Radiation Protection Program
Bluewater Uranium Mill

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Presented by:

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RADIATION PROTECTION PROGRAM

1.0 GENERAL

The Atlantic Richfield Company (ARCO) is committed to radiation protection of workers, the general public and the environment. The Radiation Protection Program outlined in this document will be implemented to provide radiation protection to personnel, the general public, and the environment during reclamation of the Bluewater Uranium Mill Site (the Site). This program includes radiation safety organization and responsibilities, occupational health physics monitoring, exposure control measures, internal and external exposure protection, radiation safety training, radiation work permits, controlled area designation, and record keeping. This program complies with applicable requirements set forth in 10 CFR Part 19, 20 and 40 and 40 CFR Part 61 and ARCO's Uranium Byproduct Material License #SUA-147 (the License) issued by the United States Nuclear Regulatory Commission (NRC).

This revision to the Radiation Protection Program was done to make the radiation protection program commensurate with the scope and extent of the site activities. The mill buildings and process facilities have been decommissioned under the previous Radiation Protection Program with exposures to the workers and personnel below ten percent of the occupational dose equivalent limits. Prior to the implementation of this plan, the tailings will have been consolidated and covered with clean soil. The only remaining work is to demolish the last of the support facilities and dispose of the debris and to place the erosion protection cover on the covered disposal areas and tailings piles. The remaining support facilities currently meet the contamination limits for unconditional release and therefore, are not anticipated to pose a significant radiological risk to the workers or the environment.

This program will be implemented for the remaining portion of the reclamation activities. ARCO anticipates that additional post reclamation activities will be necessary prior to termination of the radioactive materials license. These include on-site surveillance and maintenance activities and perhaps environmental monitoring tasks. Since these tasks are expected to be nonintrusive, ARCO will not implement any of the requirements of this program for such activities The program will however be implemented for any such task where contact with concentrated byproduct material is anticipated.

1.1 As Low As Reasonably Achievable (ALARA) Policy

ARCO's policy is to maintain radiation exposure to workers and the general public to levels "As Low As Is Reasonably Achievable" (ALARA) from the maximum limits specified in 10 CFR Part 20. ARCO will implement its ALARA policy by training all workers for radiation safety, implementing Standard Operating

Procedures (SOPs), using appropriate control measures, Radiation Work Permits (RWPs), good housekeeping practices, administrative control limits, and radiation protection equipment as needed. These elements of the ALARA policy are integrated in this Radiation Protection Program to maintain the radiation exposure ALARA.

2.0 RADIATION SAFETY ORGANIZATION

ARCO employees, contractors and visitors to the Site will adhere to the Radiation Protection Program and the ALARA policy. All individuals involved with reclamation work or other related activities within the restricted area have responsibility for radiation safety. The radiation safety organization is depicted in the following chart:

ARCO
Project Manager/Representative

ARCO
Project Engineer

ARCO
Radiation Safety Officer

Construction Contractor
Project Manager

ARCO
Health Physics Staff
Lead Health Physics Technician
Health Physics Technicians

Radiological QA/QC

Workers

2.1 Responsibilities

All personnel, from management to workers, are responsible for radiation protection and implementation of ALARA policy. The Radiation Safety Officer (RSO) will have the primary responsibility for overseeing and implementing the Radiation Protection Program and ALARA policy. The specific responsibilities of the RSO are as follows:

- Implement and oversee the Radiation Protection Program, along with radiation safety procedures. Review the Radiation Protection Program and its implementation annually.
- Implement ALARA policy.
- Establish occupational health physics and radiological monitoring procedures for site activities.
- Review radiological monitoring data to evaluate exposures and assure that any radiation exposures are ALARA.

- Evaluate control measures with appropriate managers to maintain radiological exposures ALARA.

- Implement and maintain a dosimetry program.

- Control of excavation and removal of uranium byproduct contaminated material.

- Necessary radiological contamination surveys of equipment and materials released to the unrestricted area.

- Advise and instruct workers concerning performance of their radiation safety responsibilities.

- Observe Site activity to ensure compliance with the Radiation Protection Program and the ALARA policy.

- Assure that decontamination and release of equipment and material is in compliance with the Radiation Protection Program.

- Cease Site activity if there is a potential for inadvertent excessive radiation exposure to workers, the general public, or the environment.

- Maintain records of radiological monitoring and exposures.

- Provide the exposure and monitoring data to the appropriate regulatory agencies and the individual in accordance with applicable rules or regulations.

- Provide necessary radiation safety training to all individuals.

- Assure that all radiation survey instruments are properly calibrated and certified.

ARCO will utilize in-house Health Physics (HP) staff to implement and maintain the Radiation Protection Program. ARCO will provide the required qualified HP technicians to conduct necessary radiological monitoring and surveys for radiation protection. The HP technicians will also perform contamination surveys for equipment and material to be released to the unrestricted area where requ red.

