

ENGINEERING CHANGE NOTICE

1a. ECN 726516 R 0

Page 2 of 2

DM FM TM

1b. Proj. ECN N/A - - R

22. Revisions Planned (Include a brief description of the contents of each revision)

N/A

Note: All revisions shall have the approvals of the affected organizations as identified in block 12 "Approval Designator," on page 1 of this ECN.

23. Commercial Grade Item Dedication Numbers (associated with this design change)

N/A

24. Engineering Data Transmittal Numbers (associated with this design change, e.g., new drawings, new documents)

N/A

25. Other Non Engineering (not in HDCS) documents that need to be modified due to this change

Type of Document	Document Number	Update Completed On	Responsible Engineer (print/sign and date)
Alarm Response Procedure	N/A	N/A	N/A
Operations Procedure	N/A	N/A	N/A
Maintenance Procedure	N/A	N/A	N/A

26. Field Change Notice(s) Used?

Yes No

If Yes, Record Information on the ECN-2 Form, attach form(s), include a description of the interim resolution on ECN Page 1, block 18, and identify permanent changes.

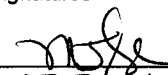


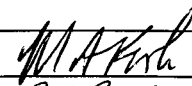
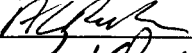

NOTE: ECNs are required to record and approve all FCNs issued. If the FCNs have not changed the original design media then they are just incorporated into the design media via an ECN. If the FCN did change the original design media then the ECN will include the necessary engineering changes to the original design media.

27. Design Verification Required?

Yes No

If Yes, as a minimum attach the one page checklist from TFC-ENG-DESIGN-P-17.

28. Approvals

Facility/Project Signatures		Date	A/E Signatures		Date
Resp. Engineer	MJ Holm 	10-21-09	Originator/Design Agent	Andrew Lord 	10/19/09
Resp. Manager	WB Barton 	10/22/09	Professional Engineer	_____	_____
Quality Assurance	_____	_____	Project Engineer	_____	_____
IS&H Engineer	_____	_____	Quality Assurance	_____	_____
NS&L Engineer	_____	_____	Safety	_____	_____
Environ. Engineer	_____	_____	Designer	_____	_____
Engineering Checker	M.A. FISH 	10/23/09	Environ. Engineer	_____	_____
Other	Project Manager: DL Parker 	10/21/09	Other	_____	_____
Other	Closure Manager: KD Quigley 	10/22/09	Other	_____	_____
Other	_____	_____	DEPARTMENT OF ENERGY / OFFICE OF RIVER PROTECTION		
Other	_____	_____	Signature or a Control Number that tracks the Approval Signature		
Other	_____	_____	_____		
Other	_____	_____	ADDITIONAL SIGNATURES		
Other	_____	_____	_____		
Other	_____	_____	_____		

Closure Demonstration Grout Test Report


DL Parker
Prepared by Columbia Energy & Environmental Services, Inc. for
Washington River Protection Solutions
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-08RV14800

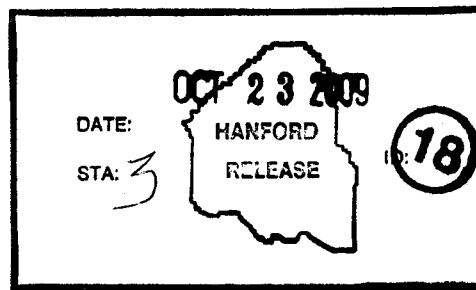
EDT/ECN: ECN-726516-R0 UC:
Cost Center: Charge Code:
B&R Code: Total Pages: 461

Key Words: Tank closure, waste stabilization grout, bulk fill grout.

Abstract: This report documents the results from the off-site cold testing of candidate grout formulations for tank closure. This testing satisfies test objectives 1, 2, 3, 4 and 6 in *Test Plan for the Closure Demonstration Cold Testing* (RPP-PLAN-39837).

