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SYSTEM ACCEPTANCE AND OPERABILITY TESTING for ROTARY MODE CORE SAMPLING IN FLAMMABLE GAS TANKS

J. E. Corbett

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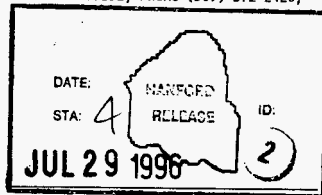
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Abstract: This document provides instructions for the system
acceptance and operability testing of the rotary mode core sampling
system, modified for use in flammable gas tanks.

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SYSTEM ACCEPTANCE AND OPERABILITY TESTING
for
ROTARY MODE CORE SAMPLING
IN FLAMMABLE GAS TANKS

J. E. Corbett

TWRS Characterization Project

WESTINGHOUSE HANFORD COMPANY

JULY, 1996

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1.0 PURPOSE

The purpose of this system acceptance and operability test procedure is to provide instructions for system acceptance and operability testing of the rotary mode core sampling (RMCS) system modified for use on flammable gas tanks. This testing fulfills the applicable requirements of WHC-SD-WM-ETP-177, Section 3.2.7; WHC-SD-WM-FDC-048, Section 5.9; WHC-SD-WM-TP-488; WHC-SD-WM-SAD-035, chapter 6; and WHC-CM-6-1, EP-4.2 (see section 4.3 of this document for complete references).

2.0 SCOPE

System acceptance and operability testing of the Rotary Mode Core Sampling System will verify that system design requirements, as well as functional and operational requirements, have been met. Testing will be completed in two phases. The first phase of testing (section 7) will involve integrating and operating RMCS equipment to demonstrate acceptable operation of systems modified to perform tasks required during sampling of flammable gas tanks. The second phase of testing (section 8) will demonstrate the operational functioning by taking repeated samples in a simulated operational environment. These tests will be conducted at the "Rock Slinger" test site, located just south of U-Plant in the 200 West Area.

Tests will be done in a simulated flammable gas tank environment. All testing will be controlled to prevent contamination release, and stand-in materials shall be used to simulate waste tank conditions. To reduce hazardous waste generated during testing, sampler ball valves will be closed during sampling (no sample will be taken), and samplers may be reused in testing. Systems will interface in a manner similar to that expected in the field.

3.0 RESPONSIBILITIES

Safety, QA, Characterization Project Operations (CPO), Equipment Design (CED), and Field Engineering (CFE) shall approve this test procedure (hereafter referred to as the OTP), prior to its release. Responsibilities are as follows:

Operations Test Director

Responsible for the overall performance of the OTP. Responsible for the proper conduct of operations for the entire test site as well as all personnel involved in the testing. Ensures the execution of all testing activities are within the scope of the OTP. Exercises stop work authority for unsafe activities or activities not conforming to this OTP. Directs the overall conduct and sequencing of testing activities. Ensures configuration management is properly maintained. Directs actions to be taken to prevent injury to employees or damage to equipment. Acts through the core sampling PIC for the proper performance of all operations at the test site. Receives technical advice from CED and CFE engineers on system and equipment design parameters. Maintains cognizance of test exceptions as documented by the CFE Cognizant engineer and the resolution of same. Concurs with all changes and with the acceptability and reliability of the equipment by signing the OTP.

Core Sampling PIC

Responsible for the assignment of personnel and directing the operation of the various systems. Controls configuration and access to the test area in order to maintain a safe environment. Aids the Cognizant Engineer in maintaining configuration control. Approves changes to the OTP in terms of operational steps or equipment configuration with concurrence of CED and CFE cognizant engineer and Operations Test Director. Conducts a pre-job safety meeting at the start of each shift during the performance of the OTP. Briefs the personnel on testing to be performed that day and associated hazards.

CFE Cognizant Engineer

Provides on site technical expertise and advice to the PIC and Test Director as required. Controls the sequence in which the OTP is conducted through the Test Director and with concurrence of CED. Maintains configuration control during testing. Approves any changes to the OTP. Notes exceptions to testing on the "Exception / Resolution Data Sheet." Resolves exceptions with the concurrence of CED and the assigned Quality Engineer for those exceptions relating to items which initially required Quality verification. Concurs with the acceptability and reliability by signing the OTP.

Characterization Equipment Design (CED)

Provides on site technical expertise and advice to the PIC and Test Director as required. Advises Cog. Engineer and Test director on equipment capabilities, recommended test sequence changes, and test requirements. Responsible for issuing any Engineering Change Notices (ECN's) required to support maintaining configuration control during testing. Approves any changes to the OTP. Responsible for obtaining additional support from engineering. Reviews and approves test procedure and test report. Obtains Design Authority approval of test procedure and test report. Resolves any design or project related deficiencies.

Core Sampling Operations Management

Responsible through the Operations Test Director for the overall testing program. Reviews and approves test procedure. Ensures effective safety meeting is held prior to test start. Monitors testing to extent approval may be given for satisfactory equipment operability and reliability.

Core Sampling Operators

Conducts testing according to the OTP procedure as directed by the Operations PIC. Notifies the PIC of concerns, exceptions and off-normal conditions during testing.

Quality Assurance

Reviews and approves test procedure to assure compliance with appropriate regulations. Resolves exceptions requiring quality verification jointly with CFE Cognizant Engineer. Quality verification of exceptions is only necessary for those exceptions relating to items which initially required Quality verification.

Safety

Reviews and approves test procedure to assure compliance with applicable regulations. Monitors testing as appropriate.

CPD Radiological Control

Supports testing according to the OTP procedure as directed by the Operations PIC. Notifies the PIC of concerns, exceptions and off-normal conditions during testing. Ensures work performed is within the scope of the applicable Radiological Work Permit (RWP).

4.0 INFORMATION

4.1 TERMS AND DEFINITIONS

| | |
|-----------|--|
| CE or COG | - Core Sampling Cognizant Engineer |
| CED | - Characterization Equipment Design |
| CFE | - Characterization Field Engineering |
| CPO | - Characterization Project Operations |
| CW/CCW | - ClockWise/Counter ClockWise |
| DA | - Design Authority |
| DS | - Drill String |
| EPDT | - Electrical Power Distribution Trailer |
| FGD | - Flammable Gas Detector |
| FC | - Flow Control |
| FGC | - Flammable Gas Concentration |
| FGWL | - Flammable Gas Watch List |
| HEPA | - High Efficiency Particulate Air |
| HBD | - Hydraulic Bottom Detector |
| HH | - Hydrostatic Head |
| OP | - Operator |
| OTP | - Operability Test Procedure |
| OTR | - Operability Test Report |
| PG | - Purge Gas |
| PIC | - Person In Charge |
| Psi/Psid | - Pound per square inch / Psi differential |
| QA | - Quality Assurance |
| QC | - Quality Control (inspection) |
| RLU | - Remote Latch Unit |
| RMCS | - Rotary Mode Core Sampling |
| RWP | - Radiological Work Permit |
| SCFM | - Standard Cubic Feet per Minute |
| SOV | - Solenoid Operated Valve |
| SR | - Shielded Receiver |
| TD | - Test Director |
| TWRS | - Tank Waste Remediation System |
| VAC | - Volts, Alternating Current |
| XRI | - X-Ray Imager |

4.2 TEST GUIDANCE

Authorization for the implementation of this document is controlled by the associated Engineering Data Transmittal. Approval indicates that the testing called out in this procedure will verify the required performance of the equipment and provide the required protection of personnel.

Operability testing will be completed in two phases. Initial testing will confirm that the modified components are functionally acceptable and will operate over their expected range. Records for this portion of the testing will be documented in the left margin and supplied tables within the text of the procedure. The second phase of testing will involve sampling operations using the closed-valve samplers. The second phase of testing will follow a procedure which is similar to that currently used in the field, revised to accommodate flammable gas controls. Portions of this procedure will be adapted and reused given the nature of the

sampling process. Pertinent operating parameters will be documented on separate "Test Sample Data Sheets" for each sample taken.

Initial instrument calibrations shall be conducted prior to Operability testing. Calibrations will not be reconfirmed for OTP testing as no advantage will be realized. Field validation of some Preventative maintenance and Calibration procedures will be conducted at the same time as the OTP, but these validations will not be included as a part of the formal OTP.

Discrepancies, deviations, or irregularities involving the test procedure or equipment performance are to be noted, as they occur, on the "Exception / Resolution Data Sheet". An exception number shall be noted in the procedure margin, next to the related test section or step. These exceptions shall be jointly resolved between the Cog Engineer, the Design Authority, the Test Director, and the assigned Quality Assurance Representative. Quality verification of exceptions is only necessary for those exceptions relating to items which initially required Quality verification. All resolutions to the exceptions must be agreed upon by the responsible personnel, documented on the exception list, and initialed. Hand written exception sheets may be replaced, if replacement sheets are initialed.

No testing shall be done which directly involves faulty equipment. However, at the discretion of the Cog Engineer and with the concurrence of the Test Director, CED and the PIC, tests may proceed on equipment which is not affected by faulty equipment. Any test exceptions caused by equipment failure not associated, directly or indirectly, with the system modifications for flammable gas tank sampling, should be dispositioned as "general maintenance" on the Exception / Resolution Data Sheet.

If, due to testing circumstances, on-site modifications of the test procedures are warranted, written changes ("redlines") may be made by the core sampling PIC with the written approval (initialing in the left margin) of the Test Director, Cog Engineer and CED. These changes must also be documented on the Exception / Resolution Data Sheet prior to test completion sign-off. Amendments shall be per instructions in WHC-CM-6-1, "Standard Engineering Practices", EP-4.2, "Testing Requirements," Rev. 5, Change 1.

New operating procedures, written for RMCS operations in flammable gas tanks, are referenced for use as directional information within this OTP. These procedures will be approved for use in OTP testing by the Test Director, Cog Engineer and industrial safety. The procedures will be marked as "DRAFT" to prevent unauthorized use in tank farms. The same procedures will be revised for operational use after a formal procedure validation and finalized procedure approval & release. Procedure validations will be performed in parallel with OTP testing, but are not part of any OTP acceptance criteria and are not required for OTP completion sign off. A redlined copy of each of these procedures will be included in the OTR as Appendix 5 for information only. Cog. engineer redlines to these procedures, including the use of "N/A" to mark steps not required for testing, do not require the use of the Exception / Resolution Data Sheet.

4.3 REFERENCES

| | |
|---|---|
| WHC-SD-WM-ETP-177, Rev. 0 | <i>Engineering Task Plan for Core Sampling in Flammable Gas Watch List Tanks</i> |
| WHC-SD-WM-FDC-048, Rev. 0 | <i>Functional Design Criteria for Core Sampling in Flammable Gas Watch List Tanks</i> |
| WHC-SD-WM-TP-488, Rev. 0 | <i>ATP/OTP Test Plan for Rotary Mode Core Sampling in Flammable Gas Tanks</i> |
| WHC-SD-WM-SAD-035, current rev. | <i>Safety Assessment of RMCS in Flammable Gas Single Shell Tanks</i> |
| WHC-CM-6-1; EP-4.2, Rev. 5, Change 1 | <i>Standard Engineering Practices; Testing Requirements</i> |

4.4 SAFETY ISSUES

To reduce the possibility of injury, all persons in the vicinity of the test equipment must be made aware of the following concerns:

- Warning** - The purge gas piping system on the core sample truck is potentially contaminated. Do not vent nitrogen directly to atmosphere. The RMCS exhaustor or other HEPA filtration should be used for nitrogen flow from the purge gas piping system.
- Warning** - Exercise caution concerning loose clothing and pinch points while working on or near rotating equipment.
- Warning** - Personal protective equipment should be used during testing, such as safety glasses, gloves, hearing protection and safety shoes, when appropriate.
- Warning** - At times, nitrogen gas will be supplied to the sample truck at high pressure. Breaking containment of a pressurized cavity will cause a rapid release of gas. All indicators must be observed so that each cavity is vented prior to being opened.
- Warning** - Avoid contact with liquid nitrogen. The nitrogen in the Liquid Nitrogen Support Trailer nitrogen tank and vaporizer supply line is a liquid and is stored at high pressure and extremely low temperatures (-320°F). Exposure at these conditions will freeze skin, causing severe "burns."
- Warning** - Pressure relief venting of the propane supply on the nitrogen trailer can occur unexpectedly. The vent line for the propane is the copper tubing on the right side of the trailer and the outlet is below and at the rear of the trailer. All flammability warnings posted on the nitrogen trailer must be observed.
- Warning** - If engines need fuel, refuel only when the engines are cool.

