Health and Safety Plan

Former Schwartzwalder Mine Water Treatment Plant

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Prepared for:

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1.0 INTRODUCTION

This Health and Safety Plan (HSP) has been developed to provide site-specific health and safety guidance for work conducted at the Schwartzwalder Water Treatment Plant (SWTP) located in Golden, Colorado (Site). The purpose of this HSP is to identify potential hazards associated with site activities, establish procedures to mitigate those hazards, and define roles and responsibilities to protect the health and safety of all personnel on site. It serves as a working document to ensure compliance with applicable health and safety regulations and to promote a safe work environment throughout the duration of the project.

This HSP supplements Linkan's 2025 Health and Safety Manual (**Appendix A**) with site-specific material for this site and project. The Health and Safety Manual has been reviewed by a Certified Industrial Hygienist and this Supplement meets all the recommended modifications to assure compliance for this site and project.

2.0 ORGANIZATIONAL STRUCTURE

The operation of the SWTP is organized according to the following Organizational Chart (Figure 1):

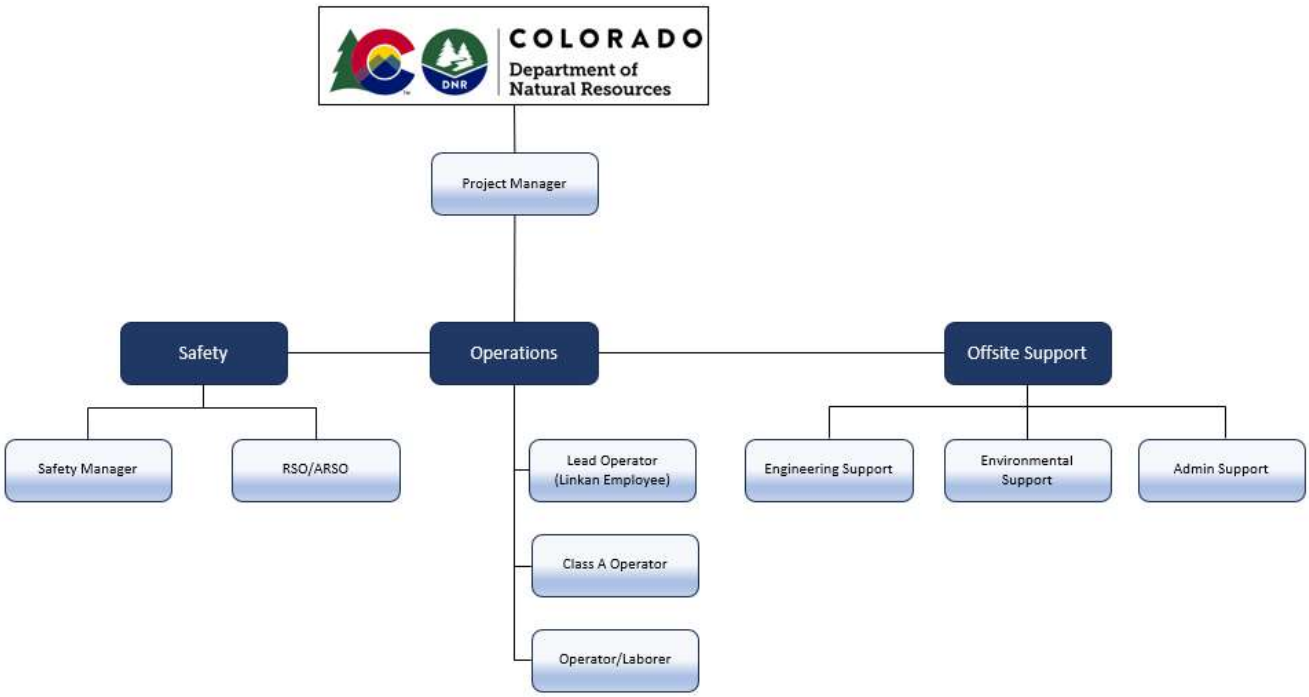

Figure 1 SWTP Organizational Chart

2.1. Project Manager

The Linkan Project Manager (PM) is the overall authority on the project and has the responsibility and authority to direct all operations and decisions pertaining to the project at the SWTP.

The PM will have overall responsibility for ensuring that the project meets applicable DRMS, and CDPHE requirements, site specific data quality objectives (DQOs), and Site project requirements. In addition, the PM or their designated employee will be responsible for technical QC and project oversight. The PM will be responsible for the generation of project planning documents, procedures, and policies, and for ensuring that these plans, policies, and procedures are successfully implemented in the field.

2.2. Safety Manager

The Linkan Safety Manager is responsible for implementing the site-specific Health and Safety Plan and ensuring compliance with OSHA regulations, including 29 CFR 1910.120. The Safety Manager has the authority to manage all aspects of site health and safety, conduct safety briefings and audits, initiate incident investigations, and interface with emergency services as needed. The safety manager ensures that all the relevant safety information is disseminated and understood amongst the site personnel including information in this HSP, the QAPP, the SAP and all other safety documentation and in accordance with Linkan overall Health and Safety Plan.

2.3. Radiation Safety Officer (RSO) / Alternative Radiation Safety Officer (ARSO)

The Radiation Safety Officer (RSO) / Alternate Radiation Safety Officer (ARSO) is responsible for ensuring compliance with all applicable radiation safety requirements, including those outlined in the project's Radioactive Materials License(s), as well as regulations established by the Occupational Safety and Health Administration (OSHA), the U.S. Nuclear Regulatory Commission (NRC), the Colorado Department of Public Health and Environment (CDPHE), and all relevant company policies and procedures. The RSO/ARSO oversees the safe handling, use, and storage of radioactive materials and is responsible for maintaining employee exposure to radioactivity as low as reasonably achievable (ALARA). In addition, the RSO/ARSO conducts radiation surveys, exposure assessments, and monitoring activities as required by the QAPP, RPP and regulatory guidelines. The RSO/ARSO also ensures that project personnel receive appropriate radiation safety training and use personal protective equipment and dosimetry correctly. Any incidents involving potential radiation exposure or contamination are thoroughly investigated and reported in accordance with regulatory requirements and internal protocols.

2.4. Lead Operator

The Lead Operator will be responsible for the overall coordination of operational activities at the site and ensuring that all procedures are properly implemented. This individual oversees daily operations, supervises sampling activities, and ensures that all collected data meets quality standards. The Lead Operator serves as the primary point of contact for any operational quality control issues and communicates regularly with the PM. Additionally, the Lead Operator ensures that all team members are adequately trained, understand their responsibilities, and follow established standard operating procedures (SOPs) and safety protocols.

2.5. Class A Operator

The Class A operator is a senior, certified operator who supports the Lead Operator and is authorized to make key operational decisions in their absence. This individual is responsible for monitoring system performance, optimizing treatment processes, and ensuring that regulatory and quality objectives are met. The Class A Operator oversees the proper calibration, use, and maintenance of monitoring equipment and provides technical oversight to junior operators. They are also responsible for identifying and documenting any deviations from normal operating conditions or quality control procedures and implementing corrective actions as needed.

2.6. Operator

The Operator is responsible for executing routine operational tasks in accordance with the established procedures. These tasks include monitoring equipment, recording system parameters, making process adjustments, and assisting with field sampling activities. Operators are required to complete field logs and data sheets accurately and report any operational or equipment issues to supervisory personnel. They are expected to follow all site-specific safety, quality assurance, and radiation protection protocols at all times.

2.7. Offsite Engineering Support

Offsite Engineering Support provides technical assistance to the onsite team by addressing operational challenges and supporting engineering-related issues as they arise. This role involves reviewing system performance data, assisting with troubleshooting and optimization of treatment processes, and offering recommendations for process improvements or modifications. Offsite engineering personnel may also support equipment evaluations, design modifications, and response planning for operational upsets. Their expertise helps ensure the system operates efficiently, safely, and in accordance with project objectives and regulatory requirements.

2.8. Offsite Environmental Support

Offsite Environmental Support is responsible for reviewing laboratory and field analytical data to ensure it meets project-specific quality objectives and complies with applicable regulatory standards. This person evaluates sampling results, identifies trends or anomalies, and supports the interpretation of data in relation to treatment performance and environmental compliance. The Offsite Environmental Support role also assists in verifying that QA/QC procedures have been properly followed and ensures that any potential exceedances or issues are promptly communicated to the on-site team. This support helps maintain data integrity and provides an additional layer of quality oversight for the project.

2.9. Lines of Authority, Responsibility and Communication

In accordance with 29 CFR 1910.120(b)(2)(i)(D), clear lines of authority, responsibility, and communication are established to ensure effective coordination of health and safety on site. The Project Manager holds overall authority for site operations and decision-making. Reporting to the Project Manager is the Lead Operator, who supervises daily field activities and directs the Class A Operator and Operator in the execution of work tasks. The Class A operator assumes emergency response duties in the absence of the Project Manager and the Lead Operator.

The Safety Manager has full authority over general health and safety matters. The RSO/ARSP hold authority specific to radiation safety. They oversee compliance with radiation protection protocols and may also suspend work involving radioactive materials if unsafe conditions are identified. All personnel have the authority to stop work if conditions present an imminent danger or violate safety procedures.

Regular communication is maintained through daily briefings, safety meetings, and direct supervisor interaction to ensure that health and safety responsibilities are clearly understood and properly executed across all roles.

3.0 COMPREHENSIVE WORK PLAN

This Comprehensive Workplan outlines the anticipated activities, operational procedures, personnel responsibilities, and systems to ensure safe and compliant work at the Schwartzwalder Mine Water Treatment Plant (SWTP). Developed in alignment with OSHA's Hazardous Waste Operations and Emergency Response Standard (HAZWOPER), this plan addresses the required elements of 29 CFR 1910.120(b)(3), including site operations, personnel implementation, training, hazard communication, and medical surveillance.

3.1. Anticipated Clean-up Activities and Normal Operating Procedures

This section outlines both the routine activities and the potential clean-up operations that may occur during the operational season at the SWTP.

Normal operating procedures include:

- Chemical storage, handling, mixing, and dosing.
  - Onsite chemicals include: Antiscalant (Avista 5100), Sodium Hydroxide (Caustic), Barium Chloride, EDTA, and Hydrochloric Acid (HCl).
- Water sampling and laboratory testing.
- Preparing and shipping water samples.
- Equipment monitoring, inspection, and maintenance.
- Data recording and reporting.

Anticipated clean-up activities may include:

- Site housekeeping and removal of minor debris or residues.
- Decontamination of equipment and tools following maintenance or repair.
- Containment and neutralization of minor chemical spills during mixing or transfer.
- Cleaning or flushing of chemical dosing lines.

All clean-up activities will be performed by trained personnel in accordance with site-specific SOPs and spill response protocols. No confined space entries are anticipated or required for any tasks on site.

3.1.1. *Non-Routine Tasks and Procedures*

Non-routine tasks are those that are not part of the plant's daily or weekly standard operating procedures and may present elevated or unfamiliar risks to personnel. These tasks require additional planning and oversight to ensure compliance with 29 CFR 1910.120 and safe execution.

Examples of Non-Routine Tasks Include:

- RO membrane change-outs
- Cartridge filter replacements
- Replacement of chemical lines or system modifications

The following protocols are required to be followed:

1. Pre-Task Hazard Assessment: The onsite operations and safety team led by the Lead Operator will evaluate potential hazards, review SDSs, identify PPE needs and determine whether exposure limits or controls must be updated.
2. Job Safety Analysis (JSA) / Tean Risk Assessment (TRA): a written JSA/TRA will be conducted and document for complex or high-risk tasks.
3. Use of Lockout/Tagout (LOTO): Any work requiring isolation of energy sources (pressure, electrical, chemical) must comply with LOTO procedures.
4. PPE Review: Personnel will be issued task-specific PPE based on hazards identified in the pre-task hazard assessment.
5. Work Authorization and communication: Non-routine tasks must be approved by the Lead Operator or Project Manager before starting. All personnel must be notified of changes to normal operations.
6. Post-Task Inspection and Restoration: Equipment will be inspected and safely brought back online. Any spills or exposure incidents will be documented according to the incident resolution procedure and reviewed by the Safety Manager.

By following these protocols, the SWTP ensures that all non-routine tasks are conducted with the same level of safety and regulatory compliance as routine operations.

3.2. Work Tasks, Objectives, and Methods for Accomplishment

Table 1 identifies the primary work tasks at the SWTP, their operational objectives, and the general methods and controls used to accomplish them. Standard Operating Procedures (SOPs) will be developed or refined as part of this plan's implementation to provide detailed instructions and ensure safety and consistency.

Table 1 SWTP Work Tasks, Objectives and Methods of Accomplishment

Task	Objective	Method
Chemical Handling, Mixing and Dosing	Safely and accurately dose treatment chemicals into the water treatment process	Use of chemical dosing systems, appropriate PPE, adherence to SOPs
Water Sampling and Water Quality Testing	Collect and analyze water samples at the 4 sample locations (Outfall 001A, Mine Pool, SW-AWD, SW-BPL) to verify treatment performance and compliance	Follow protocols outlined in the SAP and QAPP, adhere to SOPs, use proper containers, and field meters
Preparing and shipping water samples	Properly pack, label, and ship water samples for off-site laboratory analysis	Follow chain-of-custody protocols, use appropriate coolers and packaging, comply with lab requirements
Preventative and Corrective Maintenance on equipment in the SWTP	Maintain and restore equipment functionality to maintain proper and efficient operation of the SWTP	Equipment inspections, LOTO procedures, SOP adherence
Cartridge Filter Changeouts	Efficiently and safely change out the cartridge filters to maintain efficient filtration for plant operation	Shutdown and isolate the system, depressurize and drain housing, replace the filters, bleed the air,

Task	Objective	Method
		restart the system per SOP using proper PPE
RO membrane Changeouts	Efficiently and safely change out the RO membranes to restore performance in the RO system to maintain treatment and operation objectives	Shutdown and isolate the RO Unit, depressurize and drain the RO, open the RO vessels, replace and properly install the membranes, reestablish vessel for proper unit integrity, bleed the air, restart the system per SOP using proper PPE

All methods will incorporate appropriate hazard controls including engineering controls, PPE, administrative procedures, and regular safety training.

3.3. Personnel Requirements for Implementing the Plan

Successful implementation of this plan requires coordination between on-site and off-site personnel. The following roles support the operational, safety, and compliance efforts at the SWTP:

- Project Manager: Has overall responsibility for project execution, including oversight of health and safety compliance, coordination of site personnel, and communication with internal and external stakeholders.
- Safety Manager: Ensures adherence to OSHA and company safety standards, supports incident response, and coordinates with the Lead Operator and RSO for training and inspections.
- Lead Operator: Oversees daily on-site activities, schedules tasks, coordinates with off-site support, and ensures adherence to safety protocols.
- Class A operator: Performs routine and non-routine activities including chemical handling, system monitoring, maintenance, and sampling. Must sign off on the operation personnel's abilities per the Delegation of Duties and Responsibilities (per regulation 100).
- Operator: Carry out day-to-day operations, sample collection, basic maintenance, chemical handling, and routine checks under the direction of the Lead Operator and Class A Operator
- RSO/ARSO: Provides site-specific safety training, performs inspections, and supports implementation of the Radiation Protection Plan.
- Offsite Support (Environmental, Engineering, Administrative): Offers technical, regulatory, and documentation support to field personnel and management.

Routine operations typically involve 1–4 staff members onsite. Additional support may be brought in during non-routine maintenance or specific project phases.

3.4. Implementation of Training Requirements (1910.120(e))

All site personnel involved in hazardous waste operations or emergency response must complete training as required by 29 CFR 1910.120(e). Training for the SWTP includes:

- HAZWOPER Training (40-hour) for all personnel potentially exposed to hazardous substances.
- Site-specific radiation protection training provided by the RSO as outlined in the RPP (Appendix B).
- Applicable annual refresher training as required under 1910.120(e)(8).

Training records will be maintained onsite and made available to regulatory agencies upon request.

3.5. Implementation of Informational Programs (1910.120(i))

In compliance with 29 CFR 1910.120(i), an informational program will be implemented to ensure all site personnel are aware of the chemical hazards, operational risks, and emergency procedures associated with the work at the treatment plant.

Key elements of the informational program include:

- Chemical Hazard Awareness: Personnel will be informed of the presence and hazards of substances such as sodium hydroxide (NaOH), hydrochloric acid (HCl), barium chloride, EDTA, and antiscalant. Material Safety Data Sheets (SDSs) will be maintained onsite and made readily available.
- Posting of Site Information: A current site map, evacuation routes, and emergency contact numbers will be posted in the officer trailer.
- Emergency Procedures: All personnel will be briefed on alarm signals/notifications, muster points, fire extinguisher locations, and emergency shutdown procedures as part of their site orientation.
- Tailgate Safety Meetings: Daily safety meetings will be conducted onsite by the Lead Operator or Class A Operator to review upcoming tasks, reinforce hazard awareness, and communicate any site-specific updates.

3.6. Implementation of Medical Surveillance Programs (1910.120(f))

As outlined in section 3.3 of the RPP, based on five years of recent and available occupational radiation exposure and dose monitoring records for routine WTP workers (from 2019 – 2023) at the former Schwartzwalder Mine, maximum annual radiation doses for WTP workers are expected to remain well below the 500 mrem/yr regulatory threshold that triggers occupational dose monitoring requirements under Part 4.18 of CDPHE Regulations. By that same notion, a medical surveillance program is not required for personnel under current site conditions.

4.0 SITE SPECIFIC SAFETY AND HEALTH PLAN

The following sections identify specific procedures for operations performed at this site/plant. The specific needs and challenges of the plant are addressed with specific tasks and risks being mitigated for these risks at this time. The plan is supplemented by the overall Health and Safety Plan located in **Appendix A**.

4.1. Task-Specific Hazard Analysis and Control Measures

In accordance with 29 CFR 1910.120(b)(4), this section provides a safety and health hazard analysis for each site task and operation identified in the work plan. While many of the tasks performed during operations at the SWTP are routine in nature, each activity presents its own set of potential hazards that must be addressed to ensure worker safety.

This task-specific analysis (Table 2) outlines foreseeable hazards, associated health and safety risks, and appropriate controls to be implemented for both routine and non-routine activities. Controls include engineering and administrative measures, required personal protective equipment (PPE), and relevant training or standard operating procedures (SOPs).

This structured approach ensures compliance with OSHA HAZWOPER requirements and provides clear, actionable guidance for site personnel. The Safety Manager, RSO or ARSO will review these hazards with site workers and provide additional precautions, when necessary, especially for non-routine or higher-risk activities.

Table 2 Task-Specific Hazard Analysis and Control Measures

Task	Potential Hazards	Health/Safety Risks	Controls	Required PPE
Chemical Handling, Mixing and Dosing	Chemical exposure (splash, inhalation), spills	Skin/eye irritation, respiratory exposure, burns	Use specific equipment for specific chemicals (i.e., NaOH transfer pump, EDTA drum pump), Work in well-ventilated areas, have spill kit on hand, buddy system, Chemical SDS	Nitrile gloves, chemical goggles, face shield, chemical-resistant apron, rubber boots
Water Sampling and Water Quality Testing	Exposure to untreated water, wet/slippery surfaces, minor splashes, exposure to wildlife	Contamination, slips/trips/falls, minor chemical exposure	Use proper sampling technique, buddy system, bear spray, snake guarders	Nitrile gloves, safety glasses, slip-resistant footwear
Preparing and shipping water samples	Exposure to untreated water (Mine pool samples), chemical exposure (preserved samples),	Minor chemical exposure, ergonomic strain	Double-contain preserved samples, follow proper packing procedures	Hard hat (if prepared in the plant), safety glasses, nitrile gloves

Task	Potential Hazards	Health/Safety Risks	Controls	Required PPE
	ergonomic lifting hazard			
Preventative and Corrective Maintenance on equipment in the SWTP	Moving parts, sharp tools, energized systems, pinch points, Noise	Impact injuries, slips/trips/falls, cuts, and scrapes	Lockout/tagout procedures, tool inspection, use of guarding, work permits for energized systems	Hard hat, gloves, safety glasses, steel-toe boots, Hearing protection
Cartridge Filter Changeouts	Radiological exposure, exposure to untreated water, wet/slippery surfaces	Cuts, ergonomic strain, residual exposure, slips/trips/falls, cuts, and scrapes	Follow SOP for cartridge filter changeouts, Use appropriate tools, two-person lifts, proper waste handling, proper decontamination procedures	Hard hat, safety glasses, safety boots with boot covers or rubber boots, Tyvek coveralls (or similar full-body disposable coveralls), face shield
RO membrane Changeouts	Radiological exposure, heavy lifting, awkward posture, residual chemical exposure,	Back strain, ergonomic strain, residual exposure, slips/trips/falls, cuts, and scrapes	Follow SOP for RO membrane changeouts, team lifting and proper lifting techniques, proper decontamination procedures	Hard hat, safety glasses, safety boots with boot covers or rubber boots, Tyvek coveralls (or similar full-body disposable coveralls), face shield

Note: The Safety Manager and/or RSO/ARSO will reassess risks if tasks deviate from their expected procedures or if new hazards are introduced. Non-routine tasks will receive additional evaluation to determine if further controls or permits are required before work begins.

4.2. Employee Training Assignments

All personnel performing on-site operations must be trained in MSHA 40 and HAZWOPER 40 for hazardous waste considerations. These training certifications are held and maintained by the Safety Manager and are verified for each on-site personnel.

No individual will be permitted to perform work on-site unless they have received the appropriate training required for their role. Training requirements and expectations are communicated in advance of site work to ensure full compliance. Refresher training is monitored and required on an annual basis, and documentation is maintained for the duration of the project.

In addition to these core training requirements, other relevant certifications may be held by project personnel depending on their duties. These may include, but are not limited to:

- First Aid / CPR
- Forklift Operation

While not required for all employees, these certifications are encouraged and utilized, as appropriately, based on individual responsibilities and assigned tasks.

General and site-specific radiation safety training for this project will be conducted by the RSO/ARSO. Records of radiation training will be maintained by the RSO/ARSO and shared with both the Linkan Safety Manager and the Project Manager.

Additionally, task-specific, and site-specific training will be provided by the Lead Operator or Class A Operator to ensure that all work is conducted in accordance with established procedures and best practices. This training includes instructions on safe operation, chemical handling, and equipment/tool use tailored to the specific tasks and systems at the SWTP.

4.3. PPE to be used by Site Personnel

All personnel are required to wear appropriate personal protective equipment (PPE) while performing tasks at the SWTP. For normal plant operations, the minimum required PPE includes:

- Hard Hat
- Steel Toed Boots
- Safety High-Visibility Vest
- Ear Protection (as needed in designated areas)
- Safety Glasses

Task-specific PPE requirements are outlined in **Table 2** of this plan and in the associated Standard SOPs. These requirements are based on the specific hazards identified for each operation.

For non-routine or higher-risk tasks, additional PPE may be required. The Safety Manager and/or the RSO/ARSO will determine the appropriate level of protection based on the nature of the task and site conditions. All site personnel must comply with PPE requirements as directed to ensure safe and compliant operations.

4.4. Medical Surveillance Requirements

As outlined in section 3.6 of this plan and section 3.3 of the RPP, a medical surveillance program is not required for personnel under current site conditions.

4.5. Monitoring and Sampling

This section describes the air, personnel, and environmental monitoring to be conducted during the project, as well as the equipment, calibration, and maintenance requirements for monitoring instrumentation.

4.5.1. *Air Monitoring*

Based on the scope of work and materials handled at the SWTP, no hazardous airborne contaminants are anticipated during normal operations. Therefore, routine air monitoring is not required. The air monitoring requirements will be reassessed if non-routine tasks or chemical releases occur. If unexpected conditions arise (e.g., spills or suspected airborne exposure), real-time air monitoring will be conducted using direct-read instruments (e.g., PID or multi-gas meters) as directed by the Safety Manager or RSO/ARSO.

4.5.2. *Personnel Monitoring*

As noted in Section 3.3 of the RPP, for the most recent 5-year period of available occupational radiation dose records for SWTP operators have remained well below 10% of the overall Total Effective Dose Equivalent (TEDE) limit for Radiation Workers as specified in Part 4.18 of CDPHE Regulations (i.e., < 500 mrem/yr), and occupational radiation exposure monitoring is technically not required for current routine WTP operations. For these reasons, routine occupational radiation exposure monitoring and annual dose calculations for WTP workers are not required under the RPP or HSP. However, the RSO will conduct and document monthly workplace gamma survey measurements at select locations in and around the WTP building.

For non-routine activities, events, or potential radiological exposure circumstances that could result in more significant worker doses (e.g., maintenance activities or unplanned release events), the RPP and this HSP will rely on Radiation Work Permits (RWPs) issued by the RSO/ARSO. Where warranted, RWPs shall provide occupational radiation exposure/dose monitoring as needed for any non-routine task, activity, event, or circumstance with the potential for occupational doses to exceed 100 mrem/yr under an assumption that up to five RWPs may be issued in a given year, resulting in a potential cumulative dose to any individual worker in excess of 500 mrem/yr.

When occupational radiation exposure monitoring is required under an RWP, the applicable methods and procedures specified in SOP-4 (Radiological Monitoring for Occupational Exposure) of the RPP shall be specified in the RWP by the RSO/ARSO and followed as directed. This may include the use of external dosimetry badges, calculated external doses based on exposure rate measurements in the RWP work area, personal breathing zone (BZ) air particulate monitoring, representative airborne radon progeny sampling, and potentially, with urine bioassay sampling. Determination of occupational radiation doses to workers shall be based on RWP exposure monitoring data, estimated worker occupancy times (exposure durations), and applicable calculation methods as specified in SOP-5 (Occupational Radiation Dose Calculation) of the RPP.

4.5.3. *Environmental Sampling*

Water quality monitoring is a primary component of the project and is described in detail in the SAP. Monitoring will be conducted to assess well water, surface water, and plant process streams for compliance with treatment performance and discharge criteria.

Sampling frequency will follow the schedule outline in the SAP and includes daily weekly, bi-weekly, monthly, and quarterly samples from the 4 sample locations (as seen in Figure 2) required for the project (Outfall 001A, Mine Pool, SW-AWD, SW-BPL).

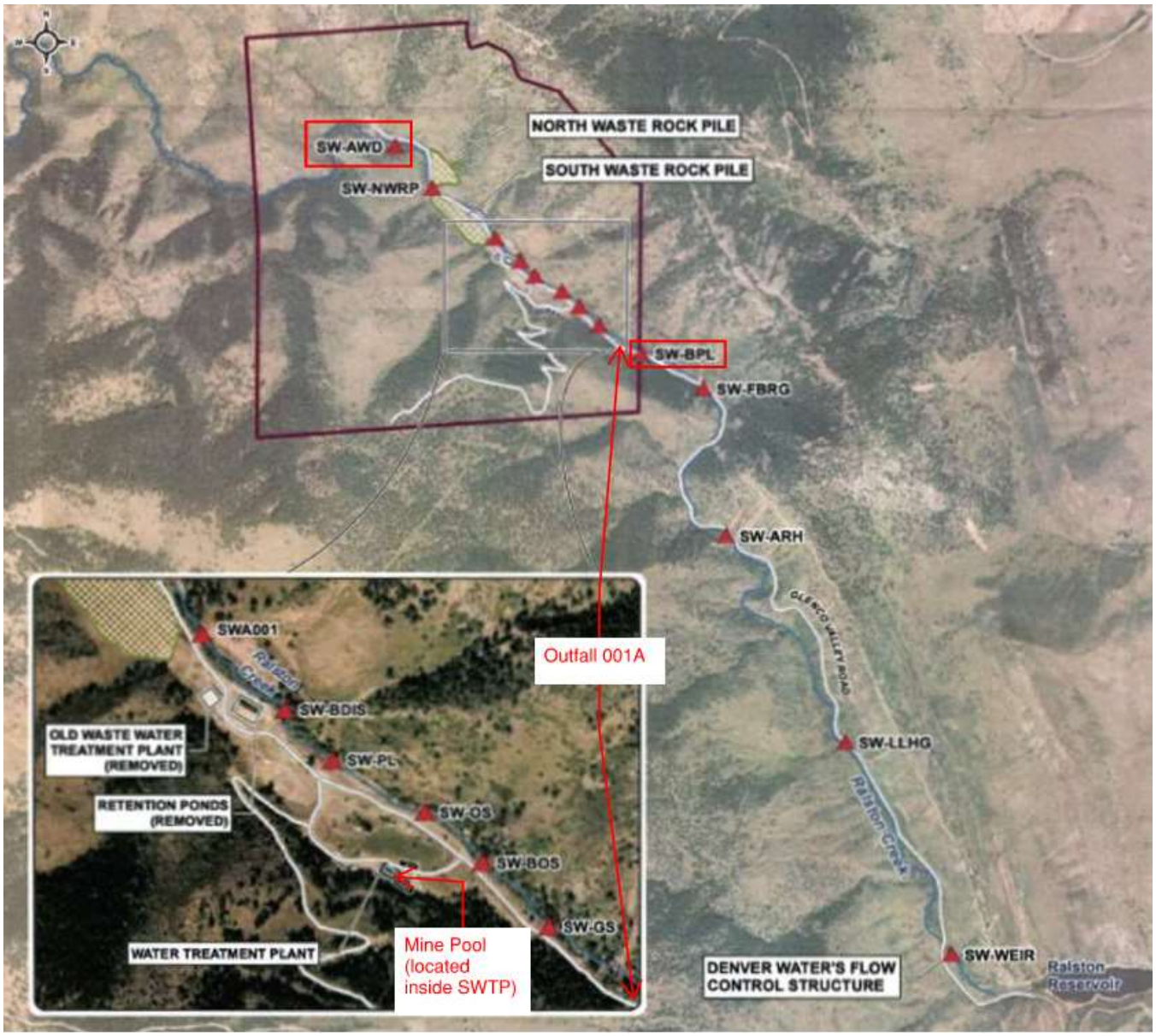

Figure 2 **Sample Locations**

Sample will be collected using a clean, disposable container, not the sample bottle, and with the aid of a "dipper" where necessary. Samples requiring filtration (dissolved metals) will be filtered in the field at the time of their collection. Samples will be placed in labeled bottles pre-charged with preservatives so care must be taken to not overfill the bottles. Once collected, samples will be stored in the plant refrigerator until they are ready to be shipped at which time they are packed into a pre-provided cooler.

4.5.4. *Instrument Calibration and Maintenance*

All sampling and monitoring equipment (e.g., Myron L meter, YSI meter, radiation detectors) will be maintained and calibrated according to the manufacturer's instructions. Field instruments will undergo:

- Calibration checks before each use.
- Routine full calibrations at a frequency recommended by the manufacturer.
- Documentation of all calibration activities.

Only trained personnel shall operate and calibrate monitoring instruments.

4.6. Site Control Program

4.6.1. *Engineering Controls*

The SWTP is situated within privately owned land with fencing and locked/posted gates at two vehicular access points. The doors to the SWTP building are posted with warning signs indicating "Caution Radioactive Materials" or similar messaging, and the building is kept securely locked at all times when authorized Site personnel are not onsite. SWTP walls and locked doors provide physical controls on access to Controlled and Restricted Areas within the SWTP building (see Figure 3). Licensed materials within the SWTP are contained within closed water treatment systems or storage containers that under normal operational conditions remain completely isolated from the open atmosphere (pipes, tanks, totes, etc.). Small, sealed radioactive check sources that are exempt from licensing requirements, and which are used for instrument testing are securely stored in the office trailer, which is also locked at all times when authorized personnel are not onsite.

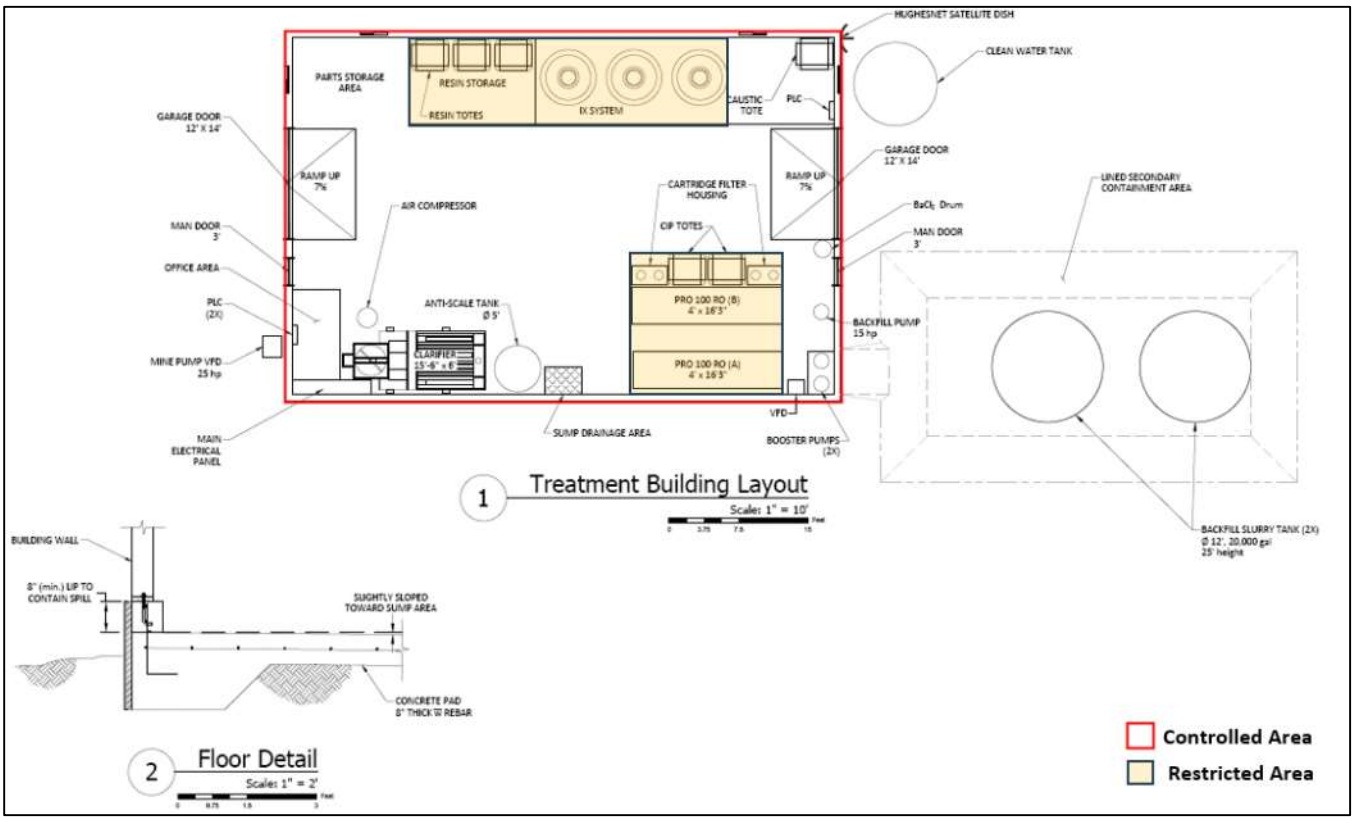

Figure 3 Schematic of Water Treatment Plant Facility Layout

4.6.2. *Administrative Controls – Access Restrictions*

4.6.2.1. Controlled Area

The Controlled Area (Figure 3) is designated as such because this portion of the WTP has administrative restrictions and physical controls on access for reasons other than radiation protection. Operations team members have administrative access to the Controlled Area without escort. Visitors and contractors require escort in Controlled portions of the WTP, and at minimum must receive a Hazard Recognition Briefing as described in SOP1 (Radiation Protection Training) of the RPP. Operations team members shall ensure that any personnel or equipment potentially exposed to licensed radioactive material in the Controlled Area are surveyed for contamination prior to leaving the SWTP building.

4.6.2.2. Restricted Area

The Restricted Areas (see Figure 3) includes portions of the SWTP where gamma exposure rates are typically significantly elevated in excess of background levels, and access is restricted primarily for radiation protection purposes. All personnel and equipment leaving a Restricted Area require contamination surveys. Depending on planned activities and expected potential for radiological exposure/dose, Operations team members conducting non-routine work in the Restricted Area may also require radiological monitoring of occupational exposures under an RWP at the discretion of the RSO. Handling of licensed radioactive materials associated with mine water treatment operations, both within

and beyond Restricted Area, is administratively limited to trained operations team members and radiation protection management personnel (the RSO and ARSO). Escorted Visitors are not allowed to handle licensed radioactive materials, regardless of location relative to Restricted Areas. Contractors working under an RWP may handle radioactive materials as needed to perform their duties under the RWP, but only after receiving RWP training, and only when supervised by a trained operations team member. The Lead Operator is responsible for responding to any incidents or upset conditions and must ensure that all RWP contractors and equipment are surveyed for contamination before leaving the WTP building.

4.6.2.3. Temporary Exclusion Zone

In cases where licensed material will be handled beyond the permanent Restricted Areas within the SWTP (Figure 3), a temporary exclusion zone may be specified by the RSO under an RWP. Temporary exclusion zones are functionally equivalent to a Restricted Area in terms of administrative controls on access, but the access restrictions are only temporarily in place while the RWP for handling licensed material is in effect. For example, cleaning up a spill of contaminated water treatment solutions beyond the Restricted Areas may warrant an RWP with a temporary exclusion zone established around the affected area. Once the affected area has been cleaned up to meet radiological release criteria, restrictions on access under the temporary exclusion zone will be lifted by the RSO and the RWP will be closed out.

4.7. Decontamination Procedures

4.7.1. *Equipment Decontamination*

Various methods may be used when equipment surfaces do not meet contamination release limits and decontamination is required. Common options for affected equipment are listed below, not necessarily in any order of priority or applicability:

1. Remove large deposits of radiologically contaminated soil with hand tools such as a shovel or wire bush.
2. Using water, or soap and water, is generally sufficient for removing contaminated dirt and dust from surfaces. A rag or brush may also be used. Items like rag and brushes shall be presumed contaminated after use for decontaminating equipment. Detergents, such as Alconox (or similar), may also be used.
3. Clean the object with a power washer or nozzle on a hose with a high-pressure setting. Depending on the level of contamination, disposable coveralls (e.g., Tyvek suit) may be appropriate if contamination of personnel from spray-generated aerosols is possible. Wear a face shield to prevent splashing and contamination of the face.

4.7.2. *Personnel Decontamination*

Various methods may be used when personnel, including exposed skin, clothing, boots, PPE, etc. do not meet contamination limits and decontamination is required. Brushing off visible accumulations of dirt or mud with a semi-stiff bristled brush may be sufficient for clothing or personal protective equipment (PPE). However, contaminated skin should only be gently washed with mild soap and water. Personnel decontamination approaches that can abrade the skin should be avoided to prevent the potential for internalization of contamination. Double-sided sticky tape can be effective a removing a fine film of

contaminated dust particles on clothing or PPE. In cases where these simple decontamination efforts to remove long-lived radiological contamination (as opposed to plate-out of short-lived radon progeny, see Cautionary Note below) on personnel prove ineffective, notify the RSO for further advising.

Cautionary Note: Short-lived airborne decay products of radon gas (progeny) can readily adhere to hair, clothing, and PPE. Certain plastics and fleece-like materials can build up a static charge and become subject to “plate out” of radon progeny attached to dust particles. Radon progeny commonly produce false positive readings on personnel contamination surveys. This circumstance is not considered contamination nor is it a health concern as the alpha activity is external to the body and within several hours, associated activity will no longer be present. Washing skin and use of double-sided sticky tape rollers (lint removal devices) on clothing can help to remove radon progeny and reduce “false positive” survey results for long-lived radionuclides, which are the primary concern. In the event that these measures do not reduce survey readings to acceptable levels, the individual may wait for 30-60 minutes and resurvey – if readings have measurably decreased, this is an indication of radon decay products.

Alternatively, the article of clothing may be placed in a plastic bag for several hours and resurveyed or left onsite at the survey station and be rescanned the following morning to verify that short-lived radon progeny have decayed away and readings have returned to background levels.

Further details on the Decontamination Plan can be found in the RPP.

4.8. Emergency Response Plan

An Emergency Action Plan (EAP) in has been developed for this project and is maintained as a separate document in accordance with OSHA regulations. The EAP is available on-site in both hard copy and electronic formats and will be reviewed during the site-specific safety orientation. All employees are required to be familiar with its contents and to understand their roles in the event of an emergency.

The following is a summary of key emergency response procedures:

- Muster Point:
  - The primary muster point in the office trailer
  - The secondary muster point is north of the SWTP near MW-17
- Emergency Contacts: Site-specific contact lists for emergency services and all site personnel is provided in the EAP.
- Fire Response: Fire extinguishers are available in the office trailer and throughout the SWTP. Fire extinguishers should be used as a tool for evacuation in emergency situations. Personnel must only fight fires if properly trained and it is safe to do so.
- First Aid Kits: First aid kits are available in the office trailer.
- Radiological Emergencies: Covered in detail in the Radiation Protection Plan (RPP) and coordinated with the RSO.

A summary of actions to be taken in the event of an emergency is shown in Table 3:

Table 3 Incident Resolution Process Form

Action	Responsibility	Time Frame	Complete	N/A
Work Stops				
Incident is evaluated and reported	Lead Operator and Crew	Immediately		
Area is barricaded	Lead Operator and Crew	Immediately		
Medical				
Emergency medical services are notified (if applicable)	Lead Operator	Immediately		
Urinalysis (U/A) are administered on all incidents	Safety Manager			
Evidence				
Evidence is collected and preserved	Lead Operator	Immediately		
Take pictures	Lead Operator	Immediately		
Obtain witness statements	Lead Operator	Immediately		
Linkan Notification				
Lead operator calls Operations Manager and Safety Manager	Lead Operator	Immediately		
Customer Notification				
Lead operator calls customer's representative	Lead Operator	Immediately		
Safety Manager notifies regulatory agency (MSHA 7000-1 and MSHA 7000-2 forms)	Safety Manager	Immediately		
Transport				
If required, team member is transported to medical facility & accompanies by Linkan Safety Rep	First responders, Lead operator or Safety Manager	As needed		
Safety Rep. notifies HR and Safety manager	Safety Manager	Prior to transport		
Linkan Reports				
Witness statements	Crew	Within 24 hrs.		
Supervisor statement	Lead Operator	Within 24 hrs.		
Incident report form	Lead Operator and Crew	Within 24 hrs.		
Property damage report form	Lead Operator and Crew	Within 24 hrs.		
Near Miss report to Supervisor/Safety	Lead Operator and Crew	Within 24 hrs.		
Photos	Lead Operator	Within 24 hrs.		
Work Comp Reports				
C-1 (notice of injury or occupational disease)	HR and Safety Manager	Within 24 hrs.		
C-4 (employee claim for compensation-report of initial	HR and Safety Manager	Within 24 hrs.		
Distribution				
Reports are turned in to Safety Department and HR and President	Lead Operator	Within 24 hrs.		
Safety Gram				
Safety Gram is developed and sent to all team members by safety manager	Safety Manager	Within 48 hrs.		
Investigation				
All incidents shall be investigated using one of three methods to find the cause of the incident: Taproot Five Why Fishbone Root	Safety Manager, Lead operator, Crew, Customer's team (if applicable)	Within 7 days		
Corrective Actions				
Training Procedures, Plans developed, Controls put in place	Lead Operator,Safety Manager, President	Within 30 days		

4.9. Confined Entry Procedures

The site is not a confined space per 1910.120 and should never have anything defined as a confined space within the course of the work. Under no circumstances should confined entry be required or even considered, as it is not applicable to this, or any part of the work. Therefore, only the acknowledgement of the standard is found here.

4.10. Spill Containment Program

A comprehensive description of the spill response plan is found in the RPP. Spills should be avoided, but should they occur, they must be dealt with immediately in a safe manner to prevent further spills/damage and to avoid environmental distress. Should a spill occur, the immediate actions are as follows:

1. Stop or secure the operation causing the spill (examples: upright a container, stop a pump, close a valve).
2. Warn others in the area using available means (e.g., verbal in person, radios, cellphones).
3. Isolate the affected spill area. Establish control boundaries, if possible, and identify any other hazard(s) that may be present.
4. Minimize individual exposure to the spilled material (e.g., set control boundaries distant enough to reduce exposure rates to background levels, move personnel upwind, etc.).
5. Notify the Safety Manager and RSO.
6. The RSO shall evaluate the circumstances and make a determination whether an RWP is needed to clean up and decontaminate the area, and to provide related instruction on methods and procedures to be used, including the disposition of released material following spill cleanup.

5.0 STANDARD OPERATING PROCEDURES (SOPS)

Many of the Standard Operating Procedures (SOPs) referenced throughout this HSP are included in the Radiation Protection Plan (RPP), which serves as the primary source for procedural guidance related to radiological safety and other key site activities. These SOPs provide step-by-step instructions to ensure safe and compliant execution of both routine and non-routine tasks. For reference, the following SOPs from the RPP are applicable to this project:

- SOP-1: Radiation Protection Training
- SOP-2: Instrument Testing and Calibration
- SOP-3: Radiological Contamination Surveys
- SOP-4: Radiological Monitoring for Occupational Exposures
- SOP-5: Occupational Radiation Dose Calculation
- SOP-6: Radiation Work Permits
- SOP-7: Audits and Inspections
- SOP-8: Spill Response and Reporting
- SOP-9: Materials Handling, Transport, and Disposal

Note: SOP-9 Includes SOPs for cartridge filter and RO membrane changeouts.

APPENDIX A

LINKAN 2025 HEALTH AND SAFETY MANUAL

Health and Safety Manual

Linkan
2720 Ruby Vista Drive, Suite 101
Elko, NV 89801

Quinn Westmoreland:	**President**
Stacy Bott:	**Health and Safety**
Drew Horseman:	**Water Treatment Manager**
Adam Bill:	**Operations**
Travis Mothershead:	**Electrician**
Teryn Faiman:	**HR**

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EXECUTIVE SUMMARY

It is the policy of Linkan Engineering (LINKAN) that the health and safety of our employees, clients and the public affected by our activities are of high importance. Each employee is responsible for implementing this policy. Employees have the responsibility to act and rectify situations that appear to present a health or safety hazard. Employees are directed to bring health and safety concerns to the attention of their supervisor. Supervisors' responsibilities include:

1. Reviewing the specific situation
2. Collaborating with the Company Safety Officer as necessary, and
3. Produce findings and actions regarding the significance of the situation.

This Health and Safety Manual is a compilation of health and safety requirements, practices, and procedures to guide employees. Items contained herein are drawn from the Mine Safety and Health Administration (MSHA), the Occupational Safety and Health Administration (OSHA), applicable Canadian requirements, generally recognized work practices, procedures from industry, and our own internal requirements gained from experience and considered important by management.

Compliance with the directives in this manual is required. The concerted effort of each and every employee to maintain proper work practices and safety compliance will provide a healthy and safe work environment.

Management recognizes the need for a uniform approach to safe working practices. Thus, this Manual shall be used to provide a safe work environment but may not contain a statement of all safety issues that may be encountered on a project. Employees are urged to comply with the Manual and to exercise special judgment in matters that may not be incorporated herein.

Our Health and Safety Manual contains guidelines for tasks frequently performed by our company. It is intended to be a dynamic working document to which new practices, procedures, and methodologies shall be added periodically to update the emphasis on, and commitment to, health and safety.

Quinn Westmoreland,

President

1.0 SAFETY POLICY STATEMENT

The safety and health of our employees are fundamental priorities at Linkan. Recognizing that industrial injuries and property losses from accidents are preventable, we have established a comprehensive safety and health program founded on core safety principles and supported by strong management commitment.

Core Safety Principles

1. **Safety First**: Safety always takes precedence over time gained through unsafe shortcuts.
2. **Employees Responsibility**: All employees are expected to actively reduce accident risks.
3. **Compliance**: Employees must follow all safety rules, procedures, laws, and ordinances.

Mandatory Safety Practices

- Toolbox Talks: Conducted and documented at the start of each shift.
- Team Risk Assessments/Job Safety Analysis (JSA):Completed at the beginning of each shift.
- Field Level Risk Assessment (FLRA): Performed by each team member at the start of their shift pr when new tasks are introduced.
- Pre-Operation Inspections: Conducted on light-duty vehicles and equipment before use.

All completed forms must be signed and submitted daily to the Safety Manager.

Employee Accountability

- Conduct all operations safely to prevent injuries, property damage, or environmental harm.
- Take responsibility for personal safety and the safety of coworkers.
- Understand and comply with all company safe rules.

Workplace Inspections

A competent individual will inspect each workplace at least once per shift to identify and promptly address safety or health concerns.

1.1. Disciplinary Action

Linkan addresses safety violations with corrective actions, including instruction or training, whenever feasible. If these measures are insufficient, the following progressive disciplinary steps may apply:

1. **First Offense**: Verbal warning.
2. **Second Offense**: Written warning.
3. **Third Offense**: Suspension (with or without pay).
4. **Further Offenses**: Termination of Employment.

Policy Considerations

- Progressive discipline is not guaranteed; actions may escalate based on the severity of the violation.
- Linkan reserves the right to terminate employment at its discretion, with or without cause, and without prior progressive discipline.

1.2. Safety Meetings

Linkan aligns with MSHA and OSHA guidelines, promoting employee participation in weekly company-wide safety meetings. These meetings address general safety topics, review recent accidents, and discuss prevention measures. Attendance is documented to ensure all employees are informed.

Daily Tailgate Discussions

- Required for all construction, commissioning, or operations site work.
- Topics are recorded on the designated Linkan daily log sheet.

Special Safety Meetings

Occasional company-wide meetings may address specific safety concerns, such as fire response procedures or security issues. Notifications will be provided, and all employees are encouraged to attend.

Job Hazard Analysis (JHA) / Team Risk Assessment

A JHA/TRA or similar hazard assessment must be conducted before starting tasks that pose significant risks or are not covered by Standard Operating Procedures. Consultation with the Project Construction or Operations Manager is required to determine the appropriate methodology.

1.3. Cardinal Rules

Linkan has established seven **Cardinal Rules** to reinforce employee safety. Violations of these rules will result in immediate suspension pending investigation, with potential termination based on the findings.

1. **Restricted Areas**: Do not cross red tape without prior authorization.
2. **Lockout/Tagout**: Always follow lockout/tagout procedures.
3. **Suspended Loads**: Do not work or walk beneath suspended loads.
4. **Fall Protection**: Use proper fall protection equipment when working at heights.
5. **Customer Rules**: Adhere to customer specific Cardinal Rules while on their site.
6. **Equipment Use** : Operate equipment only with proper certification and / or training.
7. **Incident Reporting** : Report all incidents immediately.

Additional Disciplinary Action

For safety infractions not covered under the Cardinal Rules, disciplinary actions may include verbal warnings, written warnings, suspension (with or without pay), or termination, as determined by management.

2.0 ROLES AND RESPONSIBILITIES

Linkan is committed to maintaining a robust safety culture through clearly defined roles and responsibilities. Each role plays a critical part in fostering a safe and compliant work environment.

2.1. Employee

Employees are the first line of defense in identifying and addressing unsafe conditions. Their proximity to work activities provides unique insights into potential hazards. Employees are responsible for:

- **Safety Training**: Attending and understanding the specific safety training required for each site.
- **Hazard Reporting**: Speaking up when unsure or aware of an unsafe condition and reporting it to their immediate supervisor.
- **Safe Execution**: Performing their duties in alignment with the safety protocols established for each site.
- **Knowledge of Regulations**: Understanding their rights and responsibilities under relevant safety authorities, including:
  - Occupational Safety & Health Administration (OSHA)
  - Mine Safety & Health Administration (MSHA)
  - Canadian Occupational Health and Safety Act (COHSA)

Employees also have the **authority to stop unsafe work** and the **responsibility** to notify their supervisor, operator, or affected parties, allowing for corrective measures to be implemented.

