

BTP-SMF-008: REV1 DRAFT

FIELD LOGGING, HANDLING, AND DOCUMENTING BOREHOLE SAMPLES

NOTES

This "Information Copy" indicates changes made to BTP-SMF-008 Rev 0, (approved 7/7/89) as a result of prototype drilling in Utah. All changes have been italicized in this copy.

KEY:

- (+) Means the preceding phrase has been added to the original
- (-) Means preceding phrase has been deleted from the original
- (#) Means preceding phrase has been changed from the original

Sometimes an explanation regarding changes has been included.

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TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE	1
2.0 APPLICABILITY	1
3.0 DEFINITIONS	1
4.0 RESPONSIBILITIES	3
5.0 PROCEDURES	4
5.1 Introduction	4
5.2 Pre-drilling Preparation	4
5.2.1 Facilities	5
5.2.2 Equipment	5
5.2.3 Documentation	5
5.3 Core Handling	6
5.3.1 Staging	6
5.3.2 Photodocumentation	9
5.3.3 Removal of Whole Core Specimens From the Drill Site	11
5.3.4 Core Logging	13
5.3.5 Loading of Core Boxes	18
5.3.6 Labeling of Boxes	19
5.3.7 Photodocumentation of Boxed Core	19
5.3.8 Sealing of Core	20
5.3.9 Sealing of Boxes	20
5.4 Cuttings Handling Procedure	20
5.4.1 Logging	20
5.4.2 Bagging	20
5.4.3 Boxing and Labeling	21
5.5 Other Borehole Samples	21
5.5.1 Blown Core	21
5.5.2 Lexan Cyclone Tubes	22
5.6 Temporary Storage of Borehole Samples	22
5.7 Shift Drilling Summary	22
5.8 Completion of the Borehole	21
5.9 Records Storage	24
5.10 Identification and Resolution of Discrepancies	24
5.11 Nonconformance Reporting	24
6.0 REFERENCES	24
7.0 FIGURES	25
8.0 QA RECORDS	25

FIELD LOGGING, HANDLING AND DOCUMENTING BOREHOLE SAMPLES

1.0 PURPOSE AND SCOPE

This procedure describes the Yucca Mountain Project Office (Project Office) requirements and responsibilities for documentation, lithologic and structural logging, core photography, and packaging of selected Yucca Mountain Project (Project) borehole samples at the borehole site.

2.0 APPLICABILITY

This procedure applies to staff of Sample Management (SM), Technical and Management Support Services (T&MSS) contractor, performing field logging, documentation, and packaging of cores, cuttings, fluids, and other borehole samples acquired at Project surface-based and subsurface-based drill sites (Project Office Administrative Procedure [AP] AP-6.2Q), exclusive of those samples requiring alternative handling as directed by the Sample Overview Committee (SOC).

3.0 DEFINITIONS

3.1 Sample Management

SM of the T&MSS contractor is the organization responsible for the collection, documentation, storage, and control of selected samples, remnants, and records. SM includes the Sample Management Facility (SMF) and Field Operations (FO). SM staff consists of management and operations personnel who ensure that SM operations and documentation satisfy applicable regulatory and quality requirements.

3.2 Sample

A sample is part of a population whose properties are studied to gain information about the whole or group. Geologic, hydrologic, environmental, or other types of examinations are conducted on samples covered by this procedure. Examples of samples include core, cuttings, and fluids collected at Project borehole sites.

3.3 Core

A core is a cylindrical section of rock, or fragment thereof, taken as a sample of the interval penetrated by a core bit and brought to the surface for examination and/or analysis.

3.4 Cuttings

Cuttings are chips of rock produced during drilling that are removed from the borehole by circulation of drilling fluids (gas, foam, or liquid).

3.5 Rubble

Rubble is comprised of pieces of core with *average maximum* (#) diameters smaller than half the diameter of whole core *and broken in such a manner* (#) that reconstruction between individual pieces is impossible.

3.6 Specimen

A specimen is a subsection or portion which has been removed from a sample.

3.7 Whole Core Specimen

A whole core specimen is a subsection of whole core that constitutes the entire core sample recovered for the depth interval represented.

3.8 Fluids

Fluids collected as samples include gases and liquids.

3.9 Sidewall Sample

A sidewall sample is rock material recovered from the sidewall sampler.

3.10 Core Run

A core run is an attempt to drill and recover a length of core; also the piece of core recovered from a core barrel during the core run.

3.11 Cyclone Separator

A cyclone separator is a collecting device attached to the end of the cuttings return line. It is equipped with a valve at the bottom from which cuttings are collected.

3.12 Curatorial Sample Inventory and Tracking System

The Curatorial Sample Inventory and Tracking System (CSITS) is a computer-based system designed to aid in the control and documentation of Project samples.

3.13 Drilling Program Package

A Drilling Program Package, prepared for each borehole, is a set of plans describing the scope of work to be performed, the general and detailed requirements for performing the work, and the parameters to be used while drilling or performing work on Project boreholes. The Drilling Program Package consists of a work order, a Criteria Letter, a Drilling Program, and a Cost Estimate. Drilling activities will be coordinated according to AP-5.10Q.

3.14 Sample Overview Committee

The SOC is comprised of representatives from Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Sandia National Laboratories, the U.S. Geological Survey, SM, T&MSS, and the Project Office. It was formed to ensure a balance between Project sample needs, acquisition, and use, and the need to curate

samples for posterity.

4.0 RESPONSIBILITIES

4.1 Sample Management Manager

The SM Manager shall coordinate the overall development and implementation of the Project sample management activities.

4.2 Field Operations Manager

The FO Manager shall coordinate and administer borehole sample documentation, basic sample logging, sample marking and packaging, photography, and transfer of borehole samples to the SMF. Primary responsibilities will include interaction with the Principal Investigator (PI) and the Project Office Site Representative to ensure acceptability of samples and documentation for curation at the SMF. The FO Manager shall supervise the activities of the Shift Supervisor.

4.3 Field Operations Shift Supervisor

The Shift Supervisor shall report shift activities to the FO Manager and shall ensure that all borehole sites are adequately staffed at all times. The Shift Supervisor shall have signature authority on appropriate documentation. The Shift Supervisor shall supervise the FO Geologist and shall assist in training all appropriate FO staff. The Shift Supervisor shall interact with appropriate participants to recommend suspension of drill site activities having a negative impact on the collection and documentation of quality borehole samples, complying with Project Office Quality Management Procedure (QMP) QMP-01-02. The resolution of issues affecting the collection and documentation of quality borehole samples is the responsibility of the Shift Supervisor and shall be accomplished through appropriate interfaces.

4.4 Field Operations Geologist

The FO Geologist shall perform sample logging and handling activities at the drill site. These activities include collection of cuttings, depth validation, sample marking, packaging, and completion of all geologic field logs and reports. The FO Geologist shall direct activities of the FO Geotechnician and support staff.

4.5 Field Operations Geotechnician

The FO Geotechnician shall perform collection of cuttings, sample staging, marking, packaging, and documentation as directed by the FO Geologist.

4.6 Technical Staff Assistant

The Technical Staff (TS) Assistant shall ensure that all requirements necessary to log and document borehole samples are followed and conform to QA requirements and will report any nonconformance to this procedure, as described in Section 5.11.

4.7 Field Operations Administrative Assistant

The FO Administrative Assistant shall submit records resulting from implementation of this procedure to the T&MSS Local Records Center (LRC) according to

QMP-17-01.

4.8 Nevada Test Site (NTS) Support Contractors

NTS Support Contractors affected by this procedure include Reynolds Electrical & Engineering Company, Inc. (REECo) and Pan Am World Services, Inc. (Pan Am). REECo staff shall place samples in temporary storage (if applicable), load the samples onto the transport vehicle, and operate all preparation and loading equipment, including banders and forklifts. Pan Am shall photograph field samples and complete documentation, as needed.

4.9 Project Participant

The participant, outside interest, or designee shall supply the SMF with the appropriate information required to remove whole core specimens from the drill site (Section 5.3.3) and shall sign a receipt for these specimens.

4.10 Sample Overview Committee

The SOC shall recommend the allocation of whole core and other specimens to the Director of the Regulatory and Site Evaluation Division (RSED Director), Project Office, who shall approve or disapprove the recommendations.

5.0 PROCEDURES

5.1 Introduction

5.1.1 The initial handling and staging of core at the drill site is the point at which depth assignments are made that become the reference points on which all future measurements for sample examinations and for acquisition of whole core and other specimens are based. If these depth assignments are incorrect or indeterminate, the useability of analytical data derived from whole core and other specimens may be compromised. These initial activities significantly impact the entire sample management process; therefore, the quality controls delineated by this procedure must be rigorously followed.

5.1.2 This procedure prescribes the specific methods to be followed and documentation to be prepared during handling and field logging of all borehole samples. Responsibilities of and interfaces between organizations and personnel relevant to, but not directly affected by, this procedure are described in AP-6.2Q. A copy of this procedure with supporting references and forms will be available at the drill site at all times. The Drilling Program Package (prepared in accordance with AP-5.10Q) for the particular borehole will also be available at the drill site and is the document controlling drill site activities. During the course of activities described by this procedure, the logging facility containing (+) all (-) borehole samples and sample containers (+) will either (-) be in constant visual contact by SM field personnel, or borehole samples (+) will be in access-restricted storage controlled by SM.

