



March 30, 2011

Mr. Steve Tarlton, Manager
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Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

Subject: Reclamation Plan Updates
Colorado Radioactive Materials License Number Colo. 369-01

Dear Mr. Tarlton:

Cotter Corporation (N.S.L.) ("Cotter") hereby submits two documents for review and approval. The first document is entitled "Soil Remediation Plan for Site Decommissioning and Radioactive Materials License Termination". This plan is intended to show compliance with Criterion 6(6) of Part 18 of the regulations as specified in *NUREG 1620 Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978*.

The second document is entitled "Update of the Tailings Reclamation Plan for the Primary and Secondary Impoundments" and was prepared by MWH Americas, Incorporated, the same firm that prepared the 2005 document.

Incorporated by reference are the various documents under review, including the Master Demolition Plan submitted March 29, 2011, and its' associated individual building plans.

If you or your staff has any questions, please contact me.

Sincerely

John S. Hamrick
Vice President, Mill Operations



Cotter Corporation (N.S.L.)
CANON CITY MILLING
FACILITY

**Update of the Tailings
Reclamation Plan for the
Primary and Secondary
Impoundments**

March 2011



MWH

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1.0 INTRODUCTION

This report summarizes an update of the 2005 tailings reclamation plan for the Cotter Corporation (N.S.L.) (Cotter) Canon City Milling Facility in Fremont County, Colorado. This report has been prepared for Cotter by MWH Americas Inc. (MWH). This report has been prepared in response to requests to Cotter by the Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division (CDPHE).

1.1 Previous Reclamation Plans

The previous tailings reclamation plan was prepared for Cotter by MFG, Inc. (MFG, 2005) and was used in renewal of Cotter's Radioactive Materials License 369-01. Site conditions and Cotter mill operational history are outlined in MFG (2005).

MFG (2005) also outlines the differences between the 2005 plan and the previous tailings reclamation plan outlined in ESCI (1995), as well as the prior plan in WWL (1990). Borrow material characterization for cover materials is summarized in the 2005 plan, based on a cover material characterization investigation presented in WWL (1990).

1.2 Updated Site Conditions

Site conditions that have changed since 2005 are outlined below.

- The alkaline mill was demolished, with the demolition debris placed in the western corner of the primary impoundment (PI).
- Additional soil cleanup in the Old Ponds area has been conducted, with the soils placed in the PI.
- Demolition of the acid mill has been initiated, with demolition debris placed in the western end of the PI.
- The secondary impoundment (SI) contains tailings from initial cleanup of the Old Ponds area. The top surface of SI was used for evaporation of process water until 2009, when this area was no longer needed for evaporation. In order to provide dust control on the SI, interim cover material has been placed on the tailings surface.
- Cotter has conducted additional site evaluation work to estimate remaining contaminated soils to be placed in the PI.
- Evaporation of process water has been accomplished, utilizing surfaces within the SI and PI. The remaining volume of process water in the PI is sufficiently small that the surface of the SI and evaporation ponds in the PI are no longer needed.

1.3 Conditions Affecting the Tailings Reclamation Plan

The 2005 closure plan was based on discharge of additional tailings in the PI to a maximum elevation of 5598 ft. As mentioned above, demolition of the acid mill has been initiated, with no additional tailings to be discharged in the PI or SI.

This updated concept for closure of the PI and SI is based on no additional tailings discharge, and placement of materials from mill demolition and site soil cleanup only. This concept

significantly reduces the volume of material to be placed in the PI (to an average elevation of approximately 5580 ft).

This lower average elevation of materials in the PI as well as interim cover placement over the SI provides for an update and enhancement of the drainage plan for reclamation of the PI and SI, which is described in the following sections of this report.

1.4 Scope of Report

This report presents a summary of the updated plan for reclamation of the PI and SI for review by CDPHE. The components of the updated tailings reclamation plan that are the same as the 2005 reclamation plan are outlined below.

- Cover design for radon attenuation and infiltration control (the uniform cover system alternative).
- Erosion protection on cover surfaces, regraded embankment surfaces, and in channels.
- Borrow areas for cover materials and sources of erosion protection material.

Due to the reduced volume of material to be placed in the PI, the updated plans for drainage from the SI and across the PI have been modified. The design analyses that support the updated tailings reclamation plan will be documented as appendices to this report.