2.2. Supervisors

Supervisors are responsible for maintaining safe working conditions within their departments and ensuring the safety of their team and the work environment. Their responsibilities include:

- Knowledge and Training:
  - Understanding the safety roles of employees and actively supporting their knowledge and participation.
  - Successfully completing a 30-hour OSHA Training Course in Construction Safety and Health.
- **Hazard Surveillance**: Conducting frequent safety observations to assess for inherent dangers, including new or changing conditions.
- **Employee Engagement**:
  - Listening to employee recommendations and concerns.
  - Taking immediate action on identified unsafe conditions.
- **Corrective Actions:**
  - Addressing unsafe conditions promptly.
  - Coordinating with the Safety Officer to implement and monitor corrective actions to prevent recurrence.
- **Incident Reporting**: Reporting unsafe acts, conditions, or accidents immediately to the Safety Officer.

2.3. Lab Supervisor

The Lab Supervisor is responsible for ensuring safety in laboratory environments and compliance with safety protocols specific to lab operations. Their duties include:

- **Safety Oversight**: Maintaining a safe working environment in the laboratory and ensuring compliance with chemical, biological, and equipment safety standards.
- **Training and Knowledge**:
  - Providing lab-specific safety training for employees and ensuring that all staff understand and follow lab safety procedures.
  - Keeping up to date with relevant safety standards and regulations.
- **Hazard Management:**
  - Identifying and mitigating potential hazards within the lab.
  - Ensuring that all safety equipment (e.g., eyewash stations, fume hoods) is functional and inspected regularly.
- **Incident Response**: Reporting and responding to lab-related safety incidents and coordinating investigations as needed.
- **Collaboration**: Working closely with the Safety Officer to align laboratory safety protocols with overall company policies.

2.4. Safety Officer

The Safety Officer leads the implementation and oversight of the workplace safety program. Their responsibilities include:

- **Program Leadership**:
  - Understanding the safety roles and responsibilities of supervisors and employees.
  - Actively supporting their knowledge, participation, and adherence to safety protocols.
- **Incident Management**:
  - Following up on reported unsafe acts or accidents.
  - Filing required reports and documentation in compliance with MSHA and OSHA guidelines.
- **Program Development:**
  - Regularly evaluating and updating safety procedures to ensure relevance and applicability.
  - Advising the President on safety incidents and policy improvements.
- **Policy Recommendations**: Suggesting changes to enhance the company's safety program.

2.5. Company President

The Company President holds the ultimate responsibility and authority to ensure the safety program is effective, funded, and compliant with all applicable regulations. Responsibilities include:

- Policy Oversight:
  - Evaluating and revising safety policies with input from the Safety Officer to maintain program relevance and functionality.
  - Ensuring alignment with Federal, State, and local laws.

- **Resource Allocation**: Providing the necessary funding and resources to support the safety program.
- **Leadership Commitment**: Demonstrating a commitment to workplace safety by fostering a culture of accountability and continuous improvement.

3.0 ACCIDENT, INJURY, AND ILLNESS REPORTING

Ensuring the prompt reporting of occupational accidents, injuries, illnesses, or near-miss incidents is critical to maintaining a safe work environment. All employees must immediately report any incidents—no matter how minor—to their supervisor and complete an occupational illness or injury form. The supervisor is responsible for contacting the company's Safety Officer and supporting all necessary actions at the office, field, or job site. The Safety Officer ensures proper reporting, compliance, and mitigation measures, working collaboratively with employees and supervisors.

3.1. Specific Reporting Requirements

Reporting procedures may vary depending on client requirements, job site policies, MSHA/OSHA/Canadian OHS regulations, and insurance protocols. Additional policies may apply based on jurisdiction.

3.1.1. Site Specific Reporting

Reporting procedures may vary depending on client requirements, job site policies, MSHA/OSHA/Canadian OHS regulations, and insurance protocols. Additional policies may apply based on jurisdiction.

3.1.2. Workers' Compensation

- **Responsibility:** Supervisors must work with HR to initiate and complete all required paperwork for workers' compensation claims.
- **Action:** Ensure timely reporting and documentation submission to facilitate claims processing.

3.1.3. MSHA Reporting

- **Responsibility:** Supervisors collaborate with mine operators to fulfill MSHA requirements, including:
  - **Immediate Reporting:** Mine operators must report incidents within **15 minutes** of awareness for:
    - Fatalities.
    - Injuries with reasonable potential to cause death.
    - Entrapments or other critical incidents.
  - **10-Day Reporting:** All reportable incidents require submission of Form 7000-1 within ten working days.
  - **Quarterly Reporting:** Hours worked on MSHA sites must be reported quarterly via Form 7000-2.

First Aid Exceptions: Cases treated without medical care or work restrictions, such as minor scratches or splinters, are recordable but not reportable.

3.1.4. OSHA Reporting

- **Responsibility:** Employers must document and report all workplace safety incidents meeting OSHA criteria, including:

- **Action:** Log incidents, maintain documentation for employee review, and report directly via:
  - OSHA hotline: **1-800-321-OSHA (6742)**.
  - Local OSHA office.
  - OSHA online reporting forms.

3.2. Near Miss Reporting

Linkan defines a near-miss as an unintended event or deviation in work practices that could have caused injury or property damage but did not. Examples include equipment malfunctions or minor leaks of non-reportable fluid volumes.

- **Employee Responsibility:** Notify supervisors immediately via verbal communication, email, text, or a formal report.
- **Supervisor Responsibility:** Report near-misses to the Safety Officer, conduct interviews if needed, and analyze the incident to prevent recurrence.
- **Purpose:** Documenting near-misses provides opportunities for improvements and safer designs. Failing to report a near-miss deprives the organization of valuable lessons learned.

3.3. Incident Resolution Process

Action	Responsibility	Time Frame	Complete	N/A
Work Stops				
Incident is evaluated and reported	Foreman and crew	Immediately		
Area is barricaded	Foreman and crew	Immediately		
Medical				
Emergency medical services are notified if applicable	Foreman	Immediately		
U/A are administered on all incidents	Linkan Safety Mgr.	As soon as possible		
Evidence				
Evidence is collected and preserved	Foreman	Immediately		
Take pictures	Foreman	Immediately		
Obtain witness statements	Foreman	Immediately		
Linkan Notification				
Call your supervisor	Foreman	Immediately		
Supervisor calls Safety Department and Director of Operations	Supervisor	Immediately		
Customer Notification				
Supervisor calls customer's representative	Supervisor	Immediately		
Safety Manager notifies regulatory agency (MSHA 7000-1 and MSHA 7000-2 forms)	Linkan Safety Mgr.	Immediately		
Transport				
If required, team member is transported to medical facility & accompanied by Linkan Safety Rep)	First responders or Linkan Safety Mgr.	As needed		
Safety Rep. notifies HR & Safety Mgr. to contact (consulting agency)	Linkan Safety Mgr.	Prior to transport		
Linkan Reports				
Witness statements	Foreman	Within 24 hrs.		
Supervisor statement	Supervisor	Within 24 hrs.		
Incident Report form	Foreman and crew	Within 24 hrs.		
Property Damage Report Form	Foreman and Crew	Within 24 hrs.		
Near Miss Report to Supervisor/Safety	Foreman and Crew	Within 24 hrs.		
Photos	Foreman	Within 24 hrs.		
Work Comp Reports				
C-1 (notice of injury or occupational disease)	HR & Safety Mgr.	Within 24 hrs.		
C-4 (employees claim for compensation-report of initial treatment)	HR & Safety Mgr.	Within 24 hrs.		
Distribution				
Reports are turned in to Safety Department and HR and President	Foreman	Within 24 hrs.		
Safety Gram				
Safety Gram is developed and sent to all team members by Safety Mgr.	Linkan Safety Mgr.	Within 48 hrs.		
Investigation				
All incidents shall be investigated using one of three methods to find cause of incident: Taproot Five Why Fishbone Root	Linkan Safety, Foreman, Crew, Customer's team (if applicable)	Within 7 days		
Corrective Actions				
Training Procedures, Plans Developed, Controls put in place	Supervisor, Safety Rep, President	Within 30 days		

3.4. Accident / Incident Investigation

1. **Purpose:**

This document provides requirements for accident and incident investigations, to ensure worker safety. This document highlights requirements referenced in the source document section. All written records must be kept of work-related fatalities, injuries, and illnesses. All applicable regulatory or Linkan requirements must be followed.

2. **Applicability**:

This document applies to all Linkan employees that will participate in accident and incident Investigations; on Linkan sites.

3. **Standard**:

It is the policy of Linkan, that all accidents and incidents be reported and investigated immediately. All recordable illnesses or injuries must be recorded on the OSHA 300 Log within seven calendar days of receiving information that the injury occurred. The Safety Manager will be responsible for signing and ensuring the OSHA 300 logs are posted in a visible location at all facilities. Further the OSHA records will be kept on file for five years at a minimum.

4. **Responsibilities**:
5. **Employees**:
   a. All employees must report all accidents and incidents to his/her supervisor immediately.
   b. If medical attention is needed for a work-related injury during non-working hours the employee must attempt to contact his/her supervisor before seeking medical attention and must receive a medical release before returning to work.
   c. A mandatory drug test must be done on all employees seeking off-site medical treatment.
   d. Employees must use the designated medical facility.
6. **Supervisor**:
   a. Conduct the initial investigation of **ALL** accidents and incidents, which occur within his/her area responsibility.
   b. For work-related injuries complete the supervisors' injury report and the workers' compensation report as needed.
   c. Inform the employee about seeking medical attention if needed and about needing a work release to return back to work.
   d. Contact the Safety Manager within 24 hours with all the required paperwork. In the event of a serious incident the Safety Manager will respond immediately to assist the Supervisor in investigation and remedial actions.
7. **Safety Leader**:
   a. Follow up on all accidents and incidents in a timely manner.
   b. Check up on all injuries that require medical attention.
   c. Perform the required reporting to the appropriate agencies.
   d. Maintain records as required by Federal and State regulations.

8. **Definitions**:

   Accident – An undesired event that results in harm to people, damage to property, loss of process or harm to the environment.

   Incident – An undesired event which, under slightly different circumstances, could have resulted in harm to people, damage to property, loss of process or harm to the environment.

○ Supervisors' Accident / Incident Report

(To be completed within 24 hours)

Date/Time of Accident/Incident:	
Date/Time Reported:	
Date/Time of Report:	
Years of Experience:	
Nature of Accident/Incident:	
Location of Accident/Incident	
Supervisor:	
Description of Accident/Incident:	
Cause:	
Proposed Corrective Action:	
Case Status:	
Summited by:	Date:

○ Employee's Report of Accident / Incident

(To be completed within 24 hours)

Employee Name:	Age:	Sex:
Address:	Phone:	DOB:

Job Position/Title:	SS No:
Years/Months in present position:	Shift Hours:
Supervisor Name:	Scheduled workdays:
Date/Time of Accident/Incident:	Location:

Task performed when accident/incident occurred:
Name(s) of witnesses:
Describe how accident/incident occurred:
What part of body was injured:
Describe injuries in detail:
Date/Time you first sought medical attention:
Name of Doctor and/or Hospital:
What could be done to prevent accident/incident of this type:

Signature:	Date:

○ Witness Accident/Incident Statement

Print Name:
Signature:
Date of Accident/Incident:
Date of Signature and Statement:
Description of Accident/Incident:

○ Near Miss Report

Instructions: 1. Report to be completed by individual involved in near miss. 2. Use and attach additional letter size sheets if more space is required. 3. Turn in completed copy to your supervisor and or Safety Department.			Department:
Date of Occurrence:	Time:	Location:	Weather condition at this time?
Describe in detail what happened (include a sketch if needed):			
What do you feel caused this near miss to occur:			
Date & Time supervisor was notified:	Employee filling report (optional) Signature: _____		Supervisor receiving report: Signature: _____

○ Accident / Incident Investigation

Investigation findings:
How would you control loss and prevent this near miss from occurring in the future:

Property Damage Report

Location:	This form is to be completed and turned in within 24 hours from time of incident. If personal injury resulted from this incident, an Accident/Incident form must also be completed and turned in within 24 hours.	
Department:	Date of occurrence:	
Name:	Were you injured: Yes ☐ No ☐	Where were you hurt (hand, foot,etc.):
Did this incident cause personal injury? (see top right)	Are there other persons that may have knowledge of the incident:	
Are other personnel and or equipment affected in any way by this incident? List personnel and or equipment that are affected by this incident:		
Does this incident require MSHA, OSHA, Law enforcement agencies:	How long have you done this job:	Number of consecutive days worked:
How did this incident occur:	Hours into the shift: (circle one) 1 to 3 3 to 6 6 to 9 9+	
Are you aware of any problems with the equipment involved:	Unit number equipment:	
Were you involved in the incident in any way? If yes, please describe:		
If not directly involved, how did you become aware of the incident:		
Are you aware of any abnormal operating acts, conditions or practices that may have contributed to the incident:		

○ Accident / Incident Investigation

<table>
<tr><td colspan="3">Describe your actions after the incident:</td></tr>
<tr><td colspan="3">Describe any events, anything unusual and conversations before and after the incident with those that may have been involved:</td></tr>
<tr><td colspan="3">Are you aware of any system, personal or job factors that may have contributed to the incident:</td></tr>
<tr><td colspan="3">Describe any other factors or events that may have directly caused the incident:</td></tr>
<tr><td rowspan="2">Date & Time Supervisor notified:</td><td>Employee filing Report:</td><td>Supervisor receiving Report:</td></tr>
<tr><td>Signature</td><td>Signature</td></tr>
<tr><td colspan="3">How would you control this loss and prevent this incident from occurring in the future:</td></tr>
<tr><td colspan="3">Investigation findings:</td></tr>
<tr><td>Cost Estimate</td><td colspan="2">Risk of Recurrence and Potential for Loss

A. ( ) Likely to occur 4 or more times per year OR cause injury pr property damage> $1,000.

B. ( ) Likely to occur 2 to 4 times per year AND has low potential for injury or damage.

C. ( ) Likely to occur once or less per year AND has a low potential for injury or damage.</td></tr>
</table>

***Instructions**:

The employee involved in the incident must complete all areas of the report that apply. The supervisor of the individual involved will complete the remaining areas and turn in the report with any investigation findings to the Safety Manager within 24 hours. If additional space is needed, attach a separate sheet of paper. If this incident involves a personal injury, a C-1 form must be completed. The Safety/Loss Control Department will review the incident to determine if additional action is necessary. **All medical claims and serious Property Damage will be reviewed by the Safety Leader and the Director of Operations.**

_____

Supervisor

_____

Safety Leader

_____

Director of Operations

4.0 EMPLOYEE SAFETY TRAINING

4.1. General

Linkan is committed to ensuring employee safety through comprehensive training programs that equip our workforce to effectively implement the Linkan Health and Safety Plan.

4.2. Job Specific Safety Training

Linkan tailors its safety training programs to address potential risks specific to the nature of our work. This focused approach enhances employee preparedness and risk mitigation.

4.3. MSHA Safety Compliance

Given Linkan's extensive fieldwork in heavy industrial and mining environments, compliance with the United States Mine Safety and Health Act (MSHA) is a top priority. Linkan Engineering maintains its own MSHA identification number and submits quarterly reports to MSHA, detailing work hours and safety statistics.

4.4. General Safety Training

All Linkan employees are required to complete and maintain MSHA-approved safety training in compliance with **30 CFR Part 48**. Certified third-party trainers conduct all MSHA training, which is documented on **MSHA Form 5000-23**. The Company Safety Officer oversees tracking and documentation of employee training, including annual refresher courses.

Each employee is responsible for ensuring their MSHA training and site-specific refresher courses remain current. The safety training program includes the following components:

1. **New Miner Training**

As part of the new employee orientation, new miners complete 24 hours of mine-specific training covering:

- Mine Act and Miners' Rights and Responsibilities
- Dust and Respiratory Protection
- Confined Space Entry
- Ergonomics
- Personal Protective Equipment (PPE)
- Transportation and Communication Systems
- Surface Ground Control
- Explosives Handling
- Lockout/Tagout Procedures
- Accident Reviews
- Conveyor Systems and Guarding
- First Aid and CPR

- Hazard Recognition
- Electrical Safety
- Accident Prevention Techniques
- Hazard Communication
- Self-Rescue Devices
- Mine Gas Safety

2. **Hazard Recognition Training**

Employees receive instruction on the specific hazards associated with the facility where they will work.

3. **Site Specific Training**

Employees receive instruction on the specific hazards associated with the facility where they will work.

4. **MSHA Annual Refresher Training**

Employees participate in an 8-hour annual refresher course to renew their MSHA Part 48 training.

5. **OSHA Compliance**

In locations or situations where MSHA regulations do not apply. Linkan adheres to standards established by the Occupational Safety and Health Administration (OSHA). This ensures that all work environments meet rigorous safety and health guidelines, regardless of jurisdiction. Employees working on OSHA sites are required to complete OSHA10.

5.0 DRUG & ALCOHOL POLICY

5.1. Purpose

Linkan is dedicated to maintaining a safe, healthy, and productive work environment for all employees. To meet this commitment, it is essential that all employees are physically and mentally fit to perform their duties safely and efficiently. Employees are responsible for adhering to this policy and ensuring their mental and physical condition supports a safe and healthy workplace.

Linkan enforces a **zero-tolerance policy** for drug and alcohol use in the workplace. Employees are prohibited from the unlawful use, possession, sale, or transfer of drugs or narcotics. Additionally, employees must comply with all restrictions on alcohol use and possession outlined in this policy.

Where federal, state, and/or local laws permit, Linkan employs **random** and **for-cause testing** to uphold this policy.

5.2. General

Employees must be drug- and alcohol-free when reporting to work, conducting company business, driving a company vehicle, or using company-sponsored transportation. Employees are expected to remain in this condition throughout the workday.

The following actions are strictly prohibited and may result in disciplinary measures, including termination and/or removal from Linkan property:

- Testing positive for drugs or alcohol on a test administered by or at the direction of Linkan.
- Reporting to work under the influence of illegal drugs or alcohol.
- Use, possession, sale, or solicitation of illegal drugs, whether on or off the job.
- Use of alcohol on Linkan property or client sites.
- Refusing to submit to a drug or alcohol test directed by Linkan.
- Intentional adulteration of urine or other test samples.

Prohibited Drugs include substances that are illegal under federal, state, or local laws. These may include, but are not limited to:

- **Amphetamines** (e.g., methamphetamines)
- **Opiates Metabolites** (e.g., codeine, morphine, heroin)
- **Phencyclidines (PCP)**
- **Marijuana Metabolites** (e.g., THC)
- **Cocaine Metabolites**

5.3. Drug and Alcohol Testing

Linkan employs various testing methods, such as urine, hair, blood, and oral swabs, following U.S> Department of Transportation (DOT) guidelines under **49 CFR Part 40**, unless superseded by specific state or local regulations. For alcohol testing, a concentration of **0.02 or greater** using an evidential breath testing (EBT) device is considered a positive result.

5.3.1. Pre-Employment Testing

- Drug and alcohol testing is required as part of the pre-employment process for all prospective hires, including full -time, temporary, and seasonal employees.
- Employment is contingent upon passing a urine drug and alcohol screening. A positive result will result in rescinding the offer of employment.

5.3.2. For Cause Testing

- Testing will be conducted as part of investigations into vehicle accidents, workplace injuries, or at a supervisor's discretion in cases of:
  - Near-miss incidents (vehicular or personal).
  - Irrational or unusual behavior.
  - Reporting to work in an unfit condition.
  - Observable behavior or the smell of alcohol.
- Refusal to test will result in termination or removal from Linkan property. Employees suspected of influence will be removed immediately and transported for testing.

5.3.3. Random Testing

- A minimum of 20% of the workforce is randomly tested annually.
- Testing is conducted by qualified testers, following strict confidentiality and chain-of-custody procedures.
- Employees testing positive will be placed on paid leave pending confirmation. If confirmed, they will be terminated.

Linkan prohibits employees from transporting themselves off-site after a positive test. If refused, site management may involve law enforcement to ensure safe transportation home.

5.3.4. Annual Testing

- All Employees working at MSHA sites are required to test at least once per year, as well as any other applicable testing.

5.4. Confidentiality

All drug and alcohol test results are strictly confidential. Linkan will not disclose test results or related information to third parties without written consent, except as necessary for professional or legal purposes.

5.5. Prescription and Over-the-Counter Drugs

Employees must notify their supervisor if they are using prescription or non-prescription drugs that could impair their ability to perform work duties safely. Non-disclosure may result in disciplinary action.

5.6. Alcohol Use

Alcohol consumption is strictly prohibited during work hours, including rest and meal periods. Possession or use of alcohol on Linkan property, client sites, or in company vehicles is grounds for disciplinary action, up to and including termination.

5.7. Administration

This policy is for informational purposes only and does not constitute an employment contract. Linkan reserves the right to interpret, modify, or revoke this policy at its sole discretion.

5.8. Fit for Duty

1. **Expectations for Employees**

Employees are required to report to work without any physical or mental impairment that could endanger their safety or the safety of others. Employees must maintain the condition throughout their work shift.

2. **Reporting Impairment**

If an employee is observed behaving in a manner that suggests impairment or poses a safety risk, it must be reported to a supervisor immediately. If the observed individual is the site supervisor, the matter should be escalated to company management as soon as possible. Employees found to be impaired will be disciplined in accordance with Linkan Drug and Alcohol Policy.

6.0 SUBCONTRACTOR MANAGEMENT

The Subcontractor Management Program is integral to all Linkan projects and forms part of the site-specific Health and Safety Plan established at the start of each project. This policy outlines procedures and requirements to ensure subcontractors comply with Linkan's safety, operational, and regulatory standards.

6.1. Prequalification and Bidding Process

During the prequalification process, the following considerations are essential:

- **Qualifications**: Review the subcontractor's experience and capability to complete similar work.
- **Resources**: Ensure the subcontractor has adequate manpower, financial stability, equipment insurance, surety bonding capacity, and licensing to meet project requirements.
- **Legal and Regulatory Compliance**: Assess the subcontractor's history of litigation, OSHA/EPA violations, and overall safety record.
- **References**: Verify references and past customer satisfaction with the subcontractor's work.
- **Experience Modification Rate (EMR)**; Evaluate the subcontractor's EMR as a measure of workplace safety performance.

6.2. Insurance Considerations

Before project commencement, subcontractors must provide a valid certificate of insurance demonstrating adequate coverage for workers' compensation, employer's liability, and automobile liability. Key insurance requirements include:

- **Policy Validity**: Coverage must be maintained throughout the project and provided by insurers with an A.M. Best rating of "A-" or better.
- **Notification of Changes**: Policies must include a clause requiring a minimum of 30 days' written notice for cancellation or termination.
- **Additional Insured**: Linkan must be named as an additional insured, with coverage as primary insurance.

6.3. Safety Training and Recordkeeping Policies

6.3.1. Safety Training

Subcontractors must provide site-specific safety training to their employees before work begins and furnish documentation to Linkan. Training must include:

- Recognition of site-specific hazards.
- First-aid procedures and emergency response protocols.
- Communication of safety information provided by Linkan.

6.3.2. Recordkeeping

Subcontractors are responsible for maintaining comprehensive safety records, including:

- Records of all safety training for their employees.

- Copies of forms provided by Linkan.
- Emergency contact numbers for local medical and fire services.
- Safety Data Sheets (SDS) and information or chemicals used.
- OSHA Form 300/300A logs and accident reports for all job-related incidents.

6.4. Work Site Written Safety Plan

Subcontractors and their employees must comply with site-specific safety policies outlined by Linkan. Noncompliance may result in disciplinary actions, including contract termination. The plan typically includes:

- Management commitment and responsibilities.
- Safety rules and disciplinary policies.
- Emergency response procedures and workplace violence prevention strategies.

6.5. Site Orientation and Coordination

The Linkan Project Manager or Construction Manager will conduct a site orientation for each subcontractor before work begins. Subcontractors must participate in daily safety meetings and maintain active coordination to ensure site-wide safety compliance.

6.6. Safety Inspections

Regular safety inspections will be conducted by both Linkan and subcontractors. A "competent person," as defined by MSHA/OSHA, will perform daily inspections of equipment, materials, and operations, documenting findings, and corrective actions in Daily Inspection Reports.

6.7. Work in Progress and Post-Project Reviews

6.7.1. Work in-Progress Reviews

Conduct regular reviews to monitor subcontractor performance and ensure project milestones are met. These reviews should include:

- Project progress and status.
- Performance issues and improvements.
- Risk management and schedule updates.

6.7.2. Post Project Reviews

Evaluate subcontractor performance upon project completion. Satisfactory subcontractors may be added to an approved contractors list, while those underperforming should be reviewed for potential improvement opportunities.

This structured approach to subcontractor management ensures alignment with Linkan's safety, quality, and operational standards, promoting successful project outcomes.

7.0 RIGHT TO ACT AND STOP WORK AUTHORITY (SWA) PROCESS

The Right to Act and Stop Work Authority (SWA) process empowers all employees to prevent work-related fatalities, injuries, illnesses, environmental releases, and adverse events. This policy ensures a proactive approach to hazard identification and control while fostering a culture of safety without fear of retaliation.

7.1. Purpose and Empowerment

1. **Overview of SWA**

   All employees will be trained in the Right to Act and Stop Work Authority process by the Health and Safety team. This training emphasizes the importance of identifying and addressing unsafe or unhealthy conditions and understanding the critical nature of stopping work when hazards are identified.

2. **Empowered Decision Making**

   Each employee is authorized, in good faith, to evaluate work situations they believe may be unsafe, unhealthy, or in violation of safety policies or standards. Employees have the authority to halt a task, job, operation, or process and communicate condes to their supervisor without fear of retribution.

7.2. Procedure for Raising Concerns

1. **Initial Notification**

   Employees who identify potential safety or health risks must notify their supervisor and Health and Safety representative, explaining their concerns regarding hazards that could result in injury, environmental harm, or damage to the facility.

2. **Supervisor's Assessment**

   Upon receiving a concern, the supervisor will assess the situation in collaboration with the employee and, if necessary, consult management and Health and Safety Representatives to determine the validity of the identified risks.

3. **Escalation Process**

   If the supervisor cannot resolve the issue, the matter will escalate to the department manager, who will involve the highest-ranking facility manager. If the assessment confirms potential safety or health risks, management will halt the task, job, operation, or process until it is deemed safe to resume.

4. **Final Determination**

   If the employer disagrees with the identified concern, the worker may file a written grievance. The issue will then be reviewed by the Executive team, who will determine if the employee acted in good faith in exercising their SWA.

7.3. Resolution and Employee Protections

1. **Arbitrator Decision**

   - If the arbitrator determines that no unsafe condition existed, the employee will resume work.
   - Regardless of the outcome, employees will not face any penalties for exercising their SWA in good faith.

2. **Protections Against Retaliation**

Under no circumstances will employees be discriminated against or retaliated against for using the SWA process. There will be no loss of pay, seniority, or benefits for employees who exercise their SWA rights or for employees affected during the SWA period.

7.4. Training and Competency

All employees, whether hourly or salaried, will receive annual SWA training to ensure competency in recognizing and addressing hazards. New employees will be trained in the SWA process before beginning work.

8.0 PERSONAL PROTECTIVE EQUIPMENT (PPE) PROGRAM

This program applies to all Linkan projects and is included in the site-specific Health and Safety Plan prepared at the start of each project.

8.1. Purpose

PPE is a supplementary injury-prevention tool designed to **enhance safety measures** or provide protection where other measures are not possible.

Clothing Requirements

Workers must wear **serviceable and suitable clothing** appropriate for the work environment. Specific guidelines:

General Requirements:

- **Personal Clothing**: Must be snug fitting to minimize entanglement risks. Shirts must be worn at all times, shorts are prohibited.
- **Footwear**: ASTM/ANSI or CSA rated safety shoes are mandatory. Canvas or tennis shoes are forbidden.
- **Gloves**: Use when required; avoid finger rings while working.

Prohibited Items

- Loose clothing (e.g., sleeves, ties, cuffs) near machinery.
- Clothing saturated with flammable or harmful substances until cleaned.
- Metal jewelry or metal-framed glasses near electrical circuits.

Material Preference

- opt for cotton or wool over synthetics, as synthetic clothing can melt and fuse to the skin under intense heat or electrical exposure.

8.2. Personal Protective Equipment

General Requirements

- Minimum PPE includes **hard hats, eye protection, safety vests, and safety-toed shoes** in the field, on construction sites, or client facilities.
- Additional equipment (e.g., goggles, life jackets, safety belts) will be provided as required.
- PPE must be maintained in **safe working conditions** and properly fitted.

Client-Specific Requirements

Follow site-specific instructions, which may include:

- Fire-resistant clothing.
- Hearing protection.
- Specialized footwear (e.g., metatarsal protection).
- Seasonal gear like ice cleats or foam gasketed eyewear.

8.2.1. Hard Hats

- Required where there's a risk of falling objects or head impacts.
- Must comply with **ANSI Z89.1-1989** and inspected daily for damage.
- Avoid placing any material (e.g., hoodies) between the head and suspension system.

8.2.2. Eye and Face Protection

- ANSI Z87.1-compliant eyewear is mandatory in areas with risks of flying particles, dust, or chemical exposure.
- Safety glasses with side shields must be worn consistently.
- Follow **NFPA 70E** rules for additional protection if required.

8.2.3. Safety Vests

- High visibility safety vests conforming to **ANSI Class 2 or Class 3** must be worn. Substitute with appropriate high visibility shirts when applicable.

8.2.4. Safety Shoes

- Heavy leather work boots with safety toe protection are required.
- CSA footwear must be needed for Canadian clients.

8.2.5. Hand Protection

- Use gloves to protect against cuts, burns, or irritation.
- Confirm cut resistance ratings meet client specifications.

8.2.6. Special Work-Conditions

- Reflective clothing is required for work near vehicular traffic.
- Weather appropriate clothing (e.g., rain jackets, insulated gear) must be used if needed.

8.3. Noise Protection

- Evaluate job sites for noise levels exceeding local or national codes.
- Provide hearing protection (e.g., earplugs or earmuffs) based on site specific protocols.

8.3.1. Life Preservers

- Safety equipment (e.g., life preservers, ring buoys) must be used when working near water.

8.3.2. Respirators

- Use NIOSH approved respirators in environments with airborne contaminants not mitigated by engineering controls.
- A project hazards assessment shall be conducted at the start of all projects to define the hazards and communicate these to the employee.

- The minimum PPE required shall be as follows:

PERSONAL PROTECTIVE EQUIPMENT SUMMARY CHART		
TYPE OF EQUIPMENT	**PROTECTION AGAINST**	**GENERAL INFORMATION**
HEAD PROTECTION		
HARD HATS. Made of aluminum alloy, laminated plastic, or glass fiber. Resistant to impact, fire, and moisture; also, non-electrical conductor types. General and specific purpose hats are available in a variety of styles and colors. Accessories include chin straps and cold weather liners.	Falling objects; strike against hazards such as low beams and other head-level obstacles.	Wide brim hat style offers maximum protection. "Baseball cap" type is popular with employees. Adhesive nameplates enhance personal value. ********** Compare makes for impact resistance, ease of removing and cleaning cradle, weight, conductivity, and other essential characteristics.
EAR PROTECTION		
EAR PLUGS. Made of plastic, rubber, or waxed cotton. Permanent types can be molded to provide the individual fit. Wax and cotton type is expendable.	Noise levels between 90 and 130 decibels, depending upon the quality and type of earplug.	The need for ear protection depends upon the amount of exposure as well as the noise level. Ear protection is no
EARMUFFS. Made of a variety of materials. Held in place over the years by a headband. Provide protection for specific ranges of sound frequency. Earmuffs may supplement earplugs or vice-versa in high noise levels.	Noise levels between 90 and 135 decibels, depending upon the quality and type of earplug used with the earmuff.	substitute for reduction of noise at the source. Permanent types should be fitted by medical personnel. Require regular cleaning for hygienic reasons. ********** Selection should be governed by the amount of protection and comfort afforded the wearer. Consult specialist before selecting a specific make.
FACE PROTECTION		
FACE SHIELDS. Generally, of plastic, attach to hard hats or special headgear. Vary in resistance to impact, warping, scratching, and distortion of vision. Special purpose shields of wire mesh are available.	Various sizes of particles thrown off by such operations as metal sawing, grinding, sanding, chipping, etc.; also, chemical splashes, and flames. Wire mesh shields protect against radiant heat plus, large thrown particles.	Compare makes for face coverage, vision distortion, and resistance to impact and scratching. Select only non-flammable types. Should be replaced when plastic is cracked, brittle, or badly scratched.
HOODS. Design and type of material depends upon the special purpose, e.g., protection against heat, chemicals, gases, fumes, dust, etc. Some hoods are designed for forced ventilation for use in hazardous atmospheres.	Extreme heat, chemical splashes, toxic, corrosive, or otherwise harmful dust, gases, fumes, vapors, and mists.	Compare available makes for durability, wearer comfort, protective properties, and ease of cleaning. Forced ventilation type should be considered in warm, humid, surroundings. necessary for toxic dust, gases, fumes, etc.
EYE PROTECTION		

PERSONAL PROTECTIVE EQUIPMENT SUMMARY CHART		
MONOGOGGLE. A single plastic shield which fits over both eyes. The frame may be plastic or rubber, held in place by an elastic headband. General purpose types provide relatively inexpensive eye-protection.	Windblown debris, moderate impact particles, corrosive gases and vapors, chemical splashes.	The type of eye protection selected must be suitable for hazards to which men are exposed. Consult a specialist before deciding on the type of eye protection. ********** Compare different makes of the same type for impact resistance, comfort, ventilation, the closeness of fit, resistance to heat and corrosion, and ease of repair and maintenance. ********** General purpose eye protection is no substitute for more specific types of eye protection needed in certain hazardous operations. ********** Where corrective lenses are needed, the best solution is to incorporate correction into safety lenses. Fitting of correctives should be done by professionals. ********** Trend is 100% eye protection for employees who work in areas characterized by eye hazards rather than use only at points-of-operation.
GOGGLES. Goggles rest on the bones around the eyes. Usually held in place by glass, wire mesh, or plastic. A variety of special purpose goggles for specific hazards are available as well as general purpose Impact goggles around the eyes.	Windblown debris, moderate to heavy impact particles, splashing metal, corrosive gasses and vapors, chemical splashes, glare and brightness, harmful Radiation.	
SPECTACLES. Spectacles rest on the bridge of the nose and are held in place by ear frames. Frames are metal or plastic, with or without side-shields. Lenses are tempered glass or plastic. Must be selected for specific purposes. May be prescription ground. Spectacles lack the tight-fitting characteristics of goggles.	Moderate to heavy impact particles, metal sparks and spatter, glare and brightness, metal, windblown debris (when used with side-shields).	
HAND PROTECTION		
GLOVES. A variety of special gloves are made of asbestos (A), metal mesh (M), rubber (R), neoprene, vinyl, and rubber (N), leather (L), reinforced leather (RL), fabrics (F), and coated fabrics (CF). Some styles provide forearm and upper arm protection.	(A) thermal bums and heat. (M) knife cuts, sharp objects. (R) electrical contacts. (N) chemical contacts. (L) rough objects, moderate heat, sparks, blows. (RL) same as (L), but for heavy-duty use. (F) dirt, abrasion, slivers. (CF) chemicals, moist materials.	Compare types of hand protection for protective characteristics, durability, dexterity interference, and comfort in use. ********** Gloves should not be worn by operators working around rotating machinery because of the hazard of being caught on or between moving parts. Metal reinforced gloves should not be worn for electrical work. ********** Widespread use of hand protection calls for
HAND PADS & MITTENS. Hand-pads are used where full, and protection is not needed. Made of various materials for handling different kinds of materials. Mittens are usually for cold weather.	Abrasion, splinter, sharp metal edges, hot objects, cold weather.	

PERSONAL PROTECTIVE EQUIPMENT SUMMARY CHART		
FINGER COTS. Cover one or more fingers; made of a variety of special purpose materials. Used where the hazard is directed at a specific finger instead of the hand as a whole.	Cuts, burns, irritation, abrasion, Abrasion, splinter, sharp metal edges, hot objects, cold weather.	a repair and rehabilitation program to reduce costs. Return of defective hand protection should be required for replacements. ********** Gloves for working around high voltage equipment must be regularly tested by specialists.
FOOT AND LEG PROTECTION		
STEEL-CAPPED SHOES. The steel cap is flanged at the bottom. Most such shoes will take a minimum static load of 2,500 lbs. and a minimum impact load equivalent to a 50 lb. weight dropped 1 foot. Similarly rated composite toes are available in select footwear. Available in a wide variety of styles, and special purpose constructions for non-slipping, non-sparking, non-conducting, and resistance to oil, water, and heat.	Toe injuries caused by falling, rotting, and otherwise moving objects. When solid objects weighing more than 50 lbs. are handled regularly, heavy-duty slip-on foot guards are advisable for greater protection than normally given by the steel-cap safety shoes.	All production and maintenance employees should be encouraged to wear general purpose safety shoes. Available in both dress and work shoe styles. ********** Company purchased shoes can usually be made available to employees at a cost often less than the same quality non-safety shoe purchased at retail outlets. ********** Foot guards and metatarsal guards should be mandatory for occupations doing heavy manual material handling on a regular basis. ********** Variation in quality, fit, weight, and comfort is considerable for safety shoes. Look them over carefully.
METATARSAL GUARDS. Protect the instep of the foot. Available as integral part of high-topped safety shoes or as a strap-on unit which fits over regular safety shoe.	Instep injuries caused by falling, rolling. or otherwise moving objects.	
LEGGINGS & CHAPS. Made of leather, fabric, asbestos, rubber, and coated fabrics for a variety of special purposes to protect legs and clothing.	Sparks, flames, heat. molten metal, hot liquids, corrosive chemicals, flying particles, rough objects, brush.	Legging & Chaps must be selected based on the specific usage.

9.0 WORK ENVIRONMENT SAFETY PROGRAM

This section establishes guidelines for maintaining a safe, clean, and hazard-free work environment across all work settings, including field sites, shops, offices, and wastewater facilities.

9.1. Housekeeping

Maintaining a clean and organized workplace is essential for safety. The following practices are mandatory:

- **Shared Responsibility:** All employees and supervisors must prioritize good housekeeping practices.
- **Tool and Material Storage:** Tools and materials must not be left in areas where they could create hazards for others, particularly the public.
- **Debris and Trash Removal:**
  - Employees must clean up their own messes promptly.
  - If excessive debris or an unsafe condition exists upon arrival, notify a supervisor immediately for assistance and cleanup.
- **Personal Cleanliness:** Dispose of soiled clothing, food scraps, and drink containers in appropriate receptacles.
- **Spill Management:** Clean up spilled liquids or materials immediately to prevent accidents.
- **Work Area Organization:** Maintain a clean and orderly workspace throughout the day, at the end of the workday, and upon project completion.
- **Unobstructed Pathways:** Ensure clear and safe access to and from work areas at all times.
- **Hazardous Protrusions:** Remove or secure sharp objects, such as nails and wires, to prevent injury.
- **Electrical Safety:**
  - Avoid performing housekeeping tasks near energized electrical hazards without safeguards.
  - Do not use electrically conductive cleaning materials near energized parts unless proper procedures are followed.

9.2. Shop Safety

Shop environments present unique safety considerations. Adhere to the following:

- **Floor Safety**:
  - Keep floors clean and free from debris.
  - Immediately cover slippery spills with absorbent materials until cleaned.
- **Pathway Maintenance:** Ensure walkways and travel routes remain clear of obstructions such as tools, parts, or racks.
- **Marking Observance:** Respect floor markings around electrical panels and safety showers. Do not store items inside designated red-line zones.
- **Tool Condition:** Use only tools in good repair. Worn tools (e.g., mushroomed heads, damaged wrenches) are prohibited.
- **Ladder Safety:**
  - Use sound ladders for elevated work.
  - Inspect ladders regularly for damage and adhere to load and angle guidelines.

- **Equipment Stabilization:** Secure equipment and attachments against unintended movement using stable blocking methods.

9.3. Office Safety

Offices may seem inherently safe but still pose risks. Follow these best practices.

- **Mud and Water Management:** Wipe shoes on provided mats to avoid tracking in mud or grease. Clean water spots and spills immediately.
- **Trash and Scrap Removal:** Prevent fire and tripping hazards by promptly disposing of excess materials. Never use trash containers as ashtrays.
- **Trip Hazards:**
  - Keep telephone cords, wires, and wastebaskets neatly arranged and out of walkways.
  - Store sharp or pointed objects securely.
- **Safe Climbing:** Use appropriate step stools or ladders; ensure stable footing.
- **Door Safety:** Avoid standing in front of closed doors that might open unexpectedly.
- **Focused Reading:** Read mail and documents only while seated at your desk.
- **Drawer Management:** Use handles to close drawers and avoid leaving them open or unattended.
- **Walking and Stair Use:** Walk, do not run, and use handrails where available.
- **Chair Safety:** Avoid leaning back on chairs or testing their limits recklessly.
- **Filing Cabinet Safety:** Open only one drawer at a time to prevent tipping.
- **Heavy Equipment Placement:** Position heavy office machines securely, away from desk edges.

9.4. Working with or Around Wastewater

Special precautions are required when working in wastewater environments.

- **Drinking Safety:** Never drink water from hoses or spigots at wastewater treatment facilities.
- **Water Assumptions:** Treat all water at wastewater plants as if it is raw wastewater.
- **Hygiene Practices:**
  - Wash hands thoroughly with antibacterial soap before eating and at the end of the workday.
  - Follow proper decontamination procedures before leaving the site.
- **Chemical Facility Safety:** Adhere to all plant safety procedures when working around chemical handling or storage areas.
- **Food and Beverage Restrictions:** Do not consume or store food or beverages in restrooms or areas exposed to hazardous materials.

10.0 ELECTRICAL SAFETY

This section is to ensure that continuity and resistance tests of grounding systems are conducted on a specific schedule. These tests will alert the plant operations staff and/or mine operator if a problem exists in the grounding system which may not allow the circuit protective devices to quickly operate when faults occur. Numerous injuries and even fatalities have occurred due to high resistance or lack of continuity in equipment ground systems. These accidents could have been prevented by proper testing and maintenance of grounding systems.

10.1. Testing Grounding Systems

Installed grounding systems typically include the following:

1. ***Equipment grounding conductors*** - the conductors used to connect the metal frames or enclosures of electrical equipment to the grounding electrode conductor.
2. ***Grounding electrode conductor*** - the conductors connecting the grounding electrode to the equipment grounding conductor; and
3. ***Grounding electrodes*** - usually driven rods connected to each other by suitable means, buried metal, or other effective methods to provide a low resistance earth connection.

This installing Electrician must conduct the following tests at the conclusion of construction, and the plant operations staff shall then retest on a regular basis (at least annually).

1. ***Equipment grounding conductors*** - continuity and resistance must be tested immediately after installation, repair, or modification, and annually if conductors are subjected to vibration, flexing, frequent hot / cold expansion, or corrosive environments.
2. ***Grounding electrode conductor*** - continuity and resistance must be tested immediately after installation, repair, or modification, and annually if conductors are subjected to vibration, flexing, frequent hot / cold expansion, or corrosive environments; and
3. ***Grounding electrodes*** - resistance must be tested immediately after installation, repair, or modification, and annually thereafter.

Conductors in fixed installations, such as rigid conduit, armored cable, raceways, cable trays, etc., that are not subjected to vibrations, flexing or corrosive environments may be examined annually by visual observation to check for damage in lieu of the annual resistance test. When plant operators elect to conduct this visual examination as a method of compliance with 30 CFR 56/57.12028, MSHA will require that a record is maintained of the most recent annual visual examination.

The grounding conductors in trailing cables, power cables, and cords that supply power to tools and portable or mobile equipment must be tested as prescribed above. This requirement does not apply to double insulated tools or circuits protected by ground-fault circuit interrupters that trip 5 milliamperes or less.

Testing of equipment grounding conductors and grounding electrode conductors is not required if a fail-safe ground wire monitor is used to continuously monitor the grounding circuit which will cause the circuit protective devices to operate when the grounding conductor continuity is broken.

A record of the most recent resistance tests conducted must be kept and made available to the MSHA Secretary or his authorized representative upon request. When a record of testing is

required by the standard, MSHA intends that the test results be recorded in resistance value in ohms.

10.2. Electrical Cordage Safe Work Practices

10.2.1. *Standard Operating Procedure*

Linkan recognizes that electricity can kill or injure employees. The following work practices are to be observed at all times to minimize the potential dangers associated with extension cords and electric tool power cords. This section does not include lockout / tag-out procedures or power tool usage. These topics are discussed elsewhere in the safety program.

10.2.1.1. General

- Each circuit encountered shall be considered live until proven otherwise.
- Testing of circuits shall be performed by a qualified person using proper tools.
- Do not touch an exposed wire unless the circuit is determined to be dead.
- Improper temporary connections to a local power tab such as HVAC or other rooftop power source must be avoided. Electrical code must be followed in all cases.
- If the plug you are trying to insert into a receptacle does not fit, do not alter the device, or force the plug. Obtain assistance from a qualified person.
- Never disconnect a plug from a receptacle by pulling on the cord.

10.2.1.2. Extension Cords

- Prior to using an extension cord, the power rating of the cord must be verified against the load to be operated. Using a cord that is too long or of insufficient wire gauge will result in problems.
- Extension cords are not to be used in place of fixed wiring. They are for temporary use only.
- All extension cords must be three-pronged at each end for 115V. Higher voltage cords (230V+) vary in configuration. IF you are not sure what to use ask a qualified person.
- Each extension cord will be tested for continuity and ground faults on a yearly basis and marked by color-coded tape to indicate when the inspection occurred.
- Visually inspect every extension cord before each use.
- If any extension cord is found in disrepair or fails required testing, it will be tagged and taken out of service, repaired by a qualified individual, and retested before it goes back into service. If it is deemed unrepairable, it will be discarded.
- Any extension cord that does not have the grounding pin will be taken out of service.
- Do not run extension cords through holes in walls, ceilings, or floors unless a properly designed grommet is used to protect the cord.
- Extension cords are not to be attached in any way to the surface of a building.
- Never route an extension cord under a carpet or other mat that contacts the cord. If travel over the cord is necessary, use a properly designed protective chase.
- Do not use any extension cord of the “flat wire” type. Only use those cords that have each wire individually insulated and further protected by an outside cover.

10.2.1.3. Power Tools and Attached Cords

- Each power tool will be tested for continuity and ground faults on a yearly basis and marked by color-coded tape to indicate when the inspection occurred.
- Visually inspect every power tool and cord before each use.
- If any power tool is found in disrepair or fails required testing, it will be tagged and taken out of service, repaired by a qualified individual, and retested before it goes back into service. If it is deemed unrepairable, it will be discarded.
- Any power cord that does not have the grounding pin will be taken out of service. Exception will be made for those tools with factory cords clearly identified by factory labeling to be double insulated.

10.2.1.4. Test Frequency

Each tool with cord and extension cord shall be tested.

- Before the equipment is first used.
- Before it is returned to service following any repairs.
- Before the equipment is used after any incident that can reasonably be suspected to have caused damage to the tool, such as a vehicle running over the cord.
- Once per year at a minimum unless more frequent testing is described in another SOP.

10.2.1.5. Color-Coding

Linkan uses a system of colored tape to indicate that a piece of equipment has passed continuity and ground fault testing. A single band of colored tape is placed on each extension cord or equipment cord according to the chart below.

Annual testing will be completed during January. The new tape shall be applied after removal of the previous tape. Any new tools or cords that are placed into service during a given calendar year shall be tested and taped to indicate compliance and retested at the start of the next year regardless of partial year service. The following chart shows colored tape selections.

YEAR	COLOR
2022	RED
2023	YELLOW
2024	WHITE
2025	GREEN
2026	BLUE
Repair/Damaged	BLACK

This Program and SOP will be reviewed annually in January as part of the tool and cord testing process.

11.0 CONFINED SPACE ENTRY PROGRAM

1. **Purpose**

The purpose of this program is to protect workers from hazards associated with entry into confined spaces during construction activities. It establishes procedures in accordance with OSHA regulations **29 CFR 1926 Subpart AA** (Confined Spaces in Construction) to ensure that employees entering confined spaces are trained, equipped, and safeguarded from hazards.

2. **Scope**

This program applies to all employees and subcontractors who may be involved in confined space work at Linkan construction sites. It defines roles, responsibilities, and procedures for identifying, evaluating, and controlling hazards in confined spaces.

3. **Definitions**

- **Confined Space:** A space that is large enough for a worker to enter, has limited or restricted means of entry or exit, and is not designed for continuous occupancy.
- **Permit-Required Confined Space (PRCS):** A confined space that has one or more of the following hazards:
  - Contains or has the potential to contain a hazardous atmosphere.
  - Contains a material that could engulf an entrant.
  - Has walls that converge inward or floors that slope downward and taper into a smaller area that could trap or asphyxiate an entrant.
  - Contains any other recognized serious safety or health hazard.

4. Responsibilities

- **Program Administrator:** Responsible for developing, implementing, and maintaining the Confined Space Entry Program.
- **Entry Supervisor:** Responsible for determining if acceptable entry conditions are present, authorizing entry, overseeing entry operations, and terminating the entry.
- **Authorized Entrants:** Employees authorized to enter a confined space and trained in confined space entry procedures.
- **Attendants:** Stationed outside the confined space to monitor the entrants, maintain communication, and summon rescue if needed.
- **Rescue and Emergency Services:** Designated team or third-party service responsible for providing emergency rescue in confined space incidents.

a. 5. Rescue Personnel or Services

- **Identify rescue personnel prior to entry:** Before any entry into a PRCS, the Entry Supervisor must ensure that qualified rescue personnel or services are **identified and readily available**. The rescue team must be capable of responding promptly in the event of an emergency.
- **Verify rescue team capability:** The rescue team must be trained and equipped to perform confined space rescues, including the use of appropriate rescue equipment and techniques.
- **Non-entry rescue equipment:** If feasible, non-entry rescue equipment such as retrieval lines or harnesses must be in place before the entry begins to facilitate rescue without requiring personnel to enter the confined space.

- **Notify and inform rescue services:** If a third-party rescue service is utilized, they must be notified before the confined space entry begins, and the specifics of the confined space, including hazards and access points, must be communicated.

3. **Identification and Evaluation of Confined Spaces**

- **Confined Space Inventory:** A list of all known confined spaces at the worksite will be maintained. Confined spaces will be classified as either permit-required or non-permit spaces based on hazard assessment.
- **Hazard Evaluation:** Prior to each entry, a hazard evaluation must be conducted. This includes monitoring for atmospheric hazards (oxygen deficiency, combustible gases, toxic substances), engulfment hazards, and configuration or mechanical hazards.

4. **Permit System**

- **Permit Authorization:** A confined space permit will be required for all entries into PRCS. The permit will include:
  - Description and location of the confined space.
  - Hazards present in the space.
  - Methods to eliminate or control hazards.
  - Atmospheric monitoring results.
  - Names of the entry supervisor, authorized entrants, and attendants.
  - Required PPE and rescue equipment.
  - Communication methods between attendants and entrants.
  - Emergency procedures.
- **Permit Termination:** The entry supervisor will terminate the entry and cancel the permit when the entry operations have been completed or if a new hazard has been introduced. Procedures for terminating the permit include:
  - Ensuring that all personnel have safely exited the confined space.
  - Confirming that the space is secured against unauthorized entry.
  - Reviewing the conditions that caused the new hazard and ensuring corrective actions are taken before re-entry.

