WORK PLAN FOR THE CHARACTERIZATION AND REMOVAL OF SELECTED MATERIALS IN THE "RADIOLOGICAL CONTROL AREA"

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TABLE OF CONTENTS

Section **Page**

SECTION 1.0 INTRODUCTION 1
1.1 Scope of Work 2
1.2 Radiological Control Area Definition 2
1.3 Location 4
1.4 Applicable Regulations 5
1.5 Previous Monitoring and Data Acquisition 6

SECTION 2.0 DATA QUALITY OBJECTIVES 8
2.1 Problem Statement 8
2.2 Identify the Decision 9
2.3 Identify the Inputs to the Decision 9
2.4 Define the Study Boundaries 10
2.5 Develop a Decision Rule 11
2.6 Specify Limits on Decision Errors 12
2.7 Optimize the Design 12

SECTION 3.0 WORK PLAN 13
3.1 Phase 1 - Materials Characterization 13
3.1.1 Radiometric Survey 13
3.1.2 Pipe Sampling 14
3.1.3 Soil Sampling 14
3.1.4 Analytical Requirements 15
3.2 Phase 2 – Waste Determination and Landfill Acceptance 16
3.3 Phase 3 - Waste Removal 17
3.3.1 Excavation Procedures 17
3.3.2 Excavation Monitoring 17
3.3.3 Procedure for Unanticipated Situations 18
3.4 Phase 4 - Verification Survey and Sampling 19
3.5 Dose Assessments and Contamination Control Monitoring 19
3.5.1 External Radiological Dose Assessment 19
3.5.2 Internal Radiological Dose Assessment 20
3.5.3 Radiological Contamination Control Monitoring 20
3.6 Quality Assurance and Quality Control Procedures 21
3.6.1 Sample Collection 22
3.6.2 Sample Identification 22
3.6.3 Handling, Preservation and Transport 23
3.6.4 Quality Assurance Samples 24
3.6.5 Decontamination of Sampling Equipment 24
3.7 Investigation Derived Waste 25

Section **Page**

SECTION 4.0 HEALTH AND SAFETY 26
4.1 Training Requirements 26
4.2 Personal Protective Equipment 27
4.3 Engineering Controls 27
4.4 Job Safety Analysis 27

SECTION 5.0 REFERENCES CITED 28

Figures

Figure 1 Project Location
Figure 2 Yerington Mine Units
Figure 3 Location of Radiological Control Area
Figure 4 Radiological Survey Map

Tables

Table 1-1 Annual Radiation Exposure Control Levels 3
Table 1-2 Radiological Control Area Characteristics 4
Table 2-1 Maximum concentration of Contaminants for the Toxicity Characteristic 11
Table 3-1 Analytical Methods and Detection Limits 15
Table 3-2 Contamination Control Monitoring/Sampling Frequency 21

Appendices

Appendix A Selected Photographs of the Radiological Control Area
Appendix B USA Environment Statement of Qualifications
Appendix C Job Safety Analysis – Radiological Control Area Sampling and Excavation

SECTION 1.0
INTRODUCTION

The Atlantic Richfield Company ("ARC") has prepared this Work Plan for the Characterization and Removal of Selected Materials in the Radiological Control Area ("RCA Work Plan") as an interim remediation activity located in the Process Areas of the Yerington Mine Site ("Site"). The project location and mine units are shown in Figures 1 and 2, respectively. The purpose of the Work Plan is to characterize the materials associated with a relatively small area of elevated radiometric readings, and to remove the source of that activity for off-site disposal. This action is not intended to meet the requirements of final remediation for site closure, as site clean-up levels are yet to be determined, but only to remove the areas of greatest concern to the stakeholders and reduce any potential risks for Site workers. The proposed interim action is consistent with other interim actions on the Site recently performed by the U.S. Environmental Protection Agency ("EPA"), such as fugitive dust mitigation and improvements to the Arimetco fluid management system.

The activities outlined in this work plan will be completed using a phased approach, where the results of one phase of work will dictate the activities of the next phase. The phases of activity include:

- Phase 1: Waste characterization survey and sampling, including soils and piping, in the RCA.
- Phase 2: Waste determination and landfill approval will be completed based on laboratory results from characterization sampling and will determine how the materials will be managed.
- Phase 3: Waste excavation and transport to selected disposal facility, as required.
- Phase 4: Verification survey and sampling to evaluate any residual contaminants in the remaining materials and soil.

The remainder of Section 1.0 of this Work Plan describes the scope of work, defines the RCA, describes applicable regulations, and summarizes previous sampling and analytical results in the

area of the RCA. Section 2.0 outlines the data quality objectives ("DQOs") for this Plan in more detail. Section 3.0 presents the details of the proposed work activities including proposed waste characterization sampling, waste removal, and verification sampling. Section 4.0 of this Work Plan identifies the task-specific health and safety requirements in the context of a more comprehensive Site Health and Safety Plan ("SHSP"). Section 5.0 lists the references cited in this RCA Work Plan.

1.1 Scope of Work

The scope of work outlined in this Work Plan: 1) is limited to the removal of the currently identified RCA in the Process Areas for the purpose of worker and site visitor protection (i.e., to the extent that the localized area is below defined RCA action levels); 2) does not include further evaluation of the Process Areas or other areas of the Site for additional RCA determinations; and 3) is not intended to remove materials to meet any site specific final cleanup levels, as those levels are not yet determined. Removal of radiological materials from the RCA will allow future site investigations in the Process Areas to be completed without restricted worker access. Sufficient radiological surveys have been completed in conjunction with the Process Areas investigation (Brown and Caldwell, 2005b), and other investigations (Brown and Caldwell, 2005c), to determine if frequently visited areas of the site pose a risk to worker safety.

The radiological surveys and sampling included in this work plan are not intended to meet Multi-Agency Radiation Survey and Site Investigation Manual ("MARSSIM") requirements because the final outcome of this removal action is not intended to be compliant with a site specific cleanup level, but only to remove the highest levels of recognized radiological activity that could pose a hazard to workers in the area.

