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ACTIVITY/PROJECT SPECIFIC PROCEDURE

SP 13-4
LOGGING AND MANAGEMENT OF CUTTINGS AND OTHER ROCK SAMPLES AT THE SURFACE
Revision 1

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1.0 Purpose and Scope

This procedure describes the processes that guide in the collection, description, and (as appropriate) preservation of geologic samples and data by Sandia National Laboratories-Carlsbad Programs Group (SNL-CPG) personnel or contractors during, or in conjunction with, drilling of boreholes from the surface. This procedure only applies to work related to the Waste Isolation Pilot Plant (WIPP) programs carried out by (SNL-CPG). This procedure applies specifically to geologic samples such as cuttings. Specific requirements for dealing with core samples may be included in the future, if needed. Any incidental fluid samples (i.e., drilling fluids or encounters with groundwater, brine, etc.) will be non-QA information or will be obtained under appropriate procedures. This procedure also describes documentation regarding geologic samples and related information acquired during the drilling of a drillhole from the surface. Templates for recording information are provided that are somewhat generalized and can be modified as needed to meet any requirements that subsequently develop.

The Principal Investigator (PI), or designee, will outline the logging and management requirements in the work control documents (i.e., test plan, work package) for tests that require the extraction of core and will determine which core samples will require logging and management. The work control documents should reference this procedure for specific QA requirements.

NOTE: In the remainder of this document, the use of the term “PI” includes their delegate.

The PI whose activities warrant the use of this procedure is responsible for implementing the requirements of this procedure, and for assuring that the latest revision of this document is followed.

Acronyms and definitions for terms used in this procedure may be found in the Glossary located at the Sandia National Laboratories (SNL) WIPP Online Documents web site.

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2.0 Implementation Actions

2.1 Cuttings and Miscellaneous Rock Samples

The most common rock samples collected while drilling are cuttings returned to the surface during auguring or drilling. They are ordinarily collected using a sieve at the point where auguring returns material to the surface, or at a flow point for circulating air, air and fluid, or another drilling fluid. More sophisticated systems for monitoring cuttings and hydrocarbons used during oil and gas exploration are not used for these shallow wells at the WIPP.

Cuttings are collected to represent the rock intervals encountered by one of two systems: 1) at intervals, or 2) as a composite sample of an interval. While either system has value, a single system should be designated for each drillhole that best suits the purposes of the drillhole. Collecting samples at intervals is better at showing differences with depth, while a composite sample more likely represents all the lithologies of an interval. Drillholes more recently completed as wells for WIPP (SNL-series), used sampling at regular intervals modified by additional sampling at significant lithologic changes. Whether collected as composite samples over an interval or limited samples at particular depths (e.g., 20 ft intervals), the interval can be modified over the course of drilling a well to reflect data needs. Sampling intervals in recent wells have typically been between 10-20 ft for the redbed sequence above the Rustler Formation, and 10 ft for the Rustler Formation itself. Where or when core is not taken through intervals (e.g., Culebra Dolomite Member of the Rustler Formation), sample intervals may be shortened (e.g., 5 ft). While a sampling frequency may be generally established prior to drilling, the on-site geologist has the responsibility for selecting appropriate sample depths.

Occasionally, miscellaneous lithologic samples may be taken to supplement drillhole data. Some sources might be nearby trenches, excavated mudpits, or outcrops. The shallow subsurface rocks encountered while auguring or drilling and for setting surface conductor casing are most likely represented by such miscellaneous samples.

All personnel who use this procedure will have current training to the elements of the SNL-QA program applicable to the work being performed.

2.2 On-site Description of Cuttings, Cores, or Other Geologic Data

Drillhole geology is described mainly on-site as cuttings and cores are collected. Some form of “strip log” is developed with an appropriate vertical scale (10-20 ft/inch is common). Essential information includes depth and lithology, along with appropriate data about the drillhole, dates, and responsible parties involved. There are many forms of such logs, ranging from verbal description to checklists. The responsible geologist shall choose the format and it will be used for any drillhole. A useable form is attached to this SP.

Lithologic information recorded exclusively on any drillhole should include: 1) rock name with the appropriate modifiers (eg., Dolomite, sandy), 2) color(s) determined employing either the Munsell Soil Color Chart, or the Munsell Rock Color Chart (note: color notation will include if the color was determined while the sample was wet or dry, 3) grain size and grain sorting determination, 4) a description of inherent sedimentary structures, such as bedding, cross-stratification, imbrication, bioturbation and/or other observable features with scales as appropriate, 5) secondary features including diagenesis, cementation and the degree of lithification or induration, 6) the nature of unit or bedding contacts (e.g., sharp, undulatory, gradational), and 7) thickness or depth interval for the descriptive unit. The detail of this information will vary due to recovery percentage differences of each sample and the inherent nature of the samples (e.g., very-fine cuttings versus coarse chips or core).