Warning - Stand clear of exhaust pipes on the test equipment.

Warning - The warning sirens on the sample truck are very loud.

Note - Under normal conditions, periodic venting of the nitrogen trailer will occur. Venting is automatic when excessive pressure builds in the nitrogen storage tank. The vent outlet is located near the right rear of the trailer on top of the enclosure.

4.5 RADIATION AND CONTAMINATION CONTROL

All testing will be controlled to prevent contamination release, and stand-in materials shall be used to simulate waste tank conditions. All test activities must comply with the requirements listed in the RWP issued for this test.

4.6 QUALITY ASSURANCE

Quality Assurance shall approve of the Operability Test Procedure prior to its release. A Quality Control representative shall verify all steps requiring QC verification during testing.

4.7 SYSTEM ALARM ACTIVATION AND CANCELLATION

The sample truck is equipped with two alarm systems. The hydraulic bottom detector (HBD) system prevents excessive downward force from being applied to the drill bit. The sequence of events to complete should an HBD alarm go off will be described within the test procedure.

The second alarm system is computer controlled. The computer will warn the operator if conditions are not acceptable. Most of the alarms function in the same way, but because some alarms are more serious than others, the required operator response will vary. The alarms which are critical and require immediate operator action will be forced to occur during testing in section 7.7. The sequence of events to complete should an unanticipated alarm go off, is as follows:

- 1) NORMAL CONDITION - No lights on or flashing.
 - Continue as is.
- 2) UNACKNOWLEDGED ALARM - Warning light flashes fast.
 - Press ACKNOWLEDGE button.
 - Make appropriate adjustment.
 - Press RESET button.
- 3) ACKNOWLEDGED ALARM - Warning light stays on.
 - Unacceptable condition is still present.
 - Make appropriate adjustment.
 - Press RESET button.

4) ALARM NORMALIZED - Warning light flashes slow.

- Unacceptable condition is gone.
- Press RESET button.
- Verify alarm clears.

5) FULL ALARM - Siren and Strobe both go off.

- Unacceptable condition exists for a critical parameter.
- Press ACKNOWLEDGE to silence horn and strobe.
- Correct problem or truck may shut down.
- Press RESET when condition 4 exists.

4.8 ACCEPTANCE CRITERIA

Items to be tested in the OTP which are critical, in relation to safe core sampling operations in flammable gas tanks, are part of the critical alarm instrumentation (engine shutdown) system. All of the alarm checks shall be accepted ONLY if they operate within the limits defined in the SA for core sampling in flammable gas tanks (WHC-SD-WM-SAD-035). Flow rate, pressure, and leak rate criteria will be applied to the Purge Gas system.

The remainder of this test verifies basic operation functions of the equipment. Except where otherwise noted, the acceptance criteria for these remaining test sections is based on the operability of the equipment modified for flammable gas tank sampling, functioning in an operational scenario. Each step shall be evaluated and signed off by the cognizant engineer as well as Operations to verify that the equipment is acceptable for field use.

Qualification testing to validate quantitative reliability data is not a requirement of this test. Reliability of the modified equipment shall be evaluated qualitatively during sampling operations, section 8.0, as well as throughout this test procedure. Reliability shall be based on the number of evolutions required to ensure operability of the modified equipment. Acceptable reliability based on these evolutions shall be determined by the judgement of the cognizant engineer and the operations manager. The acceptance of the overall reliability of the modifications to the system is documented by signatures on the test completion sign-off sheet.

All persons responsible for signing the test completion sign-off sheet shall perform a joint test group review of the completed procedure to verify technical acceptability of all data and exception resolutions.

5.0 RECORDS

Pertinent operating conditions will be documented where requested in the OTP. Records for the testing of equipment, (section 7), will be recorded within the procedure. The operator, (and other test personnel requested to do so), will initial in the space provided in the left-hand margin upon satisfactory completion of designated tasks. All persons initialing within this procedure (including the Exception / Resolution Data Sheet) will initial and sign the Signature Log Sheet.

Information whose acceptance condition is designated as "For Record Only" may vary. This information may be subject to the situation at hand; therefore, it is left to the equipment operator and cognizant engineer and PIC to determine whether the equipment operates acceptably.

Operating parameters for the sample collection phase of testing, (section 8), will be recorded on a separate "Test Sample Data Sheet" for each sampling cycle. All data recorded on the data sheet is designated "For Record Only".

A post test review meeting will be held within one week of test completion. All test data will be released, as an Operability Test Report, after the conclusion of OTP testing.

6.0 PREREQUISITES

6.1 EQUIPMENT and SUPPLIES

| EQUIPMENT UNDER TEST | TEST SUPPORT SUPPLIES |
|----------------------------------|--|
| Rotary Mode Core Sample Truck | Breathing Air Compressor |
| RMCS Exhauster | Sample Cask Transport Truck |
| Nitrogen Trailer | X-ray Imager |
| Portable Electric Generator | Support Truck, with water, heater & Pump |
| Electrical Power | Pneumatic Foot Clamp |
| Distribution Trailer | Cask Stand |
| FGD Interlock | Transport Casks with Liners |
| Riser Sleeve and Spray Washer | Hand Levels |
| Drill Rod | Tape Measure |
| Core Barrel and Rotary Drill Bit | Cask Adapters and Cap |
| Riser Equipment and Gaskets | PVC Sleeves |
| Sampler Change Out Assembly | Pull Rod Container |
| Non-sparking Tools | Universal Samplers |
| Drill String Locking Collar | Cable Spray Washer and Cap |
| | Plastic Sheeting/Sleeving and Bags |
| | Rubber Matting |
| | Kraft Paper |
| | Permanent Ink Fine Point Marker |
| | Stop Watch |
| | Soap Test Solution |
| | Kamlok Adapters and Caps |
| | (for quill Rod and Drill String) |
| | Jack Collars |
| | Waste Simulants |
| | Waste Receptacles |
| | Test Pit Modification Equipment |
| | (with riser flanges) |

6.2 PROCEDURES

TO-060-345, Liquid Nitrogen Support Trailer and Indeeco Nitrogen Heater Operations

TO-020-900, Onan 150DGFA Generator Set Operation

TO-020-056, Operate the Aeroflow Model 2AN137 Breathing Air Compressor

TO-020-451, Perform Setup and Takedown of Rotary Truck at Waste Storage Tanks [DRAFT]

TO-080-518, Perform Rotary Core Sampling of Hydrogen/Flammable Gas Watchlist Waste Storage Tanks [DRAFT]

TO-060-342, Operate Rotary Mode Sampling System Exhauster #4 (EXH-C) [DRAFT]

6.3 CONDITIONS

- ▶ The Job Hazard Analysis must be complete prior to test start.
- ▶ Pre-job safety meetings shall be held at the start of each shift during testing.
- ▶ PRE-START INSPECTION (Appendix 3 Data Sheet) shall be completed EVERY time the RMCS truck is powered up.
- ▶ Calibrations and PM's shall be current and complete prior to testing effected equipment.
- ▶ All work packages for installation/functional check of flammable gas modifications must be work complete prior to related testing.
- ▶ Exhauster post-modification functional test must be complete, per ETP-182 Rev. 1.
- ▶ FGD Interlock ATP must be complete, per ATP-HEIF-0001.

7.0 TEST PROCEDURE (EQUIPMENT)

7.1 EQUIPMENT IDENTIFICATION AND SETUP

NOTE: The following steps are intended to verify all fittings and receptacles mate properly. If a connection was made previously, **VERIFY** connection and initial step. Refer to the setup procedure listed in 6.2 if connection or grounding details are required.

OP/ICE ____/____ 7.1.1 **POSITION** RMCS equipment, listed in the table below, in a convenient location to allow testing.

OP/ICE ____/____ 7.1.2 PIC or Cog Engineer, **RECORD** the identification numbers for the major components used in this procedure in the table below. Use the blank lines to record any changes made (record test sections effected by the change).

| COMPONENT | IDENTIFICATION * NUMBER |
|--|----------------------------|
| Core Sample Truck | |
| Exhauster | |
| Flammable Gas Detector (FGD) Interlock | |
| Liquid Nitrogen Support Trailer | |
| Breathing Air Compressor | |
| Portable Generator | |
| Electrical Power Distribution Trailer (EPDT) | |
| Service Trailer | |
| Support Truck | |
| X-Ray Imager (XRI) | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

* For equipment identification, use HO# or other unique identifier.

OP/ICE ____/____ 7.1.3 **CONNECT** the electrical grounding wires from the generator and EPDT to an acceptable ground at the test site.

- OP/CE ____/____ 7.1.4 **CONNECT** the electrical grounding wire from the service trailer to an acceptable ground at the test site.
- OP/CE ____/____ 7.1.5 **CONNECT** the electrical grounding wire from the exhauster to an acceptable ground at test site.
- OP/CE ____/____ 7.1.6 **CONNECT** electrical grounding wire from the FGD Interlock to an acceptable ground on riser flange.
- OP/CE ____/____ 7.1.7 **CONNECT** intrinsic safety barrier ground wires from the sample truck to an acceptable ground on riser flange.
- OP/CE/QC ____/____/____ 7.1.8 **VERIFY** resistance between intrinsic safety barrier ground lug and riser flange ground is 1 ohm or less.
- OP/CE ____/____ 7.1.9 **CONNECT** the EPDT to the generator using the cable reel on the EPDT.
- OP/CE ____/____ 7.1.10 **CONNECT** the 120/240 volt power cable to the sample truck from the EPDT. The receptacle is on the driver's side of the truck, near the ladder on the stationary platform.
- OP/CE ____/____ 7.1.11 **CONNECT** the air compressor to the EPDT. The air compressor is attached to the core sample truck frame on the passenger side beneath the rotating platform.
- OP/CE ____/____ 7.1.12 **CONNECT** the service trailer to the EPDT with the cable located on the EPDT.
- OP/CE ____/____ 7.1.13 **CONNECT** the X-Ray Imager to the EPDT with the cable located on the X-Ray Imager.
- OP/CE ____/____ 7.1.14 **CONNECT** the 240 volt power cable to the water heater receptacle on the support truck.
- OP/CE ____/____ 7.1.15 **ENSURE** exhauster equipment is connected between exhauster skid and test riser flange, including flexible duct, flange & adapter rings, instrument stand, and seal pot outlet line.
- OP/CE ____/____ 7.1.16 **ENSURE** signal and power cables are connected between FGD Interlock components (power distribution skid, carts, sampler spool piece/junction box, and riser instrument stand).
- OP/CE ____/____ 7.1.17 **CONNECT** the signal cable from the FGD interlock cart to the exhauster.
- OP/CE ____/____ 7.1.18 **CONNECT** a 120 volt control cable from each FGD interlock cart to the exhauster.
- OP/CE ____/____ 7.1.19 **CONNECT** the pressure shutdown control cable from the exhauster skid to the exhaust riser instrument stand.
- OP/CE ____/____ 7.1.20 **CONNECT** the 480 volt power cable from the EPDT to the FGD interlock power distribution skid.

- OP/CE ___/___ 7.1.21 **CONNECT** the 480 volt power cable from the FGD interlock power distribution skid to the exhauster.
- OP/CE ___/___ 7.1.22 **CONNECT** the 120 volt power cable from the nitrogen trailer to the diesel generator (the propane generator on the nitrogen trailer is not required for this test).
- OP/CE ___/___ 7.1.23 **CONNECT** the 480 volt power cable between the breathing air compressor and the generator.
- OP/CE ___/___ 7.1.24 **PLUG IN** the 480 volt space heater to the EPDT.
- OP/CE ___/___ 7.1.25 **CONNECT** the exhauster interlock cable from the exhauster to the sample truck.