5. **Pre-Entry Procedures**

- **Atmospheric Testing:** Prior to entry, the atmosphere inside the confined space must be tested for:
  - Oxygen levels (must be between 19.5% and 23.5%).
  - Flammable gases (must be below 10% of the Lower Explosive Limit).
  - Toxic substances such as hydrogen sulfide or carbon monoxide.
- **Ventilation:** If hazardous atmospheres are detected, ventilation will be provided to ensure safe entry. Continuous monitoring will be conducted during entry.
- **Isolation:** Mechanical or electrical hazards must be isolated by locking out and tagging out equipment and machinery that could pose a danger to entrants.
- **PPE Requirements:** Based on the hazard assessment, appropriate PPE (e.g., respirators, gloves, protective clothing) must be provided to all entrants.

6. **Entry Procedures**

7. **Communication:** Entrants and attendants must maintain continuous communication via radio or other reliable means.

- **Attendant Responsibilities:** The attendant will continuously monitor the status of the entrants and the conditions inside and outside the space. The attendant must not leave their post or enter the confined space under any circumstances.
- **Continuous Monitoring:** Atmospheric conditions will be continuously monitored throughout the entry process. If hazardous conditions are detected, all entrants must immediately exit the space.

Completion of Work

- **Verify that all tasks have been completed:** Before closing out the permit, the Entry Supervisor must confirm that the work specified on the permit (e.g., repairs, maintenance, inspections) has been completed in accordance with safety protocols and the scope of work outlined in the permit.
- **Inspect the confined space:** After work has been completed, the confined space should be inspected to ensure there are no remaining hazards (such as residual chemicals, equipment, or debris) that could pose a danger to personnel.

Accounting for Personnel

- **Ensure all personnel have exited the confined space:** The Entry Supervisor or Attendant must verify that all authorized entrants have safely exited the confined space. A headcount or check-in/check-out system should be used to confirm that no one is left inside.
- **De-energize equipment:** If any equipment was in use during the entry, it should be de-energized, locked out, and tagged out (LOTO) before closing the permit.

Remove Hazard Controls

- **Remove isolation devices:** Any devices or systems used to isolate hazards—such as lockout/tagout, ventilation systems, or barriers—should be properly removed or deactivated after confirming that they are no longer needed.
- **Restore the space to a safe condition:** Once work is finished, any temporary safety measures (e.g., signs, barricades) used to protect personnel should be removed, and the confined space should be restored to its original condition, free of hazards.

Final Atmospheric Monitoring

- **Conduct final atmospheric testing:** Perform a final test of the confined space atmosphere (oxygen levels, flammable gases, toxic substances) to ensure it is safe. This is especially important if ventilation or atmospheric controls were used during entry.
- **Record monitoring results:** Document the final atmospheric conditions as part of the permit closeout process.
- **Inform the entrants of testing results:** All authorized entrants must be informed of the atmospheric testing results before entering the space. This includes information about oxygen levels, the presence of flammable gases, vapors, and any toxic air contaminants.

Permit Termination

- **Review the permit for completeness:** The Entry Supervisor will review the permit to ensure that all required tasks, monitoring, and safety procedures have been documented correctly.

- **Sign and date the permit:** The Entry Supervisor will formally terminate the permit by signing and dating the document, indicating that the confined space entry has been completed and that it is safe to close out the permit.

Hazard Identification and New Hazards

- **Evaluate for new hazards:** If new hazards were identified during the entry, the permit must be terminated immediately, and corrective actions must be taken before re-entry is allowed.
- **Take corrective actions:** If new hazards were introduced, the space must be reassessed, and additional hazard controls may need to be implemented before issuing a new permit for re-entry.

Canceling the Permit

- **Mark the permit as "closed" or "canceled":** Once the entry operation is complete and the permit has been reviewed, it must be officially closed or canceled. The canceled permit should be clearly marked to indicate that it is no longer active.
- **Document the reason for termination if entry is stopped early:** If the entry is terminated before completion due to an unexpected hazard or issue, the permit must reflect why the entry was stopped, and corrective actions taken must be documented.

Recordkeeping

- **Retain the permit**: The terminated permit, along with any related records (such as atmospheric test results), must be retained for at least one year, as required by OSHA regulations. These records can be used for program review and incident investigations.
- **Conduct a permit review**: Regular reviews of terminated permits should be conducted to identify any trends or issues with confined space entries and to improve future entries.

Releasing the Space

- **Re-secure the space:** Once all personnel have exited and the permit is closed, ensure that the confined space is properly secured to prevent unauthorized entry. This may include locking or sealing access points and posting warning signs.
- **Notify affected personnel:** Inform all relevant personnel (including supervisors and other workers) that the confined space entry is complete and that the space is no longer considered a PRCS.

Emergency and Rescue Procedures

- **Non-Entry Rescue:** Whenever possible, non-entry rescue methods (e.g., retrieval lines) will be used.
- **Rescue Team:** A designated rescue team or third-party rescue service will be available and capable of responding promptly to confined space emergencies. They will be trained and equipped to perform rescues safely.
- **Rescue Drills:** Rescue personnel will participate in annual drills that simulate confined space emergencies.

Training

- **Initial Training:** All employees who are authorized to enter confined spaces, act as attendants, or serve as entry supervisors will receive confined space entry training prior to their initial assignment.
- **Refresher Training:** Additional training will be provided when there is a change in assigned duties, introduction of new hazards, or deviation from standard operating procedures.

- **Training Records:** All training must be documented and records maintained for at least three years. These records will be made available to employees and their authorized representatives upon request.

Documentation and Recordkeeping

- **Permit Retention:** All entry permits will be retained for one year following the entry operation. A review of canceled permits will be conducted to identify and correct any deficiencies in the confined space entry program.
- **Training Records:** As mentioned, training records will be maintained and made available for review.
- **Program Review:** This program will be reviewed annually or after any confined space incident to evaluate its effectiveness and make necessary updates.

11.1. Confined Space Entry Permit

Permit valid for one shift only. Permit must be posted near entry point. Keep permit on file for one year

Date: _____ **Entry Time**:_____ AM / PM **Permit Expirations Time**:_____AM / PM
Confined Space Name/ID: _____ **Location**: _____
Reason for Entry: _____
Entry Point: TOP BOTTOM SIDE **Communication used** VOICE HAND SIGNAL RADIO OTHER _____

Hazard Identification & Control Identify potential or known hazards for the confined space. For "OTHER" explain in notes

Atmospheric Hazards present or potentially present – (check all that apply). **YES NO NA**

☐ Oxygen Deficient <19.5% ☐ Flammable Gases, Vapers when ≥ 10% LFL ☐ Airborne combustible dust
☐ Oxygen Enriched ≥ 23.5% ☐ Toxic Gases, Vapors when ≥ PEL ☐ Other _____
Control ☐ Test before entry ☐ Continual monitoring ☒ Natural ventilation ☐ Forced air ventilation ☐ Other

Engulfment & Entrapment Hazards present or potentially present – (check all that apply). **YES NO NA**

☐ Flowing material ☐ Hung up, bridged, crushed material ☐ Inwardly converging walls ☐ Sloping floors ☐ Other
Control: ☐ LOTO fill and/or emptying equipment ☐ Lock gates ☐ Block spouts/pipes ☐ Drain/empty ☐ Lifeline use

Potential/Known hazard	YES	NO	Type / Control used	Potential/Known hazard	YES	NO	Type/Control used
Egress hazards	☐	☐		Raspatory hazards	☐	☐	
Insufficient lighting hazard	☐	☐		Skin hazards	☐	☐	
Chemical hazards	☐	☐		Heat/Cold hazards	☐	☐	
Mechanical hazards (unguarded items)	☐	☐		Snakes, Rodents, Animal, and Insect hazards	☐	☐	
Electrical hazards	☐	☐		Vehicle hazards	☐	☐	
Fall hazards	☐	☐		Noise hazards	☐	☐	

Other Hazards & Control:

Safety & Emergency Resue:	YES	NO	N/A	**Rescue/ Fire Contact #:**	YES	NO	N/A
Entry area secure	☐	☐	☐	Safety harness & lifeline or retrieval line	☐	☐	☐
LOTO de-energization & isolation	☐	☐	☐	PPE inspection completed before use	☐	☐	☐
Lighting (rated fir type of space/work)	☐	☐	☐	Mechanical retrieval device	☐	☐	☐
Hot work permit	☐	☐	☐	Respirator	☐	☐	☐
GFCI equipment	☐	☐	☐	Hearing Protection	☐	☐	☐
Non-sparking tools	☐	☐	☐	Other PPE	☐	☐	☐

Entrants should always wear hard hats. Work boots, and eyewear.

Rescue equipment available?	**YES NO**	Type: _____
Stand by personnel used?	**YES NO**	Name(s): _____
CPR trained person available:	**YES NO**	Name(s): _____

Atmospheric Information	Acceptable atmospheric entry conditions must meet the limits stated below.

Monitor calibrated? **YES** **NO** Date Calibrated: _____ Monitor functioning correctly? **YES** **NO**

Bump test conducted against know concentration of gases, is your meter set up to check? **YES** **NO**

Pre-entry / Initial Air Monitor Readings

Time	O2 19.5 – 23.5%	LFL <10%	CO ≤ 50 ppm	H2S ≤ 10 ppm	PH3 ≤ 0.3 ppm	Other _____	Signature

Periodic Air Monitor Reading - Test every ½ hour unless entrant wears meter continuously.

Time	O2	LFL	CO	H2S	PH3	Other _____	Signature

Notes:

I have been trained for the confined space job duties assigned and agree with the conditions listed on the entry permit.

Entrants(s):

_____ Print Name _____ Signature _____ Print Name _____ Signature

Attendant(s):

_____ Print Name _____ Signature _____ Print Name _____ Signature

I certify all conditions and actions necessary for safe entry have been performed and the entry is authorized.

Entry Supervisor: _____ **Print Name** _____ **Signature**

Permit Cancellation Time: _____ **AM** **PM** Structure returned to operating condition. **AM** **PM**

Entry Supervisor Signature: _____ Date: _____

Ensure employees has received the appropriate training for the job & tasks and the training documented.

12.0 MACHINE GUARDING

Purpose

The purpose of this program is to establish procedures and guidelines to ensure the safety of operators and other employees from hazards associated with machinery, in compliance with 29 CFR 1910.212(a)(1), (a)(2), (a)(3)(ii), (a)(5), and other relevant safety standards. This program identifies potential hazards and outlines appropriate machine guarding methods to protect employees.

Scope

This program applies to all employees who operate or work near machinery within the facility. It addresses all machines that may pose risks from point of operation hazards, ingoing nip points, rotation parts, flying chips, and sparks.

Policy Statement

The company is committed to providing a safe work environment. One or more methods of machine guarding will be Implemented to protect employees from potential hazards associated with machinery.

Hazard Identification

The following hazards will be identified and assessed:

- **Point of Operation Hazards**: Areas where work is performed on material.
- **Ingoing Nip Points**: Areas where body parts could be caught.
- **Rotating Parts**: Components that may cause injury.
- **Flying Chips and Sparks**: Debris generated from machine operations.
- **Fan Blades**: Blades of fans located at heights less than seven (7) feet above the floor or working level.

Methods of Machine Guarding

The following acceptable guarding methods will be utilized based on the type of machinery and identified hazards, in compliance with 29 CFR 1910.212(a)(1), (a)(2), (a)(3)(ii), and (a)(5):

- **Barrier Guards**: Fixed or adjustable barriers that prevent access to hazardous areas during operation.
- **Two-Hand Tripping Devices**: Mechanisms that require the use of both hands to operate the machine, ensuring the operator's hands are away from the danger zone.
- **Electronic Safety Devices**: Sensors and light curtains that detect the presence of personnel in hazardous areas and immediately shut down the machine.
- **Fixed Guards**: Guards shall be affixed to the machine wherever possible, providing a permanent barrier to hazardous areas.
- **Interlocked Guards**: Guards that automatically shut down the machine when opened or removed, ensuring safety during maintenance or setup.
- **Adjustable Guards**: Guards that can be modified for different operations while maintaining safety.

- **Self-Adjusting Guards**: Guards that adjust automatically based on the size of the workpiece.
- **Point of Operation Guards**: For machines, whose operation exposes employees to injury, the point of operation shall be guarded to prevent any part of the operator's body from entering the danger zone during the operating cycle.
- **Fan Blade Guards**: When the periphery of fan blades is less than seven (7) feet above the floor or working level, the blades must be guarded. The guard shall have openings no larger than one-half (1/2) inch to prevent accidental contact with the blades.
- **Personal Protective Equipment (PPE)**: When guards cannot be used effectively, appropriate PPE such as safety goggles, gloves, and face shields must be worn.

Dress Code and Personal Safety

To minimize the risk of injury, the following dress code will be enforced.

- **Prohibition of Loose-Fitting Clothing and Jewelry**: Employees are strictly forbidden from wearing loose fitting clothing and/or jewelry when working around or with moving parts. This includes but is not limited to:
  - Long sleeves that can catch on machinery
  - Necklaces or bracelets that can become entangled.
  - Loose-fitting pants or skirts

Guard Installation and Safety

- Guards shall be securely attached to the machine wherever possible. If attachment is not feasible for any reason, guards shall be secured elsewhere to prevent displacement during operation.
- All guards must be designed and installed to eliminate any potential hazards they may create. This includes ensuring that guards do not have sharp edges, pinch points, or other features that could pose a risk of injury.

Training and Awareness

All employees will receive training on:

- The importance of machine guarding.
- Identifying hazards associated with machinery.
- Proper use and maintenance of guards.
- Emergency procedures in the event of an incident.
- The importance of adhering to the dress code for personal safety.

Inspection and Maintenance

Regular inspections of machines and guards will be conducted to ensure they are in good working order. A maintenance schedule will be established to address any repairs or replacements promptly.

Incident Reporting and Response

All incidents or near-misses involving machine hazards must be reported to a supervisor immediately. An investigation will follow to determine the cause and prevent future occurrences.

13.0 LOCKOUT/TAGOUT (LOTO)

13.1. Purpose

This program establishes procedures for compliance with OSHA's Mechanical and Electrical lockout and tagout program requirements, 29 CFR 1910.147 and 29 CFR 1910.333). These procedures are designed to protect our employees from the hazards and subsequent injuries that occur as the result of the unexpected release of a hazardous energy source during the performance of maintenance operations.

13.2. Training

The training for both the **mechanical and electrical lockout/tagout** is included in this program, and will include several employee classification including **qualified, authorized, affected and others**. Those falling specifically under the mechanical LOTO program will include the following:

1. Authorized
2. Affected
3. Other

For the electrical LOTO program we have only one classification:

1. Qualified

13.3. Definitions

An **authorized employee** is one who locks or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee can also become an authorized employee in his or her duties including servicing and maintenance along with the operation of the machine equipment.

An **affected employee** is one whose job requires him/her to operate or use a machine or equipment on which servicing, or maintenance is being performed under the lockout/tagout program or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Another employee is one who under normal conditions is not identified in the qualified, authorized, or affected categories.

A **qualified employee** is one who has been trained in 29 CFR 1910.331 through 335, to avoid the electrical hazards of working on or near exposed energized parts. It is possible for an employee to be considered qualified with regard to certain equipment in the workplace but unqualified as to other equipment. An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified employee is considered qualified for the performance of those duties.

Further, the relevant paragraphs of 1910.333 have been incorporated into the training curriculum outlined herein, for work that is performed on electrical circuitry and equipment.

13.4. Training

13.4.1. Training for Authorized Employees

The training for authorized employees will include all aspects of the LOTOTO program and all specific procedures for each individual machine or equipment identified in the program.

13.4.2. Training for Affected Employees

The training for affected employees will include the purpose of the program, and how to recognize a LOTOTO operation and how it will affect them.

13.4.3. Training for Other Employees

The training for other employees will include notification that a LOTO program exists and to stay clear of a LOTO operation in progress.

13.4.4. Training for Qualified Employees

Training for the qualified will include the same training as for the authorized employee in addition to the following:

1. The skill and techniques necessary to distinguish exposed parts from other parts of electrical equipment.
2. The skills and techniques necessary to determine the nominal voltage of exposed live parts.
3. The capability of working safely on energized circuits.
4. Familiar with the proper use of precautionary techniques, personal protective equipment and.
5. How to use insulating and shielding materials, and insulated tools.
6. Proper use of test equipment.
7. How to test circuit elements and electrical parts of equipment to which employees may be exposed.
8. How to verify that circuit elements and equipment are de-energized.
9. How to check if the test equipment is working properly before and after each operation.
10. How to determine if any energized condition exists and if it exists as a result of inadvertently induced voltage or unrelated voltage back-feed even though specific parts of the circuit have been de-energized.

13.5. Methods to Enforce Compliance

Supervisory personnel will enforce compliance with our LOTO program by disciplining employees who do not follow the policies and procedures set forth in this program. The chain of command will be followed when disciplinary action is required. Each supervisor will be held responsible for the actions of his or her employees. In addition to the employee being disciplined, his/her supervisor will also be disciplined when appropriate.

The first action will be to verbally warn an employee of their noncompliance with the program. Immediately thereafter, verbal instruction will be provided as to how to perform the work properly.

For every subsequent violation, the following actions will be taken:

- 1st offense – written warning
- 2nd offense – indefinite suspension
- 3rd offense – termination of employment

NOTE: THE PROGRAM INCORPORATES MANY SIGNIFICANT AND CRITICAL ELEMENTS FOR ITS SUCCESS; THEREFORE, A HEAVY RESPONSIBILITY IS PLACED ON EACH EMPLOYE TO FOLLOW THESE PROCEDURES.

13.6. General LOTO Process

Preparation for shutdown – Before authorized, qualified, or affected employees turn off a machine or equipment that is to be maintained or serviced, they will have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the means to control that energy.

An assessment will be made to determine all energy sources associated with the specific piece of equipment or machinery. A specific procedure will then be developed which will document the methods to be used for isolating the energy (see specific procedures), which will be followed by the authorized or qualified employee performing the servicing or maintenance operation.

Machine or equipment shutdown – The machine or equipment will be turned off or shut down using the specific procedures. An orderly shutdown will be followed to avoid any additional or increased hazards to employees as the result of equipment de-energization.

Machine or equipment isolation – All energy control devices that are needed to control the energy to the machine or equipment will be physically located and operated in such a manner as to isolate the machine or equipment from the energy source.

Lockout or tagout application – Lockout or tagout devices will be affixed to energy isolation devices by authorized or qualified employees. The lockout devices will be affixed in a manner that will hold the energy isolation device in a “safe” or “off” position.

Where tagout devices are used they will be affixed in a manner that will clearly state that the operation or the movement of energy isolation devices from the “safe” or “off” position is prohibited.

Locks and/or tags must identify the company employee that applied the locks and/or tags with their name, company, and contact #.

The tagout devices will be attached to the same point a lock would be attached. If the tag cannot be affixed at that point the tag will be located as close as possible to the device in a position that will be immediately obvious to anyone attempting to operate the device.

Stored energy – Following the application of the lockout or tagout devices to the energy isolating devices, all residual energy will be relieved, disconnected, restrained, and otherwise rendered safe.

Where the re-accumulation of stored energy to a hazardous energy level is possible, verification of isolation will be continued until the maintenance or servicing is complete.

Verification of isolation – Prior to starting work on machines or equipment that have been locked or tagged out.

The authorized or qualified employee will verify that isolation or de-energization of the machine or equipment has been accomplished.

Release from lockout or tagout – Before lockout or tagout devices are removed and the energy restored to the machine or equipment, the following actions will be taken:

- The work area will be thoroughly inspected to ensure that non-essential items have been removed, and that machine or equipment components are operational.
- All machine guards are re-installed and secured.
- The work area is checked to ensure that all employees have been safely positioned or removed. Before lockout or tagout devices are being removed.
- Each lockout or tagout device will be removed from each energy device by the employee who applied the device.

Group lockout or tagout – When servicing or maintenance is to be performed by a crew, they will each be provided with a lock or a tag. An authorized or when appropriate, qualified employee will assume responsibility of the entire crew so as to determine the exposure status of each group member and ensure continuity of protection.

Each employee will affix a personal lockout or tagout device to a group lockout device, group lockbox or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

Shift or personnel changes – In order to maintain continuity of lockout/tagout protection the manager will assume responsibility and will assure that:

- Employees affected by the transfer of lockout-tagout devices between the off-going and oncoming employees are apprised of the transfer to coordinate the change.
- Certify that all aspects of the lockout/tagout devices between the off-going and oncoming employees are apprised of the transfer to coordinate the change.
- Certify that all aspects of the lockout/tagout program are followed to minimize exposure to hazards from the unexpected energization, start-up of machine or equipment or release of stored energy.

13.6.1. *Outside Personnel (Multi-Employer Worksites)*

With regards to our mechanical lockout/tagout program, all outside contractors will be informed by the manager of our lockout/tagout procedures and they will be expected to follow them. No work will be performed by outside personnel until the manager has certified the awareness of our procedures.

The electrical contractor will be required to follow our lockout/tagout program. The only exception will be that they (electrical contractor) will be required to develop their own specific procedures for the work they were contracted to perform. The manager will certify the procedure and grant permission for the work to proceed.

Failure to follow this process is a serious breach of our LOTO procedures and will result in disciplinary action up to and including termination of the contract.

SAMPLE OF SPECIFIC LOTO PROCEDURE

Name of machine/equipment: _____

Authorization: Only authorized employees are certified to perform service or maintenance on this conveyor.

1. Energy Sources	Isolation Procedure:	Location:
Electrical	turn switch to the electrical	panel to the off position

Place lockout device on panel. Test switch to ensure it cannot be turned on. Notify all affected employees in the area.

2. Place lockout device on panel. Test switch to ensure it cannot be turned on. Notify all affected employees in the area.

Energy restoration procedure:

- Ensure all employees, tools etc., are removed.
- Remove lockout device.
- Test cycle machine to ensure it operates as expected.
- If further adjustment is necessary, reinstall lockout.
- Remove lockout and notify appropriate personnel the equipment is ready for operation.

NOTE: A similar SPECIFIC PROCEDURE has to be developed for each and every machine or equipment identified as coming under the LOTOTO program.

INSPECTION CERTIFICATION

OSHA requires that completed inspections be certified and kept up to date. That the certification contains the name of the employee, date, and time, whether retraining is necessary, the machine/equipment on which energy control procedures are being utilized, and the name, date, and signature of the inspector.

Therefore, the following format will be used to certify the inspection process:

EMPLOYEE NAME _____ DATE/TIME _____

MACHINE/EQUIPMENT RETRAIN ___Y ☐ ___N ☐

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____

INSPECTOR NAME _____ DATE _____

SIGNATURE OF INSPECTOR _____

14.0 LADDER SAFETY PROGRAM

This Ladder Safety Program applies to all Linkan projects and is incorporated into the site-specific Health and Safety Plan (HASP) developed at the commencement of each project. It establishes comprehensive guidelines to ensure safe ladder use, aligning with OSHA and ANSI standards.

14.1. Ladder Specifications and Maintenance

1. **Standards Compliance**

   All portable ladders must comply with applicable OSHA/ANSI specifications.
2. **Ladder Limits**

   Ladders must not be used beyond their OSHA/ANSI rated load capacity.
3. **Maintenance and Condition**
   a. Ladders must be kept in good condition.
   b. Joints between steps and side rails must be secure.
   c. Hardware and fittings must be properly attached, and movable parts should operate freely without binding or excessive play.
4. **Non-Slip Features**

   All ladders must be equipped with non-slip safety feet to ensure stability.
5. **Surface Conditions**

   Ladders rungs and steps must be kept free of grease, oil, or other slippery substances.

14.2. Proper ladder Use

1. **Safe Placement**
   a. Ladders must not be placed:
      i. In front of doors that open toward the ladder unless the door is locked, blocked open, or guarded.
      ii. On unstable surfaces, such as boxes or barrels, to gain additional height.
2. **Climbing Practices**
   a. Employees must face the ladder when ascending or descending using 3 points of contact.
   b. The top step of ordinary stepladders must not be used unless specifically designed for that purpose.
3. **Inspection and Faulty Equipment**
   a. All Linkan ladders must undergo monthly inspections.
   b. Faulty ladders (e.g., missing, or damaged steps, rungs, or side rails) must be tagged “Do Not Use” and removed from service immediately.
4. **Extension and Securing Ladders**
   a. When used to access elevated surfaces, ladder side rails must extend at least **3 feet** above the landing.
   b. The base of the ladder must be placed at a **4:1 ratio** (1 foot out for every 4 feet of height).
   c. Ladders must be secured at the top to prevent displacement.
5. **Portable Metal Ladders**

   a. Metal ladders must be clearly labeled with the warning. **“CAUTION – DO not Use Around Electrical Equipment.”**
6. **Nonconductive Side Rails**
   a. Ladders must have nonconductive side rails when used near energized parts or electrical equipment.
7. **Restricted Uses**
   a. Ladders must not be used as braces, skids, or poles, or for any purpose other than their intended design.
8. **Stability**
   a. Ladders must be placed on firm level, and dry ground to ensure stability.

14.3. Inspections and Monitoring

1. **Daily Inspections**
   a. A competent person must inspect all ladders and stairs daily, documenting findings to ensure compliance and safety.
2. **Crossovers and Elevated Walkways**
   a. Crossovers, elevated walkways, ramps, and stairways must be constructed of durable materials, including handrails, and be maintained in good condition.
3. **Toe Boards**
   a. Toe boards must be installed where necessary to prevent tools or materials from falling.
4. **Fall Protection**
   a. Openings near travel paths must be protected with railings, barriers, or covers.
   b. If protective devices cannot be installed, appropriate warning signals must be used.

15.0 MATERIAL HANDLING POLICY

15.1. Overview

This section provides detailed guidelines to ensure the safe handling and lifting of materials at all Linkan job sites. It aims to minimize hazards associated with material handling and to promote efficiency, safety, and compliance with regulatory standards.

15.2. General Guidelines

1. **Securing Loads on Trucks**
   a. Before releasing binders on a loaded truck, ensure the load will not shift.
   b. Whenever feasible, secure all layers except the top with an additional binder or ensure that each layer is wedged before releasing binders.
   c. Th top layer must be secured to prevent skids or pallets from destabilizing the load.
2. **Body Positioning**
   a. Employees must never position any part of their body between slings, chockers, and the load during rigging or handling.
3. **Trip Hazard Mitigation**
   a. Crating materials, binding straps, and similar debris must be promptly disposed of to eliminate trip hazards for workers and the general public.
4. **Material Stacking and Securing**
   a. Materials must be properly stacked and secured using methods such as blocking, banding, interlocking tiers, or other techniques to prevent rolling, tipping, sliding, falling, or collapsing.
5. **Safe Travel in Storage Areas**
   a. Stored materials must not obstruct access to aisles, stairways, ladders, or other passageways. Ensure clear and safe means of travel around storage areas.
6. **Special Considerations for Public Safety**
   a. When materials are left near public walkways or roadways, use safety measures such as barricades, warning tape, blocking, and flashing lights to ensure the safety of pedestrians and vehicles.
7. **Proper Lifting Techniques**

Employees handling materials manually must adhere to the following rules:

   a. Get close to the load and bend your knees to lift.
   b. Maintain a straight back while lifting.
   c. Lift gradually, using leg strength, without twisting or jerking motions.
   d. Keep the load close to your body's centerline.
   e. Seek assistance for heavy or bulky loads.

8. **Use of Equipment for Heavy Items**
   a. Utilize motorized equipment or specialized tools, such as forklifts, hoists, or hand trucks, to move or position heavy or awkward items.

15.3. Lifting Guidelines

1. Preferred Use of Equipment
   a. Use mechanical equipment like forklifts or hoists wherever feasible to minimize manual handling risks.
2. **Jobsite Risk Assessment**

Supervisors must identify and mitigate the following risks:

   a. Materials posing lifting hazards (e.g., bulky items or objects with potential sudden weight shifts).
   b. Tasks involving repetitive lifting, twisting, or bending motions.
   c. Incorrect use or fit of safety belts by workers.

3. **Back Support Belts**
   a. Back support belts have not been proven effective in reducing injuries and are not recommended as a preventive measure.
4. **Clear Work Areas**
   a. Ensure areas where materials are carried or lifted are free from obstacles or trip hazards.
5. **Ergonomic Adjustments**
   a. Organize work areas to reduce strain. For instance, elevate pallets holding heavy items, such as cement bags, to minimize bending and squatting.
6. **Secure Grip**
   a. Instruct workers to establish a firm grip on materials before lifting to ensure stability and control.
7. **Testing Weight of Objects**
   a. Workers should not lift objects solely to assess their weight. Always evaluate and plan lifting strategies in advance.

15.4. Handling Hot Materials

1. **Protective Clothing**
   a. Workers handling hot materials must wear long sleeves that are fully buttoned and protective gloves to prevent burns.
2. **Safe Handling Practices**
   a. **Caution on Surfaces**: Move carefully over rough or uneven surfaces to avoid spills or accidents.
   b. **Avoid Overhead Risks**: Do not carry hot material over individuals working below.
   c. **Restrictions on Ladders**: Hot materials must not be transported up or down ladders under any circumstances.

16.0 HAND TOOLS AND PORTABLE EQUIPMENT

16.1. Overview

This policy establishes guidelines for the safe use, maintenance, and inspection of hand tools and portable equipment on all Linkan job sites. The goal is to mitigate hazards associated with faulty tools, improper use, or unsafe conditions, ensuring the safety of all employees.

16.2. General Guidelines

1. **Tool Maintenance and Inspection**
   a. All tools and equipment, whether company – or employee owned, must be maintained in good working condition.
   b. Tools must be inspected prior to each use. Any damaged tools must be repaired before use or replaced.
2. **Hazard Awareness**
   a. Employees must be trained to recognize hazards caused by faulty tools or improper use of hand tools.
3. **Personal Protective Equipment (PPE)**
   a. Safety glasses, face shields, or other appropriate PPE must be worn when using tools or equipment that could produce flying debris or present breakage hazards.
4. **Tool Handles**
   a. Tool handles must be securely attached and tightly wedged to the tool head. Any movement of the handle is unacceptable and constitutes a safety hazard.

16.3. Portable Power Tools and Equipment

1. **Safety Guards**
   a. Grinders, saws, and similar equipment must be equipped with proper safety guards. These guards must remail in place and must not be removed or tampered with.
2. **Guarding Rotating or Moving Parts**
   a. Rotating or moving parts of equipment must be guarded to prevent accidental contact.
3. **Electrical Safety**
   a. All electrically operated tools and equipment must be effectively grounded or be approved double-insulated types.
   b. Temporary electrical circuits (15 and 20-ampere) used during construction must comply with applicable electrical codes and be equipped with ground-fault circuit interrupters (GFCIs) where required.
4. **Inspection of Cords and Equipment**
   a. Portable equipment and extension cords must be inspected visually before each use. Inspections should identify external defects (e.g., loose parts, frayed cords, damaged insulation) or evidence of internal damage.
   b. Tools and cords that remain stationary and are not exposed to damage need not be re-inspected until they are moved.

5. **Adapters and Continuity**
   a. Adapters that interrupt the grounding connection of equipment are prohibited.
6. **Use in Conductive Environments**
   a. Portable electrical tools and extension cords may not be used in highly conductive environments (e.g., areas with standing water) without authorization from the project supervisor.
7. **Additional Guarding Requirements**
   a. Equipment with belts, pulleys, chains, or sprockets, such as air compressors or concrete mixers, must have effective guards in place at all times.
   b. Portable fans must have full guards or screens with openings no larger than ½ inch.
8. **Hoses on Pneumatic and Hydraulic Tools**
   a. Pneumatic and hydraulic hoses must be regularly inspected for signs of wear, deterioration, or damage.

16.4. Inspecting Handheld Tools (Powered and Unpowered)

1. **Daily Inspections**
   a. Employees must inspect personnel, and company issued tools daily. Defective tools must be tagged and removed from service for repair or replacement.

Enforcement and Training

Supervisors are responsible for ensuring compliance with these guidelines. Training programs will cover the proper use, maintenance, and inspection of tools and equipment, emphasizing hazard recognition and best practices. Regular audits and inspections will be conducted to ensure adherence to this policy, and retraining will be provided, as necessary.

17.0 HOT WORK

Purpose

This document outlines the requirements and safety measures for welding, cutting, and burning procedures to ensure worker safety during hot work activities. It incorporates both Linkan-specific requirements and regulatory standards to ensure compliance. All welders and supervisors will receive job-specific, non-production training to understand their responsibilities thoroughly. Adherence to the most stringent applicable regulations and standards is mandatory.

Applicability

This policy applies to all Linkan employees engaged in hot work procedures, including welding, cutting, grinding, brazing, or any activities that produce open flames or sparks.

Scope

The procedure defines the safety requirements necessary to protect personnel from fire and explosion hazards associated with hot work operations.

Procedure

17.1. Safe Work Permit

- A **Safe Work Permit** with a dedicated Hot Work section must be issued before any hot work commences.
- Hot work permits are restricted to essential activities to minimize risks.
- Only a **qualified person** or **operating supervisor** has the authority to issue permits.
- The workers performing hot work must complete and review the Hot Work section with the permit issuer.

17.2. Permit Application

The Hot Work section of the permit is mandatory for operations in:

- Active operational areas.
- Vessel entries.
- Hazardous or unknown pipelines.
- Locations covered under **29 CFR 1926.352** or other applicable standards.

17.3. Covered Activities

Hot Work permits apply to tasks such as:

- Welding, cutting, or brazing.
- Grinding or hot tapping.

Fire Hazards

To mitigate fire risks:

- Gas leaks or chemical spills
- Bomb threats
- Medical emergencies
- Explosions
- Workplace violence
- Fire Hazards

Procedural Guidance:

- **Fires:** Activate alarms, evacuate, and engage fire extinguishers if trained and safe
- **Gas Leaks, Chemical Spills**: Follow safe work protocols, use PPE, and notify responders.
- **Bomb Threats**: Gather threat details, notify authorities, and evacuate if necessary.
- **Medical Emergencies**: Provide basic first aid, notify medical responders, and ensure emergency transport.
- **Explosions**: Seek cover, evacuate once safe, and await clearance to re-enter.
- **Workplace Violence**: Prioritize personal safety, notify security, and avoid direct confrontation.

17.4. Emergency Response Equipment

Equipment Requirements:

- Identify and maintain emergency equipment (e.g., fire extinguishers, alarms, first aid kits).
- Perform regular inspections, documenting maintenance and inspection records for retention.

Monthly Inspections:

- Designated personnel will use Linan Emergency Inspection Checklist to ensure readiness.

17.5. Media Response Plan

Employees must not engage with media or external parties without prior authorization from Linkan's Legal Department.

- Refer all media inquiries to the Chief Operating Officer.
- Obtain approval before participating in interviews or providing statements.
- Notify Legal if unplanned interviews or interactions occur.

17.6. Training and Drills

Training Requirements:

- All employees must receive EAP training tailored to their roles.
- Training shall include fire prevention, evacuation procedures, and regular drills.
- Annual reorientation or as-needed updates ensure continued preparedness.

Documentation:

- Maintain training records, including attendance and competency assessments.

1. **Removal of Fire Hazards**
   a. Move flammable materials at least 35 feet away from the hot work area, or relocate the work to a safe environment, such as a maintenance shop, whenever possible.
2. **Stationary Objects**
   a. If the object cannot be moved, remove all nearby fire hazards, or relocate them to a safe distance.
3. **Object Contents**
   a. Hot work is not permitted on objects containing combustible materials unless properly cleaned and certified safe.

17.7. Guards and Fire Watch

17.7.1. Guarding Requirements

- Use appropriate guards to confine heat, sparks, and slag, protective immovable fire hazards.
- Install protective barriers around work areas to reduce fire hazards in adjacent spaces.

17.7.2. Fire Watch Requirements

A fire watch is required under the following conditions:

- Combustible materials are closer than 35 feet to the work area or are easily ignited by sparks.
- Openings within a 35-foot radius expose adjacent areas to fire hazards.
- Combustible materials are located on the opposite side of metal partitions, walls, or floors.
- Ductwork or conveyor systems could transport sparks or slag to combustible materials.
- Grating flooring extends the hazard radius to the ground level beneath the work area.

17.8. Restrictions on Hot Work

Hot work is prohibited under these conditions:

- **Unauthorized Areas:** Without explicit management authorization.
- **Impaired Fire Suppression:** In sprinkler-protected buildings where systems are disabled unless a fire watch is assigned.
- **Explosive Atmospheres:** In areas with flammable gases, vapors, or dust.
- **Flammable Material Storage:** Near large quantities of combustible materials that cannot be removed or safeguarded.

17.9. Combustible Gas Testing

- A qualified person must conduct a combustible gas test in non-operational areas to confirm safety.
- This person must be trained in the operation, limitations, and interpretation of the gas meter.

17.10. Permit Issuance and Management

- The permit must only cover the expected duration of the task.
- Upon completion or permit expiration, the issuing supervisor must be notified.
- In emergencies or unplanned evacuations, the permit is invalidated, and work cannot resume until the situation is re-evaluated, and a new permit is issued.

17.11. Rights and Responsibilities

Workers and supervisors have the authority to:

- Delay or halt hot work if conditions are unsafe or have changed.
- Ensure fire hazards are addressed, and safe conditions re-established before resuming work.
- Refuse to start work without a valid permit and documented safety measures.

17.12. Emergency Procedures

- During emergency evacuations, all hot work must stop, and workers must vacate the area immediately.
- New permits must be issued after conditions are reviewed and deemed safe for work to resume.

17.13. Hot Work Permit Form:

Permit No.	This permit must be completed for all cutting , welding and other hot work performed outside a dedicated workshop area. The permit must be displayed at the work site and returned to the authorized site representative on completion of work for sign off and filing.

Application for Hot Work

Company/ Department Performing Work: _____

Contact Name: _____ Tel: ( )

Location of Work: _____

Description of Work:

Equipment to be used:

Permit Begins	Permit Expires
Date: / / Time: am/pm	Date: / / Time am/pm

Emergency Information

If a fire occurs, call: _____ Tel: ( )

Nearest fire alarm:

Authorization by Site Representative

The above work is authorized to proceed subject to the following action being taken prior to work starting and procedures being maintained for the duration of the work. Each item is to be checked by the authorized Site Representative prior to work starting for each period(delete and initial if and where Not Applicable).

Authorized by: Signed: Date: / /

1	Fire Sprinklers and/or Thermal Detectors must be confirmed as operational(where installed	☐	6	Combustible materials located within 10m must be removed or protected with non-combustible curtains, metal guards or flameproof covers (not ordinary tarpaulins). In a retail/office environment if 10m clearance is not practical then the largest distance possible (minimum of 3m) is acceptable.	☐
2	Smoke Detectors must be isolated in the work area and Impairment Procedures followed.	☐	7	All floor & wall openings within 10m must be covered to prevent transmission of sparks.	☐
3	Fire equipment to be provided as follows: ▪ Fire Hose Reel ▪ Fire Extinguisher Mandatory fire watcher present	☐ ☐ ☐	8	The hot work area and any adjoining areas must be patrolled from the start of work until 30 minutes after the work is completed (including break periods).	☐
4	Barricades, warning signs & spark/flash screens must be provided.	☐	9	Special Conditions. (**Please detail**)	
5	Work area, trenches, pits, etc. must be clear of flammable liquids, gases, or vapors.	☐			

Work Completed and Area Safe

The work area has been inspected by the Authorized Site Representative 30 minutes after completion of work:

Signed: Date / / Time: am/pm

This permit is only valid for 24 hours. Ensure contractor returns this form.

18.0 EMERGENCY ACTION PLAN (EAP)

18.1. Emergency Action Plan Overview

This Emergency Action Plan (EAP) establishes procedures and responsibilities to ensure a safe and effective response to emergencies. Each Linkan location shall have a site-specific written EAP, tailored to the workplace's hazards and compliant with applicable regulations. The plan aims to mitigate risk, ensure personnel safety, and minimize operational disruption.

Purpose

The EAP is designed to prepare Linkan facilities for emergencies that may necessitate evacuation or rescue, addressing hazards both within the workplace and those from adjacent areas. Each plan shall:

- Include responses to anticipated emergency scenarios (e.g., fire, chemical spills).
- Be accessible to all employees for review.
- Be maintained in writing, except for sites with fewer than 10 employees, where oral communication of the plan is permissible.

18.2. Emergency Response Planning, Issuance, and Review Guidelines

Issuance and Orientation:

- Emergency procedures shall be communicated to all new or transferred employees upon assignment.

Annual Review:

- EAPs will be reviewed and updated annually to reflect workplace changes, operational updates, or the introduction of new hazards.
- Plans shall be developed and revised in collaboration with Linkan safety staff and management.

Employee Training and Updates:

- Employees will review the EAP when it is initially issued, updated, or when their job responsibilities change.

18.3. Emergency Evacuation Procedures

Core Elements of Evacuation Planning:

1. **Notification**: Inform staff, including first aid personnel, about the emergency type and location.
2. **Evacuation Routes**: Establish clear evacuation paths, identify assembly areas, and assign exit routes.
3. **Accountability**: Implement procedures to account for employees at designated assembly points.
4. **Responder Notification**: Notify local emergency services and adjacent workplaces if they are at risk.

18.4. List of Potential Emergencies

Each site will identify potential emergencies through risk assessment, including but not limited to:

- Fires
- Gas leaks or chemical spills

- Bomb threats
- Medical emergencies
- Explosions
- Workplace violence

Procedural Guidance:

- **Fires**: Activate alarms, evacuate, and engage fire extinguishers if trained and safe.
- **Gas Leakes. Chemical Spills**: Follow safe work protocols, use PPE, and notify responders.
- **Bomb Threats**: Gather threat details, notify authorities, and evacuate if necessary.
- **Medical Emergencies**: Provide basic first aid, notify medical responders, and ensure emergency transport.
- **Explosions**: Seek cover, evacuate once safe, and await clearance to re-enter.
- **Workplace Violence**: Prioritize personal safety, notify security, and avoid direct confrontation.

18.5. Emergency Response Equipment

Equipment Requirements:

- Identify and maintain emergency equipment (e.g., fire extinguishers, alarms, first aid kits).
- Perform regular inspections, documenting maintenance, and inspection records for retention.

Monthly Inspections:

- Designated personnel will use the Linkan Emergency Inspection Checklist to ensure readiness,

18.6. Media Response Plan

Employees must not engage with media or external parties without prior authorization from Linkan's Legal Department.

- Refer all media inquiries to the Chief Operating Officer.
- Obtain approval before participating in interviews or providing statements.
- Notify Legal if unplanned interviews or interactions occur.

18.7. Training and Drills

Training Requirements:

- All employees must receive EAP training tailored to their roles.
- Training shall include fire prevention, evacuation procedures, and regular drills.
- Annual reorientation or as-needed updates ensure continued preparedness.

Documentation:

- Maintain training records, including attendance and competency assessments.

18.8. Emergency Facilities

The EAP shall list all emergency facilities and resources available at each site. Off-site locations must identify and communicate external resources before commencing activities.

18.9. Fire Protection and Response

Fire Prevention:

- Evacuate promptly when alarms sound and proceed to designated assembly points.
- Re-enter facilities only after clearance by the Emergency Coordinator.

Fire Response:

- Evacuate promptly when alarms sound and proceed to designated assembly points.
- Re-enter facilities only after clearance by the Emergency Coordinator.

18.10. Alarms and Communication

Alarm Systems:

- Use distinctive alarms to signal evacuation or action.
- Direct voice communication may suffice for smaller sites (10 or fewer employees).

Communication Devices:

- Ensure reliable access to telephones, cell phones, and radios for emergency coordination.

18.11. Rescue and Evacuation Procedures

Rescue Operations:

- Rescue duties are performed by client or local emergency responders.
- Designated personnel will wear appropriate PPE and maintain communication during operations.

Evacuation Protocols:

- Conduct annual evacuation drills with pre-assessment of routes and assembly areas.
- Document drill outcomes using the Linkan Evacuation Report.

18.12. Emergency Response Program Management

Roles and Responsibilities:

- **Emergency Coordinator**: Oversees drills, facility inspections, and evacuation procedures.
- **Site Safety Supervisor**: Supports the Emergency Coordinator as needed.
- **Fire Wardens**: Manage evacuation efforts and ensure accountabilities for all personnel.
- **Emergency, Contractors, and Visitors**: Comply with evacuation instructions and know the designated assembly areas.

Ongoing Maintenance;

- The EAP will be updated to address evolving workplace hazards and operational changes.

19.0 HAZARD COMMUNICATION

19.1. General Overview

The Hazard Communication (HazCom) Program is designed to ensure that all individuals working at LINKAN's mine site, including miners, contractors, and visitors, are adequately informed about the hazardous chemicals that may be present, stored, used, or produced. This program provides a framework for training, labeling, and other methods to warn and protect employees and visitors from chemical hazards, ensuring compliance with OSHA and the Mine Safety and Health Administration (MSHA) regulations, specifically 30 CFR Part 47.

It is the RIGHT TO KNOW of every individual entering the mine property to be informed about the hazardous chemicals to which they may be exposed under normal working conditions, during an accidental release, or in the event of chemical misuse.

This program is applicable to the following:

- All LINKAN work areas .
- All hazardous chemicals brought to or produced at LINKAN work areas that are determined hazardous by the Project Manager, using the Hazard Determination Criteria outlined in this program.
- Hazardous chemicals to which personnel can be exposed during normal operations, accidental releases, or misuse.
- Chemicals that are not exempted from the program under Subpart I of MSHA's HazCom rule 47.81.
- All employees of LINKAN, contractors, and their employees, as well as any other individuals who may be exposed.

This written program will be reviewed annually. The person responsible for conducting the review is Quinn Westmoreland, who will ensure compliance by evaluating chemicals brought into the LINKAN work areas, verifying labels, ensuring proper SDS collection, and ensuring affected employees are trained on new hazards.

19.2. Hazard Identification

Upon receipt of a new chemical, the Project Manager should be contacted immediately. The chemical's labeling will be checked for legibility and accuracy, ensuring that the chemical in the container matches the label.

The following steps will be followed to maintain an accurate hazardous chemical list:

- Any chemicals no longer in use will be removed from the list, and the Project Manager will be notified.
- Notification of hazardous chemicals will be provided when the Safety Data Sheet (SDS) is received. The Lab Manager will assess whether the chemicals are hazardous based on the established criteria.
- The Lab Manager will update the hazardous chemical list, distributing any changes to individuals who have access to the written program.

The Lab Manager will maintain current, legible, and accessible SDSs. Any damaged or illegible SDSs will be replaced, and any changes to SDSs will be communicated to all relevant personnel.

19.2.1. Hazard Determination Criteria

Chemicals will be considered hazardous if they have the potential to cause harm, as indicated by any of the following:

- The chemical's label or SDS identifies it as a hazard.
- The chemical is produced at LINKAN operations and has scientifically valid evidence indicating it poses a risk to those exposed.
- The chemical is a mixture produced at LINKAN operations containing at least 1% of a hazardous chemical or 0.1% of a carcinogen.

The Lab Manager will assess whether a chemical meets the criteria by asking:

- Does it have a warning label or SDS indicating a hazard?
- Could individuals be exposed to it under normal work conditions, in the event of a spill, or if misused?
- Is it a mixture containing 1% of a hazardous chemical or at least 0.1% of a carcinogen?

If the answer is YES to any of these questions, and the chemical is not exempted under MSHA's regulations, it must be included in LINKAN's hazardous chemical list.

19.3. List of Hazardous Chemicals

Appendix A contains the current list of hazardous chemicals used, stored, or produced at LINKAN's work areas, including hazardous chemical waste. Every hazardous chemical listed will be clearly identified in the same manner across its label, SDS, and chemical list.

19.4. Labeling

Hazardous chemicals must be labeled according to the manufacturer's specifications, including the chemical's trade name and CAS number. The label should be:

- Clear, legible, and in English.
- Accurate, identifying specific hazards (e.g., flammability, skin irritation, carcinogenicity).
- Updated if any labels are found to be missing, defaced, or illegible. In cases where the chemical's identity is certain, the Lab Manager will create a new label or temporary tag before the chemical is used.

Pipes carrying hazardous chemicals or containing hazardous materials (such as asbestos) must also be labeled with the chemical name and CAS number.

Exceptions to labeling requirements include:

- Stockpiles and portable containers used for a single shift by one person, which must be properly labeled at the end of the shift.
- Vehicles transporting hazardous chemicals, which must display DOT-approved labels or placards and include a manifest or bill of lading.
- Consumer products, cosmetics, food, tobacco, medical products, and wood products that do not release harmful chemicals during normal use.

19.5. Safety Data Sheets (SDS)

Every hazardous chemical at LINKAN must have a current, legible, and accessible SDS. The SDS should be cross-referenced with the chemical's label and the chemical list, using the common trade name and CAS number.

If a chemical is received without an SDS, the Lab Manager will contact the supplier to obtain the SDS promptly. Employees will be trained on new chemicals before they are used.

The Lab Manager is responsible for ensuring that outdated SDSs are replaced immediately when new revisions are received. A master file of all SDSs will be kept at LINKAN's office or electronically.

If discrepancies or errors are found in an SDS, the Lab Manager will contact the supplier or manufacturer for clarification. Employees may request a copy of any SDS or the chemical list from the Lab Manager.

19.6. Training and Sharing HazCom Information

The Safety Manager is responsible for tracking HazCom training. Training will include MSHA's HazCom interactive training course.

New employees will receive HazCom training before their first assignment to an area with hazardous chemicals. Existing employees must attend annual refresher training.

When a new hazardous chemical is introduced to a work area, employees must be trained on the specific hazards before working with or around that chemical.

Contractors will receive training from the Project Manager, who will inform them of any hazardous chemicals in the area, the location of SDSs, and the labeling system. Contractors must provide LINKAN with a MSHA-approved HazCom written plan.

Visitors must register and undergo safety training before entering LINKAN's work areas and must be escorted by LINKAN personnel while in those areas.

19.7. Emergency Procedures for Non-Routine Tasks Involving Hazardous Chemicals

In the event of chemical spills or unexplained odors, appropriate emergency procedures will be followed, and employees must contact the Safety Manager for guidance. Contractors must also adhere to emergency procedures and report any hazards immediately.

Appendix A-a

List of Hazardous Chemicals

Name	CAS No.	Manufacture	Location	Amount Used	Period

20.0 HEAT ILLNESS PREVENTION PROGRAM

20.1. Purpose

The Heat Illness Prevention Program (HIPP) has been established to safeguard employees from the hazards associated with heat exposure and heat-related illnesses. This program is an addendum to the company's Injury and Illness Prevention Program (IIPP) and will be maintained alongside the IIPP at each job site.

20.2. Program Responsibility

The **Safety Manager** is responsible for the administration and periodic review of the Heat Illness Prevention Program to ensure its effectiveness. Supervisors are responsible for enforcing program requirements, providing necessary heat illness prevention resources (such as potable water and shade), ensuring employee training, and implementing emergency response procedures when required.

20.3. Program Compliance

Linkan will prioritize education and training to ensure employee understanding and compliance with the Heat Illness Prevention Program. However, employees who fail to comply with the program's provisions may be subject to disciplinary actions as per the procedures outlined in the IIPP.

20.4. Communication

All new and reassigned employees will receive training in heat stress prevention prior to exposure. Supervisors will hold regular heat stress prevention meetings at the start of the high heat season, when extreme heat conditions are anticipated to last for more than one day, and as necessary thereafter to address ongoing heat stress risks.

20.5. Identifying, Evaluating, and Controlling Exposures

Supervisors will conduct regular worksite inspections to identify heat-related hazards, monitor temperature and environmental conditions, and assess employee health and performance. These inspections will be supplemented by observations, employee feedback, and accident investigations. During extreme heat conditions, supervisors will monitor the availability of water and encourage employees to hydrate regularly to mitigate the risk of heat-related illness.