1.2 Radiological Control Area Definition

A Radiological Control Area is defined as any area on the Yerington Mine Site that exceeds 0.2 mrem/hr external dose exposure level at a height of one meter, or approximately waist height, as measured by a tissue-equivalent survey meter. The RCA action level is based on the site specific

allowable worker exposure level established in the *Radiological and Chemical Exposure Control Plan* ("RCECP"; RMEC, 2004) of 500 mrem/year, as summarized in Table 1-1.

Table 1-1. Annual Radiation Exposure Control Levels

Personnel Class	Type of Exposure	Annual Limit [a]
Routine Site Worker	Whole Body (internal + external)	500 mrem [b]
Declared Pregnant Worker	Embryo/Fetus	500 mrem per gestation period
Visitors [c] and Public	Whole Body (internal + external)	100 mrem

[a] Exposures due to background radiation, therapeutic and diagnostic medical procedures, and voluntary participation in medical research programs shall not be included in either personnel radiation dose records or assessment of dose against the limits in this table.

[b] The legally enforceable annual Occupational Safety and Health Administration Exposure Limit for radiation is 5,000 mrem (5 Rem). However, in accordance with prudent practice, radiation exposure levels should be kept as low as reasonably achievable (ALARA). Therefore, ARC has established a goal of maintaining annual radiation exposure levels below 500 mrem for site workers. This ALARA goal will be reevaluated as exposure data becomes available.

[c] Applies to visitors who have not completed training in accordance with applicable Site Health and Safety Plans. This dose limit applies specifically to doses received by personnel while on the Yerington Mine site. It was derived from recommendations from the International Commission on Radiological Protection (ICRP).

This annual limit of 500 mrem/year was established by ARC as the "as-low-as-reasonably-achievable" ("ALARA") goal, and is based on limiting potential worker exposure to no more than ten percent of the legally enforceable Occupational Safety and Health Administration ("OSHA") Permissible Exposure Limit ("PEL") of 5,000 mrem/year (5 rem/year or 1 ¼ rem/quarter). A constant external exposure of 0.2 mrem/hr over a standard 2,000-hour work year would result in a cumulative external exposure level of 400 mrem/year, 80 percent of the established ALARA goal. This is conservative based on the assumption that up to 100 mrem/year may occur as internal exposure. Characteristics of the RCA, and appropriate control actions identified in the RCECP, are summarized in Table 1-2.

Table 1-2. Radiological Control Area Characteristics

Area Type	Survey Type and Equipment	Action Level[a]	Control Actions
Non-Hazard Area	External Radiation Survey with a Tissue Equivalent Meter	< 0.2 mrem/hour above background	▪ Standard work clothing and precautions prescribed in site-specific safety and health plan. No additional radiation precautions are necessary.
Radiological Control Area	External Radiation Survey with a Tissue Equivalent Meter	> 0.2 mrem/hour above background	▪ Mark area with warning tape and radiation signs. ▪ Use latex gloves, disposable booties and coveralls. ▪ Use ½ face respirator with P-100 cartridges. ▪ Entrants wear thermo-luminescent dosimeters. ▪ Survey personnel and equipment leaving the area. Decontaminate as necessary. ▪ Initiate personal and area air monitoring to determine internal dose.

[a] Measured at one meter above ground level (approximately waist height) based on OSHA PEL whole body exposure limit, which is measured at the torso.

1.3 Location

The RCA, shown in Figure 3, is a small area located on the southwest side of the iron launder precipitation tanks in the Process Areas, identified during investigation activities completed by ARC and the U.S. Bureau of Land Management ("BLM"). The RCA is approximately 30 by 30 feet, and consists of several lengths of 12-inch diameter transite piping discarded on the ground surface adjacent to the tanks. The pipes were apparently used for the transfer of acidic process solutions, and show signs of localized interior degradation where the solutions caused the material to swell and become friable.

The highest activity readings occur inside some of the pipes or in the soil underneath the pipes, but diminish to near background levels within about twenty feet of the pipe. Results of the 2004 radiological survey completed by a Bartlett Services health physicist for Atlantic Richfield are shown in Figure 4, including survey results measured at waist height around the perimeter and outside of the RCA and measured at waist and ground heights inside the RCA. Additional photographs of the RCA and the degraded transite pipes are provided as Appendix A.

The radioisotopes that have been found to occur in the soils, tailings and sediments at the Site originated from "naturally occurring radioactive materials" ("NORM") in the ores that were

mined for their copper content. The processing of these ores has resulted in the concentration of some radiochemicals in the process solutions, tailings and waste streams. Such concentrated radiochemicals are termed "technologically enhanced naturally occurring radioactive materials" ("TENORM"). The elevated levels of radiochemicals found in the RCA are likely to be the result of radium- and thorium-bearing materials precipitated out of the process solutions in the pipes that were used to transfer those solutions in the Process Areas. The solutions appear to have formed a precipitated scale on the insides of portions of these pipes, and to have absorbed into the construction materials in areas where the pipes may have been damaged. Some of the scale appears to have accumulated on native soils adjacent to open ends of the pipes.

Given the survey data and observed conditions of the pipes, ARC believes that portions of the transite pipes are the source of the elevated radiometric readings. The pipes have been moved from their original location, which was likely to have been in the concrete trench adjacent to their current position. One section of pipe is still in place inside the trench and also exhibits elevated radiometric readings. The trench was used as a piping conveyance route between the vat leach tanks, the solution tanks and the iron launders. Only the pipes located in this area of the plant have been observed to have elevated radiometric readings. Surveys of other pipes in the area and in other locations in the Process Areas have not demonstrated elevated radiometric levels.

1.4 Applicable Regulations

Applicable worker exposure limits to NORM and TENORM radiochemical sources are defined and regulated by OSHA 29 CFR 1910.1096 (Subpart Z, Toxic and Hazardous Substances, Ionizing Radiation). The Department of Energy ("DOE") and the Nuclear Regulatory Commission ("NRC") are agencies that regulate work practices, worker exposure limits and disposal requirements for facilities that directly handle regulated radiological material as defined by the Atomic Energy Act ("AEA"), including sources generated during energy and weapons production and uranium mining and milling operations.