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Release Approval Date



Approved For Public Release

**Tank Operations Contractor (TOC)
RECORD OF REVISION**

(1) Document Number:
RPP-RPT-41550

Page 1

(2) Title:

Closure Demonstration Grout Test Report

Change Control Record

(3) Revision	(4) Description of Change -- Replace, Add, and Delete Pages	Authorized for Release	
		(5) Resp. Engr. (print/sign/date)	(6) Resp. Mgr. (print/sign/date)
0	Initial Release	MJ Holm	DG Baide
1	ECN-726592-R0, Document Update	MJ Holm	DG Baide
1A MS	ECN-726516-R0, Addition of Appendix C	MJ Holm MS 10-21-09	WB Barton WB 10/22/09

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1

2.0 BACKGROUND 2-1

3.0 RESULTS 3-1

 3.1 TEST OBJECTIVE 1..... 3-1

 3.1.1 Results..... 3-3

 3.1.2 Observations 3-3

 3.2 TEST OBJECTIVES 2 AND 6..... 3-5

 3.2.1 Bulk Fill Grout Drop..... 3-7

 3.2.2 Waste Stabilization Grout Drop..... 3-13

 3.2.3 Observations 3-20

 3.3 TEST OBJECTIVE 3..... 3-21

 3.3.1 Tank Structure..... 3-21

 3.3.2 Grout Material..... 3-22

 3.3.3 Methodology 3-22

 3.3.4 Results..... 3-25

 3.3.5 Observations 3-29

 3.4 TEST OBJECTIVE 4..... 3-30

 3.4.1 Results..... 3-38

 3.4.2 Observations 3-43

4.0 REFERENCES 4-1

LIST OF APPENDICES

A Grout Formulation Optimization Test Report (CEES-0524, Rev. 0) A-i

B Tank Closure Grout Test Procedure (CEES-0501, Rev. 0) B-i

C Follow-on Shrinkage Testing..... C-i

LIST OF FIGURES

3-1. Test Objective 2 Grout Drop Trenches..... 3-6

3-2. Test Objective 2 Typical Grout Drop Trench..... 3-6

3-3. Setting the Boom to the 50-foot Drop Height..... 3-8

3-4. Start of Bulk Fill Grout Drop..... 3-9

3-5. Bulk Fill Drop After Approximately 10 Cubic Yards 3-9

3-6. Bulk Fill Batch Testing..... 3-10

3-7. Bulk Fill Drop After Approximately 20 Cubic Yards 3-10

3-8. Bulk Fill Drop Complete 3-11

3-9. Waste Stabilization Drop Area with Simulant..... 3-13

3-10.	Start of Waste Stabilization Grout Drop.....	3-15
3-11.	Waste Stabilization Drop After Approximately 10 Cubic Yards	3-16
3-12.	Waste Stabilization Batch Testing.....	3-16
3-13.	Waste Stabilization Grout After Approximately 20 Cubic Yards	3-17
3-14.	Waste Stabilization Grout Drop Complete	3-17
3-15.	Simulant Encapsulation	3-19
3-16.	Simulant Encapsulation During Demolition.....	3-20
3-17.	Temperature Test Schematic.....	3-23
3-18.	Temperature Test Set-up.....	3-23
3-19.	Six-foot Diameter Tank with Thermocouple Tree.....	3-24
3-20.	Temperature Profile in 6-foot Lift	3-25
3-21.	Temperature Profile in 5-foot Lift	3-26
3-22.	Temperature Profile in 4-foot Lift	3-27
3-23.	Temperature Profile	3-28
3-24.	Temperature Profile–6-foot Tank Center and Sidewall.....	3-29
3-25.	Pipe Flow Test Configuration.....	3-31
3-26.	Pipe Fill Test Configuration As Built View 1	3-31
3-27.	Pipe Fill Test Configuration As Built View 2	3-32
3-28.	Pipe Fill Testing Grout Pour.....	3-34
3-29.	Pipe Fill Test Grout Fill Sequence.....	3-35
3-30.	Pipe Fill Grout Flows into PVC Lines View 1	3-36
3-31.	Pipe Fill Grout Flows into PVC Lines View 2	3-36
3-32.	Pipe Fill Grout Flows into PVC Lines View 3	3-37
3-33.	Air Bubbles From Capped Lines	3-37
3-34.	Grout in Standpipes of 4- and 6-inch Diameter Lines	3-38
3-35.	Open Ended 2-inch Diameter Pipe Fill Test Results	3-39
3-37.	Open Ended 6-inch Diameter Pipe Fill Test Results	3-39
3-38.	Capped End 2-inch Diameter Pipe Fill Test Results – Upstream Side.....	3-40
3-39.	Capped End 2-inch Diameter Pipe Fill Test Results – Downstream Side.....	3-40
3-40.	Capped End 4-inch Diameter Pipe Fill Test Results – Downstream Side.....	3-41
3-41.	Capped End 6-inch Diameter Pipe Fill Test Results – Downstream Side.....	3-42
3-42.	6-inch Diameter Capped Line – Grout Fill at 19 Feet	3-42