20.6. Training

Training will be provided to all employees who may be exposed to heat-related illnesses. The training will cover the following key components:

20.6.1. Training for All Employees

- Recognizing environmental and personal risk factors for heat illness.
- Procedures for identifying, evaluating, and controlling heat stress exposures.
- The importance of frequent hydration, specifically drinking up to four cups of water per hour in extreme heat conditions.
- Understanding acclimatization and its role in heat illness prevention.

- Identifying the signs and symptoms of various heat illnesses, including heat exhaustion and heat stroke.
- Reporting heat illness symptoms in themselves or coworkers immediately to their supervisor or employer.
- Emergency procedures for addressing heat-related illness, including when to seek medical attention and how to contact emergency medical services (EMS).
- Procedures for providing clear and accurate directions to the worksite for EMS responders.

20.6.2. Training for Supervisors

In addition to the above employee training, supervisors will receive additional instruction on:

- Implementing and enforcing the Heat Illness Prevention Program on the job site.
- Specific actions to take when an employee shows signs of heat illness, including appropriate emergency response protocols.

20.7. Provision of Water

Employees will have access to potable water at all times during their shifts. The company will provide a minimum of one quart (four cups) of water per employee per hour. Supervisors will encourage frequent hydration and ensure that water supplies are adequately stocked and accessible throughout the workday. Water stations will be strategically placed as close to the work area as feasible to minimize employee effort in accessing hydration.

20.8. Access to Shade

Employees suffering from heat-related illnesses or requiring rest breaks will be provided access to a shaded area for a minimum of five minutes. Shade must be open to the air or equipped with ventilation or cooling systems. Shade will be located as close to the work area as practical, ensuring that workers can take frequent, brief breaks without delay.

20.9. General Emergency Procedures for Heat-Related Illnesses

As part of the Emergency Medical Services Plan, supervisors will have clear instructions regarding the location of the nearest hospital, emergency phone numbers, and specific emergency medical procedures for each job site. In the event of a heat-related emergency, the following procedures should be followed:

- **Heat Rash & Heat Cramps**: These early signs of heat illness require immediate attention. Employees should be moved to a shaded or cool area, hydrated with cool water, and allowed to rest.
- **Heat Exhaustion**: Symptoms include weakness, dizziness, nausea, and confusion. Immediate actions include:
  - Call 911 or transport to a nearby medical facility.
  - Move the employee to a cool area and provide hydration with cool water.
  - Remove or loosen tight clothing.
  - Provide a cool shower or sponge with water to lower body temperature.
- **Heat Stroke**: Heat stroke is a life-threatening condition characterized by confusion, irrational behavior, loss of consciousness, and dry, hot skin. Immediate actions include:

- Call 911 immediately.
- Begin aggressive cooling (e.g., immersion in cool water, spraying with cool water, or wrapping in cool wet sheets).
- Do not administer fluids to unconscious victims.

20.10. Work Procedures During Extreme Heat

20.10.1. Supervisors' Responsibilities

- Provide workers with frequent breaks in shaded or cool areas.
- Adjust work practices to accommodate workers experiencing heat stress, including modifying tasks, providing rest periods, or rescheduling work.
- Oversee heat stress training and ensure proper acclimatization for new employees or those returning after a break from work.
- Monitor temperature and environmental conditions, adjusting the work schedule and practices as necessary to reduce exposure to extreme heat.
- Use fans or other cooling devices to increase air circulation.
- Ensure adequate hydration by checking water supplies and encouraging workers to drink regularly.
- Account for the additional heat stress caused by personal protective equipment (PPE) and adjust tasks or work schedules accordingly.
- Plan hot tasks during cooler parts of the day, scheduling maintenance, and repairs in hot areas during early morning or late afternoon hours.
- Provide cooling devices (e.g., cooling vests, neck bands) to help workers mitigate heat exposure.

20.10.2. Employee Responsibilities

- Adhere to the training and guidelines provided for managing heat stress.
- Stay vigilant for symptoms of heat illness in themselves and coworkers.
- Avoid working if prescribed medications may increase sensitivity to heat or sunlight.
- Wear light, loose-fitting clothing to allow sweat evaporation.
- Drink small amounts of water regularly (approximately one cup every 15 minutes).
- Avoid caffeinated or alcoholic beverages, as they increase dehydration.
- Avoid eating heavy meals during periods of high heat.
- Refrain from taking salt tablets unless prescribed by a physician.
- Apply sunscreen regularly to protect against sunburn.

An example table is shown in Table 2-1. The table text is Arial, size 10. The table header has 15% shading with bold text. The outline around the table is 1½ bold outline with ¾ internal lines.

21.0 HEARING CONSERVATION PROGRAM

21.1. Purpose

The purpose of this Hearing Conservation Program is to minimize occupational hearing loss caused by excessive noise exposure in the workplace. This program outlines preventive measures, monitoring procedures, and employee training to protect employees from potential hearing damage associated with high noise levels in the workplace.

21.2. Scope

This program applies to all employees exposed to noise levels exceeding 85 decibels (dB(A)) during their work activities. In situations where work is conducted at a non-owned or operated site, the host operator's program shall take precedence, provided it meets or exceeds the requirements of this program. This document governs Linkan employees and contractors on owned premises or in cases where no operator's program exists, or when such a program is less stringent than this one.

21.3. Definitions

- **Audiometric Testing**: A procedure where the individual being tested identifies the lowest sound intensity (pure tones) they can hear, to detect any hearing threshold shifts.
- **Decibels (dB)**: A unit of sound intensity measured using the "A" weighting scale, which simulates the human ear's response to different frequencies.
- **Slow Response**: A sound meter setting that averages out short-duration impulses that might cause large fluctuations in sound level readings.
- **Standard Threshold Shifts(STS)**: A change in hearing threshold of an average of 10dB or more in the 2000, 3,000 and 4,000 Hz frequency range, relative to the baseline audiogram, in either ear.

21.4. Key Responsibilities

- **Managers and Supervisors:**
  - Ensure the requirements of this program are implemented and maintained.
  - Oversee training programs and ensure compliance with the procedures outlined.
- **Employees**:
  - Properly wear hearing protection where required, attend training sessions, and cooperate with monitoring and testing efforts.

21.5. Procedure

Occupational hearing loss is a cumulative effect of prolonged exposure to high sound levels. Protection strategies focus on reducing noise levels at the employee's ear or limiting exposure time to reduce the risk of hearing damage. Linkan will provide hearing protection devices (HPDs) to all employees exposed to noise levels above the 85 dB threshold, or upon request.

21.5.1. Hearing Conservation Program Requirements

Linkan shall administer a Hearing Conservation Program for employees exposed to noise levels of 85 dB(A) or greater on an 8-hour time-weighted average basis. This program will be continuously effective as long as employees are exposed to hazardous noise levels.

- Employees working in areas with noise levels exceeding 85 dB(A) will be required to wear hearing protection and comply with specific signage in affected areas.
- Monitoring programs will be implemented if exposure data suggests that employees may be subjected to an 8-hour time-weighted average of 85 dB or more.

21.6. Noise Surveys and Monitoring

Noise surveys will be conducted by qualified personnel or third-party services to assess exposure levels. The evaluation considers overall sound levels, exposure duration, and an individual's total exposure. The following information will be recorded during the surveys:

- Area name and location.
- Date and time of survey.
- Person conducting the survey.
- Type of sound level.
- Environmental conditions during the survey.
- Description of employees exposed.

Results will be communicated to each employee, including noise exposure levels and potential risks. A noise exposure map will be created and maintained for all owned facilities.

- Sound measuring equipment must be calibrated before and after each survey. Calibration records must be kept for a minimum of 20 years.
- Noise surveys must be repeated when there are significant changes in the work environment, such as increased noise levels or the introduction of additional employees.

21.6.1. Sound Level Surveys

- Facilities with suspected noise levels exceeding 85 dB (A) must be assessed to confirm exposure levels.

21.6.2. Exposure Surveys

- Representative sampling will be conducted to assess employees' noise exposure over a specified period.
- Noise surveys must be repeated when there are significant changes in the work environment, such as increased noise levels or the introduction of additional employees.

21.7. Signage

Clearly visible signs must be posted at entrances to or within areas where noise levels exceed 85 dB(A). These signs should describe the noise hazard and required protective measures.

21.8. Audiometric Testing

Linkan will implement an audiometric testing program for employees exposed to noise levels at or above 85 dB(A) on an 8-hour time-weighted average. Audiometric tests will be provided at no cost to the employee.

21.9. Baseline Testing Guidelines

- A baseline audiogram will be established for each employee within six months of their initial exposure to noise at or above the action level.
- If a mobile van is used for testing, baseline audiograms must be completed within one year,
- A qualified third party will conduct audiometric testing and provide a report.
- Al least 14 hours without noise exposure is required before baseline testing. Hearing protection may be used to meet this requirement.

21.10. Annual Testing Guidelines

- Audiometric testing will be performed annually for employees exposed to 85 dB(A) or higher on an 8-hour time-weighted average. The annual audiogram will be compared with the baseline to detect any shifts in hearing.
- Employees will be notified in writing within 21 days if a standard threshold shift (STS) is detected.

21.11. Actions Following a Standard Threshold Shift

If an STS is detected:

- Hearing protection will be re-evaluated and/or refitted.
- A medical evaluation may be required to assess the impact.
- Employees may be advised to wear hearing protection more consistently, or in some cases, a reassignment of duties may be necessary to limit further exposure.

21.12. Hearing Protection Devices

- Linkan will provide hearing protection devices at no cost to all employees exposed to an 8-hour time-weighted average of 85 dB(A) or higher.
- Hearing protection will be replaced as necessary, and employees will receive training on proper use, care, and fitting.
- Employees will have the option to select hearing protectors from a variety of suitable options provided by Linkan.

21.13. Training

- All employees exposed to noise levels at or above the action level will receive training on the risks of noise exposure, the use of hearing protection, and the proper maintenance of hearing protectors.
- Training will be conducted at least annually, and additional training will be provided whenever there are changes to PPE or work processes.
- Documentation of all training will be maintained, and employees will receive written certification of their training.

22.0 BLOODBORNE PATHOGENS

22.1. Purpose

The Bloodborne Pathogen Exposure Control Plan is established to ensure a safe and healthful working environment and serves as a performance standard for all employees. This program applies to all occupational exposure to blood or other potentially infectious materials (OPIM). The content of this plan complies with OSHA Standard 29 CFR 1910.1030 (Occupational Exposure to Bloodborne Pathogens).

22.2. Scope

This program addresses all occupational exposure to blood or OPIM, such as bodily fluids that may contain Hepatitis B (HBV) or Human Immunodeficiency Virus (HIV). OSHA mandates that all employers who can "reasonably anticipate exposure" of employees to infectious materials must prepare and implement a written exposure control plan.

22.3. Key Responsibilities

22.3.1. Exposure Control Officer (Stacy Bott)

- Responsible for developing and implementing the Exposure Control Plan across all facilities.

22.3.2. Site Project Managers and Supervisors

- Accountable for managing exposure control within their designated areas.

22.3.3. Employees

- Identify tasks that may involve occasional exposure.
- Conduct all operations in accordance with established work practice controls.
- Maintain good personal hygiene practices.

22.4. Procedure

22.4.1. Training

All employees with occupational exposure are required to participate in a training program. Training will occur.

- Prior to initial assignment,
- Annually, within one year of the previous training.

Training includes:

- Understanding bloodborne pathogens and protective measures.
- Recognizing warning signs and labels.
- Familiarity with OSHA requirements for bloodborne pathogens.
- Information on the Hepatitis B vaccine, offered at no cost to employee.

22.5. Availability of Procedure to Employees

All employees have access to the Exposure Control Plan in a reasonable time, place, and manner.

22.5.1. Review and Update of the Procedure

The plan is reviewed annually and updated as needed, particularly when new positions involving exposure to biohazards are established.

22.6. Exposure Determination

- No job classifications inherently involve exposure to bloodborne pathogens in routine duties.
- Employees trained in first aid and basic life support may encounter exposure during such activities and must adhere to this program.
- No medical sharps or similar equipment are provided for use by employees rendering first aid.
- Exposure determination is made without considering the use of personal protective equipment (PPE).
- A list of trained first aid responders is maintained at each site and in each first aid kit.

22.7. Methods of Compliance

22.7.1. Universal Precautions

All body fluids are treated as potentially infectious when differentiation is not feasible.

22.7.2. Engineering Controls

- Engineering and work practice controls are implemented to minimize employee exposure.
- Handwashing facilities are readily accessible. If unavailable, antiseptic hand cleaners and towels are provided.
- Containers for contaminated reusable sharps are:
  - Puncture resistant.
  - Color-coded or labeled with a biohazard warning.
  - Leak-proof.
- Secondary containers are:
  - Leak-proof.
  - Color-coded or labeled.
  - Puncture-resistant, if necessary.

22.7.3. Work Practice Controls

- Employees must wash hands immediately after removing PPE or after skin contact with blood or OPIM.
- Eating, drinking, smoking, applying cosmetics, and handling contact lenses are prohibited in areas with exposure risks.
- Contaminated surfaces and equipment must be cleaned and decontaminated promptly.
- Bloodborne pathogen kits must be used in emergencies and replaced once used.

22.8. Personal Protective Equipment (PPE)

- PPE is provided at no cost to employees.
- Employees must use PPE, such as gloves and masks, unless exceptional circumstances apply.
- Contaminated PPE must be removed immediately and disposed of properly.
- PPE is repaired, replaced, or laundered, as necessary.

22.9. Housekeeping

- Equipment and surfaces are cleaned and decontaminated after contact with infectious materials.
- Protective coverings are replaced regularly.
- Contaminated glassware is picked up using mechanical tools.

22.10. Post-Exposure and Follow Up

22.10.1. Post Exposure Evaluation and Follow Up

- Incidents involving exposure are promptly investigated by the Linkan Safety Manager or Supervisor.
- Exposed employees receive medical consultation and treatment.
- Confidential documentation is maintained, detailing the exposure and subsequent actions.

22.10.2. Information Provided to Healthcare Professionals

- A copy of the OSHA standard.
- Details of the exposure incident.

22.10.3. Healthcare Professionals' Written Opinion

The healthcare professional provides a written opinion including:

- Hepatitis B vaccination recommendations.
- Results of the evaluation.
- Confirmation that the employee was informed of any finding requiring further treatment.

22.11. Record Keeping

- Training records are kept for at least three years.
- All records are confidential and disclosed only with employee consent or as required by law.

22.12. Labels and Signs

Biohazards warning labels are affixed to:

- Regulated waste containers.
- Sharps disposal containers.
- Contaminated laundry and equipment.

23.0 CHEMICAL EXPOSURE SAFETY PROGRAM

Introduction Linkan has developed the Chemical Exposure Safety Program to address the inherent risks associated with working in water treatment facilities, where exposure to hazardous chemicals is a routine part of operations. This program is designed to enable employees to:

1. Recognize potential hazards related to working with or near hazardous chemicals.
2. Follow established procedures to minimize exposure risks.
3. Respond effectively in the event of chemical exposure.

It is the responsibility of project supervisors to ensure that employees working with or near treatment chemicals are familiar with and adhere to this program. Supervisors must:

- Review project specific Safety Data Sheets (SDS) with employees.
- Explain the dangers of chemical interactions and proper handling techniques.
- Ensure employees understand chemical hazards, necessary protections, and methods for identifying unsafe conditions,

Training Requirements: All employees, regardless of prior experience, must undergo comprehensive training on Linkan's Chemical Exposure Safety Program. Retraining will be provided as necessary to ensure ongoing compliance and understanding.

23.1. Purpose

The primary purpose of this program is to ensure the safe use and handling of hazardous chemicals and to maintain compliance with OSHA's Hazard Communication Standard(HCS 2012).

23.2. Introduction

In 2012, ISHA revised the Hazard Communication Standard to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). This program:

- Establishes procedures for inventorying chemicals, maintaining SDSs, and labeling chemical substances.
- Outlines employee training on chemical hazards.
- Reflects Linkan's ongoing commitment to workplace safety.

All Linkan facilities must adhere to this program, which is available to employees, their representatives and government officials upon request.

23.3. Scope

This program applies to all Linkan employees who may encounter hazardous chemicals. For non-owned or operated sites, the operator's safety program will take precedence unless it is less stringent than Linkan's program.

23.3.1. Responsibilities

23.3.1.1. Safety Manager or Designee

The safety manager (or designee) oversees the implementation and administration of the program. Responsibilities include:

- Reviewing hazards and safe use of chemicals.
- Maintaining an updated list of hazardous chemicals and PSDSs.
- Ensuring proper labeling of containers.
- Providing initial and ongoing training for employees.
- Retaining training records.
- Assessing risk of non-routine tasks and notifying contractors of potential hazards.
- Reviewing the program's effectiveness and ensuring compliance with regulations.

23.3.1.2. Employees

Employees are responsible for:

- Complying with all program requirements.
- Labeling secondary containers appropriately.
- Identifying hazards and reading SDSs and container labels.
- Reporting damaged or missing labels to supervisors.
- Using provided protective equipment (PPE) and adhering to safety instructions.
- Proper care, use, and maintenance of PPE
- Participating in training sessions.

23.3.2. Procedures

23.3.2.1. Hazardous Chemical List

A comprehensive list of hazardous chemicals will be maintained and updated by the Safety Manager or designee. This list will be reviewed annually and made accessible to employees upon request.

23.3.2.2. Safety Data Sheets (SDS)

SDSs must be:

- Obtained and maintained for each chemical used.
- Readily accessible to employees in work areas or primary job sites.
- Retained for chemicals used in the workplace and for employees exposed during their employment.
- Regularly updated, with obsolete SDSs removed when chemicals are no longer in use.

23.3.3. Non-Routine Task Hazards

For non-routine tasks, such as cleaning reactor vessels, employees will.

- Undergo a Job Hazard Assessment (JSA).
- Receive guidance on specific precautions, PPE, and chemical hazards.

- Be provided with relevant SDSs by supervisors.

23.3.4. Labeling and Warnings

- All chemical containers must display:
  - Product identifier
  - Signal word
  - Hazard statement
  - Pictograms
  - Precautionary statements
  - Manufacturer contact information
- Portable containers used immediately do not require labeling unless shared among employees or used across shifts.
- Damaged or incomplete labels must be reported.
- GHS labeling standards will be used.

23.3.4.1. Muti-Employer and Multi-Site Requirements

At multi-employer or multi-site projects, pre-job briefings will ensure contractors and employees understand:

- Chemical hazards present.
- Safety measures and emergency protocols.
- The availability of SDSs and label information.

23.3.5. Training

All employees will receive:

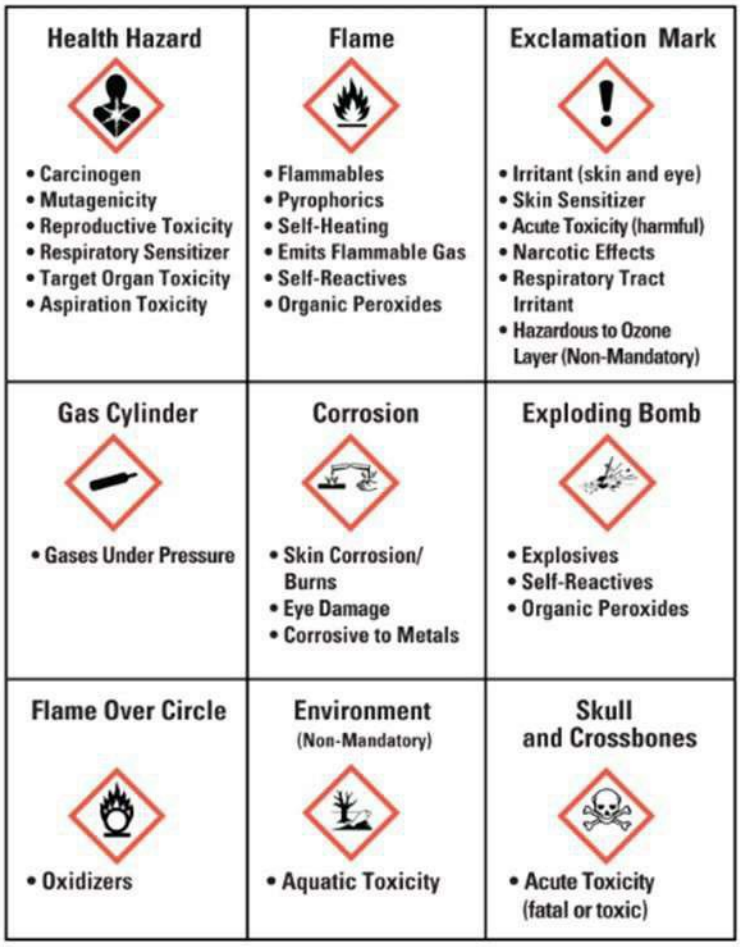
- Initial training upon assignment.
- Ongoing training when new hazards are introduced.
- Additional instruction for non-routine tasks.

Training will cover:

- OSHA Hazard Communication Standard requirements.
- Hazard detection methods (e.g., visual or odor cues).
- Use of SDSs and workplace labeling systems.
- Safe chemical handling and hazard mitigation.

Records of all training sessions will be maintained by the Safety Manager.

23.3.6. *Pictograms and Hazards*



Example Label:

24.0 SPILL PREVENTION AND RESPONSE PLAN

This Spill Prevention and Response Plan is applicable to all Linkan projects across the company and is incorporated into the site-specific Health and Safety Plan developed at the initiation of each project. The plan is designed to address project-specific requirements and must be revised and updated for each project location. Revisions are mandatory whenever the hazardous substance inventory changes. Below are the general requirements and procedures for managing hazardous substances at Linkan projects.

24.1. General Requirements

- **Labeling**: Ensure all hazardous substances are properly labeled according to applicable regulations and standards.
- **Storage and Handling**: Store, dispense, and use hazardous substances in a matter that prevents unintentional releases.
- **Secondary Containment**: Provide secondary containment for hazardous substances stored in bulk quantities (approximately 55 gallons or more).
- **Housekeeping**: Maintain good housekeeping practices for all chemical materials on site to minimize risks of spills or contamination.
- **Inspections**:
  - Conduct routine daily checks of the hazardous substance storage area, performed by the Site Operator or Construction Manager,
  - Perform monthly inspections of storage areas, secondary containment systems, and the annular spaces of double wall tanks (Above ground Storage Tanks [ASTs] and Underground Storage Tanks [USTs]). Document these inspections in this plan.

24.2. Spill Containment

The general spill response procedure involves stopping the spill source, containing the material, and cleaning up promptly to prevent injury or damage. Site personnel should handle small spills if it is safe to do so.

- **Spill Kits**: Each project must have a minimum of one spill kit readily accessible. Personnel must be able to deploy a kit within five minutes.

24.2.1. Emergency Procedures

1. **Immediate Notification**:
   a. On mine sites, call the designated mine emergency number.
   b. Offsite or in other scenarios, dial 911 in the event of injury, fire, potential fire, or hazardous substance spill that constitutes an emergency.
2. **Retrieve Spill Kit**:
   a. Locate and bring the nearest spill kit to the site of the spill.
3. **Assess the Spill**:
   a. Determine the size of the spill and the risk of it reaching storm drains, floors, or permeable surfaces.

   b. If there is an immediate risk, attempt to block the spill from contacting drains or permeable surfaces using absorbent material (e.g., cat litter, sock booms, or rags). Prioritize safety and avoid exposure to hazardous substances.
4. **Contain the Spill**:
   a. Deploy absorbent booms or other containment materials to encircle the spill and direct it away from hazards.
   b. If safe, plug or stop the source of the leak using appropriate protective equipment (e.g., gloves, goggles, protective clothing).
5. **Clean Up and Reporting**
   a. After containment, contact the spill cleanup contractor or initiate cleanup procedures.
   b. Ensure any immediate risks to storm drains or permeable surfaces are mitigated before cleanup begins.

24.3. Plan Management

- The primary contact or designee is responsible for administering this plan. Responsibilities include ensuring updates, maintaining documentation, and incorporating new information as necessary.

24.4. Training

- **Personnel Training**: All personnel who may respond to spills must be trained on this plan's contents and procedures.
- **Training Log**: Maintain a training log with the names of trained individuals and their training dates.
- **Response Limitation**: Only trained personnel may respond to spills. Untrained personnel witnessing a spill should immediately notify their supervisor or Site Safety personnel.

24.5. Spill Tracking

- **Documentation**: Record all spills in the Spill Log. For large or catastrophic spills, include additional pages detailing:
  - Known or possible causes
  - Areas affected
  - Cleanup effectiveness
  - Review of the cleanup contractor and procedures
- **Preventive Measures**: Take corrective actions to prevent recurrence of similar spills.

24.6. Facility Inspections

- **Daily Inspections**: Conduct visual inspections of hazardous substance containers and surrounding areas for signs of spills or leaks. These inspections do not require documentation unless a spill or leak is detected.
- **Monthly Inspections**: Perform comprehensive site inspections using an inspection form. Log the inspection results and attach the form to this plan if issues are identified. If no issues are found, log the results in the Inspection Log.

This plan ensures compliance with safety protocols and regulatory requirements while prioritizing environmental protection and the safety of personnel. It is vital that all team members adhere to the outlined procedures to mitigate risks associated with hazardous substances.

24.7. Chemical Spill Log

Date of Spill	Location of Spill	Size of Spill (- gal)	Prevention Measures Taken	Spill Kit Materials Reordered	Was the Spill Kit Adequate? (List any deficiencies. i.e., missing equipment, etc..)

25.0 ELECTRICAL SAFETY PROGRAM FOR QUALIFIED PERSONNEL

Purpose

This program establishes standardized procedures to ensure compliance with electrical safety standards, mitigate potential electrical hazards, and guide safe operations in environments with electrical risks.

Scope

This program applies to all employees. On non-owned or operated sites, the host operator's safety program takes precedence unless it is absent or less stringent than this program, which then governs all Linkan employees and contractors.

Key Responsibilities

Managers and Supervisors:

- Implement and enforce the electrical safety program.
- Inform workers of electrical hazards before work near energized equipment.
- Ensure compliance with local, provincial, and national electrical codes.
- Approve and maintain proper electrical equipment suitable for use, tested as recommended.

Employees:

- Comply with the electrical safety program requirements.

Procedures:

1. **Qualifications of Electrical Workers**:
   a. Only certified personnel may perform electrical work.
   b. Electrical systems must be de-energized, isolated, and locked out before work, per NFPA 70E. standards.
   c. Qualified workers must demonstrate knowledge of safe practices, PPE, and emergency procedures.
2. **PPE and Tools**:
   a. Use appropriate PPE to prevent electrical shock and arc flash.
   b. Only non-conductive tools are permitted near live electrical installations.
   c. Remove damaged tools from service immediately.
3. **Safe Work Practices**:
   a. Use non-conductive hardhats in high-risk areas.
   b. Require at least two authorized personnel for work on energized equipment above 750 volts.
   c. Tag defective equipment as out of service.
   d. Maintain a clear path to ground for circuits and equipment.
4. **Electrical Fire Safety**:
   a. Minimize fire risks through proper sealing and fire-stopping.
   b. Keep Class C fire extinguishers accessible near high-voltage equipment.
   c. Take special precautions in explosive environments.

5. **Signage and Warnings**:
    a. Use signs and tags to warn of hazards.
    b. Label electrical control panels with danger markings.
    c. Restrict access to control rooms to authorized personnel.
6. **Working Near Energized Parts:**
    a. Maintain safe distances from energized parts based on voltage.
    b. Follow Lockout/tagout (LOTO) procedures.
7. **Lockout/Tagout (LOTO)**
    a. Disconnect, lock out, and tag power supplies before work.
    b. Use tags indicating purpose, status, and responsible personnel.
    c. Employ rubber gloves and protective barriers when needed.
8. **Guarding**
    a. Protect live parts with approved barriers or enclosures.
    b. Ensure switches and receptacles are covered appropriately.
9. **Egress and Access**:
    a. Keep workspaces around electrical equipment clear.
    b. Maintain a minimum 1-meter clearance around equipment.
    c. Ensure safe egress routes from rooms containing electrical equipment.
10. **Hazardous Locations**:
    a. Classify and equip hazardous areas appropriately.
    b. Install service panels in non-hazardous areas when possible.
11. **Portable Equipment**:
    a. Inspect equipment and cords before use.
    b. Use GFCIs in outdoor or damp areas
    c. Ensure tools are grounded or double insulated.
12. **Working Under Overhead Lines**:
    a. Maintain safe clearance distances based on voltage.
    b. Use insulating barriers or de-energized lines as needed.
13. **Emergency Procedures:**
    a. Verify panels with voltage testers before handling.
    b. Disconnect power before assisting victims.
    c. Call emergency services for incidents involving high-voltage lines.
14. **Closing Electrical Panels**:
    a. Stand to the side while operating switches.
    b. Ensure all control switches are off before engaging master switches.
15. **Electrical Contact Response**:
    a. Avoid touching victims until power is disconnected.
    b. Use non-conductive materials to separate the victim.
    c. Administer first aid, including CPR if trained.
16. **High Voltage Contact**:

a. De-energize areas before assisting victims.
b. Immediately notify emergency services.

25.1. Training Requirements

25.2. Training for Unqualified Personnel

All Linkan personnel will receive annual training in the requirements of this program and general electrical safety procedures. The training will cover the following key elements:

- Employees exposed to electric shock risks but not classified as qualified personnel will be trained in electrical safety practices relevant to their roles.
- Training will include safety-related work practices specific to job assignments.
- Unqualified personnel must maintain a minimum distance of 42 inches from exposed circuits or equipment energized between 50 and 750 volts, except when supervised by a qualified individual.
- Instruction on clearance distances based on voltage, including those for overhead power lines, will be provided.
- Emergency response procedures for electrical contact will be covered.
- All training will be documented and retained on file for recordkeeping purposes.

25.3. Training for Qualified Personnel

These training requirements apply to employees who are exposed to electrical shock risks that cannot be mitigated to a safe level and those authorized to work on or near exposed energized components (i.e., certified Electricians). Training will include:

- Safety-related work practices relevant to specific job assignments.
- Skills to distinguish live parts from other components of electrical equipment.
- Techniques to determine the nominal voltage of exposed live parts.
- Knowledge of clearance distances as specified in OSHA regulation 1910.333(c) and the corresponding voltages to which the qualified individual may be exposed.
- Training for work involving direct contact with energized equipment or indirect contact using tools or materials, in compliance with OSHA regulation 1910.333(c)(2).
- Comprehensive understanding of NFPA 70E 2015 standards.

This training ensures that both unqualified and qualified personnel are equipped with the knowledge and skills necessary to perform their duties safely and in compliance with regulatory standards.

26.0 MOBILE EQUIPMENT

This section outlines the specific hazards associated with working with mobile equipment and provides strategies for mitigating these risks to ensure the safety of all personnel involved.

Hazards if Working with Mobile Equipment:

26.1. Collisions

Hazard: Collisions can occur between mobile equipment and personnel, other vehicles, or stationary objects, leading to serious injuries or fatalities.

Mitigation Strategies:

- Implement clear traffic control measures, including designated pathways and signage.
- Use spotters in congested areas to guide operators.
- Provide high-visibility clothing for workers in the vicinity of mobile equipment.

26.2. Tip-Overs

Hazard: Mobile equipment can tip over due to improper loading, uneven surfaces, or abrupt maneuvers, posing risks to operators and nearby personnel.

Mitigation Strategies:

- Ensure operators are trained on load limits and center of gravity principles.
- Conduct site assessments to identify and address uneven or unstable surfaces.
- Use stabilizers and outriggers where applicable.

26.3. Falling Objects

Hazard: Loads or equipment parts may fall from cranes, forklifts, or other mobile equipment, posing risks to personnel below.

Mitigation Strategies:

- Always secure loads with appropriate rigging and straps
- Establish exclusion zones beneath lifting operations.
- Use appropriate barriers and nets when working at heights.

26.4. Mechanical Failures

Hazard: Equipment can fail due to lack of maintenance, resulting in accidents or injuries.

Mitigation Strategies:

- Implement a regular maintenance and inspection schedule for all mobile equipment.
- Train operators to recognize early warning signs of mechanical issues.
- Keep a log of inspections and maintenance performed.

26.5. Environmental Hazards

Hazard: Environmental conditions such as poor visibility, weather changes, and ground conditions can significantly impact safe operations.

Mitigation Strategies:

- Monitor weather conditions and adjust operations accordingly.
- Ensure adequate lighting in work areas, particularly during low light conditions.
- Conduct risk assessments for specific environmental challenges on site.

26.6. Operator Fatigue

Hazard: Fatigue can impair an operator's ability to safely control mobile equipment, increasing the risk of accidents.

Mitigation Strategies:

- Implement policies for breaks and shift limits to prevent fatigue.
- Encourage operators to report fatigue and take breaks as needed.
- Monitor workloads to ensure they are manageable.

26.7. Inadequate Training

Hazard: Operators who lack proper training may not recognize hazards or may operate equipment unsafely.

Mitigation:

- Provide comprehensive training programs for all operators, including hands-on training and assessments.
- Conduct regular refresher courses and drills to maintain skill level.
- Ensure operators understand emergency procedures and safety protocols.

26.8. Visibility Issues

Hazard: Blind spots around mobile equipment can lead to accidents, especially in crowded or confined spaces.

Mitigation Strategies:

- Equip mobile equipment with mirrors or cameras to improve visibility.
- Train operators on safe driving practices, including the importance of checking blind spots.
- Use audible alarms or warning systems to alert personnel when equipment is in motion.

1. **Operator Training and Experience Requirements**

Operators of mobile equipment must be adequately trained and possess the appropriate experience to safely operate the equipment. This training ensures that operators understand:

- The specific functions and controls of the equipment they will be operating.
- Safe operating procedures and practices to minimize hazards.
- How to conduct pre-operation inspections and identify potential issues.

2. **Authorization to Operate Mobile Equipment**

In addition to meeting the training and experience requirements, the program mandates that operators of mobile equipment must be authorized by the company prior to operating any mobile equipment. This authorization process includes:

- **Verification of Training**: Operators must provide proof of completed training specific to the type of mobile equipment they will operate.
- **Assessment of Competence**: Operators may be required to undergo a practical evaluation to demonstrate their proficiency in operating the equipment safely.
- **Company Issuance of Authorization**: Only those operators who meet the training, experience, and assessment criteria will receive formal authorization to operate mobile equipment.

3. **Ongoing Training and Reauthorization**

- Operators must participate in ongoing training to stay updated on any changes in equipment, procedures, or safety regulations.
- Reauthorization may be required at regular intervals or after any incidents involving mobile equipment to ensure continued competence and safety.

By adhering to these requirements, the company aims to ensure that only qualified and authorized personnel operate mobile equipment, thereby enhancing safety for all employees and minimizing the risk of accidents in the workplace.

Pre-Use Inspection Requirements

1. **Pre-Use Inspection Requirement**

All affected company employees must perform a thorough inspection of mobile equipment prior to use to verify that the equipment is in a safe and operational condition. This requirement is essential to identify potential hazards and ensure the safety of both the operator and other personnel in the vicinity.

2. **Inspection Procedure**

Before operating mobile equipment, the following steps must be taken:

1. **Visual Inspection:**
   a. Check for visible signs of damage or wear on the equipment.
   b. Inspect tires or tracks for proper inflation or wear.
   c. Ensure that all safety devices, such as guards and lights, are intact and functional.
2. **Operational Checks:**
   a. Test the controls to ensure they are responsive and functioning correctly.
   b. Check brakes, steering, and other operational components for proper functionality.
3. **Fluid Levels**:
   a. Verify that fuel, oil, hydraulic fluid, and other necessary fluids are at appropriate levels.
4. **Load Capacity Verification**:
   a. Ensure that the load capacity is clearly marked and not exceeded.
   b. Inspect any attachments to confirm they are suitable for the intended load.

5. **Documentation**:
   a. Complete a pre-use inspection checklist, documenting any findings or necessary repairs.
   b. Report any issues to a supervisor before operating the equipment.

26.9. Accountability and Compliance:

- Operators are responsible for conducting these inspections and ensuring that any identified issues are resolved before use.
- Supervisors must verify that inspections are performed and documented as part of their oversight responsibilities.
- Failure to perform a pre-use inspection may result in disciplinary action, as it compromises safety and compliance with company policies.

26.10. Backup Alarm Requirement

To enhance safety and reduce the risk of accidents when operating mobile equipment, all mobile equipment utilized by company employees must be equipped with a functional backup alarm or signal. This requirement is essential for alerting personnel in the vicinity of the equipment's movement, particularly when reversing.

Specifications for Backup Alarms:

- **Audible Backup Alarms**: All mobile equipment must be fitted with a backup alarm that emits a sound loud enough to be heard over surrounding noise levels.
- **Visual Signals**: In addition to audible alarms, visual signals such as flashing lights may also be utilized to enhance awareness of the equipment's operation.
- **Testing and Maintenance**: Back-up alarms must be regularly tested to ensure they are functioning properly. Any malfunctions should be reported immediately and addressed before the equipment is operated.

Operator Responsibilities:

Operators of mobile equipment are responsible for ensuring that the backup alarm is operational prior to beginning work. This includes:

- Performing a quick visual check of the backup alarm as part of the pre-use inspection.
- Reporting any issues with the alarm to a supervisor for prompt repair.

Compliance and Accountability:

- Supervisors must ensure that all mobile equipment on site is equipped with the required backup alarms and that they are maintained in good working order.
- Compliance with this requirement is mandatory, and failure to equip mobile equipment with backup alarms may result in disciplinary action.

26.11. Seat Belt Requirement

All company employees operating mobile equipment must wear a seat belt when starting and using the equipment, provided that the mobile equipment is equipped with a seat belt. This requirement is essential for ensuring the safety of operators and reducing the risk of injury in the event of an accident.

Implementation of the Seat Belt Policy;

- **Mandatory Use**: Operators are required to fasten their seat belts before starting the equipment and keep them fastened throughout operation.
- **Pre-Operation Checks**: Operators should verify that the seat belt is functional and in good condition as part of the pre-use inspection.

Operator Responsibilities:

- Operators must ensure they are securely buckled in before operating the equipment.
- They are responsible for reminding any passengers (if applicable) to wear seat belts as well.

Training and Awareness:

- All operators will receive training on the importance of seat belt use, including statistics on the reduction of injuries and fatalities.
- Regular safety meetings will reinforce the necessity of wearing seat belts while operating mobile equipment.

26.12. Load Limit Requirement

All company operators of mobile equipment are required to adhere strictly to the established load limits for each piece of equipment. This requirement is critical to ensuring safe operations and preventing accidents or equipment failures.

Implementation of Load Limit Policy:

- **Awareness of Load Limits**: operators must familiarize themselves with the load capacity specified by the manufacturer, which is typically displayed on the equipment or in the operator's manual.
- **Load Verification**: Before loading, operators should verify that the weight of the load to ensure it does not exceed the equipment's rated capacity.

Operational Procedures:

- **Loading Techniques**: Operators should use safe loading techniques to distribute weight evenly and maintain stability.
- **Monitoring During Operation**: Operators must continuously monitor the load during transport to ensure stability and balance.

27.0 LIGHT DUTY VEHICLES

27.1. General Requirements

1. Employees may only operate vehicles for which they possess a valid driver's license specific to the vehicle type. Operating vehicles for commercial purposes, transporting materials, or carrying hazardous materials requires appropriate licensing and certifications.
2. Before operating motorized equipment, the following components must be inspected for proper function and adjustment: taillights, headlights, signal lights, mirrors, windshield wipers, and backup alarms. A vehicle inspection form should be used to document checks.
3. Each company vehicle must carry a fully charged fire extinguisher in good condition, with a minimum B:C rating.
4. Cutting tools or sharp-edged tools transported in passenger compartments must be secured in closed containers or boxes.
5. Workers are prohibited from riding on fenders, tailgates, running boards, or loads under any circumstances.
6. Vehicles must not be backed up when the driver's rear view is obstructed unless an operable backup alarm is in place, or a designated observer provides clearance signals.
7. Drivers must confirm that any trailers or equipment being towed are securely attached to the towing device with safety chains connected to both the truck and the towed item. Additionally, brake and signal lights must be properly connected when required.
8. Trucks must not be operated in hazardous areas, such as the edges of deep fills, cut banks, or steep slopes, to avoid the risk of overturning. No workers should remain inside trenches during backfilling unless they are clearly visible to the operator.
9. When parking vehicles, the parking brake must be engaged, and the ignition turned off. Vehicles must not be left unattended until the engine is off, parking brakes set, and gears placed in low or reverse.
10. Employees must not work under a vehicle supported by jacks or chain hoists unless the vehicle is securely blocked or supported with jack stands to prevent injury in the event of equipment failure.
11. No smoking or vaping is permitted in Linkan Company vehicles.
12. Moving violations cited while driving Linkan company vehicles must be reported to management by end of shift.
13. Any accidents or damage to Linkan company vehicles must be reported immediately and appropriate incident reports must be turned in within 24 hours.
14. Accidents involving other vehicles, pedestrians or non Linkan property require a police report as well as immediate notification to management.
15. Drivers are responsible for keeping Linkan company vehicles clean on the inside and out.
16. Keep the gas tank full for the next person.
17. Remove excessive mud from the undercarriage of vehicles.

27.2. Light Vehicle Pre-Op Inspection

Date:		
Equipment #:		
Project ID:		
Vehicle Mileage:		
Employee Name:		
Item	**OK**	**R&M**
Exterior Housekeeping	☐	☐
Body (Dents, Dings, Damage)	☐	☐
Buggy Whip	☐	☐
Strobe Light	☐	☐
Wheel Chocks	☐	☐
Fluid Levels	☐	☐
Tires	☐	☐
Interior Housekeeping	☐	☐
Lights: Headlights, Taillights, Turn Signal	☐	☐
Parking/Emergency Brake	☐	☐
Brakes	☐	☐
Backup Alarm	☐	☐
Horn	☐	☐
Seatbelt	☐	☐
Wipers/Washer	☐	☐
Fire Extinguisher	☐	☐
Windshield	☐	☐
Repair & Maintenance Notes		
R&M Technician Notes		
Employee Signature		
R&M Initials: **Date:**		

28.0 CONCRETE/ MANSONRY CONSTRUCTION

28.1. Purpose

The purpose of this program is to prevent injury from hazards associated with concrete and masonry construction work.

28.2. Scope

This program covers all employees involved in concrete and/or masonry work.

28.3. Key Responsibilities

28.3.1. Managers/Supervisors

- Shall ensure that all employees are aware of the hazards associated with concrete and masonry during construction and are properly trained prior to their exposure of those hazards.
- Shall ensure that initial training is conducted for all new employees and that retraining is conducted when employee behaviors suggest that retraining is warranted.

28.3.2. Employees

- Shall follow all requirements regarding safe work practices and the requirements of this program.
- Report all hazards if not previously made aware of them, especially when changes occur.

28.4. Procedure

28.4.1. Hazards Associated with Concrete/Masonry Construction

- Concrete Buckets: Impact injuries due to defective slings/hardware.
- Concrete Pumper Truck: Electrical injuries due to overhead power lines; Impact injuries due to improper operator operations.
- Concrete: Caustic burns to eyes and skin; Impact injury due to falling buckets, blocks, bricks, or other objects; Respiratory hazards due to concrete dust.
- Cranes: Impact injuries due to defective slings or unbalanced load.
- Electric Saws: Shock injuries due to defective power cords or non-grounded circuit.
- Flagging: Impact injuries for flaggers exposed to traffic.
- Forklifts: Impact injuries due to exceeding the lifting capacity or improper operation by operator.
- From Work: Fall injuries from height, ladders, or open excavation; Slips and trips working with footers: Cuts and puncture wounds from exposed nails.
- Leading Edge Work: Fall injuries due to height and lack of knowledge - only experienced and authorized workers allowed.
- Rebar: Struck Against injuries due to impalement on end of rebar; Slips and trips working with rebar.

Injuries can result from unsafe work practices including:

- Premature removal of formwork.

- Failure to brace masonry walls.
- Failure to adequately support precast panels.
- Inappropriate operation of equipment.
- Failure to guard the end of reinforcing steel.
- Inadequate shoring, which can lead to formwork collapse.

28.4.2. Safe Work Practices and Requirements

Construction Loads:

Linkan must not place construction loads on a concrete structure or portion of a concrete structure unless Linkan determines, based on information received from a person who is qualified in structural design, that the structure or portion of the structure is capable of supporting the intended loads.

Reinforcing Steel:

- All protruding reinforcing steel, onto and into which employees could fall, must be guarded to eliminate the hazard of impalement.

Post-Tensioning Operations:

- Employees (except those essential to the post-tensioning operations) must not be permitted to be behind the jack during tensioning operations.
- Signs and barriers must be erected to limit employee access to the post-tensioning area during tensioning operations.

Concrete Buckets:

- Employees must not be permitted to ride concrete buckets.

Working Under Loads:

- Employees must not be permitted to work under concrete buckets while the buckets are being elevated or lowered into position.
- To the extent practicable, elevated concrete buckets must be routed so that no employee or the fewest employees possible are exposed to the hazards associated with falling concrete buckets.

28.4.3. Concrete and Masonry Construction

Personal Protective Equipment:

Employees must not be permitted to apply cement, sand, and water mixture through a pneumatic hose unless they are wearing protective head and face equipment.

General Requirements for Formwork:

Formwork must be designed, fabricated, erected, supported, braced, and maintained so that it will be capable of supporting without failure all vertical and lateral loads that might be applied to the formwork. As indicated in the Appendix to the standard, formwork that is designed, fabricated, erected, supported, braced, and maintained in conformance with Sections 6 and 7 of the American National Standard for

Construction and Demolition Operations—Concrete and Masonry Work (ANSI) A10.9-1983 also meets the requirements of this paragraph.

Drawing or Plans:

Drawings and plans, including all revisions for the jack layout, formwork (including shoring equipment), working decks, and scaffolds must be available at the jobsite.

Shoring and Reshoring:

- All shoring equipment (including equipment used in reshoring operations) must be inspected prior to erection to determine that the equipment meets the requirements specified in the formwork drawings.
- Damaged shoring equipment must not be used for shoring. Erected shoring equipment must be inspected immediately prior to, during, and immediately after concrete placement. Shoring equipment that is found to be damaged or weakened after erection must be immediately reinforced.
- The sills for shoring must be sound, rigid, and capable of carrying the maximum intended load. All base plates, shore heads, extension devices, and adjustment screws must be in firm contact and secured, when necessary, with the foundation and the form.

If single-post shores are used one on top of another (tiered), then additional shoring requirements must be met. The shores must be as follows:

- Designed by a qualified designer and the erected shoring must be inspected by an engineer qualified in structural design,
- Vertically aligned,
- Spliced to prevent misalignment, and
- Adequately braced in two mutually perpendicular directions at the splice level. Each tier also must be diagonally braced in the same two directions.

Adjustment of single-post shores to raise formwork must not be made after the placement of concrete.

Reshoring must be erected, as the original forms and shores are removed, whenever the concrete is required to support loads in excess of its capacity.

Vertical Slip Forms:

The steel rods or pipes on which jacks climb or by which the forms are lifted must be specifically designed for that purpose and adequately braced where not encased in concrete.

Forms must be designed to prevent excessive distortion of the structure during the jacking operation. Jacks and vertical supports must be positioned in such a manner that the loads do not exceed the rated capacity of the jacks.

The jacks or other lifting devices must be provided with mechanical dogs or other automatic holding devices to support the slip forms whenever failure of the power supply or lifting mechanisms occurs.

28.4.4. Requirements for Cast in Place Concrete

- The form structure must be maintained within all design tolerances specified for plumbness during the jacking operation.

- The predetermined safe rate of lift must not be exceeded. All vertical slip forms must be provided with scaffolds or work platforms where employees are required to work or pass.

28.4.5. Reinforcing Steel

Reinforcing steel for walls, piers, columns, and similar vertical structures must be adequately supported to prevent overturning and collapse.

Linkan must take measures to prevent unrolled wire mesh from recoiling. Such measures may include, but are not limited to, securing each end of the roll, or turning over the roll.

Removal of Formwork:

Forms and shores (except those that are used for slabs on grade and slip forms) must not be removed until Linkan determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Such determination must be based on compliance with one of the following:

- The plans and specifications stipulate conditions for removal of forms and shores and such conditions have been followed, or
- The concrete has been properly tested with an appropriate American Society for Testing and Materials (ASTM) standard test method designed to indicate the concrete compressive strength and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

28.4.6. Precast Concrete

- Precast concrete wall units, structural framing and tilt-up wall panels must be adequately supported to prevent overturning and to prevent collapse until permanent connections are completed.
- Lifting inserts that are embedded or otherwise attached to tilt-up wall panels must be capable of supporting at least two times the maximum intended load applied or transmitted to them. Lifting inserts for other precast members must be capable of supporting four times the load. Lifting hardware shall be capable of supporting at least five times the maximum intended load applied or transmitted to the lifting hardware.
- Only essential employees are permitted under precast concrete that is being lifted or tilted into position.

28.4.7. Lift-Slab Operations

- Lift-slab operations must be designed and planned by a registered professional engineer who has experience in lift-slab construction. Such plans and designs must be implemented by Linkan and must include detailed instructions and sketches indicating the prescribed method of erection. The plans and designs must also include provisions for ensuring lateral stability of the building/structure during construction.
- Jacking equipment must be marked with the manufacturer’s rated capacity and must be capable of supporting at least two and one-half times the load being lifted during jacking operations and the equipment must not be overloaded.
- Jacks/lifting units must be designed and installed so that they will neither lift nor continue to lift when loaded in excess of their rated capacity and jacks/lifting units must have a safety device which will cause the jacks/lifting units to support the load at any position in the event of their malfunction or loss of ability to continue to lift.

- No employee, except those essential to the jacking operation, shall be permitted in the building/structure while any jacking operation is taking place unless the building/structure has been reinforced sufficiently to ensure its integrity during erection.
- Under no circumstances shall any employee who is not essential to the jacking operation be permitted immediately beneath a slab while it is being lifted.

28.4.8. Masonry Construction

Whenever a masonry wall is being constructed, employers must establish a limited access zone prior to the start of construction. The limited access zone must be as follows:

- Equal to the height of the wall to be constructed plus 4 feet and shall run the entire length of the wall.
- On the side of the wall that will be unscaffolded;
- Restricted to entry only by employees actively engaged in constructing the wall; and
- Kept in place until the wall is adequately supported to prevent overturning and collapse unless the height of the wall is more than 8 feet and unsupported, in which case it must be braced. The bracing must remain in place until permanent supporting elements of the structure are in place.

29.0 PANDEMIC PREPAREDNESS

29.1. Purpose

Business continuity means ensuring that essential business functions can survive a natural disaster, technological failure, human error, or other disruption. Many existing business continuity plans anticipate disruptions such as fires, earthquakes, and floods. These events are restricted to certain geographic areas and the time frames are fairly well defined and limited.

Pandemic disease, however, demands a different set of continuity assumptions since it will be widely dispersed geographically and potentially arrives in waves that could last several months at a time.

29.2. Assignment of Ownership of the Pandemic Disease Plan

A pandemic disease plan or disease containment plan is developed for Linkan, and a coordinator appointed. We have identified a workplace coordinator who will be responsible for dealing with disease issues and their impact at the workplace. This may include contacting local health departments and health care providers in advance and developing and implementing protocols for response to ill individuals.

29.3. Assumptions

A pandemic disease will spread rapidly and easily from person to person, affecting all businesses due to absenteeism. Businesses that are relied upon by other businesses will be facing the same massive absentee rates and will be unable to provide essential components to maintain the daily operations.

Risk assessments to identify the essential/critical components of our business operation need to be conducted.