ARCO will utilize contractors to perform reclamation activities at the Bluewater Mill Site. Contractor supervisory personnel have an important role in the radiation protection of personnel working under them. The supervisory personnel will be responsible for ensuring their subordinates are supplied with required

radiation training and personal protective equipment. They shall ensure that the personnel under their supervision will follow the rules and regulations of the Radiation Protection Program and ALARA policy. Supervisors are also responsible for knowing the radiation hazard conditions and the need for radiation personal protection equipment through necessary communications with HP staff. All individuals, including supervisors working in the restricted area, will be trained by ARCO for radiation hazards and radiation safety. The contractor's supervisors will immediately notify the RSO of any radiation safety violation or hazardous condition noticed by or reported to the contractors.

Each individual is responsible for understanding and adhering to the Radiation Protection Program and the ALARA policy. Workers will be required to understand, by training, the radiological conditions of the specific area of the Site to which they are assigned. Individuals shall stop working if situations or conditions arise that might adversely affect radiation exposures and must notify their supervisor and the RSO immediately for evaluation of the situation or condition prior to resuming work. Each individual will be required to report any condition that may lead to a violation of the Radiation Protection Program to their supervisor and the RSO. Workers will be advised of their rights under 10 CFR §19 such as instructions, notifications, reports and request for inspections.

Any violation of the Radiation Protection Program by any individual will result in disciplinary action.

3.0 RADIATION DOSE LIMITS

The decommissioning of the Bluewater Uranium Mill was completed in January 1991. ARCO is currently engaged in the final stages of reclamation of the Bluewater Mill Site, which involves demolition of support structures on the site, burial of the remaining debris in Disposal Area No. 1, and placing the erosion protection material on the covered mill tailings and other disposal areas. The radiological hazard from uranium byproducts is similar to that of uranium ore dust, consisting of uranium and its daughters. During reclamation activities, uranium byproducts presents a potential exposure due to internal radiation hazards from alpha emitting radionuclides (U-nat, Ra-226, Th-230, and Rn-222 progeny) and external radiation hazards from gamma emitting radionuclides (primarily Bi-214). Exposure from beta radiation from the uranium byproducts is insignificant because of the low concentrations of beta emitting radionuclides, and self- absorption of beta radiation in the uranium byproduct contaminated material.

3.1 Occupational Dose Limits

Consistent with 10 CFR §20.1201 (May 1991), the dose limits for occupational exposure to radiation at the Bluewater Mill Site are as follows:

a. The annual limit is the more limiting of:

1. The total effective dose equivalent equal to 5 rems;
2. The sum of the deep-dose equivalent and committed dose equivalent to any individual organ equal to 50 rems. (Bone surface is the highest exposed organ from the intake of uranium and decay products; the lungs are the highest exposed organ from the inhalation of insoluble uranium (yearly lung clearance class)

b. The annual limits to the lens of the eye and to the skin are:

1. An eye dose equivalent of 15 rems; and
2. A shallow-dose equivalent of 50 rems to the skin or to any extremity.

3.2 Occupational Dose Limits to Minors

The annual occupational dose limits for a minor (under the age of 18 years) is 10 percent of the annual dose limits for an adult as set forth in 10 CFR §20.1201. The RSO will review minors' work assignments to assure that any exposures are maintained ALARA.

3.3 Dose Limit to an Embryo/Fetus

The radiation dose limit to an embryo/fetus during entire pregnancy, due to occupational exposure of a declared pregnant woman, will be 0.5 rem (500 mrem), consistent with 10 CFR §20.1208. ARCO will inform all female workers to notify ARCO in writing of their pregnancy immediately upon knowledge or suspicion of pregnancy. The RSO will review work assignments of any declared pregnant woman to assure that the embryo/fetus dose does not exceed the 0.5 rem limit and is maintained ALARA.

3.4 Planned Special Exposures

Due to low levels of radioactivity associated with the uranium byproduct material, ARCO does not intend to authorize any planned special exposures at the Bluewater Mill Site. In the event circumstances warrant a planned special exposure, ARCO will authorize such exposures consistent with the requirements of 10 CFR §20.1206.

3.5 Summation of External and Internal Doses

It is highly unlikely that the summation of external and internal doses as specified in 10 CFR §20.1202 will be required at the Bluewater Uranium Mill because the doses from neither the external nor internal radiation exposures are likely to

exceed 10% of the limit specified in 10 CFR §20.1201. However, if sampling indicates that both the internal and external doses are likely to exceed 10% of the limit, one of the following two methods will be used to demonstrate compliance with the limits:

3.5.1 If it is determined that both the internal radiation dose from air sampling measurements, and the external radiation dose from TLDs, is likely to exceed 10 percent of the limit, the committed effective dose equivalent(CEDE) and Deep Dose Equivalent (DDE) will be summed consistent with 10 CFR §20.1202(a). This will demonstrate compliance with Total Effective Dose Equivalent (TEDE). The internal radiation dose will be calculated as described in section 4.1.2 and the external radiation dose will be assessed as described in section 5.1.