NOTE: In the following step, a 7 ft. test unique riser sleeve will be used instead of the 15 ft. operational riser sleeve.

- OP/CE ___/___ 7.1.26 **CONNECT** the core sampling riser equipment to the test pit drilling riser.
- OP/CE ___/___ 7.1.27 **CONNECT** the nitrogen supply line from the nitrogen trailer to the sample truck. The receptacle on the truck is located below the platform by the driver's door.
- OP/CE ___/___ 7.1.28 **CONNECT** the nitrogen supply line from the nitrogen trailer to the exhauster. The receptacle on the exhauster is next to the fan motor housing.
- OP/CE ___/___ 7.1.29 **CONNECT** the nitrogen VENT TO TANK line from the sample truck to the vent port on the riser sleeve.
- OP/CE ___/___ 7.1.30 **CONNECT** the nitrogen RISER SLEEVE PURGE line from the sample truck to the drill rod washer.
- OP/CE ___/___ 7.1.31 **CONNECT** the spray wash water supply hose from the support truck to the drill rod spray wash connection on the riser sleeve flange.
- OP/CE ___/___ 7.1.32 **DISCONNECT** the spray wash water supply hose from the riser sleeve flange, and **CONNECT** hose to the riser sleeve spray wash connection on the riser sleeve spray washer assembly.
- OP/CE ___/___ 7.1.33 **VERIFY** unique connections are provided for both the drill string and riser equipment nitrogen purge systems and spray wash systems, as well as the hydrostatic head systems for the drill string and shielded receiver.
- OP/CE ___/___ 7.1.34 **DISCONNECT** the nitrogen supply line from the sample truck, and the spray wash water supply hose from the riser sleeve spray washer.

7.2 CORE SAMPLE TRUCK START UP

NOTE: When truck electronics are powered up, a 20 min warm up period is required prior to operation.

NOTE: Whenever truck electronics are powered up without establishing nitrogen supply pressure and Z-purge flow, the LOW PURGE GAS PRESSURE and SR WEATHER COVER PG PRESSURE alarms will sound. These alarms should be acknowledged and no further action taken prior testing in sections 7.6 & 7.7.

- OP/CE ____/____ 7.2.1 **OPERATE** the generator as required throughout testing. (See operating procedures listed in 6.2)
- OP/CE ____/____ 7.2.2 **ACTIVATE** all breakers on the POWER DISTRIBUTION panel, located on the control console.
- OP/CE ____/____ 7.2.3 **TURN ON** the power switches for the ENCODER ASSEMBLY and MOTOR CONTROL panels.
- OP/CE ____/____ 7.2.4 **TURN** the air compressor ON and allow it to run until it automatically shuts off.
- OP/CE ____/____ 7.2.5 **START** the drill rig engine as directed below (operate the drill engine as required throughout testing):
- 7.2.5.1 **ENSURE** that the five (5) HYDRAULIC JACK leveling control valves are closed.
 - 7.2.5.2 **PLACE** the 4-way manual valve in the HEAD position.
 - 7.2.5.3 **ENSURE** that the clutch is DISENGAGED and the chuck is CLOSED.
 - 7.2.5.4 **PUSH** and **HOLD** the black start button and **TURN** the key clockwise to start the drill engine. **ADJUST** the throttle to approximately 1500 RPM.

7.3 DRILL RIG MANEUVERING

NOTE: The sample truck is raised by hydraulic rams, located at the front and rear of the truck, and is leveled using portable hand levels. The center jacks, consisting of two additional rams located on each side of the truck, are used to stabilize the truck for platform rotation. The center jacks are not designed to withstand heavy loads, and should only be lowered after lowering the front and rear lifting jacks. When leveling the truck, lower the rams slowly so that the truck is lifted uniformly. The hydraulic controls associated with leveling are the 4-way manual control valve and the turn valves which control flow to each of the jacks.

OP/CE ____/____ 7.3.1 **ENSURE** hydraulic hoses, lines, and fittings are clean and do not exhibit any visible leakage.

OP/CE ____/____ 7.3.2 **LEVEL** the sample truck by referring to the set up procedure listed in 6.2, or by using the following steps:

7.3.2.1 **PLACE** the 4-way control valve in the FLOAT position.

7.3.2.2 **CONNECT** the hydraulic leveling hoses from the main reservoir to the leveling system. The hoses are stored and coupled near the right rear leveling ram.

7.3.2.3 **PLACE** the 4-way control valve in the RAISE position.

7.3.2.4 **LOWER** the front and rear lifting jacks to the ground using the control valves.

7.3.2.5 **LEVEL** the truck at convenient height for testing.

7.3.2.6 **LOWER** the two side stabilizer jacks to the ground.

7.3.2.7 **INSTALL** the jack collars on each jack.

7.3.2.8 **PLACE** the 4-way control valve in the FLOAT position.

7.3.2.9 **DISCONNECT** and **STORE** the hydraulic leveling hoses.

WARNING: For the following platform rotation, and throughout testing, always ensure that the drill head, SR, and drill rig are positioned to avoid equipment damage prior to moving the rotating platform. Whenever practical, the drill head and SR should be in the up position and the drill rig transversely centered before making any rotation.

NOTE: For the following steps in this test, the Control Select Panel is used to select either pendant or control console hydraulic controls. When in pendant control, traverse and fast rotation are available using the control console as well as the pendant. For all other control/command combinations, the control selected is enabled and the other control is locked out.

- OP/CE ____/____ 7.3.3 **VERIFY** the SLOW ROTATION mode for both the console and pendant in both the CW and CCW directions. Rotation should automatically stop at the limits.
- OP/CE ____/____ 7.3.4 **VERIFY** the FAST ROTATION mode for both the console and pendant in both the CW and CCW directions. Rotation should start after the alarm sounds and a 3 second delay, and should automatically stop at the limits.
- OP/CE ____/____ 7.3.5 **ROTATE** the platform so that the SR is at the rear of the truck.
- OP/CE ____/____ 7.3.6 **HOLD** the console TRAVERSE switch to FORWARD to fully extend the SR then **RETRACT**. Also **VERIFY** operation of the pendant TRAVERSE controls.
- OP/CE ____/____ 7.3.7 **EXTEND** the SR over the edge of the platform. **VERIFY** the SR UP/DOWN operation on the control panel and pendant.
- OP/CE ____/____ 7.3.8 **ENSURE** the SR is in the up position, and drill rig is centered.
- OP/CE ____/____ 7.3.9 **ROTATE** the platform to position the drill rig to the rear.
- OP/CE ____/____ 7.3.10 **VERIFY** the slew operation for both console and pendant controls. (The drill should slide about 4 inches from center each way.)
- OP/CE ____/____ 7.3.11 **HOLD** the console TRAVERSE switch in the REVERSE position to fully extend the drill rig then **RETRACT**. Also **VERIFY** operation of the pendant TRAVERSE controls.
- OP/CE ____/____ 7.3.12 **LOWER** the drill head while monitoring the digital depth display and mechanical position indicator. **VERIFY** one foot change on the digital depth display corresponds to approximately one foot change on the mechanical position indicator.

- OP/CE ___/___ 7.3.13 **RAISE** the drill head while monitoring the digital depth display and mechanical position indicator. **VERIFY** one foot change on the digital depth display corresponds to approximately one foot change on the mechanical position indicator.
- OP/CE ___/___ 7.3.14 **LOWER** the drill head while monitoring the penetration rate display and mechanical position indicator. Using a stopwatch, **VERIFY** one inch per second drill head travel corresponds to approximately one inch per second penetration rate on the digital display.
- OP/CE ___/___ 7.3.15 **RAISE** the drill head while monitoring the penetration rate display and mechanical position indicator. Using a stopwatch, **VERIFY** one inch per second drill head travel corresponds to approximately one inch per second penetration rate on the digital display.
- OP/CE ___/___ 7.3.16 **VERIFY** hydraulic hoses, lines, and fittings do not exhibit any visible leakage.

7.4 SAMPLE ACTUATOR / HBD (HYDRAULIC BOTTOM DETECTOR)

The grapple hoist motor control is interlocked to the grapple hoist load cell. The hoist motor will automatically stop when the load cell detects a load ≥ 250 lbs.

- OP/CE ___/___ 7.4.1 **VERIFY** the load cell loop calibration is completed using the above set point (Ref. 6-ES-415).
- OP/CE ___/___ 7.4.2 **POSITION** the platform to allow actuator testing.
- OP/CE ___/___ 7.4.3 **PLACE** the mode switch to GRAPPLE LOWER and **HOLD** the HOIST switch in the DOWN position to lower the grapple through the quill rod adapter.
- OP/CE ___/___ 7.4.4 **TURN OFF** the grapple load cell power switch and **VERIFY** the hoist will not operate, then **TURN ON** the grapple load cell power switch.
- OP/CE ___/___ 7.4.5 **TEST** the hoist speed control at various settings, then **SET** a moderate hoist speed for further testing.
- OP/CE ___/___ 7.4.6 **COMPLETE** the steps below to verify slack detection capability. The hoist motor should stop when the load cell display is approximately 9 to 12 pounds.
- 7.4.6.1 **PLACE** the grapple mode switch to GRAPPLE LOWER, then **HOLD** the HOIST switch in the DOWN position to lower the grapple until slack in the cable automatically stops the hoist motor.
- 7.4.6.2 **VERIFY** HYDRAULIC INTERLOCK light on the control console is ON.

CAUTION: If the hydraulic interlock does not function properly, upward movement of the ram, when the grapple cable is slack, can cause cable misalignment on the hoist drum. During the following interlock test DO NOT allow ram movement to cause more than 1/4 inch change in ram position indication while the HYDRAULIC INTERLOCK light is ON.

7.4.6.3 **VERIFY** hydraulic rams cannot be raised.

7.4.6.4 **VERIFY** HYDRAULIC INTERLOCK light remains ON.

7.4.6.5 **REMOVE** the slack by placing the mode switch to SAMPLING POSITION and holding the HOIST switch to UP until the hoist stops when slack is removed.

7.4.6.6 **VERIFY** HYDRAULIC INTERLOCK light is OFF.

OP/CE ____/____ 7.4.7 **PLACE** the grapple mode switch to GRAPPLE LOWER then **HOLD** the HOIST switch to UP to raise the grapple into the quill rod.

OP/CE ____/____ 7.4.8 **INSERT** a pintle rod into the grapple.

OP/CE ____/____ 7.4.9 **HOLD** the HOIST switch in the UP position to raise the grapple until the pre-pintle release switch stops the hoist.

OP/CE ____/____ 7.4.10 **VERIFY** that the HYDRAULIC INTERLOCK light is ON.

CAUTION: If the hydraulic interlock does not function properly, downward movement of the ram, while the grapple is in the UP position, can destroy the actuator system. During the following interlock test DO NOT allow ram movement to cause more than 1/4 inch change in ram position indication or to exceed 200 pounds on load cell reading, while the HYDRAULIC INTERLOCK light is ON.

OP/CE ____/____ 7.4.11 **VERIFY** hydraulic rams cannot be lowered.

OP/CE ____/____ 7.4.12 **HOLD** the pintle release switch to the UP LIMIT BYPASS position and the HOIST switch to UP until the pintle rod releases.

OP/CE ____/____ 7.4.13 **VERIFY** HYDRAULIC INTERLOCK light remains ON.

OP/CE ____/____ 7.4.14 **DEPRESS** the DOWN BYPASS button then **HOLD** the HOIST switch to DOWN to lower the grapple until the HYDRAULIC INTERLOCK light goes out.

OP/CE ____/____ 7.4.15 **ENSURE** 5 to 10 feet of drill string is installed into the test pit drilling riser and connected to the quill rod.

OP/CE/QC ____/____/____ 7.4.16 **VERIFY** the maximum speed of the grapple hoist is ≤ 1 ft/sec by performing the following steps:

7.4.16.1 **RECORD** drill string length (including all sections below the grapple) in the following table.

