

FINAL
COMPLETION REVIEW REPORT
for the
REMEDIAL ACTION
of the
GREEN RIVER, UTAH
URANIUM MILL TAILINGS SITE

July 1992

Division of Low-Level Waste Management
and Decommissioning
U. S. Nuclear Regulatory Commission

FINAL COMPLETION REVIEW REPORT

for the Remedial Action
at the Green River Uranium
Mill Tailings Site

Green River, Utah

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety
and Safeguards
Division of Low Level Waste Management
and Decommissioning

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GREEN RIVER, UTAH COMPLETION REVIEW REPORT

INTRODUCTION

The Green River site is one of the 24 abandoned uranium mill tailings sites to be remediated by the Department of Energy (DOE) under the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). UMTRCA requires, pursuant to Section 104(f)(1), that the Nuclear Regulatory Commission (NRC) concur with the DOE's determination that the remedial action has been properly completed. This Completion Review Report (CRR) documents the NRC staff's basis for its concurrence decision with respect to DOE's Certification Report for the completion of the Green River site (DOE, 1990).

1.0 BACKGROUND

1.1 UMTRCA

Title I of UMTRCA provides for remedial action at abandoned uranium mill tailings sites and associated vicinity properties. The purpose of this legislation is to protect the public health and safety and the environment from radiological and non-radiological hazards associated with the radioactive materials at these sites.

UMTRCA directs DOE to select and perform remedial actions at 24 abandoned uranium mill tailings sites to ensure compliance with the general environmental standards promulgated by the Environmental Protection Agency (EPA) under Section 275(a) of the Atomic Energy Act of 1954, as amended by UMTRCA. UMTRCA also requires DOE to obtain NRC's concurrence with DOE's selection and performance of the remedial actions. Following completion of the remedial actions, UMTRCA authorizes NRC to license the long-term custody, maintenance, and monitoring of the disposal sites to ensure continued protection of the public health and safety and the environment. Appendix C includes a more detailed discussion of this legislation.

1.2 Concurrence Process for the Selection of DOE's Remedial Actions

To document its selection of the remedial action to be implemented at a particular site, DOE develops and issues a Remedial Action Plan (RAP) (DOE, 1989a; 1989b; 1988; 1987a; 1987b; 1987c). The RAP describes the series of activities and presents the design proposed by DOE to stabilize the residual radioactive materials at the disposal site and to provide for the long-term protection of the public and the environment. In accordance with UMTRCA Section 108(a)(1), the NRC staff reviews and concurs with the RAP, and any subsequent modifications. By its review and concurrence in the remedial action selection, the NRC staff concludes that the planned remedial actions will comply with EPA's applicable standards in 40 CFR 192, Subparts A, B, and C. The basis for the NRC staff's concurrence in DOE's selection of remedial action at the Green River site is documented in a Technical Evaluation Report (TER) issued in March, 1990 (NRC, 1990b).

1.3 Concurrence Process for the Performance of DOE's Remedial Actions

The remedial action work is performed by DOE contractors under Federal procurement regulations. During construction, DOE inspects and documents activities in accordance with the UMTRA Project Quality Assurance Plan, the Remedial Action Inspection Plan (RAIP), and the RAP. In addition, the NRC staff conducts independent inspections during construction.

Upon the completion of the remedial action, DOE compiles construction records and prepares a completion report to document that remedial actions were performed in accordance with the RAP or RAP modifications, and the RAIP. Based on this information, DOE certifies that all provisions of the RAP have been satisfied and, therefore, that the remedial actions comply with the applicable EPA standards in 40 CFR 192. Based on its review of DOE's documentation, and on its site visits and observations, NRC makes a concurrence decision with regard to DOE's remedial action completion determination for the sites, and then documents the basis for this concurrence decision in the CRR. By its review and concurrence in the remedial action performance, the NRC staff concludes that the remedial action has been completed in accordance with the concurred-in design. NRC's concurrence with DOE's completion determination fulfills the Commission's responsibility under UMTRCA Section 104(f)(1) to concur with DOE's determination of completion of remedial action.