Recognize that a pandemic includes:

- Healthcare services not being available (they are already full at present with the usual ailments).
- Schools, churches, and other public places are not open.
- Borders are partially or fully closed, especially airports, leaving people (our families, employees, business partners, customers, and suppliers) “stranded.”
- Essential materials and supplies may be limited due to distribution chains that are affected by the travel restrictions or absentee workers supporting those transportation means.
- Essential services around utilities, food distribution/access and banking systems may not be at “normal levels;” access to cash flow could be tight.
- People may not be willing to or able to come to work.

29.4. Effective Internal/Employee Communication Procedure

Communications during a pandemic involves both internal communications and external communications. Internal communication will be provided to employees to educate them about pandemic diseases and measures they can take to be prepared.

Key contacts, a chain of communications and contact numbers for employees, and processes for tracking business and employee status should be developed.

Risk communication is critical to inform employees regarding changes in the pandemic status. The following is one method for providing such information.

Alert: conveys the highest level of importance; warrants immediate action or attention.

Advisory: provides key information for a specific incident or situation; might not require immediate action.

Update: provides updated information regarding an incident or situation; unlikely to require immediate action.

Provide continuous updates through internal & external communications when a pandemic is imminent:

- Notification to employees of operational changes
- Provide frequent updates about the pandemic status,
- Provide advisories and alerts as conditions change,
- Ensure vendors and suppliers have available a dedicated communications contact,
- Monitor local, state, and federal pandemic updates,

We will use our phone systems that can perform automatic dialing from a database with each employee contact number to send notifications and messages about alerts. The use of the company website also will serve as a portal for sharing information with employees and vendors.

29.5. Effective External/Customer Communication Procedure

A procedure must be developed to notify key contacts, including both customers and suppliers, in the event an outbreak has impacted our ability to perform services. This procedure must also include notification to customers and suppliers when operations resume.

29.6. Business Continuity Planning

Business continuity plans should be prepared so that if a large or significant absenteeism of personnel become ill or changes in business practices are required business operations can be effectively maintained.

Command Staff:	
Incident Commander (President / CEO)	Organizes and directs all aspects of the incident response.
Public Information Officer (Media / Public Relations)	Creates and releases upon approval from the incident commander all information to the staff, media and public.
Liaison Officer (Vice President)	Establishes and maintains relationships with outside organizations.
Safety Officer (Safety Manager)	Ensures the safety of all persons involved with the pandemic.
Operations Section:	
Operation Section Chief (Director of Operations)	Initiates and manages ongoing operations throughout a pandemic.

Logistics Section: Logistics Section Chief (Purchasing/Inventory Manager)	Meets the goods, services, and staffing needs of the operation during the Pandemic.
Planning Section: Planning Section Chief (Lead Administrator)	Collects information and resources potentially relevant to the pandemic and company operations. .
Finance Section: Finance Section Chief (Purchasing/Account Manager)	Monitors all expenditures and ensures fiscal resources availability during pandemic.

29.7. Pandemic Response by Pandemic Phase

Currently the WHO has created various phases for a pandemic but does not always relate to events locally.

- Level 0 (WHO Phase 3) - Novel virus alert- not human-to-human transmission.
- Level 1 (WHO Phase 4) - Confirmed cases of human-to-human transmission of novel disease virus.
- Level 2 (WHO Phase 5) - Suspected/confirmed cases in the local area.
- Level 3 (WHO Phase 5) - Numerous suspected/confirmed cases in the local area.

29.8. Work at Home or Stay at Home Policy

Flexible work policies should be developed as much as possible. Workers should be encouraged to stay at home when ill, when having to care for ill family members, or when caring for children when schools close, without fear of reprisal. Tele-commuting or other work-at-home strategies should be developed.

29.9. Infection Control Measures

Guidelines for infection control are important to clarify the routes of transmission and the ways to interrupt transmission through measures of hygiene. Infection control is an essential component of pandemic management and a component of public health measures. Essential measures include:

- Hand washing and use of hand sanitizers should be encouraged by Linkan supervision. Hand washing facilities, hand sanitizers, tissues, no touch trash cans, hand soap and disposable towels should be provided by Linkan.
- Workers are encouraged to obtain appropriate immunizations to help avoid disease. Granting time off work to obtain the vaccine will be considered when vaccines become available in the community.
- Limiting large or crowded gatherings of personnel if an outbreak or increased level of disease is in progress - Social distancing including increasing the space between employee work areas and decreasing the possibility of contact by limiting large or close contact gatherings should be considered.
- Equipment and/or working surfaces shall be cleaned periodically. Clean all areas that are likely to have frequent hand contact (like doorknobs, faucets, handrails) periodically and when visibly soiled. Work surfaces should also be cleaned frequently using normal cleaning products.

Additional examples of infection control measures include:

- Stay at home when you are sick. If possible, stay away from work, school and from running errands. You will help others from catching your illness.
- Cover your coughs and sneeze into tissue, or cough into your shirt sleeve.
- Enhance existing housekeeping service by wiping down and disinfecting work areas (i.e., keyboards, telephones, desks, etc.) frequently.
- Enhance housekeeping services for general public use areas several times throughout the work period.
- Use personal protective equipment where appropriate to minimize exposure (i.e., gloves- for handling money, masks- for ill employees).

29.10. Implementation, Testing, and Revision of the Plan

The Pandemic Plan is reviewed and/or tested. The plan and emergency communication strategies should be periodically tested to ensure it is effective and workable.

29.11. Process of Implementing Lessons Learned following a Pandemic Event

Following a pandemic event, the person responsible for implementation of the plan will identify learning opportunities and take action to implement any corrective actions.

A review of the plan's-initiated actions completed will identify all action items that were taken versus and when the action items were to be completed via a gap analysis indicating when specific action items were to occur, and when actual completion dates were completed.

Input will be asked from our staff and management regarding what went well and what could be improved during the event. All findings that indicate where improvements can be made will be used as Lessons Learned process to modify this plan as required. Corrective actions will be assigned to specific management representatives as required. Implementation of the Lessons Learned will be communicated to all employees and a revised plan issued.

29.12. Training

Employees will be trained in health issues of the pertinent disease to include prevention of illness, initial disease symptoms, preventing the spread of the disease, and when it is appropriate to return to work after illness. Disease containment plans and expectations should be shared with employees. Communicating information with non-English speaking employees or those with disabilities must be considered.

Documentation of all training is required.

30.0 WORKING AT HEIGHTS

30.1. Policy Statement

Working at Heights Policy requires that fall protection systems must be used if persons are working where a fall of six feet or greater could occur or whenever the performance of a task could expose a person to the risk of falling.

30.2. Purpose

The purpose of this Working at Heights Policy is to ensure the safety and health of all employees, including contract employees, by controlling the potential of injury from a fall.

30.3. Scope

The purpose of this Working at Heights Policy is to ensure the safety and health of all employees, including contract employees, by controlling the potential of injury from a fall.

30.4. Responsibilities

30.4.1. All Personnel

All personnel (as defined in “Scope” above) are responsible for adhering to the requirements of this Policy and are responsible for the condition and proper use of their personal fall protection systems.

30.4.2. Safety, Health & Security Personnel

Safety, Health & Security personnel shall:

1. Approve all personal fall protection equipment and components purchased for use by Linkan personnel.
2. Provide program oversight, coaching, and coordinating.
3. Ensure the training required by this Policy is conducted.
4. Track annual fall protection harnesses and equipment inspections (not to exceed 12 months) and ensure that annual inspections are completed.
5. Conduct fall protection audits at Linkan to ensure:
   a. That fall protection policies and procedures are being followed.
   b. The accuracy of the equipment tracking system.
6. Ensure that proper equipment is available in stock.

Will provide:

1. Assistance in Fall Protection Equipment inspections to ensure that Linkan stays in compliance with fall protection inspection requirements.
2. Assistance for Fall Protection questions or concerns at Linkan.
3. The required fall protection training for new hires.
4. The required annual refresher training in fall protection with this required training as needed.

30.4.3. Management

Managers shall provide resources and support for this Policy.

30.4.4. Subcontractors

Subcontractor Working at Heights Programs must meet or exceed the standards and design parameters of this Policy. Linkan does not supply fall protection equipment or training to subcontract personnel.

30.4.5. Temporary Contract Employees

Temporary Employees are often under contract to work for Linkan. Where such Temporary Employees are assigned to work on activities requiring fall protection, Linkan will provide the necessary fall protection equipment and training.

30.5. Definitions

Personal Fall Protection System: A Personal Fall Protection System can be either a Fall Arrest System (a system that safely limits and controls a fall hazard), or a Fall Restraint System (a system that prevents and controls exposure to a fall hazard). Included in fall protection systems are Handrails, Scaffolding, Ladders, Personal Safety Berms, Manlifts, etc.

Personal Fall Arrest System: A Personal Fall Arrest System is an assembly including a full body harness, lanyard (equipped with a fall deceleration device) and/or lifeline, connectors and anchorage used in accordance with manufacture instructions and ANSI Z359.2-1992.

1. Designed to prevent impact with a lower level by limiting and controlling the distance of a fall.

Personal Fall Restraint System: A Personal Fall Restraint System is a system similar to a Personal Fall Arrest System with the following exceptions:

1. Designed to prevent exposure to a fall hazard by restricting access to the hazard.
2. The anchorage is to be capable of withstanding at least 5,000 pounds of force.

Worker positioning System: Worker Positioning systems do not replace Fall Arrest Systems. They are designed and intended use is to free the workers' hands. They are allowed when accompanied by an approved Personal Fall Arrest System.

Handrails: Handrails are railings placed, in accordance with MSHA Standard 57/56.111002, to prevent falling from an elevated travel way or platform. Handrails are installed under guidelines set forth in OSHA Standards STD 03-10-003 and STD 3-10.3 – 29. Handrail parameters under these OSHA standards include:

1. **Handrails:** Handrails are railings placed, in accordance with MSHA Standard 57/56.111002, to prevent falling from an elevated travel way or platform. Handrails are installed under guidelines set forth in OSHA Standards STD 03-10-003 and STD 3-10.3 – 29. Handrail parameters under these OSHA standards include:
   a. Shall be secured to vertical supports and kept taut utilizing a tensioning device to reduce sag, as necessary.
   b. Shall be free of sharp edges, burrs or projections which may be a hazard.

c. Must be securely attached to vertical supports and/or structures of substantial construction with a horizontal and vertical deflection of 3 inches or less when a load of 200 pounds is applied.

Fall Protection Champions: Full time employees who have completed a 40-hour training program in Fall Protection and have been certified and are assigned by each division.

Competent Person (End User): Full time employees who have been trained and certified through Linkan to inspect their own harness as needed and use fall protection systems offered by Linkan.

Fall Protection "Trainer/Facilitator/Inspector": Full time employees who have attended Linkan's train the trainer course offered by fall protection champions.

Personnel Safety Berm: A Personnel Safety Berm is a structure of earth, rock, or other material of sufficient height "42 inches minimum" and width to prevent a person from inadvertently falling over or through the barrier.

Six Foot Rule: The Six-Foot Working at Height Rule requires employees to use fall protection at all times when exposed to a fall equal to or greater than six feet. A field level risk assessment must be completed for tasks at heights below 6 feet. If warranted fall protection, fall prevention, other forms of fall prevention and safe access is required less than six feet.

Ten Foot Rule: The Ten Foot Rule pertains to the distance measured from where a person is standing or working next to the edge of a sloped roof, sloped top of tank, sloped top of silo, open hole, open stope, similar structure, or another fall hazard.

Fall protection shall be provided when employees work at heights of six feet or greater in construction and four feet or greater in general industry.

30.6. Policy Guidelines

Guidelines for Fall Protection Systems when there is a danger to falling:

1. Prior to beginning a task, a Field Level Risk Assessment (FLRA) is required to identify and address fall hazards. Fall Hazards include but are not limited to the following:
2. Housekeeping, slipping or tripping hazards.
3. Working from heights that would trigger the use of fall protection systems.
4. Certain types of exposed climbing and access to work areas.
5. Working near edges where there is a risk of falling.
6. Based upon the FLRA of the fall hazards identified, fall hazard controls would include:
7. Requiring the use of the appropriate type of fall protection system.
8. Identifying the location of approved tie-offs and/or anchor points.
9. Establishing barricades, signs, handrails (portable or fixed), etc.

This Policy sets forth guidelines for the use of Personal Fall Restraint Systems and Personal Fall Arrest Systems in specific situations to eliminate fall hazards where the Six-Foot working height rule or the Ten Foot off-set rule would most likely and most frequently be applicable.

Personal Fall Restraint Systems are required:

1. To safely carry out a task next to the edge of a highwall, at all times where a fall hazard exists. The mandated fall restraint system would be worn whenever a person is working within 6 feet of the edge (in exception to the Ten Foot off-set rule) and prevents exposure to a fall. If a person is working inside of an adequate safety berm, barricade, or handrail that adequately controls a fall hazard, then the need for a Personal Fall Restraint System is avoided in these cases.
2. To safely carry out a task next to the edge of open holes, or next to excavations or trenches greater than 6 feet deep with vertical walls. The mandated fall restraint system would be worn whenever a person is working within 10 feet of the edge and prevents exposure to a fall. If a person is working inside of an adequate safety berm, barricade or handrail that controls a fall hazard the need for personal fall restraint systems is not needed.
3. To safely carry out a task on a roof, top of tank, top of silo, or similar structure safe access will be provided and fall restraint system would be designed, engineered, and implemented at the time of the work activity in such a fashion to preclude any person from coming within 10 feet of the edge. If a person is working inside of an engineered safety barricade or handrail that adequately controls a fall hazard, then the need for a Personal Fall Restraint System is avoided in these cases.
4. in reference to controlled access zones, a competent person must be designated to identify fall hazards, warn employees unaware of fall hazards or performing in an unsafe manner, be on the same working surface and within visual sight, close enough for verbal communication, not be assigned other duties that might interfere with the monitor's ability to perform the monitor's designated duties

Visual demarcation lines and signage can be utilized as warnings to identify fall hazards and indicate that Personal Fall Protection Systems are required when working around open holes. Materials that can be used for demarcation lines include painted lines, flagging, cones, signs, or any other suitable marking material that will not deteriorate. Fall hazard warnings will be visible from all directions of approach, warn of the hazard, and be located such as to alert personnel and control exposure prior to entry into the fall hazard area.

Guidelines for Fall Arrest Systems

Personal Fall Arrest Systems are required when working near an edge where a danger from falling exists. Thus, a Personal Fall Arrest System must be used at all times:

1. To safely carry out a task when within 6 feet from a fall hazard in or on a flat solid structure such as the edge of an opening in a floor grating, the edge of a hole in a floor, the edge of a hole in a roof, the edge of a flat roof, or similar structure. If a person is working inside of an adequate safety barricade or handrail that controls a fall hazard, then the need for Personal Fall Arrest Systems is avoided.
2. Fall protection systems will be used to safely carry out a task when within 10 feet from a fall hazard on a sloped solid structure such as the edge of a sloped roof, the edge of a sloped tank, the edge of a sloped silo, or similar structure. If a person is working inside of an engineered safety barricade or handrail that adequately controls a fall hazard, then the need for Personal Fall Arrest Systems is avoided.

Visual demarcation lines and signage can be utilized as warnings to identify fall hazards and indicate that Personal Fall Arrest Systems are required beyond that point. Materials that can be used for demarcation lines include painted lines, flagging, cones, signs, or any other suitable marking material that will not deteriorate. Fall hazard

warnings will be visible from all directions of approach, warn of the hazard, and be located such as to alert personnel and control exposure prior to entry into the fall hazard area.

If Personal Fall Arrest Systems are required to safely carry out the task, then a plan to ensure immediate rescue in the case of a fall shall be established before the work requiring fall arrest is started.

1. No person shall work alone when the task being performed requires fall arrest.
2. A second person in the immediate work area will satisfy the requirement if that person knows they must remain in the area to notify Emergency Response Teams and assist in a rescue if needed.
3. During and throughout a task that has required the use of Fall Arrest Systems:
4. All personnel that are required to utilize a Personal Fall Arrest System must maintain 100% tie-off at all times.
5. The lanyard(s), equipped with a fall deceleration device, must be attached to the D-ring in the middle of the back with the other end of the lanyard(s) secured to a tie-off capable of withstanding at least 5,000 pounds of force.
6. If the ability of the structure to support the tie-off is in question, personnel must contact their supervisor, who will in turn work with the fall protection champion to determine if an alternate method is needed.

30.7. Inspection and Care of Personal Fall Protection Systems

Prior to use, all personnel will inspect all components of the fall arrest or restraint system. Any component that is oil soaked, cut, frayed, or otherwise appears damaged must be immediately removed from service and inspected by a competent person prior to use.

Any harness, tie-off strap and lanyard that have stopped a fall by any person must be immediately taken out of service and destroyed.

Personal Fall Protection System components are to be cleaned by washing with plain water only.

30.8. Training

Prior to use of a Personal Fall Protection System, personnel must be task trained in the safe work procedures required to safely utilize the system by a competent person. Approved trainers must complete a Linkan Training Sheet certifying that the task training has been completed excluding contractors. Contractors will be expected to provide and document training for all their employees per the requirements of this Policy.

Refresher training covering fall protection and the requirements of this policy will be conducted annually. Documentation of such training will be recorded on company forms.

A competent person shall monitor the safety of other employees and comply with the company's fall protection plan as a safety monitor.

30.9. Full Body Harness Form

Full Body Harness

Areas of inspection:

Hardware: (Including D-rings, buckles and Keepers) Inspect for damage, distortions, sharp edges, burrs, cracks, and corrosion.
Webbing: Inspect for cuts, burns, tears, abrasion, frays, excessive soiling, and discoloration.
Stitching: Inspect for pulled or cut stitches.
Labels: Inspect, make certain all labels are securely held in place and legible.

Harness Make	Harness Model	Serial Number	Pass	Fail	Initial	Date

30.10. Rescue

1. No person shall work alone when the task being performed requires fall arrest.
2. A second person in the immediate work area will satisfy the requirement if that person knows they must remain in the area to notify the ERT and assist in a rescue if needed.

Communication and pre-planning for rescue.

1. Radio or cell phone for quick response time.

A Risk Assessment will be completed before working in fall arrest.

1. Evaluate the circumstances and conditions under which a rescue may be required.
2. The rescue plan must be well thought out and all individuals involved must thoroughly understand the rescue plan.

Primary rescue should be “self-rescue” (i.e., man lift, ladder, etc.) with emphasis on:

1. Preventing prolonged suspension time.
2. Identifying orthostatic intolerance (trauma shock).
3. Performing rescue and treatment as quickly as possible.

29 CFR 1926.502(k)(7) where other methods of fall protection are not utilized, that those areas must be designated as controlled access zones and a safety monitoring system used.

31.0 FATIGUE MANAGEMENT

Policy Statement:

Linkan is committed to ensuring the health and safety of all employees. Fatigue can impair judgment, slow reaction times, and increase the risk of accidents and injuries. Therefore, it is our policy to manage and mitigate fatigue risks to protect the well-being of our employees, contractors, and visitors.

Objective:

The objective of this policy is to establish guidelines and procedures to identify, prevent, and manage fatigue-related risks in the workplace effectively.

Scope:

This policy applies to all employees, contractors, and visitors who may be affected by fatigue-related hazards during their work activities.

Procedure:

1. **Risk Assessment**:
   a. Conduct a thorough assessment to identify tasks and work conditions that may contribute to fatigue.
   b. Consider factors such as shift length, workload, overtime, night work, and travel.
2. **Fatigue Prevention**:
   a. Implement scheduling practices that allow for sufficient rest periods between shifts.
   b. Limit overtime hours to prevent excessive fatigue.
   c. Provide training on fatigue awareness and management techniques.
3. **Monitoring and Reporting**:
   a. Encourage employees to self-monitor their fatigue levels and report any concerns promptly.
   b. Use fatigue risk assessment tools where applicable to identify potential hazards.
4. **Fatigue Management Strategies**:
   a. Offer fatigue management resources such as napping facilities (where feasible), access to caffeine, and strategic use of breaks.
   b. Rotate tasks to reduce monotony and mitigate the impact of fatigue.
5. **Emergency Situations**:
   a. Ensure that employees are alert and capable of performing their duties safely during emergencies.
   b. Have contingency plans in place to manage fatigue-related emergencies effectively.
6. **Continuous Improvement:**
   a. Review and revise fatigue management procedures regularly based on feedback, incident reports and emerging best practices.
   b. Conduct audits to assess compliance with fatigue management policies.

Training:

- Provide initial and refresher training on fatigue management to all employees.
- Include information on risks of fatigue, recognition of symptoms, and strategies for prevention.

Documentation:

- Maintain records of fatigue risk assessments, training sessions, and incidents related to fatigue management.
- Ensure that all documentation is accessible for review and audit purposes.

Compliance:

- Adhere to all relevant OSHA regulations and guidelines concerning fatigue management.
- Investigate any reported incidents related to fatigue promptly and take corrective actions, as necessary.

Communications:

- Promote open communication between management and employees regarding fatigue concerns.
- Encourage a supportive environment where employees feel comfortable discussing fatigue related issues.

APPENDIX B

RADIATION PROTECTION PLAN (RPP)

RADIATION PROTECTION PLAN

WATER TREATMENT OPERATIONS
FORMER SCHWARTZWALDER MINE SITE

RADIOACTIVE MATERIALS LICENSE CO 1332-01, AMENDMENT 01

JEFFERSON COUNTY, COLORADO

REVISION 00

APRIL 2025

PREPARED FOR:
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1 INTRODUCTION

The Schwartzwalder Mine is a former underground uranium mine located in Jefferson County near Golden, Colorado. Situated in a steep canyon adjacent to Ralston Creek, this Mine operated from 1953 to 2000. The deposit was discovered by Fred Schwartzwalder in 1949, and initial mining pursued near-surface deposits on the hillside above the creek. In 1953 the Federal government provided some assistance with exploration and early mining. Production and exploration increased after Fred Schwartzwalder sold the mine to Denver-Golden Oil and Uranium Co. in 1956. Several adits were developed and vertical shaft advancement began in pursuit of deeper ore along the Illinois Fault System. Cotter Corporation purchased the Mine in 1966 and by 1968 three vertical shafts had been advanced. The maximum depth of underground mine workings was approximately 2,200 feet below the Steve Level adit as situated about 50 feet above Ralson Creek (Figure 1-1). Mining operations continued until May 2000, when all dewatering pumps were shut off and mine workings below the Steve Level were allowed to flood.

FIGURE 1-1: SCHWARTZWALDER MINE SURFACE FACILITIES CIRCA 1968 ON THE PAD BENCH NEAR THE STEVE ADIT.

Treatment of mine water at Schwartzwalder began in the late 1960s with surface ponds to remove suspended solids, and later to remove radium-226 (Ra-226) with barium co-precipitation treatments. A water treatment plant was constructed in 1977 to remove both uranium and radium. This plant was periodically upgraded through the 1980s and 1990s to improve treatment efficiency and meet more stringent water quality standards. In addition to treatment of mine dewatering solutions, the water treatment plant also treated water collected from a series of sumps in the alluvium and waste rock fill materials configured to form a "pad" to support Mine operations next to Ralston Creek.

For much of its history, the Mine operated under Colorado Mining Permit No. 77-300 and Colorado Discharge Permit No. CO-0001-244. In 2017, Radioactive Materials License (RML) No. CO-369-06 was amended to permit relocation of the water treatment plant to its current location on the pad bench near the Steve Level adit. In

2018, Colorado Legacy Land (CLL) took over water treatment and site reclamation efforts, and the RML was transferred to CLL. In early 2023, CLL declared financial insolvency but managed to secure funding sufficient to support water treatment through the end of seasonal operations in 2023, along with a license amendment (RML Amendment No. 10) which authorized reverse osmosis (RO) water treatment and onsite possession, use, and disposal of RO reject brine solutions and solid waste (used water treatment media). After 2023, CLL could no longer meet its regulatory obligations at the Mine Site, and the Mine Permit was revoked by the Colorado Division of Reclamation, Mining and Safety (DRMS).

In 2024, DRMS assumed control of water treatment at the Site with forfeited surety under the revoked Mine Permit, and a new RML was issued to DRMS by the Colorado Department of Public Health and Environment (CDPHE, RML No. CO 1332-01). In 2025, DRMS applied for an amendment to the RML (Amendment 01) to update the radiation protection plan (RPP; this document) and related standard operating procedures (SOPs), and to assign radiation protection responsibilities to a new Radiation Safety Officer (RSO) and Alternate RSO (ARSO) of record under the DRMS license. The proposed RSO and ARSO are specialized, experienced, and qualified professional health physics consultants. The proposed RSO is based in Colorado with ready access to the Schwartzwalder Mine Site, and the ARSO is a Certified Health Physicist (CHP) with extensive past radiation protection experience with water treatment at the Schwartzwalder Site.

The objective of this RPP is to optimize radiation protection approaches, methods and procedures in a manner that ensures compliance with applicable CDPHE regulations and the conditions of the RML, and considers current radiological hazards and exposure pathways to identify appropriate and cost-effective measures for keeping radiological doses to workers and the public as low as reasonably achievable (ALARA) below regulatory limits. This RPP and associated set of SOPs are intended to clearly and comprehensively define RPP requirements and implementing SOPs; they supersede all previously approved procedures for managing radiation protection for water treatment operations at the former Schwartzwalder Mine under previous RMLs and associated license amendments.

2 DESCRIPTION OF WATER TREATMENT OPERATIONS

The current water treatment plant (WTP) consists of a reverse osmosis (RO) treatment system for removal of uranium, radium, and metals from mine water, followed by an ion-exchange (IX) system to “polish” the treated water and ensure compliance with the discharge permit limit for uranium prior to discharge to Ralston Creek. The layout of water treatment systems and equipment in the WTP is depicted in Figure 2-1.

The objective of treating mine pool water is to maintain a water level within the flooded underground mine workings at an elevation well below Ralston Creek in the vicinity of the Mine Site (Figure 2-2). This creates a local hydraulic groundwater flow gradient away from Ralston Creek and towards the mine pool. Regulatory requirements for drawdown of the mine pool stipulate that the maximum permissible elevation of the mine pool is 150 feet below the Steve Level (Figure 2-2).

Based on operational data between 2016 and 2022, the maximum flow of influent mine water to be treated is on the order of 344 gallons per minute (gpm). Of this maximum influent flow, approximately 200 gpm of treated permeate is produced and discharged to Ralston Creek, while 144 gpm of brine concentrate or “RO reject water” is returned to the mine pool at a depth of approximately 1,160 feet below the Steve Level.

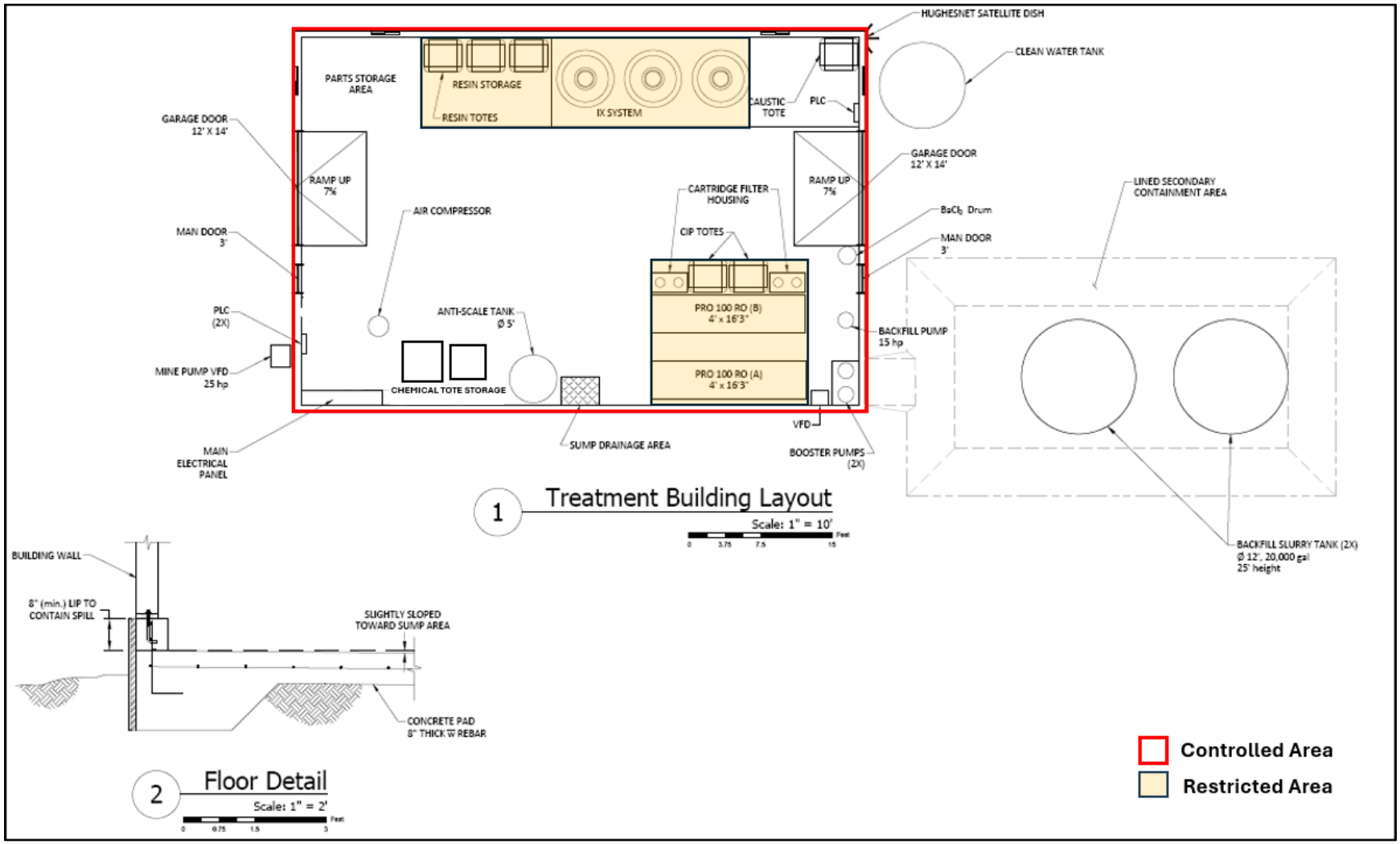


FIGURE 2-1: SCHEMATIC OF WATER TREATMENT PLANT FACILITY LAYOUT.

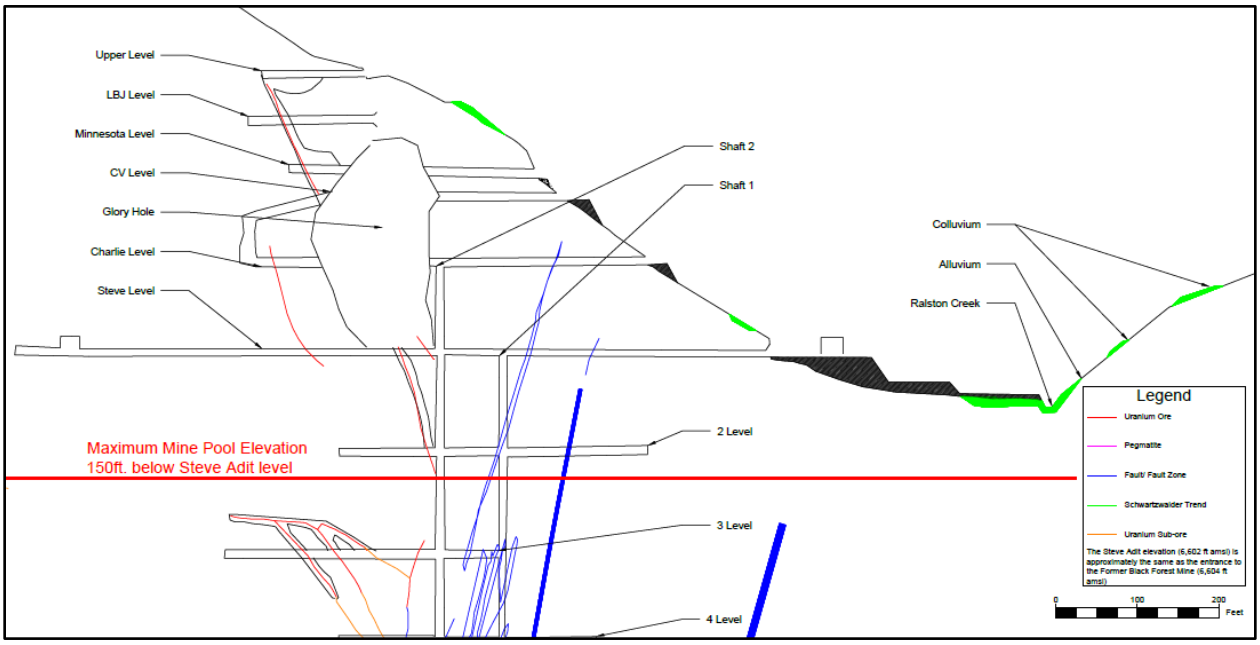


FIGURE 2-2: SCHEMATIC OF UNDERGROUND MINE WORKINGS AND MAXIMUM PERMISSIBLE MINE POOL ELEVATION.

Licensed radioactive materials that are subject to the uranium and Ra-226 possession limits specified in the RML include influent mine water contained within the WTP at any given time, along with RO reject water, and residual radionuclides contained in cartridge filters, RO membranes, IX resin, and any spent water treatment media stored in the WTP pending onsite disposal (in the mine pool for liquid wastes) or offsite disposal (for solid wastes). Portions of the WTP dedicated to RO and IX treatment systems and associated spent media storage areas, are considered "Restricted Areas" as defined in Part 1 of Colorado Rules and Regulations Pertaining to Radiation Control (6 CCR 1007-1), herein referred to as "CDPHE Regulations". Other portions of the WTP are considered a "Controlled Area" as defined in Part 1 of CDPHE Regulations. Figure 2-1 depicts these designated radiation control areas. Respective definitions are provided in Section 5.2.1 of this RPP.

3 RPP NECESSITY AND OBJECTIVES

3.1 REGULATORY REQUIREMENTS

Condition 12.A of RML CO 1332-01 specifies that the licensee shall comply with applicable provisions of Colorado Regulations Pertaining to Radiation Control (6 CCR 1007-1), including:

- Part 3, "Licensing of Radioactive Material".
- Part 4, "Standards for Protection Against Radiation".
- Part 10, "Notices, Instructions and Reports to Workers; Inspections".
- Part 17, "Transportation of Radioactive Material".

Part 4.5 of CDPHE Regulations requires licensees to maintain a formal RPP sufficient to ensure compliance with the provisions of Part 4. The RPP must be designed, to the extent practical, using procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and

doses to members of the public that are ALARA. This RPP and associated SOPs are designed to meet these regulatory objectives.

3.2 LICENSE CONDITIONS

RML CO 1332-01 (Amendment 01) contains various license conditions (LC) of relevance to this RPP and associated SOPs, including the following summary of key requirements (note that this summary highlights select information of relevance to this RPP, and the RML should be consulted to understand all provisions and limitations):

LC 10: This LC lists radioactive materials and sources that are specifically licensed by CDPHE for the licensee's (DRMS) authorized possession, use, and storage prior to disposal, including the following materials/sources of relevance to this RPP:

A. Not more than 500 mCi (18.5 GBq) of natural uranium bound to ion exchange water treatment media, and not more than 200 mCi (7.4 GBq) of natural uranium and 17.8 mCi (658.6 MBq) of radium-226 from influent mine water, bound to RO filter media or contained in RO reject water.

LC 11: This LC describes the requirements for Authorized Users that are permitted to handle and use the licensed radioactive materials specified in LC 10. Authorized Users will be designated by the RSO based on applicable radiation protection training requirements as specified in this RPP and in SOP-1 (*Radiation Protection Training*). The RSO must keep a list of Authorized Users, date(s) of training, and RSO approvals.

LC 12: This LC describes General Requirements of relevance to this RPP including: A) compliance with applicable CDPHE Regulations, B) transfer of possession or control of licensed materials, C) accuracy of info listed in license, D) transport of radioactive materials, and E) prohibition on false statements, representations, or certifications in any application, record, report, plan or other document regarding radiation levels, tests, or radiological safety conditions or practices.

LC 13: The licensee shall monitor the occupational dose for each of its employees who are likely to receive an occupational dose exceeding 10% of any applicable limit specified in Part 4 of the Regulations.

LC 14: This LC describes specific license requirements including: A) containment of IX media, B) handling, storage, sampling requirements according to license application commitments, C) keeping WTP locked when authorized personnel not present, D) radiation posting requirements, E) surety requirements, F) annual report demonstrating proof of surety and any updated decommissioning plans.

LC 15: This LC provides requirements for licensee commitments and citation of license tie-down reference documents.

3.3 RADIOLOGICAL EXPOSURES

Licensed radionuclides of importance for potential human exposure to ionizing radiation at the Schwartzwalder WTP include natural uranium (U-nat) and radium-226 (Ra-226). In addition, radon-222 gas (Rn-222) and its short-lived decay progeny are a potential concern. While each of these radionuclides decay by emission of radioactive alpha particles, three major types of ionizing radiation, including alpha and beta particles and electromagnetic gamma radiation, are emitted by radionuclides associated with the uranium-238 (U-238) and uranium-235 (U-235) decay chains.

Elevated concentrations of the above radionuclides may exist in licensed materials, including influent mine water, RO reject water, and solids sorbed to cartridge filters and RO membranes. Only isotopes of uranium are likely to be elevated in used IX resin. Isotopes of U-nat (U-238, U-234 and U-235) have very long half-lives and are thus not very radioactive. Toxicity-based health risks from uranium are possible if soluble forms of U-nat are inhaled or ingested in sufficiently large quantities. Potential radiation dose to WTP workers is generally limited to the following occupational exposure pathways:

- Inhalation of short-lived radon decay products (radon progeny) in air associated with the escape of radon gas from influent mine water, RO cartridge filters, and RO membranes. The potential for release of radon gas from these sources is generally possible only during exchanges of cartridge filters and RO membranes (i.e., when these closed water treatment systems are temporarily exposed to the open atmosphere). Releases are also possible during non-routine system maintenance activities, or as a result of spills or leaks of solutions or solids.
- Inhalation of long-lived particulate radionuclides in air. As with radon, the potential for release of air particulates is generally limited to activities that expose licensed materials to the open atmosphere. However, because particulate radionuclides are not a gas and are generally present only in solutions or saturated treatment media, energy must be imparted to the material for release of radioactive aerosols to occur (e.g., during spills or leaks, or from system cleaning or maintenance activities).
- Exposure to external (direct) gamma radiation from licensed material sorbed to water treatment media, including cartridge filters, RO membranes, and used IX resin.
- Accidental ingestion of solid-phase residues or dissolved radionuclides in water treatment solutions. While this intake pathway is possible, it can essentially be eliminated with proper industrial hygiene, use of personal protective equipment (PPE), and prohibitions on eating, drinking, or use of tobacco products in Restricted or Controlled work areas.

Based on five years of recent and available occupational radiation exposure and dose monitoring records for routine WTP workers (from 2019 – 2023) at the former Schwartzwalder Mine (Table 2-1), maximum annual radiation doses for WTP workers are expected to remain well below the 500 mrem/yr regulatory threshold that triggers occupational dose monitoring requirements under Part 4.18 of CDPHE Regulations.

TABLE 2-1: MAXIMUM ANNUAL RADIATION DOSES FOR WTP WORKERS

Year	CEDE[1] (mrem)	DDE[2] (mrem)	TEDE[3] (mrem)
2019	39	124	163
2020	33	10	43
2021	47	8	55
2022	12	24	36
2023	91	6	97

[1]Committed effective dose equivalent (internal)
[2]Deep dose equivalent (external)
[3]Total effective dose equivalent

In addition, gamma radiation exposure rate surveys will be performed monthly during seasonal water treatment operations at the locations shown in Figure 2-3. A summary of measurement results from 2019 through 2023 for these locations is provided in Table 2-2. With respect to members of the public, assuming

exposure to the highest measured gamma exposure rate in the WTP between 2019 and 2023 (810 µR/hr), using a conservative annual occupancy time assumption for the maximally exposed public receptor (40 hours for an assumed facility maintenance vendor), and assuming that airborne releases of radon and air particulates are negligible for these "closed" water treatment systems, the maximum potential annual dose to any member of the public is calculated to be 32.4 mrem. This conservative maximum estimate is well below the 100 mrem/yr public dose limit specified in Part 4 of CDPHE Regulations.

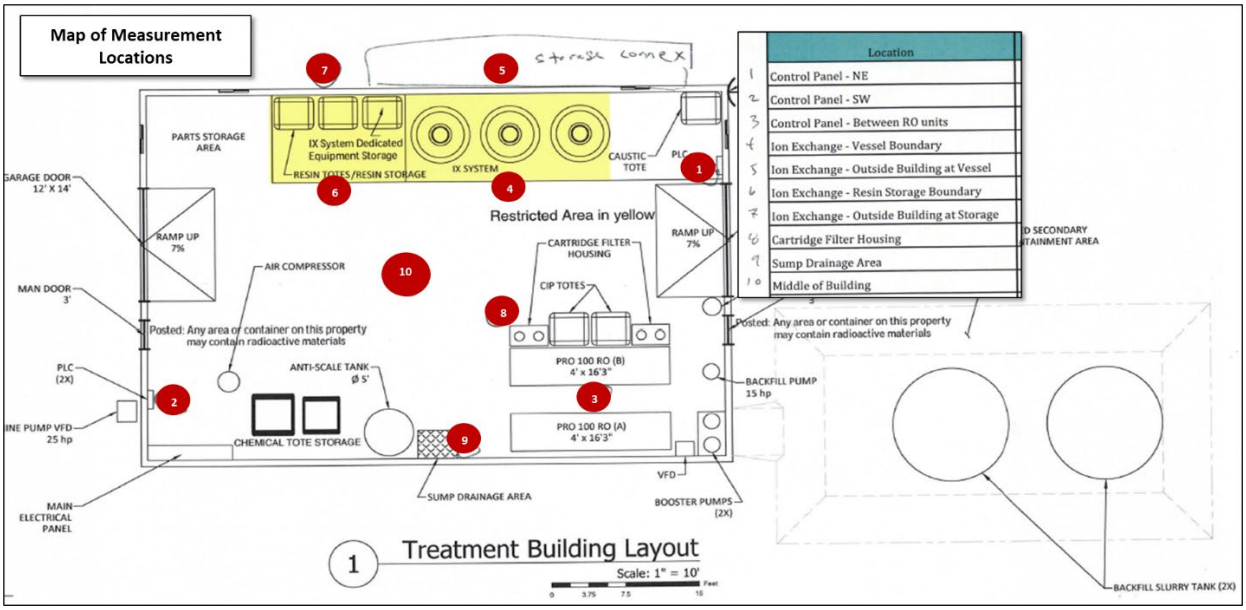


FIGURE 2-3: LOCATIONS OF ROUTINE GAMMA EXPOSURE RATE MEASUREMENTS.

TABLE 2-2: EXPOSURE RATES WITHIN THE WATER TREATMENT BUILDING, 2019 - 2023

Location	Maximum (µR/hr)	Average (µR/hr)
1. Control Panel NE	56	39
2. Control Panel SW	25	21
3. Control Panel - Between RO Units	535	264
4. IX - Vessel Boundary	122	76
5. IX - Outside Building at Vessel	31	23
6. IX - Resin Storage Boundary	183	71
7. IX - Outside Building at Resin Storage	28	22
8. Cartridge Filter Housing (at 1 ft)	810	489
9. Sump Drainage Area	126	67
10. Middle of Building	240	91
Trailer/Parking Lot (Background)	27	19

Based on the above data, occupational radiation exposure monitoring is not required under Part 4 of CDPHE Regulations, and is thus not required for WTP operators under this RPP. However, at the discretion of the RSO, a radiation work permit (RWP) may be issued for non-routine activities or events (e.g., system maintenance, water treatment media exchanges, unplanned spills, etc.) and specify occupational radiation exposure/dose

monitoring requirements based on the dosimetric criteria specified in Standard Operating Procedure SOP-6 (*Radiation Work Permits*). RWPs are further discussed in Section 5.2.7 of this RPP.

3.4 ALARA POLICY

As stated in Part 4.5.2 of CDPHE Regulations, "*The licensee shall use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).*" An overarching objective of this RPP is to keep radiological doses, potential releases of radioactive materials, and contamination of personnel or equipment at ALARA levels. Accordingly, the following policy statement applies to WTP operations at the Schwartzwalder Site:

> *Water Treatment Plant workers shall make every reasonable effort to maintain radiological exposure and contamination levels as low as reasonably achievable below applicable regulatory limits, consistent with the purpose for which the activity is undertaken, and taking into account the state of technology and economics of improvements in relation to benefits to public health, safety, and the environment.*

All WTP workers and contractors must acknowledge this policy and abide by it. The ALARA concept is founded on a principle of "optimization", one of the following three fundamental radiation protection principles:

1. Justification – no exposure to radioactive materials is allowed unless justified by a benefit, including both planned and unplanned exposures. Benefits of working with radioactive materials associated with water treatment at the Site include employment compensation for WTP workers, and treatment of mine water as required by applicable State agencies will minimize the potential to exceed water quality standards in Ralston Creek.

2. Optimization – the ALARA principle is based on optimization of measures to keep exposures/doses as low as possible below regulatory limits, consistent with the work to be accomplished, and considering reasonable feasibility on required costs, human resources, and equipment/technology available to complete the work. Contravening trade-offs that could increase other types of health and safety issues or cause unintended environmental consequences should also be considered in optimizing radiation protection. In general, the RPP should be optimized to maximize radiation protection for the expected radiological conditions, given reasonable limits on the availability and cost of resources and technologies needed to keep doses below regulatory limits, and to achieve these objectives without incurring unintended consequences from other types of impacts to human health or the environment.

3. Limitation – this is accomplished through compliance with specified limits on exposures and doses to WTP workers and members of the public (see Section 5.2.2, Tables 5-1 and 5-2).

This RPP and associated SOPs are designed in accordance with these radiation protection principles, including optimization under the ALARA concept. In addition, this RPP was developed to provide a clear definition of the RPP under applicable CDPHE Regulations and the conditions of RML CO 1332-01 (Amendment 01). SOPs associated with this RPP (Appendix A) provide the procedures designed to maintain compliance with RPP requirements.

4 RPP MANAGEMENT AND ADMINISTRATION

On behalf of DRMS (the licensee), Linkan Engineering (Linkan) will operate and maintain the WTP and associated treatment systems and infrastructure. Environmental Restoration Group, Inc. (ERG) will provide RSO and ARSO services, along with related radiation protection support and occupational health physics oversight. ERG will train Linkan WTP operators as "Authorized Users" under the license to enable Linkan staff to physically handle, manage, and securely store licensed radioactive materials in compliance with CDPHE Regulations, RML conditions, and the requirements of this RPP. ERG will also train Linkan WTP operators on the SOPs necessary to perform and document routine radiological contamination release surveys for equipment and personnel. The RSO will visit the Site on a monthly basis during the operational treatment season to audit RPP records and perform radiological surveys of the workplace. The RSO will also evaluate non-routine maintenance tasks and any unplanned releases (leaks, spills) of licensed radioactive materials to determine the need for an RWP and any occupational radiation exposure monitoring that may be required. The ARSO will serve as RSO in the event that the RSO is temporarily unavailable, and will provide health physics advising and support as needed.

4.1 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

- **Licensee (DRMS):** Maintains the RML in good standing with CDPHE and ensures availability of resources as necessary to implement this RPP. Supports the ALARA policy, RSO advising on radiation protection matters, and leads an organizational culture that recognizes the importance of radiological health and safety across all aspects of WTP operations.

- **WTP Operator:** Contractor, conducts water treatment operations in compliance with the radiological health and safety requirements of CDPHE Regulations, RML conditions, and this RPP. Supports the ALARA policy, RSO advising on radiation protection matters, and fosters an organizational culture that recognizes the importance of radiological health and safety across all aspects of WTP operations.

- **Radiation Safety Officer (RSO):** Contractor, oversees implementation of the RPP, conducts monthly Site visits for RSO audits of RPP records, performs quarterly workplace gamma surveys, develops recommendations for improvements in radiation protection and corrective actions for identified deficiencies, and performs radiological dose assessments as needed. Reviews work plans for non-routine maintenance activities and evaluates any unplanned releases of licensed radioactive materials to determine the need for RWPs and any occupational radiation exposure monitoring that may be needed. Provides general radiological advising on occupational and environmental health physics matters.

- **Alternate RSO (ARSO):** Contractor, supports the RSO as needed and serves as RSO in the event the RSO is temporarily unavailable to respond to RPP-related matters. Provides general radiological advising as needed for occupational and/or environmental health physics matters.

- **Authorized User (AU):** AUs include regular WTP workers that have completed annual radiation protection training from the RSO, and are trained on the SOPs and RWPs necessary to perform related duties under applicable CDPHE Regulations, RML conditions, and this RPP. Authorized Users are permitted to access and work in Restricted Areas (Figure 2-1) without escort, physically handle licensed radioactive materials, and perform radiological surveys, monitoring, and sampling as specified in this RPP and associated SOPs (Appendix A). Authorized Users have stop work authority for any identified noncompliance or upset

condition that could result in a significant unplanned worker exposure or unexpected release of radioactive materials to the environment. For any stop work event, the AU will notify the RSO or ARSO as soon as practicable. A current list of AUs will be maintained in the field office supporting onsite water treatment operations.

4.2 QUALIFICATIONS AND TRAINING

4.2.1 RPP STAFF QUALIFICATIONS

Qualifications for radiation protection staff are generally based on guidance found in NRC Regulatory Guide 8.31. The minimum qualifications and training required for radiation protection staff are as follows:

- **Radiation Safety Officer (RSO)** – A minimum of a 4-year degree in physical sciences, health physics, engineering or industrial hygiene with an accredited university, or an equivalent combination of training and relevant radiation protection experience at uranium recovery (UR) facilities. Two years of relevant experience can be considered equivalent to 1 year of academic study. At least 1 year of work experience with applied health physics at a UR facility or similar industrial setting. Unless the RSO is a currently certified health physicist (CHP) with ongoing continuing education requirements to maintain the CHP credential, the RSO must attend relevant health physics refresher training every 2 years. The RSO shall have a thorough working knowledge of applicable regulations, health physics principles, radiation measurement instruments, radiological sampling/monitoring methods, calculation of doses from radiological exposures, and an understanding of sources of ionizing radiation that may be encountered during WTP operations.
- **Alternate RSO (ARSO)** – ARSO qualifications are identical to the RSO qualifications specified above.
- **Authorized Users** – While there are no minimum educational or experience qualifications for AUs, they are required to complete radiation protection training annually from the RSO, and are also required to be trained on SOPs and RWPs as necessary to perform related duties under this RPP. RPP data and documentation generated by AUs are subject to monthly review by the RSO as well as occasional inspection by CDPHE staff under the license.

4.2.2 RADIATION PROTECTION TRAINING

As detailed in SOP-1 (*Radiation Protection Training*), there are four Site personnel training categories that require various levels or types of radiation protection training (Table 4-1), depending on the potential level of radiological exposures and scope of authorized activities or job duties for WTP operations.

TABLE 4-1: SITE PERSONNEL TRAINING CATEGORIES

Personnel Category	Required Training
Escorted Visitors and Contractors	Radiation hazard recognition and general H&S briefing
Authorized Users (AUs)	Annual radiation protection training, RWP and SOP training
RWP Workers[1]	RWP training
Females of Reproductive Age[2]	Prenatal radiation exposure training

TABLE 4-1: SITE PERSONNEL TRAINING CATEGORIES	
Personnel Category	**Required Training**

[1]Contractors working under a RWP (Radiation Work Permit) require supervision from an AU while onsite, and the AU must perform contamination surveys of personnel and equipment when leaving any Restricted Areas.