- 7.4.16.2 **LOWER** the grapple, at maximum speed, to the bottom of the drill string, using a stop watch to measure time required to travel the length of drill string.
- 7.4.16.3 **RECORD** elapsed time in the table below (TRIAL 1).
- 7.4.16.4 **RAISE** the grapple, at maximum speed, to the top of the drill string, using a stop watch to measure time required to travel the length of drill string.
- 7.4.16.5 **RECORD** elapsed time in the table below (TRIAL 2).
- 7.4.16.6 **CALCULATE** and **RECORD** grapple hoist speeds in the table below.

| PARAMETER | CONDITION | TRIAL 1 | TRIAL 2 |
|-----------|--------------------------|---------|---------|
| Distance | feet, FOR RECORD ONLY | | |
| Time | seconds, FOR RECORD ONLY | | |
| Speed | ft/sec, MUST BE ≤ 1 | | |

7.4.17 **TEST** the HBD as directed below:

NOTE: On the final sample, when the full ram stroke is complete or should the drill bit contact the bottom of the tank, the HBD alarm will go off and flow to the rams will automatically be reversed; thus separating the drill bit from the bottom of the tank.

- OP/CE ___/___ 7.4.17.1 **POSITION** suitable material beneath the drill head for HBD testing.
- OP/CE ___/___ 7.4.17.2 **PLACE** the 4-way valve in the HEAD position.
- OP/CE ___/___ 7.4.17.3 **ENSURE** that the DOWN hydraulic control valve is CLOSED.
- OP/CE ___/___ 7.4.17.4 **OPEN** the UP ram control about 1/3 of a turn.
- OP/CE ___/___ 7.4.17.5 **TURN** the LOWER RAM PRESSURE/SET POINT switch on the instrumentation enclosure to SET POINT, then **ADJUST** the LOWER RAM PRESSURE SET POINT dial to 80 to 120 psig.
- OP/CE ___/___ 7.4.17.6 **RECORD** the set point pressure, as indicated on the LOWER RAM PRESSURE/SET POINT readout, in the table below.
- OP/CE ___/___ 7.4.17.7 **PUSH** and **HOLD** the START BYPASS button on the HBD Panel.
- OP/CE ___/___ 7.4.17.8 **PLACE** the 4-way control valve in the LOWER position.
- OP/CE ___/___ 7.4.17.9 When the UP and DOWN ram gauge pressures stabilize, **TURN** the HBD DRILL key ON then **RELEASE** the START BYPASS button.

- OP/CE ___/___ 7.4.17.10 **TURN** the LOWER RAM PRESSURE/SET POINT switch to PRESSURE.
- OP/CE ___/___ 7.4.17.11 **LOWER** the drill head until the alarms activate as the pressure is reached.
- OP/CE ___/___ 7.4.17.12 **TURN** the HORN knob to SILENCE to quiet the siren, **POSITION** the 4-way valve to FLOAT to stop the rams, and **ROTATE** the DRILL key on the HBD panel to OFF to stop the strobe and disable the HBD.
- OP/CE/QC ___/___/___ 7.4.17.13 **DOCUMENT**, in the table below, whether the HBD ram reversal and alarm activation occur at the recorded pressure or not.

| PARAMETER | CONDITION | TRIAL 1 | TRAIL 2 | TRAIL 3 |
|------------------------|-----------|---------|---------|---------|
| HBD Set Point Pressure | psig | | | |
| HBD Activation | OK/BAD | | | |

- OP/CE ___/___ 7.4.17.14 **RETURN** to step 7.4.15 and **REPEAT** process at two additional set point pressures.

7.5 SHIELDED RECEIVER / REMOTE LATCH UNIT

- OP/CE ___/___ 7.5.1 **ROTATE** the platform to allow shielded receiver (SR) and remote latch unit (RLU) testing.
- OP/CE/QC ___/___/___ 7.5.2 **VERIFY** the maximum speed of the sampler hoist is ≤ 1 ft/sec by performing the following steps:
- 7.5.2.1 **LOWER** the RLU into the drill string.
 - 7.5.2.2 **RECORD** encoder display reading in the following table (TRIAL 1).
 - 7.5.2.3 **LOWER** the RLU, at maximum speed, to the bottom of the drill string, using a stop watch to measure time required to travel the length of drill string.
 - 7.5.2.4 **RECORD** elapsed time and encoder display reading in the following table (TRIAL 1).
 - 7.5.2.5 **RAISE** the RLU, at maximum speed, to the top of the drill string, using a stop watch to measure time required to travel the length of drill string.
 - 7.5.2.6 **RECORD** elapsed time and encoder display reading in the following table (TRIAL 2).
 - 7.5.2.7 **CALCULATE** and **RECORD** sampler hoist distance and speeds in the following table.

| PARAMETER | CONDITION | TRIAL 1 | TRIAL 2 |
|----------------|--------------------------|---------|---------|
| Encoder, start | feet, FOR RECORD ONLY | | |
| Encoder, end | feet, FOR RECORD ONLY | | |
| Time | seconds, FOR RECORD ONLY | | |
| Distance | feet, FOR RECORD ONLY | | |
| Speed | ft/sec, MUST BE ≤ 1 | | |

OP/CE ____/____ 7.5.3 **TURN OFF** the SR load cell power switch and **VERIFY** the hoist will not operate, then **TURN ON** the SR load cell power switch.

7.5.4 **PERFORM** the following steps to test the load cell:

OP/CE ____/____ 7.5.4.1 **LOWER** the RLU through the SR.

OP/CE ____/____ 7.5.4.2 **RECORD** the load-cell weight in the following table.

OP/CE ____/____ 7.5.4.3 **ATTACH** an empty sampler to the RLU.

OP/CE ____/____ 7.5.4.4 **RECORD** the load-cell weight in the following table.

OP/CE ____/____ 7.5.4.5 **CALCULATE** and **RECORD** below the sampler weight.

| LOADING | CONDITION | LOAD-CELL WEIGHT |
|----------------------|-----------------|------------------|
| RLU + Sampler Weight | For Record Only | |
| RLU Weight | For Record Only | |
| Sampler Weight | For Record Only | |

7.5.5 **TEST** the latch unit as directed below:

OP/CE ____/____ 7.5.5.1 **RAISE** the RLU and sampler into the SR, then **ATTACH** a core barrel and drill bit to the SR.

OP/CE ____/____ 7.5.5.2 **LOWER** the sampler into the core barrel. The hoist will automatically stop when cable slack is detected. **VERIFY** load cell display is approximately 20 pounds when the hoist motor stops.

OP/CE ____/____ 7.5.5.3 **OBSERVE** the load cell display as the RLU releases the sampler. The sampler is released when the load cell weight is no longer changing (approximately 2 minutes).

OP/CE ____/____ 7.5.5.4 **RAISE** the RLU into the sight glass and **VERIFY** that the sampler is not attached.

OP/CE ____/____ 7.5.5.5 **LOWER** the RLU onto the sampler (the hoist will automatically stop when cable slack is detected).

- OP/CE ____/____ 7.5.5.6 **RELEASE** the hoist switch.
- OP/CE ____/____ 7.5.5.7 **SET** hoist speed control to 0%, **HOLD** hoist switch in UP position, and slowly **INCREASE** speed control to raise the sampler into the sight glass.
- OP/CE ____/____ 7.5.5.8 **VERIFY** that the sampler is attached to the RLU. If sampler is **NOT** attached, repeat the above three steps one additional time.
- OP/CE ____/____ 7.5.5.9 **RETURN** to step 7.5.3 and **REPEAT** process a minimum of ten times.
- OP/CE ____/____ 7.5.5.10 **POSITION** the RLU, with sampler attached, over transport cask.
- OP/CE ____/____ 7.5.5.11 **LOWER** the sampler into the cask and **RELEASE** the sampler from the RLU.

7.6 NITROGEN SUPPLY SYSTEM

- OP/CE ____/____ 7.6.1 **ENSURE** all manual purge gas flow control valves on the truck are closed and the nitrogen supply line from the nitrogen trailer to the sample truck is disconnected. The receptacle on the truck is located below the platform by the driver's door.
- OP/CE ____/____ 7.6.2 For each of the switch settings shown in the below table, **VERIFY** the proper response on indicator light panel.

| SWITCH SELECTIONS | | | | Type of Command | INDICATOR LIGHT | | | | CONDITION |
|-------------------|------------------------------|-------------------------|-------------|-----------------|-----------------|-----------|-----------|-------------|-----------|
| Purge gas | Pressurize shielded receiver | Pressurize drill string | Mode | | SOV 14 PG | SOV 15 SR | SOV 16 DS | SOV 17 vent | |
| OFF | OFF | OFF | Drill | VALID | OFF | OFF | OFF | OFF | |
| OFF | ON | OFF | Drill | INVALID | Flash | Flash | Flash | Flash | |
| OFF | OFF | ON | Drill | INVALID | Flash | Flash | Flash | Flash | |
| OFF | ON | ON | Drill | INVALID | Flash | Flash | Flash | Flash | |
| ON | OFF | OFF | Drill | VALID | ON | OFF | OFF | ON | |
| ON | ON | OFF | Drill | INVALID | ON | Flash | Flash | ON | |
| ON | OFF | ON | Drill | INVALID | ON | Flash | Flash | ON | |
| ON | ON | ON | Drill | INVALID | ON | Flash | Flash | ON | |
| OFF | OFF | OFF | Sample Rec. | VALID | OFF | OFF | OFF | ON | |
| ON | OFF | OFF | Sample Rec. | INVALID | Flash | Flash | Flash | ON | |
| OFF | ON | OFF | Sample Rec. | VALID | OFF | ON | OFF | OFF | |
| ON | ON | OFF | Sample Rec. | INVALID | Flash | ON | Flash | Flash | |
| OFF | OFF | ON | Sample Rec. | VALID | OFF | OFF | ON | ON | |
| ON | OFF | ON | Sample Rec. | INVALID | Flash | Flash | ON | ON | |
| OFF | ON | ON | Sample Rec. | VALID | OFF | ON | ON | OFF | |
| ON | ON | ON | Sample Rec. | INVALID | Flash | ON | ON | Flash | |

- OP/CE ___/___ 7.6.3 **RETURN** switch settings to OFF and DRILL.
- OP/CE/QC ___/___/___ 7.6.4 **ENSURE** the purge gas piping system soap solution leak test is complete. Acceptance criteria is: no visible leakage. **RECORD** test document or work package number:
- OP/CE/QC ___/___/___ 7.6.5 **ENSURE** the riser sleeve nitrogen supply soap solution leak test and flow measurements are complete. Acceptance criteria is: no visible leakage, and measured flow is ≥ 2 scfm at 40 psid. **RECORD** test document or work package number:
- OP/CE ___/___ 7.6.6 **CONNECT** the nitrogen supply line from the nitrogen trailer to the sample truck.
- OP/CE ___/___ 7.6.7 **FOLLOW** the operating procedure (listed in 6.2) to set up and start the nitrogen trailer system.
- OP/CE/QC ___/___/___ 7.6.8 **TEST** the Z-purge system as directed below:
- 7.6.8.1 **ENSURE** the Z-purge metering valve, located on the shielded receiver lifting frame, is fully open.
 - 7.6.8.2 **VERIFY** pressure reading on Z-purge pressure gauge is above 0.5 inches water gauge.
 - 7.6.8.3 **RESET** the SR WEATHER COVER PG PRESSURE alarm, located in the instrument enclosure.
 - 7.6.8.4 **ENSURE** nitrogen supply line is leak checked (using soap-type solution) between the pressure switch fitting and the weather cover penetration. No visible leakage is allowed.
 - 7.6.8.5 **CLOSE** the metering valve to reduce pressure to approximately 0.3 inches water gauge.
 - 7.6.8.6 **VERIFY** that alarm horn sounds and strobe flashes, and that the SR WEATHER COVER PG PRESSURE alarm light flashes.
 - 7.6.8.7 **OPEN** metering valve.
 - 7.6.8.8 When pressure reading on Z-purge pressure gauge is above 0.5 inches water gauge, **PRESS** the ALARM RESET button.
 - 7.6.8.9 **VERIFY** that the SR WEATHER COVER PG PRESSURE alarm light goes out.