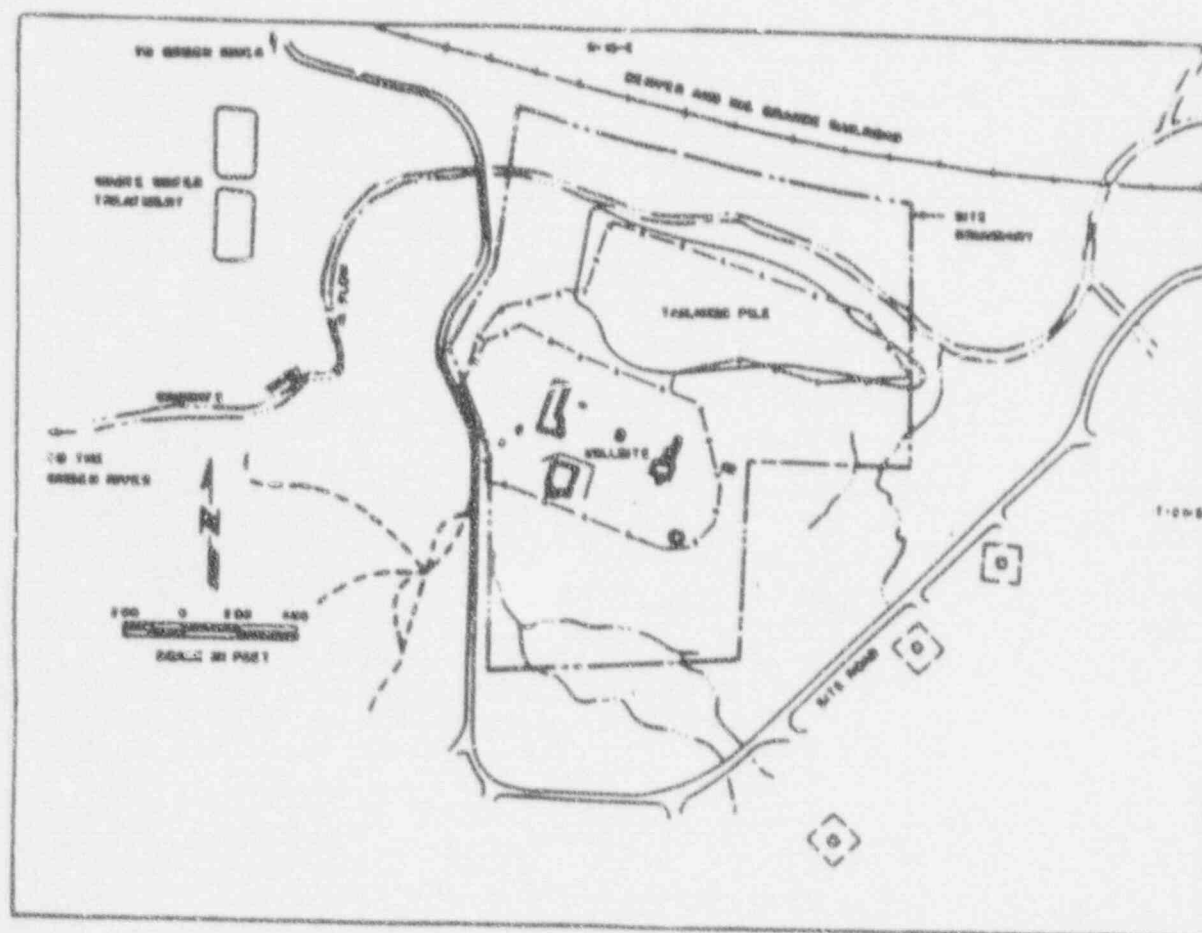
1.4 Green River Site

The Green River uranium mill tailings site is located in Grand County, Utah, approximately one mile southwest of the city of Green River. Prior to remedial action, the uranium mill tailings on the designated site and the windblown contaminated materials totalled approximately 382,000 cubic yards (cys) (See Figure 1.1)

The remedial action performed by DOE consisted of the following major activities:

1. Movement of all contaminated materials (uranium mill tailings, windblown and waterborne contaminants, and demolition debris from the mill building addition, office building addition, and roaster building) to a disposal embankment on a terrace located above Brown's Wash;
2. Stabilization of contaminated material in the embankment constructed primarily below the existing ground surface; placement and compaction of tailings and windblown contaminated material on top of a six-foot thick buffer layer of select soil fill; and

FIGURE 1.1
Pre-Remedial Action Site Conditions



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3. Coverage of the embankment with 1) a three-foot-thick infiltration/radon barrier of compacted silty clay, amended with a six percent by weight sodium bentonite; and 2) an erosion protection layer consisting of bedding material, and Type A and Type B riprap. The cover has been designed to ensure long-term stability, reduce radon emissions and protect ground and surface water.

The NRC was not involved with the actual remedial action activities, which were performed by the DOE contractors. However, DOE obtained NRC concurrence with the site construction design and significant modifications thereof. NRC also performed site inspections to monitor the progress of the construction activity (see Appendix A).

1.5 Completion Review Report (CRR) Organization

The purpose of this final CRR is to document the NRC staff review of DOE's Green River Completion Report. Section 2 of this report presents the analysis of remedial action construction. This section is organized by technical discipline and addresses geotechnical engineering, surface water hydrology, groundwater hydrology, and radiation protection aspects of the remedial action. Appendix A provides a listing of all NRC staff visits to and inspections of the Green River site. Appendix B provides a table that cross-checks the requirements of the RAP/RAIP as concurred in by the NRC staff with DOE's Completion Report documentation. Appendix C presents a detailed description of the requirements of UMTRCA and the resulting phased process of the UMTRA Project.

2.0 ANALYSIS OF DOE REMEDIAL ACTION PERFORMANCE

2.1 Previous Actions

The NRC staff, based on its review of the RAP and RAP modifications, concurred that the remedial action as designed would meet the applicable EPA standards. This concurrence was based on technical findings that there is reasonable assurance that the selection of the remedial action would meet the standards for long-term stability, radon attenuation, water resources protection and cleanup of contaminated land and buildings. Staff reviews included assessments in the areas of health physics and radiation protection, geotechnical engineering, surface water hydrology, ground-water hydrology, and geology. The NRC gave a conditional concurrence with the RAP on March 22, 1990 (NRC, 1990b) and concurrence with RAP Modification No. 2 (DOE, 1991b) on August 7, 1991 (see Section 2.2.4). The NRC staff also reviewed and concurred with DOE's Remedial Action Inspection Plan (Rev D) on March 20, 1990 (NRC, 1990a). This concurrence was the NRC staff's agreement that the quality control program, i.e., the plan for testing and inspections, was acceptable for the Green River site. The NRC, however, did not concur with RAP modification No. 1 (DOE, 1991a), which proposed the removal of the neutron prot.s.

2.2 Review of Remedial Action Performance

The NRC staff's primary objective in reviewing DOE's certification of remedial action completion is to determine whether the remedial actions have been performed in a manner consistent with specifications provided in the RAP, RAP modifications, and the RAIP, and if not, that deviations to these specifications do not significantly affect compliance with the EPA standard. In support of this action, the NRC staff participated in site inspections (See Appendix A), field observations, assessments of onsite data and records, and review of DOE Site Audit Reports. The following sections present the results of the review of remedial action performance by individual technical discipline. Note that for the Green River remedial action completion review, the pertinent technical disciplines are 1) geotechnical engineering, 2) surface water hydrology and erosion protection, 3) radiation protection, and 4) groundwater hydrology. Groundwater cleanup is not addressed at this time, since DOE has elected to postpone any groundwater remedial action activities to a separate phase of the project.

2.2.1 Geotechnical Engineering Review Results

NRC staff reviewed the Green River draft Completion Report (CR) to determine whether the geotechnical engineering aspects of the remedial action were completed in accordance with (1) the applicable construction specifications in the RAP and design (DOE 1989a, 1987c), (2) all the appropriate RAP modifications (DOE 1989b, 1988), and (3) the RAIP (MK-Ferguson 1990). Items reviewed include descriptions of construction operations, as-built drawings, laboratory and field testing data, and DOE Quality Assurance Audits. In addition, the review was based on staff observations and review of records during onsite inspections.

During its review, the NRC staff noted the following:

1. Appropriate tests (gradation) and inspections were performed to assure that the proper type of material was placed for each feature of the construction. The loose thickness of the lifts was verified by DOE periodically to ensure compliance with the specifications for that material. Placement and compaction operations were routinely inspected and tested to verify that the moisture and density requirements were met and that the soil moisture was uniform throughout the compacted lifts.
2. Documented results of laboratory and field testing indicate that they were conducted in accordance with acceptable procedures by trained and qualified personnel.
3. The CR shows that the frequencies of material testing and inspection comply with the frequencies specified in the RAIP.