3.5.2 If routine air sampling and TLD results indicate that the dose from either internal or external radiation exposure could exceed 10% of the limit, the summation requirements of internal and external radiation doses under 10 CFR §20.1202(b) will be met. The sum of the deep dose equivalent (mrem, as determined by TLDs) divided by 5000 (mrem, TEDE) and the total number of Derived Air Concentration (DAC) hours for all radionuclides, as determined in section 4.1.1 herein, divided by 2,000 does not exceed one.

Since the summation method specified in section 3.5.1 determines the actual radiation dose, not just the exposure, ARCO may use this method to demonstrate compliance with the limit in lieu of the method presented in section 3.5.2.

3.6 Determination of Prior Occupational Dose

If any individual at the Bluewater Mill is likely to receive, in one year, an occupational dose in excess of 10% of the limit, ARCO will determine the individual's prior occupational dose as follows:

a. A determination will be made based on information on the nature and the amount of prior occupational dose disclosed in a signed statement from the individual or from the individual's most recent employer for work involving radiation exposure for the current year.

b. ARCO will attempt to obtain the records of life-time cumulative occupational radiation dose in the NRC Form 4 or an equivalent form , signed by the individual and countersigned by an appropriate representative of the most recent employer for any work involving radiation exposure.

3.7 Radiation Dose Limits for Individual Members of Public

The dose limits for individual members of the public from the reclamation activities at the Bluewater Mill Site will be consistent with 10 CFR §20.1301 as follows:

a. Total effective dose equivalent of 0.1 rem (100 mrem) per year to individual members of public; and

b. Maximum dose rate of 0.002 rem/hour in the unrestricted area from external radiation sources.

If any member of the public enters any controlled area, which is isolated outside the restricted area, the above dose limits will apply.

In addition to the above limits, ARCO will comply with EPA's applicable standards of 40 CFR §190 and 40 CFR §61 (NESHAPs).

3.7.1 Compliance with Dose Limits for Individual Members of the Public

ARCO will monitor airborne particulate radionuclides (U-nat, Ra-226, Th-230 and Pb-210) and ambient Rn-222 gas concentrations at the restricted area boundary during reclamation activities. The permanent air sampling stations are located, as defined in Condition 37 of the License, both upwind and downwind of tailings piles. The upwind sampling station, Berryhill House, will be used as the background station. The measurements made at the background station will be subtracted from downwind station measurements to demonstrate compliance with the limits specified in section 3.7 herein. The air will be sampled continuously for airborne radionuclide concentrations. The air particulate filters in the air samplers will be changed weekly and composited for quarterly analyses by an EPA-certified laboratory for a quarterly average of radionuclides concentrations. The continuous Rn-222 measurement will be made using track etch radon monitoring devices, which will be exchanged and analyzed quarterly for a quarterly average concentration. Also, direct gamma radiation measurements from environmental TLDs will be made for a quarterly exposure rate measurement at each station. The TLDs will be exchanged and analyzed quarterly.

ARCO will collect one annual composite soil and vegetation sample from each station. These samples will be analyzed for U-nat, Ra-226, Th-230 and Pb-210. No surface water is discharged at the Bluewater Mill Site.

ARCO will demonstrate compliance with dose limits for individual members of the public as specified in 10 CFR §20.1302(b). Following are the effluent concentration limits specified in Table 2, Column 1 of Appendix B.

U-nat: 9.0E-14 μCi/ml
Ra-226: 9.0E-13 μCi/ml
Th-230: 2.0E-14 μCi/ml
Pb-210: 6.0E-13 μCi/ml
Rn-222: 1.0E-08 μCi/ml*

* For Rn-222, the limit for the class "with daughters removed" (1.0E-8 μCi/ml) will be used because the track etch radon monitor is equipped with a filter that removes the daughters prior to the measurement.

4.0 INTERNAL RADIATION DOSE ASSESSMENT

The radionuclides of significance in the uranium decay series of the uranium byproducts which would result in committed dose equivalent are U-nat, Ra-226, Th-230, and Rn-222 progeny. If required, the internal radiation dose will be assessed in accordance with the section 4.1 below.

4.1 Calculations

ARCO will use airborne concentrations to assess either the occupational internal radiation exposure, or the dose, for demonstration of compliance with the limits of 10 CFR §20.

4.1.1 Internal Radiation Exposure from Inhalation

The internal radiation exposure in terms of Derived Air Concentration (DAC) hours for each radionuclide will be calculated as follow:

$$\text{DAC hrs.} = (C/DAC) \times h$$

where:
- C = area airborne concentration of radionuclide, μCi/ml
- DAC = DAC of radionuclide, appendix B, μCi/ml
- h = hours worked in the area, hrs

The DAC hours for all radionuclides will be summed to obtain total DAC hours.

4.1.2 Internal Radiation Dose from Inhalation

The committed dose equivalent (CDE) to any organ (bone surface and lungs) and committed effective dose equivalent (CEDE) will be calculated using the following equation:

Committed Dose, mrem = C x h x IR x f

where: C = area concentration, μCi/ml
h = hours worked in area
IR = inhalation rate, 1.2E+06 ml/hour
f = mrem/μCi, exposure to dose conversion factor

The exposure to dose conversion factor (f) for radionuclides from Table 2.1 of International Committee on Radiation Protection (ICRP), Publication 30 will be used. The most restrictive (conservative) factor (f) of the lung clearance class (D, W or Y) will be used for dose calculations.

