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FINAL RADIOLOGICAL MONITORING REPORT
OCTOBER 2004 – APRIL 2005

YERINGTON MINE
SITE INVESTIGATION OPERATIONS
LYON COUNTY, NEVADA

FINAL REPORT:
October 10, 2005

PREPARED FOR:

ATLANTIC RICHFIELD COMPANY

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EXECUTIVE SUMMARY

To ensure that contractor employees performing site investigation and maintenance activities at the Yerington Mine Site in Lyon County, Nevada are adequately protected from overexposure to radiological and chemical hazards, the Atlantic Richfield Company (ARC) contracted with RMEC Environmental, Inc. (RMEC) of Salt Lake City, Utah to develop and implement a Radiological and Chemical Exposure Control Plan (RCECP) for the site. The RCECP was finalized in November of 2004 and included provisions for independent radiological monitoring of work areas at the Yerington Mine Site, contractor requirements for radiological monitoring and criteria for establishing radiological control areas at the site. A Radiological Control Technician (RCT) from Bartlett Nuclear was brought onto the site in December 2004, January 2005 and March 2005 to help implement the radiological monitoring and control requirements of the RCECP.

This report summarizes the results of radiological surveys, air monitoring for radioisotopes and personal radiation dosimetry performed to date at the Yerington Mine Site by Brown and Caldwell, the primary contractor performing site characterization for ARC, Applied Hydrology International, Inc. (AHI) the contractor operating and maintaining the Pumpback Well System at the site, and by RMEC/Bartlett Nuclear Services. The monitoring has included surveys of work areas using gamma survey instruments, area and personal gamma radiation dosimetry, radiological surveys of removable and fixed contamination on personnel and equipment, and air monitoring for airborne radioisotopes.

The general area radiological surveys, personal dosimetry, personnel and equipment contamination surveys and airborne radioisotope monitoring performed to date have shown that worker internal and external radiation exposures during routine site investigation activities are well below the as low as reasonably achievable (ALARA) goal of 500 mrem/year that ARC established for the site. At this time, no additional engineering, administrative controls or personal protective equipment (PPE) will be required to reduce worker radiation exposures during site investigation work in the areas surveyed. However, the need for additional administrative, engineering or PPE controls will have to be reevaluated on a constant basis as site conditions and work tasks change.

The area surveys indicated that isolated locations within the process area of the mine have elevated radiation levels. These areas have been marked with wooden stakes, warning tape and/or radiation warning signs. Only a small portion of the mine property was surveyed during this initial effort and other isolated areas of elevated radiation, both on the surface and sub-surface, may exist. Therefore, the specific procedures that have been described in the RCECP to characterize and minimize worker radiation exposures should be continued when additional site investigation activities are performed in all areas of the Yerington Mine Site.

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Specifically, any contractors performing activities on the site should continue to utilize gamma survey instruments to screen work areas for elevated radiation levels as they perform tasks in these areas. If work area radiation levels exceed the threshold levels specified in the RCECP, all work in that area should be stopped until a RCT or another individual capable of assessing radiation exposures can be brought onto the site. The RCT can then perform an independent evaluation of the work area for potential external and internal radiation exposures and implement the RCECP, as necessary. In addition, contractors performing duties on site for extended periods (greater than one month) should be issued personal radiation dosimeters and the dosimeters should be analyzed on a quarterly basis.

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1.0 INTRODUCTION

This report summarizes the results of radiological surveys, air monitoring for radioisotopes and personal radiation dosimetry performed to date at the Yerington Mine Site in Lyon County, Nevada by contractors for the Atlantic Richfield Company (ARC). Two contractors are currently performing site characterization and maintenance activities for ARC at the Yerington Mine Site. Brown and Caldwell is the primary contractor involved in the site characterization at the Yerington Mine. They are performing surface and subsurface soil sampling, water sampling and air sampling at the mine site. Applied Hydrology International, Inc. (AHI) is tasked with operating and maintaining the Pumpback Well System at the site as well as conducting ground water monitoring on and off site.

To ensure that chemical and radiological hazards at the site are evaluated and controlled, ARC contracted with RMEC Environmental, Inc. (RMEC) of Salt Lake City, Utah to develop and implement a Radiological and Chemical Exposure Control Plan (RCECP) for the site. The RCECP was finalized in November of 2004 and included provisions for independent radiological monitoring of work areas at the Yerington Mine Site, contractor requirements for radiological monitoring and criteria for establishing radiological control areas at the site. The RCECP also established specific work practices for activities in any established "radiological control areas". A Radiological Control Technician (RCT) from Bartlett Nuclear was brought onto the site in December 2004, January 2005 and March 2005 to assist in the implementation of the RCECP.