4. As-built drawings indicate that the completed remedial action is consistent with the NRC-approved design.

Details of the staff's geotechnical engineering review, which provide the basis for the above statements, are included in the attached Appendix B. The NRC staff concurs that the remedial action at the Green River UMTRA project has been adequately completed with respect to geotechnical engineering.

2.2.2 Surface Water Hydrology and Erosion Protection Review Results

NRC staff reviewed the surface water hydrology and erosion protection aspects of remedial actions at Green River to ensure that they were constructed in accordance with the applicable construction specifications as stipulated in the RAP/design, RAP modifications, and RAIP. Areas of review included as-built drawings, construction operations, laboratory and field testing, and quality assurance audits. In addition, the review was based on NRC observations of the remedial actions and reviews of records and testing during NRC onsite inspections (See Appendix A).

The remedial action design featured riprap erosion protection in several specific areas, including the top and side slopes of the encapsulation cell and in the apron surrounding the cell. The erosion protection was designed to prevent long-term erosion and gullyng of the cell cover.

The NRC staff reviewed each of these features and determined that their testing, placement, and configuration complied with specifications in the RAP, RAP modifications, and the RAIP. The review was partially based on NRC staff observations and review of onsite records during the remedial actions, as well as assessment of the results presented in the DOE Completion Report.

During its review, the NRC staff noted the following:

1. Tests (gradation and durability) and inspections were performed by DOE to assure that erosion protection materials for the cell were properly selected. The review of the documentation indicated that placement of materials was routinely inspected by DOE to assure that the rock size and gradation specifications were met. Likewise, the thickness of each rock layer was verified periodically by DOE or its agent* to ensure compliance with the specifications for the particular type of material.
2. Laboratory and field testing was documented by DOE in accordance with specified test procedures.
3. Testing and inspection frequencies for materials used at the

site for erosion protection were documented by DOE as complying with the frequencies specified in the RAIP.

Based on NRC staff observations and review of onsite records during the remedial actions, as well as assessment of the verification results presented in the DOE Completion Report, the NRC staff concludes that the required durability and gradation tests were performed during the remedial action. The riprap is of adequate quality and has been acceptably placed. The NRC staff concurs that remedial action has been adequately completed at Green River with respect to erosion protection.

2.2.3 Site Cleanup Review Results

The NRC staff reviewed the radiation protection aspects of remedial actions at Green River to ensure that cleanup of residual radioactive materials was performed in accordance with specifications in the RAP and RAP modifications, RAIP, and the final design. Areas of review included contaminated material excavation, verification of cleanup, laboratory and field testing, and quality assurance audits. In addition, NRC geotechnical engineering staff reviewed the design and construction of the disposal cell cover to ensure compliance with the RAP design for limiting radon releases, and thus with the EPA standards (See Section 2.2.1). Specific discussion of the details of this review can be found in Appendix B. The review was based on NRC staff assessment of the results presented in the DOE Completion Report.

During its review of the processing site cleanup aspects of the remedial action completion documentation, the NRC staff noted the following:

1. The techniques, which DOE states to have used for verifying radiologic cleanup at the processing site, complied with DOE's summary protocols.
2. The radiological survey records support compliance with EPA's cleanup standards in Subpart B of 40 CFR Part 192. This includes the soil Ra-226 concentration and the interior gamma and radon progeny levels for habitable buildings on the site.
3. The surface alpha contaminations of the three remaining buildings, as documented in Appendix J of the CR, were reduced to the cleanup levels designated in the RAP.

Based on the above observations, the NRC staff concludes that the remedial action at the Green River UMTRA project processing site cleanup meets applicable standards.

2.2.4 Water Resources Protection

The NRC staff reviewed the construction elements and the ground-water and unsaturated moisture monitoring performed during the remedial actions that relate to ground-water resource protection. This review is based on NRC staff assessment of verified results presented in the DOE Completion Report.

During its review, the NRC staff noted the following:

1. Ground-water characterization wells located within the boundaries of the disposal cell and wells located outside of the disposal cell (which were not designated for continued monitoring) have been abandoned and grouted.
2. A buffer layer (six feet in thickness) has been installed at the base of the disposal cell to retard contaminant movement toward the ground water.
3. Compacted windblown tailings ('contaminates') were placed above the buffer layer, but below other tailings.
4. Four neutron access holes were installed for monitoring moisture content within the tailings and buffer layer at different depths. No measurements were provided in the Completion Report. Subsequent measurement schedules should be provided in the Long-Term Surveillance Plan.
5. Arsenic, lead, and methylene chloride were added to the hazardous constituents list for ground-water monitoring, during the RAP review and concurrence process. Subsequently, DOE submitted a RAP modification request to delete methylene chloride from the list. The NRC staff has agreed with the request to delete methylene chloride from the constituents list; however, toluene has been detected in the tailings fluid and identified in ground-water monitoring results. DOE provided an adequate rationale for not including the toluene as a hazardous constituent.
6. Quarterly monitoring results from wells 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, and 813 were provided in Appendix K of the CR and were used to finalize the concentration limits for the post closure ground-water monitoring.

Details of the staff's ground-water performance review, which provide the basis for the above observations, are included in the attached Appendix B. The NRC staff concludes that the ground-water protection aspects of the remedial action were adequately completed in accordance with the design and procedures identified in the RAP, RAP modifications, and RAIP.

3.0 SUMMARY

The NRC staff reviewed geotechnical engineering, surface water hydrology, radiation protection, and hydrologic aspects of the remedial action performed at the uranium mill tailings site in Green River. The purpose of this review was to determine whether DOE had performed remedial actions at the site in accordance with specifications in the RAP, RAP modifications, and other supporting project documents, and thus with the EPA standards in 40 CFR Part 192, Subparts A-C. Based on our review of the final Completion Report and on observations during periodic site inspections, the NRC staff concurs that the Department of Energy (DOE) has performed remedial action at the Green River site in accordance with the approved plans and specifications and that this action complies with the Environmental Protection Agency's standards in 40 CFR Part 192, Subparts A-C. With the exception of selection and performance of a groundwater cleanup program, remedial actions are complete for the Green River site. DOE has proposed deferral of this aspect of the remedial action at this time, and plans to handle this as part of a separate groundwater restoration program. The NRC staff considers DOE's deferral to be acceptable.

