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		Date 12/07/94
Project Title/Work Order WHC-SD-WM-TP-266, Rev. 0 Test Plan for Slow Speed Core Sampling Envelope Test		EDT No. 604993
		ECN No.

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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 604993

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1	WHC-SD-WM-TP-266		0	TEST PLAN FOR SLOW SPEED CORE SAMPLING ENVELOPE TEST	SQ	1	1	

16. KEY		
Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 4. Review 2. Release 5. Post-Review 3. Information 6. Dist. (Receipt Acknow. Required)	1. Approved 4. Reviewed no/comment 2. Approved w/comment 5. Reviewed w/comment 3. Disapproved w/comment 6. Receipt acknowledged

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1	2	Cog. Mgr. Roy J Blanchard	<i>[Signature]</i>	12/2/94 R1-57	Nancy J Milliken	<i>[Signature]</i>	12/2/94 H4-03	1	2
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1	1	Safety Muhammad N Islam	<i>[Signature]</i>	12/15/94 R2-03	A Cockrell	<i>[Signature]</i>	12/15/94	1	2
		Env.			Keith S Witwer	<i>[Signature]</i>	12/22/94 L6-13	1	1
3 XMK		QC James L Logston							

18. GL Ralston <i>[Signature]</i> 12/22/94 Signature of EDT Date Originator	19. GL Ralston <i>[Signature]</i> 12/22/94 Authorized Representative Date for Receiving Organization	20. Roy J Blanchard <i>[Signature]</i> 12/22/94 Cognizant Manager Date	21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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RELEASE AUTHORIZATION

Document Number: WHC-SD-WM-TP-266, REV. 0

Document Title: Test Plan for Slow Speed Core Sampling Envelope Test

Release Date: 12/27/94

**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Niki Solis

12/27/94

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SUPPORTING DOCUMENT		1. Total Pages <i>17 20</i>
2. Title Test Plan for Slow Speed Core Sampling Envelope Test	3. Number WHC-SD-WM-TP-266	4. Rev No. 0
5. Key Words Core Sampling Rotary Mode Push Mode Slow Speed	6. Author Name: GL Ralston <i>GL Ralston</i> Signature Organization/Charge Code 71130/N4059	
7. Abstract This plan describes the testing parameters used to establish an operating envelope for slow rotation core sampling without purge gas for cooling.		
		8. RELEASE STAMP <div style="border: 1px solid black; padding: 5px; width: fit-content;"> OFFICIAL RELEASE BY WHC DATE DEC 27 1994 35 <i>Station 21</i> </div>

WHC-SD-WM-TP-266

Rev. 0

TEST PLAN FOR
SLOW SPEED CORE SAMPLING ENVELOPE TEST

G. L. Ralston
Safety Equipment Development

December 15, 1994

TABLE OF CONTENTS

	<u>Page</u>
1 INTRODUCTION	1
2 OBJECTIVE	2
3 SCOPE	3
4 TEST DESCRIPTION	5
4.1 Test Equipment	5
4.2 Test Material	6
4.3 Instrumentation	7
4.4 Test Data	7
5 TEST PROCEDURE	8
6 SAFETY	9
7 QUALITY ASSURANCE	10
8 QUALITY CONTROL	10
9 ORGANIZATIONAL RESPONSIBILITIES	11
9.1 Engineering Testing, D. S. Dutt, Manager	11
9.2 Characterization Equipment, R. J. Blanchard, Manager	11
9.3 Chemical Engineering Laboratory, M. J. Schliebe, Manager	11
9.4 Quality Assurance, D. C. Board, Manager	11
9.5 Quality Control, J. L. Logston, Manager	12
9.6 Nuclear Safety, M. N. Islam, Manager	12
10 REPORTING	12
11 REFERENCES	12
12 APPENDIX A: FIELD TEST DATA SHEET	13
13 APPENDIX B: THERMOCOUPLE CHARACTERIZATION DATA	15

TEST PLAN FOR SLOW SPEED CORE SAMPLING ENVELOPE TEST

1 INTRODUCTION

Samples of material contained in underground storage tanks at Hanford will have to be extracted and analyzed in order to characterize radioactive waste material. Core sampling, in 48 cm (19 in.) segments from the top of the waste surface to the bottom of the tank, is one of the successful methods used for sampling the material. This process can be performed by pushing a core sample drill bit, drill string, and sampler through the waste, or by rotating the drill string through the material to produce the core sample.