1.1 BACKGROUND INFORMATION

1.1.1 History of the Site

The Yerington property has a long history of copper mining and milling. The site covers approximately 3,500 acres. From 1952 through 1978 Anaconda operated both an oxide vat leach and sulfide flotation plant. Within the Anaconda facility area, there are approximately 160 million tons of oxide tailings and 58 million tons of sulfide tailings. ARC purchased Anaconda in 1977 as the Yerington Mine was shutting down. In 1978, the mine was sold to a private entrepreneur who leased portions of the site to other companies for salvage operations. Arimetco, Inc. purchased the property, including unpatented mining claims in 1988. From 1989 through 1999 Arimetco, Inc. operated five copper leach pads followed by a solvent extraction and electrowinning process to produce a pure copper product. Arimetco filed for bankruptcy in 1997 but continued to operate the mine until January 2000 when it abandoned the site leaving approximately 51 million tons of leached material between five separate leach pads and 92 million gallons of pregnant leach solution still in the system.

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In 1985 ARC was ordered by the Nevada Department of Environmental Protection (NDEP) to address potential groundwater contamination concerns at the Yerington Mine site. ARC installed a series of extraction wells along the northern, down gradient boundary. Additional wells were installed in 1999 in an effort to contain groundwater that has migrated off-site. In 2002, NDEP ordered ARC to perform investigations to determine the nature and extent of contamination from the site.

1.1.2 Radiological Materials at the Site

The radioisotopes in the soils, tailings and sediments at the Yerington Mine originated from naturally occurring radioactive materials (NORM) in the ores and soils that were mined for their copper content. The processing of these ores resulted in the concentration of some radioisotopes in the tailings and waste streams. When this occurs, the concentrated radioisotopes are termed technologically enhanced naturally occurring radioactive materials (TENORM). Several sampling efforts were performed at the Yerington Mine prior to RMEC's involvement to identify and characterize the NORM, TENORM and the associated radiation levels at the site. RMEC used the data from these investigations to formulate the RCECP.

In the summer of 2004 an assessment was performed by Walker and Associates, a contractor for the Bureau of Land Management (BLM) which manages a large portion of the Yerington Mine Site. Walker and Associates performed radiological surveys and surface soil sampling throughout the process area of the mine. The results of their sampling indicated "high" gross alpha and beta radioactivity levels in the process area soils (up to 1,440 and 592 pico-curies per gram (pCi/g), respectively). The sampling also indicated that some soils contained "high" levels of radium-228, -226 (up to 139 and 157 pCi/g, respectively) and "high" concentrations of uranium and thorium (up to 430 milligrams per kilograms (mg/kg) and 1,350 mg/kg, respectively). Based on the radioisotope analyses performed on these soils, it appeared that the processing of the copper ores changed the composition of the uranium and thorium in the ores such that the decay progeny were not in equilibrium with the parent chain.

In the summer of 2004, BLM representatives collected supplemental soil samples from the Vat Leach Tailings Pile and Tailings Ponds at the mine site. These samples were also analyzed for gross alpha and beta as well as specific radioisotopes. The highest gross alpha and beta measured in these soil samples was 2,370 pCi/g and 615 pCi/g, respectively. Radioisotopes present in the samples included radium-226 and-228, thorium-230 and-232 and uranium-234, -235, and-238. Based on these radioactivity levels, the BLM concluded that elevated radioactivity levels should be addressed through a monitoring and worker protection program.

A third assessment on the site was performed by SRK and their subcontractor, Foxfire. SRK was a consultant to the NDEP and had been contracted to manage the former Arimetco heap leach fluids at the mine. SRK/Foxfire performed two radiological dose

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assessments, one for workers at the Yerington Mine and another for off-site receptors from fugitive dust emissions. For each assessment, SRK/Foxfire used a survey instrument to screen surface soils and locate areas of elevated radioactivity, or "hot spots", at the evaporation ponds, finger ponds, tailings ponds and bermed areas. SRK/Foxfire then collected soil samples from these hot spots, which were then analyzed for gross alpha, total metals, total radioisotopes and gamma spectroscopy. The sampling locations, methodology and analyses performed employed by SRK/Foxfire differed from the sampling performed by Walker and Associates; therefore, direct comparison of these results would not be appropriate. However, the SRK/Foxfire sampling generally showed lower levels of radioactivity on the site than the Walker and Associates data and SRK/Foxfire concluded that radiological risk to site workers and the general public would be negligible. The heavy metal data obtained from the SRK/Foxfire sampling efforts indicated that worker exposures to these chemicals would be negligible.