4.0 REFERENCES

- MK-Ferguson, 1990, "UMTRA Project - Green River, Utah, Remedial Action Inspection Plan, Revision D," February 9, 1990.
- U. S. Department of Energy, 1991a, "RAP Modification 1, Remedial Action Plan and Site Conceptual Design for Stabilization of the Inactive Uranium Mill Tailings Site at Green River, Utah, January 16, 1991.
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Matthew, M., U.S. Department of Energy, providing concurrence on
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....., 1990b, Lohaus, P.H. letter to Matthew, M., U.S. Department of
Energy, transmitting the final TER and providing conditional
concurrence on the RAP, March 22, 1990.

....., 1991a, Surmeier, J.J. letter to Matthew, M., U.S. Department of
Energy, providing concurrence on RAP Modification No. 2.,
August 7, 1991.

....., 1991b, Surmeier, J.J. letter to Matthew, M., U.S. Department of
Energy, providing non-concurrence on RAP Modification No. 1,
February 7, 1991.

APPENDIX A:
NRC SITE VISITS TO THE
GREEN RIVER UMTRA PROJECT SITE

Appendix A

NRC Site Visits to the Green River UMTRA Project Site

<u>DATE</u>	<u>STAFF/DISCIPLINE</u>	<u>PURPOSE</u>
10/1/86	J. Grimm/geology M. Haisfield/project management T. Johnson/surf hydrology-erosion S. Smykowski/geotechnical M. Young/groundwater S. Bilhorr/project management	Part of multiple site tour; observation of site characteristics
4/28/87	J. Grimm/geology	Resolution of geological issues (dRAP review)
6/8/87	M. Young/groundwater J. Starmer/management K. Westbrook/geology	Resolution of hydrological issues
8/2/88	S. Wastler/project management J. Grimm/geology L. Deering/hydrology	Part of multiple site tour; observation of site characteristics
6/12/89	D. Gillen/geotechnical engineer T. Johnson/surf hydrology-erosion M. Weber/hydrology M. Fliegel/management	Routine construction inspection/visit borrow areas
10/11/89	T. Johnson/surf hydrology-erosion G. Konwinski/hydrology	Construction visit
5/1/90	D. Gillen/geotechnical engineer A. Fan/hydrology T. Johnson/surf hydrology-erosion J. Gilray/quality assurance	Final site inspection

APPENDIX B:
DETAILED COMPARISON OF DESIGN SPECIFICATIONS
WITH COMPLETED REMEDIAL ACTIONS PERFORMED AT
GREEN RIVER UMTRA PROJECT SITE

NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 1. Type A Select Fill, Tailings/Contaminated Material

A. CONFIGURATION

RAP Requirement

(1) Location

- The disposal cell is approximately 500 feet south of Brown's Wash, and 70 feet above the Brown's Wash flood plain. (final RAP Executive Summary)

(2) Design Feature

- Excavation for the disposal cell down to el. 4098 ft., about 17 ft. into bedrock.

- 6 ft. thick buffer layer (Type A Select Fill) between the bedrock foundation and contaminated materials.

- Embankment:

Slope 5H:1V

Embankment Top el. 4165.0 ft.

Determination

(1) The Completion Report (CR) states the actual distance to be 600 feet.

(2) As-built drawing GRN-PS-10-0517 indicates the bottom of excavation to be el. 4098 ft.

As-built drawing GRN-PS-10-0517 indicates the thickness of the buffer layer above the foundation bedrock to be 6 feet.

As-built drawing GRN-PS-10-0517 indicates the side slope were 5H:1V, as per design, and that the embankment top was at el. 4180.97, which is higher than the design elevation in the RAP. Since the as-built slope geometry did not match the design, DOE was requested to verify that the as-built slopes were stable. In response to NRC's question, DOE stated that the elevation change was to accommodate additional contaminated material (381,761 cyd instead of 200,000 cyd estimated in design). DOE performed additional stability calculations which verified that stability considerations would be met with the as-built geometry, which addressed NRC's concerns satisfactorily.

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NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 1. Type A Select Fill, Tailings/Contaminated Material

B. PLACEMENT

RAP Requirement

(1) Material

- Type A Select Fill Material: Soil from foundation excavation but should not contain more than 5 % of combined particles larger than one-inch and excavated bedrock particles. (Spec. page 02200-8 & 27; RAIP Section 6.2.2, one gradation test per 2000 cyd)

- Contaminated Materials: No requirements except it should be contaminated material

(2) Lift Thickness

- 12" loose (Spec. pg 02200-20).

(3) Compaction

Density and Moisture control

- Type A Select Fill: 95 % of maximum dry density determined by ASTM D698 Test; compaction density to be verified by at least one test per every 1,000cyd of material placed (Spec. page 02200- 26). Placement moisture content of zero to four percent below the optimum moisture content determined in ASTM D698 test. (Spec. 02200-23, 26 & 28; RAIP Section 6.1.4, 6.1.5)

- Tailings Contaminated Materials: 90 % of maximum dry density determined by ASTM D698 Test. Trial compaction on first four lifts and first 1,000 cyd of material to establish the compaction procedures including the number of passes and equipment to be used for both windblown/vicinity property material and tailings material that would result in complying with the specified density requirements. Production compaction to comply with the established procedure. Also, density to be verified by tests at a frequency of one test per 6,000 cyd of compacted material. Placement moisture content should be drier than 3 % below optimum moisture content determined by ASTM D698 test and the average volumetric moisture content should be less than 5 % by volume for tailings and 10.5 % by volume for windblown and vicinity property materials. (Spec. pg. 02200- 22, 23, 27; RAIP Rev. D Section 6.1.4, 6.1.5, 6.4.5).

NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 1. Type A Select Fill, Tailings/Contaminated Material

Determination

(1) Material

- CR states that gradation of Type A Fill Material was tested by 39 tests, and all tests passed the gradation specification. The testing frequency was one test per 1,342 cyd of material against a Spec/RAIP requirement of one test per 2,000 cyd of material. Although tests were not performed at exact intervals, efforts were made to assure that representative tests were taken throughout the course of placement.

- No gradation requirement for contaminated material.