Regulations promulgated by these agencies are not applicable at the Site because the radiometric sources are naturally-occurring by-products generated during non-uranium mining and ore processing. The State of Nevada has the right to regulate NORM materials generated or disposed of within the State but, at this time, has not created any state specific regulations that are applicable to the RCA materials.

1.5 Previous Monitoring and Data Acquisition

This section briefly describes available data and investigation activities completed in the RCA as well as the general radiation investigation activities done in the Process Areas in order to identify areas of elevated radiation.

Bureau of Land Management, Site Health and Safety Plan (2004)

The initial radiation investigation of the Process Areas was completed by Walker and Associates for the BLM in order to identify potential safety hazards for their Site Health and Safety Plan ("HASP"; BLM, 2004). The BLM investigation consisted of activity readings using handheld a Geiger-Muller ("GM") detector and collection of several soil samples around the Process Areas and ponds on the mine site. BLM identified the location by the iron launders as the area with the highest readings on the Site, and several other locations as elevated-above-background, including: 1) the surge pond; 2) the lower truck sludge pond; 3) a low area at the north end of the Process Areas; 4) a small area within the sulfide tailings process solution recycling ponds; and 5) an area in the northwest corner of the Pond 1 evaporation pond.

Process Areas Site Characterization (2004-2005)

ARC conducted radiological investigations in conjunction with the Process Areas Soil Characterization activities in 2004 and 2005, which are summarized in the Data Summary Report for Process Areas Soils Characterization (Brown and Caldwell, 2005b). Radiometric readings were taken at over 250 sample locations and most soil samples were analyzed for uranium, thorium and radium concentrations.

A health physicist was on site part time during sampling activities and conducted more detailed investigations of the RCA and other areas identified by the BLM HASP. Based on additional investigations performed by the health physicist, the only on-site area identified using this criterion was the area of the transite pipes addressed in this RCA Work Plan (i.e., all other areas identified by the BLM were not considered to be a health hazard due to significantly lower radiometric readings). Results of these investigations were described in the *Final Radiological Monitoring Report, October 2004 to April 2005* prepared by RMEC Environmental for ARC (RMEC, 2005).

EPA Scanner Van Study (2005)

In April 2005, the EPA conducted a survey of the mine site and surrounding areas using a scanner van to measure gamma activity levels. The results, reported in the *Scanner Van Survey of the Yerington Mine Site and Surrounding Areas* (EPA, 2005), also confirmed that the highest readings were those in the vicinity of the iron launders. Other areas that were evaluated with the Scanner Van exhibited very low radiometric readings at, or slightly above, background.

Radiological Data Compilation (2005)

In December 2005, Brown and Caldwell compiled all available radiological data to facilitate an understanding of the distribution of TENORM at the Site. Previously described investigations and studies were summarized in this report.

SECTION 2.0
DATA QUALITY OBJECTIVES

The Data Quality Objectives ("DQOs") for activities described in this RCA Work Plan include the collection of data to support the characterization of selected materials within the RCA to evaluate appropriate disposal options. The following seven-step DQO process has been developed to ensure that data of sufficient quality are collected to meet the project objectives:

Step 1. State the Problem;
Step 2. Identify the Decision;
Step 3. Identify the Inputs to the Decision;
Step 4. Define the Boundaries of the Study;
Step 5. Develop a Decision Rule;
Step 6. Specify Limits on Decision Errors; and
Step 7. Optimize the Design.

2.1 Problem Statement

A small area within the Process Areas has been identified as having radiometric levels that could pose a potential health risk to site workers who may have occasion to work in this area. Current protection for workers is provided by using the administrative control of restricted access. A more effective protection measure can be applied by implementing the engineering control of removal of the hazard. In order to remove the risk to site workers, ARC would like to implement a phased approach to characterize and remove, as required, any materials that are the source of the elevated radiometric readings. Once the characterization phase is completed, appropriate management requirements can be determined.

It has been hypothesized that the source of the radiometric activity is the transite pipes that were used by Anaconda for some period between the 1950s and 1980s for the purpose of transferring process leach solutions within the Process Areas. At some point in the past, the pipes were removed from the adjacent cement trench and stockpiled on the surface. Because the radiometric

levels are elevated inside the pipes as well as on the surface soil underlying the pipes, it is presumed that precipitated scale and solids developed inside the pipes during operations and was subsequently released to the soil.

2.2 Identify the Decision

The objective is to determine the waste disposal requirements for the materials located within the RCA, including safety and health procedures, proper handling and conveyance requirements for these materials. The material is likely to be classified as a NORM waste, which is generally a low-level radioactive waste that is not regulated by the Atomic Energy Act. As such, it will not be classified as a low level waste ("LLW") and disposal restrictions are not regulated by the NRC. Typically, NORM waste disposal restrictions are regulated on a state-by-state basis. Additionally, the material could be considered a "mixed waste" if certain levels of toxic metals exceed the EPA hazardous waste criteria.

The presence of asbestos in the pipes (friable or non-friable) will not affect the disposal requirements if the material is determined to be either NORM waste or hazardous waste, as asbestos alone does not qualify material as hazardous waste in Nevada and will not result in classification as a mixed waste. The decision is the determination of the waste classification as either a NORM waste, a mixed waste consisting of both radiochemical and toxicity characteristics, or an unregulated construction and debris waste.

2.3 Identify the Inputs to the Decision

In order to determine if the material meets NORM waste definitions, it is necessary to know the concentrations of radiochemicals that are derived from naturally-occurring uranium and thorium decay series. The long-lived decay products of uranium typically include: uranium-234, uranium-238, thorium-230, thorium-232, radium-226 and radium-228. Since each State in which potential disposal facilities are located may have different waste acceptance criteria, it is prudent to analyze for gross alpha and gross beta concentrations as well as determine the presence and concentrations of all existing gamma emitters through gamma spectroscopy analysis.