2.0 DESIGN CRITERIA

The Canon City Milling Facility site conditions, including geology, seismicity, climate, geology, and geohydrology, are outlined in the 2005 reclamation plan. Criteria for tailings reclamation are discussed in the 2005 reclamation plan, and summarized below.

2.1 CDPHE Reclamation Criteria

The pertinent regulations administered by CDPHE for the Canon City mill site are found in 6 CCR 1007-1, Part 18. Specific regulations for operation and closure are found in Appendix A to Part 18. Criteria in Appendix A for tailings reclamation include conditions for erosional stability (Criterion 4), groundwater protection (Criterion 5), and cover design for isolation and control of radiological hazards (Criterion 6).

2.2 NRC Reclamation Guidance

The Criteria in Appendix A of the CDPHE regulations are consistent with performance criteria outlined Appendix A of 10 CFR 40, administered by the U.S. Nuclear Regulatory Commission (NRC). The NRC has interpreted the long-term performance criteria to include acceptable performance of reclaimed facilities under the probable maximum precipitation (Johnson, 2002) and the maximum credible earthquake. Guidance for cover design for radon emanation is provided in NRC (1989), and guidance for erosion protection is provided in NRC (1990) and Johnson (2002).

Following site reclamation and prior to transfer of a designated area of the site to the U.S. Department of Energy for institutional control and long-term care and maintenance, the reclamation of the tailings impoundments will be reviewed by the NRC for compliance with applicable design criteria and guidance (specifically Appendix A of 10 CFR 40). The guidelines for reclamation review are presented in NRC (2003).

3.0 RECLAMATION PLAN COMPONENTS

The major components of the updated reclamation plan for the PI and SI are outlined below. The general site layout is shown on Figures 1 and 2. The major components are shown on Figure 3.

3.1 Conditions for Closure

The updated tailings reclamation plan is based on closure of the Canon City Milling Facility with no additional ore processed in the mill, and no additional materials brought to the facility from off site. Closure is essentially based on current on-site conditions, which are outlined below.

Secondary impoundment. The SI contains tailings from cleanup of the Old Ponds area that have been placed as an unsaturated fill material in lifts. Settlement monitoring of the surface of the SI by Cotter has shown minimal settlement of this surface, consistent with controlled placement of fill material. Following use of the surface of the SI for evaporation, an interim soil cover has been placed over the SI surface. The surface of the interim cover on the SI drains to the southeast at slopes of 2 percent to less than 0.5 percent.

Additional material to be placed in the SI from site cleanup will be used to fill in low areas to meet final grades.

Primary impoundment. The PI contains tailings from various phases of Canon City mill operation (described in the 2005 reclamation plan). These tailings have been discharged in the PI as a slurry, with the tailings settling out of the slurry and consolidating as a saturated material. Some of the tailings above the water pool elevation in the PI have become unsaturated from drainage and desiccation. Dewatering of tailings in the PI can be enhanced by pumping extractable porewater from the tailings from the underdrain system within the PI.

Materials from site cleanup have been placed in the west corner and northwest side of the SI. These include contaminated soils, structural debris from demolition of the alkaline mill, acid mill, and other on-site facilities. Berms for evaporation ponds have been constructed with contaminated soils along the southwest and southeast sides of the PI. These ponds are no longer needed for evaporation of remaining process water.

The estimated volume of material to be placed in the PI from facilities demolition and site cleanup totals approximately 500,000 cy, as summarized below.

- Mill facility debris: 100,000 cy
- Contaminated soils within site area: 300,000 cy
- Relocation of contaminated soil berm material within the SI: 100,000 cy

Based on the elevation-capacity relationship within the PI (from current surface topography), this volume of material (if placed in the lowest parts of the PI) would reach an elevation of 5580 ft. The actual surface of contaminated materials within the PI would be sloping to be consistent with the reclamation drainage plan (as described below).

3.2 Reclamation Plan Drainage

The plans for reclamation drainage are based on the performance criteria in Appendix A of Part 18, which affects the direction of drainage and the slopes of reclaimed surfaces. The general plans are outlined below.