LIST OF TABLES

3-1.	Grout Formulations (Test Objective 1).....	3-2
3-2.	Small Batch Test Results (Test Objective 1)	3-4
3-3.	Bulk Sluiced Sludge Simulant Recipe	3-7
3-4.	Bulk Fill Grout Drop Test Results	3-12
3-5.	Waste Stabilization Grout Drop Test Results	3-18
3-6.	Grout Mixture (Test Objective 4).....	3-33

APPENDIX C

FOLLOW-ON SHRINKAGE TESTING

C1.0 BACKGROUND

Small batch samples of both the stabilization grout and the bulk fill grout were taken during testing. The grout samples obtained during testing were allowed to cure for 24 days in a lime-saturated water bath (per ASTM 157C, section 10.2). Changes in length measurements were obtained periodically during this period to document any shrinkage or growth in the samples.

C2.0 TEST DATA

Small samples measuring 1.0 inch x 1.0 inch x 11.23 inches were produced for both the bulk fill grout and the stabilization grout with water contents of +0 percent, +10 percent and +25 percent. The samples were allowed to cure in their molds for 24 hours, at which point they were removed and initial measurements were taken. Immediately after being measured they were placed in a lime-saturated water bath where they remained for the next 24 days, being removed periodically for measurements. Once the samples had been observed for the required 24 days, the results were submitted to Columbia Energy for publication. After a period of 47 days it was determined that further testing was required and the samples were moved to a dry environment.

Table C-1. Stabilization Small Batch Test Results.

Water Content	Specimen ID	Shrinkage (%)				
		Day 24	Day 47 ^(a)	Day 82	Day 141	Day 155
+0% H ₂ O	RLG-09-0019-A ^(b)	N/A	N/A	N/A	N/A	N/A
	RLG-09-0019-B	-0.013	-0.016	0.014	0.035	0.052
+10% H ₂ O	RLG-09-0020-A ^(c)	N/A	N/A	N/A	N/A	N/A
	RLG-09-0020-B ^(d)	N/A	N/A	N/A	N/A	N/A
+25% H ₂ O	RLG-09-0021-A	-0.029	-0.032	-0.001	0.024	0.043
	RLG-09-0021-B	-0.029	-0.031	0.000	0.017	0.035

^(a)The specimens were removed from the lime-saturated water bath and were stored in air at this time.

^(b)Baseline stabilization specimen RLG-09-0019 A broke shortly after initial comparator reading.

^(c)Baseline stabilization specimen RLG-09-0020 A broke shortly after initial comparator reading.

^(d)Baseline stabilization specimen RLG-09-0020 B broke during the de-molding process.

Table C-2. Bulk Fill Small Batch Test Results.

