| Identifier: **EP-ERSS-SOP-5030 (was SOP-04.04)** | Revision: **0.0** | Los Alamos NATIONAL LABORATORY EST. 1943 |
|---|---|---|
| Effective Date: **02/09/07** | | |

# Environment & Remediation Support Services

# Standard Operating Procedure

# for CONTRACT GEOPHYSICAL LOGGING

**APPROVAL SIGNATURES:**

| **Subject Matter Expert:** | **Organization** | **Signature** | **Date** |
|---|---|---|---|
| Mark Everett | ERSS | Signature on File | 1/26/07 |
| **Quality Assurance Specialist:** | **Organization** | **Signature** | **Date** |
| Phil Noll | QA-IQ | Signature on File | 12/22/06 |
| **Responsible Line Manager:** | **Organization** | **Signature** | **Date** |
| Dwain Farley | ERSS | Signature on File | 12/22/07 |

## 1.0 PURPOSE AND SCOPE

The purpose of this procedure is to describe the process for obtaining borehole logging data that meets acceptable data quality requirements. The scope of this procedure specifies the data requirements to meet the site characterization and/or subsurface sampling requirements at an Environment & Remediation Support Services (ERSS) work site or project, and as part of a RCRA Facility Investigation (RFI) in accordance with the Order on Consent. This procedure is required to be implemented by all ERSS staff members and subcontractors for ERSS work.

## 2.0 BACKGROUND AND PRECAUTIONS

### 2.1 Background

In ERSS applications, borehole logging techniques are used in situ to determine physical, chemical, geological, and hydrological conditions in an open borehole. Certain borehole logging methods are used inside the well casing after construction. Borehole logs are used to determine formational lithologic makeup and thickness, locate water bearing zones, and to facilitate well design. Borehole data can be used to help solve waste clean-up problems as part of initial site characterization, during remediation, and for post-remediation monitoring.

For accurate results with a given logging system, it is essential that the system be calibrated against accepted standards and monitored for any malfunction or significant drift of the system calibration. In addition, the data must be corrected for nonstandard conditions (i.e., conditions other than those encountered in the calibration).

### 2.2 Precautions

Potential hazards during a logging operation are associated with machinery, electrical devices, radioactive sources, weather, possible contact with contaminants, and other hazards. The hazards associated with the work are described in the Integrated Work Document (IWD) for the scope of work.

Some hazards specific to logging include the following:

- Logging-tool problems (e.g., the tool becoming stuck in the borehole due to a hole collapse, the cable pulling out of the cable head at the tool, contamination of equipment, etc.); and
- Radioactive sources used as components in some logging tools (e.g., high-intensity isotopic or chemical gamma-ray and neutron sources, pulsed-neutron sources, etc.).

## 3.0 EQUIPMENT AND TOOLS

- array induction imager tool (AIT);
- triple lithodensity (TLD) tool;
- fullbore formation micro imager (FMI);
- combinable magnetic resonance (CMR) tool;
- natural gamma tool;
- natural gamma ray spectrometry (NGS);
- epithermal compensated neutron log (CNL);
- caliper;
- mechanical sidewall coring tool (MSCT); and
- elemental capture spectrometer (ECS).

## 4.0 STEP-BY-STEP PROCESS DESCRIPTION

### 4.1 Activities Required Prior to Issuing a Contract for Geophysical Logging

| | | |
|---|---|---|
| Project Leader and Field Team Leader | 1. | Before soliciting contract geophysical logging bids, prepare detailed Borehole Logging Technical Specifications (BLTSs) which must specify the following:<br>• Type of logging system;<br>• Required logging parameters;<br>• Precision;<br>• Data accuracy and repeatability;<br>• Depth accuracy;<br>• Sample interval;<br>• Calibration schedules and requirements; and<br>• Data formats and media.<br>[NOTE: Contract specifications are a part of the Integrated Work Package [IWP] prepared in accordance with procedure EP-ERSS-SOP-5018, Integrated Fieldwork Planning and Authorization, which is required for project work.] |
| Logging Contractor | 2. | Submit Contractor-Specific Logging Procedures (CSLPs) for approval by the Project Leader.<br>[NOTE: The CSLPs must conform to the requirements of this procedure.] |
| Project Leader | 3. | Approve the specific CSLPs submitted by the logging contractor for the logging system proposed for the project work. |
| | 4. | Finalize the logging contract with the help of the Procurement Office. |