5.2 Pre-drilling Preparation

Prior to drilling operations, portable logging facilities will be set up at the drill site and will contain supplies such as logging equipment, reference materials, copies of the Drilling Program Package, copies of this and other applicable procedures, and

adequate quantities of documentation forms. The FO Geologist, FO Geotechnician, and/or FO Shift Supervisor (collectively known as FO Staff) will be at the drill site sufficiently in advance of drilling operations to prepare the work area and to organize the working procedures.

5.2.1 Facilities

Portable facilities for geologic sample logging will contain the following equipment: desk, core racks, core transport trays, work table, and container labeling and securing equipment. The facilities will be well-lit, heated and air conditioned, and placed at a convenient location on the drillpad. Samples will be maintained in environmental conditions as defined in approved design documents according to AP-5.10Q.

5.2.2 Equipment

Field equipment will be assembled prior to initiation of field activities. The equipment will minimally include the following items:

engineering measuring tape	wire mesh sieve
colored temporary markers	core boxes and dividers
indelible marker pens	pocket transit (0-360 degree)
grain size chart	index cards ("4" x 6" "-)
hand lens	rock hammer
polystyrene core cradles	heat sealer
knife	lay flat tubing
chisel	geologic dictionary and other
magnet	references and volumes
rags/sponges	Project Office Geologic Field
PVC core trays	Logging Manual
non-tearing, waterproof labels	photographic equipment
cuttings bags (or boxes)	spray bottle
standard rock color chart	filament tape
miscellaneous office supplies	rock saw
"polystyrene labeled markers" (+)	protractor
impermeable packaging	"binocular microscope" (-)

5.2.3 Documentation

5.2.3.1 The information to be recorded on the field records listed below attempts to maximize efficient information-gathering and minimize redundancy. Each document will be fully described in this procedure in order of appearance during the course of drilling operations. All documents will be completed in indelible black ink and will be photocopied daily upon completion on paper marked "Copy". *All documents will remain on site until they are completed.* (+) The documents are:

- Field Photographic Log
- Whole Core Specimen Field Removal Checklist and Contract
- Structural Log
- Lithologic Log
- Shift Drilling Summary
- Borehole Completion Report

5.2.3.2 In addition to these documents, a Daily Activities Log will be maintained at all

times in the portable logging facility. The Daily Activities Log can be summarized as a chronological log of all activities that affect the daily scope of drill site operations. This log will be a paginated, hardbound, ruled notebook and will be a permanent part of the borehole record. All entries will be legible, concise, and in indelible black ink. A 24-hour timeclock (0000-2400 hrs) will be used to record daily events in chronological order. These events include, but are not limited to:

Sign On/Off - all drill site personnel *associated with sample handling activities* (+) will sign in and sign out at the logging facility upon on-site arrival and departure.

Drilling time - run information (Sections 5.3.1.3 and 5.3.1.4) and time required to cut the runs, as well as drilling times and intervals of other samples collected.

Non-drilling time - may include trip time, standby, rig maintenance and repair, well tests, geophysical logging, checks between depth recording instruments and pipe tallys, etc.

Communication - duration and type of communication with key field operations personnel with Project participants and outside interests, and any consequences of the communication.

5.2.3.3 The degree of detail necessary to document these activities depends upon the events of the day and upon the individual making entries. Entries in the Daily Activities Log will be made by FO Staff. Incoming staff shall read the day's entries and shall be briefed by outgoing staff, as necessary. All entries will be initialed; in addition, any deletions or changes will be marked through with a single line and initialed.

5.3 Core Handling

Core handling procedures shall be performed in the following sequential order. Any deviation from this procedure or from the Drilling Program Package requires prior consultation and agreement between field operations personnel and the FO Manager, and is subject to the stipulations of Criteria VI in the Project Quality Assurance Plan (QAP) NNWSI/88-9, Rev. 2 and the requirements of AP-5.10Q. Deviations and references to authorizing documents shall be recorded in the Daily Activities Log.

5.3.1 Staging

The inner core barrel sleeve or inner sleeve containing the core will be removed from the core barrel by drilling rig personnel. One end of the inner sleeve will be appropriately marked to designate top of the run, ensuring that the run will not be switched end-for-end during transport to the portable logging facility. Run information (run number, interval) will be obtained by FO Staff from the driller, the driller's report, or a calibrated depth recording instrument (Geolograph, Totco, or equivalent) and will be written on a temporary run card (index card). (#) The interval of the run is determined by standard and appropriate drilling techniques and will include, but is not limited to, the use of pipe tallies or calibrated depth recording instruments. ("Pertinent drilling activities ..." -) The inner sleeve will then be carried to the logging facility by ("ReeCo" -) FO Staff and placed in a core rack. The FO Staff will open the inner sleeve to expose the core. A polystyrene foam Run Marker with the borehole identification (ID), run number, and run interval

(Figure 1) will replace the *temporary* ("driller's" replaced by "temporary") run card at the top of the run. *Polystyrene foam Information Markers* will also be appropriately placed in the inner sleeve and may include identification Not Attempted (NAT) existence code intervals (Section 5.3.6). (+)

5.3.1.1 Fitting (*Fitting placed before Cleaning*)

5.3.1.1.1 Starting at the top of the core run, pieces of core are fitted together (as in a jigsaw puzzle) by the FO Staff to reconstruct larger sections of core. Rubble zones will be ("*reconstructed*" -) placed to represent as accurately as possible the interval from which they were recovered. All artificial breaks sustained during handling of the core will be marked with parallel heavy black lines on both sides of the break. In zones of closely-spaced, parallel breaks, green alignment marks will be drawn perpendicular to and across the surface trace of the break, staggered horizontally (Figure 1). If a small piece of core between parallel breaks in such a zone is lost or temporarily misplaced, these short, green alignment marks would not match across the break, thus identifying a potential fitting problem.

5.3.1.1.2 Ideally, after a length of core has been fitted, it duplicates in situ conditions. This rarely occurs, however, because breaks in the core cannot always be fitted together perfectly. When this happens, a *temporary* (+) black non-orientation mark (*) shall be written on *both* ("*one*" replaced by "*both*") sides of the break, indicating a departure from the in situ condition (Figure 2).

5.3.1.2 Cleaning

The FO Staff will clean the samples according to instructions of the primary PI responsible for the borehole, exercising caution to avoid disturbing unconsolidated zones.

5.3.1.3 Measurement of Run Interval

After the core has been fitted and non-orientation marks placed, the FO Staff will measure the core with a steel tape to the nearest 0.1 ft. Subtracting the amount recovered from the amount cut determines whether an apparent core loss exists. The amount of core drilled and recovered will be entered in the Daily Activities Log and on the Run Marker (Figure 1). True core loss will be determined as described in the following section and will not be documented until the next run is recovered.

5.3.1.4 Determination of *Unrecovered* ("*lost*" replaced by "*unrecovered*") Core

5.3.1.4.1 If *unrecovered* ("*lost*" replaced by "*unrecovered*") core is indicated after measuring the core, the FO Geologist and the driller will attempt to determine the interval(s). Calibrated depth recording instruments installed on the rig, the presence of core marks, and the driller's logs may offer clues.

5.3.1.4.2 Sometimes during coring, the bottom portion of a run is not recovered until the following run is cut because it is left at the bottom of the hole. This apparent *interval of unrecovered core* ("*lost*" replaced by "*unrecovered*") may result in inaccurate core measurement if the bottom of a core run is not matched with the top of the successive run. This apparent *unrecovered* ("*lost*" replaced by "*unrecovered*") core may be recovered in the following run and may be identified by bit marks, core match, or other clues. The core stub may also be ground up and subsequently recovered as rubble in the next run.

5.3.1.4.3 If more core is recovered from the barrel than was cut by that run, *this core interval (#)* shall be reconciled with the last (uphole) core loss *or with the next downhole run.* ("sometimes more ..." -) *If the ends of two successive core runs do not fit together, the unrecovered core interval will arbitrarily be placed at the bottom of the previous run. (#)*

5.3.1.4.4 If the ends of two successive core runs fit together, the position(s) of the *unrecovered core ("lost" replaced by "unrecovered")* will be determined using the following procedure unless otherwise directed by the PI, based on previous drilling experience in a particular rock type:

- a. The *interval of unrecovered core ("lost" replaced by "unrecovered")* will be assigned to obvious loss zones. These are best recognized immediately after opening the inner sleeve as intervals with substantially reduced sample amounts.
- b. If there are no obvious zones of *unrecovered core, ("lost" replaced by "unrecovered")* the *interval* shall be assigned to the lowermost rubble zone in that run.
- c. If there are no rubble zones, the *unrecovered core ("lost" replaced by "unrecovered")* will be placed immediately below the lowermost non-orientation mark.

5.3.1.4.5 The borehole ID, the *unrecovered core ("lost" replaced by "unrecovered")* interval, and the total amount of *unrecovered core ("lost" replaced by "unrecovered")* will be entered on the label of a polystyrene foam *Unrecovered ("lost" replaced by "unrecovered")* Core Marker (Figure 1) and placed at the proper location. The *unrecovered core interval* will be entered alongside the run information in the Daily Activities Log. The amount of *unrecovered core ("lost" replaced by "unrecovered")* will be entered on the Run Marker, and a black *unrecovered ("lost" replaced by "unrecovered")* core non-orientation mark (\emptyset) will be written on both sides of the loss (Figure 1). *Unrecovered core information shall be given to the driller. (+)*

5.3.1.5 Depth Notation

The FO Staff will measure the core to the nearest 0.1 ft. Footage marks will be written on the core with a ("blue" -) temporary marker at one-foot intervals, encircling the core as much as possible. *Depths will be written alongside the footage marks. (+)* The FO Staff will ensure that the depths written on the core correspond to the depths noted on the Run Marker. The top of the run shall be the starting point for measurement. If the top of the run is angled (e.g., a fracture) and does not match with the previous run, the starting point shall be the mid-point of the core. When a footage mark falls within a rubble zone, the depth will be written on an index card and placed appropriately in the inner sleeve (Figure 2).