An additional sampling effort was performed at the Yerington Mine site in December, 2004, after the development and implementation of the RCECP, by Technical Resources Group, Inc. (TRG) another contractor for the BLM. During a one-day site visit, representatives from TRG performed waist and ground-level gamma radiation measurements with a Ludlum 2241-3 survey instrument and 1x1 inch Sodium Iodide (NaI) detector. The surveys were restricted to the process areas of the mine that were determined to have elevated radiation levels in previous survey efforts. Three soil samples were collected from areas with elevated gamma radiation levels and analyzed for total and isotopic uranium, isotopic thorium, radium 226 and radium 228. The data from the TRG effort indicated that the majority of the elevated radiation levels measured in the process area of the Yerington Mine site were due to radium 226 and associated decay nuclides. The TRG report also indicated that the major thorium 232, uranium 238 and uranium 234 decay products in the soil samples from the process area of the mine were not in equilibrium with the parent compounds and that the processing of the copper ores likely resulted in the decay nuclides becoming concentrated in some site soils.

1.1.3 Current Radiological Exposure Monitoring Efforts

RMEC developed the RCECP in November, 2004 to provide an independent assessment of worker exposures at the Yerington Mine Site. The plan focused on evaluating and controlling both external and internal radiological exposures as well as exposures to other potential chemicals of concern. Due to the changing site conditions and tasks, the RCECP was designed to be a dynamic document to describe the evaluation methods that will be employed on the site. In addition to establishing criteria and controls for work in areas of elevated contamination, the plan also provided corrective actions to be implemented if the exposure assessments indicated excessive radiological or chemical exposures.

Brown and Caldwell and Applied Hydrology International (AHI) have each developed Health and Safety Plans (HASPs) for their activities at the Yerington Mine Site and each

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have implemented radiological exposure monitoring as part of the their HASPs. Methods and materials used in each of the monitoring efforts at the Yerington Mine and the results of the monitoring are described below.

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2.0 METHODS AND MATERIALS

The following sections discuss the various types of monitoring conducted by AHI, Brown and Caldwell and RMEC.

2.1 APPLIED HYDROLOGY INTERNATIONAL

2.1.1 Area Radiological Surveys

AHI has trained their personnel in the use of a Meter Conversions, Inc. RadScanner Model 500 survey meter coupled with a LND #712 gas-filled Geiger tube detector. This hand-held unit provides a total measurement of direct radiation (gamma radiation exposure rates in micro Roentgens per hour (µR/hour)). This meter is used to monitor external radiation exposure rates at the well sites where AHI performs monitoring and maintenance tasks. The device is set to alarm at a radiation exposure level of 1,000 µR/hour (1mrem/hour). AHI has developed a procedure to immediately leave any area when the radiation levels exceed 1,000 µR/hour. Information provided by Meter Conversions Company indicated that the survey meter had a current calibration record.

2.2 BROWN AND CALDWELL

2.2.1 Area Radiological Surveys

Since October of 2004, Brown and Caldwell has performed and documented radiological monitoring during all activities they have performed at the Yerington Mine Site. The monitoring has consisted of screening work areas for gamma radiation with a survey meter and screening excavated and disturbed soils for alpha and gamma contamination. The instruments being used by Brown and Caldwell include a Ludlum Model 19 gamma radiation scintillation instrument and an Eberline PRS-1 “Rascal” with an AC-3 alpha radiation scintillation probe. All instruments were supplied by Energy Labs of Casper, Wyoming. Energy Lab personnel calibrated the instruments prior to delivery to the site and provided on-site training for Brown and Caldwell personnel when the instruments were delivered to the site. RMEC reviewed the survey procedures used by Brown and Caldwell and determined that their survey methods were performed in accordance with standard industry practices.

2.2.2 Personal Radiological Dosimetry

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Brown and Caldwell also implemented a radiological dosimetry program to measure and document external radiation exposure of all personnel working on the site. All Brown and Caldwell employees, as well as the contractors performing routine activities on the site, were issued optically stimulated luminescence dosimeters (OSLDs) that were worn during all on-site activities. An additional OSLD was kept in the Mine Administration Building as a control. The OSLDs were supplied and analyzed by Landauer, Inc. of Glenwood Illinois. The OSLDs were changed approximately on a monthly basis over the following time periods:

- October 15 through November 14, 2004
- November 15 through December 14, 2004
- December 15, 2004 through January 14, 2005
- January 15 through February 14, 2005
- February 15 through March 14, 2005
- March 15 through April 15, 2005 (Phase 1 Project Completion)