Hazardous waste toxicity characteristics will be evaluated only for metal toxicity using the Toxicity Characteristics Leaching Procedure ("TCLP"). The EPA regulates materials as hazardous waste if they contain leachable concentrations of certain metals in excess of the levels defined in 40 CFR Part 261.24 (Identification and Listing of Hazardous Waste; Toxicity Characteristic). The metals that must be evaluated to determine hazardous waste toxicity include: arsenic, barium, cadmium, chromium, mercury, lead, selenium and silver.

The presence of asbestos in the waste material in conjunction with either radiochemical or metal toxicity is not likely to affect disposal restrictions, but should be noted on the waste profile to ensure proper handling. Friable asbestos waste is defined as any material containing greater than one percent asbestos that, when dry, can be crumbled or reduced to powder by hand pressure.

2.4 Define the Study Boundaries

The physical boundary of the study and work area is currently demarcated by stakes and roping used to define the RCA based on survey work completed by RMEC in 2004 and 2005. The marked area is located on the southwest side of the iron launder precipitation tanks in the Process Areas. The boundary will be resurveyed during Phase 1 sampling activities using the same survey tools and techniques as used in the original survey, and further defined in Section 3.0 of this RCA Work Plan. Sampling and material removal will be limited to this area or expanded as needed if additional elevated locations are found in the area during excavation.

Physical sample collection will be limited to pipes and soils within the re-surveyed RCA boundary. Limited soil impacts are expected due to the local accumulation of pipe scale, and soil samples will be collected at depths of 0-6 inches and 12-18 inches. The soil samples are intended to characterize the waste, not to define the extent of contamination. Therefore, deeper sampling would not be required unless radiometric sources are encountered during excavation.

For worker health and safety, as well as minimization of offsite impacts, intrusive work activities will be limited to periods with wind speeds not exceeding sustained levels greater than

approximately 15 mph or gusts exceeding approximately 30 mph based on visual observation of dust loading and wind transport. Sampling activities can be conducted at any time

2.5 Develop a Decision Rule

Two key decisions have been identified that will enable the determination of waste classification for the material removed from the RCA and allow for the selection of an appropriate disposal facility. These decision rules are as follows:

a) If concentrations of Ra-226 are greater than 5 pCi/g[1], then the material is considered a NORM waste. Following the waste determination, a selection of landfills will be evaluated that are permitted to receive NORM waste and the determination will be made if there are any state specific land disposal restrictions and waste acceptance criteria that will affect the approval of the receipt of the RCA material for disposal at a selected landfill.

b) If concentrations of any of the EPA listed toxic metals in the TCLP leachate exceed maximum concentration limits as shown in Table 2-1, then the material will be considered a characteristically hazardous waste.

c) If both decision rule (a) and (b) are found to be true, then the material will be considered a mixed waste.

Table 2-1. Maximum Concentration of Contaminants for the Toxicity Characteristic

Metal	Leachate Concentration (mg/L)
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Mercury	0.2
Lead	5.0
Selenium	1.0
Silver	5.0

[1] The State of Nevada states that any person that receives naturally occurring radioactive material that contains greater than 5 pCi/g Radium-226 is subject to licensing and transportation requirements (NAC 459.184).

2.6 Specify Limits on Decision Errors

The baseline hypothesis is that the soil and pipe materials in the RCA will be classified as a NORM mixed waste. The types of errors that could be made during data evaluation and characterization determination include a) deciding the waste is hazardous when it really is not (false positive), or b) deciding that the waste is not hazardous when, in fact, it is (false negative). The consequence of a false negative error is that hazardous waste may be disposed at a non-hazardous waste landfill that does not have the appropriate protection systems to safeguard the environment and human health. The consequence of a false positive error is that unnecessary money is spent on a more protective disposal method, but there is no additional risk to health or the environment. Therefore, it is necessary to minimize the potential for false negative errors more so than false positive errors.

Tolerable error levels for this waste characterization activity will be established at 5% allowable false negative errors and 20% allowable false positive errors. This will be implemented during the comparison of the sample data to the decision rules established in Section 2.5.

2.7 Optimize the Design

These decision errors will be minimized by implementing a biased sampling design that will generate waste characterization data that are likely to be higher than those achieved by a statistically random sampling plan. Based on existing information, it is expected that the sample results will far exceed the limit established in decision rule (a), further reducing the risk of a false negative error. Details of the sampling design are provided in Section 3.0.

SECTION 3.0
WORK PLAN

All site investigations, and related quality assurance and quality control ("QA/QC") procedures, will be consistent with the DQOs presented in Section 2.0. ARC proposes to conduct the following activities:

- Radiometric readings and sampling of soil and piping in the RCA;
- Characterization of the materials to determine their waste designation; and
- Removal and disposal of materials at an appropriate off-site disposal facility, as necessary, to reduce the external dose level to less than 0.2 mrem/hr at waist height (one meter) at all points within the RCA.

3.1 Phase 1 - Materials Characterization

The proposed Phase 1 field activities will be conducted for the purpose of defining the extent of the RCA, identifying elevated areas within the RCA, and characterizing the materials for waste disposal. As described above, transite pipe and underlying soils will be sampled. Analytical results will be used during Phase 2 in the selection of a waste disposal facility based on comparison of the analytical results to the disposal facility's waste acceptance criteria ("WAC").

3.1.1 Radiometric Survey

A preliminary radiometric survey will be completed by a health physicist in order to re-establish the boundaries of the RCA and delineate areas for materials characterization (i.e., sampling and analysis). A µrem meter or tissue equivalent gamma survey meter will be used to complete the survey. The survey will be conducted on a meter grid at the 1-centimeter (i.e. on-contact) and waist-high levels (i.e. one meter), although additional readings may be obtained to provide greater definition to the RCA boundaries and to localize any identified elevated areas.

3.1.2 Pipe Sampling

Two discrete samples will be collected of pipe material located within the RCA or in the adjacent trench. Samples will be collected from the accessible open ends of two pipes that exhibit the highest radiometric readings. The construction material for the pipe is transite, which is an asbestos-containing cement material designed to be heat and acid resistant. Generally, the pipes are very hard making them difficult to sample. However, portions of the transite material have been degraded by the presence of solutions that caused the material to swell and become friable within the interior. Pipe samples will be collected from these areas, which are also likely to represent the areas of greatest radioactivity.

