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Subject: Contract DE-AC03-99SF21530 - RMHF Slope Remediation

**Reference:** "Final Status Survey Report: Characterization and Final Status Survey – Radioactive Materials Handling Facility Perimeter." R58KXZ05-09-2532, March 2006.

## 1.0 Remediation of RMHF North Slope

This report documents the field activities relating to the removal of impacted soil from the RMHF north slope which measured approximately 100 sq ft. and about 6" deep. The area was located on a slope having an approximate slope of forty five degrees.

The effort required the use of trained radiation workers, a backhoe excavator and appropriate containers for the excavated soil. Several prerequisites were required to be completed before the fieldwork could begin. A civil engineer evaluated the stability of the slope to support a 16,000 pound backhoe. An additional issue involved working with Health & Safety to study the issue of fall protection for the workers on the slope.

## 1.1 Safety and Engineering Considerations

The ability to safely use a backhoe excavator to remediate the slope area was evaluated by performing an engineering study. This study tested the top of the north slope area to determine if it could withstand the weight of the backhoe tractor and its movements without suffering slope failure. A registered civil engineer prescribed the proof loading of the portion of the hillside where the excavation equipment was to be placed. The backhoe excavator was determined to weigh 16,100 pounds. A proof-load of 2 ½ times the weight of the backhoe excavator was placed on the slopes edge for more than two days. The civil engineer visually inspected the site and determined there was no signs of movement or soil fatigue and approval to use the equipment in the approved manner was given.

Worker fall protection in the form of worker orientation and training using specialized equipment was integrated into the project. Several workers were trained on using the new SALA rope grab restraint system. The Health & Safety group identified the SALA system and provided training. The excavation activities were periodically monitored by Health & Safety personnel to maintain compliance with the relevant requirements.

## 1.2 Remediation Operations

Remediation site identification and mapping was accomplished by locating each sample location within the 100 square foot area using flags. A catch fence was installed with the intention of limiting debris rolling down the slope and out of the controlled area. Consent from the RMHF Management and Radiation Safety to open the perimeter fencing and close the fence at the end of each day was coordinated. The backhoe excavator first removed all vegetation and large sandstone boulders within the remediation area. Radiation Safety performed radiological surveys and smears of the excavated boulders. The boulders were relocated out of the area upon approval.

The backhoe excavator was used to remove the first 6" of top soil from the remediation area. The soil excavation operations started at the top of the slope, and continued downward covering every inch of the roped off area. Once the backhoe operation was complete, radiation workers using fall protection proceeded with hand excavation activities. The backhoe excavator provided the means for the workers to dump their excavated soil from 5gal. buckets into the backhoe bucket, which was in turn, was emptied into the excavated soil container. This approach reduced climbing up and down of the slope by the workers and minimized slips and falls.

Workers did not observe any stained, discolored soil or unusual odors which would indicate chemical contamination was present. Type-4 boxes were used to containerize approximately 200 cubic feet of excavated soil. A Quality Assurance representative was on site inspecting the contents from the slope to ensure compliance with Nevada Test Site requirements. The containers were closed at the end of each shift. Once the boxes were filled, lot-followers were prepared and QA approved after surveys and smear reports were provided by Radiation Safety.

