

October 12, 1995

MEMORANDUM TO: Joseph J. Holonich, Chief
HLUR/DWM/NMSS
FROM: Michael J. Bell, Chief /S/
ENGB/DWM/NMSS
SUBJECT: COMPLETION REPORT REVIEW
TUBA CITY SITE

As requested by HLUR, we have completed our review of the geotechnical engineering and surface water hydrology aspects of DOE's Completion Report for the referenced site. The attached are the applicable sections to the Completion Report Review document being prepared by HLUR.

This review was performed by Tim Harris and Ted Johnson. If you have any questions, they can be reached at 415-6613 and 415-6658, respectively.

Attachments: As stated

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OFC	ENGB	E	ENGB	ENGB	ENGB
NAME	THarris/eb	TLJohnson	KMcConnell	MBell	
DATE	10/6/95	10/6/95	10/6/95	10/6/95	

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Attachments

INPUT TO COMPLETION REPORT REVIEW
TUBA CITY - TITLE I

2.2.1 Geotechnical Engineering Review Results

NRC staff reviewed the geotechnical engineering aspects of the Tuba City remedial action to determine whether the remediation was completed in accordance with applicable construction specifications in the RAP, and the RAIP. Items reviewed in the CR included construction operation narratives, as-built drawings, laboratory and field testing data, and quality assurance audits. The review included staff observations and review of records during on-site construction evaluations. As a result of its review, NRC staff noted the following:

1. Appropriate tests (gradation) and inspections were performed to ensure that the proper type of material was placed for each element of the construction. Specific elements examined in this review included the subgrade material, contaminated material, and radon barrier. The loose thickness of the lifts was verified periodically to ensure compliance with the specifications. Placement and compaction operations were routinely inspected and tested to verify that the moisture and density requirements were met.
2. Documented results of laboratory and field testing indicate that the tests were conducted in accordance with acceptable procedures by trained and qualified personnel.
3. The CR shows that the frequency of material testing and inspection comply with frequencies specified in the RAIP, except as noted below.
4. As-built drawings indicate that the completed remedial action is consistent with the NRC-approved design.

NRC staff identified several areas wherein the testing did not explicitly meet the requirements of the specifications. Many of these deviations were previously identified by Morris Knudsen-Ferguson (MK-F) in their quality assurance audits. MK-F provided corrective actions which typically consisted of training for non-compliance items. However, the following items were not identified by MK-F:

- 1) Sandcone verifications were not performed for nuclear density testing performed between 12/03/88 and 3/27/89. Approximately 62 nuclear density tests were performed during this period.
- 2) Classification tests were not performed on the radon barrier material between 7/25/89 and 8/28/89. This equates to approximately 21,500 yds. of material which was not tested.

DOE noted that the average testing frequency for each element was met. Considering the number and frequency of tests and consistency of test results, NRC staff concludes that the non-compliance items will not adversely affect the performance of the remedial action.

APPENDIX B:

DETAILED COMPARISON OF DESIGN SPECIFICATIONS
WITH COMPLETED REMEDIAL ACTIONS PERFORMED AT
TUBA CITY UMTRA PROJECT SITE

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Subgrade Contaminated Material	
RAP Requirements	Verification
1. Configuration: A. Areal Extent - Tailings and contaminated materials to be stabilized in place with no excavation, as indicated in RAP Drawing TUB-PS-10-0819	1. Configuration: A. Areal extent verified in As-Built Drawing TUB-PS-10-0819 dated 2/26/91
2. Material - Not applicable	2. Material - Not applicable
3. Placement: A. Material to be stabilized in place shall be compacted to 90% of maximum dry density in accordance with ASTM D698 (Design Specs. 02200, Rev. 2, Part 3.6.B.1).	3. Placement: from Completion Report, App. E. A. There were 18 failing in-place density tests in 7 areas of the embankment perimeter requiring reworking. After reworking those areas, 140 tests met the density requirement.
4. Test Frequency: A. In-place soil density tests - 1 test per 1500 square yards of compacted ground. (Source of spec. unknown.) B. At least one test for each isolated area measuring less than 1500 square yards. (Source of spec. unknown.) C. One-point Proctor tests are required for every ten field density tests performed (RAIP, Rev. 3A, Procedure 6.1.7).	4. Test Frequency: from Completion Report, App. E A. On average, one test performed per 1276 square yards. Testing frequency charts show acceptable distribution and frequency of tests. B. Testing frequency charts show acceptable distribution and frequency of tests. C. On average, one Proctor test was performed per 5.2 field density tests. Testing frequency charts show acceptable distribution and frequency of tests.