Currently, waste tanks that contain soft material are being core sampled using the push method, while tanks containing hard material must be sampled by rotary mode core drilling. In a number of cases, tanks principally contain soft material but also a limited amount of "firm" material. This firm material can cause inaccuracy in the sample (as the drill string advances it effectively pushes a "plug" of the firmer material downward), or, prevent push mode operation from continuing. In this case, it would be cost effective if a small amount of rotation could be imparted to the bit to penetrate the firm material and allow the push mode process to continue.

In rotary mode drilling, rotation will heat the bit. Excessive heating can lead to safety concerns, especially in certain tanks (e.g., ferrocyanide tanks). Heating is

controlled by imposing operating limits on the following: downward force, rotation speed, purge gas flow rate, and bit type. Reference 11.1 describes the envelope testing performed to establish combinations of safe operating ranges for these parameters.

In contrast, push mode sampling does not use purge gas, and a wider variety of bits are available. The envelope testing referenced above does not address these issues except in a limited fashion in Section 7.4, Steel Plate Drill Tests, and 7.6.3, Low Purge Flow Test Results. In both instances typical (large) rotary mode rotational speed and downforce values were used since the intent was to measure the elapsed time for the temperature delta to exceed established values.

2 OBJECTIVE

This test plan describes the envelope testing required to establish safe operating parameters for rotating the bit during push mode sampling, and for rotary mode sampling without purge. This document will provide a description of the items to be tested, performance criteria for those items, a description of testing to be performed, and the procedure by which the testing activity will be conducted.

The test will be conducted with the following constraints:

- No purge gas will be used during drilling activity

- Drill bit temperature may not increase more than 57 degrees celsius (103°F) above the ambient temperature of the waste material.
- Test material will be chosen to represent conservative heat transfer capability (lower values than any waste simulants used in reference 11.1 testing)

3. SCOPE

Testing will determine the effects of three operating parameters on bit temperature.

These operating parameters are:

- Rotational speed
- Downward force
- Time

To establish a high confidence level that drill bit temperature remains below the maximum allowable, a series of tests will be performed with various combinations of the following:

Rotational Speed (rpm)	5	10	15
Downward Force (lb)	* 200 (approx)	500	1000

* The equipment will be operated in "float" mode (no hydraulic pressure)

Anytime a test exceeds the maximum temperature criteria, further testing with more severe conditions will not be done, unless directed otherwise by Characterization Equipment (R. J. Blanchard, Manager). For those tests which are successful, a second run will be made for data comparison.

Three types of bit will be utilized for each sequence of tests:

- 60° smooth-faced
- 60° toothed
- Standard rotary core drilling bit

For each bit, the results of the tests can be used to fit an equation relating drill bit temperature to the values of the independent variables (rotational speed, downward force,

and drill time). The best-fit coefficients of the equation will define an operating envelope in which core drilling of waste tank materials can safely take place. The rms (root mean square) error of the fit will determine the confidence level assigned to the envelope.

The above test procedure will also be duplicated with the test material replaced by a steel plate in order to model the unlikely event of sampling equipment making contact with the tank liner.

4 TEST DESCRIPTION

Testing will be performed by or under the direction of lab personnel working in conjunction with cognizant engineers assigned to this test.

4.1 Test Equipment

Drilling Equipment

Testing will be performed with the Longyear drill rig located at the 305 Laboratory.

Bit Types

- 60° smooth-faced
H-2-85345, Assy #2
- 60° toothed
Blue Bore Inc, Spokane, WA (534-1588)
Part # BX C-3 XB238A, Bit # 130GA

- Standard rotary core drilling bit

H-2-821457, Item #10 (Longyear Part # 100IVD/5)

Drill String

The test drill string will not contain sample tube hardware or water. Deletion of these items will allow the bit temperature to climb more rapidly to a value approaching the maximum.

Since the test will be conducted outside during cold weather conditions, an enclosure will be placed around the drill string/bit to minimize convective cooling effects (wind). The fact that the drill string is actually surrounded by waste in actual operation is not considered significant in terms of its effect on the maximum temperature obtained from this test.

4.2 Test Material

The test material will be a portland cement/diatomite mixture with properties very close to the portland cement of Reference 11.1. During the Reference 11.1 testing, portland cement produced the greatest temperature rise of all the materials tested.

4.3 Instrumentation

Data taken during the core drilling tests will consist of drill bit temperature, rotational speed, depth of penetration, and downward force. All data will be read at one minute intervals by a personal computer equipped data acquisition system. In addition, rotation and downforce measurements will also be manually obtained at the start and end of each test run.

Temperatures of the drill bit will be measured with a stainless steel, sheathed type K thermocouple, silver soldered or epoxied into place on the cutting surface of the bit. These will be characterized by the Westinghouse Hanford Company Standards Laboratory at 0, 100, 200, 300, and 400 degrees Celsius and found to be within $\pm 2.2^{\circ}\text{C}$ or $\pm 0.75\%$ (whichever is greater) prior to and after testing.