Water Content	Specimen ID	Shrinkage (%)				
		Day 24	Day 47 ^(a)	Day 82	Day 141	Day 155
+0% H ₂ O	RLG-09-0022-A	-0.024	-0.027	0.020	0.030	0.045
	RLG-09-0022-B	-0.023	-0.028	0.013	0.035	0.047
+10% H ₂ O	RLG-09-0023-A	-0.026	-0.031	0.013	0.033	0.045
	RLG-09-0023-B	-0.025	-0.027	0.020	0.037	0.050
+25% H ₂ O	RLG-09-0024-A ^(b)	-0.097	-0.098	N/A	N/A	N/A
	RLG-09-0024-B	-0.023	-0.026	0.006	0.037	0.051

^(a)The specimens were removed from the lime-saturated water bath and were stored in air at this time.

^(b)Specimen RLG-09-0024-A was damaged after curing in the tank.

C3.0 RESULTS

Shrinkage results for the first 24 days are presented in Table 3-2 of the test report. The negative percent change in length shown in Table 3-2 indicates that the samples had been growing instead of shrinking. Subsequent to completion of the initial shrinkage testing it was decided that additional testing was required to determine whether the results were due to storage in the lime-saturated water bath. The samples were removed from the lime saturated bath after 47 days and were stored in air at a controlled temperature in the range of 69-75 degrees Fahrenheit. The samples were periodically measured to determine whether they were expanding or contracting once they had been removed from the lime-saturated water bath. Removal from the water bath also better represents curing conditions in the tank. The results of these tests for stabilization and bulk fill are summarized in Tables C-1 and C-2 respectively.

The change in water content in the bulk fill grout (baseline, +10 percent, +25 percent) had little effect on the shrinkage of the grout samples. The original datasheets/test reports showing shrinkage values for the bulk fill and waste stabilization grout formulations are presented in Figures C-1 through C-6.

**Figure C-1. Original Shrinkage Datasheet for Stabilization Grout Mixture:
+0% Water Content.**



Quality Inspection Services, Inc.

LENGTH CHANGE OF HARDENED HYDRAULIC-CEMENT
MORTAR AND CONCRETE TEST REPORT
(ASTM C 157/C 157M)

FINAL

Report #: R-09-0059 Spec: N/A
 Date: 04/23/09 Time: 1357 HRS
 Client: Columbia Energy Project Name: Grout Testing
 Job #: 0300-09-CIV-0011 W.O. #: 09-0300-0050
 Weather: Partly Cloudy Air Temperature: 72 °F
 Retest: Yes N/A No X Original Rpt#: N/A
 Location of Sample: A.R.P. Lab Technician: Lucas Hay


Specimen Type:	Mortar	N/A	Concrete	N/A	Grout	X
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Type	Maximum Size	Moisture Condition	Grading of Aggregate	Size of Specimen
Grout	#4	N/A	N/A	1.0" x 1.0" x 11.25"

Flow (in.):	6.25	Consolidation:	Rodding	X	Vibration	N/A
Slump (in.):	N/A	Storing Condition:	Water	X	Air	N/A
Mix Temp. (°F):	64					

Initial CRD (in.):	A:	0.0080	B:	0.0064	C:	N/A	Gage Length (in.):	10.00
Specimen ID	Age	CRD (in.)	$\Delta L_x \% = \left(\frac{CRD - \text{Initial CRD}}{G} \times 100 \right)$					
RLG-09-0019-A	24 hrs	0.0080	N/A					
RLG-09-0019-B	24 hrs	0.0064	N/A					
RLG-09-0019-A	-	-	-					
RLG-09-0019-B	4 days	0.0061	-0.003					
RLG-09-0019-B	7 days	0.0058	-0.006					
RLG-09-0019-B	14 days	0.0050	-0.014					
RLG-09-0019-B	24 days	0.0051	-0.013					
RLG-09-0019-B	47 days	0.0048	-0.016					
RLG-09-0019-B	82 days	0.0078	0.014					
RLG-09-0019-B	141	0.0099	0.035					
RLG-09-0019-B	155	0.0116	0.052					

Comments: Baseline Stabilization -- +0% H₂O. Specimen RLG-09-0019-A broke shortly after initial comparator reading. A negative % length change indicates a positive growth.