Numerous ancillary observations are possible but not predictable for any individual drillhole. These include tool drops (cavernous porosity), thin zones of hard drilling (e.g., common in the upper Dewey Lake Formation), depths where drilling rates change and moist or wet cuttings when drilling with air. The on-site geologist can note these observations on the geological strip log or on other forms as appropriate.

Field observations generally are made macroscopically or with simple tools or aids. Standard tools include: 1) a rock hammer, 2) a 100 ft tape with decimal units, 3) a hand lens, 4) mild acid (~10% HCl), 5) a Munsell Soil or Munsell Rock Color Chart, 6) sample bags, 7) squirt bottle(s), 8) strainers (each attached to a hefty stick with duct tape), 9) sample washing bucket(s), and 10) templates or gauges for features such as grain size and grain sorting. The same templates, gauges or color charts will be used by all geologists assigned to any particular drillhole for maximum consistency. While other tools (e.g., binocular microscope) may be used as available or desired, the pace of drilling and sampling in the field may not allow regular use. Numerous other tools (e.g., petrographic microscope, X-ray diffraction) may be applied to extend the basic geologic data under specific procedures for those tools.

Cuttings may require some cleaning for best description. The two most common ways are with fresh water or with fresh brine. Fresh water is generally preferred, but fine cuttings from halite-bearing beds may require using brine or very limited fresh water. Samples may be examined wet and/or dry, but samples should be reasonably dry before storing, especially if the bagging material is relatively air-tight. A small amount of each sample will be temporarily placed on the examining table in order to better compare the lithology without having to reopen sample bags.

2.3 Geophysical Logs

Geophysical logs provide a record of various responses of the rocks that can be interpreted independently in terms of the gross lithology as well as some properties of the rock (e.g., Doveton, 1986). Some logs (e.g., natural gamma), record physical phenomena that require no external stimulus. Others (e.g., acoustic, density, neutron, resistivity) measure the response of the rock or a rock interval to an external stimulus. There are numerous specialized tools, but a more standard suite provides the basic information normally needed for WIPP studies.

The priority information acquired from geophysical logs for WIPP include definition of depth and thickness of stratigraphic units, lithology, identification of zones or units that include water, wellbore conditions, and information bearing on the hydraulic properties of units or zones. The natural gamma log is common to most geophysical logging as a standard between logs of depth to stratigraphic contacts and as a useful partial indicator of lithology. The neutron log reflects the abundance of hydrogen and, in beds without hydrocarbons, is therefore an important indicator of porosity and water. Either a density log or an acoustic velocity (sonic) log is an excellent complement to the natural gamma and neutron logs for more detailed interpretation of lithology with depth. For an indicator of the porosity and salinity of the units in a drillhole, resistivity logs (especially the laterolog) are useful. The neutron, acoustic, and density logs should be run with a caliper log to permit compensating for borehole diameter variations (e.g., borehole compensated density or borehole compensated acoustic logs). A caliper log may also be run or used to calculate volume of the annulus outside of the casing to be installed in a monitor or pumping well.

The standard suite of logs, to be modified as needed, is:
- Natural gamma
- Caliper
- Borehole compensated density or acoustic (sonic)

● Neutron (compensated, if practical)
● Resistivity (dual laterolog, or laterolog with multiple depths of investigation)

Possible additional logs include:
● SP (spontaneous potential)
● Density log through casing

Default log parameters for display on printed or electronic files are 100 API units for natural gamma and 2.0 to 3.0 for density. Other logs may be displayed according to the range that is found through logging. Copies of printed logs are required for records and field interpretation. Electronic files should include some standard display version (e.g., .pdf, or WellCad or other proprietary software with a reader), a text format for utilization with other software, and an (.las) format that is readable by different specialized software. Field checks during and after logging include proper name for the well, location, reference elevation if available, reference point for logging, and header information for each log type.

2.4 Photographs

Photographs of cuttings may be taken, but they are not required. Photographs are most commonly desired when logging core. A record of sample photographs, identified with respect to drillhole, sample depth and stratigraphic unit, shall accompany electronic files that are suitable for submission as permanent records. Non-quality photography of the drillhole location, activities, and any materials (e.g., casing) are useful to illustrate the activities at the drillhole as described in a basic data report or other record of the drillhole.