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Contaminated Fill	
RAP Requirements	Verification
1. Configuration: A. Areal Extent: Excavation - contaminated material from the site including processing areas, evaporation ponds, and windblown areas to be excavated in areas and to depths as indicated on RAP Drawings TUB-PS-10-0819, -0820, AND -0821. B. Areal Extent: Placement - contaminated material to be consolidated on tailings pile and contoured as shown on RAP Drawings TUB-PS-10-0823 and -0824.	1. Configuration: A. Excavations verified in As-Built Drawings TUB-PS-10-0819, -0820, and -0821, dated 2/26/91. B. Areal extent and contours verified in As-Built Drawings TUB-PS-10-0823 and -0824, dated 2/26/91.
2. Material: Not applicable	2. Material: Not applicable
3. Placement: A. Lift Thickness - Not greater than that required to achieve required compaction, and no greater than 12 inches (Design Specs. 02200, Rev. 2, Part 3.6.B.7). B. Compaction/Moisture - At least 90% of maximum dry density. Soil to be conditioned as required to achieve required compaction moisture (Design Specs. 02200, Rev. 2, Part 3.6.C.1).	3. Placement: from Completion Report, App. E A. Continuously monitored to ensure that loose lifts did not exceed 12 inches. B. 21 areas failed and were reworked, 1070 passing tests averaged 95.2%.

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Contaminated Fill	
RAP Requirements	Verification
<p>4. Test Frequency:</p> <p>A. In-place soil density and moisture content, a minimum of one test per 1000 cubic yards of contaminated and uncontaminated material placed (Design Specs. 02200. Rev 2, Part 3.6.D.2.a).</p> <p>B. At least 2 density/moisture tests required per day of material placement exceeding 150 cy (Procedure 6.1.4.d of the RAIP, Rev. 3A).</p> <p>C. Maximum dry density determinations required at least once per 10,000 cy of material placed (Procedure of the RAIP, Rev. 3A.).</p> <p>D. One-point Proctor tests required to ensure the correct maximum dry density value was applied when performing field density tests, at least once per 10 field density tests (Procedure 6.1.7 of RAIP, Rev. 3A).</p> <p>E. At least one oven-dried sample is required to verify each 10 microwave-oven moisture determinations (Procedure 6.1.2 of the RAIP, Rev. 3A).</p>	<p>4. Test Frequency: from Completion Report, App. E</p> <p>A. On average, one test performed per 916 cy placed. Testing frequency charts show acceptable distribution and frequency of tests.</p> <p>B. Testing frequency charts show acceptable distribution and frequency of tests.</p> <p>C. On average, one test performed per 8910 cy. Testing frequency charts show acceptable distribution and frequency of tests.</p> <p>D. On average, one Proctor test performed per 6.6 density tests. Testing frequency charts show acceptable distribution and frequency of tests.</p> <p>E. On average, one oven-dried test performed per 7.8 microwave determinations. Testing frequency charts show acceptable distribution and frequency of tests.</p>

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Radon Barrier	
RAP Requirements	Verification
1. Configuration: A. Areal Extent - Radon barrier to be placed over all contaminated material (RAP Drawing TUB-PS-10-0825). B. Thickness requirement varies from 3 to 6 feet based upon radiation measurements of contaminated material (RAP Drawing TUB-PS-10-0825).	1. Configuration: A. Areal extent verified in As-Built Drawing TUR-PS-10-0825, dated 2/26/91. B. Thickness verified 3 to 6 feet in As-Built Drawing TUB-PS-10-0825, dated 2/26/91.
2. Material: A. Gradation - Minimum of 20% passing No. 200 sieve, no particle larger than 2 inches (Design Specs. 02200, Rev. 2, Part 2.1.D.1.b). B. Classification - SC or SM material according to ASTM D2487 (Design Specs. 02200, Rev. 2, Part 2.1.D.1.b).	2. Material: from Completion Report, App. E. A. A summary of the gradation test results was submitted. B. 33 tests on visually questionable material at borrow; 4 failed samples were remixed and tested.
3. Placement: A. Lift Thickness - shall not exceed 9 inches for radon barrier material (Design Specs. 02200, Rev. 2, Part 3.6.B.7). B. Compaction/Moisture - radon barrier material shall be compacted to at least 100% of maximum dry density per ASTM D698 (Design Specs. 02200, Rev. 2, Part 3.6.C.1).	3. Placement: from Completion Report, App. E A. Lift Thickness did not exceed 9 inches. B. On average, compaction achieved was 101.8% of maximum dry density.

