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Environment & Remediation Support Services

Standard Operating Procedure

for **SUBSURFACE MOISTURE MEASURING USING A NEUTRON PROBE**

APPROVAL SIGNATURES:

Subject Matter Expert:	**Organization**	**Signature**	**Date**
John Hopkins	ERSS	Signature on File	12/05/06
Quality Assurance Specialist:	**Organization**	**Signature**	**Date**
Phil Noll	QA-IQ	Signature on File	12/7/06
Responsible Line Manager:	**Organization**	**Signature**	**Date**
Craig Eberhart	ERSS	Signature on File	12/6/06

1.0 PURPOSE AND SCOPE

The purpose of this procedure is to describe the process used to make subsurface moisture measurements using a neutron probe in the Environment & Remediation Support Services (ERSS) Division of the Los Alamos National Laboratory (Laboratory). The scope of this procedure applies to all ERSS work at Nuclear Environmental Sites (NES) and non-NES.

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

This procedure is used with an approved Integrated Work Document (IWD) or a Site-Specific Health and Safety Plan (SSHASP) for controlling work in the field. The IWD or SSHASP may be part of a larger scope project which is controlled by an Integrated Work Package (IWP).

2.2 Precautions

The neutron probe emits ionizing radiation from a sealed, registered source. The neutron probe is subject to all special nuclear materials control requirements specified in LIR 402-700-01.2, Occupational Radiation Protection Requirements.

Exposure to the neutron probe should be limited as follows:

- Keep the probe as far away from the body as possible when it is necessary to remove the probe from the housing for any reason.
- Minimize the length of time the probe spends on the surface when it is unshielded by the surface assembly.
- Transport the neutron probe instrument in its case by the handle.
- Require personnel not involved in the probe's operation to maintain a minimum distance of 10 feet from the probe, when the probe is not down-hole.
- In general, minimize both the number of individuals near the probe, and the time individuals spend near it.

Do not transport or use neutron probes with any observed or suspected damage, until the Source Custodian, HSR-1, and HSR-12 verify the integrity of the neutron source.

In the event of a stuck probe or emergency, contact HSR-1 and HSR-12 using the contact information provided at the pre-job briefing.

The neutron probe and cable are designed for use in vertical access holes. As designed, the instrument is placed over a borehole, or access tube casing, and the probe and cable are deployed directly from the surface assembly into the subsurface. When used in this way, do not remove the probe from the surface assembly, or handle the probe directly.

The moisture probe may also be used in angle holes and horizontal access holes. When used in this type of access hole, the probe is removed from the surface assembly. Deployment of the probe may be possible, using gravity, if the access hole has a steep enough angle. However, shallow angles and horizontal holes require additional measures for successful probe deployment. These measures may include towing the probe with a cable or rope, deployment with rods, or deployment using positive-pressure, averting membranes. [NOTE: This procedure does not permit neutron probe deployment by any means other than gravity.]

The cable is marked in 1-foot increments, but the first mark on the cable indicates a depth of 2 feet. This marking assumes the direct deployment of the probe and cable from the surface assembly, and takes into account the 1 foot height of the surface assembly itself.

When the probe is not deployed from the surface assembly, the Logging Technician must add 1 foot to the depth indicated on the cable (e.g., if the cable increment reads 20 feet, record a depth to the probe of 21 feet).

The use of cables different from the cable matched to the neutron probe instrumentation assembly, may require specifying correction factors to derive the correct depth of the probe from the surface.

3.0 EQUIPMENT AND TOOLS

- Neutron Probe CPN 503DR; and
- Cable (depth incremented cable compatible with the CPN 503DR Neutron Probe)

4.0 STEP-BY-STEP PROCESS DESCRIPTION

4.1 Verification of Neutron Probe Operator Authorization

Project Leader or Field Team Leader	1.	Ensure the Neutron Probe Operator is authorized by verifying the following: • Completed Laboratory Radiation Worker Training (Level I or II); • Completed on-the-job training to this procedure; and • Correctly wearing an Albedo-type Dosimeter. [NOTE: Dosimeters are issued by HSR-4.]

4.2 Daily Field Standard Count

[NOTE: The standard count serves as an instrument check to ensure that the instrument source, detector and electronics are operating within the manufacturer's specifications.]