2.5 Storage and Retention of Samples and Records

It is useful to record two additional kinds of records during drilling: 1) drilling-related actions, and 2) general daily activities. The drilling-related activities may include, but are not limited to: 1) drilling time (e.g., time at which depths are reached), 2) sampling intervals and times, 3) any drill bit drops, circulating fluids and adjustments, 4) intervals of non-drilling activities (e.g., time of adding joints or repairs), and 5) materials used in completion of the well or in plugging the drillhole. Some general daily activities that may be useful include: 1) total water or brine used during a day, 2) loss of circulation intervals, 3) well development, 4) measurement of fluid levels to understand production in the drillhole or loss of fluids, and 5) personnel on site. These records will be kept within a scientific notebook(s) and/or in associated forms. A standard form for recording depth, time, samples, and related information is included in this SP (Appendix A).

Other useful records could include letters, memoranda, or reports that specify objectives of the drillhole, decision-making regarding drilling and completion of the well, and records of sample transmittals and retention. If a mud rotary system is employed, it is a good idea to closely monitor the mud properties (density, mud cake, pH, sand content, etc.) and input this information in the remarks section of the Core/Cuttings Log Form SP 13-4-1 (see Appendix A of this SP).

Other records from the drillhole may be submitted for retention in the Records Central. These may include various media that preserve electronic files of reports, photographs, geophysical logs, and other records kept in the field, including original paper documents as needed.

Each drillhole or related set of drillholes will be described in a form of a basic data report that shows the objectives of the drillhole, geology of the rocks encountered, any indications of water encountered during drilling, and completion or plugging of the drillhole. These may vary from letter report, memorandum, or SAND report, depending on the significance of the drillhole for WIPP activities. A

basic data format has been established for more recent drillholes (SNL-series) that may be taken as a template as needed.

2.6 Safety

Cuttings sample logging, storage, requisition, and shipping activities performed at the WIPP site shall conform to Environment, Safety, and Health (ES&H) requirements governed by the latest revision of WIPP Procedure 12-IH.01 *WIPP Chemical Hygiene Plan,* WIPP Procedure WP 12-IH.02 *WIPP Industrial Hygiene Program,* and WIPP Procedure WP 12-IS.01 *WIPP Industrial Safety Program.*

Cuttings sample collection and logging activities performed at other facilities shall conform to the facility ES&H requirements and as a minimum to the requirements of the *SNL ES&H Manual.*

Cuttings samples acquired by standard drilling operations (air or brine cutting fluid) are classified as non-hazardous material. These small quantities (less than 10 lb) of obsolete or used WIPP cuttings samples may be disposed of via the normal facility trash disposal operations. Contact the SNL ES&H Coordinator or designee for guidance.

3.0 Records

The following records, generated through implementation of this procedure, shall be prepared and submitted to the Records Center in accordance with NP 17-1 (Records):

<u>QA Record</u>

- Core/Cuttings Log (Form SP 13-4-1)

<u>Non Quality (NQ) Record</u>

- Any electronic media

4.0 Appendices

Appendix A: Form SP 13-4-1, Core/Cuttings Log

Appendix A

ACTIVITY/ PROJECT SPECIFIC PROCEDURE Sandia National Laboratories	**Core/Cuttings Log**	**Form Number:** SP 13-4-1 **Sheet** _____ **of** _____

Hole ID: _____	**Location:** _____	
Drill Date: _____ **Drill Crew:** _____ _____ _____	**Drill Method:** _____ **Hole Diameter:** _____ **Hole Depth:** _____ **Hole Orient:** _____	**Drill Make/Model:** _____ **Barrel Specs:** _____ **Drill Fluid:** _____ **Core Preserv:** _____
Logged by: _____	**Date:** _____	**Scale:** _____

	Northing	Easting	Elevation
Survey Coordinate: (Ft)			

Comments:

Run Number	Depth ( )	% Recovered	RQD	Profile (Rock Type)	Description	Remarks

ACTIVITY/ PROJECT SPECIFIC PROCEDURE Sandia National Laboratories	**Core/Cuttings Log** **(Continuation Sheet)**	**Form Number:** **SP 13-4-1** **Sheet _____ of _____**

Hole ID: _____ **Location:** _____

Logged by: _____ **Date:** _____

Run Number	Depth ( )	% Recovered	RQD	Profile (Rock Type)	Description	Remarks

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