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Radon Barrier	
RAP Requirements	Verification
3. Placement: (continued) C. Moisture content shall be maintained within 0 to plus 3% of optimum as determined by ASTM D698 (Design Specs. 02200, Rev. 2, Part 3.6.C.2).	3. Placement: (continued) C. Average moisture content was 1.1% above optimum.
4. Test Frequency: A. In-place moisture and density - required once per 500 cubic yards of radon material placed (Design Specs. 02200, Rev. 2, Part 3.6.D.2.a). B. At least 2 field density and moisture tests required per day of material placed exceeding 150 cy (Procedure 6.1.4.d of the RAIP, Rev. 3A). C. Classification/Gradation - required once per 2000 cubic yards of radon material placed. A minimum of one test per day if more than 150 cubic yards of radon barrier are placed (RAIP, Rev. 3A, Procedure 6.1.10). D. One-Point Proctor - at least one test for each 10 field density tests (RAIP, Rev. 3A, Procedure 6.1.7). E. Maximum Density/Optimum Moisture - at least one test for each 15,000 cubic yards radon barrier material placed (RAIP, Rev. 3A, Procedure 6.1.6).	4. Test Frequency: from Completion Report, App. E. A. On average, 1 in-place moisture/density test performed per 451 cy placed. Testing frequency charts show acceptable distribution and frequency of tests. B. Testing frequency charts show acceptable distribution and frequency of tests. C. On average, 1 classification was performed per 1455 cy, and one gradation test was performed per 1263 cy placed. Testing frequency charts show an acceptable average frequency of tests. The specific frequency was not met as noted in the body of the CRR. D. On average, one Proctor verification was performed per 6.0 passing density tests. Testing frequency charts show acceptable distribution and frequency of tests. E. On average, one density/moisture test was performed per 4546 cy placed. Testing frequency charts show acceptable distribution and frequency of tests.

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Radon Barrier	
RAP Requirements	Verification
4. Test Frequency: (continued) F. At least one oven-dried moisture test shall be completed for each ten microwave or nuclear-density gauge moisture tests performed (RAIP, Rev. 3A, Procedure 6.1.2). G. When a nuclear density gauge is used for in-place density measurements, a correlation sand-cone density test shall be performed at least once for each 5 nuclear density tests (RAIP, Rev. 3A, Procedure 6.1.3).	4. Test Frequency: (continued) F. On average, one oven-dried comparison was performed per 4.5 microwave and 4.9 nuclear-density gauge tests. Testing frequency charts show acceptable distribution and frequency of tests. G. On average, one sand-cone correlation was performed per 4.9 nuclear density measurements. Testing frequency charts show an acceptable average frequency of tests. The specific frequency was not met as noted in the body of the CRR.

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Bedding Material	
RAP Requirement	Verification
1. Configuration: A. Areal Extent - bedding to be placed beneath riprap on tailings embankment, aprons, and drainage ditches (RAP Drawing TUB-PS-10-0825). B. Thickness - 6 inches in all places, with tolerances of 90% to 125% (5.4 to 7.5 inches) (Design Specs. 02278, Rev. 2, Part 3.2.A.2 and 3.2.A.3). C. Elevation - top surface within 0.1 feet of elevations shown on subcontract drawings (Design Specs. 02278, Rev. 2, Part 3.2.A.1).	1. Configuration: A. Areal extent verified As-Built Drawing TUB-PS-10-0825. B. 6 inches in all places with a thickness tolerance of 0.1 feet (4.8 to 7.2 inches) (Completion Report, App. E). C. As-built elevations are addressed in Appendix E of the Completion Report.
2. Material: A. Gradation - See Design Specs. Rev. 2, Part 2.1.D.2. B. Durability - Material shall have specific gravity not less than 2.65 (Design Specs. 02278, Rev. 2, Part 2.1.C.3). C. Durability - Not more than 5% weight loss in 5 sodium sulfate soundness cycles (Design Specs. 02278, Rev. 2, Part 2.1.C.3).	2. Material: from Completion Report, App. E A. Gradation summary curve verifies that bedding material met the gradation requirement. B. Average specific gravity value of 2.91, lowest value of 2.89. C. Soundness tests resulted in 2.37% average loss, 3.28% maximum loss.
3. Placement: A. Nominal 6-inch lifts to be compacted by four passes of 2- to 3-ton vibratory roller (Design Specs. 02278, Rev. 2, Part 3.1.C). B. Material to be distributed uniformly with minimization of voids (RAIP, Rev. 3A, Procedure 6.3.6).	3. Placement: A. The material was compacted as required. B. The placement was visually inspected and depth checks were performed.