(2) Lift Thickness

- CR states that loose thickness of each lift was 12 inches or less (CR, Vol II, Appendix E, Type A Select Fill, page 1; Contaminated Materials, page 3)

(3) Compaction

Type A Select Fill

- Average percent compaction obtained was 98.5% of maximum dry density determined by ASTM D698. This was verified by 83 field density tests for a total of 52,339 cyd of material, resulting in a test frequency of 1 test for every 631 cyd of material placed. Spec/RAIP requires one test for every 1,000 cyd of materials placed. Efforts were made to test at regular intervals; however, it is not implied that tests were run every 631 cyd.

- Nine maximum Proctor density determinations (ASTM D698) were made resulting in a test frequency of 1 test per 5,815 cyd of material placed. RAIP requires one such test for every 15,000 cyd of material placed. Tests were performed when material characteristics were believed to have changed from previous values.

- Seventeen one-point Proctor density tests were made for a total of 52,339 cyd of material (83 field density tests), resulting in a test frequency of one test for every 4.9 field density determinations. RAIP requires one such test for every five field density determinations.

NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 1. Type A Select Fill, Tailings/Contaminated Material

- Fourteen density determinations by sand cone test method and 66 density determinations by nuclear density method resulted in correlation test frequency of one sand cone test for every 4.7 nuclear density tests. RAIP requires one sand cone correlation test for every ten nuclear density tests.

- Eighty-three moisture content tests were performed during placement of 52,339 cyd of material, which resulted in one test for every 631 cyd of material placed. RAIP requires one test for every 1,000 cyd of material placed. The average placement moisture content was 1.5% less than the optimum moisture content. RAIP required the placement moisture content to be zero to four percent less than the optimum moisture content.

- Thirty-three moisture content determinations were by microwave method, and there were 6 oven dried moisture content correlation tests resulting in one correlation test for every 5.5 microwave method determinations. RAIP requires one correlation test for every 10 microwave method determinations.

(CR, Vol II, Appendix E, Type A Select Fill Material, pages 1, 2 & 3)

Tailings/Contaminated Materials

- Average percent compaction obtained was 95.2% of maximum dry density determined by ASTM D698 test. This was verified by 79 field density tests for a total of 339,377 cyd of contaminated materials, resulting in a test frequency of 1 test per 4,296 cyd of material placed. RAIP requires one test for every 6,000 cyd of material placed.

- Thirty-five one-point Proctor density tests were made to verify the appropriateness of 79 field density tests, resulting in a test frequency of one-point Proctor test for every 2.3 field density tests. RAIP requires one-point Proctor test for every 5 field density determination.

- Forty-four maximum Proctor density (ASTM D698) determinations were made for placing 339,337 cyd of contaminated material, resulting in a frequency of one test per 7,713 cyd of material placed. RAIP requires one test for every 10,000 cyd of material placed.

NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 1. Type A Select Fill, Tailings/Contaminated Material

- The contaminated materials were placed at an average moisture content of less than 3 % below the optimum moisture content.
- There were 254 moisture content determinations in connection with placing a total of 339,377 cyd of material, resulting in a test frequency of 1 per 1,336 cyd of material placed. The RAIP requires one test for every 2,000 cyd of material placed.
- The volumetric moisture content was 10.6 % against a requirement of 10.5 % for windblown/vicinity property materials. For tailings, the measured volumetric moisture content was 7.1 % against a volumetric moisture content requirement of 5 %. This non-compliance was evaluated in the final RAP review stages and the TER concludes that the slightly higher placement moisture has no adverse impact on the groundwater protection performance of the disposal cell.
- There were a total of 386 moisture content determinations using microwave method and these were correlated with 75 oven dried moisture content determinations, resulting in one oven dried moisture content test for 5.1 microwave test. RAIP requires one oven dried test for every 10 microwave test method of moisture content determination.

NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: Banad Jayannath/Dan Rom

RAP FEATURE: 2. Radon Barrier

A. CONFIGURATION

RAP Requirement

- Areal extent as per Drawing GRN-PS-10-0517, RAP Modification, PID No. 10-S-03, Rev. 3
- Thickness 2 feet

Determination

- As-built drawing GRN-PS-10-0517 indicates the areal extent and thickness of the radon barrier to be as per the RAP design.

B. PLACEMENT

RAP Requirement

(1) Material

- Silty Clay from borrow source identified in the RAP. Gradation requirement is a maximum of 10% weight retained on No. 4 sieve. In addition, the material for first lift of the radon barrier required to have a minimum of 70% passing No. 200 sieve and the material for subsequent lifts a minimum of 50% passing No. 200 sieve. The radon barrier material should be amended with 6% by weight Bentonite (Envirogel-200).
(RAP Spec. page 02-200-9)

(2) Lift Thickness

- 9 in. compacted thickness or 12 in. loose thickness.

(3) Compaction

- 100 percent of maximum density determined as per ASTM D698 test.
- Placement moisture content should be zero to 3 % above the optimum moisture content determined by ASTM D698 test.

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Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 2. Radon Barrier

- Between lifts, the moisture content of preceding in-place layers should not be drier than a maximum of one percent below the optimum moisture content.

(4) Saturated Hydraulic Conductivity

- The saturated hydraulic conductivity should not be higher than 2×10^{-8} cm/sec. To be demonstrated by laboratory tests on field compacted block samples taken from radon barrier layer. The frequency of tests should be a minimum of one per 2,000 cyd of radon barrier material.

Determination

(1) Material

- A total of 60 gradation tests were conducted for 27,911 cyd of radon barrier borrow material. This resulted in a test frequency of one test per 465 cyd. RAIP requires one test for every 500 cyd of borrow material. The Bentonite amendment was closely monitored to comply with the specifications, as per statements in the CR.

(2) Lift Thickness

- The lift thickness during placement was closely monitored to comply with the specifications, as per statement in the CR.

(3) Compaction

- One-hundred-eleven in-place field density tests were performed to verify placement density of 27,911 cyd of material. This results in one test per 251 cyd of material placed. RAIP and specification requires one test per 500 cyd of material placed. The average degree of compaction was 101.6% of maximum density determined in ASTM D698 test.

NRE STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 2. Radon Barrier

- Thirty one one-point Proctor tests were performed to verify the maximum density value used in the above mentioned 111 field density determinations. This resulted in one one-point Proctor test for 3.7 field density tests. RAIP requires one one-point Proctor density test for every 5 field density tests.
- Fourteen maximum dry density determinations (ASTM D698) were performed for a total of 27,911 cyd of material compacted. This resulted in a test frequency of one test per 1,994 cyd of material. RAIP requires one Proctor test for every 15,000 cyd of material compacted.
- The average placement moisture content was 1.6 % higher than the optimum moisture content.
- One-hundred-sixty-one moisture content determinations were made to ensure that the preceding layer of the radon barrier layer had not dried beyond the specification limits prior to placing the next layer of the radon barrier.
- There were a total of 423 moisture content determinations using microwave test method and these were correlated by performing 89 oven dried moisture content determinations resulting in one correlation test for 4.8 microwave method tests. RAIP requires one correlation test for every 10 microwave method tests.

(4) Saturated Hydraulic Conductivity

- 14 block samples were taken from as-compacted radon barrier layer to determine saturated hydraulic conductivity by laboratory tests. The block sample locations were distributed so that the results may be considered to be representative of the as-built field conditions. All the 14 tests indicated saturated hydraulic conductivity of 2×10 to the minus 8 cm/sec or less and complied with the specifications and design requirements. The frequency of test was one per 1,994 cyd of radon barrier material compacted. Spec/RAIP required one test for every 2,000 cyd of radon barrier material.

NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 3. Bedding Layer

A. CONFIGURATION

RAP Requirement

- Areal extent as per Drawing GRN-PS-10-0517, above the radon barrier
- Thickness 6 inches

Determination

- As-built drawing GRN-PS-10-0517 shows the areal extent. The thickness of the bedding layer is 6 inches. There were 60 depth or thickness checks which showed the as-placed thickness to be within 0.1 ft. of the design thickness of 0.5 ft.

B. PLACEMENT

RAP Requirement

(1) Material

- Gradation (spec. page 02278-10)
- Percent of clay lumps and friable particles 3%
- Rock quality score of 50 percent or greater (Spec. page 02278-8)

(2) Compaction

- Uniform distribution, minimization of voids. Placement procedure and equipment to be used is specified.

Determination

(1) Material

- four gradation tests (frequency as per Section 6.3.3 of RAIP) performed. Average gradation of the four tests comply with the specifications.
- Material met the 3% limit on clay lumps and friable particles. Average content of percent clay and friable particles was 0.85%

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Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 3. Bedding Layer

- Rock quality durability score was 62.

The scope of testing was in compliance with the provisions in the specifications and project RAIP.

(CR, Vol. II, Appendix E, Bedding Material, pages 1-4)

(2) Compaction

- CR states that the inspection and testing during construction resulted in the bedding material placed as per specifications.

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Site: Green River, Utah

Reviewer: Banad Jagannath/Dan Rom

RAP FEATURE: 4. Gravel Fill
 5. Type B Select Fill

Gravel Fill and Select Fill were sufficiently far removed from the disposal cell area that all parties agreed a formal write-up in the CR would not be required. This issue was discussed in a conference call on December 18, 1991.

In lieu of the formal write-up, DOE provided Gravel Fill gradations test locations and agreed to make available General Fill records on request. It was noted that the General Fill consisted substantially of "non-testable" material (30% retained on the 3/4 inch sieve), and relatively few moisture/density tests were taken, a new section would not be added.

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Site: Green River, Utah

Reviewer: T.L. Johnson

RAP FEATURE: 6. Rock Cover

A. CONFIGURATION

RAP Requirements

- (1) Areal Extent
- (2) Thickness: 12 inches

Determination

- (1) Verified in As-built drawings and by visual observation during site visit.
- (2) Acceptable based on review of DOE testing in 39 locations on a 100' x 100' grid. Reworking was performed where not acceptable.

B. MATERIAL

RAP Requirement

- (1) Gradation - Section 02278 of Specification
- (2) Durability - Rock score must equal 80, in accordance with NRC procedures included in the specifications

Determination

- (1) Gradation summary curves provided in Appendix E indicate that all the select rock met the gradation requirement.
- (2) Average Score: 85; range 78 - 90

C. PLACEMENT

RAP Requirement

- (1) Uniform distribution, minimization of voids

Determination

- (1) "Daily inspections of the Type A Riprap were conducted during excavation, production, stockpiling, transporting, and placement to

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Site: Green River, Utah

Reviewer: T.L. Johnson

RAP FEATURE: 6. Rock Cover

assure the following: That proper techniques were employed to prevent degradation of the material due to improper handling; that distribution was uniform; that voids were kept as minimal as possible; and that proper gradation was maintained." (Appendix E - Riprap Type A, page 3)

D. TEST FREQUENCY

RAP Requirement

- (1) Gradation tests at 1/3-points of production
- (2) Durability tests - same frequency as Gradation tests

Determination

- (1) 4 tests were conducted. They were at the required frequency.
- (2) 4 tests were conducted. They were at the required frequency.

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Site: Green River, Utah

Reviewer: T.L. Johnson

RAP FEATURE: 7. Apron

A. CONFIGURATION

RAP Requirements

- (1) Location
- (2) Cross Sections
- (3) Site grading

Determination

Verified in As-built drawings and by visual observations during site visit.

B. MATERIAL, PLACEMENT, AND TEST FREQUENCY

RAP Requirement

(See Rock Cover, Feature 4)

Determination

DOE states that required tests were performed at the required frequency. There were no failing tests. Rock quality met requirements (See Rock Cover, Feature 4, also)

NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: E. Brummett

RAP FEATURE: 8. Site Cleanup

A. CLEANUP VERIFICATION PROCEDURES

RAP Requirements

- RAP Section C.3.4 and RAC HP Procedures, 015 (Grid Sampling System)

Determination

- Appendix J documents that the entire site was divided into 10 foot grids and sampled per RAC-015 sampling and analysis procedures

B. TEST RESULTS

RAP Requirements

- All areas of the site to be cleaned up to meet the EPA radium-in-soil standards, not to exceed background by:

1. 5 pCi/g Ra-226 top 15 cm.
2. 15 pCi/g Ra-226 for any subsurface 15 cm. layer (averaged over areas of 100 m²)

Determination

- 4326 soil samples were measured for Ra-226. All meet the EPA standards (average 2.4 pCi/g; maximum 14.9 pCi/g; minimum 1.3 pCi/g). Th-230 was measured in some verification samples. Calculations indicate that the Th-230 decay will not cause the Ra-226 to exceed the EPA standards in 1000 years (Appendix J).

C. DECONTAMINATION OR DEMOLITION

RAP Requirements

- (1) Six existing buildings at the site to be decontaminated or demolished as necessary in accordance with the EPA standards for habitable/occupied buildings, not to exceed:
 - Annual average radon decay product concentration of 0.01 WL, including background.

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Site: Green River, Utah

Reviewer: E. Brummett

RAP FEATURE: 8. Site Cleanup

- Gamma radiation levels of 20 micro R/hr above background.
- (2) Surface alpha shall not exceed limits that will ensure that potential airborne radionuclide concentrations will not exceed 10 CFR 20, App. B standards and that physical contact with surfaces will not result in a measurable radiation exposure. (UMTRA Project Environmental, Health, and Safety Plan per RAP Section C.1)

Determination

- (1) The roaster building and the additions to the office and mill buildings were demolished and the debris placed in the disposal cell. Three other buildings were decontaminated, as necessary, and left for future use. Residual contamination was reduced to levels that were as low as possible using reasonable efforts.
 - Measured radon decay products in the three remaining buildings approximate background levels.
 - All interior gamma readings were less than 5 micro R/hr above background.
- (2) All surface alpha levels met the criteria of:
 - removable 1000 dpm/100 sq.cm.
 - fixed 5000 dpm/100 sq. cm.
 - total(maximum) 15000 dpm/100 sq. cm.(NRC Reg. Guide 8.30)

NRC STAFF REVIEW OF DOE'S VERIFICATION OF REMEDIAL ACTION PLAN ACTIVITIES

Site: Green River, Utah

Reviewer: M. Layton

RAP FEATURE: 9. Hydrology

A. INSTALLATION AND TESTING PROCEDURES

RAP Requirement

- (1) Ground-water characterization wells situated beneath the designated disposal cell will be properly abandoned. Wells located outside of the disposal cell, which were not designated for continued monitoring, will also be abandoned. This requirement was not specifically listed in the RAP, but was presented as an item in the list of construction drawings contained in the RAP.
- (2) The bottom six feet of the disposal cell will be filled with a compacted, selected clean fill (buffer layer) to retard the movement of contaminants to ground-water from overlying contaminated materials.
- (3) Compacted windblown tailings (mixed with clean soil) will be placed above the buffer layer.
- (4) Four neutron access holes for neutron logging will be used to monitor moisture within the tailings, vicinity property material, other contaminated material, and buffer materials at different depth.
- (5) Arsenic, lead, and methylene chloride are added to the hazardous constituents list for ground-water monitoring at the disposal cell.
- (6) DOE committed to continuing the background ground-water quality measurements in the six POC wells, four new upgradient wells, and existing well 813 on a quarterly schedule for two years following completion of the disposal cell. The purpose of this sampling is to establish the statistical maximum concentrations for the hazardous constituents identified at the site.

Determination

- (1) Document No. 5057-GRN-5-01-00291-02 provides subcontractor well abandonment procedures. As-Built Drawing GRN-PS-10-0518 "Monitor Well Abandonment and Boring Location Plan" shows locations and surveyed coordinates of abandoned wells, including those in vicinity of disposal cell and outside of the disposal cell.
- (2) Document No. 5057-GRN-S-01-002494-07 "Earthwork Specification Type 'A' Fill"; Calculation No. 10-591-01-00 "Tailings Offpile, Buffer

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Site: Green River, Utah

Reviewer: M. Layton

RAP FEATURE: 9. Hydrology

materials: In-Place Parameter Characterization"; As-Built Drawing GRN-PS-10-0517 "Tailings Embankment and Final Site Grading Sections and Details" provide details of material specifications and location and thickness of buffer layer.

- (3) Photos 9-17A through 10-2A show placement of 'contaminates' above buffer layer (Type 'A' fill) and below tailings.
- (4) As-Built Drawing GRN-PS-10-0516 "Tailings Embankment and Final Site Grading Plan" provides locations and coordinates for four neutron access holes within the constructed disposal cell. No measurements from neutron holes are presented in the DOE Completion Report, but are to be reported during the long-term surveillance.
- (5) RAP modification was requested by DOE on June 18, 1991 to delete methylene chloride from the hazardous constituents list, based on ground-water monitoring results. NRC agreed with the request to delete methylene chloride on August 7, 1991; however, toluene has been detected in samples of tailings pore fluid and identified in some of the ground-water monitoring results. NRC has requested clarification as to why toluene has not been added to the hazardous constituents list. DOE responded by letter dated November 21, 1991, which provided additional information and clarified the reasons that toluene was not included as a hazardous constituents for ground-water monitoring. NRC agreed that toluene should not have been included as a hazardous constituent, based on the clarifications in the November 21, 1991 letter.
- (6) Appendix K of the CR provides the monitoring results for upgradient wells 177, 178, 179, and 180; in addition to POC wells 171, 813, 172, 173, 174, 175, and 176. The Appendix also provides the statistical results used to establish the final concentrations limits. The NRC staff noticed that several data gaps existed in the analytical results for these wells:
 - Well 175 did not have any results for the sampling episode of 1/13/91;
 - Net gross alpha results were not reported for wells 177, 178, 179, and 180 for sampling episode of 8/23/90; and
 - Combined radium-226 and -228 were not reported for wells 177, 178, 179, and 180 for the sampling episode of 1/13/91.

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Site: Green River, Utah

Reviewer: M. Layton

RAP FEATURE: 9. Hydrology

No explanation was provided for these data; however, these gaps should not adversely affect the statistical determinations of background conditions at the site, and the NRC staff does not consider these gaps as significant.

APPENDIX C:

UMTRCA, THE EPA STANDARDS, AND THE PHASED UMTRA PROJECT

APPENDIX C

UMTRCA, THE EPA STANDARDS, AND THE PHASED UMTRA PROJECT

Title I of UMTRCA defines the statutory authority and roles of the DOE, the NRC, and the EPA with regard to the remedial action program for inactive uranium mill tailings sites.

The Standards

UMTRCA charged the EPA with the responsibility for promulgating remedial action standards for inactive uranium mill sites. The purpose of these standards is to protect the public health and safety and the environment from radiological and non-radiological hazards associated with radioactive materials at the sites. UMTRCA required that EPA promulgate these standards by no later than October 1, 1982. After October 1, 1982, if the EPA had not promulgated standards in final form, DOE was to comply with the standards proposed by EPA under Title I of UMTRCA until such time as the EPA had promulgated its standards in final form.

The final EPA standards were promulgated with an effective date of March 7, 1983 (48 FR 602; January 5, 1983); See 40 CFR Part 192 - Standards for Remedial Actions at Inactive Uranium Processing Sites, Subparts A, B, and C. These regulations may be summarized as follows:

1. The disposal site shall be designed to control the tailings and other residual radioactive materials for up to 1000 years, to the extent reasonably achievable, and, in any case, for at least 200 years [40 CFR 192.02(a)].
2. Provide reasonable assurance that the disposal site design shall prevent radon-222 from residual radioactive material to the atmosphere from exceeding 20 picocuries per square meter per second or from increasing the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than one-half picocurie per liter [40 CFR 192.02(b)].
3. The remedial action shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials from any designated processing site, the concentrations of radium-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than 5 picocuries/gram averaged over the first 15 centimeters of soil below the surface and 15 picocuries/gram averaged over any 15 centimeters more than 15 centimeters below the surface [40 CFR 192.12(a)].

The portion of the EPA standards dealing with ground water requirements, 40 CFR 192.20(a)(2)-(3) were remanded by the Tenth Circuit Court of Appeals on September 3, 1985. Based on this court decision, EPA was directed to promulgate new groundwater standards. EPA proposed these standards in the

form of revisions to Subparts A-C of 40 CFR Part 192 in September, 1987, and now is in the process of completing action to promulgate the final groundwater standards.

As mandated by Section 108(a)(3) of UMTRCA, however, the remedial action at the inactive uranium processing sites, is to comply with EPA's proposed standards until such time as the final standards are promulgated. DOE continues to perform remedial action at the inactive processing sites in accordance with NRC's concurrence with the remedial action approach based on the proposed EPA groundwater standards (52 FR 36000; September 24, 1987). Delaying implementation of the remedial action program would be inconsistent with Congress' intent of timely completion of the program. Modifications of disposal sites after completion of the remedial action to comply with EPA's final ground water protection standards may be unnecessarily complicated and expensive and may not yield commensurate benefits in terms of human and environmental protection. Therefore, the Commission believes that sites where remedial action has been essentially completed prior to EPA's promulgation of final ground water standards will not be impacted by the final ground water standards. Although additional effort may be appropriate to assess and clean up contaminated ground water at these sites, the existing designs of the disposal sites should be considered sufficient to provide long-term protection against future ground water contamination. NRC does not view UMTRCA as requiring the reopening of those sites that have been substantially completed when NRC concurred with the selection of remedial action in accordance with applicable EPA standards, proposed or otherwise in place at the time such NRC concurrence was given.

DOE Selection (Design) Phase

For each site, UMTRCA requires that DOE select a plan of remedial action that will satisfy the EPA standards and other applicable laws and regulations, and with which the NRC will concur. For each site, this phase includes preparation by DOE of an Environmental Assessment or an Environmental Impact Statement, and a Remedial Action Plan (RAP). The Remedial Action Plan is structured to provide a comprehensive understanding of the remedial actions proposed at that site and contains specific design and construction requirements. To complete the first phase, NRC and the appropriate State or Indian tribe review the RAP and then concur that the RAP will meet the EPA standards.

The Performance (Construction) Phase

In this phase the actual remedial action (which includes decontamination, decommissioning, and reclamation) at the site is done in accordance with the Remedial Action Plan. The NRC and the State/Indian tribe, as applicable, must concur in any changes to the concurred-in plan that arise during construction. At the completion of remedial action activities at the site, NRC concurs in DOE's determination that the activities at the site have been completed in accordance with the approved plan. Prior to licensing (the next phase), title to the disposed tailings and contaminated materials must be transferred to the United States and the land upon which they are disposed of must be in Federal

custody to provide for long-term Federal control. Disposal sites on Indian land will remain in the beneficial ownership of the Indian tribe.

NRC concurrence in the DOE determination that remedial action at a processing site has been accomplished in accordance with the approved plan may be accomplished in two steps where residual radioactive material is not being moved from the processing site to a different disposal site. The Uranium Mill Tailings Remedial Action Amendments Act of 1988 allows for a two step approach for 1-1 disposal sites. The Amendments Act will allow DOE to do all actions, other than ground water restoration, for the first step of licensing. The second step, which can go on for many years, will include existing ground water restoration. When ground water restoration is complete, the Long-Term Surveillance Plan required under the licensing phase will be appropriately amended. For sites that are being moved, licensing will be a one step. There is no ground water restoration at the disposal site and the processing site will not be licensed after completion of remedial action.

The Licensing Phase

Title I of the RCA further requires that, upon completion of the remedial action program by DOE, the permanent disposal sites be cared for by the DOE or other Federal agency designated by the President, under a license issued by the Commission. DOE will receive a general license under 40 CFR Part 40.27 following (1) NRC concurrence in the DOE determination that the disposal site has been properly reclaimed and (2) the formal receipt by NRC of an acceptable Long-Term Surveillance Plan (LTSP). NRC concurrence with DOE's performance of the remedial action indicates that DOE has demonstrated that the remedial action complies with the provisions of the EPA standards in 40 CFR part 192, Subparts A, B, and C. This NRC concurrence may be completed in two steps as discussed above. There is no termination date for the general license.

Public involvement has been and will continue to be provided through DOE's overall remedial action program for Title I sites. The local public will have an opportunity to comment on the remedial action or closure plans proposed and implemented by DOE and to raise concerns regarding final stabilization and the degree of protection achieved. NRC fully endorses State/Indian tribe and public input in all stages of the program, especially in the planning stages of remedial action when such input can be most effective in identifying and resolving issues affecting long-term care. At the time the LTSP is submitted, the NRC will consider the need for a public meeting in response to requests and public concerns. Therefore, NRC encourages State/Indian tribe and public participation early in the remedial action and closure process and will provide additional opportunities, as needed, later in the process.

The Surveillance and Monitoring Phase

In this phase DOE and NRC periodically inspect the disposal site to ensure its integrity. The Long-Term Surveillance Plan (LTSP) will require the DOE to make repairs, if needed.

One of the requirements in the EPA standards is that control of the tailings should be designed to be effective for up to 1000 years without active maintenance. Although the design of the stabilized pile is such that reliance on active maintenance should be minimized or eliminated, the NRC license will require emergency repairs as necessary. In the event that significant repairs are necessary, a determination will be made on a site specific basis regarding the need for additional National Environmental Policy Act (NEPA) actions, and health and safety considerations from 10 CFR Parts 19, 20, and 21.