- Minimizing runoff onto the reclaimed tailings impoundments from upstream drainages.
- Conveying drainage away from tailings embankments, such that runoff on reclaimed embankment slopes is limited to precipitation falling on the embankment slopes, and major components of drainage are not flowing over embankment slopes. The SI and PI embankments would be regraded to 5:1 (20 percent) slopes.
- Conveying drainage of runoff from the cover surfaces to channels located on natural ground, so that major channels are not located over tailings.
- Selecting reclaimed surfaces slopes to provide erosional stability with locally-available cover riprap or rock mulch.

Secondary impoundment. For the SI, surface runoff would be directed to the east, to the location of the current decant pipe. This runoff would then discharge into a diversion channel on natural ground the east side of the PI. The cover surface slopes would range from 0.25 to 1.0 percent.

Primary impoundment. For the PI, surface runoff from the cover surface would be directed to the east and into a diversion channel located on natural ground. At the north end of the PI, excavation of fill material and tailings may be required to reach natural ground levels and meet channel grades for discharge to the north. The cover surface slopes would range from 0.5 to 1.0 percent. In the west corner of the PI, the cover slope over mill demolition debris would range from 2.0 to 2.5 percent. This area of the PI would have a rock mulch on the cover surface for erosion protection.

The diversion channel would discharge runoff to the north, through the embankment on the north side of the PI. Runoff from natural ground south and east of the PI would also drain into this channel, as well as runoff from the reclaimed SI (shown on Figure 3). The diversion channel would be lined with riprap for erosion protection.

3.3 Cover Design

The planned cover over the PI and SI is the uniform cover system outlined in the 2005 reclamation plan. The total cover thickness is a minimum of six feet, consisting of the components outlined below (from top to bottom).

- Topsoil layer (0.5 ft thick) to provide the seedbed and upper portion of plant growth zone. The topsoil would be obtained from soils currently stockpiled on site. This layer would be placed with minimal compaction to encourage plant growth.
- Clayey sand layer (4.0 ft thick) to provide a subsoil layer for water retention and plant growth, as well as radon attenuation. These soils would be obtained from the Northwest borrow area or Old Ponds borrow area. This layer would be placed in multiple lifts with nominal compaction to provide a root growth and water retention zone. This zone would

not be highly compacted; the density of this zone would be selected to replicate the natural, long-term density of soils in the area.

- Random fill zone (within a minimum thickness of 1.5 ft when directly above tailings) to provide a zone of separation between tailings or mill materials and the remaining cover system and a base for the clayey sand layer. These soils will be obtained from the Old Ponds borrow area. The top surface of this zone would be compacted to form a firm base for the clayey sand cover layer.

3.4 Erosion Protection

Erosion protection on reclaimed surfaces will consist of riprap on regraded embankment slopes and in diversion channels. The riprap will be underlain by appropriately-sized filter material to meet filter compatibility between the riprap and underlying embankment material or natural ground. As outlined in the 2005 reclamation plan, a commercial rock quarry source near Canon City has been evaluated on a preliminary basis, and can provide the estimated quantity of rock for reclamation that meets NRC criteria for long-term durability.

As outlined in the 2005 reclamation plan, the cover surfaces (if at slopes of 0.25 to 1.0 percent) are erosionally stable with a vegetated surface (with no gravel or rock mulch). Portions of the PI cover surface for the updated reclamation plan with slopes over 1.0 percent will be evaluated for erosional stability, and rock erosion protection (such as rock mulch added to the topsoil) included as necessary.

3.5 Additional Cover Components

The planned uniform cover system with a minimum thickness of six feet is acceptable for the additional cover design factors listed below.

- The 4.5-ft thick topsoil and clayey sand zone is sufficient for rooting depth of grass species in the area (ranging from 1 to 3 ft).
- The average frost depth in the Canon city area is approximately 2.3 ft, which is shallower than the cover thickness. Furthermore, freezing and thawing of the cover materials will not affect their performance, due to the cover material density being similar to that for natural soils in the area.
- Biointrusion from plant species will be minimized by encouragement of grass species and management of undesirable weeds and deep-rooting brushy species. This will be accomplished with passive maintenance of the cover surfaces.
- Biointrusion of burrowing vertebrates into the tailings is mitigated by the thickness of the cover and random fill over the tailings. The minimum 6-ft depth exceeds the burrowing depth of most vertebrates in the region (Waugh, 1997).