Operator	1.	Perform and document the daily field standard count at the beginning of each day of field measurements, using the following sequence of steps.
	2.	Place the carrying case on the ground.
	3.	Verify no other radioactive sources are within 30 feet.
	4.	Verify no significant sources of hydrogen (e.g., people) are within 10 feet.
	5.	Remove the moisture probe from the carrying case.
	6.	Place the probe on the metal plate located on the lid of the carrying case.
	7.	Attach the cable to the probe.

Operator (Continued

8. Attach the cable to the surface assembly.

9. Ensure the display panel on the instrument reads “Ready”.

10. If not, press “Clear”.

11. Press “Std” on the instrument keypad; the instrument displays the stored current standard count.

12. Press “Step”; the instrument displays the stored previous standard count.

13. Press “Step” again; the instrument displays the “Xi” value for the stored standard count.

14. Press “Step” again; the instrument displays “NEW STD?”.

15. Press “Enter,” which is equivalent to “Yes”. [NOTE: The instrument now collects 32 counts and averages them. This is the standard count. When the count is complete, the instrument displays “S ####,” where “####” is the standard count.]

16. [CAUTION: STAND BACK AT LEAST 10 FEET DURING THE STANDARD COUNT.]

17. Press “Enter” to store the standard count.

18. Press “Step”; the previous standard count is displayed.

19. Press “Step” again; the current Xi value is displayed, and

Standard Count Function Check

If . . .	**Then . . .**
The Xi value is not between 0.75 and 1.25,	Repeat the process above.
The Xi value is between 0.75 and 1.25,	Proceed to Step 21
The instrument consistently returns Xi values outside of the acceptable range.	Do not use the instrument; the instrument requires servicing by the manufacturer.

20. Record the standard count, the previous standard count, and the Xi value in the logbook.

[NOTE: Pressing “Clear” at any time during the standard counts aborts the standard count. Use “Clear” to clear the instrument display and return to the “Ready” mode. A small black dot in a corner of the display panel indicates a low battery; recharge the moisture probe overnight before use.]

4.3	**Preparation of Instrument for Field Measurements**	
Operator	1.	Calculate moisture content in spreadsheets, which employ the applicable calibration.
	2.	Set the instrument to return raw counts as follows: • Press “Units” on the instrument keypad; • Press “Step” until the display reads “CNT”; • Press “Enter” on the instrument keypad; the instrument returns to the “Ready” mode.
4.4	**Field Measurements**	
Operator	1.	Follow the steps below to take field measurements.
	2.	Lower the probe through the surface assembly with the cable to the desired depth.
	3.	Press “Start” on the instrument keypad; the instrument counts for 16 seconds. [NOTE: At the “beep”, the instrument displays the value for that depth.]
	4.	Record the measurement on a Field Logbook Entry Form (see Attachment 1).
	5.	Repeat the steps until all of the required measurements are complete.
4.5	**Field Measurement Documentation**	
Project Leader	1.	Ensure all field personnel who are assigned field notebooks read and implement the requirements before documenting assigned tasks in any technical notebooks.
Operator	2.	Record the following information on a Field Logbook Entry Form: • Field technician; • Date; • Location ID; • Standard count; • Previous standard count; • Xi value; • Surface casing stick-up (if any); • Access hole diameter; • Casing type (e.g., PVC); • Casing depth; • Access hole total depth (below top of casing); and • Data with units identified (i.e., raw counts) versus depth below top of casing.
	3.	Close out the logbook.

4.6 Records

Project Leader	1.	Submit the following records generated by this procedure to the Records Processing Facility: • Completed Field Logbook Entry Forms.

5.0 PROCESS FLOW CHART

Flow chart is to be included at a later date.

6.0 ATTACHMENTS

Attachment 1: 5040-1 Field Logbook Entry Form (1 page)

7.0 REVISION HISTORY

Author: Ken Kisiel

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-07.05	E

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ATTACHMENT 1: FIELD LOGBOOK ENTRY FORM

5040-1

Field Logbook Entry Form

Records Use only

Los Alamos NATIONAL LABORATORY EST. 1943

Date:	**Logging Technician:** _____ **Printed Name/Signature** **Date**		
Location:		**Access Hole ID:**	
Casing Stick-up:	**Casing Diameter:**	**Casing Depth:**	
Casing Type:		**Standard Count:**	
Previous Standard Count:		**Xi:**	

Depth (ft) Below Top of Casing	Counts	Depth (ft) Below Top of Casing	Counts

Comments: