OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

YUCCA MOUNTAIN QUALITY ASSURANCE DIVISION

QUALITY ASSURANCE SURVEILLANCE REPORT

OF

REYNOLDS ELECTRICAL AND ENGINEERING COMPANY, INC.
AND
RAYTHEON SERVICES NEVADA

SURVEILLANCE YMP-SR-93-041

CONDUCTED AT THE EXPLORATORY STUDIES FACILITY
NORTH PORTAL STARTER TUNNEL, AREA 25, YUCCA MOUNTAIN SITE AND
THE RAYTHEON SERVICES NEVADA MATERIAL TESTING LABORATORY
IN MERCURY, NEVADA

SEPTEMBER 14 THROUGH OCTOBER 18, 1993

ACTIVITIES SURVEILLED:

SHOTCRETE TEST PANEL FABRICATION, STORAGE, HANDLING,
TRACEABILITY, PRETEST PREPARATION AND TESTING

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Approved by: Donald G. Horton Date: 11/2/93
Donald G. Horton
Director
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1.0 EXECUTIVE SUMMARY

This report summarizes the results of a quality assurance surveillance that was performed by the representatives of the Yucca Mountain Quality Assurance Division (YMQAD) from September 14 through October 18, 1993. This surveillance was performed to evaluate compliance to Reynolds Electrical and Engineering Company, Inc. (REECo) procedure TC-581-SP-0007, Revision 1, "Starter Tunnel Shotcrete," with regard to the fabrication, storage and handling, pretest preparation, and the traceability of shotcrete test panels.

This Surveillance was performed by the YMQAD in accordance with the requirements of Quality Assurance Administration Procedure QAAP 18.3, Revision 3, Surveillance Program.

No Corrective Action Requests (CAR) were issued as a result of this surveillance. However, two recommendations were issued by the surveillance team and are documented in Section 6.0 of this report. In addition, the Office of Civilian Radioactive Waste Management (OCRWM) CAR YM-93-061, issued July 7, 1993, identifies failure of shotcrete test samples to meet compressive strength tests and commits to issuance of Nonconformance Reports (NCRs) for test failures.

2.0 SCOPE

This surveillance was performed to assure that shotcrete test panels were fabricated, handled, prepared for testing, tested, and evaluated in accordance with specification and procedural requirements.

3.0 SURVEILLANCE TEAM

Fred H. Lofftus, Surveillance Team Leader, YMQAD/Quality Assurance Technical Support Services (YMQAD/QATSS)
Raul A. Hinojosa, Senior Quality Assurance Specialist. YMQAD/QATSS

4.0 PERSONNEL CONTACTED

C. Mogrense, Engineer-1, REECo
W. Waggoner, Quality Assurance Inspector. M&O
C. Ruth, Shift Superintendent, REECo
S. Ricks, Quality Control, Senior Quality Assurance Specialist, REECo
P. Bryant, Quality Assurance Quality Control Section Chief, REECo
D. Herrington, Materials Testing Laboratory Senior Specialist, Raytheon Services Nevada (RSN)

F. Beason Quality Control Senior Technical Specialist, M&O
B. Patel, Materials Testing Laboratory Supervisor, Materials, RSN
D. Anderson, Materials Testing Laboratory Technician, RSN
J. Kiefer, Staff Mining Engineer, M&O
J. Pye, Staff Mining Engineer, M&O
E. Mouser, Quality Assurance Quality Control Inspector, REECo
R. Ruth, Quality Assurance, M&O
R. Strote, Materials Testing Laboratory Technician, RSN
W. Williams, Quality Control, Quality Control Inspector, REECo
D. Busick, Quality Control, Quality Control Inspector, REECo

5.0 SURVEILLANCE RESULTS

Compliance to procedure TC-581-SP-0007, Revision 1, was verified as follows:

Paras. 6.1.3/6.4.1 require that personnel operating the shotcrete nozzle be qualified as Nozzlemen prior to actual shotcrete placement. It was verified that the three nozzle operators for the graveyard, day and swing shift (J. Hasting, R. Vigil and H. DiCamillo, respectively) were trained and certified as required.