5.3.1.6 Orientation Stripes

Orientation stripes will now be placed on the core. Orientation in this context has no relation to azimuthal bearings (from true north, clockwise); rather, it serves to maintain the fit achieved previously and also provides a reference for fracture logging. The FO Staff will use red and blue permanent markers taped together to

place orientation stripes on the core, red on the right, from the uppermost depth to the lowermost depth (Figure 2). The last piece of core from a run will be used to fit and orient the first piece of core from the next run. Orientation between two runs may not be possible; if so, a non-orientation mark will be placed at the bottom of the first run and at the top of the next run. The core run is now ready for photodocumentation.

5.3.2 Photodocumentation

5.3.2.1 Field photography of the core prior to excessive handling is a reliable method to document the approximate in situ condition of the core and provides a visual record in the event of core destruction. Field photodocumentation occurs twice: while core is in the inner sleeve and after core has been logged and boxed.

5.3.2.2 Initial photographs shall be taken of the core still in the inner sleeve, immediately after core orientation and marking is completed. All photographs will be taken by qualified T&MSS contractor personnel or by NTS Support Contractor photographers.

5.3.2.3 The Field Photographic Log (Figure 3) will be completed by the photographer and contains header information and information columns. The header information includes:

Borehole ID - unique alphanumeric designation given to each borehole.

Checked by - FO Staff member's initials and date verifying that information on record is correct; staff member must have been trained on the procedure and cannot have taken picture if signing here.

Pagination - numbers sequentially assigned to sheets; first blank contains the number of that particular sheet and the second blank contains the total number of sheets, filled in after completion of the borehole.

Photographed by - photographer's initials and date.

FO Manager - signature and date.

The information columns include:

Roll number / ASA - film rolls assigned sequential numbers; ASA number for that particular roll of film.

Exposure number / f-stop / speed - exposure number begins at '1' for the first exposure; continues sequentially until all the exposures on the particular roll have been made; f-stop and speed of each exposure.

Run number / interval - run number of the run being photographed; interval documented by that particular exposure (when core is in sleeve).

Box FCT bar code # / interval - FCT bar code #; interval contained in that box (when core is in box).

Other - documentation of any other feature being photographed, including an interesting item in the core, drawing of a drilling activity, etc., which the FO

Geologist feels requires photodocumentation.

5.3.2.4 A 35mm format single lens reflex camera or other appropriate format camera will be used for primary field photography. Equipment and accessories will include, but are not limited to:

Lenses - 50 mm standard; 28-35 mm wide angle and other appropriate accessories for close-up photographs.

Lens filters - skylight or UV filter; polarizer for eliminating glare from wet core (if applicable).

Film - indoor film shall be matched with the type of lighting (i.e., light source, type of electronic flash); unexposed film will be stored in a cool, dry place.

Camera rack - to standardize distance and establish consistent camera position; camera rack will be above core rack to accommodate repetitive exposures of core in the inner sleeve.

Flood lights and/or flash unit - floods normally used if appropriate power source is available; electronic flash to back up flood lights.

Instant print camera and accessories - instant print camera used to photograph core after boxing.

Miscellaneous - color card, scale in 0.1 ft intervals; ("4"X6" "-) index cards.

5.3.2.5 Methods

5.3.2.5.1 All core markings and labels shall be complete, accurate, legible, and visible to the photographer. A Color Card and an Information Card (4"X6" index card -) labeled with the borehole ID, run number, depth interval of the run (+), and date("core loss interval(s)" -) will be centered in the photograph above the core. A scale marked in 0.1 ft intervals will be placed parallel to the section being photographed.

5.3.2.5.2 The camera will be attached to the camera rack and checked for distance, focus, f-stop, and shutter speed. The field of view will be checked for shadows or obstructions. Each exposure will include 2 ft of core; the first exposure will be made at the top of the run, and continuous exposures will be made until the entire run of core is photodocumented.

5.3.2.5.3 Individual close-up exposures of specific interesting features in the core may be taken after the entire length of the run has been sequentially exposed. This will be done by placing a Color Card and an index card with the borehole ID, depth or depth interval, and description of the feature beside the core section of interest. If macro-focus of the feature is not conducive to this, the same information shall be written in the "Other" column of the Field Photographic Log. (+)

5.3.2.5.4 Adhesive labels with the following information will be attached to the film canister and to the roll of film: borehole ID, run number(s), date, roll number, and total footage interval documented by the roll. The exposed film will be locked in a cool, dark location by the FO Staff and will be periodically transferred to the SMF by

the Shift Supervisor. The signature of the Shift Supervisor on the Field Photographic Log signifies receipt of the film rolls by the Shift Supervisor for the SMF.

5.3.2.5.5 After photodocumentation of the core run, the core is ready to be geologically logged unless the immediate sealing and removal of whole core specimens from the drill site is required. As appropriate, the primary PI may direct activities to ensure that important geologic features are documented before the removal of whole core specimens.

5.3.3 Removal of Whole Core Specimens From the Drill Site

5.3.3.1 It may occasionally be necessary to immediately remove and seal intervals of whole core directly from the drill site and release them to a participant for immediate transport to that participant's laboratory, without benefit of SMF processing. These instances shall be directed by the RSED Director and shall be dictated by *special* ("*peculiar*" changed to "*special*") analysis requirements such that the time necessary for SMF processing would jeopardize the analytical integrity of the whole core specimen. No core will be removed from the field before it has been staged and photographed as described in Sections 5.3.1.1 through 5.3.1.4 and 5.3.2. Whenever possible, the core will be logged as described in Section 5.3.4 before removal from the field.

5.3.3.2 As whole core specimens are removed from the drill site, the FO Staff will complete the Whole Core Specimen Field Removal Checklist and Contract (contract; Figure 4). The contract consists of the header and the information columns. The header information includes:

Recipient - participant, outside interest, or designee qualified to accept custody of whole core specimens at the drill site.

Organization - recipient's organization.

Telephone - recipient's telephone number; also FTS.

Address - recipient's address.

Courier - person accepting specimen in field or transporting specimen.

Completed By / Date - FO Staff performing removal process and date.

RSED Director authorization - may be an assigned number, a document, or other correspondence; describe briefly, as necessary.

Borehole ID - unique alphanumeric designation assigned to borehole from which whole core specimens were removed.

Pagination - numbers sequentially assigned to sheets; first blank contains the number of that particular sheet, and the second blank contains the total number of sheets.

SHP bar code label - shipment bar code label representing a single shipment, which may consist of any number of whole core specimens; if there is more than one page of contracts to document the shipment, the pages will be stapled

together, and label will only be placed on the first page.

5.3.3.3 The following steps shall be followed to remove whole core specimens from the drill site. Underlined steps describe the information columns of the contract.

- a. Prior to field operations, the RSED Director must approve requests from participants for whole core removal (AP-6.4Q); a copy of RSED Director authorization and approved requested interval (including a buffer) will be available to qualified site personnel prior to whole core removal.
- b. FO Geologist will compare the approved requested interval or feature to the interval pick at the drill site by the participant; conflicts resolved by the RSED Director or designee.
- c. SPC bar code label: specimen bar code label will be affixed to the specimen (if possible), the Contract, and packaging material containing specimen; a check will be placed in the "Affixed" Column.
- d. Interval removed and date created: whole core interval will be sawed (if necessary) and removed by FO Staff; actual interval removed and date created will be noted.
- e. Foam marker: place check (✓) here when polystyrene foam Whole Core Removed marker labeled with borehole ID, interval, date, PI, and laboratory or location where core will be sent has been placed in inner sleeve.
- f. Marked/tag: *if possible and if approved by the recipient, the actual footage shall be marked directly on the specimen.* (+) If it is undesirable or impossible to mark directly on the core, an alternate method of identifying that interval of the core will be used, including affixing an aluminum tag to the core labeled with borehole ID, interval, date, and laboratory or placing the sample in a labeled container. If a bar code label cannot be directly attached to the specimen, a bar code label shall be placed in the packaging with the specimen. Place a check (✓) in this column ("here" replaced by "in this column") to indicate that either footage marks and orientation stripes are written directly on the specimen or that the specimen has been properly identified with an alternate method.
- g. Packaged / description: segregated core will be packaged by the FO Staff to specifications of the participant assuming responsibility of the specimen. Impermeable packaging will be used if required to retain in situ moisture; other types of packaging may be used to preserve certain rock characteristics. Orientation stripes and footages will be written on the packaging, regardless of whether they exist on the specimen. Include a description of the packaging material.
- h. Photographed: segregated whole core specimens will be photographed *unless the specimen has been packaged in opaque packaging material.* (+) All core markings shall be complete, accurate, legible, and visible to the photographer. A Color Card and Information Card ("4"X6" index card"-) labeled with borehole ID, depth interval, date, PI, and laboratory will be centered in the photograph above the core. A scale marked in 0.1 ft intervals will be placed parallel to the section being photographed. After the exposure,

all information on the Information Card and the SPC bar code number will be recorded in the "Other" Column on the Field Photographic Log (Figure 3). Place a check (✓) to indicate that the specimen was properly photographed and that the information was entered on the Field Photographic Log.