Field notes will be maintained during the sample collection and will document the radiometric gamma activity levels at each sample location before the sample is collected. A second reading will be taken of the isolated sample material in a neutral background area outside of the RCA. This second reading will more accurately document the true activity level of the sample material without interference from other nearby sources.

3.1.3 Soil Sampling

Twelve discrete soil samples will be collected within the RCA including six samples collected from surface soils (0 to 6 inches) and six sub-surface samples collected at the 12- to 18-inch depth in the same locations as the surface samples. Two of the sample locations will be collected directly in front of the open ends of pipes with elevated radiometric readings and two locations will be selected based on elevated radiometric readings within the RCA but not directly in front of the pipes.

Two additional sample locations will be collected from an area of the RCA where the radiometric readings are greater than 0.2 mrem/hr but not maximum observed levels. These sample locations will provide a range of radiological concentrations within the RCA that will allow for a more accurate waste determination. All samples will be collected using a hand auger. The same radiometric gamma activity levels will be recorded for the soil samples as for the pipe samples described in Section 3.1.2.

ARC anticipates that any impacts to the soil would be shallow in nature, and related to solid materials that may have fallen out of the piping, based on the reasonable assumptions that: 1) the pipes contained no solution when they were re-located to the RCA; and 2) subsequently, no hydraulic head was available to drive any radiological constituents deeper into the soil column. The deeper sample is intended to verify this theory, and provide guidance on the amount of soil that may require excavation.

3.1.4 Analytical Requirements

A list of proposed constituents (radiochemicals, metals and asbestos), methods and detection limits is provided in Table 3-1.

Table 3-1. Analytical Methods and Detection Limits

Constituent/ Analysis	Method	Detection Limit	Sample Type	
			Soil	Pipe
Radiochemistry:				
Uranium (total)	6020	0.5 mg/kg	√	√
Thorium (total)	6020	0.5 mg/kg	√	√
Radium-226	903.0	0.1 pCi/g	√	√
Radium-228	904.0	0.1 pCi/g	√	√
Gross alpha	900.0	0.1 pCi/g	√	√
Gross beta	900.0	0.1 pCi/g	√	√
Gamma Spectroscopy	901.1	Depends on sample size	√	√
Metals (TCLP Extraction/Total):				
Arsenic	1311 6010B	0.2 mg/L or 500µg/kg	√	√
Barium	1311 6010B	0.2 mg/L or 500µg/kg	√	√
Cadmium	1311 6010B	0.1 mg/L or 500µg/kg	√	√
Chromium	1311 6010B	0.1 mg/L or 1000µg/kg	√	√
Lead	1311 6010B	0.1 mg/L or 500µg/kg	√	√
Mercury	1311 7470B	0.002 mg/L or 0.2 mg/kg	√	√
Selenium	1311 6010B	0.1 mg/L or 1000µg/kg	√	√
Silver	1311 6010B	0.2 mg/L or 1000µg/kg	√	√
Asbestos				
Asbestos	600/M4-82-020 or 600/R-93/116 (Polarized Light Microscopy)	1%		√

Radiochemical constituents to be analyzed on all samples include total uranium, total thorium, radium-226, and radium-228. Gross alpha and gross beta will be analyzed as well as gamma spectroscopy to identify other potential gamma emitting isotopes. Metals were present in the process solutions, though concentrations of those metals are not known. The potential exists for metals to have absorbed into the pipe or spilled into the soil, so only those metals that could potentially create a hazardous waste will be evaluated, including the eight metals listed in Table 3-1 analyzed after completing a TCLP leach test. Asbestos concentration will be determined on the pipe samples only, as the concentration of asbestos in the soil is expected to be insignificant.

3.2 Phase 2 – Waste Determination and Landfill Acceptance

This phase of work does not require any field activities. Waste determination will be completed by evaluating the analytical results from Phase 1 sampling and determining the maximum and average concentrations of contaminants in the sampled materials. The average concentration is representative of the entire material that the landfill will be receiving but the maximum concentration will be used as guidance in evaluating landfill waste acceptance criteria in order to ensure the selected landfill will not be receiving a class of waste material that they are not permitted to receive.

Several disposal facilities that accept the types of waste expected to be generated during the RCA interim removal action are located in the western United States. WACs for these facilities will be reviewed during Phase 2 in order to determine which facility is best suited to receive the RCA materials. Selection of the landfill will be based on determined waste characteristics, landfill WAC, disposal cost, and transportation cost. Potential disposal facilities include, but are not limited to:

- US Ecology (Richland, Washington) – Accepts Class A, B and C low-level radioactive waste.
- US Ecology (Grand View, Idaho) – Accepts RCRA/TSCA wastes as well as NORM/TENORM and other NRC exempt low level radioactive materials.
- Envirocare (Clive, Utah) – Accepts low-level Class A radioactive waste, NORM/ TENORM waste, and mixed wastes that contain both radioactive and RCRA hazardous waste components.

3.3 Phase 3 - Waste Removal

Waste removal and transportation will be conducted by a certified contractor qualified in the handling of radioactive materials, asbestos and hazardous wastes. USA Environment of Houston, Texas has been selected as the contractor for this project and their Statement of Qualifications is provided in Appendix B.

3.3.1 Excavation Procedures

Excavation will be completed utilizing a small track excavator (Caterpillar 312 or similar) to facilitate the removal of contaminated soils and debris. Excavated soils will be stockpiled and staged in an area immediately adjacent to the RCA to determine radiological activity and physical composition necessary to properly complete the waste profile and shipping documents. Pipe will be loaded whole, where possible, and thoroughly wet for sections that would require breaking into smaller lengths before loading. If practical, pipes will be loaded in such a way that allows placement of soil in and around the pipe, to fill voids and optimize the load size.