### 4.2 Pre-Operational Activities Prior to Logging

| | | |
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| Field Team Leader | 5. | Before the arrival of the logging contractor, do the following:<br>• Obtain approval for property access in accordance with EP-ERSS-SOP-5008, Obtaining Access Agreements for non-DOE-Owned property;<br>• Review the site-specific work plan, and/or IWD and SSHASP, and the BLTSs;<br>• Verify the logging equipment meets the BLTSs; and<br>• Verify CSLPs meet specifications outlined in BLTSs for each logging method to be applied. |
| | 6. | Clear the work site of all brush and minor obstructions (if allowed), and have the location of utilities properly staked and identified. |
| | 7. | Ensure all specific logging equipment to be used on the work is shop calibrated in accordance with EP-ERSS-SOP-5006, Control of Measuring and Test Equipment, within the required time period before the logging operation, as specified in the BLTSs. |
| | 8. | Ensure all logging equipment is shop calibrated, within the required time period before the logging operation, as specified in the BLTSs. |
| | 9. | Ensure all logging equipment is shop calibrated after any repair or modification, even if the equipment is not yet due for a routine shop calibration. |
| | 10. | Ensure all calibrations are within acceptable accuracy tolerances, as defined in the BLTSs. |
| | 11. | Ensure all logging equipment, including cable, cable head, and logging tool, are decontaminated before use in accordance with EP-ERSS-SOP-5061, Field Decontamination of Equipment. |

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| Field Team Leader and Radiation Protection Personnel | 12. | Coordinate with radiation protection personnel, to ensure proper documentation is provided by the Contractor for all radioactive sources that will be brought onto LANL property for geophysical logging.<br>[NOTE: Documentation includes licenses, written documentation of the Contractor's radiation safety program, training certificates, and routine equipment and personnel radiation monitoring results.] |
| **4.3 Conduct Borehole Geophysical Logging Activities** | | |
| Field Team Leader | 1. | Conduct all logging operations in accordance with the requirements in the site-specific work plan, the Integrated Work Package (IWP), the Integrated Work Document (IWD)/SSHASP and this procedure. |
| | 2. | Implement all requirements of the CSLPs. |
| | 3. | Ensure the appropriate radiation monitoring personnel are present to monitor the logging equipment, before it leaves the work site, for contamination and/or leaks. |
| | 4. | Calibrate, or field verify, each logging tool as required in the CSLPs and the BLTSs.<br>[NOTE: The acceptable calibration or verification limits are specified in the BLTSs.] |
| | 5. | Decontaminate the logging equipment between sampling events, as specified in procedure EP-ERSS-SOP-5061, Field Decontamination of Equipment. |
| | 6. | If borehole samples (e.g., water, sidewall-core, or percussion-gun samples) have been collected by the logging contractor, then field screen the borehole materials for hazardous and radioactive constituents. |
| | 7. | If borehole samples contain hazardous or radioactive constituents, process the hazardous or radioactive borehole materials according to procedure EP-ERSS-SOP-5022, Management of Project Waste, and procedure EP-ERSS-SOP-5023, Waste Characterization. |
| | 8. | Complete a Chain-of-Custody/Request for Analysis Form in accordance with EP-ERSS-5058, Sample Control and Field Documentation, for all analytical samples. |
| | 9. | Collect, containerize, and properly dispose of all waste materials and decontamination solutions in accordance with procedure EP-ERSS-SOP-5022, Management of Project Waste. |
| | 10. | Complete Borehole Status Form (see Attachment 1). |
| **4.4 Post-Operation Activities Following the Logging Activities** | | |
| Field Team Leader | 1. | Verify all tools are properly calibrated, and the logging runs covered the specified depth intervals of the borehole. |
| | 2. | Verify log headers are correct and complete, and meet the specifications in the BLTSs. |
| | 3. | Sign and date the Log Header Form (see Attachment 2), as a witness. |
| | 4. | Make at least five (5) paper copies of the field data. |
| | 5. | Make at least one (1) copy of the data in digital form, using one 1) CD with the data in ".las" or ASCII format, as specified in the BLTSs.<br>[NOTE: These field copies are an important part of the data quality record, even though reprocessed data may be submitted by the logging contractor at a later date.] |
| | 6. | Verify all borehole logging equipment is accounted for, decontaminated in accordance with EP-ERSS-SOP-5061, Field Decontamination of Equipment, and ready for transport. |
| | 7. | Verify the site is restored to pre-logging operation conditions, or as specified in the site-specific work plan or IWD. |

| | | |
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| Field Team Leader (Continued) | 8. | Verify the borehole is capped and/or marked, as required by this procedure. |