Following are the factors (f), listed in ICRP 30, for CEDE for stochastic effect that will be used for calculations:

Ra-226 (W) = 8.58E+03 mrem/μCi
Th-230 (Y) = 3.26E+05 mrem/μCi
U-nat (Y) = 1.25E+05 mrem/μCi

There is no conversion factor listed in ICRP 30 for Rn-222 progeny. The CEDE will be calculated on the basis that the intake of one ALI (100 μCi) is equal to 5,000 mrem CEDE (10 CFR §20.1204(h)). The CEDE from all above radionuclides will be summed as total CEDE.

The most highly exposed organ from intake of insoluble uranium (tailings) is the lung and the bone surface from intake of Ra-226 and Th-230. The CDE to the bone surface from uranium, according to ICRP 30, is insignificant. The CDE to the bone surface from the inhalation of insoluble uranium is less than the CEDE. The factors (f) that will be used for calculation of CDE, non stochastic dose, to the bone surface from ICRP 30 are as follows:

Ra-226 (W) = 2.81E+04 mrem/μCi
Th-230 (Y) = 7.99E+06 mrem/μCi
U-nat (Y) = 1.04E+06 mrem/μCi

The CDE from Ra-226 and Th-230 for bone surface will be summed to demonstrate compliance with the organ limit.

4.2 Oral Ingestion, Inhalation, and Skin Absorption

Bioassay data for reclamation workers during previous phases of activity at the site indicated that there were few measurable uptakes of radionuclides. These measurable uptakes most likely arose from sample cross contamination since the personnel with measurable uptakes a) were either working in low contamination areas, b) were on-site for very short periods, c) were working in areas with others who did not show a measurable excretion of uranium, or d) the radionuclide concentrations were so low that a reasonable intake of radionuclides would have not resulted in a measurable level of uranium in the urine. During 1994, there were 843 urine bioassay samples collected. Only six of the samples were reported above the minimum detectable activity. None exceeded the 15 μg/cc investigative level or the 30 μg/cc work restriction level. This was to be expected due to the low concentrations of radioactivity in the materials that were handled.

More than 2500 air samples were taken in the work areas from 1992 through 1994 where the yearly average concentration was less than four percent of the derived air concentration for the most limiting radionuclide. This clearly shows that even during the handling of the tailings material, the airborne concentrations were maintained to very low levels.

Now that the tailings have been consolidated and covered with clean soil, ARCO considers that there is no potential for measurable oral ingestion or skin contamination associated with working at the Bluewater Site since workers will not come into contact with materials contaminated above unrestricted release criteria. Therefore all radiation control measures including access control, frisking, emergency wash stations, personal protective equipment, showers, and the urine bioassay program are not required.

4.2.1 Surveys and Monitoring for Internal Radiation Exposure

The internal radiation exposure will be assessed based on a monthly air sample taken in the work area and the exposure time of each worker as obtained from the worker's work-area record.

If the exposure to airborne concentrations exceeds ten percent of the 2,000 DAC-hours limit, the internal dose will be calculated for all workers and summed with the external dose equivalent. Otherwise, it will be documented that the maximally exposed individual received less than 10 per cent of the internal dose limits and the internal contribution to the TEDE will not be assessed for each worker.

As stated in Section 3.5, the internal radiation dose is not likely to exceed 10 percent of the limit in 10 CFR §20.1201(1) especially since all work

related to tailings and process residues has been completed and the work will be done outdoors. However, during periods of time when reclamation work is being done, ARCO will perform area sampling for airborne gross alpha activity from uranium and its daughters (U-nat, Ra-226, and Th-230).

The DAC for a mixture of radionuclides consisting of uranium and its daughters in ore dust, as specified in 10 CFR 20, Appendix B, is 3.0E-11 μCi/ml of gross alpha activity from uranium and its daughters (U-234, U-238, Th-230 and Ra-226). This is based on uranium and its daughters being in equilibrium in the ore dust. However, the activity ratio of U-nat, Th-230 and Ra-226 is different in the uranium byproduct material, due to uranium recovery from ore by milling processes which also alters the solubility of thorium and radium. For these reasons, the DAC value for uranium ore dust may not be used for radiation protection purposes during mill tailings reclamation.

The gross alpha activity in the uranium decay chain is made up of alpha activity from U-nat (U-234 and U-238), Th-230, Ra-226, Rn-222, Po-218, Po-214 and Po-210. For Rn-222, Po-218 and Po-214, there is no DAC listed in Appendix B or exposure to dose conversion factor in ICRP 30. The DAC for Po-210 is 3.0E-10 μCi/ml, similar to Ra-226, which is the highest of three longest lived alpha emitters (U-nat, Th-230 and Ra-226) of the decay chain. For this reason, an approach for radiation protection in which one assumes that all of the airborne gross alpha activity from reclamation activities is from only U-nat, Th-230 and Ra-226 is conservative.