Excavation and removal activities will not be performed during adverse weather conditions with moderate to strong winds. Dust suppression methods, including application of water spray over the work area and waste stockpiles, will be implemented during the waste removal activities to minimize airborne particles.

Wastes will be transported to the disposal facility in fully enclosed and lined roll-off containers that typically hold approximately twenty yards of material. Waste containers will be properly placarded, according to Department of Transportation ("DOT") shipping requirements, and prepared for transport to the disposal facility. A waste manifest document will be completed and signed by a representative of ARC. Upon receipt at the disposal facility, the manifest will be signed by a representative of the facility and a copy returned to ARC for recordkeeping.

3.3.2 Excavation Monitoring

The remediation criterion for this removal activity is to achieve an external dose rate of less than 0.2 mrem/hr at waist height from all points within the RCA. Radiometric readings will be taken

throughout the removal activity to monitor the location and relative activity of remaining contamination and to determine if unanticipated levels of contamination are encountered at depth. Surveys will be completed at least once per hour and will consist of a qualified radiation technician walking several transit lines, spaced approximately one meter apart, over the floor of the excavation area. A µrem meter or tissue equivalent gamma survey meter will be used to conduct the survey and the readings will be measured at waist height. The results and times of the surveys will be documented in the field notes. Removal will continue until the remediation criterion is achieved.

3.3.3 Procedure for Unanticipated Situations

Although all potential scenarios cannot be anticipated, the most probable unanticipated situations that may arise during excavation activities include:

- Encountering buried pipes in the excavation area;
- Encountering a buried sealed radiation source, such as a density gauge;
- Encountering increased levels of radiochemical contamination at depth in the soils; or
- Encountering another contaminant, such as hydrocarbons or PCBs, that were not previously identified or described in the waste profile.

In the event that any of these or other unanticipated situations arise during the implementation of this Work Plan, all on-going removal activities will be suspended while the scope of the situation is evaluated by the on-site ARC field manager, a health physicist and/or industrial hygienist, and the waste removal contractor field manager. Any buried materials, other than contaminated soils, will be left intact and not opened or disturbed until an external radiological survey is completed.

If the radiometric levels are within levels that can be handled by the qualified personnel onsite and the discovered item can be moved using the existing equipment without causing damage, the material will be moved from the excavation area and set aside for further evaluation or waste characterization. Protective barricades and signs will be placed around the material to restrict access and samples will be collected for submittal to a laboratory, if applicable.

3.4 Phase 4 - Verification Survey and Sampling

Upon completion of the waste removal activity, three verification soil samples will be collected from the excavated area to assess remnant soil contaminant levels. Since no site-specific cleanup levels have been determined, the verification sample results will only be used to document the as-left conditions following waste removal. As action levels are determined in the future, based on a risk assessment evaluation, a comparison of the results of the verification samples can be made to those action levels to determine any additional remediation requirements. The verification samples will be collected from randomly selected locations on the floor of the excavated area, and will be analyzed for the radiochemicals and total metals listed in Table 3-1.

A radiometric survey will be done at the completion of the waste removal activity to document the external dose levels remaining in the RCA area. The radiometric survey will be completed similar to the surveys conducted during Phase 1. The survey will be conducted on a meter grid at the 1-cm and waist-high levels, although additional readings may be obtained as necessary to fully document the as-left condition. A Data Summary Report ("DSR") for activities completed during this RCA Work Plan will be prepared, and will include a radiometric survey of the excavated area on a meter grid at ground and waist levels.

3.5 Dose Assessments and Contamination Control Monitoring

A variety of monitoring methods will be employed throughout this work activity to: 1) monitor site worker external exposure; 2) monitor site worker internal exposure; and 3) monitor removable contaminant levels on equipment and personnel to minimize the spread of contaminants on- or off-site.

3.5.1 External Radiological Dose Assessment

External radiation dose monitoring will be performed on all site workers working in or near the designated RCA. Monitoring will be conducted by the use of personal dosimeters such as thermo-luminescent dosimeters ("TLD") or optically stimulated luminescence ("OSL") badges to monitor cumulative radiation doses. Dosimeters will be submitted to a laboratory following completion of the work or after a one month period, whichever is shorter, and replacement

dosimeters should be worn until the work is completed. An electronic dosimeter may also be worn to provide a real-time reading of worker exposure levels to know if very high exposures are occurring during the course of the work, though these are considered to be less accurate and should not be used in place of the TLD/OSL. Analysis of the TLD/OSL badges or electronic dosimeters will be evaluated against the established ALARA and employees that have exposure levels that are near to or greater than this action level will be removed from the work activity.

3.5.2 Internal Radiological Dose Assessment

A high volume sampler will be used to collect representative air samples once per each day that excavation or waste handling activities are completed to determine airborne levels of radioactivity. The sample filters will be analyzed for total particulate mass as well as specific radioisotopes identified as occurring in the waste material to allow an estimate of internal radiation exposure. The air sample will be collected throughout the period that waste handling activities are being done by placing a sample pump and filter on the downwind side of the work area at the border of the contamination control zone. Meteorological conditions and site activities during air sampling operations will be noted and recorded so these conditions can be correlated with the measured airborne radioisotope levels.

3.5.3 Radiological Contamination Control Monitoring

A contamination control zone ("CCZ") will be established encompassing the RCA and sufficient area around the RCA to permit waste removal activities. Personnel and equipment that have entered the CCZ, or contacted any of the removed waste, will be monitored for surface radiological contamination prior to leaving the area using a survey meter with a probe suitable for measuring alpha/beta contamination that reads in disintegrations per minute ("DPM"). All accessible surfaces of the equipment or persons must measure below 200 DPM per 100 cm^2 of removable contamination[2], below 3000 DPM per 100 cm^2 maximum fixed contamination, and below 1000 DPM per 100 cm^2 fixed contamination averaged over one square meter above Site background levels for unrestricted release from the area. If surfaces show activity levels greater

then 200 DPM per 100 cm^2 above background, they will be cleaned until the prescribed level is met. All disposable personal protective equipment ("PPE") worn in the CCZ must be removed upon exit, disposed of in plastic bags and stored in labeled 55-gallon drums to be evaluated and disposed of as investigation derived waste. Non-disposable PPE will be frisked and must meet the same release requirements as those defined above.