- i. Affix an SHP bar code label to the contract (Section 5.3.3.2).
- j. The participant or designee and the FO Geologist will sign and date contract.
- k. The specimen and photocopy of contract will be shipped or released directly to participant.
- l. If data communications are available at the drill site, information from the contract shall be entered into CSITS.

5.3.4 Core Logging

Geological core logging will occur in two distinct phases: recording structural information (fracture frequency, rubble zones, etc.), and recording lithologic information (rock type and description, accessory mineralization, etc.).

5.3.4.1 Structural Logging

5.3.4.1.1 Significant structural features will be logged by the FO Geologist on a Structural Log (Figure 5). Each horizontal row represents a description of a single structural feature in the core. Two rows are used together to represent intervals of similar features with discrete upper and lower depths. The log includes:

Borehole ID - unique alphanumeric designation given to each borehole.

From / To - interval documented on the particular sheet.

Core Diameter - diameter of core being logged.

Inclination and Bearing - engineered attitude of borehole; inclination expressed in degrees from vertical, and bearing expressed as a 360° azimuthal bearing; does not relate to natural drift of the hole. "NA" will be entered in these spaces if the hole is vertical, i.e., has no engineered inclination and bearing. (+)

Page numbers - numbers sequentially assigned to sheets; first blank contains the number of that particular sheet, and the second blank contains the total number of sheets, filled in after completion of the borehole.

Completed by and date - FO Geologist's signature and date.

Checked by and date - FO Staff not directly responsible for completion of this form but trained on this procedure.

5.3.4.1.2 The 41 vertical information columns are coded as follows to yield the pertinent information:

Bracket /-X (1) - A "/" and "X" are entered to delineate zones of similar

fracturing or breakage, core losses, intervals of rubble, and significant void intervals. The "/" is entered beside the upper depth (top) of the zone and the "X" on the next row beside the lower depth (bottom) of the zone. This column is left blank for single features that occur at a particular depth. Entries made in the first row of a bracket interval indicate the predominance of that feature over the interval and not that the feature physically occurs near the top of the interval. Likewise, entries noted in the lower row of a bracket interval indicate the less predominant role of that feature and not that the feature occurs near the bottom of the interval. The "/" and "X" associated with a particular bracket shall always be entered on the same page of the log.

Depth (2-6) - The depth of each fracture or interval is entered to the nearest 0.1 ft. Fractures will be located at their mid-point (*except Fracture Length; see below*). (+)

Frac. origin (7) - A letter code is used to designate the origin of the fracture or feature. The codes are:

- N: **Natural** - natural fractures are normally characterized by mineral coatings or fillings, a weathered appearance, and/or tectonic features such as slickensides or fabric element offset.
- C: **Coring-induced** - coring-induced fractures are recognized by fresh, tightly fitting surfaces with a rough fracture line and always a lack of mineralization (*and evidence of grinding* -). Four (*"five" changed to "four"*) types of coring-induced fractures *may be* (*"are" changed to "may be"*) recognized: PC - petal centerline, HC - helical clockwise, HCC - helical counterclockwise, (*CIR- coring* ...) and D - disc. These codes will be entered in the Remarks Column, *if recognized*. (+)
- H: **Handling-induced** - handling-induced fractures are either inadvertently or purposefully caused; whenever a fracture is induced by handling, it is immediately marked with *permanent* (+) heavy black lines (*"indelible marker"* -) parallel to and on either side of the break.
- I: **Indeterminate** - indeterminate is used when the origin of the fracture cannot be determined. *Rotation marks on the core is an example*. (+) It is preferable to be conservative when using the designations (N) and (C).

Bracket code (8-9) - A letter code is entered to identify those features bracketed in Column 1. The codes are:

- RZ: **Rubble zone** - zone containing rock fragments with a maximum average diameter less than half the diameter of the whole core and broken in such a manner as to render impossible the reconstruction between individual fragments. The origin of an RZ may be natural (N), coring-induced (C), or *indeterminate (I)*. (+)
- FZ: **Fracture zone** - zone of open and/or closed fractures, generally with associated primary and secondary orientations (Columns 14-17) and dip (Columns 18-19)
- FL: **Fracture length** - applies to high angle (greater than 60°), single entry fractures generally with a length of 0.5 ft or longer; the only case in which a bracket code is used to describe a single feature. *These fractures will be located at the uppermost point where the trace of the fracture intersects the core*. (+)
- UC: **Unrecovered core** - (*"lost" replaced by "unrecovered"*) used to designate

intervals in which no core was recovered

FS: Fracture set - used for a set of similar (parallel) fractures within the bracketed interval. (+)

VI: Void interval - interval with lithophysal or other voids, estimated at greater than 5% of total volume, estimated using a percent volume chart.

WC: Whole core removed - see Section 5.3.3. (+)

Numeric value (10-13) - Every bracket code (except PC) has an associated numeric value (NV). The NV for an RZ represents the average maximum length of the rubble pieces. The NV for an FZ represents the average spacing between the breaks or fractures comprising the FZ. When used in conjunction with the FL bracket code, NV represents the measured length of that fracture to the nearest 0.05 ft. The numeric value ("NV" replaced by "numeric value") for a UC or WC (#) bracket code represents the length of the interval (+) to the nearest 0.1 ft. The NV for a FS bracket code is the average spacing between the fractures, less than 0.35 ft (#) (if the spacing is greater than 0.35 ft (#), a piece length exists - see Columns 38-40). The NV for a VI bracket is the estimated volume percent of lithophysal voids in that interval. NVs will be measured to the nearest 0.05 ft. (+)

Orientation (14-17) - The dip direction (not an azimuthal bearing) of fractures and slickensides relative to the long axis of the core is recorded in these columns. The direction is determined using a coordinate system relative to the orientation stripes (Figure 6). An example is shown in Figure 7. The core is divided into four quadrants counterclockwise from the orientation stripes (with the core held in correct horizontal position); these quadrants are assigned letters A through D and are further divided in half and designated A1, A2; B1, B2; C1, C2; and D1, D2. Planar fractures transect the core in an elliptical plane. The orientation is determined by first noting the uphole intersection point of the fracture plane, followed by the downhole intersection point. The one-eighth divisions of the core are used to designate these intersection points. If orientation is not discerned (i.e. fractures with 0 or 90 degree dip or fractures that do not transect the core), columns 14-17 will be slashed. (+)

Dip (18-19) - Dip is the angle between a plane normal to the vertical axis of the core and the line of the feature, expressed in degrees. It is used primarily for fractures and inclined bedding. It does not necessarily represent the true in situ dip of the feature.

Fracture description (20-21) - An alphanumeric code is entered to describe the fracture. Any combination of the numbers and letters below may be used to describe the fracture. The letters are: A - continuous, when the fracture can be traced around the entire core boundary; B - discontinuous, when the fracture can not be traced around the entire core boundary. The numbers are: 1 - open, a fracture with no infilling in the aperture; 2 - healed, a fracture with infilling in the aperture such that the fracture has been closed up; 3 - partly open/partly healed; 4 - hairline, a fracture with a very small, almost indiscernable aperture. (#)

Fracture line (22) - Fracture line refers to the intersection of the fracture plane with the exterior surface of the core. These single digit codes are:

1 - planar; 2 - irregular; 3 - curved; and 4 - undulatory.

Surface characteristics (23) - A single digit code is chosen to indicate the

character of the surface of the fracture. This is usually applied to those that are open, but often the surfaces of closed fractures may be inferred. The codes are: 1 - smooth or polished; 2 - irregular; 3 - curved; and 4 - undulatory.

Tectonic features (24-25) - Tectonic features are generally discerned from examination of disrupted phenocrysts, pumice or lithic fragments. *If no tectonic features are noted, columns 23-24 will be slashed. (+)* The codes are:

- SR: Solution removal of matrix, as evidenced by mismatching of phenocrysts or pumice across the fracture in two or more places.
- SS: Slickensides. Rake, if discerned, is recorded in the Remarks Column.
- ON: Offset normal to the longitudinal axis of the fracture face. If a magnitude of offset can be measured, include in the Remarks Column.
- OP: Offset parallel to the longitudinal axis of the fracture face. If a magnitude can be measured, include in the Remarks Column.
- OO: Offset oblique to the longitudinal axis of the fracture face. If a direction or magnitude can be measured, include in the Remarks Column.

Secondary mineralization (26-37) - Mineralization is indicated by placing a numeral (1,2,3,4) in the appropriate mineral column. The extent of mineralization on a single fracture or within a bracketed fracture zone is generalized by the numeral assigned. The codes are: 1 - predominant (fracture surface[s] 75-100% mineralized); 2 - moderate (50-75%); 3 - minor (25-50%); and 4 - trace (< 25%). Thus, a "1" in a particular mineral column indicates that that mineral predominates the fracture surface(s) being described, and a "4" in a mineral column indicates that that mineral occurs in trace amounts. Any combination of numerals may be used to accurately portray the mineralization observed. When dealing with a bracketed zone, numerals will be placed only in the row indicating the top depth (/) of that bracket. Three columns (35-37) marked "other" are reserved for three-letter abbreviations for mineralization other than those listed.