4.4 Test Data

The data acquisition file associated with each test run will be used to record test description information, the manual measurements noted above, and any other pertinent observations. The Appendix A data sheet will be used to record this data in the field, with subsequent transfer to the data acquisition file.

5 TEST PROCEDURE

- 5.1 QC verify test thermocouples against WHC Standards Lab characterization report (Appendix B).

QC _____ Date _____

- 5.2 Adjust RPM to test value, then stop rotation.
- 5.3 Zero scale.
- 5.4 Position test bit in test "hole" (approximately 3" - 12" deep) and allow temperature to stabilize to within 2°C of the temperature of test material at drum boundary.
- 5.5 Place the drill string in "float" mode, or adjust pressure controls to achieve the required downforce.
- 5.6 Activate data acquisition system.
- 5.7 Start rotation and re-check/record RPM and scale reading.
- 5.8 Continue rotation until the temperature reaches a near steady state value and does not increase more than 2°C in 5 minutes.
- 5.9 Record final RPM and scale reading.
- 5.10 Remove the drill bit from test material.
- 5.11 Repeat steps 5.2 - 5.10 for each test.
- 5.12 QC verify test thermocouples against post-test WHC Standards Lab characterization report (characterization to be completed after testing).

QC _____ Date _____

6 SAFETY

The precautions listed on Material Safety Data Sheets for the test material will be observed during preparation/test activities. All test activities will comply with the requirements of WHC Industrial Safety and Hygiene Manuals (WHC-CM-4-3 and WHC-CM-4-40, respectively).

Specific requirements are noted below:

6.1 Eye protection will be in accordance with the above referenced Safety/Hygiene Manuals.

6.2 Combustible material shall be removed from the test area where feasible.

6.3 A class ABC fire extinguisher will be available in the immediate vicinity of the drilling machine during its operation and refueling.

6.4 Access control to the test area and hazard warning requirements will comply with the above referenced Industrial Safety/Hygiene Manuals and any additional restrictions imposed by cognizant Lab 305 personnel.

6.5 IAW WHC-CM-4-3, -CM-9 & -CM-10 standards - Equipment operators & Test personnel shall wear appropriate Personal Protective Equipment for hazards associated with the operations and equipment involved.

7 QUALITY ASSURANCE

Quality Assurance will review and approve all documentation associated with this testing activity.

8 QUALITY CONTROL

Quality Control will verify the calibration of the instrumentation prior to and after testing. Quality Control witnessing of testing and preparation of test material will be performed at the discretion of the Quality Assurance Engineer.

9 ORGANIZATIONAL RESPONSIBILITIES

9.1 Engineering Testing, D. S. Dutt, Manager

Engineering Testing will be responsible for fitting the specimen bits with thermocouples and providing support to the testing activity.

9.2 Characterization Equipment, R. J. Blanchard, Manager

Characterization Equipment will be responsible for review of test documentation and for providing funding for removal and disposal of any regulated materials used in conducting the testing.

9.3 Chemical Engineering Laboratory, M. J. Schliebe, Manager

The Chemical Engineering Laboratory will assist in preparation and/or physical characterization of the test material.

9.4 Quality Assurance, D. C. Board, Manager

Quality Assurance will be responsible for review and approval of documentation.

9.5 Quality Control, J. L. Logston, Manager

Quality Control will provide witnessing and verification of testing as required.

9.6 Nuclear Safety, M. N. Islam, Manager

Nuclear Safety will be responsible for review and approval of documentation.

10 REPORTING

A supporting document test report will be released following the conclusion of testing. Weekly reporting of status, highlights, and planned activities to Characterization Equipment will occur as needed. Photographs and videotaping of testing will also be performed as necessary to record and report on test results.

11 REFERENCES

- 11.1** C. M. Keller, "Core Drill Operating Envelope Test Report," WHC-SD-WM-TRP-123, Rev. 1, Dec 1993. Westinghouse Hanford Company, Richland, Washington.

12 APPENDIX A: FIELD TEST DATA SHEET

FIELD TEST DATA SHEET

Bit Type: _____

[illegible]

13 APPENDIX B: THERMOCOUPLE CHARACTERIZATION DATA

THERMOCOUPLE CHARACTERIZATION DATA

WHC Standards Lab Data Sheet Reference No./Date _____ / _____

T/C Serial No.

651

Expires

Q/C

Test Engr

654

Expires

Q/C

Test Engr

671

Expires

Q/C

Test Engr

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