4.0 PLANS AND PERFORMANCE MONITORING

4.1 Additional Plans

Additional plans associated with and providing technical support for this document will be prepared for submittal to CDPHE. Preliminary versions of these plans are presented in the 2005 reclamation plan. Updated versions of these plans would be prepared for submittal to CDPHE at least one year prior to decommissioning of the PI and SI. These plans are summarized below.

- Cover construction plan, including material specifications for the uniform cover materials, specifications for placement and compaction of these materials, and requirements for construction quality assurance testing and reporting.
- Rock sampling and analysis plan, for the selected rock for use as erosion protection material. This plan will include the size and durability specifications for rock to be used as riprap or rock mulch, the size specifications for filter and bedding materials as required, the specifications for placement of these materials to minimize segregation and erosion loss, and the requirements for construction quality assurance testing and reporting.
- Tailings dewatering plan. This plan would outline the procedures for evaporation of the remaining water in the PI and removal of extractable porewater from the tailings in the PI (through the underdrain system) to enhance tailings consolidation and increase tailings bearing capacity. Extractable water from the SI would be removed (through the underdrain system) if there is sufficient water yield.
- Settlement monitoring plan. Monitoring of tailings settlement (from monitoring of tailings, random fill, or interim cover surfaces) will be conducted prior to cover placement to ensure sufficient consolidation has occurred to allow cover construction.

4.2 Performance Monitoring

Elements of post-reclamation performance monitoring (to be conducted prior to site transfer to the U.S. Department of Energy) are outlined below.

- Radon monitoring of the cover surface, according to EPA procedures.
- Post-reclamation cover settlement monitoring, to assess cover settlement after construction by surveying of settlement monuments.
- Vegetation monitoring, to assess vegetation performance and compare with the revegetation plan for the cover surface.
- Erosional stability monitoring, including inspection of cover surfaces for areas of settlement or ponding, gulying or excessive erosion, lack of vegetation, or other elements of unplanned reclamation performance.
- Groundwater protection monitoring, to be continued under current requirements with CDPHE.

5.0 REFERENCES

- Earth Science Consultants, Inc. (ESCI), 1995. "Decommissioning and Reclamation, Chapter 9," prepared for Cotter Corporation and included in the Cotter Application for Radioactive Materials License 369-01, December.
- Johnson, T. L., 2002. "Design of Erosion Protection for Long-Term Stabilization," U.S. Nuclear Regulatory Commission, *NUREG 1623*, Final Report, September.
- MFG, Inc., 2005. "2005 Update of the Mill Decommissioning and Tailings Reclamation Plan for the Cotter Corporation Canon City Milling Facility," prepared for Cotter Corporation, August.
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- Waugh, W.J., 1997. "Ecology of Uranium Mill Tailings Covers," in *Landfill Capping in the Semi-Arid West: Problems, Perspectives, and Solutions*, T.D. Reynolds and R.C. Morris, Eds., Environmental Science and Research Foundation, pp 199-212.

TAILINGS RECLAMATION PLAN – APPENDIX AND ADDITIONAL PLAN SUMMARY

Reclamation Plan Appendix	Additional Investigations or Studies	2011 Work Scope Task No.	Planned Completion Date	Comments
A – NRC Review Checklist	Review and update	6	Apr 29	Refers to source of information
B – Surface and Channel Hydraulic Analyses	New analyses for SI and PI surfaces and for diversion channel	6	May 27	New analyses with no new site data
C – Erosional Stability Analyses	New analyses for SI and PI surfaces and for diversion channel	6	May 27	New analyses with no new site data
D – Radon Emanation Analyses	Review of input values for contaminated materials and cover material water content	6	Jun 30	Borrow material water and clay contents used in analyses
E – Cover Infiltration Analyses	Review and update	6	Jun 30	Borrow material water and clay contents used in analyses
F – Cover Borrow Material Evaluation	Sampling of borrow areas and embankment materials for shear strength and clay content	5	Jun 30	Results used in stability and radon analyses
G – Erosion Protection Material Evaluation	Confirmation of rock source, quality, and quantity	5	May 27	New sample from preferred rock quarry for durability test and petrographic analysis
H – Technical Specifications for Tailings Impoundment Reclamation	Review and update for revised reclamation plan	6	Jul 29	Revisions to specifications dependent on analyses
I – Tailings Dewatering Plan	Review and update	6	Apr 29	Input from Cotter on plan
J – Settlement Monitoring Plan	Review and update	6	May 27	Input from Cotter on interim plans