Weathered (38) - This refers to a surficial dull, dirty, or altered appearance of a fracture surface which cannot be classified as mineralized and which is not a surficial coating of drilling mud. An "X" is placed in this column if this condition is noted for the fracture.

Piece length (39-42) - Lengths of ("intact" -) core equal to or greater than 0.35 ft (#) are noted. These are measured between any two open natural breaks, *open indeterminate breaks, or any combination thereof. (+)* Piece lengths bounded by fractures at either or both ends are measured from the center of the top fracture to the center of the bottom fracture. The measurement is listed in the same row as the lowermost break. Figure 8 exemplifies a piece length entry in which a two-foot ("unbroken" -) section of core lies between 1210.0 ft and 1212.0 ft. *Piece lengths will be measured to the nearest 0.05 ft. (+)* These piece length measurements are used later to calculate Rock Quality Designation, Core Index, or other geomechanical indices.

Remarks - This space is set aside for comments and unusual core conditions. The cause of a nonorientation mark, if surmised, is particularly applicable. Also, the type of coring induced fracture, as described above, is entered here.

5.3.4.2 Lithologic Logging

5.3.4.2.1 A standardized lithologic logging format will be used to ensure that important comparative features of a lithologic unit (e.g., color, degree of welding, degree of vitrification, nature of lithophysae) are noted. All lithologic information derived from core and cuttings observation by the FO Geologist will be entered on the Lithologic Log (Figure 9). The two sections of the log are the header and the information rows. The header information consists of the following:

Borehole ID - unique alphanumeric designation assigned to the borehole.

Type - indicate core or cuttings.

From / To - represents the interval documented on the particular sheet.

Pagination - numbers sequentially assigned to sheets; first blank contains the number of that particular sheet, and the second blank contains the total number of sheets, filled in after completion of the borehole.

Completed by and date - FO Geologist's signature and date.

Checked by and date - FO Staff not directly responsible for completion of this form but who is trained on this procedure.

5.3.4.2.2 The information rows will be used to record a lithologic description of the rock, as well as the accepted geologic formation and/or member names, if known. Depths will be recorded in feet to the nearest 0.1 ft; features may be measured in tenths of a foot, centimeters, or millimeters, as appropriate.

5.3.4.2.3 A standard logging format will be utilized to ensure that characteristic features of lithologic units will not be overlooked. Charts, tables, and other references (compiled in the Project Office Geologic Field Logging Manual) will be available at the site to aid the FO Geologist in logging features in a consistent manner. This consistency is accomplished through the use of lithologic abbreviations in a standardized lithologic logging format, described below.

5.3.4.2.4 This logging format consists of three parts: 1) Primary Descriptive Terms, 2) General Features, and 3) Specific Features.

1. Primary Descriptive Terms, noted for every lithologic unit in the following order, offering a broad skeletal description of the interval.

Unit - a distinct body of rock, representing a discrete geologic event; distinguished from other units above and below it by different physical properties (e.g., color, mineralogy, and morphology); predominantly tuffs at Yucca Mountain.

Type - This is an adjective describing the unit, suggestive of the depositional mode and is generally ash flow, ash fall, bedded, or reworked.

Color - hue and tone noted under appropriate lighting conditions, along with reference to a standard geologic color chart (e.g., Geological Society of America Rock-Color Chart); e.g. light red (visual), SR 6/6 (color chart reference).

Welding - degree of welding; choices are: nonwelded, moderately and densely.

Vitrification - degree of vitrification; choices are vitric, moderately devitrified, and devitrified.

2. General Features: characteristic of the entire unit interval; estimate

percent volumes (volumetric proportions) of these features, when applicable, using a suitable percent volume chart; when present, general features will be described in the following order; additional detail may be added as appropriate:

Pumice - includes percent volume of the interval, degree of vitrification, color, and flattening ratio.

Lithic fragments - includes percent volume of the interval, rock type, color, shape (sphericity and roundness) and diameter of fragments.

Phenocrysts - includes percent volume of the interval, mineral type (if distinguishable and expressed minimally as mafics/quartz/feldspar), color, shape, diameter, and, if possible, the proportion of each mineral to total phenocryst volume.

Lithophysae - includes percent void of the interval, shape, size, and mineralization, if any.

Unit contact - describes nature of contact with underlying unit; generally ranges from sharp to gradational but may include any appropriate phrase.

3. Specific Features: Specific features are characteristic of a zone within a unit interval. These are isolated, localized features and are not common throughout the unit. Due to their localized nature, these features always contain depth notation, e.g., "at 1518.5', a 0.10' elongate lithophysae with calcite infilling" or "from 1325.7 - 1328.2' numerous very small (0.05') euhedral, very dark red (5R2/6) lithic fragments." Also, all marker blocks (Run, *Unrecovered Core*, ("lost" replaced by "unrecovered") *Whole Core Removed*) will be logged here as *last entries* (+)

5.3.4.2.5 A typical lithologic description might read as follows (note: this example is written out, but a field log would utilize standard lithologic abbreviations):

"304.4 - 328.6' Tuff, ash flow: light brown (5YR5/6) to moderate yellowish brown (10YR5/4), moderately welded, devitrified; 5-10% pumice, light brown (5YR5/6), devitrified, 3:1 flattening ratio; 10% lithic fragments, dusky brown (5YR2/2), mostly sub-angular with low sphericity, 1-3 cm diameter; less than 5% phenocrysts of sanidine, quartz, biotite, very small to 2 cm; 15-20% void lithophysae, sub-rounded with moderate to high sphericity, mostly 1-3 cm diameter, trace quartz infilling; from 306.9 - 310.8', numerous irregular pinpoint calcite crystals; at 311.6', a 3:1 flattened, devitrified large (0.2') pumice fragment with mineralization halo, possibly vapor-phase mineralization; gradational contact."

5.3.4.2.6 This format guarantees certain minimal detail. Although it is necessary that the sequence of the format is followed, the FO Geologist should describe lithology as thoroughly as time and logging ability allow.

5.3.5 Loading of Core Boxes

5.3.5.1 Waxed cardboard boxes fitted with polystyrene foam cradles will be stored at the drill site in sufficient numbers to accommodate projected daily core recovery cycles. Prior to recovery of a core run, the FO Staff will prepare sufficient boxes to accommodate the run.

5.3.5.2 The boxes will be placed on the core rack parallel to the inner sleeve. Core will be measured in the inner sleeve to determine where artificial cuts will be made

or pre-existing breaks (natural or coring induced) will be selected in order to fit the core in each box. If necessary, the core will be sawed, and the cut will be marked on each piece of core with a parallel set of black lines. The shallowest core from the run will be placed in Row 1, left to right, as shown in Figure 10. Core will be loaded into the box until both Rows 1 and 2 are filled. All polystyrene foam markers (Run, *Unrecovered* ("lost" replaced by "unrecovered") Core, Information (+), and Whole Core Removed) will be transferred directly from their position in the inner sleeve to their corresponding position in the core box during the loading process.

5.3.5.3 Sufficient space will be left in the core box for intervals of rubble between portions of whole core. Rubble zones will be removed with minimum disruption from the inner sleeve after all the whole core sections have been placed in core boxes. An interval of rubble will be pushed to the end of the inner sleeve. A piece of split polyvinyl chloride (PVC) tube slightly larger in diameter than the inner sleeve will be cradled under one end of the split barrel until the ends are parallel. A piece of lay flat tubing will be slipped over the inner sleeve, the split PVC tube, and the interval of rubble. The section of rubble will then be pushed over the edge of the inner sleeve while the PVC and lay-flat tubing are pulled parallel and away from the inner sleeve. All rubble will be bagged to the nearest one foot; that is, no lay-flat tubing will contain more than one foot of rubble nor will it contain rubble from both sides of a footage mark. At the discretion of the FO Geologist, rubble may also be discretely bagged to reflect changes in lithologic units or other zones of geologic interest.

5.3.5.4 After the rubble has been transferred from the inner sleeve, the split PVC tube will be removed, and the ends of the lay-flat tubing will be sealed with a heat sealing iron. The sealed sections of rubble will be labeled with the borehole ID and depth intervals represented by writing the top depth at the top of the sealed tubing and the bottom depth at the bottom of the tubing. Orientation stripes will be placed on the tubing as described in Section 5.3.1.6, and the tubing will be placed in the appropriate position in the core box.

5.3.6 Labeling of Boxes

After each run is loaded, information on the contents of the boxes containing that run will be entered by the FO Staff on two adhesive labels, each printed with the borehole ID and a bar code. The FO Staff will record the sample type, the interval of the samples contained in the boxes, and the sample existence codes and their intervals. Existence codes are:

- NAT: Not Attempted - if the sample type is core, this would represent cuttings as would occur during spot coring.
- REC: Recovered
- UNREC: Unrecovered - represents an interval of samples drilled but never recovered from the borehole.
- WCR: Whole core removed - see Section 5.3.3.
- LOST: Lost - a sample that was recovered but was subsequently lost.
- DEST: Destroyed - primarily refers to condition of specimens following analysis; also, catastrophic events at the drill site could destroy samples.
- CONS: Consumed - reserved almost exclusively for specimens.

These labels will then be affixed ("in the left-hand..." -) on the downhole end on both the lid and body of the box (Figure 11).