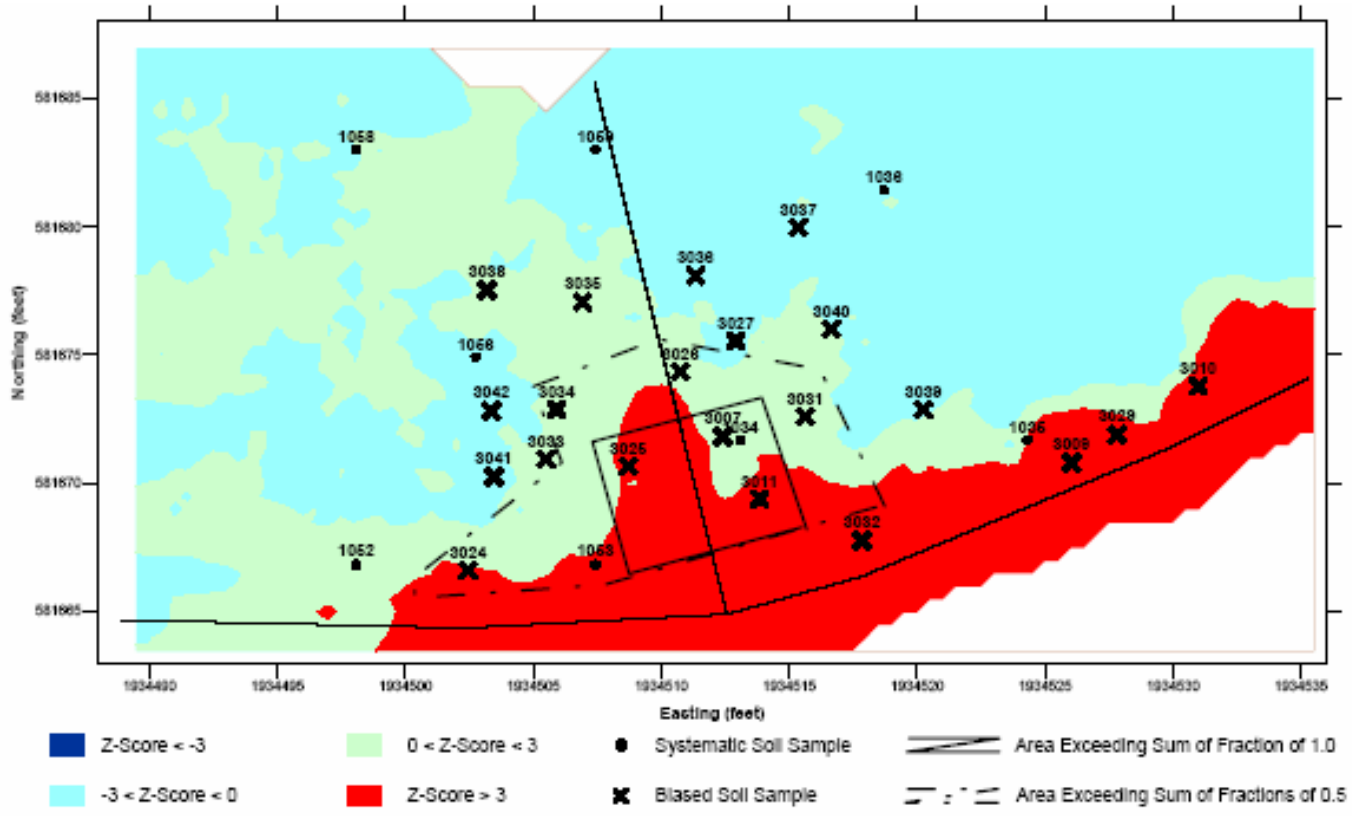
As the removal activities progressed, soil samples were retrieved and additional soil removal conducted as required. Radiation Safety personnel conducted the sampling and surveys for this area. Upon completion to the field activities**,** straw waddles were placed along this slope for erosion control of the hillside. Straw over the entire excavated slope area helped to provide additional erosion control and helped promote new plant growth.

Occasional rainfall during the project required the use of sandbags and tarp. A two day operations delay following rainfall allow for the drying out of the soil and reduce the likelihood of slippage by personnel.

## 2.0 Radiological Survey

The referenced Final Status Survey Report of the RMHF Perimeter concluded that survey units 1, 2 ,5, 6, 7, and 8 were suitable for release for unrestricted use. The report further concluded that the majority of survey units 3 & 4 was also suitable for release for unrestricted use. The report did identify one localized area overlapping the southern boundary of Survey Units 3 and 4 that had elevated cesium-137 approaching, and in several instances, exceeding the approved site-wide DCGL of 9.2 pCi/g (See Figure 1 and Table 1).

**Figure 1. Contaminated Area in Survey Units 3 & 4**



## Table 1. Pre- and Post- Remedial Soil Samples in Survey Units 3 & 4

| Sample ID | Radionuclide | Survey Unit | Pre-Remedial[1] 10/2005 | | Post-Remedial 4/18/2006[2] | | Post-Remedial 4/24/2006[3] | |
|---|---|---|---|---|---|---|---|---|
| | | | Result | Level | Result | Level | Result | Level |
| | | | pCi/g | | pCi/g | | pCi/g | |
| 1034 | Cesium 137 | 3 | 23.50 | Cs > 9.2 | 0.78 | > 0.2 | | |
| 3011 | Cesium 137 | 3 | 16.10 | Cs > 9.2 | 12.8 | Cs > 9.2 | 2.5 | 2 < Cs < 5 |
| 3025 | Cesium 137 | 4 | 9.40 | Cs > 9.2 | 4.4 | 2 < Cs < 5 | | |
| 3026 | Cesium 137 | 3 | 7.38 | 5 < Cs < 9.2 | | | 0.66 | 0.2 < Cs < 1 |
| 1053 | Cesium 137 | 4 | 5.94 | 5 < Cs < 9.2 | 2.26 | 2 < Cs < 5 | | |
| 3034 | Cesium 137 | 4 | 4.65 | 2 < Cs < 5 | | | | |
| 3031 | Cesium 137 | 3 | 4.03 | 2 < Cs < 5 | | | | |
| 3024 | Cesium 137 | 4 | 3.98 | 2 < Cs < 5 | 1.25 | 1 < Cs < 2 | | |
| 3027 | Cesium 137 | 3 | 3.91 | 2 < Cs < 5 | | | | |
| 3040 | Cesium 137 | 3 | 3.82 | 2 < Cs < 5 | | | | |
| 3037 | Cesium 137 | 3 | 3.12 | 2 < Cs < 5 | | | | |
| 3035 | Cesium 137 | 4 | 2.41 | 2 < Cs < 5 | | | | |
| 3007 | Cesium 137 | 3 | 2.39 | 2 < Cs < 5 | | | | |
| 3036 | Cesium 137 | 3 | 2.16 | 2 < Cs < 5 | | | | |
| 1059 | Cesium 137 | 4 | 1.89 | 1 < Cs < 2 | | | | |
| 1056 | Cesium 137 | 4 | 1.42 | 1 < Cs < 2 | | | | |
| 3033 | Cesium 137 | 4 | 1.06 | 1 < Cs < 2 | 0.75 | 0.2 < Cs < 1 | | |
| 3029 | Cesium 137 | 3 | 0.70 | 0.2 < Cs < 1 | | | | |
| 3039 | Cesium 137 | 3 | 0.50 | 0.2 < Cs < 1 | | | | |
| 3042 | Cesium 137 | 4 | 0.50 | 0.2 < Cs < 1 | | | | |
| 3010 | Cesium 137 | 3 | 0.46 | 0.2 < Cs < 1 | | | | |
| 3038 | Cesium 137 | 4 | 0.45 | 0.2 < Cs < 1 | | | | |
| 1035 | Cesium 137 | 3 | 0.43 | 0.2 < Cs < 1 | | | | |
| 1036 | Cesium 137 | 3 | 0.40 | 0.2 < Cs < 1 | | | | |
| 3032 | Cesium 137 | 3 | 0.38 | 0.2 < Cs < 1 | | | | |
| 1052 | Cesium 137 | 4 | 0.16 | < Background | | | | |
| 3041 | Cesium 137 | 4 | 0.11 | < Background | 1.38 | 1 < Cs < 2 | | |
| 3009 | Cesium 137 | 3 | 0.07 | < Background | | | | |