[2]Applicable only to females of reproductive age that are likely to receive an annual occupational dose in excess of 100 mrem/yr from working at the WTP.

The site personnel training categories in Table 4-1 are defined as follows:

Escorted Visitors and Contractors are individuals or small groups granted temporary access to Restricted or Controlled Areas under escort from an AU. Handling of radioactive materials is prohibited for Escorted Visitors, but at the discretion of the RSO may be permissible for contractors working under a RWP with AU supervision. Escorted Visitors are expected to encounter negligible exposure to radioactive material, but could potentially have incidental contact with contamination and shall be briefed accordingly. The escorting AU will ensure these individuals are properly surveyed for contamination before leaving Restricted Areas, or when leaving the Controlled Area if licensed materials were handled outside of permanent Restricted Areas (see Figure 2-1).

Authorized Users (AUs) are regular WTP workers and radiation protection staff that have completed annual radiation protection training from the RSO, and are also trained on applicable SOPs and RWPs as necessary to perform their duties under applicable CDPHE Regulations, RML conditions, and this RPP. AUs are permitted to access and work in the Restricted Area (Figure 2-1) without escort, provide escort, supervision, and instruction for Escorted Visitors, physically handle licensed radioactive materials, manage the security of the WTP and all licensed materials within, and perform radiological surveys, monitoring, and sampling as needed to support RPP requirements for WTP operations. AUs are expected to ensure compliance with the requirements of this RPP and associated SOPs as designed for consistency with existing RML requirements and applicable CDPHE Regulations. AUs have stop work authority for identified occurrences of noncompliance or any upset condition that could result in a significant unplanned worker exposure or unexpected release of radioactive materials to the environment. For any stop work events, the AU will notify the RSO and/or ARSO. A list of AUs shall be posted in the field office supporting onsite WTP operations.

Radiation Work Permit (RWP) Workers are AUs and supervised contractors who have been trained on RWPs issued by the RSO for tasks that involve non-routine handling of, or exposure to, licensed radioactive materials under specific conditions and limitations. Example RWP activities could include non-routine maintenance of treatment systems equipment or responding to an unplanned release of licensed radioactive material. While AU-supervised and RWP-trained contractors may handle licensed material under a RWP, contractors are not authorized to perform AU functions such as performing equipment contamination release surveys, escorting Site Visitors, and maintaining Site and WTP security. The supervising AU shall ensure that all RWP contractors and equipment are properly surveyed for contamination before leaving Restricted Areas within the WTP or before leaving the Controlled Area if licensed materials are handled beyond the Restricted Areas shown in Figure 2-1.

Females of Reproductive Age that are likely to receive occupational doses greater than 100 mrem/yr from working at the WTP shall be provided NRC regulatory information and guidance concerning potential prenatal radiation exposures (USNRC, 1993) and instruction on the procedure for declaration of pregnancy. Workers in this category may contact the RSO for additional information.

4.2.2.1 RADIATION HAZARD RECOGNITION AND GENERAL H&S BRIEFING

The following general topics are included on the Hazard Recognition Form (see Form SOP-1A) that the supervising AU must discuss and obtain signatures for each Escorted Visitor:

1. Possible physical hazards
2. Radiation Hazards
3. Safety Policies
4. Emergency Response

4.2.2.2 ANNUAL RADIATION PROTECTION TRAINING

On an annual basis, all AUs and any other routine WTP workers shall receive radiation protection training from the RSO regarding (but not limited to) the following general topics:

- Site-specific radiological hazards.
- Radioactive materials that may be encountered.
- Basic radiological science concepts (physics, units, etc.).
- Health effects of radiation exposure.
- Principles of radiation protection (justification, optimization and limitation).
- Regulatory jurisdiction(s) and applicable regulations.
- RPP elements including worker exposure/dose monitoring, radiation safety work rules, contamination control, instrument use, RWPs, spill response, audits/inspections, and material handling, transport, and disposal.
- Lessons learned from previous RPP activities including occupational exposures, accidents or unplanned releases of radioactive materials, identified procedural deficiencies, corrective actions, and general radiation protection precautions based on current data and circumstances.

The RSO or assigned AU will document this training on the General Training Form (Form SOP-1B) and post a list of AUs in the field office supporting WTP operations.

4.2.2.3 SOP TRAINING

Authorized Users shall complete comprehensive radiation protection training from the RSO before training on any SOP. SOP training for routine procedures may be given by the RSO or a qualified AU already trained and experienced with SOP implementation. When training on a given SOP is complete, the General Training Form (Form SOP-1B) shall be filled out for each worker trained. The trainer shall instruct the worker as needed to ensure that the worker:

- Can independently perform the SOP safely and completely.
- Understands the objective of the SOP and its requirements.
- Is knowledgeable about possible deviations, unusual events, or conditions they may encounter while performing the SOP and how to respond.

4.2.2.4 RWP TRAINING FOR NON-ROUTINE TASKS OR EVENTS

Training for RWPs issued by the RSO for non-routine maintenance tasks or unplanned release events (e.g., leaks or spills) shall be provided to ensure compliance with the radiation protection specifications of the RWP. Training for RWPs shall be provided by the RSO or a qualified AU. The length of training shall be commensurate with the expected level of radiological exposure and scope of activities under the RWP. When training on a given RWP is complete, the personnel table in the RWP Form shall be filled in to document the training for each RWP worker.

4.2.2.5 PRENATAL EXPOSURE TRAINING

Female workers of reproductive age that are likely to receive an occupational dose greater than 100 mrem/yr from working at the site shall be provided appropriate regulatory information and guidance (USNRC, 1992) concerning potential prenatal radiation exposures and instruction on the procedure for declaration of pregnancy. Individuals learning that they are pregnant are encouraged, but not required, to declare the pregnancy and be trained/monitored accordingly. Workers in this category may contact the RSO for additional information.

4.2.2.6 HAZMAT TRAINING FOR SHIPPING RADIOACTIVE MATERIALS

As indicated in SOP-1 (*Radiation Protection Training*), any Site personnel involved in offsite shipping of samples containing non-exempt quantities of radioactive materials from the Site (e.g., spent water treatment media samples) shall complete HAZMAT Worker training every three (3) years and retain documentation of this training pursuant to U.S. Department of Transportation (DOT) regulations found in 49 CFR Part 12.704. This training includes “general awareness and familiarization training”, and “function-specific training”. Courses for HAZMAT Worker training can be found and completed online.

5 RADIATION PROTECTION CONTROLS AND MONITORING

5.1 ENGINEERING CONTROLS

5.1.1 PHYSICAL CONTROLS ON ACCESS AND SECURITY OF RADIOACTIVE MATERIALS

The former Schwartzwalder Mine and current WTP are situated within privately owned land with fencing and locked/posted gates at two vehicular access points. The doors to the WTP building are posted with warning signs indicating “Caution Radioactive Materials” or similar messaging, and the building is kept securely locked at all times when authorized Site personnel are not onsite. WTP walls and locked doors provide physical controls on access to Controlled and Restricted Areas within the WTP building (see Figure 2-1). Licensed materials within the WTP are contained within closed water treatment systems or storage containers that under normal operational conditions remain completely isolated from the open atmosphere (pipes, tanks, totes, etc.). Small, sealed radioactive check sources that are exempt from licensing requirements and which are used for instrument testing are securely stored in the office trailer, which is also locked at all times when authorized personnel are not onsite.

5.2 ADMINISTRATIVE CONTROLS

In addition to the physical and engineering controls described above, administrative controls will be used to help ensure control and security of licensed radioactive materials, and that radiation protection is optimized in accordance with ALARA principles. In some cases, both types of controls will be utilized as described below.

5.2.1 ACCESS RESTRICTIONS

Controlled Area: The Controlled Area (Figure 2-1) is designated as such because this portion of the WTP has administrative restrictions and physical controls on access for reasons other than radiation protection. AUs and any other regular WTP workers have administrative access to the Controlled Area without escort by a supervising AU. Visitors and contractors require escort in Controlled portions of the WTP, and at minimum must receive a Hazard Recognition Briefing as described in SOP1 (*Radiation Protection Training*). AUs shall ensure that any personnel or equipment potentially exposed to licensed radioactive material in the Controlled Area are surveyed for contamination prior to leaving the WTP building.

Restricted Area: The Restricted Areas (see Figure 2-1) includes portions of the WTP where gamma exposure rates are typically significantly elevated in excess of background levels, and access is restricted primarily for radiation protection purposes. All personnel and equipment leaving a Restricted Area require contamination surveys. Depending on planned activities and expected potential for radiological exposure/dose, RWP workers conducting non-routine work in the Restricted Area may also require radiological monitoring of occupational exposures under an RWP at the discretion of the RSO. Handling of licensed radioactive materials associated with mine water treatment operations, both within and beyond Restricted Area, is administratively limited to trained AUs and radiation protection management personnel (the RSO and ARSO). Escorted Visitors are not allowed to handle licensed radioactive materials, regardless of location relative to Restricted Areas. Contractors working under an RWP may handle radioactive materials as needed to perform their duties under the RWP, but only after receiving RWP training, and only when supervised by an AU. The supervising AU is responsible for responding to any incidents or upset conditions and must ensure that all RWP contractors and equipment are surveyed for contamination before leaving the WTP building.

Temporary Exclusion Zone: In cases where licensed material will be handled beyond the permanent Restricted Areas within the WTP (Figure 2-1), a temporary exclusion zone may be specified by the RSO under an RWP. Temporary exclusion zones are functionally equivalent to a Restricted Area in terms of administrative controls on access, but the access restrictions are only temporarily in place while the RWP for handling licensed material is in effect. For example, cleaning up a spill of contaminated water treatment solutions beyond the Restricted Areas may warrant an RWP with a temporary exclusion zone established around the affected area. Once the affected area has been cleaned up to meet radiological release criteria, restrictions on access under the temporary exclusion zone will be lifted by the RSO and the RWP will be closed out.

5.2.2 REGULATORY AND ADMINISTRATIVE LIMITS

A summary of regulatory and administrative limits for WTP operations is provided in Table 5-1. Note that these limits are consistent with, as applicable for water treatment at a former uranium mine, CDPHE Regulations, NRC regulations and guidance criteria, IAEA guidance criteria, and DOT regulations for transport of radioactive materials. Administrative limits are intended to ensure consistency with the Site ALARA policy to minimize radiological exposures and potential spread of contamination. Administrative limits are typically set at 10% of the regulatory limit.

TABLE 5-1: REGULATORY AND ADMINISTRATIVE RADIATION CONTROL LIMITS.

CATEGORY	PARAMETER	REGULATORY LIMIT [1]	ADMINISTRATIVE LIMIT [1]
Limits on Occupational Exposure Levels	External Gamma Radiation	5 mrem/hour @ 30 cm [2]	500 µR/hr [3]
	Airborne Particulate Radionuclides	*Applicable* DAC[4]: U-nat: 6E-11 µCi/mL	10% of *Applicable* DAC: U-nat: 6E-12 µCi/mL
	Airborne Radon	30 pCi/L [5]	8.1 pCi/L [6]
Occupational Dose Limits	Total Effective Dose Equivalent (TEDE)	5,000 mrem/yr	500 mrem/yr
Public Dose Limits	Whole-body TEDE Air Effluent CEDE (no radon) External Dose Rate	100 mrem/yr (CCR Part 4.14) 10 mrem/yr (CCR Part 4.5.4) 2 mrem/hr (CCR Part 4.14)	10 mrem/yr TEDE (excluding radon)
Contamination Limits	Equipment Release	Alpha Activity: 5,000 dpm/100 cm^2 [7] 15,000 dpm/100 cm^2 [8] 1,000 dpm/100 cm^2 [9] Gamma Dose Rate: 2 mrem/hr [10]	Alpha Activity: 500 dpm/100 cm^2 1,500 dpm/100 cm^2 100 dpm/100 cm^2 [9] Gamma Exposure Rate: 20 µR/hr [10]
	Personnel	Alpha Activity: 1,000 dpm/100 cm^2 [9,11]	Alpha Activity: 100 dpm/100 cm^2 [9,11]
	UN2910 Excepted Packages	24 dpm/cm^2 [12] 240 dpm/cm^2 [13] 500 µR/hr [14]	N/A

[1] The regulatory limits cited in this table may reference NRC regulations or guidance criteria that are consistent with current CDPHE Regulations. Administrative limits are typically 10% of regulatory limits to meet ALARA objectives.

[2] Higher external dose rates require "Radiation Area" posting (10 CFR 20.1003).

[3] 10% of regulatory limit for "Radiation Area" posting.

[4] DAC for uranium ore with U-238 and long-lived progeny (Th-230 and Ra-226) per 10 CFR 20, Appendix B, Footnote 3.

[5] DAC for radon per 10 CFR 20, Appendix B, assuming a radon progeny/gas equilibrium ratio of 1 (unity).

[6] IAEA recommended action level (equivalent to 300 Bq/m^3) to limit public dose to 100 mrem/yr (IAEA, 2014).

[7] Average total (fixed plus removable) activity across any 1 m^2 area (NRC Reg. Guide 8.30).

[8] Maximum total activity across any 100-cm^2 area (NRC Reg. Guide 8.30).

[9] Removable surface activity (NRC Reg. Guide 8.30).

[10] The regulatory limit for gamma dose rate is based on the public dose limit in Part 4.14 of CDPHE Regulations. The administrative limit is an ALARA goal for exposure rate based on 1% of the regulatory limit.

[11] For personnel surveys, static measurements will be used to determine compliance with removable limits.

[12] Net (above background) removable alpha activity on package surface (average across 300 cm^2 area).

[13] Net (above background) removable beta/gamma or low toxicity alpha activity on package surface (average across 300 cm^2 area).

[14] Net (above background) gamma exposure rate on contact with package.

For example, if an administrative limit for contamination is exceeded, decontamination will be performed until follow-up surveys demonstrate compliance. If the administrative limit for contamination cannot be met following decontamination, the regulatory limit shall apply. If the regulatory limit cannot be met with decontamination measures, the RSO must be notified to evaluate the need for any follow-up investigation and/or potential mitigation measure(s) to keep contamination levels ALARA below the regulatory limits.

5.2.3 LIMITATION OF RADIOLOGICAL DOSE

REGULATORY DOSE QUANTITIES

In addition to the primary regulatory and administrative occupational dose limits given in Table 5-1, additional limits on various dosimetric quantities for uranium recovery facilities (NRC, 2002) apply as shown in Table 5-2. These limits are identical to those specified for licensed facilities in Part 4.6 of CDPHE Regulations.

TABLE 5-2: REGULATORY DOSE LIMITS, REPRODUCED FROM NRC RG 8.30 (REVISION 1, 2002).

Dose Limits and Associated Terminology

Type of Exposure	10 CFR Part 20 Designation	Dose Limit
Total Whole Body Dose (Sum of External and Internal)	Total Effective Dose Equivalent (TEDE) TEDE = DDE + CEDE	5 rem/year
External Dose	Deep Dose Equivalent (DDE)	(a)
Internal Whole Body Dose	Committed Effective Dose Equivalent (CEDE)	(a)
Total Organ Dose (Sum of External and Internal)	Total Organ Dose Equivalent (TODE) TODE = DDE + CDE	50 rem/year
Internal Organ Dose	Committed Dose Equivalent (CDE)	(a)
Skin Dose	Shallow Dose Equivalent (SDE), Skin of Whole Body	50 rem/year
Extremity Dose	Shallow Dose Equivalent (SDE), Maximum Extremity	50 rem/year
Eye Dose	Eye Dose Equivalent to Lens of the Eye (LDE)	15 rem/year

(a) Included in limits for whole body and individual organs. In the absence of any internal exposure, external dose is limited to 5 rem per year. In the absence of any external exposure, internal exposure is limited to 2000 DAC-hours per year or 1 annual limit on intake (ALI) (50 rem/yr non-stochastic, 5 rem/yr stochastic).

PRENATAL DOSE

In the event that a female worker declares a pregnancy in writing to the RSO (encouraged but not required), the worker may be monitored for external gamma radiation with a passive radiation dosimeter to be worn on the lower torso, provided there is a reasonable likelihood that the worker could receive an annual TEDE in excess of 100 mrem/yr. For a declared pregnancy, the limit on radiological dose to the embryo/fetus is 500 mrem during the period of gestation. Should a pregnant worker choose not to declare her pregnancy, the standard dose limits for adult workers given in Tables 3 and 4 above will apply. Routine job responsibilities for a declared

worker may be adjusted during the pregnancy to avoid activities with a probability of higher radiation exposures and to focus on routine operations with low-level or background exposure conditions.

5.2.4 OCCUPATIONAL EXPOSURE MONITORING

As noted in Section 3.3, for the most recent 5-year period of available occupational radiation dose records for WTP operators have remained well below 10% of the overall Total Effective Dose Equivalent (TEDE) limit for Radiation Workers as specified in Part 4.18 of CDPHE Regulations (i.e., < 500 mrem/yr), and occupational radiation exposure monitoring is technically not required for current routine WTP operations. For these reasons, routine occupational radiation exposure monitoring and annual dose calculations for WTP workers are not required under this RPP. However, the RSO will conduct and document monthly workplace gamma survey measurements at select locations in and around the WTP building as shown in Figure 2-3 of this RPP, and will record the results on Form SOP-3D (*Monthly Workplace Gamma Survey Form*) as attached to SOP-3.

For non-routine activities, events, or potential radiological exposure circumstances that could result in more significant worker doses (e.g., maintenance activities or unplanned release events), this RPP will rely on RWPs issued by the RSO. Where warranted, RWPs shall provide occupational radiation exposure/dose monitoring as needed for any non-routine task, activity, event, or circumstance with the potential for occupational doses to exceed 100 mrem/yr under an assumption that up to five RWPs may be issued in a given year, resulting in a potential cumulative dose to any individual worker in excess of 500 mrem/yr.

When occupational radiation exposure monitoring is required under an RWP, the applicable methods and procedures specified in SOP-4 (*Radiological Monitoring for Occupational Exposure*) shall be specified in the RWP by the RSO and followed as directed. This may include use of external dosimetry badges, calculated external doses based on exposure rate measurements in the RWP work area, personal breathing zone (BZ) air particulate monitoring, representative airborne radon progeny sampling, and potentially, with urine bioassay sampling. Determination of occupational radiation doses to workers shall be based on RWP exposure monitoring data, estimated worker occupancy times (exposure durations), and applicable calculation methods as specified in SOP-5 (*Occupational Radiation Dose Calculation*).

5.2.5 CONTAMINATION CONTROL

Controls on radiological contamination include contamination release surveys for all equipment and personnel exiting a Restricted Area or temporary exclusion zone based on methods detailed in SOP-3 (*Radiological Contamination Surveys*). Site limits for release of surface contamination on equipment and personnel are specified Table 5-1 of this RPP and Table 4-1 of SOP-3. All contamination surveys shall be supported by prerequisite instrument QC measurement requirements of SOP-2 (*Instrument Testing and Calibration*), and related records will be reviewed by the RSO and maintained with other RPP records until license termination.

As indicated in in SOP-3 (*Radiological Contamination Surveys*), any offsite shipping of samples that exceed exempt quantities of radioactive materials as defined in 49 CFR 173.436 (e.g., samples of spent water treatment media) will require radiological contamination surveys pursuant to DOT regulations for excepted packages containing limited quantities as specified in 49 CFR 173.421 and 173.422. Based on maximum radiological concentration data for previous sampling of spent RO filter media (RO membranes and cartridge filters) as shown in Table 5-5 (Section 5.3.1), it is conservatively assumed that all packages containing such

samples will exceed DOT concentration and consignment exemption limits for Class 7 hazardous radioactive materials as specified for uranium and/or Ra-226 in 49 CFR 173.436. Such packages shall be surveyed to meet the UN2910 contamination limits specified in Table 5-1 of this RPP and Table 4-1 of SOP-3 (*Radiological Contamination Surveys*). Additional information on UN2910 shipping requirements is provided in SOP-1 (*Radiation Protection Training*) and SOP-9 (*Materials Handling, Transport, and Disposal*).

5.2.6 RADIATION SAFETY WORK RULES

All Site personnel are required to observe the following radiation safety work rules when working in the Restricted Area, or when working with residual radioactive materials beyond the Restricted Area (e.g., in a temporary exclusion zone as defined in Section 5.2.1):

- Radiological Contamination Surveys – all personnel must perform exit contamination surveys before leaving the Restricted Area or temporary exclusion zone, and no equipment or materials may be released from these areas unless radiological surveys (conducted by a trained AU) verify compliance with release limits for radiological contamination (see Table 5-1).
- Decontamination – As needed to meet release limits. Decontamination procedures are provided in SOP-3 (*Radiological Contamination Surveys*).
- Personal Hygiene – Before leaving the Restricted Area or temporary exclusion zone, all personnel should wash hands before eating, drinking or using tobacco, even if personnel exit surveys show no evidence of radiological contamination.
- Eating, Drinking and Tobacco Use – Eating, drinking, and tobacco use are prohibited within the WTP, including Controlled or Restricted Areas and temporary exclusion zones.
- Personal Protective Equipment (PPE) – Typical Level D personal protective equipment (PPE) shall be used as appropriate for routine WTP operations to protect from physical hazards and minimize the potential for contamination (e.g., full-length work clothing, high visibility safety vests, safety glasses, appropriate gloves and work boots). Additional PPE (e.g., Tyvek coveralls, face shields, hard hats, steel toe boots) may be required for non-routine activities or events under an RWP at the discretion of the RSO.
- Dosimeter Badging – Dosimeters are not required for routine WTP operations, but may be required by the RSO for non-routine activities or events under an RWP. Procedures for dosimetry are provided in SOP-4 (*Radiological Monitoring for Occupational Exposure*). Criteria and procedures for issuance of RWPs are provided in SOP-6 (*Radiation Work Permits*).
- Occupational Air Monitoring – At the discretion of the RSO, monitoring of airborne particulates with a personal breathing zone (BZ) sampler may be required for non-routine activities or events under an RWP. Applicable procedures are provided in SOP-4 (*Radiological Monitoring for Occupational Exposure*) and SOP-6 (*Radiation Work Permits*).
- Spill Response – Any unplanned release of radioactive material shall be stopped immediately if possible upon discovery (e.g., by closing valves, shutting down pumps, etc.). Such releases shall be reported as soon as possible to the RSO and/or ARSO. Specific procedures for spills, leaks, or other unplanned release incidents, including criteria for notification and reporting to CDPHE, are provided in SOP-8 (*Spill Response and Reporting*).

- Stop Work Authority – All WTP workers have the authority to stop Site work activities in the event of accidents, incidents, observed safety violations, uncontrolled releases of radioactive material, or other unusual or upset conditions that could present a significant risk to worker health and safety, including the potential for significant radiological intakes or exposure to licensed radioactive materials.

5.2.7 RADIATION WORK PERMITS

A Radiation Work Permit (RWP) shall be issued by the RSO for any non-routine activity or unplanned event with the potential for occupational radiation doses or intakes to exceed 2% of respective regulatory limits, which amount to 20% of the threshold criteria for occupational radiation exposure monitoring given in Part 4.18 of CDPHE Regulations (e.g., > 100 mrem/yr). The rationale for this criterion is based on an assumption that up to five RWPs may be issued in a given year, and the cumulative occupational dose to an RWP worker in that calendar year could potentially exceed 500 mrem. In accordance with SOP-6 (*Radiation Work Permits*), each RWP shall describe the nature and scope of the nonroutine activity or project, expected radiological conditions, potential radiation exposure hazards and dose pathways, and specify occupational radiation monitoring requirements and appropriate radiation safety practices to be followed, including use of PPE.

5.2.8 SPILL RESPONSE

Procedures for responding to unplanned releases, spills, or leaks of radioactive materials associated with WTP operations are provided in SOP-8 (*Spill Response and Reporting*). In the event of an unplanned release of licensed radioactive material, the WTP Manager or RSO shall verbally notify CDPHE based on the Incident Reporting criteria specified in Part 4.52 of CDPHE Regulations. Appropriate DRMS representatives shall also be notified. If notification to CDPHE is required, a written report of the incident shall be submitted to CDPHE within 30 days as required by Part 4.53 and Part 4.53.2 of CDPHE Regulations.

5.2.9 INSPECTIONS AND AUDITS

MONTHLY RSO AUDIT

The RSO or Alternate RSO (ARSO) for WTP operations shall conduct monthly onsite audits of compliance with the requirements of this RPP and associated SOPs, and for consistency with applicable license conditions and CDPHE Regulations. Monthly RSO audits will be conducted in accordance with SOP-7 (*Audits and Inspections*). These audits need only be conducted during months in which WTP operations are conducted. Results will be documented as specified in SOP-7. A monthly RSO audit checklist will be completed and signed by the project RSO or ARSO and retained with other RPP records until license termination.

ANNUAL RPP REVIEW MEMORANDUM

Consistent with Part 4.5.3 of CDPHE Regulations, the RSO will generate an Annual RPP Review Memorandum for the licensee (DRMS) that summarizes annual occupational doses to WTP workers (where applicable for nonroutine RWP activities), along with monthly audit findings during seasonal WTP operations and the results of any CDPHE inspections. The Annual RPP Review Memorandum will also provide any recommendations for improvements in radiation protection approaches and procedures. Annual RPP Review Memorandums are subject to CDPHE inspection and will be retained with other RPP records until license termination.

Periodic CDPHE Inspections

CDPHE is expected to conduct periodic inspections of licensed activities and the RPP for WTP operations at the Site under the DRMS license (CO 1332-01). Typically these inspections occur every 1 to 5 years, and are announced to the licensee in advance of the planned inspection date. Either the RSO or ARSO must attend such inspections in person to answer questions and provide documentation of data and information produced under the RPP and associated set of SOPs.

5.2.10 RESPIRATORY PROTECTION

As indicated in the NRC's Regulatory Guide 8.15 (USNRC, 1999), respiratory protection program is a last resort to keeping occupational radiation doses at ALARA levels. Specifically, this guidance states the following:

> "*It is widely recognized among safety professionals that the use of respiratory protection devices in the workplace can impose physiological and psychological stresses on workers, obstruct their vision, hinder their movements, and make effective communications difficult. These factors increase the risk of physical injury to respirator wearers that, in many cases, far exceeds any potential risk associated with the inhalation of a small quantity of airborne radioactive material.*"

As previously indicated, occupational doses for routine WTP operations over the past five years (Table 2-1) have consistently remained well below the regulatory threshold for occupational monitoring as stated in Part 4.18 of CDPHE regulations. Consequently, there is no justification under regulation or relevant regulatory guidance for maintaining a respiratory protection program for WTP operations. For these reasons, a respiratory protection program is not included in this RPP and associated set of SOPs.

5.2.11 STANDARD OPERATING PROCEDURES

This RPP and associated SOPs have been designed to ensure compliance with applicable regulations and RML CO 1332-01 conditions, including compliance with limits on radiation exposures and doses to WTP workers and members of the public as shown in Table 5-1. The administrative limits in Table 5-1 are intended to maintain occupational and public exposures and doses at levels that are ALARA below regulatory limits. The SOPs provide procedural specifications designed to ensure that the regulatory requirements specified in this RPP, including ALARA objectives, are met. The SOP titles associated with the RPP are listed in Table 5-3 and provided in Appendix A to this RPP.

TABLE 5-3: RPP STANDARD OPERATING PROCEDURE NUMBERS AND TITLES

SOP No.	SOP Title	Revision No.	Revision Date
SOP-1	Radiation Protection Training	00	April 2025
SOP-2	Instrument Testing and Calibration	00	April 2025
SOP-3	Radiological Contamination Surveys	00	April 2025
SOP-4	Radiological Monitoring for Occupational Exposures	00	April 2025
SOP-5	Occupational Radiation Dose Calculation	00	April 2025
SOP-6	Radiation Work Permits	00	April 2025
SOP-7	Audits and Inspections	00	April 2025
SOP-8	Spill Response and Reporting	00	April 2025
SOP-9	Material Handling, Transport, and Disposal	00	April 2025

5.3 MATERIAL HANDLING, TRANSPORT, AND DISPOSAL

Radioactive materials at the WTP include influent mine pool water, RO canister filters, RO membranes, RO reject (brine) water, and used IX resin. Most of these materials have previously been characterized through sampling and laboratory analysis. Available data and descriptions of these materials are provided in the following subsection. All RO brine water is disposed onsite, deep in the mine pool. All solid radioactive waste materials shall be containerized and stored in Restricted Areas within the WTP for eventual offsite transport and disposal by a licensed professional waste broker for radioactive waste materials.

5.3.1 DESCRIPTION OF RADIOACTIVE MATERIALS

Radiological characterization of liquid water treatment streams for the WTP is provided in Table 5-4. The activity per year estimates in Table 5-4 are based on estimated maximum flow rates of 344 gpm for influent mine pool water, 200 gpm for treated permeate discharged to Ralston Creek, 144 gpm of RO brine water discharged in the mine pool (for onsite disposal), and the former operational practice of maintaining 11,000 gallons of process liquids staged in one of two slurry tanks outside of the WTP building. These values are further based on an assumed 22 weeks of seasonal water treatment operations at the Site (June – October).

TABLE 5-4: WATER TREATMENT CONCENTRATION STATISTICS

Treatment Parameter	U-nat	Ra-226	U-nat	Ra-226
Influent RO Feed from Mine Pool	***Conc. (pCi/L)[1]***		***Activity/Year (mCi)[2]***	
Mean	9,582	101	2,767	29
Std. Dev.	6,170	64	1,782	18
Maximum	28,163	276	8,132	80
N	92	92	92	92
Treated Clean Discharge to Creek	***Conc. (pCi/L)[1]***		***Activity/Year (mCi)[2]***	
Mean	9.7	0.5	0.23	0.01
Std. Dev.	11	0.4	0.26	0.01
Maximum	52	2	1.3	0.05
N	137	140	137	140
RO Brine Discharge (Calculated)	***Conc. (pCi/L)***		***Activity/Year (mCi)[2]***	
Mean	160,220	1,693	2,766	29
Maximum	470,879	4,613	8,131	80

[1]Based on sampling data from 2016 - 2022

[2]Assumes 22 weeks of mine water treatment per year (June - October)

Radiological characterization of solid waste streams generated annually due to WTP operations is provided in Table 5-5. These data, in conjunction with monthly gamma exposure rate measurements at select workplace locations within the WTP (Figure 2-3), may be used by the RSO to determine the need for an RWP, for example during routine water treatment media exchanges or responding to accidental spills involving these solid materials. Although there are no recent analytical sampling data available for used IX resin, gamma exposure rate measurements near these materials may be used by the RSO in making determinations regarding issuance of RWPs for handling of used IX media.

TABLE 5-5: RO FILTER AND MEMBRANE DATA				
RO Filter Media	**U-nat**	**Ra-226**	**U-nat**	**Ra-226**
Cartridge Filters	**Conc. (pCi/g)**		**Activity/Filter (µCi)[a]**	
Mean	1,957	1,692	53	46
Std. Dev.	2,373	1,079	65	29
Maximum	5,108	3,168	139	86
N	5	5	5	5
RO Membranes	**Conc. (pCi/g)**		**Activity/Membrane (µCi)[b]**	
Mean	817	594	11.1	8.1
Std. Dev.	803	613	10.9	8.3
Maximum	1,714	1,287	23.3	17.5
N	3	3	3	3

[a]Based on a nominal total filter weight of 2.3 kg

[b]Based on a nominal total membrane weight of 13.6 kg

5.3.2 RADIOACTIVE MATERIALS HANDLING

In general, handling of licensed radioactive materials associated with treatment of mine water at the Site is limited to periodic change-outs of IX resin and RO filter/membrane exchanges. Because IX treatment is a polishing step in the overall treatment process (following RO treatment), the need for change-out of IX resin is relatively infrequent (e.g., on the order of several years or more between resin exchanges). Similarly, because mine water is treated only on a seasonal basis (typically June through October), RO membranes usually only need to be exchanged after several years of treatment operations. RO cartridge filters are typically exchanged on a weekly to monthly basis.

Liquid radioactive materials (influent mine pool water and RO brine discharge solutions) are contained and managed through closed water treatment and discharge systems and do not require physical handling by workers during routine WTP operations. Nonroutine leaks or spills of radioactive solutions are generally captured by secondary containment and/or sump systems and while some handling of unplanned releases of solutions is necessary (potentially under an RWP issued by the RSO), the released solutions are routed back through the water treatment process.

Procedures for handling of solid radioactive water treatment waste materials (mainly RO cartridge filters and membranes along with spent IX resin) are detailed in SOP-9 (*Materials Handling, Transport, and Disposal*). Procedures for handling of nonroutine, unplanned releases of licensed water treatment process materials (both liquids and solids) are detailed in SOP-8 (*Spill Response and Reporting*).

5.3.3 RADIOACTIVE MATERIALS TRANSPORT AND DISPOSAL

Because the licensee (DRMS) intends to utilize a licensed radioactive waste broker to remove from the Site all solid waste materials generated by WTP operations for transport to an offsite disposal facility, and to do so in accordance with all applicable state and federal regulations, SOP-9 (*Materials Handling, Transport, and Disposal*) only briefly describes offsite transport and disposal of licensed radioactive waste materials. SOP-9 also details procedures for sampling of spent water treatment media and shipping of such samples in accordance with applicable DOT regulations to an offsite contract laboratory for sample analysis.

5.4 REPORTING AND RECORDS RETENTION

RPP related data, including radiological surveys, monitoring, and dose estimates, will be summarized annually by the RSO in the Annual RPP Review Memorandum as described in Section 5.2.9 and SOP-7 (*Audits and Inspections*). Documentation of these data will be maintained electronically until license termination.

6 QUALITY ASSURANCE / QUALITY CONTROL

For the purposes of this RPP, the primary objective of QA/QC requirements is to ensure that the data generated in support of radiation protection and control are of sufficient quality to support correct decisions regarding compliance with the regulatory and administrative limits on radiological exposures, doses, and contamination levels as specified in Table 5-1. To meet this objective, analytical uncertainties introduced by variability in instrument performance, monitoring methods, and survey techniques should be minimized and evaluated in terms of adequate detection sensitivity, data accuracy, and measurement precision.

In general, QA includes qualitative requirements for generation of analytical data as needed to instill confidence in results such as training of Authorized Users on SOPs to ensure proper implementation of planned methods and procedures. In contrast, QC includes quantitative measures to monitor instrument response performance and data uncertainty (sensitivity, accuracy, and precision). A generalized summary of QA/QC protocols for implementation of the required radiological surveys and monitoring in accordance with RPP and RML requirements is as follows:

RPP QA Summary:

- All radiological surveys, monitoring and supporting measurements performed to meet RPP requirements will be subject to the data QA/QC protocols outlined in this section.
- Authorized Users shall be properly trained on the SOPs and RWPs they are responsible for implementing. This training shall be documented.
- The radiometric and analytical approaches and methods to be used for surveys, monitoring, and sampling are consistent with applicable and widely accepted regulatory guidance, for example:
    - Canadian Nuclear Safety Commission. 2003. Measuring Airborne Radon Progeny at Uranium Mines and Mills. Regulatory Guide G-4. June 2003.
    - International Organization for Standardization (ISO). 1988. Evaluation of Surface Contamination – Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and Alpha-emitters.
    - U.S. Nuclear Regulatory Commission (NRC). 1992. Air Sampling in the Workplace. NRC Regulatory Guide 8.25 (Revision 1).
    - U.S. Nuclear Regulatory Commission (USNRC). 2002. Health Physics Surveys in Uranium Recovery Facilities. NRC Regulatory Guide 8.30 (Revision 1). May 2002.
    - U.S. Nuclear Regulatory Commission (USNRC). 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1. NUREG-1575 (amended in 2002). Washington, D.C.
    - U.S. Nuclear Regulatory Commission (NRC). 2014. Regulatory Guide 8.22 Bioassay at Uranium Mills. NRC. May.

- U.S. Nuclear Regulatory Commission (USNRC). 2020. Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. NUREG-1507, Revision 1.

RPP QC Summary:

- Calibration of radiation measurement instruments will be performed by the manufacturer or qualified calibration vendor within one year prior to use at the Site. Calibration certificates will be kept on file.

- Daily instrument QC function testing of radiation detection instruments shall be conducted as described in SOP-2 (*Instrument Testing and Calibration*) to verify that each instrument is responding within specified QC tolerance limits to monitor instrument performance, and track measurement precision over time.

- The commercial analytical laboratory used for analysis of any bioassay or other types of samples shall be appropriately accredited under the National Environmental Laboratory Accreditation Program (NELAP).

7 REFERENCES

Canadian Nuclear Safety Commission. 2003. Measuring Airborne Radon Progeny at Uranium Mines and Mills. Regulatory Guide G-4. June 2003.

International Atomic Energy Agency (IAEA). 2014. Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. General Safety Requirements Part 3. Safety Standards Series No. GSR Part 3.

International Organization for Standardization (ISO). 1988. Evaluation of Surface Contamination – Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and Alpha-emitters.

U.S. Nuclear Regulatory Commission (NRC). 2014. Regulatory Guide 8.22 Bioassay at Uranium Mills. NRC. May.

U.S. Nuclear Regulatory Commission (USNRC). 1992. Air Sampling in the Workplace. NRC Regulatory Guide 8.25 (Revision 1).

U.S. Nuclear Regulatory Commission (USNRC). 1992. Instruction Concerning Prenatal Radiation Exposure. Regulatory Guide 8.13.

U.S. Nuclear Regulatory Commission (USNRC). 1999. Acceptable Programs for Respiratory Protection. Regulatory Guide 8.15. Revision 1, October.

U.S. Nuclear Regulatory Commission (USNRC). 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1. NUREG-1575 (amended in 2002). Washington, D.C.

U.S. Nuclear Regulatory Commission (USNRC). 2002. Health Physics Surveys in Uranium Recovery Facilities. NRC Regulatory Guide 8.30 (Revision 1). May 2002.

U.S. Nuclear Regulatory Commission (USNRC). 2020. Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. NUREG-1507, Revision 1.

APPENDIX A: RPP STANDARD OPERATING PROCEDURES

SOP-1 RADIATION PROTECTION TRAINING

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO) Authorized Users Radiation Protection Plan

1. PURPOSE

This standard operating procedure (SOP) details the training requirements for safely working with and around licensed radioactive materials during water treatment plant (WTP) operations at the former Schwartzwalder Mine near Golden, Colorado (Site) as described in the Radiation Protection Plan (RPP). The training is based on a tiered approach with various levels or types of training for four different Site personnel training categories as shown in Table 1-1. Prenatal radiation training is included, though this training is rarely needed as employee doses are typically well below 100 millirem per year (mrem/yr), and declarations of pregnancy are relatively rare.

TABLE 1-1: SITE PERSONNEL TRAINING CATEGORIES

Personnel Category	Required Training
Escorted Visitors and Contractors	Radiation hazard recognition and general H&S briefing
Authorized Users (AUs)	Annual radiation protection training , RWP and SOP training
RWP Workers[1]	RWP training
Females of Reproductive Age[2]	Prenatal radiation exposure training

[1]Contractors working under an RWP (Radiation Work Permit) require supervision from the AU while onsite, and the AU must perform contamination surveys of personnel and equipment when leaving any Restricted Areas.

[2]Applicable only to females of reproductive age that are likely to receive an annual occupational dose in excess of 100 mrem from working at the WTP.

This training provides the means for WTP workers and contractors to understand potential radiological hazards and protection measures, to inform decisions about their own personal safety, learn about the "as low as reasonably achievable (ALARA) policy as defined in the RPP, and more generally, understand how to contribute to a culture of safety for WTP operations.

2. DEFINITIONS

The Site personnel training categories in Table 1-1 are defined as follows:

Escorted Visitors and Contractors are individuals or small groups granted temporary access to Restricted or Controlled Areas under escort from an Authorized User (AU) as described below. Handling of radioactive materials is prohibited for Escorted Visitors, but at the discretion of the radiation safety officer (RSO) may be permissible for contractors working under a radiation work permit (RWP) with AU supervision. Escorted Visitors are expected to encounter negligible exposure to radioactive material, but could potentially have incidental contact with contamination and shall be briefed accordingly. The escorting AU will ensure these individuals are properly surveyed for contamination before leaving Restricted Areas, or when leaving the Controlled Area if licensed materials were handled outside of permanent Restricted Areas (see RPP Figure 2-1).

Authorized Users (AUs) are regular WTP workers and radiation protection staff that have completed annual radiation protection training from the RSO, and are also trained on applicable SOPs and RWPs as necessary to perform their duties under applicable CDPHE Regulations, RML conditions, and this RPP. AUs are permitted to access and work in the Restricted Area (see RPP Figure 2-1) without escort, provide escort, supervision, and instruction for Escorted Visitors, physically handle licensed radioactive materials, manage the security of the WTP and all licensed materials within, and perform radiological surveys, monitoring, and sampling as needed to support RPP requirements for WTP operations. AUs are expected to ensure compliance with the requirements of this RPP and associated SOPs as designed for consistency with existing RML requirements and applicable CDPHE Regulations. AUs have stop work authority for identified occurrences of noncompliance or any upset condition that could result in a significant unplanned worker exposure or unexpected release of radioactive materials to the environment. For any stop work events, the AU will notify the RSO and/or ARSO. A list of AUs shall be posted in the field office supporting onsite WTP operations.

Radiation Work Permit (RWP) Workers are AUs and where applicable, respectively supervised contractors, whom are trained on RWPs issued by the RSO for tasks that involve non-routine handling of, or exposure to, licensed radioactive materials under specific conditions and limitations. Example RWP activities could include non-routine maintenance of treatment systems equipment, or responding to an unplanned release of licensed radioactive material. While AU-supervised and RWP-trained contractors may handle licensed material under an RWP, contractors are not authorized to perform AU functions such as performing equipment contamination release surveys, escorting Site Visitors, and maintaining Site and WTP security. The supervising AU shall ensure that all RWP contractors and equipment are properly surveyed for contamination before leaving Restricted Areas within the WTP, or before leaving the Controlled Area if licensed materials are handled beyond the Restricted Areas shown in Figure 2-1 of the RPP.

Females of Reproductive Age that are likely to receive occupational doses greater than 100 mrem/yr from working at the WTP shall be provided NRC regulatory information and guidance concerning potential prenatal radiation exposures (USNRC, 1993) and instruction on the procedure for declaration of pregnancy. Respective workers may contact the RSO for additional information.

3. SCOPE

This procedure applies to WTP workers and any work with licensed radioactive materials under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). The training needed to meet the qualification requirements for radiation protection staff (RSO, ARSO, AUs) are provided in the RPP. RPP specifications and procedures for water treatment operations at the Site are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations).

4. RESPONSIBILITY

- **Radiation Safety Officer (RSO)** – Responsible for developing, presenting, and documenting annual radiation protection training for all AUs in accordance with RPP specifications, radioactive materials license conditions (LCs), and applicable CDPHE Regulations. Also provides training on applicable SOPs and RWPs as needed for AUs and RWP contractors.

- **Authorized Users** – Responsible for receiving annual radiation protection training from the RSO, along with training on all SOPs and RWPs necessary to conduct associated duties under the RPP, this SOP, and applicable CDPHE Regulations.

5. PROCEDURE

5.1. Equipment and Materials

Presentation materials and attendance roster sheet or other documentation as needed to perform and document the radiation protection, SOP, and RWP trainings described in this SOP.

5.2. Radiation Hazard Recognition and General H&S Briefing

The following general topics are included on the Hazard Recognition Form (see Form SOP-1A) that the supervising AU must discuss and obtain signatures for each Escorted Visitor:

1. Possible physical hazards
2. Radiation Hazards
3. Safety Policies
4. Emergency Response

5.3. Annual Radiation Protection Training

On an annual basis, all AUs and any other routine WTP workers shall receive radiation protection training from the RSO regarding (but not limited to) the following general topics:

- Site-specific radiological hazards.
- Radioactive materials that may be encountered.
- Basic radiological science concepts (physics, units, etc.).
- Health effects of radiation exposure.
- Principles of radiation protection (justification, optimization and limitation).
- Regulatory jurisdiction(s) and applicable regulations.
- RPP elements including worker exposure/dose monitoring, radiation safety work rules, contamination control, instrument use, RWPs, spill response, audits/inspections, and material handling, transport, and disposal.
- Lessons learned from previous RPP activities including occupational exposures, accidents or unplanned releases of radioactive materials, identified procedural deficiencies, corrective actions, and general radiation protection precautions based on current data and circumstances.

The RSO or assigned AU will document this training on the General Training Form (Form SOP-1B) and post a list of AUs in the field office supporting WTP operations.

5.4. SOP Training

Authorized Users shall complete comprehensive radiation protection training from the RSO before training on any SOP. SOP training for routine procedures may be given by the RSO or a qualified AU already trained and experienced with SOP implementation. When training on a given SOP is complete, the *General Training Form* (Form SOP-1B) shall be filled out for each worker trained. The trainer shall instruct the worker as needed to ensure that the worker:

- Can independently perform the SOP safely and completely.
- Understands the objective of the SOP and its requirements.
- Is knowledgeable about possible deviations, unusual events, or conditions they may encounter while performing the SOP and how to respond.

5.5. RWP Training for Non-Routine Tasks or Events

Training for RWPs issued by the RSO for non-routine maintenance tasks or unplanned release events (e.g., leaks or spills) shall be provided to ensure compliance with the radiation protection specifications of the RWP. Training for RWPs shall be provided by the RSO or a qualified AU. The length of training shall be commensurate with the expected level of radiological exposure and scope of activities under the RWP. When training on a given RWP is complete, the personnel table in the RWP Form shall be filled in to document the training for each RWP worker.

5.6. Prenatal Exposure Training

Female workers of reproductive age that are likely to receive an occupational dose greater than 100 mrem/yr from working at the site shall be provided appropriate regulatory information and guidance (USNRC, 1992) concerning potential prenatal radiation exposures and instruction on the procedure for declaration of pregnancy. Individuals learning that they are pregnant are encouraged, but not required, to declare the pregnancy and be trained/monitored accordingly. Workers in this category may contact the RSO or ARSO for additional information.

5.7. HAZMAT Training for Shipping Radioactive Materials

Any Site personnel involved in shipping of radioactive materials from the Site, which in this case will be limited to the RSO or Alternate RSO (ARSO), shall complete HAZMAT Worker training every three (3) years and retain documentation of this training pursuant to U.S. Department of Transportation (DOT) regulations found in 49 CFR Part 12.704. This training includes “general awareness and familiarization training”, and “function-specific training”. Courses for HAZMAT Worker training can be found and completed online.

6. RECORDS

All radiation protection training shall be documented on a training form (attached) or similar listing. Training records shall be retained until license termination.

7. REFERENCES

U.S. Nuclear Regulatory Commission (USNRC). 1992. Instruction Concerning Prenatal Radiation Exposure. Regulatory Guide 8.13.

8. ATTACHMENTS

- Form SOP-1A: *Hazard Recognition Form*
- Form SOP-1B: *General Training Form*

FORM SOP-1A: HAZARD RECOGNITION FORM

For your safety you must be aware of some basic rules while onsite in the water treatment plant (WTP).

1. Possible physical hazards:
    a. Heavy equipment may be in use. Personnel should be aware of such equipment for their own safety.
    b. Care must be exercised when walking in or near the WTP building. Uneven, loose, or slippery surfaces represent a hazard for slips, trips, and falls.
    c. Additional personnel protective equipment may be required depending on the objectives of the visit.
2. Radiation Hazards:
    a. Any area or container on the property may contain radioactive materials.
    b. Drinking, eating, and tobacco use are prohibited inside the WTP building.
3. Safety Policies:
    a. Visitors to the WTP require escort by an Authorized User.
    b. Visitors are not permitted to handle radioactive materials.
    c. All personnel must be surveyed with radiation instruments before leaving any Restricted Area, except in the event of an emergency.
    d. Do not bring unnecessary items into the WTP building.
4. Emergency Response
    a. First aid kits are available in the field office supporting WTP operations.
    b. Call 911 for emergencies – a landline phone is located in the office, and cell phones generally have reception at the Site.

Signature_____ Company/Organization_____

Print Name_____ Date_____

FORM SOP-1B: GENERAL TRAINING FORM

Date:	Time:
Trainer Name:	Duration:
Training Subject(s):	

Worker Name	Worker Signature	Company	Date

SOP-2 INSTRUMENT TESTING AND CALIBRATION

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO) Authorized Users Radiation Protection Plan

1 PURPOSE

This Standard Operating Procedure (SOP) describes the methods for calibration, operational function checks, and measurement efficiency determinations for radiation detectors/meters prior to collecting radiological survey or monitoring data for water treatment plant (WTP) operations at the former Schwartzwalder Mine near Golden, Colorado (Site) as described in the Radiation Protection Plan (RPP).

2 SCOPE

This procedure applies to WTP workers and any work with licensed radioactive materials under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). RPP specifications and procedures for water treatment operations at the Site are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations). Specifically, this SOP covers quality assurance (QA) and quality control (QC) for the performance of various radiation detection instruments that may be used to perform radiological surveys or monitoring as required under the RPP. It also describes determination of instrument counting and detection efficiencies to determine radioactivity levels for surface contamination and measured radioactivity on air sampling filters based on count rate data.

3 RESPONSIBILITY

- **Radiation Safety Officer (RSO):** Responsible for review and evaluation of radiological survey and monitoring data, verification that the instruments used were calibrated and function checked in accordance with the methods specified in this SOP, and that RPP requirements are met. Ensures that the methods specified in this SOP are consistent with related LCs and CDPHE Regulations along with applicable technical guidance from the U.S. Nuclear Regulatory Commission (NRC) and other relevant agencies or organizations.

- **Authorized User (AU):** Responsible for completion of training in the operation, QC function testing, and use of radiation survey and monitoring instruments and devices, performing instrument QC function testing in accordance with this SOP and RPP requirements, and for proper documentation of instrument QC testing results.

4 PROCEDURE

4.1 EQUIPMENT AND MATERIALS

- Ludlum Model 2360 ratemeter/scaler with Model 43-93 alpha/beta probe, or equivalent
- Ludlum Model 3030 alpha/beta swipe counter, or equivalent
- Ludlum Model 19 micro-R ratemeter, or equivalent

- Radiological check sources: Th-230 or thoriated lantern mantle (alpha), Tc-99 (beta), and Cs-137 (gamma)
- Planchettes
- Calibration jig
- Forms: Form SOP-2A (*Instrument QC Tolerance Limits Testing*), Form SOP-2B (*Daily Instrument Function Check Form*) (see Attachments).

4.2 INSTRUMENT CALIBRATION

All radiation detection and measurement instruments must be calibrated by the manufacturer or a qualified vendor within 1 year prior to use at the Site. For gamma detectors with meters calibrated to measure gamma exposure rate (e.g. µR/hr), the calibration must include testing in known radiation fields from a certified (NIST-traceable) gamma emission source (e.g., calibration range measurements). Calibration metrics are documented with the calibration certificate. Calibration certificates for all instruments used at the Site will be kept with other RPP records. Hardcopy RPP records will be maintained onsite, and electronically scanned copies shall be maintained with other RPP records.

When annual re-calibration of an instrument is due, take the following steps for shipping the instrument to the manufacturer or qualified calibration vendor:

- Clean the outside of the instrument, including probe and meter as applicable. For alpha/beta probe faces, remove protective mesh and wipe off the mylar window. Use an alcohol wipe, lens cleaning cloth, or similar item. Do not use water.
- Ship the instrument in the packing material that came with the instrument (if not available, then pack the instrument in a manner to prevent damage) to manufacturer. Include any return forms required by the manufacturer.
- When the instrument returns from calibration, review the calibration forms to ensure that the calibration documentation is complete, save the hardcopy calibration certificate with onsite RPP records, and scan a copy and post in RPP files.
- To ensure the instrument is functioning as expected, determine QC tolerance limits for daily instrument function checks per Form SOP-2A (*Instrument QC Tolerance Limits Testing*) and SOP-2B (*Daily Instrument Function Check Form*) as described in the following Sections.