5.3.7 Photodocumentation of Boxed Core

The FO Staff will prepare the boxed core for photodocumentation (Figure 12). One core box will be placed on a photographic table equipped with registration points, lights, and a camera stand. A signboard with *bar code number, borehole ID, date, interval of the box, and color bar (#)* will be placed to the left of the box. (*"Signboards for each row of the box..." -*) A scale marked in 0.1 ft intervals will be placed parallel to the section being photographed. An exposure will be made using a 35 mm or similar format single lens reflex camera (see Section 5.3.2 for additional photographic details). The film roll number, exposure number, FCT bar code #, interval of core photographed, and film type (instant print in "Other" column) will be documented on the Field Photographic Log (Figure 3). One additional exposure will be made with an instant print camera and will be placed in a document cache affixed inside the lid of the box.

5.3.8 Sealing of Core

If it is necessary to preserve particular rock properties at the request of a participant or at the discretion of the FO Geologist, the following procedure will be used to seal core in low-permeability packaging. After photodocumentation, the FO Geologist will remove the core in exact order from the core box and place it in split PVC tubes on a level work surface. These split PVC tube cradles will allow the manipulation of the core into the packaging as complete sections. Each section of core and the split PVC tube cradle will be placed in the low-permeability packaging. The split PVC tube cradle will be removed, and the packaging will be heat-sealed. The sealed core will then be placed in the box in the same order that it was originally removed. The interval packaged will be noted on the Field Photographic Log (Figure 3) in the "Comments" column next to the interval of boxed core photographed.

5.3.9 Sealing of Boxes

Following photodocumentation, each box will be sealed by the FO Staff with nylon filament tape in preparation for temporary storage at the drill site. This does not preclude reopening the boxes for subsequent examination while still at the drill site.

5.4 Cuttings Handling Procedure

Cuttings will be collected by FO staff or REECo rig personnel with a cyclone separator or other suitable device at intervals specified in the drilling program. A sufficient quantity of representative cuttings will be collected, unless otherwise specified by the SOC. Specific samples will be collected and handled according to participant specifications, as directed by the SOC and specified in the Drilling Program Package. Every effort shall be made to collect cuttings which represent the targeted interval. (*"communication between the driller and..." -*)

Need section on collecting and bagging in plastic bags, and splitting.

5.4.1 Logging

5.4.1.1 Cuttings will be laid out in rows convenient for logging. Subdivisions within these rows may be made at the discretion of the FO Geologist. If a sample was not collected due to loss of circulation or other reason, FO staff or REECo rig personnel will place an acceptable marker in the place of the unrecovered sample to preserve

the continuity of the samples within the rows. Cuttings will be logged by scanning the rows and determining lithologic breaks based on color or other textural changes.

5.4.1.2 Lithologic descriptions shall be written on the Lithologic Log (Figure 9) in the format described in Section 5.3.4.2. The degree of detail will be less in a cuttings log; nevertheless, every effort should be made to at least complete the "Primary Descriptive Terms" section of the logging format.

5.4.2 Bagging

A sufficient quantity of representative cuttings, as specified in the Drilling Program Package, will be placed in ("*plastic-lined cloth sample bags*" -) by the FO Staff. A bag label will be labeled with the date, borehole ID, and depth interval. ("*collector and bag #*" -) A duplicate label printed on non-tearing, waterproof paper will be placed inside the bag, and the bag will be tightly sealed.

5.4.3 Boxing and Labeling

After cuttings have been bagged and labeled, the FO Staff will box the bags in a manner similar to core boxing (Section 5.3.5). The FO Staff will record the sample type, the interval of the samples contained in the box, and the sample existence codes and their intervals on two adhesive labels, each printed with the borehole ID and a bar code. Since each bag of cuttings represents a sample and each sample must be represented on the label, the following example is given to illustrate the format to be used to record similar samples in a continuous existence code:

30.0-70.0; 8 spls @ 5'	REC
70.0-80.0	UNREC
80.0-120.0; 4 spls @ 10'	REC

These labels will then be affixed to ("*in the left-hand...*" -) the downhole end on both the lid and body of the box (Figure 11). The boxes will be sealed with nylon filament strapping tape in preparation for temporary storage at the drill site.

5.5 Other Borehole Samples

The same standards for handling, labeling, and sealing of core and cuttings shall apply to any other borehole samples collected at the drill site. These standards are described above in Sections 5.3 and 5.4.

5.5.1 Blown Core

If drilled, blown core will be collected by FO Staff at the cyclone separator. (+)

5.5.1.1 Collection and Boxing

Drilling of blown core will be done in 2 ft increments. The driller will drill 2 ft, then momentarily cease drilling and circulate to allow all blown core samples to be collected from the caboose. FO Staff will place the blown core samples in 3 ft nominal length waxed cardboard boxes as described in Section 5.3.5 as the samples are retrieved from the caboose. Depth of the sample will be noted by writing the depth of the drilled interval on a styrofoam block and placing the block at the top of the interval. Thus, a block labeled 100-102 ft will be placed above the interval of blown core retrieved from the drilled interval 100-102 ft. No samples will be split between

boxes; i.e. all boxes will contain blown core ending in increments of 2 ft. (+)

5.5.1.2 Logging

Blown core will be geologically logged as described in Section 5.4.1. (+) Look at comments re RQD, struct logging of blown core.

5.5.1.3 Photo

The blown core will be photographed with the instant print camera. Photographic information shall be entered on the Field Photographic Log. (+)

5.5.1.4 Labeling and Sealing

After the blown core has been boxed and logged, the boxes will be labeled and sealed as described in Section 5.4.3. (+)

5.5.2 Lexan Cyclone Tubes

Lexan cyclone tubes shall be affixed to the cyclone separator by FO staff and shall be annotated with the borehole ID. During drilling as the tube is filling up with drilling returns, the depth shall be annotated on the tube at 10 ft increments. When the tube is full, it shall be removed from the cyclone separator and a lexan cap shall be taped securely over the open end. (+)

5.6 Temporary Storage of Borehole Samples

Samples will be maintained in environmental conditions as defined in approved design documents according to AP-510Q. Minimal provisions for temporary storage of borehole samples will include an access-restricted facility protected from direct sunlight, moisture, wind, and freezing temperatures and sufficient space to accommodate other drill site samples. Transmittal of borehole samples from the site to the SMF will be performed at least once every 24 hours during borehole sample recovery periods.

5.7 Shift Drilling Summary

Upon completion of a shift at each borehole site, the Shift Supervisor shall complete the Shift Drilling Summary (Figure 13). Information on the report consists of:

Borehole ID - unique alphanumeric designation assigned to each borehole.

Shift - "Day" or "Night" entered here.

Time - time covered by the shift, expressed in a 24-hour timeclock (0000 - 2400)

Pagination - numbers sequentially assigned to sheets; first blank contains the number of that particular sheet, and the second blank contains the total number of sheets, filled in after completion of the record.

Drilled interval - total interval drilled during the shift.

Core cut - total footage of core cut during the shift.

Core recov'd - total footage of core recovered during the shift.

Completed by and date - Shift Supervisor's signature and date.

Checked by and date - FO Staff not directly responsible for completion of this form but who is trained on this procedure.

Summary of activities - summary of shift activities and may include, but is not limited to: drilling, testing, logging, or standby activities; equipment break-down; unusual features or occurrences encountered; rig changeouts; inspections.

Geologic information - gross lithologic and structural information.

Bit Information - bit type, diameter, and footage drilled by that bit. ("Operating data" changed to "bit information")

Personnel - all personnel on site associated with sample handling activities (+) shall be noted.

5.8 Completion of the Borehole

5.8.1 During and upon completion of drilling activities, the FO Geologist will fill out the Borehole Completion Report (Figure 14). This report is designed to summarize a specific set of borehole information on a single form. It is not intended to be fully comprehensive; rather, it summarizes information that is often referenced during the course of drilling and post-drilling operations.

5.8.2 This report will be filled out as the information becomes available (e.g., 'Location' after survey, 'Total Depth' after completion of drilling). The information on the report consists of:

Borehole ID - unique alphanumeric designation assigned to each borehole.

Grd. elev. - surveyed ground elevation.

TD - total depth drilled; measured from ground elevation.

Location - location noted in two ways: 1) Section, Township, Range, Quarter/Quarter, and 2) Nevada State Surface Coordinates; also, Bottom Hole Coordinates are noted to indicate borehole drift; 'Area' refers to NTS areas.

Inclination and bearing - inclination is degrees from vertical; bearing is a compass trace of the hole.

Completed by / checked by and date - signatures of FO Geologist completing the report and individual checking the report, but not directly responsible for completing the report and is trained on the procedure; and dates.

FO Manager - signature and date upon determining that the report is correctly and completely filled out and complies with procedural requirements.

Rig on loc - date the drilling rig moves on the drilling location.

Spud date - date the drilling begins.

Completion date - date the drilling is completed.

Drilling company - REECO, unless otherwise specified.

Driller(s) - names and shift designation for each driller.

Junk - drilling debris left in the borehole, e.g., bits, core barrels, drill stems.

No. of compressors - number and type of compressor and capacity.

Drilling rigs - rig number, name, and class; primary rig listed first.

Circulating media - air/foam, air, water, etc.

Borehole size - diameters of the borehole as controlled by the bit size.

Casing - different casings, including depths, inside and outside diameters, etc.

Invasion - type (e.g., water, gas), interval, and remarks.

Logging information - names and types of geophysical log suites run.

Correlated tops - name of the unit, formation, or marker; remarks.

