: Christian Palay/YM/RWDOE@CRWMS, Andrew Orrell/YM/RWDOE@CRWMS, Mark Peters/YM/RWDOE@CRWMS, Jon Zeisloft/YM/RWDOE@CRWMS, Debbie Zesiger/YM/RWDOE@CRWMS

Subject: Help with WHB scientific notebooks/records

QA:N/A

Exclusionary

Joe,

To review our discussion, there are 12 scientific notebooks associated with the geotechnical characterization and design work supporting the Waste Handling Building foundation design. Most of these were opened by URS who is no longer on the project. The work associated with most of these is nearly closed and the books are starting to be shipped back to me. I'm to look over them, see to it that they are legible and in a condition to pass along to the technical reviewers. I've received a few boxes so far that contain some of the notebooks and related materials. Christian Palay will work with the subcontractors to get the notebooks to me here at YMP. Debbie will find a secure (fireproof if needed) place to keep them. I'd like you or your staff to go through them and see what condition these books are in. Do a preliminary review to see if they are ready to pass along to technical reviewers. If they are ready, I'll forward them out to technical reviewers who are subcontracted to the project. If they are not ready, they'll need to be returned to the authors for more work.
Thanks
for your help.
Cliff

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As directed by Cliff Howard, Responsible Manager for this work, activities towards closing out this scientific notebook began on April 30, 2001. See email above dated 04/30/2001. No technical entries were made following April 30, 2001. Activities to facilitate final technical and compliance reviews began at that time. I consider this scientific notebook to be closed. With the satisfactory completion of any modifications or additional entries to respond to Compliance and/or Technical Reviews, this scientific notebook will be ready for submittal to the Records Processing Center.

Cliff Howard
Cliff Howard, Responsible Manager

8-30-01
Date

9-4-01 JMD

Final entry above to
SW-N&O-SCI-024-VI
JMD 3/11/02