2.3 RMEC/BARTLETT MONITORING

RMEC Environmental arranged to have a Radiological Control Technician (RCT) from Bartlett Nuclear Services, Inc. (Bartlett) be at the Yerington Mine Site to help implement the requirements of the RCECP. The Bartlett RCT performed detailed area and worker radiological surveys for a two week period between December 6 and December 17, 2004 and during another visit to the site January 12 – 14, 2005. A different Bartlett RCT performed additional area, personnel and equipment surveys and air monitoring during the time period of March 17 – April 1, 2005. Mr. Frank DeRosso, MSPH, CIH from RMEC provided project oversight and accompanied the Bartlett RCT during many of these monitoring activities. All monitoring equipment used by Bartlett was calibrated and source checked to ensure it was functioning properly. Calibration records, sampling procedures and sample calculations were independently checked and validated by a Certified Health Physicist (CHP) contracted by RMEC.

2.3.1 Area Radiological Surveys

Work areas where site investigation activities were taking place were surveyed for gamma radiation using a Bicron tissue-equivalent survey meter (December 2004 and January 2005) or a Ludlum Model 19 micro-R survey meter (March 2005). All other areas at the site that the BLM had marked as “Radiation Areas” were also surveyed using the Bicron or Ludlum survey meter. During these surveys, special attention was paid to colored soils and other anomalous conditions that were observed in the site. Both ground level and waist-high gamma radiation levels were measured with the Bicron and are reported as gamma radiation exposure rates in units of micro-rems or milli-rems per hour (µrem/hour or mrem/hour). The radiation levels measured with the Ludlum Model 19 are

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reported as gamma radiation exposure rates in units of micro-roentgen or milli-roentgen per hour (µR/hour or mR/hour).

For a more accurate measurement of the gamma radiation levels, optically stimulated luminescence dosimeters (OSLDs) were placed, chest high (approximately 3-feet), at site locations where real-time instrument surveys indicated elevated gamma radiation levels were present. Five OSLDs were placed on the site for approximately a one month period from December 15, 2004 to January 19, 2005. Another five OSLDs were placed in different locations at the site for the time period January 19 through February 28, 2005 and again at these same locations for the time period March 1 through March 19, 2005. A sixth OSLD was kept in the badge storage cabinet in the administrative offices as a control sample during each of the monitoring periods. The OSLDs were supplied and analyzed by Landauer, Inc.

2.3.2 Area and Personal Air Monitoring

Area air samples were collected at the site using an Eberline RAS-1 air sampler during December and March to assess the potential for worker inhalation of radiological contaminated dust. Area air samples were collected at various locations on the site during ambient conditions and when site activities such as drilling or excavating were being performed. A MSA Escort personal sampling pump was also used to collect samples from the breathing zones of personnel performing these site activities. In addition to this, an off site perimeter sample was also collected during the January visit.

The filters from the air samples were counted for alpha and beta/gamma radiation using a Ludlum 2929 Scaler and Model 43-10-1 Detector immediately after the air sampling and 12 – 24 hours after the sampling determine residual radioactivity levels associated with particulate on the filter. Selected filter samples were submitted to Energy Laboratories and analyzed isotopic for uranium, thorium, and radium in accordance with EPA method 907.

2.3.3 Equipment and Personnel Surveys

Equipment and personnel involved with various site activities were surveyed prior to leaving work areas to determine the level of surface radiological contamination. Surface and area surveys were also performed in the Mine Administration Building Frisking was performed with either a Ludlum Model 2224 Ratemeter equipped with a Ludlum 43-89 alpha/beta probe or a Ludlum Model 2360 Ratemeter equipped with a Ludlum 43-93 alpha /beta probe.

To assess the level of removable radiological surface contamination on equipment, swipe samples were collected from the surfaces of back hoes, drill units, fork lifts, personal vehicles and other equipment that were used for routine construction and sampling/investigation activities on the site. The swipe samples were collected with 47

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mm air sampler filters and counted using the Ludlum 2929 Scaler with a Model 43-10-1 Detector.

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3.0 RESULTS/DISCUSSION

3.1 APPLIED HYDROLOGY INTERNATIONAL

3.1.1 Area Radiological Surveys

The results of the gamma radiation monitoring performed by AHI during their maintenance activities at the Pumpback System are summarized in Table 1 below. Attachment A contains detailed monitoring results.