Remarks - any pertinent remarks, additional information from the above categories, or footnotes.

5.9 Records Storage

All documents and records related to this procedure and submitted to the SMF will be submitted to the LRC according to QMP-17-01. Working copies will be retained at the SMF Documents Center.

5.10 Identification and Resolution of Discrepancies

A discrepancy exists when there is incorrect information that significantly affects documentation or notation that is beyond the scope of the immediate activity or form being completed. Any discrepancies shall be resolved upon discovery by crossing through the error, correcting it on the original document, and initialing and dating the correction. If the correction is not self-explanatory, the individual shall assign a number to the correction and attach a sheet to the original that fully describes the correction that has been performed.

5.11 Nonconformance Reporting

A nonconformance exists when there is a deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. The intent of nonconformance reporting is to assure the resolution of the conditions not meeting the requirements or to assure that undefined conditions are defined. If there are any nonconformances to this procedure noted during or after associated activities, SM staff members shall report

them to the Project Office Project Quality Manager or other individual in the Project Office QA organization. Reporting and segregation of a nonconforming item or termination of a nonconforming activity will be done according to QMP-15-01.

6.0 REFERENCES

AP-5.10, Use of NTS Contractors on the NNWSI Project.

AP-6.2Q, Management and Operation of Sample Handling Activities at Borehole Sites.

Geological Society of America Rock-Color Chart, 1984.

Project Office Geologic Field Logging Manual.

QAP, NNWSI/88-9, Rev. 2.

QMP-01-02, Stop Work.

QMP-15-01, Rev. 1, Control of Nonconformances.

QMP-17-01, Record Source and Record User Responsibilities.

7.0 FIGURES

- Figure 1 - Example of *Unrecovered* ("~~lost~~" replaced by "*unrecovered*") Core Non-orientation Marks and Marker Placement.
- Figure 2 - Example of Orientation Stripes and Footage Marks.
- Figure 3 - Field Photographic Log.
- Figure 4 - Whole Core Specimen Field Removal Checklist and Contract.
- Figure 5 - Structural Log.
- Figure 6 - Orientation System for Dip Direction.
- Figure 7 - Example of Orientation System and Designation.
- Figure 8 - Example of Piece Length.
- Figure 9 - Lithologic Log.
- Figure 10 - Core Boxing.
- Figure 11 - Field Container Labeling.
- Figure 12 - Example of Photographic Arrangement for Boxed Core.
- Figure 13 - Shift Drilling Summary.
- Figure 14 - Borehole Completion Report.

8.0 QA RECORDS

The FO Administrative Assistant shall ensure that the following QA records resulting from the implementation of this procedure are processed according to QMP 17-01 and turned over to the T&MSS LRC at least every 10 business days. Copies of these QA records will be retained by the SMF and stored at the SMF Documents Center.

1. Field Photographic Log.
2. Whole Core Specimen Field Removal Checklist and Contract.
 ("Structural Log" -. Not a record)
 ("Lithologic Log" -. Not a record)

3. Shift Drilling Summary.
4. Borehole Completion Report.
5. Daily Activities Log.
6. Photographs.

INFORMATION COPY

YUCCA MOUNTAIN PROJECT SAMPLE MANAGEMENT FACILITY

FIELD PHOTOGRAPHIC LOG BTPSMF8-1 5/89

Borehole I D _____ Checked By _____ Date _____ Page ____ of ____

Photographed By _____ Date _____ FO Manager _____ Date _____

Roll		Exposure			Run		Box		Other
No.	ASA	No.	f-stop	Speed	No.	Interval (approx.)	FCT Bar Code #	Interval	

FIELD LOGGING, HANDLING, AND DOCUMENTING BOREHOLE SAMPLES

BTP-SMF-008
REV1 DRAFT

Figure 3. Field Photographic Log.

FIELD LOGGING, HANDLING, AND
DOCUMENTING BOREHOLE SAMPLES

BTP-SMF-008
REV1 DRAFT

YUCCA MOUNTAIN PROJECT SAMPLE MANAGEMENT FACILITY						
WHOLE CORE SPECIMEN FIELD REMOVAL CHECKLIST AND CONTRACT					BTPSMF8-2 5/89	
Recipient _____		Address _____				
Organization _____		_____				
Telephone () _____		(FTS) _____				
Courier _____		_____				
Completed By _____		Date _____			PLACE SHP BAR CODE LABEL HERE	
RSED Director Authorization _____						
Borehole ID _____		Page _____ of _____				
SPECIMEN INFORMATION				CHECKLIST		
SPC Bar Code Label	Affixed?	Interval Removed Date Created	Foam Mkr?	Mkd/ Tag?	Pkgd? Desc.	Photo?
PLACE SPC BAR CODE LABEL HERE						
PLACE SPC BAR CODE LABEL HERE						
PLACE SPC BAR CODE LABEL HERE						
PLACE SPC BAR CODE LABEL HERE						
I hereby acknowledge receipt of the specimens listed above. Please return all remnant material to the Sample Management Facility when no longer needed.						
Recipient _____		Date _____		Time _____ am pm		
SMF Use Only	Checked By _____		Date _____			

Figure 4. Whole Core Specimen Field Removal Checklist and Contract.

YUCCA MOUNTAIN PROJECT SAMPLE MANAGEMENT FACILITY

STRUCTURAL LOG

BTPSMF8-3 5/89

Borehole ID _____ From _____ To _____ Core Diameter _____ Inclination _____ Bearing _____ Page _____ of _____

Completed By _____ Date _____ Checked By _____ Date _____

Bracket / X	Depth	Frac. Origin	Bracket		Orientation	Dip	Frac. Descr.	Frac. Line	Strike Char.	Tect. Feat	Secondary Mineralization									Weathered	Pc. Lgth.		Remarks																			
			Code	Numeric Value							Name	Calcite	Silica	Clay	Mng.	Zeo.	Vpr-ph.	Fe	Unk.		Other	dcml.																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	

FIELD LOGGING, HANDLING, AND DOCUMENTING BOREHOLE SAMPLES

BTP-SMF-008 REV1 DRAFT

Figure 5. Structural Log.

FIELD LOGGING, HANDLING, AND DOCUMENTING BOREHOLE SAMPLES

BTP-SMF-008
REV1 DRAFT

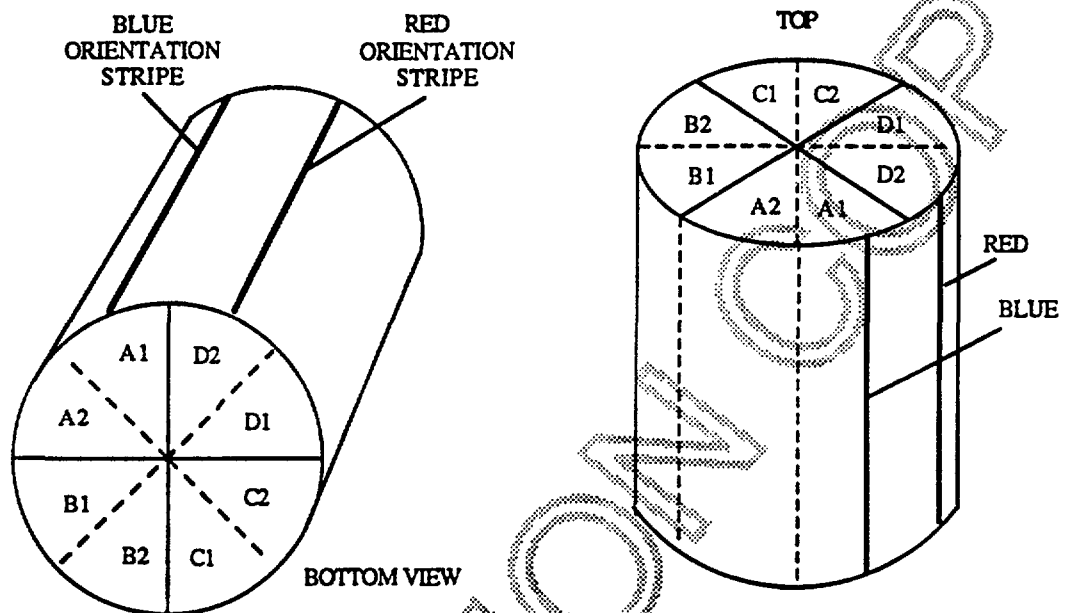


Figure 6. Orientation System for Dip Direction.

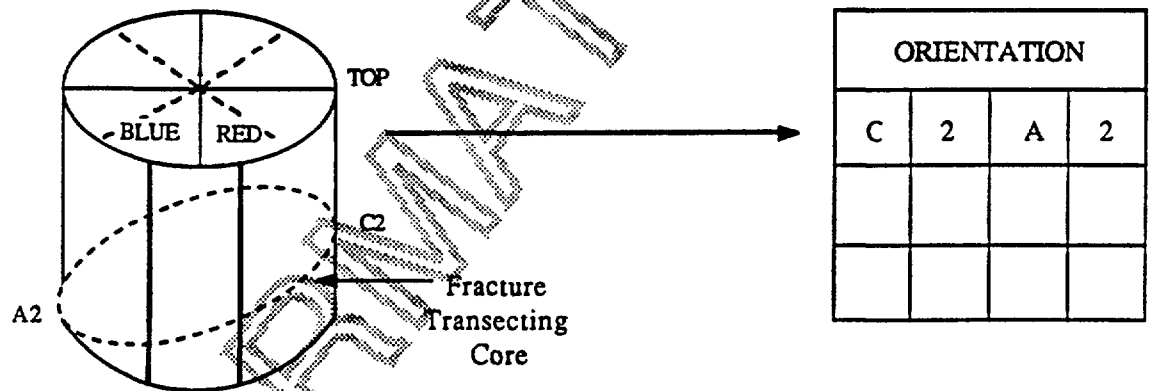


Figure 7. Example of Orientation System and Designation.