The prescribed frequency of contamination control monitoring is summarized in Table 3-2. This frequency may be modified as additional data becomes available.

Table 3-2. Contamination Control Monitoring/Sampling Frequency

Frequency[a]	Location of Condition[a]
Prior to Transfer	Of equipment and material from a Radiological Control Area.
Daily	At contamination area control points, change areas, or step-off pads when in use, or per shift in high use situations.
After	Clean up of a leak or spill of radioactive materials in previously uncontaminated areas.

[a] Contamination surveys shall be conducted in Radiological Buffer Areas established for the control of contamination and other areas with the potential for spread of contamination.

3.6 Quality Assurance and Quality Control Procedures

Procedures for material collection and analysis will follow the specifications and standard operating procedures described in this section. In addition, the procedures will adhere to the QAPP for the Yerington Mine Site (Brown and Caldwell, 2003). QA/QC methods described in the QAPP will ensure that the quality and quantity of the analytical data obtained during the field activities described in this RCA Work Plan are sufficient to support the DQOs.

[2] The removable contamination release criterion is based on Nevada Administrative Code Section 459.3861. Although this section of the code is not directly applicable, it serves as a removable contamination release criterion for areas accessible to the public deemed acceptable by the State of Nevada.

QA/QC issues include:

- Identification of appropriate sample locations and sample collection methods;
- Sample handling and transport; and
- Detection limit and laboratory analytical level requirements.

3.6.1 Sample Collection

Collected samples will be placed in containers appropriate for each analysis according to the QAPP and laboratory requirements. Soil samples for metals and radionuclide analysis shall be placed in nine-ounce (or larger) wide mouth glass jars with teflon lined lids. Containers will be supplied from the laboratory to which the samples will be sent for analysis.

Samples will be collected as depth discrete samples over a six inch interval using a 4 inch diameter hand auger. The collected soil will be placed in a ziplock bag and blended by agitating and mixing the contents of the bag. A sub-set of soil will be taken from the blended sample and transferred to the glass jar sample container for submittal to the laboratory.

3.6.2 Sample Identification

Each sample container will be identified and labeled with a permanent marker, and will include the following information:

- Sample identification
- Sample date
- Sample time
- Analyses to be performed
- Preservative
- Person who collected sample

Each sample will be tracked according to a unique sample field identification number assigned when the sample is collected, and recorded clearly in the field notebook. The sample

identification number and information will be recorded on a chain-of-custody form included with the shipment to the laboratory. The lab will continue to track samples and report final results using the designated sample identification.

3.6.3 Handling, Preservation and Transport

Chain-of-custody procedures, as specified in the QAPP, will be followed for all samples. Custody of the samples will remain in control of the sampler at all times until the samples are handed off to another responsible person, with signatures of the person releasing the samples and the person accepting the samples documented on the chain of custody form, including the date and time of the transfer. Each sample will be listed on a separate line on the chain-of-custody form prior to packing and shipping, which will contain the following information:

- Project name
- Sampler's name and signature
- Sample identification
- Date and time of sample collection
- Sample matrix
- Number and volume of sample containers
- Analysis requested
- Preservative used
- Method of shipment

The labeled sample containers will be placed in an appropriate shipping container, typically an insulated ice chest (if cooling is required for sample preservation, bagged ice will be placed in the ice chest in re-sealable plastic bags). The shipping container will be sealed shut with strapping tape and two custody seals placed on the front of the container so that the custody seals extend from the lid to the main body of the ice chest. If the ice chest is sent by mail, the chain of custody form and other sample paperwork will be placed in a plastic bag and taped to the inside of the ice chest lid, and the ice chest will be labeled with "Fragile" and "This End Up" labels. The samples will be delivered to the laboratory to ensure that holding times will not be violated.

Samples will be evaluated for radiometric activity levels prior to packaging and will be labeled according to DOT shipping requirements for dangerous goods if required.

3.6.4 Quality Assurance Samples

Duplicate samples will be collected at a frequency of one per every 20 samples for each analysis. Duplicate samples will be collected by filling the containers for each analysis at the same time the original sample is collected and will be collected in the same manner as regular samples. For quality assurance purposes, duplicate samples will be labeled in the same fashion as regular samples, with no indication that they are QC samples. Each sample from a duplicate set will have a unique sample number and the duplicates will be sent "blind" to the lab.

Equipment rinsate blanks will be collected when reusable, non-disposable sampling equipment is being used for the sampling event. A minimum of one equipment rinsate blank is prepared each day when equipment is decontaminated in the field. Equipment rinsate blanks will be collected to evaluate field sampling and decontamination procedures by pouring laboratory-grade, certified organic-free water over the decontaminated sampling equipment. The rinsate blanks that are collected will be analyzed for the same analytes as normal samples and will be preserved, packaged, and sealed in the manner described in the QAPP. A separate identification sample number will be assigned to each rinsate blank, and it will be submitted blind to the laboratory.

Field blanks will be collected to evaluate whether contaminants have been introduced into the samples during the sampling procedures. Field blanks will be created by transferring laboratory-grade, certified organic-free water into a sampling container at one of the sampling points. Field blanks will be collected at a frequency of one per every 20 samples and will be analyzed for the same analytes as regular samples. A separate identification sample number will be assigned to each blank, and it will be submitted blind to the laboratory.

3.6.5 Decontamination of Sampling Equipment

All reusable sampling equipment will be decontaminated between each sample location. In general, sampling equipment will be hand-washed with a solution of tap water and Alconox

detergent, then rinsed with dilute nitric acid and water. The decontamination wash should be accomplished with clean buckets and/or spray bottles, filled half to three-quarters full as follows:

Bucket 1: Tap water with non-phosphate detergent such as Alconox.

Bucket 2: Clean tap water.

Bucket 3: Distilled or deionized water.