Individual airborne concentrations for U-nat, Th-230 and Ra-226 will be determined. It is not practical in the field to perform isotopic analyses for U-nat, Ra-226, and Th-230 on the routine occupational airborne particulate sample filter. The airborne concentration of U-nat, Ra-226 and Th-230 can be determined from their activity fraction of the gross alpha activity of material which has the potential for becoming airborne.
A composite soil sample was collected from each tailings reclamation activity work area. The soil samples were analyzed for U-nat, Ra-226 and Th-230. The gross alpha activity was calculated by summing U-nat, Th-230 and Ra-226 activities. The individual radionuclide activity fraction of the gross alpha activity for each area sampled was determined. Since the only known surface contamination that exists at the site is the low concentrations

of radioactivity in surface soils in the general area, the mixture of radionuclides in that area will be used for dose calculations. The measured radionuclide mix for the general area is given below:

Sample Area	U-nat	Ra-226	Th-230
General Area	0.29	0.35	0.36

The airborne concentration of the radionuclide (U-nat, Ra-226, and Th-230) will be determined by multiplying the activity fraction of that radionuclide by the airborne gross alpha activity.

The individual DAC for uranium and its daughters, as specified in Table 1, Column 3 of Appendix B, is listed below:

U-nat	2.0E-11 μCi/ml
Ra-226	3.0E-10 μCi/ml
Th-230	3.0E-12 μCi/ml

The gross alpha activity that will be equivalent to DAC of a radionuclide is calculated by dividing DAC of the radionuclide by the activity fraction of that radionuclide. Following is the limiting airborne gross alpha activity for each radionuclide in the General Area:

Work Area	U-nat μCi/ml	Ra-226 μCi/ml	Th-230 μCi/ml
General Area	6.9E-10	8.6E-10	8.3E-12

The DAC for gross alpha activity that is equivalent to the most limiting DAC of an individual radionuclide in an area will be used for action levels for radiation protection, and determining if the monitoring for 10 CFR §20.1502 is required. If the RSO determines that there is a potential for airborne gross alpha activity to exceed 10 percent of this DAC for gross alpha activity, an individual of the group having the potential for the greatest exposure in the work area will be equipped with a personal air sampler. Airborne concentration measurements by the personal air sample will be used for exposure determination of the individuals in that area.

4.2.2 Bioassay

The bioassay program will be discontinued during this last phase of the Bluewater Mill Reclamation.

4.2.3 Exposure Control

Clean lunch areas will be maintained and monitored on a monthly basis while work is being conducted. No dust control measures specific for radiological control will be required. Prohibition of workers eating, drinking, smoking, and chewing in the work areas will be maintained.

4.2.4 Administrative Control Limits

To be consistent with the ALARA policy and to prevent any inadvertent overexposure, ARCO's administrative control limit for airborne radioactive material is established at 10% of the DACs specified in Section 4.2.1. This control limit will be used as an action level to implement any necessary control measures to maintain airborne concentrations ALARA.

5.0 EXTERNAL RADIATION DOSE

Uranium byproduct material poses a potential for a deep dose from exposure to external radiation sources from gamma emitting radionuclides of the uranium decay chain, primarily Bi-214 and Pb-214. The shallow dose (skin dose) from exposure to beta radiation from uranium byproduct material is insignificant because of low concentrations of beta emitting radionuclides, and absorption of beta radiation in the uranium byproduct material.

The Phase I tailings reclamation activities began in 1991 and involved consolidation of mill uranium byproducts by 1) covering the slimes portion of the main tailings impoundment with contaminated material, and 2) excavation of evaporation pond material and windblown tailings contaminated soil and placing them in the main tailings

impoundment. During the reclamation activities each worker was monitored for external radiation exposure (deep and shallow skin dose) by using individual thermoluminescent dosimeters (TLD). The highest whole body deep dose and shallow dose to any individual in 1991 was 90 mrem and 109 mrem respectively. Work continued in 1992, 1993, and 1994 whereby tailings and other byproduct material were handled. The highest TLD annual penetrating dose recorded was 55, 55, and 34 (9 months) mrem for 1992, 1993, and 1994. This is significantly less than 10 percent of annual limits specified in 10 CFR §20.1201(a) (5000 mrem).

5.1 Monitoring for External Exposure

All individuals, including workers, vendors and visitors in the restricted area will be monitored for exposure to external radiation. All individuals working in the restricted area will wear a personal TLD. At least one individual of any group of visitors to the Site who enter the restricted area will be equipped with either a personal TLD or self-reading pocket dosimeter. Following are the procedures for the personal TLD:

- The TLDs and pocket dosimeters will be issued at the beginning and returned at the end of each work shift at the access control point.

- All personal TLDs will be worn in the proper place as instructed by the RSO.

- The personal TLDs will be exchanged and analyzed quarterly. The pocket dosimeters, issued primarily to visitors, will be read after each visit.

- All exposures will be determined and recorded from the analyses of TLDs and will be used to demonstrate compliance. In the event an individual loses the personal TLD, the RSO will investigate the potential exposure conditions of the work area to estimate the external exposure for the period in which the TLD was lost.