Warning - The purge gas piping system on the core sample truck is potentially contaminated. Do not vent nitrogen directly to atmosphere. The RMCS exhaustor or other HEPA filtration should be used for nitrogen flow from the purge gas piping system.

- OP/CE ____/____ 7.6.9 **ENSURE** riser equipment is connected to rock slinger pit modification and all ducting and flex hoses on the pit modification are secured.
- OP/CE ____/____ 7.6.10 **ENSURE** the sampler change out assembly and the VENT TO TANK nitrogen hose are connected to the riser equipment.
- OP/CE ____/____ 7.6.11 **ENSURE** the exhaustor is connected to test riser and is operating.
- OP/CE ____/____ 7.6.12 **VERIFY** operation of the shielded receiver pressure (zero psig) indicator light by performing the following steps:
- 7.6.12.1 **ENSURE** Shielded Receiver is connected to the sampler change out assembly, and SR Ball Valve is closed.
 - 7.6.12.2 **TURN** PRESSURIZE SHIELDED RECEIVER to ON, and MODE switch to sample recovery.
 - 7.6.12.3 **INCREASE** the SHIELDED RECEIVER PRESSURE until green SHIELDED RECEIVER PRESSURE light goes off (about 0.2 psig).
 - 7.6.12.4 Slowly **OPEN** ball valve to decrease pressure, and **VERIFY** the green SHIELDED RECEIVER PRESSURE light comes back on when the SHIELDED RECEIVER PRESSURE display reads approximately 0 psig.
 - 7.6.12.5 **TURN** PRESSURIZE SHIELDED RECEIVER to OFF.
- OP/CE ____/____ 7.6.13 **VERIFY** operation of the drill string pressure (zero psig) indicator light by performing the following steps:
- 7.6.13.1 **ENSURE** DRILL STRING SUPPLY hose is in the drilling mode (disconnected and stowed on reel).
 - 7.6.13.2 **TURN** PRESSURIZE DRILL STRING to ON, and MODE switch to sample recovery.
 - 7.6.13.3 **INCREASE** the pressure until green DRILL STRING PRESSURE light goes off (about 0.2 psig).
 - 7.6.13.4 Slowly **OPEN** crossover manual ball valve (connecting DRILL STRING SUPPLY and VENT TO TANK lines) to decrease pressure, and **VERIFY** the green DRILL STRING PRESSURE light comes back on when the DRILL STRING PRESSURE display reads approximately 0 psig.

7.6.13.5 **TURN** PRESSURIZE DRILL STRING switch to OFF.

OP/CE ____/____ 7.6.14 **VERIFY** operation of the purge gas pressure (zero psig) indicator light by performing the following steps:

7.6.14.1 **ATTACH** a core barrel, with sampler and bit installed, to the quill rod and **POSITION** in riser equipment.

7.6.14.2 **TURN** PURGE GAS switch to ON, and MODE switch to drill.

7.6.14.3 **INCREASE** the PURGE GAS PRESSURE until green PURGE GAS PRESSURE light goes off (about 0.3 psig).

7.6.14.4 **DECREASE** pressure and **VERIFY** the green PURGE GAS PRESSURE light comes back on when the PURGE GAS PRESSURE display reads approximately 0 psig.

7.6.14.5 **TURN** purge gas switch to OFF.

OP/CE ____/____ 7.6.15 **VERIFY** operation of the nitrogen supply low pressure alarm by performing the following steps:

7.6.15.1 **ENSURE** DRILL STRING SUPPLY hose is in the drilling mode (disconnected and stowed on reel).

7.6.15.2 **SET** PRESSURIZE DRILL STRING to ON, and MODE switch to sample recovery.

7.6.15.3 **SHUT DOWN** the nitrogen trailer per operating instructions.

7.6.15.4 **VENT** nitrogen supply pressure to below 60 psi. After approximately 5 seconds **VERIFY** the SIREN sounds, the STROBE flashes, and the LOW PURGE GAS PRESSURE light comes on and flashes fast.

7.6.15.5 **PRESS** the ALARM ACKNOWLEDGE button and **TURN** PRESSURIZE DRILL STRING to OFF.

7.7 CRITICAL ALARM CHECKS

The sample truck computer continuously monitors several conditions during operation of the truck. Some of the information is monitored to warn the operator of abnormal conditions which are not related to the primary safety function of the RMCS and are not considered part of the critical alarms tested in this section. These alarm conditions have been previously tested and function the same as on RMCS trucks not modified for flammable gas tanks. Should an alarm of this nature occur during testing, the operator should simply take action to correct the situation. The temperature related alarms are described below.

The operating temperature of the instrumentation assembly must be maintained in order to provide accurate data. To accomplish this, the enclosure is equipped with an air conditioner and heater. Power will not be supplied to the enclosure instruments until the enclosure is heated to above 55°F, or cooled to below 100°F. If the enclosure temperature is above 90°F or below 50°F, the panel light will flash fast. If the condition persists for 60 seconds, the horn and strobe will go off. If purge gas temperatures below 10°F or above 140°F are detected, the horn and strobe will go off and the panel light will flash fast.

If the computer detects an operating condition which may indicate equipment failure or other unacceptable condition which requires immediate action, the drill engine will automatically initiate an immediate shutdown. Immediate shut down is defined in the SA as "the time it takes for the PLC to send a shutdown signal to the drill engine upon receipt of a valid shutdown signal with no additional programmed-delay. It is understood that the determination of a valid alarm signal requires approximately 2 seconds" (WHC-SD-WM-SAD-035). These alarms are considered the critical alarms, and are intentionally activated in the following tests.

WARNING: The purge gas piping system on the core sample truck is potentially contaminated. Do not vent nitrogen directly to atmosphere. The RMCS exhauster or other HEPA filtration must be used to exhaust potentially contaminated purge gas used during all critical alarm tests, including hydrostatic head and riser sleeve purge gas. Refer to operating procedure listed in 6.2 for exhauster start up sequence.

7.7.1 DRILL RPM ALARMS

Drill bit rotation is a critical operating parameter. The bit speed is limited to 55 rpm. If the rpm exceeds 55 an immediate shutdown will be initiated: the horn and strobe will go off and the drill rig will shut down. The low RPM alarm is used by the PLC to activate rotary mode alarms. If the rpm is less than 2 the rotary mode alarms are not active.

- | | | |
|-----------------|---------|---|
| OP/CE ____/____ | 7.7.1.1 | VERIFY the drill RPM loop calibration is completed using the above set points (Ref. 6-ES-437). |
| OP/CE ____/____ | 7.7.1.2 | ENSURE closed-valve sampler and drill bit are installed in drill string and drill string is positioned in riser equipment. |

- OP/CE ____/____ 7.7.1.3 **POSITION** the drill head for drilling into simulant and **ATTACH** quill rod to drill string.
- OP/CE ____/____ 7.7.1.4 **ENSURE** riser equipment is connected to rock slinger pit modification and all ducting and flex hoses on the pit modification are secured.
- OP/CE ____/____ 7.7.1.5 **ENSURE** the nitrogen supply trailer, exhauster, and drill rig engine are operating.
- OP/CE ____/____ 7.7.1.6 **ENSURE** the flow control valves for Z-purge and riser sleeve purge are open and all alarms are reset.
- OP/CE ____/____ 7.7.1.7 **PLACE** the nitrogen MODE switch to the DRILL position and the PURGE GAS switch to ON.
- OP/CE ____/____ 7.7.1.8 **SET** PURGE GAS flow to near 40 scfm.

WARNING: Do not open the chuck while it is rotating nor start rotation while the chuck is open. Keep the chuck closed except when connecting to or from the drill string.

- OP/CE ____/____ 7.7.1.9 **VERIFY** that the chuck is CLOSED.
- OP/CE ____/____ 7.7.1.10 **ADJUST** the ram hydraulic control valves, as necessary throughout the remainder of this test, to maintain a penetration rate greater than 0.75 inches per minute.
- OP/CE ____/____ 7.7.1.11 **PLACE** the transmission in gear and **ENGAGE** the clutch.
- OP/CE/QC ____/____/____ 7.7.1.12 **ADJUST** the engine throttle to set a drill speed near 60 rpm. **VERIFY** that the HORN sounds, the STROBE flashes, the HIGH RPM light flashes, and the truck immediately shuts down (acknowledge the alarm as it sounds.)
- OP/CE/QC ____/____/____ 7.7.1.13 **VERIFY** the shutdown light on the DR box is off and remains off for approximately 10 minutes after shutdown.
- OP/CE ____/____ 7.7.1.14 Have the instrument tech. **DISCONNECT** the instrument cable to one of the RPM sensors.
- OP/CE ____/____ 7.7.1.15 After the shutdown light comes back on, **DISENGAGE** the clutch, **RESTART** the engine, and **RESET** alarm.
- OP/CE/QC ____/____/____ 7.7.1.16 **ENGAGE** the clutch and increase the RPM to near 60 RPM. **VERIFY** alarm sounds for high RPM, and that the truck immediately shuts down (acknowledge the alarm as it sounds).
- OP/CE ____/____ 7.7.1.17 Within 10 minutes after shutdown, **VERIFY** the shutdown light is off and the drill engine can NOT be restarted.
- OP/CE ____/____ 7.7.1.18 **RECONNECT** instrument cable to above RPM sensor and **DISCONNECT** instrument cable from other RPM sensor.

- OP/CE ___/___ 7.7.1.19 After the shutdown light comes back on, **ENSURE** clutch is disengaged, and **RESTART** equipment.
- OP/CE ___/___ 7.7.1.20 **ACKNOWLEDGE** and **RESET** alarm.
- OP/CE/QC ___/___/___ 7.7.1.21 **ENGAGE** the clutch and increase the RPM to near 60 RPM. **VERIFY** alarm sounds for high RPM, and that the truck immediately shuts down (acknowledge the alarm as it sounds).
- OP/CE/QC ___/___/___ 7.7.1.22 **VERIFY** the shutdown light on the DR box is off and remains off for approximately 10 minutes after shutdown, independent of power interrupt, by performing the following:
- 7.7.1.22.1 Approximately 3 minutes after shutdown, **TURN OFF** all breakers on the POWER DISTRIBUTION panel.
 - 7.7.1.22.2 Approximately 5 minutes after shutdown, **TURN ON** all breakers on the POWER DISTRIBUTION panel, and **VERIFY** the shutdown light is off and the drill engine can NOT be restarted.
 - 7.7.1.22.3 Approximately 12 minutes after shutdown (10 minutes plus power down time), **VERIFY** the shutdown light comes back on.
- OP/CE ___/___ 7.7.1.23 **RECONNECT** instrument cable to above RPM sensor.
- OP/CE ___/___ 7.7.1.24 **ENSURE** clutch is disengaged.
- OP/CE ___/___ 7.7.1.25 **PLACE** PURGE GAS switch to OFF and **CLOSE** the PURGE GAS flow control.

7.7.2 PURGE GAS FLOW ALARMS

Adequate purge gas flow must be maintained to cool the rotating drill bit. A flow of at least 30 scfm is required to keep the bit cool. If a flow rate of less than 32 scfm is detected, the horn and strobe will go off as a warning to the operator. If a flow rate of less than 30 scfm is detected an immediate shutdown will be initiated: the horn and strobe will go off and the drill rig will shut down.

- OP/CE ___/___ 7.7.2.1 **VERIFY** the purge gas loop calibration is completed using the above set points (Ref. 6-ES-435).
- OP/CE ___/___ 7.7.2.2 **ENSURE** drill head and quill rod are positioned for testing.
- OP/CE ___/___ 7.7.2.3 **ENSURE** the nitrogen supply trailer, exhauster, and drill rig are operating, and any previous alarms are reset.