TABLE 1: Gamma Radiation Monitoring by Applied Hydrology Associates, October 2004 – January 2005

Sampling Locations	Average Survey Readings (µR/hour)	Range of Survey Readings (µR/hour)
All site wells	20	11 - 38
11 Pump back wells	22	11 - 38
26 Monitoring wells	20	10 - 36

To date, all gamma radiation measurements obtained at the well locations have been below 38 µR/hour, and well below the levels that would result in worker exposure above the ALARA goal of 500 mrem/year. While RMEC did not have the opportunity to directly observe AHI perform any survey measurements during their site activities, it appears that AHI instruments were properly calibrated and the data generated during their monitoring is consistent with survey data generated by Foxfire/SRK. Therefore, RMEC believes AHI has been performing proper and accurate measurements of gamma radiation levels in their work areas.

3.2 BROWN AND CALDWELL

3.2.1 Area Radiological Surveys

The results of the gamma radiation monitoring performed by Brown and Caldwell during their site investigation operations are summarized in the Table 2 on the following page. Attachment B contains a table of detailed monitoring results. The information in this table includes the sample number, site ID, sample ID, person who collected the sample, date and time of the sample, additional sample information (depth of core sample, water

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table depth, etc.) and the gamma and alpha radiation measurements from the work area, stock piled material, and sampled material, as appropriate.

TABLE 2: Gamma Radiation Monitoring by Brown and Caldwell, October 2004 – April 2005

Sampling Locations	Range of General Area Surveys Around Digging & Drilling Operations (µR/hour)
60 Underground utility and UST soil sample locations	14 - 140
3 Stained Soil Excavations	15 - 18
220 Drilling and coring soil and water sample locations	14 - 28

The vast majority of the drilling and excavating operational areas surveyed by Brown and Caldwell had general area gamma radiation levels in the 15 - 30 µR/hour range. Only six locations had waist-high gamma radiation levels at or greater than 50 µR/hour. They were located at sample site PA-DD5 (50 µR/hour), sample site PA-DD11 (50 µR/hour), sample site PA-EE8 (60 µR/hour), sample site PA-EE17 (65 µR/hour) and sample site PA-EE18 (50 µR/hour). The highest gamma radiation level measured in a work area occurred on November 5, 2004 at site ID #UT29. Gamma radiation levels at waist height in the dig area at this location were approximately 140 µR/hour. RMEC reviewed Brown and Caldwell's survey methodology and it to be consistent with standard practices. Brown and Caldwell's data also appeared to be consistent with other survey data collected at the site.

3.2.2 Personal Gamma Radiation Dosimetry

At the time of this monitoring report, five months of personal gamma radiation dosimetry data were available for Brown and Caldwell employees and Contractors. These data are summarized in Table 3 on the following page. Laboratory reports for the dosimeter analysis can be found in Attachment C.

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TABLE 3: Personal Dosimetry for Gamma Radiation Exposures Performed by Brown and Caldwell

Name/Description	Deep Dose Equivalent (mrem)	Eye Lens Dose Equivalent (mrem)	Shallow Dose Equivalent (mrem)
October 15 through November 14, 2004			
Control	<1	<1	<1
Site Worker #1	<1	<1	<1
Site Worker #2	<1	<1	<1
Site Worker #3	<1	<1	<1
Driller #1	<1	<1	<1
Driller #2	<1	<1	<1
November 15 through December 14, 2004			
Control	<1	<1	<1
Site Worker #1	<1	<1	<1
Site Worker #2	<1	<1	<1
Site Worker #3	<1	<1	<1
Driller #1	<1	<1	<1
Driller #2	<1	<1	<1
Driller #3	<1	<1	<1
Driller #4	<1	<1	<1
December 15, 2004 through January 14, 2005			
Control	<1	<1	<1
Site Worker #1	<1	<1	<1
Site Worker #2	<1	<1	<1
Site Worker #3	<1	<1	<1
Driller #1	<1	<1	<1
Driller #2	<1	<1	<1
Driller #3	<1	<1	<1
Driller #4	<1	<1	<1
January 15 through February 14, 2005			
Control	<1	<1	<1
Site Worker #1	1	<1	<1
Site Worker #2	1	<1	<1
Site Worker #3	<1	<1	<1
Driller #1	<1	<1	<1
Driller #2	1	<1	<1
Driller #3	<1	<1	<1
Driller #4	<1	<1	<1
Driller #5	<1	<1	<1
Driller #6	<1	<1	<1
Driller #7	2	1	<1

As can be seen in the tables, most gamma radiation external exposures were below the 1 mrem detection limit of the OSLD. These data indicate that workers performing site

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investigation tasks in the process are of the Yerington Mine received negligible gamma radiation exposures doses and were well within the established ALARA goal of 500 mrem/year.