1. Data reported in "Final Staus Survey Report - Characterization and Final Status Survey - RMHF Perimeter"
2. Sampling following 1st round of soil removal
3. Sampling following 2nd round of soil removal

| ALARA level achieved |
|---|
| Cs > 9.2 |
| 5 < Cs < 9.2 |
| 2 < Cs < 5 |
| 1 < Cs < 2 |
| 0.2 < Cs < 1 |
| < Background |

### 2.1 Pre-remedial Status

Direct exposure rates in the area ranged from 9 to 17 μR/hr with and average of 12 μR/hr. These levels are within the range of natural background. Some of the dose rate originates from building 4022 within the RMHF fence-line, though some was likely due to low levels of cesium-137 contamination in the soil.

Soil samples taken within the area indicate cesium-137 ranging from non-detect to 23.5 pCi/g. See the pre-remedial data in Table 1. The DOE and DHS approved cleanup standard i.e. Derived Concentration Guidelines Level (DCGL) for cesium-137 is 9.2 pCi/g above background. Uniformly contaminated soil at this concentration (i.e. DCGL) to a depth of 1 meter would result in an annual dose to a residential

user of 15 mrem/y or an additional 5% of the U.S. average natural background dose of 300 mrem/y. Three samples detected soil that exceeded the 9.2 pCi/g DCGL. Two samples exceeded 5 pCi/g. Nine samples exceeded 2 pCi/g. The remaining fourteen samples were less than 2 pCi/g. The average soil concentration in this area was 3.6 pCi/g.

Figure 1 above shows that the area of soil exceeding the DCGL of 9.2 pCi/g is approximately 40 $ft^2$, whereas the area exceeding 5 pCi/g is approximately 100 $ft^2$.

Even with the three samples that exceed the DCGL of 9.2 pCi/g, the two survey units pass the MARSSIM recommended statistical sign test. Both survey units therefore could be released for unrestricted use with no further remediation required. However, Boeing's ALARA remediation policy requires that any soil exceeding DCGLs will be excavated.

**2.2 Post-remedial Status**

Removal of soil was performed in April 2006 with subsequent soil sampling performed on April 18th. Eight pre-remedial sample locations, including the five highest concentration locations were triangulated prior to remediation. These exact locations were then re-sampled following remediation. Five post-remedial samples confirmed that remediation had been effective in significantly reducing contamination levels at the re-sampled locations. These were locations 1034, 3035, 1053, 3024, and 3033. Location 3041 increased slightly, presumably due to limited cross contamination during excavation. The post-remedial concentration was still much less than the DCGL. One location, 3011, failed to achieve a reduction to less than the DCGL. Sampling of one location, 3026, was inadvertently omitted. Further soil removal was conducted and re-sampling performed on April 24th. Location 3011 was reduced to 2.5 pCi/g and location 3026 was reduced to 0.66 pCi/g.

The highest post-remedial concentration was 4.4 pCi/g, down from the highest pre-remedial concentration of 23.4 pCi/g. The excavation process was therefore successful, and all samples from that area now meet the approved cesium-137 DCGL of 9.2 pCi/g.

Approximately 200 cubic feet of soil was removed and is pending disposal to the Nevada Test Site (NTS). Figures 2 and 3 show the extent of the remedial operations.

**2.3 Future Work**

This post-remedial sampling was not a MARSSIM designed final status survey. It was intended to confirm that excavation had been effective in removing contamination to below the cesium-137 DCGL. When the RMHF facility is demolished and excavated, a MARSSIM designed survey will be conducted of the whole footprint, including the localized area discussed in this letter report.

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**Figure 2. Remediated Area Looking from the North**

**Figure 3. Remediated Area Looking from the East**