- OP/CE ____/____ 7.7.2.4 **ENSURE** the flow control valves for Z-purge and riser sleeve purge are open and all alarms are reset.
- OP/CE ____/____ 7.7.2.5 **PLACE** the nitrogen MODE switch to the DRILL position and the PURGE GAS switch to ON.
- OP/CE ____/____ 7.7.2.6 **SET** PURGE GAS flow to near 40 scfm.
- OP/CE ____/____ 7.7.2.7 **VERIFY** that the chuck is CLOSED.
- OP/CE ____/____ 7.7.2.8 **PLACE** the transmission in gear, **ENGAGE** the clutch, and **ENSURE** the drill is rotating at 10 to 45 RPM.
- OP/CE ____/____ 7.7.2.9 **ADJUST** the ram hydraulic control valves, as necessary throughout the remainder of this test, to maintain a penetration rate greater than 0.75 inches per minute.
- OP/CE ____/____ 7.7.2.10 **SET** PURGE GAS flow to between 30 and 32 scfm. **VERIFY** that the HORN sounds, the STROBE flashes, and the PURGE GAS FLOW LOW light flashes fast.
- OP/CE ____/____ 7.7.2.11 **PRESS** the ALARM ACKNOWLEDGE button. **VERIFY** that the PURGE GAS FLOW LOW light stops blinking and remains lit.
- OP/CE ____/____ 7.7.2.12 **INCREASE** the PURGE GAS flow to near 40 scfm. **VERIFY** that the PURGE GAS FLOW LOW light flashes slowly.
- OP/CE ____/____ 7.7.2.13 **PRESS** the ALARM RESET button. **VERIFY** that the PURGE GAS FLOW LOW light goes out.
- OP/CE/QC ____/____/____ 7.7.2.14 **SET** PURGE GAS flow near 25 scfm. **VERIFY** that the HORN sounds, the STROBE flashes, the PURGE GAS LOW FLOW SHUTDOWN light flashes fast, and the truck immediately shuts down (acknowledge the alarm as it sounds).
- OP/CE ____/____ 7.7.2.15 **DISENGAGE** the clutch.
- OP/CE ____/____ 7.7.2.16 Within 10 minutes after shutdown, **VERIFY** the shutdown light is off and the drill engine can NOT be restarted.
- Note:** The below steps are to test the situation when one meter is not functioning and a low flow situation exists.
- OP/CE ____/____ 7.7.2.17 After the shutdown light comes back on, **RESTART** the engine and **ENGAGE** the clutch.
- OP/CE/QC ____/____/____ 7.7.2.18 With the drill rotating and flow near 40 SCFM, **TURN OFF** the power to flow meter #1.
- OP/CE/QC ____/____/____ 7.7.2.19 **DECREASE** flow to between 30 and 32 SCFM and **VERIFY** low flow alarm sounds.
- OP/CE/QC ____/____/____ 7.7.2.20 **INCREASE** flow to near 40 SCFM, **ACKNOWLEDGE** and **RESET** alarm.

- OP/CE/QC ____/____/____ 7.7.2.21 **TURN ON** power for flow meter #1.
- OP/CE/QC ____/____/____ 7.7.2.22 With the drill rotating and flow near 40 SCFM, **TURN OFF** the power to flow meter #2.
- OP/CE/QC ____/____/____ 7.7.2.23 **DECREASE** flow to between 30 and 32 SCFM and **VERIFY** low flow alarm sounds.
- OP/CE/QC ____/____/____ 7.7.2.24 **INCREASE** flow to near 40 SCFM, **ACKNOWLEDGE** and **RESET** alarm.
- OP/CE/QC ____/____/____ 7.7.2.25 **TURN ON** power for flow meter #2.
- OP/CE/QC ____/____/____ 7.7.2.26 With the drill rotating and flow near 40 SCFM, **TURN OFF** the power to flow meter #3.
- OP/CE/QC ____/____/____ 7.7.2.27 **DECREASE** flow to between 30 and 32 SCFM and **VERIFY** low flow alarm sounds.
- OP/CE/QC ____/____/____ 7.7.2.28 **INCREASE** flow to near 40 SCFM, **ACKNOWLEDGE** and **RESET** alarm.
- OP/CE/QC ____/____/____ 7.7.2.29 **TURN ON** power for flow meter #3.
- Note: The below steps are to test the situation when two meters are not functioning during normal flow.
- OP/CE/QC ____/____/____ 7.7.2.30 With the drill rotating and flow near 40 SCFM, **TURN OFF** the power to flow meters #1 and #2.
- OP/CE/QC ____/____/____ 7.7.2.31 **VERIFY** low flow alarm sounds.
- OP/CE/QC ____/____/____ 7.7.2.32 **TURN ON** power for flow meter #1.
- OP/CE/QC ____/____/____ 7.7.2.33 **ACKNOWLEDGE** and **RESET** alarm.
- OP/CE/QC ____/____/____ 7.7.2.34 With the drill rotating and flow near 40 SCFM, **TURN OFF** the power to flow meter #3.
- OP/CE/QC ____/____/____ 7.7.2.35 **VERIFY** low flow alarm sounds.
- OP/CE/QC ____/____/____ 7.7.2.36 **TURN ON** power for flow meter #2.
- OP/CE/QC ____/____/____ 7.7.2.37 **ACKNOWLEDGE** and **RESET** alarm.
- OP/CE/QC ____/____/____ 7.7.2.38 With the drill rotating and flow near 40 SCFM, **TURN OFF** the power to flow meter #1.
- OP/CE/QC ____/____/____ 7.7.2.39 **VERIFY** low flow alarm sounds.
- OP/CE/QC ____/____/____ 7.7.2.40 **TURN ON** power for flow meters #3 and #1.
- OP/CE/QC ____/____/____ 7.7.2.41 **ACKNOWLEDGE** and **RESET** alarm.

OP/CE ___/___ 7.7.2.42 **DISENGAGE** the clutch.

OP/CE ___/___ 7.7.2.43 **PLACE** PURGE GAS switch to OFF and **CLOSE** the PURGE GAS flow control.

7.7.3 DOWN FORCE ALARM

Drill bit downward force is a critical operating parameter. The down force limit is 750 pounds. If an excessive force of 700 pounds is detected, the horn and strobe will go off as a warning to the operator. If an excessive force of 750 pounds is detected, an immediate shutdown will be initiated: the horn and strobe will go off and the drill rig will shut down.

OP/CE ___/___ 7.7.3.1 **VERIFY** the down force loop calibration is completed using the above set points (Ref. 6-ES-433).

OP/CE ___/___ 7.7.3.2 **ENSURE** downforce testing drum is positioned under drill head.

OP/CE ___/___ 7.7.3.3 **ENSURE** core barrel and bit are positioned for testing.

OP/CE ___/___ 7.7.3.4 **ENSURE** the nitrogen supply trailer, exhauster, and drill rig are operating, and any previous alarms are reset.

OP/CE ___/___ 7.7.3.5 **ENSURE** the flow control valves for Z-purge and riser sleeve purge are open and all alarms are reset.

OP/CE ___/___ 7.7.3.6 **PLACE** the nitrogen MODE switch to the DRILL position and the PURGE GAS switch to ON.

OP/CE ___/___ 7.7.3.7 **SET** PURGE GAS flow to near 40 scfm.

OP/CE ___/___ 7.7.3.8 **VERIFY** that the chuck is CLOSED.

OP/CE ___/___ 7.7.3.9 **PLACE** the transmission in gear, **ENGAGE** the clutch, and **ENSURE** the drill is rotating at 10 to 45 RPM.

OP/CE ___/___ 7.7.3.10 **ADJUST** the ram hydraulic control valves, as necessary throughout the remainder of this test, to maintain a penetration rate greater than 0.75 inches per minute.

OP/CE ___/___ 7.7.3.11 **LOWER** the rams until the bit contacts the drilling surface.

OP/CE/QC ___/___/___ 7.7.3.12 **MONITOR** the downward force. **OPEN** the DOWN ram hydraulic valve to increase the force to between 700 and 750 pounds. **VERIFY** that the HORN sounds, the STROBE flashes, and the DOWN FORCE HIGH light flashes fast.

OP/CE ___/___ 7.7.3.13 **PRESS** the ALARM ACKNOWLEDGE button. **VERIFY** that the DOWN FORCE HIGH light stops blinking and remains lit.

- OP/CE ____/____/____ 7.7.3.14 **DECREASE** the drill bit down force below the 700 pound limit. **VERIFY** that the DOWN FORCE HIGH light flashes slowly.
- OP/CE ____/____/____ 7.7.3.15 **PRESS** the ALARM RESET button. **VERIFY** that the DOWN FORCE HIGH light goes out.
- OP/CE/QC ____/____/____ 7.7.3.16 **MONITOR** the downward force. **OPEN** the DOWN ram hydraulic valve to increase the force beyond 750 pounds. **VERIFY** that the drill immediately shuts down (acknowledge the alarm as it sounds).
- OP/CE ____/____/____ 7.7.3.17 **DISENGAGE** the clutch.
- OP/CE ____/____/____ 7.7.3.18 Within 10 minutes after shutdown, **VERIFY** the shutdown light is off and the drill engine can NOT be restarted.
- OP/CE ____/____/____ 7.7.3.19 **PLACE** PURGE GAS switch to OFF and **CLOSE** the PURGE GAS flow control.

7.7.4 PENETRATION RATE ALARM

Penetration rate is a critical operating parameter. The minimum penetration rate limit is 0.75 inches per minute. If an insufficient penetration occurs for 55 seconds or more in any 3 minute period, the horn and strobe will go off as a warning to the operator. If the situation is not corrected within an additional 5 seconds (60 seconds total), an immediate shutdown will be initiated: the horn and strobe will go off and the drill rig will shut down.

- OP/CE ____/____/____ 7.7.4.1 **VERIFY** the penetration rate calibration is completed using the above set points (Ref. 6-ES-438).
- OP/CE ____/____/____ 7.7.4.2 **ENSURE** core barrel and bit are positioned for testing.
- OP/CE ____/____/____ 7.7.4.3 **ENSURE** the nitrogen supply trailer, exhauster, and drill rig are operating, and any previous alarms are reset.
- OP/CE ____/____/____ 7.7.4.4 **ENSURE** the flow control valves for Z-purge and riser sleeve purge are open.
- OP/CE ____/____/____ 7.7.4.5 **PLACE** the nitrogen MODE switch to the DRILL position and the PURGE GAS switch to ON.
- OP/CE ____/____/____ 7.7.4.6 **SET** PURGE GAS flow to near 40 scfm.
- OP/CE ____/____/____ 7.7.4.7 **VERIFY** that the chuck is CLOSED.
- OP/CE ____/____/____ 7.7.4.8 **PLACE** the transmission in gear, **ENGAGE** the clutch, and **ENSURE** the drill is rotating at 10 to 45 RPM.
- OP/CE ____/____/____ 7.7.4.9 **ADJUST** the ram hydraulic control valves to set the penetration rate greater than 0.75 inches per minute.