3.3 RMEC/BARTLETT MONITORING

3.3.1 Area Radiological Surveys

Attachment D contains detailed reports of the radiological surveys performed in December 2004. Attachment E contains detailed reports of the radiological surveys performed in March 2005. The summaries include waist and ground level gamma radiation levels, maps, photographs, GPS coordinates and/or sample location points of the surveyed areas.

Only one of the areas surveyed at the site had gamma radiation levels greater than 0.20 mrem/hour and was considered to be a "radiological control area" per the criteria in the RCECP. This area was located adjacent to the iron launders in the process area of the mine. The results of the radiological monitoring performed in this area are included on Radiological Survey Map # YMS-2004-0003. This area of elevated radiation was previously identified in surveys performed by the Walker/BLM and was posted with a radiation warning sign. RMEC/Bartlett used traffic cones and warning tape to delineate the area near the iron launders where waist level gamma radiation levels exceeded 0.2 mrem/hour. Maximum gamma radiation levels in this area were 0.8 mrem/hour at waist level and 4.7 mrem/hour at ground level.

The radiological surveys performed by RMEC/Bartlett confirmed that other locations at the Yerington Mine Site, previously identified by Walker/BLM, had higher than background radiation levels; however, none of these areas had waist level radiation levels above 0.20 mrem/hour. Therefore, these areas were not considered to be "radiological control areas" per the definition in the RCECP.

In some of the areas with elevated gamma radiation levels, waist level readings were well below ground/contact readings. This indicated that small point sources of radionuclides were giving rise to the elevated gamma levels. In other areas, waist level gamma radiation levels were similar to ground/contact levels indicating a more widespread even distribution of radionuclides. General areas identified by RMEC/Bartlett to be above background gamma radiation levels are summarized in Table 4 on the following page.

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TABLE 4: Identified Areas of Elevated Gamma Radiation Levels at the Yerington Mine Site

Approximate GPS Coordinates	Survey Number (Appendix D)	Location/Description	Area Waist-Level Gamma Radiation Dose Rates (μrem/hour)
N 38.99712, W 119.20392	YER-2004-007	Solution tank area	20 - 120
N 38.99720, W 119.20005	YER-2004-002	Oil sludge pit area	20 - 40
N 39.00315, W 119.20050	YER-2004-006	Tailings pond area	40 - 110
N 38.99757, W 119.19717	N.A.*	Tailings pond area	33
N 38.99755, W 119.20329	YER-2004-003	Iron launders area	200 - 800
N 38.99903, W 119.20275	YER-2004-004	Surge pond area	30 - 145
N 39.00188, W 119.20346	N.A.*	Waste water pond area	23
N 39.01791, W 119.20912	N.A.*	Evaporation pond area	50

* Survey maps not produced for these locations. Gamma radiation dose rate data was obtained from area monitors.

Please note that the investigation was biased toward suspected or known areas of elevated radiation. The findings are not intended to represent a full evaluation of the Yerington Mine Site and only reflect the portion of the mine property that was actually surveyed during this effort.

3.3.2 Area Dosimetry Monitoring

As a result of the information obtained from the real-time surveys, the long term gamma radiation levels at select locations were measured with the OSLDs. The results from OSLDs are summarized in Table 5 on the following page. Laboratory reports are contained in Attachment C with the other OSLD data. Please note that these OSLDs were located near the hottest spots identified in previous surveys and, therefore, represent the "worst case" of the known radiological contamination areas.

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TABLE 5: Gamma Radiation Levels Measured Using Optically Stimulated Luminescence Dosimeters At Selected Areas of the Yerington Mine Site

Dosimeter # / GPS Coordinates	Location/Description	Average Radiation Level (mrem/hour)
December 15, 2004 – January 19, 2005		
Area Dosimeter #1 / N 38.99712, W 119.20392	Near piles of debris adjacent to the solution tanks in the process area of the mine	0.12
Area Dosimeter #2 / N 38.99755 W 119.20329	West of the iron launders in the process area of the mine, adjacent to the one identified "Radiological Control Area"	0.22
Area Dosimeter #3 / N 39.00315 W 119.20050	Tailings pond east of process area of the mine	0.14
Area Dosimeter #4 / N 38.99903 W 119.20275	Waste surge pond area north east of iron launders in the process area of the mine	0.17
Area Dosimeter #5 / N 38.99490 W 119.19962	Adjacent to and north of the Mine Administration Building	<0.001
January 19, 2005 – March 1, 2005		
Area Dosimeter #1 N 38.99730 W 119.20009	Oil sludge pit in process area of the mine	0.013
Area Dosimeter #2 N 38.99757 W 119.19717	Tailings pond area	0.051
Area Dosimeter #3 N 39.00188 W 119.20346	Near waste water pond area	0.023
Area Dosimeter #4 N 39.01791 W 119.20912	Evaporation pond area north end of site	0.033
Area Dosimeter #5 N 38.99490 W 119.19962	Adjacent to and north of the Mine Administration Building	<0.001

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3.3.3 Personal and Area Air Monitoring

Direct Alpha/Beta Radiation Counts

The direct alpha and beta radiation counts on the air sample filters are summarized in Table 6 below. Attachment F contains detailed reports of the area and personal air monitoring performed on the Yerington Mine Site.