BRACKET /X	DEPTH					FRAC. ORIGIN
	1	2	1	0	0	
	1	2	1	0	0	N
	1	2	1	2	0	N

PCLGTH		
↓ dcm.		
2	0	0

Figure 8. Example of Piece Length.

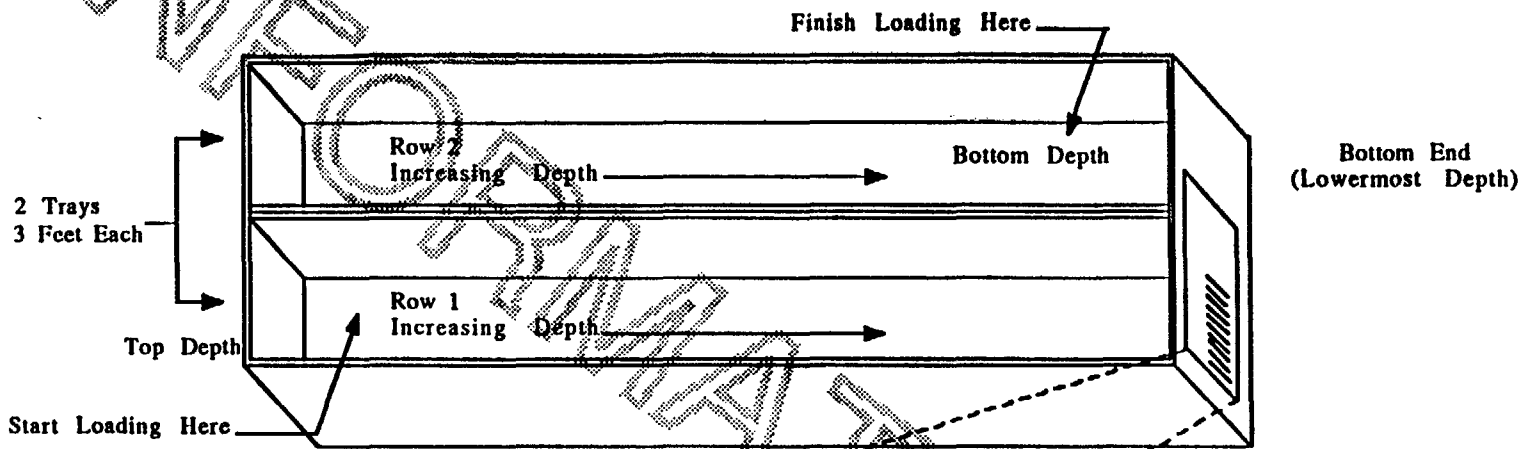



Figure 10. Core Boxing.

YUCCA MOUNTAIN PROJECT

FIELD SAMPLES CORE CUTTINGS

BOREHOLE: _____

INTERVAL: _____ to _____



FCT00010267

STATUS or MISSING:

_____	to	_____	:	_____
_____	to	_____	:	_____
_____	to	_____	:	_____
_____	to	_____	:	_____
_____	to	_____	:	_____
_____	to	_____	:	_____
_____	to	_____	:	_____
_____	to	_____	:	_____

Bottom End (Lowermost Depth)

Figure 11. Field Container Labeling.

FIELD LOGGING, HANDLING, AND
DOCUMENTING BOREHOLE SAMPLES

BTP-SMF-008
REV 1 DRAFT

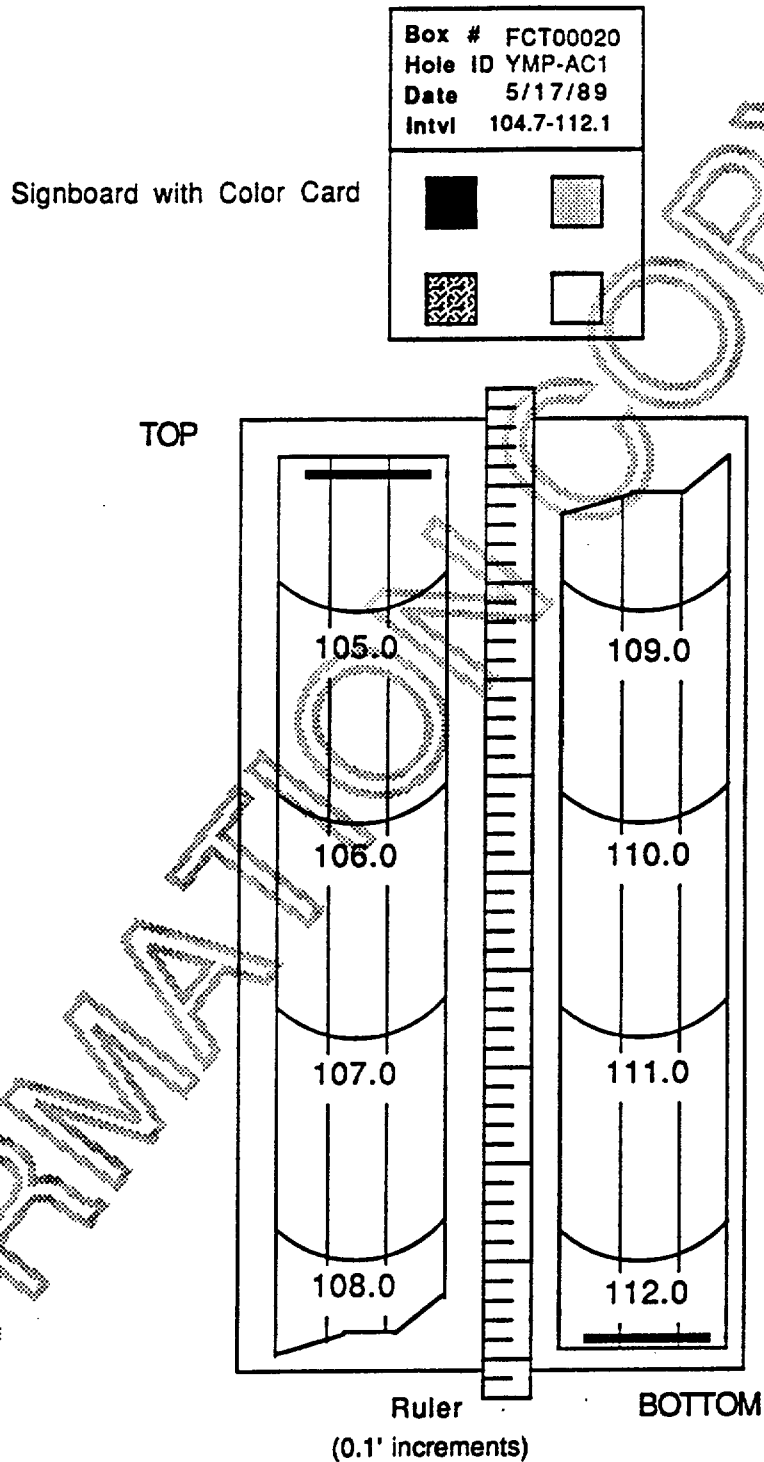


Figure 12. Photographic Arrangement for Boxed Core.

YUCCA MOUNTAIN PROJECT SAMPLE MANAGEMENT FACILITY			
SHIFT DRILLING SUMMARY			BTPSMF8-5 5/89
Borehole ID _____	Shift _____	Date _____	Page _____ of _____
Drilled Interval _____	Cut _____	Recovered _____	% Recovery _____
Completed By _____	Date _____	Checked By _____	Date _____
SUMMARY OF ACTIVITIES _____			
BIT INFORMATION:			PERSONNEL:
Type	Diam.	Footage	SM
			Other

Figure 13. Shift Drilling Summary.

FIELD LOGGING, HANDLING, AND DOCUMENTING BOREHOLE SAMPLES

BTP-SMF-008
REV1 DRAFT

YUCCA MOUNTAIN PROJECT SAMPLE MANAGEMENT FACILITY											
BOREHOLE COMPLETION REPORT						BTPSMF8-6 5/89					
Borehole ID _____			SEC _____ TWP _____ RGE _____ 1/4- 1/4 _____ ; Area _____								
Grd. Elev. _____ T.D. _____			Nev. Surf. Coord. _____ x _____								
			Bottom Hole Coord. _____ x _____								
Hole Inclination _____ Completed By _____ Date _____					Rig On Loc _____						
Bearing _____ Checked By _____ Date _____					Spud Date _____						
FO Manager _____ Date _____					Completion Date _____						
Drilling Company _____				Rig # _____		Name _____		Class _____		Circulating Media	
Driller(s) _____										From To Type	
Junk _____											
No. of Compressors _____											
Capacity _____											
Borehole Size			Casing				Water Invasion				
From	To	Size	From	To	I.D.	O.D.	From	To	Type (Perched/Wtr Table)		
Geophysical Logging Data											
Correlated Tops						Remarks					
Name	From	To	Thickness								

Figure 14. Borehole Completion Report.