Technician: Lucas Hay Date: 04/23/09
 Reviewer: Michael A. Fortier  Date: 09/09/09

**Figure C-3. Original Shrinkage Datasheet for Stabilization Grout Mixture:
+25% Water Content.**



Quality Inspection Services, Inc.

LENGTH CHANGE OF HARDENED HYDRAULIC-CEMENT
MORTAR AND CONCRETE TEST REPORT
(ASTM C 157/C 157M)

FINAL

Report #: R-09-0059 Spec: N/A
 Date: 04/23/09 Time: 1427 HRS
 Client: Columbia Energy Project Name: Grout Testing
 Job #: 0300-09-CIV-0011 W.O. #: 09-0300-0050
 Weather: Partly Cloudy Air Temperature: 72 °F
 Retest: Yes N/A No X Original Rpt#: N/A
 Location of Sample: A.R.P. Lab Technician: Lucas Hay

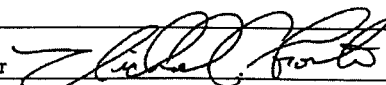
Specimen Type:	Mortar	N/A	Concrete	N/A	Grout	X
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Type	Maximum Size	Moisture Condition	Grading of Aggregate	Size of Specimen
Grout	#4	N/A	N/A	1.0" x 1.0" x 11.25"

Flow (in.):	13.5	Consolidation:	Rodding	X	Vibration	N/A
Slump (in.):	N/A	Storing Condition:	Water	X	Air	N/A
Mix Temp. (°F):	64					

Initial CRD (in.):	A:	0.0561	B:	0.0498	C:	N/A	Gage Length (in.):	10.00
Specimen ID	Age	CRD (in.)	$\Delta L_x \% = \left(\frac{CRD - Initial\ CRD}{G} \times 100 \right)$					
RLG-09-0021-A	4 days	0.0561	N/A					
RLG-09-0021-B	4 days	0.0498	N/A					
RLG-09-0021-A	7 days	0.0547	-0.014					
RLG-09-0021-B	7 days	0.0483	-0.015					
RLG-09-0021-A	14 days	0.0531	-0.030					
RLG-09-0021-B	14 days	0.0469	-0.029					
RLG-09-0021-A	24 days	0.0532	-0.029					
RLG-09-0021-B	24 days	0.0469	-0.029					
RLG-09-0021-A	47 days	0.0529	-0.032					
RLG-09-0021-B	47 days	0.0467	-0.031					
RLG-09-0021-A	82 days	0.0560	-0.001					
RLG-09-0021-B	82 days	0.0498	0.000					
RLG-09-0021-A	141	0.0585	0.024					
RLG-09-0021-B	141	0.0515	0.017					
RLG-09-0022-A	155	0.0604	0.043					
RLG-09-0021-B	155	0.0533	0.035					

Comments: Stabilization -- +25% H₂O. A negative % length change indicates growth.
 The initial reading was taken @ 4 days due to the slow-hardening of the grout.

Technician: Lucas Hay Date: 04/23/09
 Reviewer: Michael A. Fortier  Date: 09/07/09

**Figure C-4. Original Shrinkage Datasheet for Bulk Fill Grout Mixture:
+25% Water Content.**



Quality Inspection Services, Inc.

LENGTH CHANGE OF HARDENED HYDRAULIC-CEMENT
MORTAR AND CONCRETE TEST REPORT
(ASTM C 157/C 157M)

FINAL

Report #: R-09-0059 Spec: N/A
 Date: 04/23/09 Time: 1427 HRS
 Client: Columbia Energy Project Name: Grout Testing
 Job #: 0300-09-CIV-0011 W.O. #: 09-0300-0050
 Weather: Partly Cloudy Air Temperature: 72 °F
 Retest: Yes N/A No X Original Rpt#: N/A
 Location of Sample: A.R.P. Lab Technician: Lucas Hay