TABLE 6: Alpha/Beta Activity on Air Filter Samples - 24+ Hours After Sample Collection, December 2004 – March 2005

Sampling Locations	Range of Alpha Activity (µCi/cc)	Range of Beta Activity (µCi/cc)
General Area Samples During Ambient Conditions	1.93E-14 – 4.69E-13	1.1E-12 - 3.12E-12
General Area Samples During Site Investigation or Construction Activities	1.69E-14 – 7.75E-13	3.7E-14 – 3.7E-12
Personal Lapel Samples	4.33E-13 - 1.8E-12	5.13E-13 - 5.8E-12

The air samples collected in December were counted within 30 minutes of collecting and again 24+ hours after collection. The initial alpha and beta activity on these filters decreased significantly with time indicating that radon decay products were likely responsible for the initial activity detected on the air sample filters.

The total alpha and beta activity on the air filter samples 24+ hours after they were collected from various site locations was generally low. However, without radionuclide-specific information, these activity levels cannot be compared to the Derived Air Concentrations (DACs) for the radioisotopes present in the soils at the Yerington Mine site (uranium 238, 235, &234, radium 228 & 226, and thorium 230 & 232). Therefore, several of the air samples were submitted for radionuclide analysis (discussed below).

Radionuclide Analysis

The results of the uranium/thorium/radium isotopic analyses performed on the selected air sample filters are summarized in Table 7. Detailed monitoring results and laboratory reports are contained in Attachment G.

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TABLE 7: Summary of Uranium/Thorium/Radium Isotopic Analyses of Air Samples

Sample Locations and Descriptions	Radionuclide	Measured Airborne Concentration (µCi/ml)	Range % DAC[1]
General area samples and personal lapel samples collected during routine site investigation and construction activities in the Process area and the Pump Back Well System area of the Yerington Mine	Uranium 234	ND	< 0.08 % to < 2.58 %
	Uranium 235	ND	< 0.08 % to < 2.58 %
	Uranium 238	ND	< 0.08 % to < 2.58 %
	Radium 226	ND to 9.74E-13	<0.01 % to 0.33 %
	Radium 228	ND	<0.003 % to- <0.03%
	Thorium 232	ND	< 3.16 %

[1] DAC = Derived Air Concentration. The values associated with the less than sign ("<") indicates that the isotope was not detected ("ND") and, therefore, the associated values are derived from the limit of detection. The Range% DAC is based on the limits established from the NEW 10 CFR Part 20 – Appendix B – Table 1 – Col.3.
Year for Uranium 234
Year for Uranium 235
Year for Uranium 238
Week for Radium 226
Week for Radium 228
Week for Thorium 232

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These data indicate that the levels of airborne radioisotopes in the work areas were typically below detection limits. Very low levels of Radium 226 were found in some work areas; however, the measured concentrations were only a small percentage of the Derived Air Concentration for Radium 226 and therefore do not present a significant inhalation hazard. Workers performing tasks in these areas did not receive significant internal radiation exposures through the inhalation of radiological contaminated particulate. Overall anticipated inhalation doses will be well within the ALARA goal of 500 mrem/year.

3.3.4 Equipment Surveys

Attachment H contains the radiological survey reports for the pieces of equipment that were frisked/surveyed at the site.

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TABLE 8: Summary of Equipment Survey and Swipe Sampling

Sample Description	Removable Alpha Contamination (dpm/100 cm^2)	Removable Beta/Gamma Contamination (dpm/100 cm^2)
Tires, undercarriage, buckets, steps, floorboards, control panels, bumpers, etc. on equipment used in site investigation and construction activities in the process and pumpback well areas of the mine site	<20	<100
Note: All swipe readings were less than 20 dpm/100 cm^2 alpha and less than 100 dpm/100 cm^2 beta/gamma **Note:** All direct readings were less than 10 ncpm/probe alpha and less than 100 ncpm/probe beta/gamma		

Acceptable surface radioactivity levels are detailed in Appendix D of 10 CFR part 835. Appendix D states that removable uranium and uranium decay product activity should be less than 1000 disintegrations per minute per 100 square centimeters of surface area (dpm/100 cm^2). Total uranium surface contamination (fixed + removable) should be less 5000 dpm/100 cm^2. For the transuranic radioisotopes (Ra-226, Ra-228, Th-230, etc.), the acceptable removable and total surface activity levels are 20 and 500 dpm/100 cm^2, respectively. For the thorium decay series, the acceptable removable and total surface activity levels are 200 and 1000 dpm/100 cm^2, respectively. For beta /gamma emitters, the acceptable removable and total surface activity levels are 1000 and 5000 dpm/100 cm^2, respectively.