- All individuals will notify their supervisor and the RSO if they lose their TLD. A thorough investigation will be made to obtain the true exposure or the TLD. The individual will immediately be assigned a new TLD badge if the TLD can not be found.

5.2 External Dose from Airborne Radioactive Material

Even though the external radiation dose is unlikely to exceed 10 percent of the limit in 10 CFR §20.1201(a), ARCO will utilize individual TLDs to monitor deep and shallow doses.

After cover has been applied to all tailings, the gamma exposure rates will be documented at the site. These levels are expected to be near background and not affected by future work activities. Therefore no additional gamma radiation surveys will be done unless specifically requested by the RSO.

5.3 Exposure Control

In order to be consistent with the ALARA policy and to control radiation exposures, ARCO will periodically review TLD results to assure that radiation doses from external sources are being maintained as low as reasonably achievable. The administrative control limit for external exposure is set at 25% of the limit specified in 10 CFR §20.

Uranium byproduct is a low level radioactive material. There is no area or source at the Bluewater Mill Site where the exposure rate is high enough that an individual will receive a dose equivalent of 0.1 rem (100 mrem) in one hour at 30 cm from the radiation source. Therefore, there is no high radiation or very high radiation area at the Bluewater Mill Site.

No personnel access control for radiological protection purposes will be required since significant sources of radiation exposure have been attenuated through consolidation and the application of soil cover.

6.0 EXPOSURE INVESTIGATION

When estimated external exposures are above the maximum limits of 10 CFR §20, an investigation will be conducted. This investigation will include a radiation survey of the area and immediate analysis of the personal TLD. Should an individual whose exposure is under investigation lose the TLD, this individual will be removed from the work area until the investigation is complete.

7.0 RADIATION SAFETY TRAINING

10 CFR §19.12 specifies that: All individuals working in or frequenting any portion of a restricted area shall be kept informed of the storage, transfer or use of radioactive materials or of radiation in such portions of the restricted area; shall be instructed in the health protection problems associated with exposure to such radioactive materials or radiation, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed; shall be instructed in, and instructed to observe, to the extent within the worker's control, the applicable provisions of NRC's regulations and licenses for the protection of personnel from exposures to radiation or radioactive materials occurring in such areas; shall be instructed of their responsibility to report promptly to the licensee any condition which may lead to or cause a violation of NRC's regulations and licenses or unnecessary exposure to radiation or to radioactive material; shall be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material; and shall be advised as to the radiation exposure reports which workers may request pursuant to 10 CFR §19.13. The extent of these instructions shall be commensurate with potential radiological health protection problems in the restricted area.

7.1 Implementation

The Radiation Protection Program is effective if each individual is aware of radiation hazards. While the potential exposure to significant radiation sources and radioactive materials is minimal, ARCO will conduct a training program to all employees, providing them with the information necessary for assessing the degree

of potential hazards as well as for reducing their radiation exposures to as low as reasonably achievable levels. All individuals will be trained based on their work assignments. The following topics will be included in the radiation safety training:

1. Fundamentals of Health Protection

2. Radiation Protection and Personal Hygiene

3. Health Physics Monitoring

4. Radiation Protection Regulations

5. Emergency Procedures

All individuals will be tested for comprehension of radiation safety training by a written test and must pass the test in order to work in the restricted area. Individuals must sign an acknowledgement that they have received the radiation training and will comply with the Radiation Protection Program and ALARA policy.

8.0 RADIATION WORK PERMIT

In accordance with Condition 21 of the License, if there is a potential for significant exposure to radiation during non-routine activities within the restricted area for which no SOP exists, the work will be conducted under a RWP. RWPs control radiation exposure by radiological protection and monitoring to maintain radiation exposures ALARA. A RWP will be requested by the individual responsible for the activity to be performed, and will be authorized and approved by the RSO. The RSO will assure that any activity that requires an RWP is not performed until an RWP is obtained. Individuals involved with the activity will be given specific instructions for that activity so that they will be aware of the hazards and understand the use of special radiation protection equipment. The radiological data from prior activity and other operational surveys will be used for preparing the RWP. The RWP will include the location and description of activity, names of the individual requesting the RWP and all individuals involved, radiological protection equipment, special monitoring, special instructions, date

of issue and expiration, radiation surveys and levels, and approval of the RSO. The format of the RWP is shown in attachment #1. Only the RSO can terminate the RWP prior to the expiration date and only after determination that the radiological levels are below the control limits and are stable. The area where the activity is conducted under the RWP will be designated as a controlled area and may be isolated within the restricted area. Access will be limited to those individuals who are trained in and involved with the activity work in order to control exposures and minimize the spread of radiological contamination.

ARCO does not anticipate developing any RWPs during this last stage of reclamation work at the Bluewater Site.