Para. 6.1.4 requires the use of dry packaged shotcrete mix containing steel fibers. The inclusion of steel fibers in shotcrete mix was verified by examination of the REECo procurement documentation 01527-CUW-01-2 and by examination of the dry bulk shotcrete material awaiting application.

Para. 6.1.7 requires water usage to be monitored and that a chemical tracer be added to the water. Water accountability and the chemical additions were verified by examining the Water Usage Log for the three shifts on September 14, 1993.

Para. 6.1.10 requires the unconfined compressive strength of shotcrete to be a minimum of 3000 psi after seven days and 5000 psi in 28 days. It was verified that three test panels (Numbers 9309141, 9309142 and 9309143) were delivered to the test laboratory for the seven and 28 day compression test, and that three (3-inch diameter) cylinders were cored from each of the panels for compression testing. The nine cores were adequately identified before being submerged in water for the minimum 40 hour soak in accordance with the American Concrete Institute (ACI) Standard 506.2-90,

Paragraph 1.6.3.2. On the seventh day of the curing period, one core from each of the three panels was selected for the compression test. Test results were as follows:

Specimen	Value	Results
9309141	2360 psi*	Failed - Below minimum requirements Project NCRs to be issued by REECo Quality Control (QC) for all failed test panels as identified on OCRWM CAR YM-93-061.
9309142	5780 psi	Acceptable
9309143	3320 psi	Acceptable

* Before the compression test was performed, it was noted that test specimen 9309141 had a large diagonal flaw on one side. This test specimen appeared to have lack of adherence in areas containing the steel reinforcement.

Test results at the end of the 28 day curing period for the remaining six specimens as follows:

Specimen	Value	Results
9309141	*4330 psi and 5130 psi	* Failed - See above for core 9309141
9309142	7850 psi and 5970 psi	Acceptable
9309143	*4800 psi 6350 psi	* Failed - See results above for core 9309141

Para. 6.7 requires that the maximum shotcrete temperature shall not exceed 100 degrees Fahrenheit when leaving nozzle. It was verified that the mix temperature at the time test panel 9309142 was fabricated, to be 75 degrees as measured by a calibrated temperature gage No. Y10676 calibrated on June 3, 1993 and due for calibration December 3, 1993.

Compliance to Specification YMP-025-1-SP09:

Specification YMP-025-1-SP09, Revision 2, Section 03361, Shotcrete, Section 1.05a, for flexural strength requires that the design mix develop strength for Modulus of

Rupture of 500 psi after 72 hours. An initial test was performed at seven days (168 hours). REECo issued an NCR 93-048 to document this deficiency. In accordance with A/E disposition on the NCR, the test was permitted to be performed on October 16, 1993, at which time the results were determined to be acceptable.

6.0 RECOMMENDATIONS

6.1 Specification YMP-025-1-SP09, Revision 2, Section 1.05C5a states in part: "Flexural Strength: The mix design for production with the steel fiber reinforcement shall be such as to develop strength as placed on the job or in test panels progressively as follows: Modulus of Rupture is 72 hours - 500 psi, 28 days - 700 psi."

It is recommended that the specification be revised for clarification as to the requirements and acceptance of flexural strength specimens after initial acceptance of the mix designs.

6.2 Specification YMP-025-1-SP09, Revision 3, Paragraph 3.09: "Natural curing of shotcrete used on subsurface shall be done in accordance with Section 2.04 of this specification."

Section 2.04: "Shotcrete shall be naturally cured."

Paragraph 3.10 b: "The panels shall be field cured in the same manner as the work."

ACI 506.2-90, Paragraph 1.6.3.2: "Field cure panels in the same manner as the work, except that the test specimens shall be soaked in water for a minimum of 40 hours prior to testing."

It is recommended that the specification and implementing procedures be revised to clarify the requirement regarding natural field curing of shotcrete, initial and final curing.