- OP/CE/QC ____/____/____ 7.7.4.10 **MONITOR** the penetration rate. **ADJUST** the DOWN ram hydraulic valve to reduce the penetration rate to below 0.75 in/min for at least 55 seconds, but less than 60 seconds. **VERIFY** that the HORN sounds, the STROBE flashes, and the penetration rate light flashes fast.
- OP/CE ____/____/____ 7.7.4.11 **PRESS** the ALARM ACKNOWLEDGE button. **VERIFY** that the Penetration rate light stops blinking and remains lit.
- OP/CE ____/____/____ 7.7.4.12 **INCREASE** the drill bit penetration rate above the 0.75 in/min limit. **VERIFY** that the Penetration rate light flashes slowly.
- OP/CE ____/____/____ 7.7.4.13 **PRESS** the ALARM RESET button. **VERIFY** that the Penetration rate light goes out.
- OP/CE/QC ____/____/____ 7.7.4.14 **MONITOR** the penetration rate. **ADJUST** the DOWN ram hydraulic valve to reduce the penetration rate to below 0.75 in/min for a total of at least 60 seconds. **VERIFY** the drill immediately shuts down (for remaining tests acknowledge the penetration rate alarm as it sounds).
- OP/CE ____/____/____ 7.7.4.15 **DISENGAGE** the clutch.
- OP/CE ____/____/____ 7.7.4.16 Within 10 minutes after shutdown, **VERIFY** the shutdown light is off and the drill engine can NOT be restarted.
- OP/CE ____/____/____ 7.7.4.17 After the shutdown light comes back on, **RESTART** the engine and **ENGAGE** the clutch.
- OP/CE ____/____/____ 7.7.4.18 **ADJUST** the ram hydraulic control valves to set the penetration rate greater than 0.75 inches per minute.
- OP/CE/QC ____/____/____ 7.7.4.19 **MONITOR** the penetration rate and perform the following:
- 7.7.4.19.1 **ADJUST** the DOWN ram hydraulic valve to reduce the penetration rate to below 0.75 in/min for approximately 30 seconds.
 - 7.7.4.19.2 **ADJUST** the DOWN ram hydraulic valve to increase the penetration rate to above 0.75 in/min for approximately 100 seconds.
 - 7.7.4.19.3 **ADJUST** the DOWN ram hydraulic valve to reduce the penetration rate to below 0.75 in/min for approximately 30 seconds (total of 60 second low penetration time within 3 minutes). **VERIFY** the drill immediately shuts down.
- OP/CE ____/____/____ 7.7.4.20 **DISENGAGE** the clutch.
- OP/CE ____/____/____ 7.7.4.21 Within 10 minutes after shutdown, **VERIFY** the shutdown light is off and the drill engine can NOT be restarted.

- OP/CE ____/____ 7.7.4.22 After the shutdown light comes back on, **RESTART** the engine and **ENGAGE** the clutch.
- OP/CE ____/____ 7.7.4.23 **ADJUST** the ram hydraulic control valves to set the penetration rate greater than 0.75 inches per minute.
- OP/CE/QC ____/____/____ 7.7.4.24 **MONITOR** the penetration rate and perform the following:
- 7.7.4.24.1 **ADJUST** the DOWN ram hydraulic valve to reduce the penetration rate to below 0.75 in/min for approximately 30 seconds.
 - 7.7.4.24.2 **ADJUST** the DOWN ram hydraulic valve to reduce the penetration rate to above 0.75 in/min for approximately 125 seconds.
 - 7.7.4.24.3 **ADJUST** the DOWN ram hydraulic valve to reduce the penetration rate to below 0.75 in/min for approximately 30 seconds (total of 55 second low penetration time within 3 minutes). **VERIFY** the drill does NOT shut down.
- OP/CE ____/____ 7.7.4.25 **ADJUST** the ram hydraulic control valves to set the penetration rate greater than 0.75 inches per minute and **RESET** any alarms.
- OP/CE/QC ____/____/____ 7.7.4.26 **MONITOR** the penetration rate and perform the following:
- 7.7.4.26.1 **ADJUST** the DOWN ram hydraulic valve to reduce the penetration rate to below 0.75 in/min for approximately 30 seconds.
 - 7.7.4.26.2 **TURN OFF** all breakers on the POWER DISTRIBUTION POWER panel, **WAIT** approximately 30 seconds, and **TURN** breakers back ON.
 - 7.7.4.26.3 **DISENGAGE** the clutch, and **RESTART** the engine.
 - 7.7.4.26.4 **ENGAGE** the clutch, and **ADJUST** the DOWN ram hydraulic valve to maintain the penetration rate below 0.75 in/min for approximately 30 seconds (total of 60 second low penetration time within 3 minutes). **VERIFY** the drill immediately shuts down.
- OP/CE ____/____ 7.7.4.27 **PLACE** PURGE GAS switch to OFF and **CLOSE** the PURGE GAS flow control.

7.7.5 RISER SLEEVE PURGE ALARMS

Adequate purge flow must be maintained to the riser sleeve. A differential pressure of at least 40 psi is required to ensure a minimum purge flow of 2 scfm. If insufficient differential pressure is detected an immediate shutdown will be initiated: the horn and strobe will go off and the drill rig will shut down.

- OP/CE ____/____ 7.7.5.1 **VERIFY** the riser sleeve purge calibration is completed using the above set point (Ref. 6-ES-431).
- OP/CE ____/____ 7.7.5.2 **ENSURE** drill head and quill rod are positioned for testing.
- OP/CE ____/____ 7.7.5.3 **ENSURE** the nitrogen supply trailer, exhauster, and drill rig are operating, and any previous alarms are reset.
- OP/CE ____/____ 7.7.5.4 **PLACE** the nitrogen MODE switch to the DRILL position and the PURGE GAS switch to ON.
- OP/CE ____/____ 7.7.5.5 **SET** PURGE GAS flow to near 40 scfm.
- OP/CE ____/____ 7.7.5.6 **ADJUST** the ram hydraulic control valves, as necessary throughout the remainder of this test, to maintain a penetration rate greater than 0.75 inches per minute.
- OP/CE ____/____ 7.7.5.7 **VERIFY** that the chuck is CLOSED.
- OP/CE ____/____ 7.7.5.8 **PLACE** the transmission in gear, **ENGAGE** the clutch, and **ENSURE** the drill is rotating at 10 to 45 RPM.
- OP/CE/QC ____/____/____ 7.7.5.9 **CLOSE** RISER SLEEVE PURGE GAS ball valve located at the rear of the core sample truck, below the rotating platform. **VERIFY** that the HORN sounds, the STROBE flashes, the RISER SLEEVE LOW DP light flashes fast, and the truck immediately shuts down (acknowledge the alarm as it sounds).
- OP/CE ____/____ 7.7.5.10 **DISENGAGE** the clutch.
- OP/CE ____/____ 7.7.5.11 Within 10 minutes after shutdown, **VERIFY** the shutdown light is off and the drill engine can NOT be restarted.
- OP/CE ____/____ 7.7.5.12 **PLACE** PURGE GAS switch to OFF and **CLOSE** the PURGE GAS flow control.

7.8 SYSTEM START UP / POWER LOADING TEST

The purpose of the following test is to verify that all RMCS equipment can operate at the same time without causing circuit breakers to trip or other equipment problems. Voltage and current measurements are recorded for information only, and do not have quantitative acceptance criteria associated with them.

- OP/CE ____/____ 7.8.1 **START** the diesel generator.
- OP/CE ____/____ 7.8.2 **START** the Breathing Air Compressor (operate the compressor so that the pump motor cycles frequently, i.e. vent the tank).
- OP/CE ____/____ 7.8.3 **START** the air compressor on the sample truck (operate the compressor so the pump motor cycles frequently, i.e. vent the tank).
- OP/CE ____/____ 7.8.4 **START** the exhauster and FGD Interlock using procedure steps listed in section 6.2. Do not perform instrument start up calibrations or wait two hours for unit to stabilize. (Exhauster heater should cycle frequently.)
- OP/CE ____/____ 7.8.5 **TURN ON** the water heater on the support truck. (The heater should be heating throughout this test. If necessary, remove the heat blankets from the exterior of the water drum.)
- OP/CE ____/____ 7.8.6 **TURN ON** the water pump on the nitrogen trailer. (Power should be supplied to the vaporizer from the large generator not the one attached to the nitrogen trailer).
- OP/CE ____/____ 7.8.7 **TURN ON** flood lights on the service trailer.
- OP/CE ____/____ 7.8.8 **TURN ON** the 480 volt space heater.
- OP/CE ____/____ 7.8.9 **TURN ON** the power to all breakers on the sample truck console.
- OP/CE ____/____ 7.8.10 **START** the drill engine on the sample truck.
- OP/CE ____/____ 7.8.11 **TURN ON** the air conditioner in the service trailer, and allow to run for approximately 30 minutes.
- OP/CE ____/____ 7.8.12 **TURN ON** the X-Ray Imager, and operate to produce one image.

OP/CE / 7.8.13

During equipment operation, **MEASURE** and **RECORD** current and voltage readings for RMCS components in the table below (blank lines are provided for additional measurements per engineering direction).

[illegible]

7.9 EXHAUSTER SHUTDOWN TESTS

Note: The exhauster and FGD interlock are tested separately prior to integration with the balance of the RMCS system. These tests are listed in section 6.3 as test start prerequisites.

- OP/CE ____/____ 7.9.1 **PERFORM** exhauster start up per procedure steps in the exhauster procedure listed in 6.2.
- OP/CE ____/____ 7.9.2 **ENSURE** drill head and quill rod are positioned for testing.
- OP/CE ____/____ 7.9.3 **ENSURE** riser equipment is connected to rock slinger pit modification and all ducting and flex hoses on the pit modification are secured.
- OP/CE ____/____ 7.9.4 **ENSURE** the Exhauster Interlock Override switch on the core sample truck is in INTERLOCK position.
- OP/CE ____/____ 7.9.5 **ENSURE** the nitrogen supply trailer and drill rig are operating, and any previous alarms are reset.
- 7.9.6 **COMPLETE** the steps below to test the EXHAUSTER SHUTDOWN ALARM on the sample truck due to an exhauster shutdown:

The exhauster is tied to the truck via an interlock cable. The exhauster interlock is intended to prevent the sample truck from operating in the event the exhauster fails. If an exhauster shutdown is detected an immediate drill rig shutdown will be initiated: the horn and strobe will go off and the drill rig will shut down.

- OP/CE ____/____ 7.9.6.1 **PLACE** the nitrogen MODE switch to the DRILL position and the PURGE GAS switch to ON.
- OP/CE ____/____ 7.9.6.2 **SET** PURGE GAS flow to near 40 scfm.
- OP/CE/QC ____/____/____ 7.9.6.3 **SHUT OFF** the exhauster fan. **VERIFY** that the drill rig alarm HORN sounds, the STROBE flashes, the EXHAUSTER SHUTDOWN light flashes fast, and the truck immediately shuts down (acknowledge the alarm as it sounds).
- OP/CE ____/____ 7.9.6.4 **VERIFY** that the purge gas is automatically cut off when the truck shuts down.
- OP/CE ____/____ 7.9.6.5 Within 10 minutes after shutdown, **VERIFY** the drill rig shutdown light is off and the drill engine can NOT be restarted.
- OP/CE ____/____ 7.9.6.6 **PLACE** PURGE GAS switch to OFF.
- OP/CE ____/____ 7.9.6.7 **CLOSE** the PURGE GAS flow control.
- OP/CE ____/____ 7.9.6.8 **START** exhauster fan and **ACKNOWLEDGE** exhauster alarms.
- OP/CE ____/____ 7.9.6.9 **CLEAR** the EXHAUSTER SHUTDOWN alarm by pressing RESET.

7.9.7 COMPLETE the steps below to test the EXHAUSTER SHUTDOWN ALARM from a FGD Interlock shutdown command:

The interlock cable is also intended to prevent continued sampling operations during a gas release event. The FGD Interlock controls exhauster and core sample truck shutdown using the interlock cable and relays located on the exhauster. If a high flammable gas concentration (FGC), or high rate of FGC rise, or high tank pressure rise is detected an immediate drill rig shutdown will be initiated: the horn and strobe will go off and the drill rig will shut down. If a low tank pressure is detected an immediate RMCS system shutdown will be initiated: the horn and strobe will go off and the drill rig AND exhauster will shut down.