Spray/Squeeze Bottle: Dilute nitric acid solution (2% diluted with deionized or distilled water

Equipment decontamination consists of the following general steps:

1. Removal of gross (visible) contamination by brushing or scraping.
2. Removal of residual contamination by scrub-washing with soapy water in Bucket #1.
3. Rinsing in Bucket #2
4. Rinsing the equipment with a dilute nitric acid solution
5. Rinsing in Bucket #3. Change the water periodically to minimize the amount of residue carried over into the third rinse.

3.7 Investigation Derived Waste

Disposable sampling equipment and PPE (such as gloves, tyvek coveralls, and boot covers) will be containerized and handled as investigation derived waste and will be disposed of by the same method as the primary waste that it came in contact with. Decontamination solutions, from sample equipment decontamination or large equipment washing, will be collected and stored in drums or tanks. Following completion of all field activities, the collected wash solutions will be sampled and analyzed for the identified waste constituents. If those constituents are identified in the solutions, the solutions will either be solidified at the Site prior to shipment by the addition of an absorbent material such as vermiculite or bentonite (kitty litter) or will be shipped to the landfill in liquid form for solidification at the disposal site. If the solutions do not contain the identified waste constituents, the solutions will be disposed of on-site in the lined solution management ponds. Waste generated during this work activity that has not come in contact with the sampling medium, such as paperwork or packaging materials, will be handled as non-hazardous site waste and will be disposed in the onsite landfill.

SECTION 4.0
HEALTH AND SAFETY

The primary documents concerning health and safety requirements for this work plan are the SHSP and the RCECP. The SHSP identifies, evaluates, and prescribes control measures for all aspects of safety and health activities, in addition to providing for emergency response at the Yerington Mine site. The RCECP deals more specifically with radiological hazards and precautions to be implemented when working around radiological materials. Health and safety information included in this section is not intended to replace the information contained in the site health and safety documents but rather to call out the details that are important to activities related to this Work Plan. Copies of the SHSP and RCECP will be maintained at the site in Brown and Caldwell's field office as well as the Carson City office.

The primary health and safety concern during implementation of this work plan is the potential exposure to radiological materials through external exposure or inhalation of dusts. An additional inhalation exposure exists with the handling of asbestos containing pipes that may be partially friable. Physical hazards are also a safety concern and are inherent when working with earth-moving equipment, including hazards associated with ground disturbance and excavations.

4.1 Training Requirements

Prior to the start of work, field personnel and contractors will conduct a health and safety meeting to review the SHSP, RCECP and the task-specific Job Safety Analysis ("JSA") for this Work Plan (Appendix C). The JSA is a tool that is used to identify and prepare for all hazards related to a specific task by listing out the individual steps of the task, the potential hazards that could be encountered, and the steps that should be taken to mitigate those hazards. All contractors must demonstrate that they have received the required training, as outlined in 29CFR 1910.120(e) and as stated in the SHSP. Required training, depending on the particular activity or level of involvement may include OSHA 40-hour HAZWOPER training, including annual 8-hour refresher courses, and site specific health and safety orientation. Workers involved in the

removal of asbestos containing materials must have received training that meets OSHA's asbestos worker training requirements as defined in 29 CFR 1926.1101(k). At least one person must be on-site at all times during the removal of the asbestos materials that meets the OHSA definition of a "competent person" as defined by 29 CFR 1926.1101(o)

4.2 Personal Protective Equipment

Surveying, sampling and removal activities within the RCA may create dust containing radionuclides, metals and/or asbestos from the transite pipes. The minimum PPE requirements for working in this environment include:

- Hardhat, safety glasses, steel toed boots
- Tyvek coveralls (disposable; not necessary for radiometric surveys)
- Disposable or washable booties over work boots or washable steel toed rubber boots
- Latex or nitrile disposable gloves (not necessary for radiometric surveys)
- Half mask respirator with P100 dust cartridges, fit tested for each individual employee (not necessary for radiometric surveys if no ground disturbance)

4.3 Engineering Controls

Because inhalation and dispersal of dust from this area is a significant concern, dust control precautions should be taken at all times to minimize the amount of airborne dust. Dust control could be easily accomplished with the application of a water spray over the work site prior to and during work activities. If it becomes necessary to cut the transite pipe, wet cutting methods must be used to control dust generated by the cutting operation and all fine material must be collected and disposed of while it is still wet. At no time should compressed air or dry sweeping methods be used to clean the work area or equipment used during sampling or waste removal.

4.4 Job Safety Analysis

A preliminary JSA is included as Appendix C. This JSA will be reviewed with all site workers before beginning field activities and may be modified at any time to reflect a better understanding of work activities and identified hazards. The final JSA will be included in Appendix E of the SHSP and will be maintained on-site at all times during the implementation of this work.

SECTION 5.0

REFERENCES CITED

Brown and Caldwell, 2003, *Quality Assurance Project Plan*, prepared for Atlantic Richfield Company. September 19.

Brown and Caldwell, 2005a, *Site Health and Safety Plan for the Yerington Mine Site*, prepared for Atlantic Richfield Company. Revision 6: August 11.

Brown and Caldwell, 2005b, *Data Summary Report for Process Areas Soils Characterization,* prepared for Atlantic Richfield Company.

Brown and Caldwell, 2005c, *Radiological Data Compilation, Yerington Mine Site,* prepared for Atlantic Richfield Company.

Bureau of Land Management, 2004, *BLM Health and Safety Plan: Process Areas – Yerington Mine.* August.

RMEC Environmental, 2004, *Radiological and Chemical Exposure Control Plan, Yerington Mine Site Investigation Operations,* prepared for Atlantic Richfield Company. November.

RMEC Environmental, 2005, *Final Radiological Monitoring Report, October 2004 to April 2005, Yerington Mine Site Investigation Operations, Lyon County, Nevada,* prepared for Atlantic Richfield Company. October 10.

U.S. Environmental Protection Agency, 2005, *EPA Radiation and Indoor Environments National Laboratory Scanner Van Survey of the Yerington Mine Site and Surrounding Areas.* April 18-26.