9.0 RESTRICTED AREA

The fenced part of the Site which contains the general mill area, tailings impoundments, evaporation ponds, and windblown contaminated area, is designated as the "Restricted Area". The boundary of the restricted area will be posted with signs that read "Caution, Radioactive Material" in appropriate colors. All entrances to the restricted area will be posted in accordance with 10 CFR §20 or with a sign that reads "Any Area Within This Mill May Contain Radioactive Material." All individuals working in the restricted area will be trained for radiation safety. All workers will be required to wear TLDs in the restricted area. Eating, drinking, smoking and chewing will not be allowed in the restricted area, with the only exception being in the designated clean areas. Personnel frisking monitoring stations will be maintained for employees to frisk themselves at the end of the work shift or at other times deemed advisable by the RSO. Unless information is obtained where the RSO believes that frisking is essential, no records will be maintained on employee frisking.

9.1 Designated Controlled Areas

Controlled areas are established to limit radiation exposures to visitors and the general public. The designation of an area and associated posting, barriers, and necessary precautions will be established, changed or removed by the RSO. A controlled area may be established outside the restricted area if a radiation hazard exists. Access will also be controlled in any controlled area outside the restricted

area and the occupational dose limit in this area will be the same as the limit for members of the public.

9.2 Radiation Areas

There are no radiation areas at the Bluewater Mill Site.

9.3 Airborne Radioactivity Areas

Data on past operations at the site, the fact that all tailings have been consolidated and covered, and the consideration that all work is outdoors suggest that there is little potential for elevated airborne radioactivity in the work areas at the Bluewater Mill Site. Monthly air samples will be taken in the work area to assure that levels are near background levels. Levels will be compared to the regulatory limits and if they exceed the potential exposure of 12 DAC hours in one week, engineering controls will be used to reduce the concentrations to levels so that the work can be done without respiratory protection.

Since there have been no situations during the previous remedial activities (1990-1994) where respiratory protection was required, it is inconceivable that respiratory protection could be justified for the remaining reclamation activities. Therefore ARCO will rely on engineering controls, if necessary, to reduce the airborne radionuclide concentrations rather than maintain a respiratory program.

9.4 Clean Area

Any area where the radioactivity level is not high enough to require radiation protection may be designated and posted as a "Clean Area." The clean area will not exceed the surface contamination levels of 5,000 dpm/100 cm^2 averaged over one square meter, with a maximum level of 15,000 dpm/100 cm^2, not to exceed 100 cm^2 area for total alpha, and 1,000 dpm/100 cm^2 of removable alpha contamination. If any location within the restricted area meets the clean area criteria, that area may be designated as a clean area by the RSO. The contamination levels in clean areas will be maintained ALARA. Eating, drinking,

smoking and chewing will be permitted only in designated clean areas. Designated clean areas, within the restricted area, will be monitored monthly for radiological contamination. The ALARA clean up action level for clean areas is established at 100 dpm/100 cm^2 of removable alpha contamination. Each worker will be informed of clean areas during radiation safety training.

10.0 CONTAMINATED AREA REMEDIATION

The final stage of Bluewater Mill reclamation activities will include the demolition and disposal of the support facilities (Main and South Office Buildings, garage, and the change house). The handling of the building debris is not expected to create a potential airborne radiological hazard or an exposure rate hazard from direct radiation. Radiological surveys conducted on the interior of the buildings indicate that all surfaces meet the surface contamination limits for unrestricted release. Gamma-ray exposure rates are near background levels.

11.0 BYPRODUCT WASTE DISPOSAL

Material to be disposed of on the site includes building debris from the demolition of the support facilities and containerized byproduct. The building debris will be placed in Disposal Area No. 1 according to the Decommissioning Plan. A special cell will be constructed within Disposal Area No. 1 for placement of the containerized byproduct material.

Any off-site disposal of the licensed byproduct waste will be in accordance with 10 CFR §20.2001, 2002, 2004 and 2006.

Any material which was not a part of Mill processing, was not in contact with uranium byproduct material, or did not have any potential for byproduct contamination will be considered radiologically clean. Examples of this type of material are unused paints, solvents, reagents, and laboratory chemicals. The origin and type of this material will be documented by the individual collecting such a waste to assure that there was no potential for radiological contamination. Measurements of surface contamination and

beta-gamma radiation levels will be made on any containers in which this material may be shipped for off-site treatment, storage or disposal as a precaution.

12.0 RELEASE OF EQUIPMENT AND MATERIAL

The release of equipment and material to the unrestricted area will comply with Condition 11 of the License and Attachment 1 to the License "Guidelines for Decontamination of Facilities and Equipment Prior to Release For Unrestricted Use or Termination of Licenses for Byproduct or Source Materials." All materials and equipment used for work in the restricted area prior to the placement of a minimum of a six-inch thick radon barrier over the mill tailings will be presumed contaminated, unless the surface contamination levels meet the criteria for release to the unrestricted area. Equipment taken into the restricted area after the placement of the mill tailings radon barrier will be considered clean and will not be monitored prior to release.

13.0 SECURITY

Currently, there are no significant radiological hazards at the site nor would it be practical to take byproduct material from the site for possible use elsewhere. Therefore twenty-four hour security at the site is not necessary, However ARCO will maintain access control to prevent unauthorized personnel from entering the site.