- OP/CE ___/___ 7.9.7.1 After the drill rig shutdown light comes back on, **RESTART** the drill rig engine and **RESET** alarms.
- OP/CE/QC ___/___/___ 7.9.7.2 Using a known FGC sample bottle connected to the FGD interlock sample port, **INITIATE** a hydrogen alarm condition on the FGD Interlock. **VERIFY** the drill rig alarm HORN sounds, the STROBE flashes, the EXHAUSTER SHUTDOWN light flashes fast, and the sample truck immediately shuts down (acknowledge the EXHAUSTER SHUTDOWN alarm as it sounds).
- OP/CE ___/___ 7.9.7.3 **VERIFY** high hydrogen alarm indication on FGD interlock carts.
- OP/CE ___/___ 7.9.7.4 **VERIFY** exhauster fan continues to operate.
- OP/CE ___/___ 7.9.7.5 Within 10 minutes after shutdown, **VERIFY** the drill rig shutdown light is off and the drill engine can NOT be restarted.
- OP/CE ___/___ 7.9.7.6 After the shutdown light comes back on, **RESTART** the drill rig engine and **RESET** all alarms.
- OP/CE/QC ___/___/___ 7.9.7.7 Using a test line connected to the FGD interlock tank pressure port, **INITIATE** a low tank pressure alarm condition on the FGD Interlock. **VERIFY** the sample truck AND exhauster immediately shut down (acknowledge the EXHAUSTER SHUTDOWN alarm as it sounds).
- OP/CE ___/___ 7.9.7.8 **VERIFY** tank pressure alarm indication on FGD interlock carts.
- OP/CE ___/___ 7.9.7.9 Within 10 minutes after shutdown, **VERIFY** the drill rig shutdown light is off and the drill engine can NOT be restarted.
- OP/CE ___/___ 7.9.7.10 **PLACE** PURGE GAS switch to OFF.
- OP/CE ___/___ 7.9.7.11 **CLOSE** the PURGE GAS flow control.
- OP/CE ___/___ 7.9.7.12 **CLEAR** the EXHAUSTER SHUTDOWN alarm on the core sample truck.

7.9.8 COMPLETE the steps below to test the EXHAUSTER SHUTDOWN ALARM from a FGD Interlock signal loss:

The FGD Interlock is required to have redundant sensor/control capabilities and is designed to shut down the exhauster and sample truck when either cart loses signal input from the spool piece junction box or to the exhauster.

- OP/CE ____/____ 7.9.8.1 After the drill rig shutdown light comes back on, **RESTART** the drill rig engine and exhauster, and **RESET** alarms.
- OP/CE/QC ____/____/____ 7.9.8.2 **DISCONNECT** one spool piece junction box signal cable from one of the FGD Interlock carts. **VERIFY** the sample truck AND exhauster immediately shut down (acknowledge the EXHAUSTER SHUTDOWN alarm as it sounds).
- OP/CE ____/____ 7.9.8.3 **VERIFY** the exhauster can NOT be restarted.
- OP/CE ____/____ 7.9.8.4 **RECONNECT** the spool piece junction box signal cable to the FGD Interlock cart and **RESET** alarms.

7.10 DRILL STRING LOCKING COLLAR / RISER SLEEVE SPRAY WASHER

Note: The riser sleeve installed for this OTP is a test unique version. All interfaces on the riser sleeve, including nitrogen purge gas and wash water connections, are identical to the operational riser sleeve. These interfaces are tested in section 7.1. All other testing for the riser sleeve is accomplished in the riser sleeve functional test.

- OP/CE ____/____ 7.10.1 **VERIFY** the riser sleeve functional test is completed. **RECORD** test document or work package number:
- OP/CE ____/____ 7.10.2 **POSITION** drill string in foot clamp for locking collar test.
- OP/CE ____/____ 7.10.3 **ATTACH** test weights to drill string to provide a total load of 210 pounds (minimum).
- OP/CE ____/____ 7.10.4 **SECURE** locking collar to drill string.
- OP/CE ____/____ 7.10.5 **OPEN** foot clamp and **VERIFY** locking collar does not release drill string.
- OP/CE ____/____ 7.10.6 **CLOSE** foot clamp and **REMOVE** test weights and locking collar from drill string.

8.0 SAMPLING OPERABILITY TEST PROCEDURE

The following items comprise the second phase of testing, as described in section 4.2. To reduce hazardous waste generated during testing, sampler ball valves will be closed during sampling (no sample will be taken), and samplers may be reused in testing. Testing is complete after operability of the flammable gas modifications is demonstrated by completing a full sampling cycle. More than one sampling cycle may be required if equipment maintenance or repairs significantly interrupt the continuity of sampling operations.

NOTE: The PRE-START INSPECTION (Appendix 3 Data Sheet) shall be completed EVERY time the RMCS truck is powered up.

8.1 PREPARE TO SAMPLE

- OP/CE ____/____ 8.1.1 **ENSURE** sample truck and support vehicles are positioned and ready for sampling in test pit.
- OP/CE ____/____ 8.1.2 **ENSURE** cask stand and riser equipment are positioned and ready for sampling in test pit.
- OP/CE ____/____ 8.1.3 **WHEN** drill string calculations have been completed by engineering and verified by the PIC, **OBTAIN** drill rod lengths as specified by the Cog. Engineer.
- OP/CE ____/____ 8.1.4 **ENSURE** final truck leveling height conforms to FINAL QUILL ROD TO RISER FLANGE DISTANCE specified by Cog. Engineer.
- OP/CE ____/____ 8.1.5 **INSTALL** drill string, including rotary bit, core barrel, and closed-valve sampler, using applicable steps from section 5.1 of sampling procedure listed in 6.2.

8.2 PERFORM CORE SAMPLING

- OP/CE ____/____ 8.2.1 **DRILL** a 19 inch segment using applicable steps from section 5.3 of the sampling procedure listed in 6.2.
- OP/CE ____/____ 8.2.2 **RETRIEVE** pintle rod from drill string using applicable steps from section 5.4 of the sampling procedure listed in 6.2.

8.3 RECOVER SPENT SAMPLER FROM DRILL STRING

- OP/CE ____/____ 8.3.1 **REMOVE** the closed-valve sampler using applicable steps from section 5.5 of the sampling procedure listed in 6.2.
- OP/CE ____/____ 8.3.2 **LOAD** sampler into cask using applicable steps from section 5.7 of the sampling procedure listed in 6.2.

8.4 INSERT EMPTY SAMPLER INTO DRILL STRING

- OP/CE ____/____ 8.4.1 **ENSURE** a rebuilt or new closed-valve sampler is installed in sample cask.
- OP/CE ____/____ 8.4.2 **INSTALL** closed-valve sampler into drill string using applicable steps from section 5.8 of the sampling procedure listed in 6.2.

8.5 RECOVER DRILL STRING AND SECURE EQUIPMENT

Completion of operability testing does not require performance of this section. Equipment may be left in place for training or other program requirements. The following steps are provided as information to facilitate removal of RMCS equipment from the test site.

- 8.5.1 **REMOVE** the drill string using applicable steps from section 5.9 of the sampling procedure listed in 6.2.
- 8.5.2 **REMOVE** RMCS equipment using applicable steps from section 5.12 through 5.15 of the setup and takedown procedure listed in 6.2.

9.0 SIGNATURE LOG

All persons initialing or signing within this procedure (including all data sheets and the test completion sign-off sheet) shall record their signature, initials, and printed name in the table below.

[illegible]

10.0 TEST COMPLETION SIGN-OFF

All system acceptance and operability tests have been completed as delineated in this ATP/OTP. All exceptions have been documented and resolved as indicated on the Exception / Resolution Data Sheet(s). The core sample truck and associated equipment can be operated in a safe manner and are accepted as meeting all test criteria required for initial RMCS operations in flammable gas tanks.

| Signature | Date |
|---------------------------------|------|
| | |
| Operations PIC | |
| | |
| Truck Sampling Manager | |
| | |
| Quality Assurance | |
| | |
| Safety | |
| | |
| Cognizant Engineer | |
| | |
| CFE Engineering Manager | |
| | |
| Design Authority | |
| | |
| Operations Test Director | |

Exception / Resolution Data Sheet

NOTE: THIS SHEET IS AN EXAMPLE AND MAY BE REPLACED WITH A SIMILAR SHEET CONTAINING THE REQUIRED INFORMATION.

[illegible]

Test Log Comment Sheet

FOR RECORD ONLY. THIS SHEET IS AN EXAMPLE AND MAY BE REPLACED WITH A SIMILAR SHEET CONTAINING THE REQUIRED INFORMATION.

[illegible]

Test Sample Data Sheet

FOR RECORD ONLY. THIS SHEET IS AN EXAMPLE AND MAY BE REPLACED WITH A SIMILAR SHEET CONTAINING THE REQUIRED INFORMATION.

| | | | | | | |
|----|--|----------------------|----------|---------------------|----------|---------------------|
| 1 | SEGMENT NO. | CASK NO. | SEG # | CASK NO | SEG # | CASK NO |
| 2 | SAMPLER NO. | O-RING OR CHEVRON | SAMPLE # | SEAL O-RING CHEV | SAMPLE # | SEAL O-RING CHEV |
| | SAMPLE NO. | | | | | |
| 3 | WASTE EXPECTED (SALT, SLUDGE OR LIQUID) | | | | | |
| 4 | COPY FROM LINE 16 OF PREVIOUS SEGMENT | | ELEC | MECH | ELEC | MECH |
| 5 | RLU READING AT TOP "ZERO" (before lowering sampler) | | ELEC | MECH | ELEC | MECH |
| 6 | RLU READING AT BOTTOM (when lowering sampler) | | ELEC | MECH | ELEC | MECH |
| 7 | GPL COUNTER AT "ZERO" | | REV | | REV | |
| 8 | GPL COUNTER AT BOTTOM (0.9 more for 19" stroke) | | REV | | REV | |
| 9 | PG PRESSURE | PG FLOW | PSIG | SCFM | PSIG | SCFM |
| 10 | DOWN FORCE (LBS) | | LBS | | LBS | |
| 11 | PIC INITIALS | NPO INITIALS | PIC | NPO | PIC | NPO |
| 12 | PENETRATION RATE (IPM) | ROTATION SPEED (RPM) | IPM | RPM | IPM | RPM |
| 13 | GRAPPLE ACTIVITY | | TIME | DATE | TIME | DATE |
| | | | SHEAR | DROP | SHEAR | DROP |
| 14 | EXPECTED RLU AT BOTTOM (item 6 + 1.58' if 19" rod added) | | ELEC | MECH | ELEC | MECH |
| 15 | RLU READING AT TOP "ZERO" (before unseating) | | ELEC | MECH | ELEC | MECH |
| 16 | RLU READING AT BOTTOM (when unseating) | | ELEC | MECH | ELEC | MECH |
| 17 | MAX FORCE TO UNSEAT SAMPLER | | FORCE | | FORCE | |
| | | | TIME | DATE | TIME | DATE |
| 18 | RAD DOSE RATE THROUGH DS | | | | | |
| 19 | WATER USED? | | | | | |
| 20 | DS NITROGEN | | PSIG | SCFM | PSIG | SCFM |

Pre-start Inspection Data Sheet

FOR RECORD ONLY. THIS SHEET IS AN EXAMPLE AND MAY BE REPLACED WITH A SIMILAR SHEET CONTAINING THE REQUIRED INFORMATION.

| CONDITIONS <u>SHALL</u> BE VERIFIED AT THE BEGINNING OF <u>EACH</u> SHIFT. (CHECK EACH CONDITION WHEN VERIFIED.) | DATE: | | | | | |
|---|----------|--|--|--|--|--|
| | INITIAL: | | | | | |
| SR AND QR ARE POSITIONED FOR SAFE OPERATION | | | | | | |
| DRILL HEAD RAM CONTROL VALVES CLOSED | | | | | | |
| 4 WAY VALVE IN HEAD OR FLOAT POSITION | | | | | | |
| JACK HOSES DISCONNECTED | | | | | | |
| INSPECT ELECTRICAL CORDS FOR DAMAGE | | | | | | |
| INSPECT HYDRAULIC LINES & FITTINGS FOR LEAKAGE AND/OR DAMAGE | | | | | | |
| VISUALLY INSPECT AIR/N ₂ HOSES FOR DAMAGE | | | | | | |
| DRILL ENGINE WATER SATISFACTORY | | | | | | |
| DRILL ENGINE FUEL LEVEL SATISFACTORY | | | | | | |
| DRILL ENGINE OIL LEVEL SATISFACTORY | | | | | | |
| RISER LINER PURGE LINE CONNECTED | | | | | | |
| VENT TO TANK LINE CONNECTED TO RISER ASSEMBLY | | | | | | |
| ALARM LIGHTS OPERATE ON INSTRUMENT DISP | | | | | | |
| RECORDER FUNCTIONAL | | | | | | |
| VERIFY CLUTCH DISENGAGED | | | | | | |
| VERIFY CHUCK CLOSED | | | | | | |