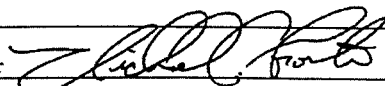
Specimen Type:	Mortar	N/A	Concrete	N/A	Grout	X
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Type	Maximum Size	Moisture Condition	Grading of Aggregate	Size of Specimen
Grout	#4	N/A	N/A	1.0" x 1.0" x 11.25"

Flow (in.):	13.5	Consolidation:	Rodding	X	Vibration	N/A
Slump (in.):	N/A	Storing Condition:	Water	X	Air	N/A
Mix Temp. (°F):	64					

Initial CRD (in.):	A:	0.0561	B:	0.0498	C:	N/A	Gage Length (in.):	10.00
Specimen ID	Age	CRD (in.)	$\Delta L_x \% = \left(\frac{CRD - Initial\ CRD}{G} \times 100 \right)$					
RLG-09-0021-A	4 days	0.0561	N/A					
RLG-09-0021-B	4 days	0.0498	N/A					
RLG-09-0021-A	7 days	0.0547	-0.014					
RLG-09-0021-B	7 days	0.0483	-0.015					
RLG-09-0021-A	14 days	0.0531	-0.030					
RLG-09-0021-B	14 days	0.0469	-0.029					
RLG-09-0021-A	24 days	0.0532	-0.029					
RLG-09-0021-B	24 days	0.0469	-0.029					
RLG-09-0021-A	47 days	0.0529	-0.032					
RLG-09-0021-B	47 days	0.0467	-0.031					
RLG-09-0021-A	82 days	0.0560	-0.001					
RLG-09-0021-B	82 days	0.0498	0.000					
RLG-09-0021-A	141	0.0585	0.024					
RLG-09-0021-B	141	0.0515	0.017					
RLG-09-0022-A	155	0.0604	0.043					
RLG-09-0021-B	155	0.0533	0.035					

Comments: Stabilization -- +25% H₂O. A negative % length change indicates growth.
 The initial reading was taken @ 4 days due to the slow-hardening of the grout.

Technician: Lucas Hay Date: 04/23/09
 Reviewer: Michael A. Fortier  Date: 09/07/09

**Figure C-5. Original Shrinkage Datasheet for Bulk Fill Grout Mixture:
+10% Water Content.**



Quality Inspection Services, Inc.

LENGTH CHANGE OF HARDENED HYDRAULIC-CEMENT
MORTAR AND CONCRETE TEST REPORT
(ASTM C 157/C 157M)

FINAL

Report #: R-09-0059 Spec: N/A
 Date: 04/23/09 Time: 1503 HRS
 Client: Columbia Energy Project Name: Grout Testing
 Job #: 0300-09-CIV-0011 W.O. #: 09-0300-0050
 Weather: Partly Cloudy Air Temperature: 72 °F
 Retest: Yes N/A No X Original Rpt#: N/A
 Location of Sample: A.R.P. Lab Technician: Lucas Hay

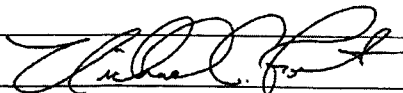
Specimen Type:	Mortar	N/A	Concrete	N/A	Grout	X
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Type	Maximum Size	Moisture Condition	Grading of Aggregate	Size of Specimen
Grout	#4	N/A	N/A	1.0" x 1.0" x 11.25"

Flow (in.):	8.25	Consolidation:	Rodding	X	Vibration	N/A
Slump (in.):	N/A	Storing Condition:	Water	X	Air	N/A
Mix Temp. (°F):	64					