4.3 INSTRUMENT QC PERFORMANCE TESTING

The first step in monitoring the performance of radiation detection and measurement instruments is to establish a designated (fixed) QC testing location to perform initial instrument response testing to establish QC tolerance limits for subsequent daily instrument QC function checks. The designated QC testing location should be selected with the following conditions in mind:

- The location should represent reasonably low background conditions for the Site.
- The radiological conditions surrounding the location should be expected to remain consistent on a long-term basis.
- This will be the location that all daily instrument QC function checks will be performed at the beginning of each work day.

Immediately following receipt of a calibrated radiation measurement instrument, conduct instrument response testing for alpha, beta, or gamma sources (depending on instrument type) at the designated QC testing location to determine net (above background) QC tolerance limits for daily instrument function checks. The ***net*** count (or exposure) rate is determined by subtracting the background count (or exposure) rate from the source count (or exposure) rate. If the response of an instrument falls outside the QC tolerance limits before the 1-year recalibration due date, and the issue cannot be resolved, return the instrument to the calibration vendor for repair and recalibration. Upon receipt of the recalibrated instrument, repeat the instrument QC performance testing to determine new net QC tolerance limits as described in Sections 4.4 and 4.6 of this SOP.

4.4 DETERMINATION OF TOLERANCE LIMITS FOR DAILY INSTRUMENT FUNCTION CHECKS

Following instrument calibration and prior to use in the field, an AU trained on this SOP will perform instrument performance testing to establish net QC tolerance limits on the response of each instrument to alpha, beta, or gamma radiation check sources (as applicable to the instrument type) under a designated (fixed) measurement location and geometry. Form SOP-2A (*Instrument QC Tolerance Limits Testing*) will be used for this testing. The QC tolerance limits for the net (above background) count (or exposure) rate (mean ± 20%) as automatically calculated in the electronic version of Form SOP-2A will be used to ensure acceptable instrument performance between calibrations or repairs. Label the date and measured QC tolerance limits on the side of the instrument, and reference these tolerance limits when evaluating daily instrument function check measurements as specified in the following section. A trained AU (trained on this SOP) shall ensure that completed copies of Form SOP-2A (*Instrument QC Tolerance Limits Testing*) are filed in hardcopy and electronically with other RPP records.

4.5 DAILY INSTRUMENT FUNCTION CHECKS

For each instrument to be used on a given workday, the AU will first perform a daily instrument function check to verify that each instrument is responding within established QC tolerance limits. Daily instrument QC measurements will be used to ensure acceptable instrument performance in between calibrations/repairs. If an instrument begins to respond oddly during the course of the day, a second function check should be performed, and if outside QC limits, the instrument should be taken out of service for repair and recalibration. The steps for daily instrument function checks, with respective data and information to be documented on Form SOP-2B (*Daily Instrument Function Check Form*), are as follows:

1) Prepare a printed copy of Form SOP-2B (*Daily Instrument Function Check Form*) for each instrument to be used in the field. Populate the Form with the applicable instrument, source, and measurement information where indicated on the Form, including:
   - Instrument models, serial numbers, calibration due date.
   - QC testing location, measurement geometry information.
   - Certified source emission rate or activity (as applicable).
   - 2π scaler instrument counting efficiency values for alpha and beta sources as applicable (should be provided by the instrument calibration vendor on the calibration certificate).

- Applicable instrument QC tolerance limits as previously determined for the instrument (this information will be labeled on the side of the instrument following instrument performance testing as described in the previous section).

Once the above information is populated on Form SOP-2B, the Form may be used for daily instrument function checks following the below steps until the Form is full and a new one must be prepared for further daily QC function checks. In addition to entering background and source readings for each set of daily instrument function check measurements, the applicable net readings (e.g. for alpha and beta sources) must be calculated and entered for comparison against the applicable QC tolerance limits listed on the Form. Also, for alpha/beta scaler counting instruments, the total detection efficiency (ε_t) should be calculated as described in Section 4.6 (i.e., Equation 2-3) and recorded where indicated on the Form. This information enables tracking and verification of total efficiency values to be used for contamination surveys on corresponding dates [per SOP-3 (*Radiological Contamination Surveys*)].

2) Remove appropriate check source(s) from secured storage.

3) Check the manufacturer calibration sticker on the side of the instrument to ensure that the calibration is still current (i.e., the recalibration due date listed on the sticker has not lapsed).

4) Perform a battery check of the instrument:

   - Survey Meter: switch the dial to BAT and instrument should be in BAT OK range.
   - Swipe/Filter Counter: is plugged in to an outlet with power (no battery)

5) At the designated instrument QC testing location and fixed measurement geometry, perform a background scalar count for alpha and beta channels with the instrument:

   - Survey Meter: count for at least 2 minutes (use longer count time to improve minimum detectable activity [MDA], if necessary).
   - Swipe/Filter Counter: place a blank planchette in planchette tray holder and count for at least 1 minute.
   - For gamma exposure ratemeters, observe the analog dial or digital readout fluctuations for at least 1 minute to estimate the average background gamma exposure rate.

6) At the designated instrument QC testing location and fixed measurement geometry, perform a scalar count or gamma exposure measurement for each applicable source (alpha, beta, or gamma) for at least 1 minute.

   - Alpha/Beta Survey Meter: place the source in the middle of the calibration source holder jig, source side up.
   - Alpha/Beta Swipe/Filter Counter: place the source face up in a planchette and inside the planchette holder.
   - Gamma Ratemeter: place the source in the middle of the calibration source holder jig.

   Record the average source reading where indicated on Form SOP-2B.

7) Compare the average net (above background) daily QC function check reading against the established QC tolerance limits for the instrument (as posted at the top of the Form), and if in compliance, proceed to use the instrument as planned for the day.

8) Return the check sources used to the locked storage cabinet.

If daily instrument QC function check results fall outside the established tolerance limits, examine the source, QC measurement geometry, and immediate area to determine if anything may have caused the QC measurement to exceed the QC limits. If a reason is found attempt to fix the problem and measure again. If results remain outside the QC tolerance limits, remove the instrument from service and send to the manufacturer for repair and recalibration.

4.6 MEASUREMENT EFFICIENCY

When counting air monitoring filters or taking measurements of alpha/beta surface contamination, the counting efficiency for corresponding instruments must be determined to convert count rate data to surface activity levels or calculated air activity concentrations. In addition, the *total* detection efficiency of the monitoring or survey method, which accounts for attenuation or self absorption of alpha/beta emissions from the surface of the air sampling filter, swipe sampling pad, or in-situ surface measurement location, shall be used in calculation of air concentrations or surface activity for comparison against the applicable regulatory and administrative limits specified in the RPP (Table 5-1). The procedures for conducting surface contamination surveys are given in SOP-3 (*Radiological Contamination Surveys*), and procedures for occupational air monitoring are provided in SOP-4 (*Radiological Monitoring for Occupational Exposure*).

The method for calculation of air concentrations or surface activity based on alpha or beta emissions is described as follows. Guidance from the International Organization for Standardization (ISO) in ISO 7503-1 (*Evaluation of Surface Contamination*) calls for use of 2π surface emission rate when determining instrument counting efficiency (ISO, 1988). Consistent with the ISO guidance, NUREG-1575 (NRC, 2000) also defines instrument efficiency as "*the ratio of the net count rate of the instrument and the surface emission rate of a source for a specified geometry*". Based on this information, the formula for instrument efficiency calculations is as follows (Equation 2-1):

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\pi}} \qquad \textbf{Equation 2-1}$$

Where:

ε_i = instrument counting efficiency.

R_{S+B} = detector count rate of the source plus background (cpm).

R_B = detector background count rate (cpm).

$q_{2\pi}$ = certified 2π surface emission rate of the source (epm, listed as cpm).

For WTP operations at the Site, 2π instrument counting efficiency values for alpha/beta scaler instruments will be measured by the instrument calibration vendor and listed on the calibration certificate. If source serial numbers and 2π surface emission rates for surface activity from certified (NIST-traceable) alpha and beta sources are listed on the instrument calibration certificate, enter this information where indicated at the top of Form SOP-2B (*Daily Instrument Function Check Form*).

In addition to instrument counting efficiency (ε_i) as defined above (Equation 2-1), ISO 7503-1 gives generic source efficiency values (ε_s) for alpha and beta emissions to account for self attenuation of emissions by the source itself (0.25 for alpha and low-energy betas, and 0.5 for beta energies > 400 keV). For WTP operations at the Site, a source efficiency value of 0.25 will be conservatively assumed for surface contamination measurements and prior determinations of total detection efficiency (ε_t) as

defined below (Equation 2-2). For UN2910 shipping of excepted packages containing limited quantities of radioactive material under DOT transportation regulations, an additional swipe removal efficiency of 0.1 must be applied. With respect to air monitoring, studies of self-absorption of alpha particles on air sample filters (Higby, 1984; Terry, 1995) indicate that a 2π emission efficiency of 0.8 is appropriate for air filter samples, but this value must be multiplied by 0.5 to obtain a proper 4π ε_s value of 0.4. Calculate the total (effective) detection efficiency for alpha and beta emissions from in-situ surfaces, swipe samples, or air filter samples as follows (Equation 2-2):

$$\varepsilon_t = \varepsilon_i \times \varepsilon_s \qquad \textbf{Equation 2-2}$$

Where,

ε_t = Total detection efficiency (counts/decay).

ε_i = 2π instrument counting efficiency, calculated as defined above.

ε_s = Source efficiency factor:

- 0.25 for alpha and beta surface activity (static count or removable swipe samples).
- 0.4 for alpha radiation on air sampling filters.
- For shipping of U.S. Department of Transportation (DOT) excepted packages containing limited quantities of radioactive material or sources (via UN2910 protocols), multiply ε_t by an additional factor of 0.1 to account for swipe removal efficiency.

Once the total detection efficiency is determined, the surface activity (dpm/cm^2) or activity concentration in air (µCi/mL) are given by Equation 2-3:

$$C = \frac{R_S - R_B}{\varepsilon_t (F)(A \text{ or } V)} \qquad \textbf{Equation 2-3}$$

Where:

C = surface activity concentration (DPM/cm^2) or air concentration (µCi/mL).

R_S = detector count rate for the surface or sampling media (cpm).

R_B = background count rate for "clean" surface or unused sampling media (cpm).

ε_t = total detection efficiency (counts/decay).

F = conversion factor (2.22E+06 DPM/µCi) (applicable to air filter samples only).

A = areal dimensions (cm^2) of active probe area (for static surface counts) or of the area swipe tested (for removable). To calculate surface activity in conventional units of DPM/100 cm^2, replace the value of A in the above formula with the ratio A/100 (see Section 6.6.1 of MARSSIM; NRC, 2000).

V = volume of air sampled (mL) (applicable to air filter samples only).

These calculations are automated in the electronic spreadsheet versions of applicable survey forms as provided in SOP-3 (*Radiological Contamination Surveys*).

4.7 MEASUREMENT SENSITIVITY

The minimum detectable activity (MDA) for static scaler count measurements is calculated as follows (Equation 2-4):

$$MDA = \frac{3+3.29\sqrt{R_b t_s\left(1+\frac{t_s}{t_b}\right)}}{(\varepsilon_t)(t_s)\left(\frac{A}{100\ cm^2}\right)}$$ **Equation 2-4**

Where:

MDA = Minimum Detectible Activity (dpm/100cm^2).
R_b = Background count rate (cpm).
t_s = Survey count time (min).
t_b = Background count time (min).
ε_t = Total efficiency (counts/decay) (per Equation 2-2).
A = Probe area (cm^2).

The MDA for scan measurements is calculated using the following equations (NRC, 2000):

$$MDCR = d'\sqrt{b_i}\left(\frac{60\left(\frac{sec}{min}\right)}{i}\right)$$ **Equation 2-5**

Where:

MDCR = Minimum Detectable Count Rate (cpm).
d' = Index of sensitivity = e.g., 2.12 for 90% true positive and 20% false positive rate [from Table 6.5 of MARSSIM (NRC, 2000)].
b_i = Number of background counts in scan interval *i*
i = Observation or scaler counting interval (sec).

$$Scan\ MDA = \frac{MDCR}{\varepsilon_t \times \left(\frac{A}{100\ cm^2}\right)}$$ **Equation 2-6**

Where:

Scan MDA = Minimum Detectable Activity while scanning (dpm/100 cm^2)
MDCR = Minimum Detectable Count Rate (cpm).
ε_t = Total detection efficiency.
A = Probe area (cm^2).

4.8 DOCUMENTATION AND RECORDS RETENTION

In accordance with specifications of the RPP, the RSO and responsible AU(s) will ensure documentation of results for all RPP records including RWPs, instrument QC measurements, and survey or monitoring results, and will maintain these records as electronic copies with other RPP records. All RPP records will be maintained until license termination.

4.9 REFERENCES

Cember, H. and Johnson, T.E. 2009. Introduction to Health Physics. Fourth Edition. The McGraw-Hill Companies, Inc.

Higby, D.P. 1984. Effects of Particle Size and Velocity on Burial Depth of Airborne Particles in Glass Fiber Filters. PNL-5278 UC-41. Pacific Northwest Laboratory.

International Organization for Standardization (ISO). 1988. Evaluation of Surface Contamination – Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and Alpha-emitters.

Terry, K.W. 1995. Alpha Self-absorption in Monazite Dusts. Health Physics, Volume 69, Number 4: pages 553-555. October 1995.

U.S. Nuclear Regulatory Commission (NRC). 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1. NUREG-1575 (amended in 2002). Washington, D.C.

5 ATTACHMENTS

- SOP-2A (*Instrument QC Tolerance Limits Testing*)
- SOP-2B (*Daily Instrument Function Check Form*)

Form SOP-2A (*Instrument QC Tolerance Limits Testing*)

Date: _____ **Source Type:** _____

Detector/Meter Models: _____ **Source Serial #:** _____

Serial Numbers: _____

Calibration Due: _____

Determination of QC Tolerance Limits

Number	Source Reading (CPM or µR/hr)	Background Reading (CPM or µR/hr)	Net Reading (CPM or µR/hr)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			

Statistics

Average Net Reading (CPM or µR/hr)	
Std. Dev. (CPM or µR/hr)	

Net* QC Tolerance Limits (CPM or µR/hr)

Mean Net +20%	
Mean Net -20%	

*Net = source - background

Mean Background Reading (CPM or µR/hr): _____

Reviewed by: _____ **Date:** _____

Form SOP-2B

Daily Instrument Function Check Form

METER	
Manufacturer:	
Model:	
Serial No.:	
Cal. Due Date:	

DETECTOR	
Manufacturer:	
Model:	
Serial No.:	
Cal. Due Date:	

Location:
Geometry:
Comments:

Alpha Source: _____ SN: _____ 2π Emission Rate: _____ EPM* Instrument Efficiency (%)**:_____ Source Efficiency (%):_____

Beta Source: _____ SN: _____ 2π Emission Rate: _____ EPM* Instrument Efficiency (%)**:_____ Source Efficiency (%):_____

Gamma Source: _____ SN: _____ Source Activity: _____ µCi Calibration Date:_____ Distance to Source (cm): _____

*Emissions per minute (EPM) = 2π Emission Rate, as provided on the instrument calibration certificate (these values may be expressed in units of CPM).
**2π instrument counting efficiency as determined by calibration vendor and listed on calibration certificate

Instrument Control Limits (net values): α Low _____ α High_____ (CPM) / β Low _____ β High_____ (CPM) / γ Low_____ γ High_____ (µR/hr)

Date	Battery OK?	Alpha (CPM)			Beta (CPM)			Total Efficiency (%)		Gamma (CPM or µR/hr)			Initials
		Source	BKG	Net	Source	BKG	Net	Alpha	Beta	Source	BKG	Net	

Reviewed by: _____ **Review Date:** _____

SOP-3 RADIOLOGICAL CONTAMINATION SURVEYS

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO) Authorized Users Radiation Protection Plan

1 PURPOSE

This Standard Operating Procedure (SOP) describes the methods to be used for conducting radiological contamination surveys for personnel and equipment for water treatment plant (WTP) operations at the former Schwartzwalder Mine near Golden, Colorado (Site) as described in the Radiation Protection Plan (RPP). The primary objective is to ensure that personnel and equipment are not released from Restricted Areas or temporary exclusion zones if contamination levels in exceed regulatory standards, and to the extent possible, verify that lower administrative limits are met for consistency with the Site's "As Low As Reasonably Achievable" (ALARA) policy as defined in the RPP. Also provided are decontamination procedures in the event that regulatory and/or administrative limits in Table 5-1 of the RPP are not met.

2 SCOPE

This procedure applies to WTP workers and any work with licensed radioactive materials under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). RPP specifications and procedures for water treatment operations at the Site are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations). This SOP covers multiple types of radiological contamination surveys that may be required under the RPP, including fixed or removable radiological surface contamination on personnel or equipment when leaving Restricted Areas or temporary exclusion zones. Gamma radiation surveys for contamination are also described.

3 RESPONSIBILITY

- **Radiation Safety Officer (RSO)** – responsible for review and evaluation of radiological contamination survey data, verification that the data were generated in accordance with the methods specified in this SOP, and that RPP requirements are met. Ensures that Authorized Users (AUs) are trained and proficient at performing and documenting contamination surveys in accordance with the methods specified in this SOP as designed for consistency with related CDPHE Regulations and applicable technical guidance from the U.S. Nuclear Regulatory Commission (NRC) and other relevant agencies or organizations.

- **Authorized Users** – responsible for completion of training in the operation, QC testing, and use of radiation survey instruments, performing contamination surveys in accordance with this SOP and RPP requirements, and for proper documentation of survey results.

4 PROCEDURE

4.1 EQUIPMENT AND MATERIALS

- Ludlum Model 2360 ratemeter/scaler with Model 43-93 alpha/beta probe, or equivalent
- Ludlum Model 2929 alpha/beta swipe counter, or equivalent
- Ludlum Model 19 micro-R ratemeter, or equivalent
- Alconox (or equivalent) detergent for washing tools or equipment, mild soap for washing skin, and a clean water supply
- Scrub brushes, paper towels
- Forms: see attachments

4.2 TYPES OF RADIOACTIVE CONTAMINATION

Unrestricted release limits for radiological surface contamination as specified in Table 5-1 of the RPP are focused on surficial alpha activity based on NRC Regulatory Guide (RG) 8.30 (USNRC, 2002). While beta radiation will also be present in surface contamination associated with WTP operations, quantitative measurements of surficial beta activity at uranium recovery facilities can be problematic due to relatively high background levels, correspondingly high detection limits, and inadequate sensitivity to reliably determine compliance with administrative release limits. In addition, a portion of beta detector response can result from gamma radiation interacting with metal detector housings or other nearby materials. Such interactions can emit free electrons due to the photoelectric effect and Compton scatter, and beta detectors cannot distinguish between beta particles and free electrons. Nevertheless, beta measurements can be qualitatively useful in identifying or verifying the presence of radioactive contamination, particularly for wet, soiled, oily, rough, or painted surfaces that can readily attenuate alpha particles but not beta particles.

Because radiological contamination at uranium recovery facilities involves long-lived radionuclides with relatively low specific activities (e.g., uranium, Th-230, and Ra-226), gamma radiation measurements are generally not useful for identifying trace deposits of surface contamination. However, due to the highly penetrating nature of electromagnetic gamma radiation, external gamma measurements can detect volumetric accumulations of contamination inside of equipment (e.g., RO membranes and cartridge filters inside of respective housing materials) that cannot be detected with external measurements of alpha or beta activity (due to attenuation).

4.3 RADIOLOGICAL CONTAMINATION RELEASE LIMITS FOR UNRESTRICTED USE

Unrestricted regulatory release limits for contamination surveys are shown in Table 4-1. Note that there are limits for both total contamination (fixed + removeable) and removable alpha contamination. Based on guidance in NRC's RG 8.30 (USNRC, 2002), all surface contamination on personnel is assumed to be removable, and thus only the removable limits specified in Table 4-1 apply. However, because swipe sampling for removable contamination on personnel is not a normal or reliable health physics practice, nor is it necessary to determine compliance with removable limits, only static survey measurements will be used to determine compliance with the removable limits under the RPP and this SOP.

In addition to the regulatory release criteria, Table 4-1 includes more restrictive administrative limits under the Site's "As Low As Reasonably Achievable" (ALARA) policy as defined in the RPP. Also shown are separate release criteria for shipping of limited quantities of radioactive material (e.g., environmental samples) with UN2910 limited quantity, excepted package protocols under U.S. Department of Transportation (DOT) regulations.

TABLE 4-1: REGULATORY AND ADMINISTRATIVE CONTAMINATION RELEASE LIMITS.

CATEGORY	PARAMETER	REGULATORY LIMIT [1]	ADMINISTRATIVE LIMIT [1]
Contamination Limits	Equipment Release	Alpha Activity: 5,000 dpm/100 cm^2 [2] 15,000 dpm/100 cm^2 [3] 1,00 dpm/100 cm^2 [4] Gamma Dose Rate: 2 mrem/hr [5]	Alpha Activity: 500 dpm/100 cm^2 1,500 dpm/100 cm^2 100 dpm/100 cm^2 Gamma Exposure Rate: 20 µR/hr [5]
	Personnel	Alpha Activity: 1,000 dpm/100 cm^2 [4,6]	Alpha Activity: 100 dpm/100 cm^2 [4,6]
	UN2910 Excepted Packages	24 dpm/cm^2 [7] 240 dpm/cm^2 [8] 500 µR/hr [9]	N/A

[1] Note that "dpm" = decays per minute, and all limits are net (above background) values.

[2] Average total (fixed plus removable) activity across any 1 m^2 area (NRC Reg. Guide 8.30).

[3] Maximum total activity across any 100-cm^2 area (NRC Reg. Guide 8.30).

[4] Removable surface activity (NRC Reg. Guide 8.30).

[5] The regulatory limit for gamma dose rate is based on the public dose limit in Part 4.14 of CDPHE Regulations. The administrative limit is an ALARA goal for exposure rate based on 1% of the regulatory limit.

[6] For personnel surveys, static measurements will be used to determine compliance with removable limits.

[7] Removable alpha activity on package surface (average across 300 cm^2 area).

[8] Removable beta/gamma activity on package surface (average across 300 cm^2 area).

[9] Gamma exposure rate on contact with package.

4.4 PRELIMINARY QC MEASUREMENTS

Following each annual instrument calibration, a trained AU shall perform instrument QC performance testing on a for each scaler instrument as detailed in SOP-2 (*Instrument Testing and Calibration*) to: 1) establish daily QC tolerance limits on the response of each radiation detection instrument to an appropriate radiation check source under a designated (fixed) measurement location and geometry, and 2) verify acceptable instrument counting performance on a daily basis.

Prior to performing a radiological contamination survey, the instrument(s) to be used each day shall be function checked for compliance with the established daily QC tolerance limits.

4.5 CLASSIFICATION OF EQUIPMENT AND MATERIALS

Equipment, materials, items or a batch of items (e.g. a box of hand tools etc.), to be released for unrestricted use shall be evaluated for potential contamination and classified into one of three survey

classes as described below. For more information on survey classifications see Radiological Surveys for Controlling Release of Solid Materials (USNRC, 2002).

- Class 1 survey items or surfaces are likely to be above the surface contamination limits based on the site knowledge. For example, equipment used to clean up a spill of water treatment media would be classified as a Class 1 survey items. For Class 1 survey items, 100% of the surface area is scanned during the survey.
- Class 2 survey items or surfaces may have some contamination but are likely to be near or below the release limits. For Class 2 survey items, at least 50% of the surface area of each item is scanned during the survey.
- Class 3 survey items or surfaces are unlikely to be contaminated, or the likely location(s) of contamination are well known. For Class 3 survey items, the area to be surveyed is up to the judgement of the surveyor, but generally 10% of the surface area of each item is scanned during the survey. The surveyor should pick areas on the item or surface that are most likely to be contaminated, based on the nature and use of the item.

If an object cannot be readily classified based on historic process knowledge, usage location, etc., then it should initially be surveyed using the specifications for Class 1 survey items. If initial survey measurements indicate little or no measurable contamination, the item may be reclassified as a Class 2 or 3 survey item.

4.6 EQUIPMENT RELEASE SURVEYS

Note that only AUs trained on this SOP may perform equipment release surveys. Supervising AUs are responsible for performing equipment release surveys for contractors working under an RWP as defined in the RPP and SOP-1 (*Radiation Protection Training*).

4.6.1 GENERAL APPROACH AND SEQUENCE

Equipment release surveys consist of scans, static measurements and removable swipe testing to identify and quantify surface contamination from alpha activity. Beta scans are use as qualitative indicators of contamination, for example when the surfaces being scanned are wet, oily, rough or painted. Gamma scans are useful for detecting volumetric quantities of radioactive materials contained inside of equipment, housings, or containers, and can provide quantitative information on external dose rates of relevance to worker cautions and area postings. While the regulatory limit for gamma radiation is based on CDPHE Regulations for public exposure to external dose rates, reasonable efforts should be made to reduce gamma emissions to meet the ALARA administrative limit (20 µR/hr above background) before releasing any equipment for unrestricted use. The sequence for surveys of equipment and materials for release for unrestricted use is summarized as follows:

1. Classify the equipment or item to determine the percentage of surface area to be surveyed.
2. If necessary, wash the equipment or item to remove visible accumulations of soil or mud. Equipment or items should be allowed to dry prior to performing a surface contamination survey, especially for measurements of alpha contamination.

3. Ensure that the survey meter has been function checked for acceptable performance following SOP-2 (*Instrument Testing and Calibration*) specifications. Determine the background count rate to apply to the survey, and for alpha/beta surface contamination surveys, use the 2π counting efficiency values determined with certified (NIST traceable) check sources or as provided by the calibration vendor (listed on the instrument calibration certificate). These instrument counting efficiency values shall be used to determine total detection efficiency and to document these values at the top of Form SOP-3A (*Equipment Surface Contamination Release Form*). Determination of instrument counting and total detection efficiency values is described in SOP-2 (*Instrument Testing and Calibration*).
4. Survey for alpha and beta surface contamination.
5. If results for alpha activity are above the administrative release limit(s) specified in Table 4-1 then decontaminate and resurvey until below the release limits. If the administrative limits cannot be met with decontamination, the regulatory limit applies. If the regulatory limit cannot be met with normal decontamination methods, contact the RSO for further instruction. Document all results on Form SOP-3A.

For gamma surveys of equipment, materials, or workplace areas based on exposure rate measurements, counting efficiency values are not used, but background measurements are needed to determine net exposure rates associated with gamma-emitting contamination. Typically, the objective of gamma surveys of equipment, materials, and workplace areas is to detect shielded contamination on the interiors of equipment or materials such as pipes, tanks, drains, and valves. Gamma exposure rate measurements are also required for surveys of packages containing limited quantities of radioactive materials (e.g., spent water treatment media samples) under DOT's UN2910 limited quantity, excepted package transportation protocols.

4.6.2 PERFORMING SURVEYS

There are many factors that can affect the approach to a contamination survey. Some examples include the size and shape of the item being surveyed, contamination that is inaccessible to surface survey measurements, variations in instrument response for different measurement geometries, and consideration of variable background conditions around larger objects. While some of these issues are discussed in this SOP, all circumstances and conditions cannot be anticipated, and professional judgement and experience may sometimes be required. If uncertain, AUs should contact the RSO for advising.

Radioactive contamination on the interior surfaces of pipes, drain lines, or tanks can be shielded from detection of alpha or beta radiation with exterior survey measurements. In some cases, representative measurements of valves or other access points may provide sufficient confidence of the status of inaccessible surfaces. In other cases, removable swipe samples can reach interior surfaces not accessible to external survey measurements. For gamma-emitting radionuclides, gamma surveys can sometimes be useful for identifying locations where interior, shielded contamination is present.

Equipment or materials with an operational history that suggests the potential for contamination, but where some surfaces are inaccessible to surface scanning or static measurements, the subject equipment or materials shall be assumed contaminated in excess of the release limits and cannot be

released for unrestricted use without further efforts to attain access for survey measurements to provide sufficient evidence of compliance with release limits.

To survey an item, perform the following steps to generate data for comparison with the release limits specified in Table 4-1:

1. Ensure the survey instrument calibration is current, and is responding properly to an appropriate check source based on the daily instrument QC function testing as specified in SOP-2 (*Instrument Testing and Calibration*).
2. Estimate the average instrument background count rate for alpha and beta radiation at a representative uncontaminated location. This is performed by taking a scaler count of at least 1 minute, or by estimation based on the apparent average reading displayed on the ratemeter's analog display.
3. For alpha or beta surface scans, position the probe face of the survey meter within 1 centimeter (cm) of the surfaces being scanned. Slowly scan the surface of the item (at ≈ 1 centimeter per second [cm/sec]) with the probe positioned over the survey area, stopping at areas of suspected contamination to verify the presence of a hotspot (i.e., elevated above background).
4. Perform static scalar counts of hotspots to measure the count rate of the contamination. Record the information on Form SOP-3A (*Equipment Contamination Survey Form*) and calculate the activity in decays per minute per 100 centimeters squared (dpm/100cm^2). The following equation shall be used (note that if the data are entered into the electronic version of this Form, the calculations are automated):

$$C = \frac{R_S - R_B}{\varepsilon_t\left(\frac{A}{100}\right)} \qquad \textbf{Equation 3-1}$$

Where:

C = surface activity concentration (dpm/100 cm^2).

R_S = detector count rate for the surface or sampling media (cpm).

R_B = background count rate for "clean" surface or unused sampling media (cpm).

ε_t = total detection efficiency (counts/decay) as determined in SOP-2 (Equations 2-1 and 2-2).

A = areal dimensions (cm^2) of active probe area (for static surface counts) or of the area swipe tested (for removable). Note that the ratio A/100 in the above formula equals unity (1) for a detector with an active probe area of 100 cm^2 such as the Ludlum Model 43-93.

5. Collect removable swipe samples when:
   a. The static, total net (above background) survey meter reading is above the applicable *removable* contamination limit.
   b. The area being measured is irregularly shaped, not an ideal flat surface.
   c. Internal surfaces of components are not accessible to static survey measurements.
6. Count the swipe with either a swipe counter or the survey meter.
7. If counting with a swipe counter (Ludlum 2929, or equivalent):
   a. Remove the swipe from the paper backing material with tweezers.

b. Place the swipe in a planchette with the sample collection side facing upwards, then place the planchette and swipe sample into the swipe counter. Make sure the swipe is laying below the rim of the planchette. If the swipe is sticking up, the mylar window of the instrument could be damaged.

c. Close the tray and lock in place.

d. Press the count start button. When the colons disappear, the count is over. Record results and compare to the limits.

8. If counting the swipe with a survey meter (Ludlum 2360 with 43-93 probe, or equivalent):

a. Place the swipe sample on a clean, flat surface or in a QC testing jig, with the sampled surface facing upwards.

b. Place the face of the detector within 1 cm of the swipe sample. Avoid contact between the potentially contaminated swipe sample and the face of the detector.

c. Perform a static count of the swipe sample. Compare results to the applicable removable limits specified on Form SOP-3A.

Survey Tips:

- Avoid touching the surface being surveyed with the probe face to avoid damaging the probe and possibility contaminating the probe face.
- Note increases in the count rates as indicted by the instruments audible output or by visually watching the ratemeter needle. Such increases indicate a potential hotspot for further assessment (direct static counts and potential swipe sampling).
- If a surface to be surveyed for alpha contamination is wet, let the surface dry prior to conducting the survey.
- Survey equipment and materials in a low background area when practical to do so.

If a hotspot on an item exceeds the regulatory release limit for surface alpha activity, even following decontamination (see Section 4.9), contact the RSO for notification and advising. As indicated in the footnotes to Table 4-1, multiple individual 100-cm^2 surface contamination measurements (represented by the size of the active probe area for a Ludlum 43-93 detector) should be averaged over 1 square meter (m^2) for comparison against the "average" release limit, while maximum contamination measurements represent the maximum individual 100-cm^2 reading for the item being surveyed (i.e., a single static measurement with a Ludlum 43-93 alpha/beta probe). Survey several different representative locations within a 1 m^2 area as needed to obtain the average count rate.

Both a swipe counter and the survey meter are acceptable methods for measuring a swipe, but the swipe counter is preferred. Note that if a survey meter is used to count swipe testing samples, the daily QC tolerance limits and counting efficiency values as defined in SOP-2 (*Instrument Testing and Calibration*) must be determined using the same survey meter and counting geometry. The benefit of using a swipe counter is that the count is more precise and sensitive, primarily because background is shielded and respective fluctuations are easier to control. Using a swipe counter will reduce the frequency of false positive readings.

4.7 SURVEYS FOR SHIPPING SAMPLES OF SPENT WATER TREATMENT MEDIA

Based on maximum radiological data for previous sampling of spent RO filter media (RO membranes and cartridge filters) as shown in Table 5-5 of the RPP (RPP Section 5.3.1), it is conservatively assumed that some all packages containing such samples will exceed DOT exemption limits for Class 7 hazardous radioactive materials as specified for uranium and/or Ra-226 in 49 CFR 173.436. Such packages must be shipped under UN2910 protocols for small quantities with excepted package requirements. Additional information on UN2910 shipping is provided in SOP-1 (*Radiation Protection Training*) and SOP-9 (*Materials Handling, Transport, and Disposal*). Such packages must be surveyed for radioactivity levels on the exterior of the package and must meet UN2910 limits as specified in Table 4-1 of this SOP.

The procedure for radiological contamination surveys for shipping UN2910 packages (transport of packages containing samples of water treatment media), is the same as indicated above for equipment release surveys (Section 4.6) except for the following:

1) The person performing the shipping package survey must be current on HAZMAT Worker training for shipping of radioactive materials as specified in SOP-1 (*Radiation Protection Training*).

2) Alpha/beta scans and static measurements for total (fixed plus removable) surface activity are not applicable.

3) The areal basis for removable contamination swipe testing is 300 cm^2.

4) In addition to the applicable total detection efficiency (ε_t) value given in SOP-2 (*Equation 2-2*) for calculation of removable surface activity, a swipe removal efficiency value of 0.1 must also be applied for determination of compliance with package release limits for UN2910 shipping.

5) Applicable release limits differ.

6) Results of the package survey are recorded on Form SOP-3B (*UN2910 Shipping Package Survey Form*) (attached).

4.8 PERSONNEL EXIT SURVEYS

All Personnel accessing Restricted Areas, or "temporary exclusion zones" for work with contaminated materials beyond the Restricted Area (as described in the RPP), are required to scan their clothing, exposed skin, and shoes upon leaving the Restricted Area or temporary exclusion zone as specified in the RPP and Section 4.3 of this SOP. All AUs will be trained on the use of the survey instruments, performing a proper personal exit survey, and documenting results on Form SOP-3C (*Personnel Contamination Survey Form*). Contractors working under an RWP may be trained to self-perform and document personnel exit surveys, but the supervising AU shall monitor these surveys and review documentation to verify proper implementation. Basic steps for personnel exit surveys are as follows:

- While holding an alpha/beta detector approximately 1 cm from the surface to be scanned, survey at a rate of approximately 1-2 inches per second, paying attention to the audible output (clicks) and/or analog dial response or digital display readings.

- If audibly or visually elevated counts (relative to background) are observed while scanning, pause at that location to confirm whether the counts are consistent with background levels or exceed background.
- If the count rate is consistent with background levels, continue with the survey.
- If the count rate exceeds the background level, carefully scan around the location to determine the extent of the elevated readings. Note the area for subsequent evaluation and potential decontamination, and continue scanning until the survey is completed.
- At the location of the highest alpha and/or beta readings, perform a static 30-second count and double the results to get the count rate for alpha activity (in CPM). If the result exceeds the ALARA administrative limit for removable alpha activity in Table 4-1, follow the decontamination procedures in Section 4.9.2 of this SOP as applicable until follow-up measurements verify that ALARA limits are met.
- If radioactivity above an administrative limit persists after decontamination, the regulatory limit for alpha activity in Table 4-1 shall apply. If the regulatory release limit cannot be met with standard decontamination procedures (Section 4.9), contact the RSO for further advising.

As mentioned above, in addition to the regulatory release limits for personnel exit surveys shown in Table 4-1, an ALARA administrative release limit for removable surface contamination of 100 dpm/100 cm^2 above background is the goal for personal exit surveys. Given typical total detection efficiencies of about 10% for alpha measurements, this criterion is approximately equal to 10 cpm above background (i.e., 100 dpm/100 cm^2 × 0.1 cpm/dpm/100 cm^2 = 10 cpm). The background reading, measured at the personnel exit survey location, will be determined each day by the AU for the survey instrument to be used. The release limits and ALARA goal for alpha contamination (in cpm and dpm/100 cm^2) will be labeled at the top of Form SOP-3C (*Personnel Contamination Survey Form*) for each the day this Form (attached) is generated.

4.9 DECONTAMINATION

4.9.1 EQUIPMENT DECONTAMINATION

Various methods may be used when equipment surfaces do not meet contamination release limits and decontamination is required. Common options for affected equipment are listed below, not necessarily in any order of priority or applicability:

1. Remove large deposits of radiologically contaminated soil with hand tools such as a shovel or wire brush.
2. Using water, or soap and water, is generally sufficient for removing contaminated dirt and dust from surfaces. A rag or brush may also be used. Items like rags and brushes shall be presumed contaminated after use for decontaminating equipment. Detergents, such as Alconox (or similar), may also be used.
3. Clean the object with a power washer or nozzle on a hose with a high-pressure setting. Depending on the level of contamination, disposable coveralls (e.g., Tyvek suit) may be appropriate if contamination of personnel from spray-generated aerosols is possible. Wear a face shield to prevent splashing and contamination of the face.

4.9.2 PERSONNEL DECONTAMINATION

Various methods may be used when personnel, including exposed skin, clothing, boots, PPE, etc. do not meet contamination limits and decontamination is required. Brushing off visible accumulations of dirt or mud with a semi-stiff bristled brush may be sufficient for clothing or personal protective equipment (PPE). However, contaminated skin should only be gently washed with mild soap and water. Personnel decontamination approaches that can abrade the skin should be avoided to prevent the potential for internalization of contamination. Double-sided sticky tape can be effective a removing a fine film of contaminated dust particles on clothing or PPE. In cases where these simple decontamination efforts to remove long-lived radiological contamination (as opposed to plate-out of short-lived radon progeny, see Cautionary Note below) on personnel prove ineffective, notify the RSO for further advising.

Cautionary Note: Short-lived airborne decay products of radon gas (progeny) can readily adhere to hair, clothing, and PPE. Certain plastics and fleece-like materials can build up a static charge and become subject to "plate out" of radon progeny attached to dust particles. Radon progeny commonly produce false positive readings on personnel contamination surveys. This circumstance is not considered contamination nor is it a health concern as the alpha activity is external to the body and within several hours, associated activity will no longer be present. Washing skin and use of double-sided sticky tape rollers (lint removal devices) on clothing can help to remove radon progeny and reduce "false positive" survey results for long-lived radionuclides, which are the primary concern. In the event that these measures do not reduce survey readings to acceptable levels, the individual may wait for 30-60 minutes and resurvey – if readings have measurably decreased, this is an indication of radon decay products. Alternatively, the article of clothing may be placed in a plastic bag for several hours and resurveyed, or left onsite at the survey station and be rescanned the following morning to verify that short-lived radon progeny have decayed away and readings have returned to background levels.

4.10 GAMMA SURVEYS

As previously noted, gamma scans can be used to help detect shielded contamination inside of pipes, drains, tanks, etc., but this is generally not a quantitative method. More commonly, gamma surveys are used to evaluate external gamma radiation emissions from contaminated solutions and residual solids inside treatment system infrastructure (e.g., pipes, media housings, etc.) for dose assessment purposes. The RSO will conduct and document monthly workplace gamma survey measurements at select locations in and around the WTP building as shown in Figure 2-3 of the RPP, and will record the results on Form SOP-3D (*Monthly Workplace Gamma Survey Form*) as attached to this SOP.

For non-routine activities or events, the RSO may require a gamma survey of specifically applicable work areas to evaluate whether an RWP is warranted, and if so, whether occupational monitoring with dosimeters and/or air sampling should be required. If required by the RSO, gamma survey measurements shall be performed as follows:

1. Verify the calibration date and battery condition of the instrument before using.
2. Perform the daily instrument QC function checks as detailed in SOP-2 (*Instrument Testing and Calibration*) to ensure proper instrument performance on the day of use in the field.
3. Record gamma exposure measurement readings for each survey location on Form SOP-3D (attached) for documentation and RSO review.

If measured exposure rates at the location where an RWP will be conducted exceed the Administrative Limit of 500 micro-roentgen per hour (µR/hr) as indicated in Table 5-1 of the RPP, the RSO will consider this data in determining any radiation protection monitoring that may be required. If the exposure rate at any location exceeds 5,000 µR/hr, which is roughly equivalent to a dose rate of 5 mrem/hr, the RSO shall be notified immediately, and the area shall be posted as a "Radiation Area" as required by CDPHE Regulations.

4.11 QUALITY ASSURANCE AND QUALITY CONTROL

Completed *Equipment Contamination Survey Forms* (Form SOP-3A), UN2910 Shipping Package Survey Form (Form SOP-3B), and *Personnel Contamination Survey Forms* (Form SOP-3C) shall be reviewed by the RSO on a monthly basis. If there are discrepancies, the RSO may initiate an investigation to determine the cause and take corrective action, if applicable. The review should include the following items:

- Instrument background is in expected range.
- The instrument QC performance metrics meet the specifications of SOP-2 (*Instrument Testing and Calibration*), including compliance with QC tolerance limits.
- The instrument use occurred within one year of the manufacturer's last calibration.
- Surveys are completed as required, and items released from the Restricted Area are below administrative and/or regulatory release limits.

4.12 DOCUMENTATION AND RECORDS RETENTION

Completed survey forms shall be filed electronically with other RPP records and retained until license termination.

4.13 REFERENCES

International Organization for Standardization (ISO). 1988. Evaluation of Surface Contamination – Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and Alpha-emitters.

U.S. Nuclear Regulatory Commission (USNRC). 1987. Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, FC 83-23.

US Nuclear Regulatory Commission (USNRC). 2002. Health Physics Surveys in Uranium Recovery Facilities. NRC Regulatory Guide 8.30 (Revision 1). May 2002.

5 ATTACHMENTS

- Form SOP-3A: *Equipment Contamination Survey Form*
- Form SOP-3B: *UN2910 Shipping Package Survey Form*
- Form SOP-3C: *Personnel Contamination Survey Form*
- Form SOP-3D: *Monthly Workplace Gamma Survey Form*

FORM SOP-3A EQUIPMENT CONTAMINATION SURVEY FORM

Site:	Equipment Use/Location:
Survey Item Description:	DATE:

Meter / Detector	Serial Number		Cal. Due Date	Background			Total Efficiency (counts/decay)	
	Meter	Detector		Alpha (cpm)	Beta (cpm)	Gamma (µR/hr)	Alpha (α)**	Beta (β)**
Model 2360 / 43-93 (α/β)								
Model 3030 Swipe Counter (α/β)								
Model 19 Gamma (or equivalent)								

Contamination Limits: (dpm/100cm²) *		Removable α 1,000 (100)			Removable β 1,000 (100)			Total α 5,000 (500)			Total β 5,000 (500)			20 µR/hr
Meas. No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm² β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm² β Total	Net Gamma (µR/hr)
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

Remarks:

Technician Name/Signature:

Reviewer Signature/Date:

*Administrative limit given in parentheses

**Per Equation 2-2 in SOP-2 (determined on Form SOP-2B)

Form SOP-3B UN2910 Shipping Package Survey Form

Site:	Package Description:	Page 1 of 1
Sample Types(s):	Package #	Date:

Meter / Detector (radiation detected):	Swipe Area (cm^2)	Serial Number: Meter	Serial Number: Detector	Cal. Due Date:	Background (CPM) Alpha (α)	Background (CPM) Beta (β)	Total Efficiency (counts/decay) Alpha (α)*	Total Efficiency (counts/decay) Beta (β)*
Model 2929 Swipe Counter (α/β)	300							
Model 19 (γ)	NA					(μR/hr)	NA	NA

DOT Package Contamination Limits:		Removable α: 24 dpm/cm^2			Removable β/γ and α_{LT}**: 240 dpm/cm^2			Max Gamma: 500 μR/hr	Package Diagram with Annotated Survey Locations
Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/cm^2 α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/cm^2 β Removable	Net Exposure Rate (μR/hr) on Contact	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

REMARKS:

RSO SIGNATURE/DATE:

*Including the Total Efficiency (ε_t) as defined in SOP-2, multiplied by a swipe removal efficiency factor of 0.1 (i.e., $\varepsilon_t \times 0.1$)

**α_{LT} = Low toxicity alpha emitters

Form SOP-3C Personnel Contamination Survey Form

Date_____ **Scan Out Location** _____

Instrument Model Numbers: Detector_____ Meter_____

Instrument Calibration Due Date: _____

Total Alpha Detection Efficiency (ε_t from SOP-2, Form SOP-2B): _____counts/emission

Alpha Background (ambient reading from uncontaminated area near scan-out station) _____ cpm

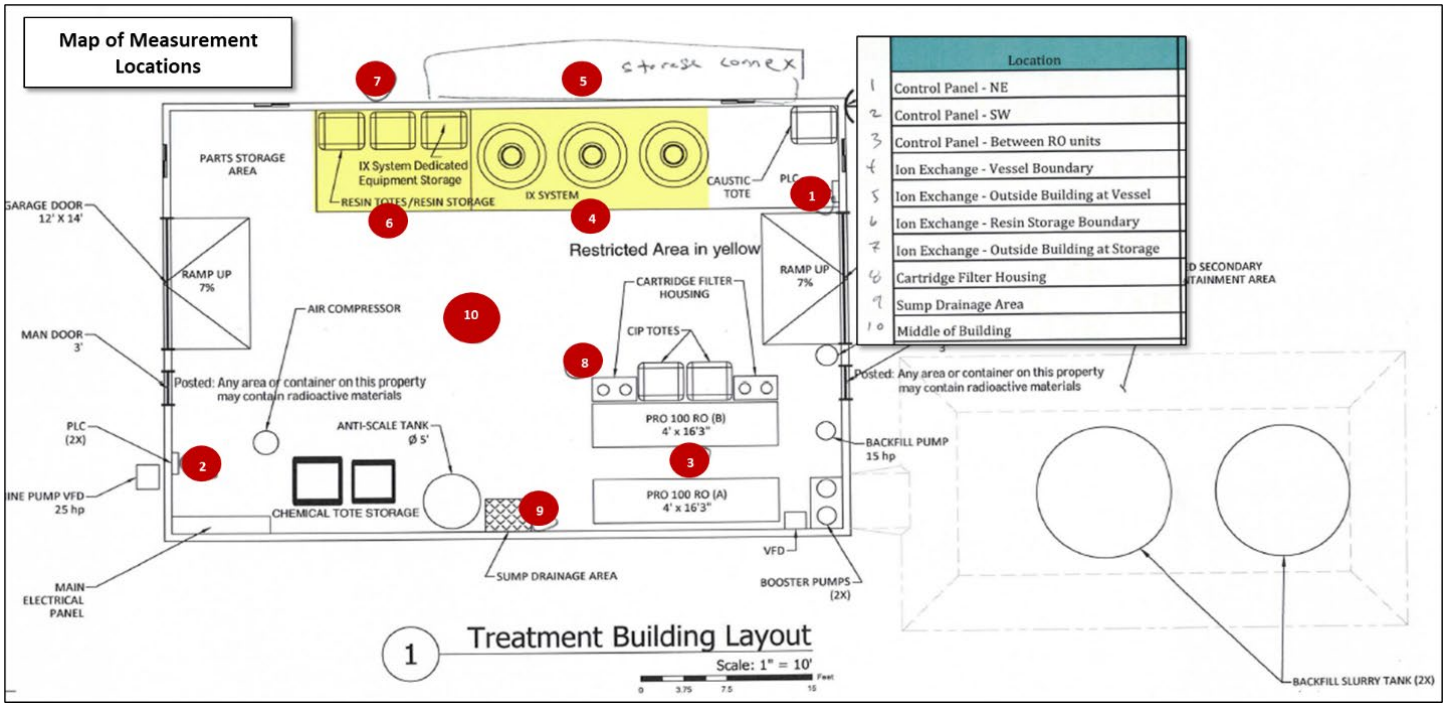
ALARA Action Level = (100 dpm/100 cm^2 × $\varepsilon_{t)}$ + Alpha Background (cpm) = _____ cpm

Regulatory Release Limit = (1,000 dpm/100 cm^2 × $\varepsilon_{t)}$ + Alpha Background (cpm) = _____ cpm

Initialing this Exit Survey Form indicates that you have performed and passed the Personnel Exit Survey.

Name (please print)	Company	Max CPM (initial)	Max CPM (post-decon)	Initials

FORM SOP-3D **MONTHLY WORKPLACE GAMMA SURVEY FORM**



MONTHLY WORKPLACE GAMMA EXPOSURE RATE SURVEY MEASUREMENTS		
Location	**Date**	**Average Gamma Exposure Rate Reading (µR/hr)**
1. Control Panel NE		
2. Control Panel SW		
3. Control Panel - Between RO Units		
4. IX - Vessel Boundary		
5. IX - Outside Building at Vessel		
6. IX - Resin Storage Boundary		
7. IX - Outside Building at Resin Storage		
8. Cartridge Filter Housing (at 1 ft)		
9. Sump Drainage Area		
10. Middle of Building		
Trailer/Parking Lot (Background)		

Surveyor Name:_____ **Surveyor Signature:**_____

Instrumentation

Gamma Detector/Meter Model:_____

Gamma Detector/Meter Calibration Due Date:_____

Acceptable Daily Instrument QC Function Check Results (Y/N):_____

SOP-4 RADIOLOGICAL MONITORING FOR OCCUPATIONAL EXPOSURE

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO)
Authorized Users
Radiation Protection Plan

1 PURPOSE

This Standard Operating Procedure (SOP) describes the methods for monitoring of occupational exposure to radioactive materials and radiological dose pathways for water treatment plant (WTP) operations at the former Schwartzwalder Mine near Golden, Colorado (Site). The Radiation Protection Plan (RPP) for this Site includes potential occupational monitoring for airborne particulate radionuclides, airborne radon decay products (progeny), bioassay, and external (direct) radiation in support of radiological dose estimates for WTP workers, where applicable.

2 SCOPE

This procedure applies to WTP workers and any work with licensed radioactive materials under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). RPP specifications and procedures for water treatment operations at the Site are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations).

This SOP covers potential forms of radiological exposure monitoring as noted above, if required by the radiation safety officer (RSO) under a radiation work permit (RWP) as detailed in the RPP and in SOP-6 (*Radiation Work Permits*). If the RSO determines that occupational exposure monitoring is required for a non-routine activity or event under the criteria specified in SOP-6 based on Part 4.18 of CDPHE Regulations, the RSO will issue an RWP that specifies respective monitoring requirements. Where occupational radiation monitoring is conducted, the RSO will use the data generated to calculate estimated radiation doses to monitored RWP workers.

3 RESPONSIBILITY

- **Radiation Safety Officer (RSO):** Responsible for determination of the need for occupational radiation monitoring requirements and issuance of RWPs, review and evaluation of RWP exposure monitoring data, verification that the data were generated in accordance with the methods specified in this SOP, and that RPP requirements are met. Ensures that the methods specified in this SOP are consistent with related LCs and CDPHE regulations along with applicable technical guidance from the U.S. Nuclear Regulatory Commission (NRC) and other relevant agencies or organizations.