### 4.5 Records Requirements

| | | |
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| Field Team Leader | 1. | Submit the following records generated by this procedure to the Records Processing Facility:<br>• Hard copies of logging data ("bluelines"), with completed headers, signed by logging contractor representative, and the Field Team Leader or other approved witness, as specified in the BLTSs;<br>• Digital data, as specified in the BLTSs;<br>• A Borehole Log Quality Report (BLQR) for each logging service run, as specified in the BLTSs;<br>• Calibration records, as specified in the BLTSs; and<br>• Completed Chain-of-Custody/Request for Analysis Forms for any borehole samples collected. |

## 5.0 PROCESS FLOW CHART

Flow chart is to be included at a later date.

## 6.0 ATTACHMENTS

Attachment 1: 5030-1 Borehole Status Form (1 page)

Attachment 2: 5030-2 Log Header Form (1 page)

## 7.0 REVISION HISTORY

Author: Rick Lawrence

| **Revision No.** Enter current revision number, beginning with Rev.0 | **Effective Date** DCC inserts effective date for revision | **Description of Changes** List specific changes made since the previous revision | **Type of Change** Technical (T) or Editorial (E) |
|---|---|---|---|
| 0.0 | 02/09/07 | New document number, reformatted and renumbered. Supersedes SOP-04.04 | E |
| | | | |

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## ATTACHMENT 1: BOREHOLE STATUS FORM

**05-0030-1**

**Borehole Status Form**

Records Use only

Los Alamos NATIONAL LABORATORY EST.1943

### BOREHOLE STATUS FORM

**To be filled out by drilling engineer or site geologist**

Logging Date: ___/___/___ Borehole / Well Name: _____

Contractor: _____

Well Status: ☐ Open Hole ☐ Completed ☐ Other _____

Number of Concentric Casing(s): _____ Current Borehole Depth _____

| | | | | | | |
|---|---|---|---|---|---|---|
| **Casing Top Depth** | | | | | | |
| **Casing Bottom Depth** | | | | | | |
| **Casing Inside Diameter** | | | | | | |
| **Casing Wall Thickness** | | | | | | |
| **Casing Type/Material** | | | | | | |
| **Bit Size** | | | | | | |
| **From** | | | | | | |
| **TO** | | | | | | |
| **Cement Plugs** | | | | | | |
| **From** | | | | | | |
| **TO** | | | | | | |

Type of Fluid in Hole: _____ Fluid Level: _____ ft.

Casing Collars: ☐ Yes

Average Spacing: _____ ft.

Shoes: ☐ Yes

Other Materials in Hole:

_____ From _____ To _____ ft

_____ From _____ To _____ ft

Reason for running log:

Comment:

**Form Completed By:** _____ **LANL Observer:** _____

**QA Reviewer:** _____

## ATTACHMENT 2: LOG HEADER FORM

**05-0030-2**

**Log Header Form**

Records Use only

Los Alamos NATIONAL LABORATORY EST 1943

# LOG HEADER FORM

Fill out one form for each logging run

Logging Date: __/__/__ Borehole / Well Name: _____

Contractor: _____ Operator: _____

Run Number: _____ Logging Vehicle Number: _____ ☐ LANL Logging Trailer

Log Type:

☐ Gamma Ray
☐ Gamma-Gamma Density
☐ Resistivity

☐ Temperature
☐ Fluid Flow
☐ Induction

☐ Hole Deviation
☐ Acoustic (Sonic)
☐ Spontaneous Potential

☐ Neutron
*Calibration Matrix:*
☐ *Dolomite*
☐ *Limestone*
☐ *Sandstone*

☐ Borehole Video
☐ Caliper
*Number of Arms*_____

☐ Other_____

Electronic File Name: _____ Format: _____

Null Value (*If Applicable*): _____

Start Time: _____ End Time: _____

Measuring Point Description: ☐ GL (Ground Level) *Default to Ground Level when suitable*
☐ Other _____

Measuring Point Relative to Ground Level: ft

Log Run Through: ☐ Casing ☐ Annular Space ☐ Tremie ☐ Open Hole

Bottom Log Depth: ft Top Log Depth: ft

Uniform Logging Speed? ☐ No Logging depth increment: _____

Quality of Log: ☐ Good ☐ Fair ☐ Poor

Quality Comment (*Required for Fair or Poor*):

Calibration Note:

Logger Remarks:

**Form Completed by:**

**LANL Observer:** _____

**QA Reviewer:** _____