Initial CRD (in.):	A:	0.0076	B:	0.0050	C:	N/A	Gage Length (in.):	10.00
Specimen ID	Age	CRD (in.)		$\Delta L_x \% = \left(\frac{CRD - \text{Initial CRD}}{G} \times 100 \right)$				
RLG-09-0023-A	4 days	0.0076		N/A				
RLG-09-0023-B	4 days	0.0050		N/A				
RLG-09-0023-A	7 days	0.0066		-0.01				
RLG-09-0023-B	7 days	0.0044		-0.032				
RLG-09-0023-A	14 days	0.0052		-0.024				
RLG-09-0023-B	14 days	0.0027		-0.023				
RLG-09-0023-A	24 days	0.0050		-0.026				
RLG-09-0023-B	24 days	0.0025		-0.025				
RLG-09-0023-A	47 days	0.0045		-0.031				
RLG-09-0023-B	47 days	0.0023		-0.027				
RLG-09-0023-A	82 days	0.0089		0.013				
RLG-09-0023-B	82 days	0.0070		0.020				
RLG-09-0023-A	141	0.0109		0.033				
RLG-09-0023-B	141	0.0087		0.037				
RLG-09-0023-A	155	0.0121		0.045				
RLG-09-0023-B	155	0.0100		0.050				

Comments: Bulk Fill -- +10% H₂O. A negative % length change indicates growth.
 The initial reading was taken @ 4 days due to the slow-hardening of the grout.

Technician: Lucas Hay Date: 04/23/09
 Reviewer: Michael A. Fortier  Date: 09/09/09

**Figure C-6. Original Shrinkage Datasheet for Bulk Fill Grout Mixture:
+0% Water Content.**



Quality Inspection Services, Inc.

LENGTH CHANGE OF HARDENED HYDRAULIC-CEMENT
MORTAR AND CONCRETE TEST REPORT
(ASTM C 157/C 157M)

FINAL

Report #: R-09-0059 Spec: N/A
 Date: 04/23/09 Time: 1444 HRS
 Client: Columbia Energy Project Name: Grout Testing
 Job #: 0300-09-CIV-0011 W.O. #: 09-0300-0050
 Weather: Partly Cloudy Air Temperature: 72 °F
 Retest: Yes N/A No X Original Rpt#: N/A
 Location of Sample: A.R.P. Lab Technician: Lucas Hay

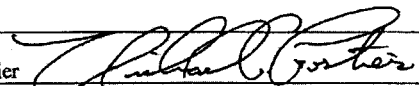
Specimen Type:	Mortar	N/A	Concrete	N/A	Grout	X
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Type	Maximum Size	Moisture Condition	Grading of Aggregate	Size of Specimen
Grout	#4	N/A	N/A	1.0" x 1.0" x 1.25"

Flow (in.):	7.75	Consolidation:	Rodding	X	Vibration	N/A
Slump (in.):	N/A	Storing Condition:	Water	X	Air	N/A
Mix Temp. (°F):	64					

Initial CRD (in.):	A: 0.0083	B: 0.0046	C: N/A	Gage Length (in.):	10.00
Specimen ID	Age	CRD (in.)	$\Delta L_x \% = \left(\frac{CRD - \text{Initial CRD}}{G} \times 100 \right)$		
RLG-09-0022-A	4 days	0.0083	N/A		
RLG-09-0022-B	4 days	0.0046	N/A		
RLG-09-0022-A	7 days	0.0069	-0.014		
RLG-09-0022-B	7 days	0.0043	-0.003		
RLG-09-0022-A	14 days	0.0058	-0.025		
RLG-09-0022-B	14 days	0.0023	-0.023		
RLG-09-0022-A	24 days	0.0059	-0.024		
RLG-09-0022-B	24 days	0.0023	-0.023		
RLG-09-0022-A	47 days	0.0056	-0.027		
RLG-09-0022-B	47 days	0.0018	-0.028		
RLG-09-0022-A	82 days	0.0103	0.020		
RLG-09-0022-B	82 days	0.0059	0.013		
RLG-09-0022-A	141	0.0113	0.030		
RLG-09-0022-B	141	0.0081	0.035		
RLG-09-0022-A	155	0.0128	0.045		
RLG-09-0022-B	155	0.0093	0.047		

Comments: Baseline Bulk Fill -- +0% H₂O. A negative % length change indicates growth.
 The initial reading was taken @ 4 days due to the slow-hardening of the grout.

Technician: Lucas Hay Date: 04/23/09
 Reviewer: Michael A. Fortier  Date: 09/09/09