All of the removable and non-removable residual surface radiation on pieces of equipment used during site investigation and construction activities in the Process and Pumpback Well areas of the Yerington Mine Site were well within accepted criteria for unrestricted release of the equipment.

3.3.5 Calibration /Source Check Records

Attachment I contains the instrument calibration records and source checks for all monitoring instruments used by Bartlett/RMEC at the Yerington Mine Site. All equipment used by RMEC/Bartlett during survey activities was properly calibrated and source-checked.

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4.0 CONLUSIONS AND RECOMMENDATIONS

The radiological surveys, air monitoring for radioisotopes and personal radiation dosimetry performed to date have shown that worker internal and external radiation exposures during routine site investigation activities have been negligible and well below the ALARA goal of 500 mrem/year. At this time, no additional engineering, administrative controls or personal protective equipment will be required to reduce radiation exposures for workers performing similar tasks in the surveyed areas of the mine site.

The surveys have indicated that isolated locations exist within the process area of the mine with elevated radiation levels. The elevated radiation levels are generally very low and appear to result from both point source and larger areas of soils and debris contaminated with naturally occurring radioactive materials (NORM) and technologically enhanced naturally occurring radioactive materials (TENORM). These areas have been marked with wooden stakes, warning tape and/or radiation warning signs. Only a small portion of the mine property was surveyed during this initial effort and other isolated areas of elevated radiation, both on the surface and sub-surface, may exist. Therefore, the specific procedures that have been implemented to minimize worker radiation exposures at the mine site should be continued when additional site investigation or construction activities are performed at the Yerington Mine Site.

Specifically, site personnel should continue to use survey instruments to screen work areas for elevated radiation levels as they perform tasks at the Yerington Mine. If work area radiation levels exceed the threshold levels for a “radiological control area”, as specified in the RCECP, all work in that area should be stopped until a RCT or another individual capable of assessing radiation exposures can be brought onto the site. The RCT will perform an independent survey of the work area and evaluate radiation exposures and implement the RCECP as necessary. In addition, contractors performing duties on site for extended periods (greater than one month) should be issued personal radiation dosimeters, which should be analyzed on a quarterly basis.

To ensure worker radiation exposures are kept below the ALARA and to ensure radiological contamination is not carried off of the site, RMEC recommends that no site investigation activities be performed in the one radiological control area established near the iron launders unless a RCT is on site to perform worker and equipment surveys. It may also be prudent to delay invasive site investigation activities, such as excavating or disturbing large volumes of soil, at other site locations where elevated radiation levels have been documented until a RCT or equivalent person can be assigned to the site to perform area radiological surveys, air monitoring and personnel and equipment screening during the activities. These locations include:

- Solution tank area. Approximate GPS coordinates N 38.99712, W 119.20392;
- Oil sludge pit area. Approximate GPS coordinates N 38.99730, W 119.20009;
- Tailings pond area. Approximate GPS coordinates 39.00315, W 119.20050;
- Tailings pond area. Approximate GPS coordinates 38.99757, W 119.19717;

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- Surge pond area. Approximate GPS coordinates N 38.99903, W 119.20275;
- Waste water pond area. Approximate GPS coordinates N 39.00188, W 119.20346
- Evaporation pond area. Approximate GPS coordinates N 39.01791, W 119.20912

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Attachment A – Applied Hydrology International Radiological Monitoring Data

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Attachment B – Brown and Caldwell Radiological Monitoring Data

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Attachment C –Area and Personal Dosimetry Laboratory Reports

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Attachment D – RMEC/Bartlett Area Radiological Surveys

December 2004

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Attachment E – RMEC/Bartlett Area Radiological Surveys

March 2005

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Attachment F– RMEC/Bartlett Area and Personal Air Monitoring Data

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Attachment G – RMEC/Bartlett Radionuclide Air Monitoring Results and Laboratory Analytical Reports

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Attachment H – RMEC/Bartlett Equipment and Building Surveys

December 2004 and March 2005

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Attachment I – RMEC/Bartlett Instrument Calibration Records and Source Checks