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Bedding Material	
RAP Requirement	Verification
4. Test Frequency: A. Durability tests - a minimum of 4 tests, and a minimum frequency of one test per 10,000 cubic yards of bedding material produced (RAIP, Rev. 3A, Procedure 6.2.1). B. Gradation tests - a minimum frequency of one test per 10,000 cubic yards of bedding material produced (RAIP, Rev. 3A, Procedure 6.2.2). C. Material blending - samples shall be obtained from the quarry conveyor belt at least once per 5000 cubic yards blended (RAIP, Rev. 3A, Procedure 6.2.5).	4. Test Frequency: from Completion Report, App. E A. On average, one test was performed per 5328 cy produced. Testing frequency charts show acceptable distribution and frequency of tests. B. On average, one test was performed per 4359 cy produced. Testing frequency charts show acceptable distribution and frequency of tests. C. On average one sample was tested per 592 cy produced. Testing frequency charts show acceptable distribution and frequency of tests.

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Rock Cover	
RAP Requirement	Verification
1. Configuration: A. Areal Extent - Rock cover to be placed as shown in RAP Drawings TUB-PS-10-0823 through -0829. B. Thickness - Type A Top Embankment 6 inches Side Slopes 12 inches Type B 12 inches Type C 18 inches Type D 24 inches Type E 24 inches Type F 36 inches (RAP Drawings TUB-PS-10-0823 through -0829)	1. Configuration: A. Areal extent verified in Drawings TUB-PS-10-0823 through -0829, dated 2/26/91 and 8/28/90. B. Daily monitoring during excavation, production, stockpiling, loading, transportation and placement; assured quality control and proper placement. Thicknesses verified in As-Built Drawings TUB-PS-10-0823, -0825, -0827, -0828, and -0829.
2. Material: A. Gradation - (Design Specs. 02278, Rev. 2, Part 2.1 C.4). Type A -pile top, side slopes, secondary bedding Type B -side slopes and ditches Type C -ditches and aprons Type D -ditches and outlets Type E -ditches Type F -ditches B. Durability - Specific gravity shall exceed 2.65. Sodium sulfate soundness test shall not result in greater than 5% weight loss after 5 cycles. Abrasion testing shall not result in greater than 10% weight loss after 100 revolutions. (Design Specs. 02278, Rev. 2, Part 2.1.C.3).	2. Material: A. Gradation summary curves verify that all gradation requirements are met (Completion Report, App. E) B. Durability testing was performed in accordance with the specifications. (Completion Report, App. E)
3. Placement: A. Uniform distribution and minimization of voids (RAIP, Rev. 3A, Procedure 6.3.6).	3. Placement: A. Daily inspections of riprap layers were conducted to assure that proper techniques were used to prevent degradation of the material, to ensure distribution was uniform and to minimize voids (Completion Report, App. E).

VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Tuba City, Arizona RAP Feature: Rock Cover	
RAP Requirement	Verification
4. Test Frequency: A. Gradation and Durability - each type of riprap shall be tested at least 4 times: once upon delivery, and then at least once per 10,000 cubic yards of each type placed. For total volumes less than 30,000 cubic yards for each type, testing shall be performed at approximate thirds, and a test at completion (RAIP Rev. 3A, Procedure 6.2.2).	4. Test Frequency: A. Testing frequency charts show acceptable distribution and frequency of tests.