A haul road to the Homestake Rock Quarry will be constructed to haul the rock for use as an erosion protection cover. During normal work days, the gate to the restricted area will remain open at the point of entry. The gate will, however, be closed during periods of time when the rock is not being hauled.

14.0 RELEASE OF RADIOACTIVE MATERIAL INTO SANITARY SEWER SYSTEM

The sanitary sewage from the offices in the unrestricted area and the change house is discharged into the sanitary sewer system. The sewer system consists of two septic tanks (3000 gallons total) and a leach field, which is located in the unrestricted area. The workers use the change house facility for showering and other personal hygiene. Worker's clothing (i.e., coveralls) is also laundered in the change house. The extent of

any radiological contamination from these personal hygiene activities is low, as determined from previous sampling of sewage discharge. ARCO will continue monitoring the sewage discharge to demonstrate compliance with 10 CFR §20.2003. The following limits for the release of uranium byproducts into the sanitary sewer system are specified in Appendix B.

U-nat	3.0E-06 μCi/ml
Ra-226	6.0E-07 μCi/ml
Th-230	1.0E-06 μCi/ml

A monthly grab sample of the discharge into the sewer system will be collected and analyzed for gross alpha activity. If the gross alpha activity is less than 6.0E-07 μCi/ml, the discharge into the sewer system will be in compliance with 10 CFR §20.2003, since the most restrictive limit is 6.0E-07 μCi/ml (for Ra-226). If the gross alpha activity exceeds 6.0E-7 μCi/ml, appropriate isotopic analyses for U-nat, Th-230, and Ra-226 will be performed to demonstrate compliance. If the concentrations of either U-nat, Ra-226, or Th-230 exceed the applicable limit, the discharge into the sewer system will cease immediately, and an acceptable alternate discharge will be established, such as discharge of wash and shower water into lined evaporation ponds. After the buildings have been demolished, no additional sampling will done.

15.0 DISPOSAL OF EXPENDABLE MATERIAL AND TRASH

All expendable material, such as disposable coveralls, gloves, towels, etc., generated within the restricted area, radiological laboratory and the soils laboratory will be placed in disposal areas at the Site in accordance with the Reclamation Plan. All other material will be disposed of at an approved off-site solid waste land fill.

16.0 SHIPPING AND RECEIVING RADIOACTIVE MATERIAL PACKAGES

At the Bluewater Mill, no packages are expected to be shipped or received that would exceed the Type A quantity specified in 10 CFR §71(a). The only Type A material expected to be shipped is ARCO's nuclear soil density gauge device (used for soils compaction testing).

16.1 Receiving Radioactive Material

ARCO will monitor the external surface of a package for radioactive contamination and beta-gamma radiation levels if the package is labeled as radioactive material, or is known to contain radioactive material and there is evidence of leakage or damage to the package. In addition to monitoring, all applicable provisions of 10 CFR §20.1906 (c),(d),(e) and (f) will be complied with.

16.2 Shipping of Radioactive Material

At the Bluewater Mill, no packages are expected to be shipped that would exceed the Type A quantity of 10 CFR §71 (a). The only Type A material likely to be shipped is ARCO's nuclear soil density gauge device (used for soils compaction testing).

All shipments of radioactive material will be in accordance with applicable requirements of 10 CFR §71 and 40 CFR §173.

17.0 HEALTH PHYSICS MONITORING PROCEDURES AND CALIBRATION

All procedures used by ARCO's Health Physics staff for radiation surveys and health physics monitoring will be approved by ARCO and will meet the Lower Limits of Detection (LLDs) requirements and quality assurance program as defined in the NRC Regulatory Guide 8.30, "Health Physics Surveys in Uranium Mills," and Reg. Guide 4.15, "Quality Assurance for Radiological Monitoring." Radiological field and laboratory analysis equipment will be calibrated using National Institute of Standards and Technology traceable standards. Frequency of calibration will be on a semi-annual basis by qualified personnel and using approved procedures. A background and function check will be made on each radiological instrument for each day it is used.

18.0 RECORDS AND REPORTS

Records of radiological monitoring, surveys, exposures, calibrations, reports, inspections, training, investigations, corrective actions, and records of reports will be maintained.

The following is a list the specific records and reports that will be maintained when applicable:

- 10 CFR §19.12 — Instruction to Worker (Radiation Safety Training)
- 10 CFR §19.13 — Reports to Individuals
- 10 CFR §20.2102 — Records of Radiation Protection Program
- 10 CFR §20.2103 — Records of Survey and Radiation Monitoring
- 10 CFR §20.2105 — Records of any Planned Special Exposures
- 10 CFR §20.2106 — Records of any Individual Monitoring
- 10 CFR §20.2107 — Records of Dose to Individual Member of the Public
- 10 CFR §20.2108 — Records of Waste Disposal
- 10 CFR §20.2202 — Notification of Incidents
- 10 CFR §20.2203 — Reports of Exposure, Radiation Levels and Concentrations of Radioactive Material Exceeding the Limits
- 10 CFR §20.2204 — Reports of any Planned Special Exposures