- **Authorized User (AU):** Responsible for completion of training in the operation, QC testing, and use of radiological exposure monitoring instruments and devices, administering occupational radiation exposure monitoring in accordance with applicable RWPs, this SOP, and RPP requirements, and for proper documentation of monitoring results.

4 PROCEDURE

4.1 OCCUPATIONAL AIR MONITORING

4.1.1 DISCUSSION

Occupational air monitoring is divided into two basic types: 1) personal breathing zone (BZ) air sampling for long-lived radionuclides in air particulates, and 2) BZ air sampling for short-lived radon progeny in air. Procedures for each are detailed in the following subsections, along with QA/QC and documentation requirements. For evaluation of internal occupational inhalation dose from air particulates, respective BZ sampling data will be used to calculate a fraction of the appropriate derived air concentration (DAC) for uranium ore with U-238 and long-lived progeny (Th-230 and Ra-226) included per 10 CFR 20, Appendix B, Footnote 3.

4.1.2 EQUIPMENT AND MATERIALS

- Gillian GirAir 5 portable personal BZ air sampler or equivalent
- 37 mm diameter membrane filter sized to fit BZ air sampler
- Filter cassette and tubing
- Defender 510 calibrator unit or equivalent
- Small flathead screwdriver
- Ludlum 3030 counting instrument or equivalent
- Radiation check sources

4.1.3 BZ MONITORING FOR AIR PARTICULATES

1. Frequency and location of personal BZ air monitoring shall be specified by the RSO in the RWP.
2. Prior to use in the field, the AU shall verify that the BZ air sampler has a fully charged battery.
3. Record the appropriate information on Form SOP-4A (*Occupational Air Monitoring Form*) at each step of sampling.
4. Before mounting a personal BZ air sampler on a worker, connect the sampler to a Defender 510 flow calibrator (or equivalent), ensure that the flow calibrator is within calibration (annual), and adjust the flow rate on the BZ air sampler pump with a small screwdriver until the Defender 510 confirms a flow rate of 3 L/min [or other flow rate determined necessary by the RSO to meet the required minimum detectable concentration (MDC)].
5. Install the BZ air sample filter and turn on the instrument making sure the worker has the sampler properly secured on their person in a manner that prevents the sampler or tubing from catching on equipment. Record the start time of the BZ air sample collection period.
6. When BZ air sampling is complete, turn off the sampler and record the stop time. Place the filter into a petri dish (or equivalent storage container) labeled with sample location and date, with the front face of the filter facing up.
7. Connect the BZ air sampler to a Defender 510 (or equivalent) and record the post-sampling period flow reading. The flow rate used in calculations shall be an average of the pre and post flow readings.
8. Wait a minimum of 12 hours to allow short-lived radon progeny to decay away.

9. Count the air sampling filters to determine a gross alpha concentration.

   a. Perform a daily QC function check of a swipe counter following SOP-2 (*Instrument Testing and Calibration*). A longer background and sample count time may be necessary to meet the MDC requirement of less than 10% of the gross alpha DAC value for uranium ore with U-238 and long-lived progeny (Th-230 and Ra-226) included per 10 CFR 20, Appendix B, Footnote 3.

   b. Count the alpha activity on the air filter sample and determine the gross alpha concentration in air (µCi/mL) as follows (Equation 4-1):

$$C = \frac{R_S - R_B}{\varepsilon_t (CF)(V)} \qquad \textbf{Equation 4-1}$$

Where:

C = gross alpha air concentration (µCi/mL).

R_S = detector count rate for the air filter sample (CPM).

R_B = background count rate for clean (unused) sampling filter (CPM).

ε_t = total detection efficiency (counts/decay) for alpha activity on air filters (per SOP-2, Equation 2-2).

CF = conversion factor (2.22E+06 DPM/µCi).

V = volume of air sampled (mL).

   c. Calculate the MDC for each gross alpha air particulate concentration measurement (Equation 4-2) based on the background count rate (cpm) and volume (mL) of air sampled as used for each air particulate sample measurement in Equation 4-1.

$$MDC = \frac{3+3.29\sqrt{R_b t_s \left(1+\frac{t_s}{t_b}\right)}}{(\varepsilon_t)(t_s)(K)(V)} \qquad \textbf{Equation 4-2}$$

Where:

MDC = Minimum Detectible Concentration (µCi/mL)

R_b = Background count rate (cpm)

t_s = Sample count time (min)

t_b = Background count time (min)

ε_t = Total detection efficiency (counts/decay) for activity on air sampling filters (per SOP-2, Equation 2-2)

K = Conversion factor (2.22E+06 dpm/µCi)

V = volume of air sampled (mL).

Note that the gross alpha air particulate concentration calculated from Equation 4-1 may be less than the MDC for the measurement as calculated from Equation 4-2. Based on occupational air sampling guidance found in NRC Regulatory Guide (RG) 8.25 (USNRC, 1992), if the calculated gross alpha air particulate concentration is less than the MDC, this does not mean the air particulate alpha concentration measurement is invalid, only that it should be assigned a data qualifier. The numeric analytical result for the measurement

should still be reported, even if the calculated value is a negative number (i.e., if the background count rate exceeds the sample count rate). Never report results of this nature as "below MDC" or similar statements in lieu of an actual numerical analytical result. Instead, flag the actual analytical result as "below MDC".

4.1.4 RADON PROGENY AIR MONITORING PROCEDURE

1. Frequency and location of air monitoring for radon progeny shall be specified by the RSO in the RWP. Calculation of radon progeny concentrations shall be based on the modified Kusnetz method as described in NRC Regulatory Guide 8.30 (USNRC, 2002).
2. Ensure there is a swipe counter available that has been properly calibrated in accordance with the specifications of SOP-2 (*Instrument Testing and Calibration*). The measurement of the air filter sample after collection is time sensitive. The required MDC for this method is 0.03 working level (10% of the DAC for radon progeny).
3. Prior to use in the field, the AU shall verify that the BZ air sampler has a fully charged battery.
4. Record the appropriate information on Form SOP-4B (*Radon Progeny Air Sampling Form*) at each step of sampling.
5. Before collecting an air sample with the BZ air sampler, connect the sampler to a Defender 510 flow calibrator (or equivalent), ensure that the flow calibrator is within calibration (annual), and adjust the flow rate on the BZ air sampler pump with a small screwdriver until the Defender 510 confirms a flow rate of 3 L/min [or other flow rate determined necessary by the RSO to meet the required minimum detectable concentration (MDC)]
6. Install the BZ air sample filter and turn on the instrument making sure the sampler is properly secured at the location to be sampled. Record the start time of the BZ air sample collection period.
7. Allow the sample to collect for exactly five minutes before turning off the air sampler and placing the filter into a petri dish labeled with sample location and date, with the front face of the filter placed face up. Record the air sampling duration in minutes.
8. Count the filter at an elapsed time between 40 and 90 minutes following the end of the air sample collection period. The elapsed time is the time between the end of sample collection and the *middle* of the count time. A count time of 10 minutes should be sufficient to meet MDC requirements.
9. Calculate the sample activity in disintegrations per minute (dpm) using Equation 4-3 below. If the sample dpm is less than the instruments' minimum detectable activity (MDA), then the sample activity can only be assumed to be as low as the counting instrument's MDA.

$$Activity = \frac{R_s - R_b}{\varepsilon_t} \qquad \textbf{Equation 4-3}$$

Where:

Activity = Gross alpha activity on the filter (dpm)

R_s = Sample count rate (cpm)

R_b = Background count rate (cpm)

ε_t = Total measurement efficiency (per SOP-2, Equation 2-2)

10. To calculate the radon-222 working level, divide the sample activity by total volume of air sampled (in liters), and divide that by the appropriate Kusnetz factor displayed in the *Kusnetz Factor Table* (see Attachments).

$$Radon\ Working\ Level\ = \frac{Activity}{KV}$$ **Equation 4-4**

Where:

Activity = Activity on the filter (dpm)

K = Kusnetz time factor based on the elapsed time (dpm/L/WL)

V = Volume of air sampled (L)

11. Calculate the MDC for radon progeny using a slightly modified version of the MDC equation from NUREG-1507 (USNRC, 2020) as follows (Equation 4-5):

$$MDC = \frac{3 + 3.29\sqrt{(R_b)(T_s)\left(1 + \frac{T_s}{T_b}\right)}}{\varepsilon_t(K)(V)(T_s)}$$ **Equation 4-5**

Where:

MDC = minimum detectable concentration (µCi/mL).

R_b = background count rate for clean (unused) sampling filter (cpm).

T_S = count time for the air filter sample (minutes).

T_b = count time for a background (blank) air filter (minutes).

ε_t = total detection efficiency (cpm/dpm) for gross alpha activity on air sampling filters (per SOP-2, Equation 2-2).

K = Kusnetz time factor (dpm/L/WL) for the elapsed time between the end of the sampling period and the middle of the counting period (between 40 to 90 minutes following sample collection). The Kusnetz time factor (see table in Attachments) can also be calculated using equations from guidance by the Canadian Nuclear Safety Commission (CNSC, 2003).

V = volume of air sampled (L).

The sensitivity of the Kusnetz radon progeny air sampling and measurement method is adequate if the calculated MDC is equal to or less than 10% of the applicable DAC value (i.e., ≤ 0.033 WL).

4.1.5 QA/QC FOR OCCUPATIONAL AIR MONITORING

Documentation produced from this procedure shall be initialed and dated by the reviewer. The RSO shall review sampling documents. Any discrepancies shall be reviewed and any corrective actions implemented and documented. The review encompasses the following items:

- The procedure was performed by a qualified AU.
- Air sampling equipment was properly calibrated.
- The sample counting instrument response testing met the specifications of SOP-2 (*Instrument Testing and Calibration*).
- All documentation is complete.

4.1.6 OCCUPATIONAL AIR MONITORING RECORDS

All occupational air sampling documentation shall be retained electronically with other RPP records until license termination.

4.2 DOSIMETRY FOR EXTERNAL OCCUPATIONAL EXPOSURES

4.2.1 DISCUSSION

If the RSO determines, based on anticipated gamma exposure rates and duration of work assignments for a specific nonroutine WTP activity or event, that external worker dose monitoring is needed under an RWP to ensure compliance with Part 4.18 of CDPHE regulations, several options are available to meet this objective, including:

1) Use of optically stimulated luminescent (OSL) dosimeters.
2) Use of digital electronic dosimeters.
3) Calculation of external doses based on known gamma exposure rates [in micro-Roentgen per hour (µR/hr)] across the work area, and documented worker occupancy times in the work area.

OSL dosimeters may be appropriate if the duration of the nonroutine activity in question could take several months to complete. If used, OSL dosimeters will be obtained from a qualified vendor that is accredited for personnel dosimetry services by the National Voluntary Laboratory Accreditation Program (NVLAP). The accreditation will cover penetrating radiation types (gamma rays, X-rays, and beta particles) and measure the following dosimetric quantities:

- Deep Dose Equivalent (DDE) at a tissue depth of one centimeter
- Lens Dose Equivalent (LDE) at a tissue depth of 0.3 centimeter
- Shallow Dose Equivalent (SDE) at a tissue depth of 0.007 centimeter

If the timeline for the nonroutine activity or event in question is expected to be of short duration and OSL dosimeters are not practical or sensitive enough to measure the expected external dose to WTP workers, the RSO may specify use of electronic digital dosimetry devices, or elect to instead calculate estimates of external doses based on gamma exposure rate survey measurements of the work area (in µR/hr) and tracked worker occupancy times in that work area.

4.2.2 EQUIPMENT AND MATERIALS

- OSL dosimeters (for quarterly measurement of cumulative external dose).
- Digital electronic personal dosimetry devices (for daily measurement of cumulative external dose).
- Gamma radiation detector, calibrated to measure exposure rate (µR/hr) for manual calculation of external dose based on measured exposure rate and known occupancy times.

4.2.3 OCCUPATIONAL DOSIMETRY PROCEDURE

Each OSL badge is identified by a unique identification or serial number assigned by the vendor and may also be assigned an employee name. Workers assigned a badge shall wear it each day they work within the applicable RWP work area. When not in use in the field, OSL badges shall be stored in the field office for the WTP. Ideally the badge storage location should be in a relatively low background gamma environment. A control badge will be provided by the vendor, and it should be continuously stored at the

designated badge storage location. If a low background area for the dosimeter storage location is not feasible, a lead-shielded container may be used, but when not in use, worker badges must always be stored with the control OSL badge in the same shielded container.

At the end of the dosimeter monitoring period (e.g., quarterly for routine monitoring), all OSL badges shall be collected and shipped back to the vendor in a box labeled "DO NOT X-RAY." Any paperwork provided by the vendor must be filled out and sent with the OSL badges. Return of OSL dosimeters for analysis by the dosimetry vendor. If the duration of the RWP work is less than one calendar quarter in duration, the dosimetry vendor must be notified that the order of OSL badges is a one-time procurement rather than a recurring order for quarterly badges.

External gamma radiation at the Site is generally expected to represent relatively uniform whole-body exposures, and personal dosimeters shall be worn on the front of the body between the neck and waist to represent whole-body exposure conditions. OSL dosimeters shall be protected from physical abuse and harsh environments (e.g. excessive heat, moisture, etc.). Protective dosimeter casings shall not be tampered with or opened.

Lost dosimeters must be reported to the RSO as soon as possible and a replacement badge issued. The RSO will estimate the missed dose based on one of the following approaches:

- By calculation based on the measured average gamma exposure rate in the RWP work area, and tracked occupancy time for that work area.
- Previous dosimetry results for the worker in question, and extrapolation or interpolation of expected doses over the period of missed dosimetry monitoring.

In the event that a non-routine project or activity is too short for practical use of OSL dosimeters, the RSO may specify in the RWP use of self-reading digital electronic personal dosimetry devices (e.g., figure at right) for daily measurement of cumulative external dose. In this case, the digital electronic dosimeter will be cleared of previous measurement data at the beginning of the daily work shift, and the cumulative external dose reading displayed at the end of the day will be recorded by the worker on a digital dosimetry tracking sheet. The RSO may also assign a single digital electronic dosimeter to the "most exposed" individual to conservatively represent a group of workers involved with the same short-term project or activity. In this case, both the daily cumulative dose reading, along with the names of other workers in the group, shall be documented on the external dose tracking sheet.

Finally, for short-term RWP tasks, the RSO may alternatively specify calculation of external doses to workers based on measured exposure rates in the work area (using an appropriate gamma survey meter, calibrated to display units of exposure rate in μR/hr), combined with tracked (documented) occupancy times for the workers involved with the RWP. In this case, the gamma survey meter is subject to applicable QC requirements as described in SOP-2 (*Instrument Testing and Calibration*), and worker occupancy times will be tracked using a daily RWP sign-in sheet or by similar means.

4.2.4 QA/QC FOR OCCUPATIONAL DOSIMETRY

The RSO will qualitatively review occupational OSL dosimetry reports for plausibility based on past results and/or known gamma radiation fields in areas where workers routinely occupy. For short-term,

nonroutine activities or events where external doses are tracked with digital electronic dosimeters or by calculation based on exposure rate measurements and occupancy times, the RSO will review the data and calculations independently of one another to ensure accuracy of data inputs and traceability and technical defensibility of resulting dose estimates.

4.2.5 OCCUPATIONAL DOSIMETRY RECORDS

All occupational dosimetry data reports or external dose calculation records shall be maintained electronically with other RPP records until license termination.

4.3 URINE BIOASSAY SAMPLING

4.3.1 DISCUSSION

Urine bioassay sampling is performed to assess worker intakes of biologically soluble forms of uranium. At the discretion of the RSO, bioassay sampling for WTP workers may be required under an RWP for nonroutine maintenance work with high potential for airborne exposures, or for an unplanned event or incident involving a known or suspected worker intake of measurable quantities of radioactive material based on unusually high air particulate monitoring results or an accidental ingestion event. The method to be used for urine bioassay sampling will be consistent with specifications of NRC Regulatory Guide 8.22 (USNRC, 2014), and will involve only analysis for uranium concentration in the urine sample(s).

4.3.2 EQUIPMENT AND MATERIALS

- Sample bottle 100-250 milliliters (mL).

4.3.3 URINE BIOASSAY PROCEDURE

Bioassay sampling under the RPP and this SOP includes four possible types of urine bioassay sampling to address various exposure circumstances and RPP objectives as follows:

1. BASELINE BIOASSAY

   Prior to implementation of work on a specific WTP task or activity under an RWP, workers may be required to provide pre-task baseline urine sample for uranium bioassay. The purpose of this initial bioassay is to determine whether baseline levels of soluble uranium can be detected in a worker's system prior to the work to be performed.

2. ROUTINE BIOASSAY

   Based on past records of internal doses associated with WTP operations at the Site, routine bioassay sampling is unlikely to be warranted and is not planned for seasonal operations under the RPP or this SOP. However, if air monitoring results under an RWP were to indicate potential exposures to airborne uranium that exceed 12 DAC-hours in any 7-day workweek (as defined in Part 1 of CDPHE Regulations for an "Airborne Radioactivity Area"), the area will be posted as an Airborne Radioactivity Area, and the RSO will require routine bioassay sampling if this condition could persist for more than one week.

3. SPECIAL BIOASSAY

   A special bioassay sample may be required by the RSO if an incident involving a potentially measurable intake of soluble uranium is known or suspected to have occurred, and there is the potential for an internal dose that exceeds applicable regulatory or administrative limits as

specified in Table 5-1 of the RPP. A special bioassay sample shall be required if occupational air monitoring results indicate a potential exposure to airborne radionuclide concentrations exceeding 12 DAC-hours in any consecutive 7-day workweek.

4. TERMINATION BIOASSAY

   At the completion of an individual's work assignment under an RWP that requires bioassay sampling, the RSO may request a termination bioassay sample. The objective is to verify that measurable uranium is not present in RWP worker urine samples at the end of the project.

Note that the rationale for bioassay sampling under an RWP is primarily focused on potential intakes from the inhalation pathway as potential exposure to airborne radionuclides can reasonably be anticipated. For most WTP activities, ingestion is not a realistic pathway for worker intakes provided the radiation safety work rules specified in the RPP are followed, including use of appropriate PPE, performing personal contamination surveys, and following best practices on maintaining good industrial hygiene (e.g., washing hands before eating, drinking, or using tobacco). Ingestion intakes can result from failure to observe these standard radiation safety practices. While less likely, ingestion intakes can also result from an unanticipated circumstance or upset condition leading to an accidental intake. When special bioassay sampling is required due to a known or suspected intake event, bioassay samples for uranium should be collected at least 36 hours after time/date of the suspected intake event. This practice helps to provide data of greatest importance to accurate modeling of the initial intake.

To collect a sample:

1. Wash hands thoroughly.
2. Label sample container with
   a. Initials;
   b. Collection date; and
   c. Collection time.
3. Fill the sample container with at least 30 milliliters of urine.
4. Fill out a chain of custody document provided by the laboratory.
5. Store in sample refrigerator until shipment.

If a result exceeds 5 µg/L the RSO shall be notified as soon as possible, and one or more follow-up bioassay samples may be requested to analyze the data and determine if there is analytical evidence to verify that an actual measurable intake event occurred. If a bioassay sample result is confirmed to exceed 15 µg/L, the RSO shall develop and implement a corrective action based on guidance provided in NRC Regulatory Guide 8.22 *Bioassay at Uranium Mills* (USNRC, 2014).

4.3.4 QA/QC FOR BIOASSAY SAMPLING

All bioassay samples shall be analyzed by a National Environmental Laboratory Accreditation Program (NELAP) accredited analytical laboratory with EPA Method 200.8.

The analytical laboratory must have a Quality Assurance Program Plan and associated quality control sampling in place to determine the relative bias, precision, and MDCs that meet the requirements for this procedure. Useful reference information for appropriate quality assurance and quality control can be found in ANSI standard *Performance Criteria for Radiobioassay* (ANSI, 2017). The requirements relevant to this procedure are:

- Percent Recovery of 30 percent for a known solution
- Relative Percent Difference of less than 20% for a lab duplicate sample or measurement
- MDC of 5 µg/L of uranium.

4.3.5 BIOASSAY SAMPLING RECORDS

The results from bioassay samples shall be retained electronically with other RPP records until license termination.

5 REFERENCES

Canadian Nuclear Safety Commission (CNSC). 2003. Measuring Airborne Radon Progeny at Uranium Mines and Mills. Regulatory Guide G-4. June 2003.

International Organization for Standardization (ISO). 1988. Evaluation of Surface Contamination – Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and Alpha-emitters.

U.S. Nuclear Regulatory Commission (USNRC). 1993. Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, FC 83-23, April 1993.

U.S. Nuclear Regulatory Commission (USNRC). 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1. NUREG-1575 (amended in 2002). Washington, D.C.

US Nuclear Regulatory Commission (USNRC). 2002. Health Physics Surveys in Uranium Recovery Facilities. NRC Regulatory Guide 8.30 (Revision 1). May 2002.

U.S. Nuclear Regulatory Commission (USNRC). 2002. Radiological Surveys for Controlling Release of Solid Materials. NRC . July 2002.

U.S. Nuclear Regulatory Commission (NRC). 2014. Regulatory Guide 8.22 Bioassay at Uranium Mills. NRC. May.

U.S. Nuclear Regulatory Commission (USNRC). 2020. Minimum Detectable Concentrations with Typical Radiation Survey for Instruments for Various Contaminants and Field Conditions. NUREG-1507. August 2020.

6 ATTACHMENTS

- Kusnetz Factor Table
- Form SOP-4A: *Occupational Air Monitoring Form*
- Form SOP-4B: *Radon Progeny Air Sampling Form*

KUSNETZ FACTOR TABLE

Elapsed Time (minutes)	Weighting Factor	Elapsed Time (minutes)	Weighting Factor	Elapsed Time (minutes)	Weighting Factor	Elapsed Time (minutes)	Weighting Factor
40	150	53	124	66	98	79	76
41	148	54	122	67	96	80	75
42	146	55	120	68	94	81	74
43	144	56	118	69	92	82	73
44	142	57	116	70	90	83	71
45	140	58	114	71	89	84	69
46	138	59	112	72	87	85	68
47	136	60	110	73	85	86	66
48	134	61	108	74	84	87	65
49	132	62	106	75	83	88	63
50	130	63	104	76	82	89	61
51	128	64	102	77	81	90	60
52	126	65	100	78	78	-	-

FORM SOP-4A OCCUPATIONAL AIR MONITORING FORM

Designated User		RWP number:		DAC:	6.00E-11 µCi/mL

Sample Collection Information					Sample Analysis Information								
Sample Date	Location/Personnel	Start Time (hh:mm)	Stop Time (hh:mm)	Sample Flow Rate (L/min)	Background Alpha (Counts)	Background Count Time (min)	Sample Alpha (Counts)	Sample Count Time (min)	Gross Alpha (µCi/mL)	% DAC	MDC (µCi/mL)	DU Initials	Notes

Comments:

Counting Instrument Information for BZ Air Filter Sample Measurements			
Sample Counter Model:		2π Instrument Efficiency (%):	18.5
Counter Serial Number:		Filter Source Efficiency (%):	40
Counter Calibration Due:		Total Detection Efficiency (%):	7.4
BZ Sampler Model:		DAC Limit	
BZ Sampler Serial Number:		U ore dust 6.00E-11 µCi/mL	

Relevant Equations

$$\varepsilon_t = \varepsilon_i * \varepsilon_s$$

Where:
ε_t = Total detection efficiency (counts/decay)
ε_i = 2π instrument counting efficiency
ε_s = Source efficiency (0.4 for alpha on air sampling filters)

$$C = \frac{R_S - R_B}{\varepsilon_t * t_s * K * V}$$

Where:
C = Gross alpha air concentration (µCi/mL)
R_S = Sample count rate (cpm)
R_B = Background count rate (cpm)
ε_t = Total detection efficiency (counts/decay)
K = Conversion factor (2.22E+6 dpm/µCi)
V = Volume of air sampled (mL)

$$MDC = \frac{3 + 3.29\sqrt{R_B t_s \left(1 + \frac{t_s}{t_b}\right)}}{\varepsilon_t * t_s * K * V}$$

Where:
MDC = Minimum Detectible Concentration (µCi/mL)
R_B = Background count rate (cpm)
ts = Sample count time (min)
t_b = Background count time (min)
ε_t = Total detection efficiency (counts/decay)
K = Conversion factor (2.22E+6 dpm/µCi)
V = Volume of air sampled (mL)

FORM SOP-4B

RADON PROGENY SAMPLING FORM

Designated User:		RWP Number:		DAC Limit:	0.33 WL

Sample Collection Information					Sample Analysis Information										
Sample Date	Location	Start Time (hh:mm)	Stop Time (hh:mm)	Sample Flow Rate (L/min)	Background Alpha (counts)	Background Count Time (min)	Start Sample Count (hh:mm)	Sample Alpha (counts)	Sample Count Time (min)	Sample Activity (dpm)	Rn-222 Working Level (WL)	% DAC	MDC (WL)	DU Initials	Notes

Comments:

Counting Instrument Information for BZ Air Filter Sample Measurements

Sample Counter Model:		2π Instrument Efficiency (%):	18.5
Counter Serial Number:		Filter Source Efficiency (%):	40
Counter Calibration Due:		Total Detection Efficiency (%):	7.4
BZ Sampler Model:			
BZ Sampler Serial Number:			

DAC Limit		
Rn-222	0.33	WL

Relevant Equations

$$\varepsilon_t = \varepsilon_i * \varepsilon_s$$

Where:
ε_t = Total detection efficiency (counts/decay)
ε_i = 2π instrument counting efficiency
ε_s = Source efficiency (0.4 for alpha on air sampling filters)

$$Activity = \frac{R_S - R_B}{\varepsilon_t}$$

Where:
Activity = Gross alpha on filter (dpm)
R_S = Sample count rate (cpm)
R_B = Background count rate (cpm)
ε_t = Total detection efficiency (counts/decay)

$$WL = \frac{Activity}{KV}$$

Where:
WL = Radon working level
Activity = Gross alpha on filter (dpm)
K = Kusnetz time factor (see SOP-4 attachment)
V = Volume of air sampled (mL)

$$MDC = \frac{3 + 3.29\sqrt{R_B t_s \left(1 + \frac{t_s}{t_b}\right)}}{\varepsilon_t * t_s * K * V}$$

Where:
MDC = Minimum Detectible Concentration (WL)
R_B = Background count rate (cpm)
ts = Sample count time (min)
t_b = Background count time (min)
ε_t = Total detection efficiency (counts/decay)
K = Kusnetz time factor (see SOP-4 attachment)
V = Volume of air sampled (mL)

SOP-5 OCCUPATIONAL RADIATION DOSE CALCULATION

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO) Authorized Users Radiation Protection Plan

1 PURPOSE

This standard operating procedure (SOP) details the methods for calculation of occupational radiation doses to workers for water treatment plant (WTP) operations at the former Schwartzwalder Mine near Golden, Colorado (Site). The Radiation Protection Plan (RPP) for WTP operations includes potential occupational monitoring for radiological exposures in support of calculated radiation dose estimates for WTP workers, where applicable.

2 SCOPE

This procedure applies to WTP workers and any work with licensed radioactive materials under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). RPP specifications and procedures for WTP operations at the Site are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations).

This SOP applies to all WTP workers subject to exposure/dose monitoring as prescribed for nonroutine activities or events under a radiation work permit (RWP) issued by the radiation safety officer (RSO) as described in the RPP. It covers the methods and technical basis for calculation of occupational radiation doses from exposure to sources involving external and/or internal dose pathways.

The temporal applicability of this SOP is generally limited to estimation of doses on an annual basis for comparison of with regulatory occupational dose limits (see RPP, Table 5-1), though the RSO may also calculate doses over shorter exposure periods of interest, for example the duration of a specific RWP that may only be in effect for exposure periods ranging from a few hours to several weeks.

Occupational doses shall be calculated for WTP workers where occupational exposure monitoring is conducted under an RWP in accordance with procedural specifications of SOP-4 (*Radiological Monitoring for Occupational Exposures*) and SOP-6 (*Radiation Work Permits*).

3 DEFINITIONS

Various dosimetric quantities, as defined by the International Commission on Radiological Protection (ICRP), are directly or indirectly applicable to the occupational dose quantities described in the RPP and this SOP. Current CDPHE radiation protection Regulations are based on definitions and terminology from ICRP Publications 26 and 30 (ICRP, 1977 and 1978). A table of ICRP 26/30 dosimetric terms and mathematical definitions of relevance to the RPP is provided in the Attachment to this SOP.

4 DISCUSSION

4.1 DOSE TRACKING REQUIREMENTS

As described in Section 3.3 of the RPP, monitoring of occupational radiation exposures and calculated annual doses to WTP workers over the most recent 5-year period with available data indicates that WTP activities at the former Schwartzwalder Mine do not warrant routine radiological monitoring for occupational exposure and tracking of worker doses under CDPHE Regulations (Part 4.18) and LC 13.A. However, it is possible that nonroutine activities or events could warrant issuance of an RWP and occupational exposure monitoring. In such cases, an RWP will be issued by the RSO to specify occupational radiation exposure/dose monitoring requirements as warranted for specific activities or events with the potential for annual occupational doses to approach or exceed the 500 mrem/yr threshold criterion for occupational exposure/dose monitoring requirements as specified in Part 4.18 of CDPHE Regulations.

4.2 TECHNICAL BASIS FOR DOSE ESTIMATION APPROACHES

The total effective dose equivalent (TEDE, see Attachment) for RWP workers shall be determined by summing doses calculated from monitoring data for external and internal exposure pathways. This section describes operational exposure circumstances that drive Site-specific monitoring and dose calculation approaches, and provides the technical basis for determination of occupational doses for applicable exposure pathways. The primary objective is determination of the overall TEDE for individual RWP workers to evaluate compliance with the regulatory and administrative occupational dose limits provided in Table 5-1 of the RPP [5,000 mrem/yr per Part 4.6 of the Regulations, and 500 mrem/yr per the "as low as reasonably achievable" (ALARA) administrative policy for WTP operations].

4.2.1 EXTERNAL EXPOSURE/DOSE

As detailed in SOP-4 (*Radiological Monitoring for Occupational Exposure*), external dose from gamma radiation exposure may be estimated based on 1) direct measurement of cumulative quarterly external dose (mrem/quarter) with passive, time-integrating Optically stimulated luminescent (OSL) dosimeters, 2) direct measurement of cumulative daily external dose (e.g., µrem/day) with digital, direct reading electronic dosimeters, or 3) calculation of external dose based on measured average gamma exposure rates (µR/hr) and occupancy times in RWP work areas.

Direct measurement of external gamma radiation dose with OSL dosimeters shall be based on the deep dose equivalent (DDE, see Attachment) as reported by the dosimetry vendor in quarterly data reports. Calibration of dosimeters to measure DDE is based on an operational dosimetric quantity known as "*ambient dose equivalent*" as defined by the International Commission on Radiation Units and Measurements (ICRU, 1993). ICRU denotes this operational dosimetric quantity as H*(10), which is a measure of absorbed dose 10 mm deep in a tissue-equivalent phantom sphere (ICRU sphere) to simulate the physical and chemical properties of human soft tissue. Dosimeters and electronic instruments calibrated to provide external "dose rate" readings are generally calibrated to measure H*(10), which is the same quantity as DDE. The intent of DDE is to provide a conservative surrogate measurement to represent the dosimetric quantity "*effective dose equivalent*" (H_E, see Attachment).

In the event that external dose is estimated by calculation based on gamma exposure rate measurements and worker occupancy times, a conservative conversion factor of 1 rem/roentgen will be used to calculate the estimated effective dose equivalent (H_E). This conversion factor is expected to be

conservative as gamma exposure rate measurements with sodium iodide (NaI)-based scintillation detectors are energy dependent and tend to overestimate the true exposure rate in typical terrestrial gamma fields associated with uranium mine materials. In addition, this conversion factor is inherently conservative as it doesn't account for partial shielding of critical organs by other portions of the body as described in UNSCEAR (2000).

4.2.2 INTERNAL INTAKE/DOSE

For internal doses, measurement of airborne particulate radionuclide concentrations shall be used to estimate internal dose from inhalation based on calculated fractions of the applicable derived air concentration (DAC)[1] and DAC-hours of exposure. An appropriate DAC for the Site is that cited for uranium ore dust in Footnote 3 to 10 CFR 20 Appendix B since this DAC assumes the presence of the key long-lived decay products in the U-238 decay series (i.e., U-238, U-234, Th-230, and Ra-226). This same DAC was approved by CDPHE for the previous licensee based on 2020 approval of SOPs for radiation protection at the Site, which included treatment of mine water.

Both CDPHE and U.S. Nuclear Regulatory Commission (NRC) regulations define internal whole-body dose as the committed effective dose equivalent (CEDE, see Attachment 5-1). For WTP activities conducted under an RWP, internal dose from air particulates via the inhalation intake pathway will be calculated based on onsite worker occupancy times and airborne gross alpha activity concentrations as measured with personal breathing zone (BZ) samplers as described in SOP-4 (*Radiological Monitoring for Occupational Exposure*).

With respect to radon, long-term integrated average radon gas (Rn-222) monitoring with passive alpha track-etch detectors would not be practical for short-term RWP tasks. Moreover, the dose from radon is primarily attributable to solid-phase short-lived radon decay products (progeny). For these reasons, occupational doses from radon, if required by the RSO under a given RWP, shall be based on representative grab sampling of airborne radon progeny concentrations using a BZ air sampler and analysis based on the modified Kusnetz method as described in SOP-4 (*Radiological Monitoring for Occupational Exposure*) based in part on guidance from NRC Regulatory Guide 8.30 (USNRC, 2002).

Finally, because internal dose from an accidental ingestion pathway is essentially entirely preventable by following radiation safety work rules prescribed in the RPP (e.g., use of appropriate PPE, prohibition on eating/tobacco use, proper industrial hygiene practices, etc.), this pathway is not monitored for determination of potential intakes or internal doses. While personal contamination surveys are routinely performed, this is not a measure of worker intake. An exception to this general expectation would be an actual known or suspected accidental ingestion event, in which case, urine bioassay sampling may be required by the RSO, depending on the nature and magnitude of the potential intake.

5 RESPONSIBILITY

- **Radiation Safety Officer (RSO)** – Responsible for RPP development and oversight, along with review and evaluation of radiological exposure monitoring data and dose calculations. Ensures that the methods specified in this SOP are consistent with related LCs and CDPHE regulations along with

[1] The DAC represents the airborne radionuclide concentration that will result in an internal dose at the regulatory occupational limit of 5,000 mrem/yr based on a breathing rate of 20 liters per minute over 2,000 hours of annual exposure to this air concentration.

applicable technical guidance from the NRC and other relevant agencies or organizations. Ensures compliance with occupational dose limits and to the extent possible, compliance with ALARA administrative limits as specified in Table 5-1 of the RPP for consistency with RML requirements and CDPHE Regulations.

- **Authorized Users (AUs)** – Responsible for completion of training in the operation, QC testing, and use of radiological exposure monitoring instruments and devices, administering occupational radiation exposure monitoring in accordance with SOP-4 (*Radiological Monitoring for Occupational Exposures*) and RPP requirements, and for proper documentation of monitoring results.

6 PROCEDURE

6.1 EQUIPMENT AND MATERIALS

- Annual occupational exposure monitoring data for RWPs conducted as part of nonroutine activities associated with WTP operations.
- WTP worker occupancy data for RWP workers (e.g., data from Site and/or RWP sign-in sheets).
- Template spreadsheets developed by the RSO to facilitate and automate dose calculations for multiple RWP workers and exposure periods.

6.2 OCCUPATIONAL DOSE CALCULATIONS

6.2.1 DETERMINATION OF EXTERNAL DOSE

1. If OSL dosimeter badges are used to monitor external occupational dose, the DDE for each monitored worker as reported in the vendor's quarterly dosimetry reports shall be used for TEDE calculations.
2. If digital electronic dosimeters are used to monitor external occupational dose:
    a) Sum the daily cumulative dose readings (e.g., µSv) for the individual wearing the electronic dosimeter over the monitoring period of interest (as recorded on a daily RWP dosimeter tracking sheet). Where applicable, convert the resulting overall cumulative external dose (equivalent to DDE) to traditional dose units (mrem), for example by multiplying DDE (in µSv) by 0.1 mrem/µSv.
    b) If multiple individuals work on the same project but only the maximally exposed individual wears an electronic dosimeter to represent external dose to each individual member of the group (this information shall be maintained on the daily dosimeter tracking sheet), assign the calculated DDE for the monitored worker over the monitoring period of interest to all workers in the same group.
3. If representative gamma exposure rate measurements are used, multiply the average exposure rate (µR/hr) by occupancy time (hrs) to obtain cumulative external exposure (µR) for each individual working in the same area, then convert to an estimated external effective dose equivalent (H_E) by multiplying by a conservative conversion factor of 0.001 mrem/µR.

6.2.2 DETERMINATION OF INTERNAL DOSE:

1. Where specified by the RSO under an RWP, collect air samples (BZ air particulates and/or radon progeny) as specified in the RWP (as applicable).

2. Calculate gross alpha air concentration (µCi/mL) in accordance with SOP-4 (*Radiological Monitoring for Occupational Exposure*). Assume all alpha activity is due to a radionuclide mixture associated with uranium ore, and calculate the fraction of the DAC for uranium ore dust as cited in Footnote 3 to 10 CFR 20 Appendix B. Monitor the fraction of the DAC results throughout the non-routine activity or project, and report any values greater than unity (1) to the RSO or ARSO for evaluation of potential additional radiological monitoring and/or corrective action.

3. For BZ air filter samples, calculate the annual CEDE for each monitored worker per Equation 6-1:

$$CEDE = \sum_{i=1}^{n} (C_i)\left(\frac{DAC}{C_D}\right)\left(\frac{t_i}{yr}\right)\left(\frac{2.5\ mrem}{DAC - hr}\right) \qquad \textbf{Equation 6-1}$$

Where:

CEDE = Annual Committed Effective Dose Equivalent from airborne radionuclide of interest (mrem/yr) due to all RWPs conducted for WTP operations in a given calendar year.

i = i^{th} RWP with air monitoring requirements for WTP workers.

C_i = Average measured gross alpha concentration in air (µCi/mL for air particulates or WL for radon progeny) for i^{th} RWP.

C_D = Air concentration equivalent to 1 DAC for the mixture of radionuclides of interest (µCi/mL for air particulates, WL for radon progeny). These parameters will be specified in the RWP.

t_i = Occupancy time (hrs) for i^{th} RWP for each individual WTP worker.

6.2.3 PRENATAL DOSE FOR DECLARED PREGNANT WORKERS

If a WTP worker learns she is pregnant, it is encouraged, but not required, to officially declare the pregnancy with the Site Manager and RSO. The declaration must be in writing, and contain the estimated date of conception. If the worker chooses not to declare the pregnancy, she and her embryo-fetus will continue to be subject to the same radiation dose limits that apply to other WTP workers.

The dose to an embryo-fetus during the entire pregnancy due to occupational exposure of a declared pregnant worker shall not exceed 500 mrem. The declared worker may be reassigned to a job involving a lower radiation exposure during the pregnancy, and efforts will be made to avoid substantial variation above a uniform monthly exposure rate. If the dose to the embryo-fetus is equal to or greater than 450 mrem before her declaration of pregnancy, then any additional occupational dose may not exceed 50 mrem for the remainder of the pregnancy.

The RSO shall ensure monitoring of radiation exposures for declared pregnant workers if they are likely to receive an annual DDE or H_E in excess of 100 mrem from working at the WTP. OSL dosimeters issued to a declared pregnant worker shall be worn on the lower portion of the torso on the front of the body, and dosimeters will be exchanged on a monthly basis to permit close tracking of any changes in external exposures. External doses to the embryo/fetus during the nine-month gestation period will be assumed equivalent to measured DDE value reported for each monthly dosimeter monitoring period. The monthly external dose shall not exceed 50 mrem.

Internal doses to the embryo/fetus during the nine-month gestation period shall be calculated as follows:

$$CEDE = (I)(TF)(DF)$$ **Equation 6-2**

Where:

CEDE = nine-month gestation committed effective dose equivalent (mrem).

I = Radionuclide intake by the declared pregnant worker during pregnancy (µCi).

TF = Transfer fraction (unitless).

DF = Dose factor (mrem/µCi).

If the declared worker does not participate in any RWPs where air monitoring is performed during the gestation period, the internal dose to the embryo/fetus from performing non-RWP duties at the WTP will be assumed to be zero. The transfer fraction and dose factor applicable to an inhalation dose will be derived using U.S. Nuclear Regulatory Commission Regulatory Guide 8.36, *Radiation Dose to the Embryo/Fetus* (USNRC, 1992).

7 QUALITY ASSURANCE AND QUALITY CONTROL

The most likely sources of uncertainty in occupational dose estimates are associated with general application of calculation parameters (e.g., dose conversion factors, breathing rates, and estimated worker occupancy factors). While these sources of estimation error may be significant, they are systemic in nature and should not significantly impact comparisons between different individuals and different monitoring periods.

In addition, since calculated dose estimates rely on radiological monitoring data, adherence to the quality assurance (QA) and quality control (QC) requirements of related procedures [e.g., SOP-2 (*Instrument Testing and Calibration*) and SOP-4 (*Radiological Monitoring for Occupational Exposure*)] should ensure that analytical uncertainties are minimized. The qualification requirements for the RSO role for WTP operations as described in the RPP provides reasonable assurance that errors in data transcription or calculation mistakes for concentrations or exposure levels based on monitoring data will be identified by the RSO's technical review and corrected before finalizing dose estimates. The ARSO will also provide independent review of dose calculations. All occupational dose calculations will be carefully reviewed by the RSO and ARSO before finalizing and generating employee dose records. All occupational dose calculations will be made available to CDPHE for review upon request.

8 RECORDS

If occupational doses are monitored in a given year in accordance with RPP and relevant SOP specifications based on Part 4.18 of CDPHE Regulations, the RSO will generate summary statistics and generic summary information in an Annual RPP Review Memorandum for review by the licensee (DRMS) as described in the RPP and in SOP-7 (*Audits and Inspections*). The Annual RPP Review Memorandum shall be available for CDPHE review upon request (e.g., during CDPHE inspections) and retained with other RPP records until license termination. If occupational dose monitoring is not required based on Part 4.18 criteria, the technical and regulatory justification shall be summarized in the Annual RPP Review Memorandum. A summary of findings, regulatory compliance information, deficiencies, and other observations of note from the monthly RSO audit reports for WTP operations during the calendar year shall also be included in the Annual RPP Review Memorandum.

Regarding any personal occupational radiation dose records for named individuals, these records are subject to privacy rights, and individuals and their occupational dose records shall be treated as

confidential information, maintained and accessible only to the WTP Manager and RSO. If needed, personal dose records may also be shared with CDPHE inspectors, with an understanding of the confidential nature of this personal information for WTP workers. Under no circumstance is personal dose information to be revealed in public-facing reports or documents to be posted in the public domain. Personal dose reports shall automatically be generated and provided to workers for any monitored individual that receives an annual TEDE in excess of 100 mrem/yr. Regardless of the magnitude of annual TEDE for any individual, an individual occupational dose record shall be generated for any monitored worker who requests this information.

9 REFERENCES

International Commission on Radiological Protection (ICRP). 1960. Report of Committee II on Permissible Dose for Internal Radiation. ICRP Publication 2. Pergamon Press, London.

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10 ATTACHMENTS

- Table of Dosimetric Quantities and Definitions

ATTACHMENT: TABLE OF DOSIMETRIC QUANTITIES FROM ICRP REPORTS 26 AND 30 (ICRP, 1977 AND 1978)

Dosimetric Quantity	Symbol	Formula	Units	Definition
Absorbed Dose	D	D = dE/dm	gray, rad	Average energy absorbed (imparted) within a specified volume of material of unit mass (m). Includes energy deposition from particles originating outside the volume. Defined for any type of particle, any material.
Dose Equivalent	H	$H = D \cdot Q$	sievert, rem	Absorbed dose at specific point of interest, modified with a radiation quality or weighting factor (Q or w_R) to account for the linear energy transfer (LET) and relative biological effectiveness (RBE) of the radiation of interest (e.g. Q = 1 rem/rad for γ).
Committed Dose Equivalent	CDE	$H_{50}(t) = \int_0^{50y} \dot{H}(t)dt$	sievert, rem	Dose equivalent in tissue or organ of interest (t) following intake of radioactive material, accumulated over a 50-year period following the intake.
Effective Dose Equivalent (Same as "Effective Dose" in ICRP 60)	H_E	$H_E = \sum_T w_T H_T$	sievert, rem	Calculated whole-body dose equivalent with same stochastic risk as irradiation of individual organs of varying radiosensitivity. W_T = tissue weighting factor = proportion of stochastic risk from the tissue (T), to the total risk when the whole body is irradiated.
Committed effective dose equivalent	CEDE	$H_{E,50} = \sum_{T,50} w_T H_{T,50}$	sievert, rem	Sum of the products of w_T for irradiated tissues and the committed dose equivalent to these organs or tissues (50-yr committed dose). ALI and DAC values are based on the CEDE for internal doses.
Deep-Dose Equivalent	DDE	$DDE = H_{(external,\ 1\ cm)}$	sievert, rem	The external whole-body exposure dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).
Total Effective Dose Equivalent	TEDE	TEDE = CEDE + DDE	sievert, rem	Sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

SOP-6 RADIATION WORK PERMITS

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO) Authorized Users Radiation Protection Plan

1 PURPOSE

This standard operating procedure (SOP) describes the use of Radiation Work Permits (RWPs) for certain nonroutine activities to be conducted during water treatment plant (WTP) operations at the former Schwartzwalder Mine near Golden, Colorado (Site). RWPs will be issued at the discretion of the Site Radiation Safety Officer (RSO) where warranted under the specifications of this SOP, the Radiation Protection Program (RPP), and applicable regulations.

2 SCOPE

This procedure applies to WTP workers and handling of licensed radioactive materials as needed under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). RPP specifications and procedures for WTP operations at the Site are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations).

More specifically, this SOP applies to all WTP workers that will participate in nonroutine activities or response to events with the potential for occupational radiation doses or intakes to exceed 20% of the threshold criteria for occupational exposure monitoring requirements as stated in Part 4.18 of CDPHE Regulations. For occupational doses, 20% of the applicable threshold criterion for monitoring in Part 4.18 of CDPHE regulations is equivalent to 100 mrem/yr, based on an assumption that up to five RWPs may be issued in a given year, and the cumulative occupational dose to any RWP worker could potentially exceed 500 mrem/yr.

RWPs identify radiological hazards and prescribe specific radiation protection measures such as use of personal protective equipment (PPE), radiological exposure monitoring, or other requirements to keep radiological exposures to RWP workers and members of the public "*as low as reasonably achievable*" (ALARA) and ensure safe completion of the nonroutine activity or event. If the RSO determines that occupational exposure monitoring is required for a non-routine activity or event under the criteria specified in Part 4.18 of CDPHE regulations, the RSO will issue an RWP that specifies respective monitoring requirements. Where occupational radiation monitoring is conducted, the RSO will use the data generated to calculate estimated radiation doses to monitored RWP workers.

3 RESPONSIBILITY

- **Radiation Safety Officer (RSO)** – Responsible for RWP development, issuance, and oversight, along with review and evaluation of data associated with contamination surveys and radiological exposure monitoring. The RSO is responsible for performing occupational radiation dose calculations based on monitoring data generated for each RWP. Ensures that the methods specified in this SOP are consistent with related LCs and CDPHE regulations along with applicable technical guidance from the

NRC and other relevant agencies or organizations. Ensures compliance with regulatory limits on contamination, occupational doses, and ALARA administrative limits as specified in Table 5-1 of the RPP for consistency with RML CO 1332-01 (Amendment 01) requirements and CDPHE Regulations.

- **Authorized User (AU)** – Regular WTP workers and radiation protection staff that have completed annual radiation protection training from the RSO, and are also trained on applicable SOPs and RWPs as necessary to perform their duties under applicable CDPHE Regulations, RML conditions, and this RPP. AUs are permitted to access and work in the Restricted Area (see RPP Figure 2-1) without escort, provide escort, supervision, and instruction for Escorted Visitors, physically handle licensed radioactive materials, manage the security of the WTP and all licensed materials within, and perform radiological surveys, monitoring, and sampling as needed to support RPP requirements for WTP operations. AUs are expected to ensure compliance with the requirements of this RPP and associated SOPs as designed for consistency with existing RML requirements and applicable CDPHE Regulations.
- **RWP Workers** – RWP workers are AUs as defined above and in the RPP and SOP-1 (*Radiation Protection Training*) and where applicable, include respectively supervised contractors that are trained on RWPs issued by the RSO for tasks that involve nonroutine handling of, or exposure to, licensed radioactive materials under specific conditions and limitations. Example RWP activities could include nonroutine maintenance of treatment systems equipment, or responding to an unplanned release of licensed radioactive material. While AU-supervised and RWP-trained contractors may handle licensed material under an RWP, contractors are not authorized to perform other AU functions as described above. The supervising AU shall ensure that all RWP contractors and equipment are properly surveyed for contamination before leaving Restricted Areas within the WTP, or before leaving the Controlled Area if licensed materials are handled beyond the Restricted Areas shown in Figure 2-1 of the RPP.

4 PROCEDURE

4.1 EQUIPMENT AND MATERIALS

- Form SOP-6A (*Radiation Work Permit*) (see Attachments).
- Work plan, written scope of work, or other description of the nonroutine activity or event to be considered by the RSO for issuance of an RWP.
- Radiological survey or monitoring instruments as needed to support the RWP activity/task. The RSO shall specify this information on the RWP Form (Form SOP-6A) and may reference various SOPs regarding general requirements for use of radiation survey or monitoring instruments.

4.2 RWP DEVELOPMENT AND IMPLEMENTATION

As previously indicted, an RWP shall be issued by the RSO for nonroutine WTP activities/tasks with the potential for occupational radiation doses or intakes to exceed 20% of the threshold criteria given in Part 4.18 of CDPHE Regulations. Evaluation of the need for an RWP will be based on the nature and scope of the activity/task as described in a written work plan, scope of work, job safety assessment, and/or other documentation. If an RWP is issued, the RSO will specify radiological circumstances and required radiation protection measures, for example:

- Expected radiological conditions based on existing survey or monitoring data.

- Expected occupational exposure/dose pathways and respective monitoring requirements (if applicable).
- Bioassay sampling (if applicable).
- Radiological contamination survey requirements.
- Personal protective equipment (PPE).

The RSO shall complete and sign off on the RWP Form (Form SOP-6A; see Attached). Before work is performed under the RWP, all RWP workers shall be instructed on identified hazards and radiation protection requirements, and must sign the RWP Form to document RWP training attendance. A copy of the completed RWP Form shall be maintained in the designated field office supporting WTP operations.

When the RWP work is completed, the RWP will expire and if occupational exposure monitoring was required, radiological doses for RWP workers will be calculated as specified in SOP-5 (*Occupational Radiation Dose Calculation*). The RWP Form (Form SOP-6A) shall be retained with other RPP records.

5 QUALITY ASSURANCE AND QUALITY CONTROL

The RSO is responsible for routinely auditing all RWP records and data (on a monthly basis during seasonal WTP operations) to ensure that RWP requirements were followed by RWP workers, and that all radiological survey and monitoring data are properly documented and meet related QA/QC requirements. The RSO will also perform occupational dose calculations (if applicable), and is responsible for a final review of all data and documentation upon completion of the RWP.

6 RECORDS

The documentation for RWPs shall include all relevant occupational or environmental monitoring or survey data attached to the RWP Form (Form SOP-6A). The RWP documentation packet shall be retained with other RPP records for WTP operations until termination of the RML.

7 ATTACHMENTS

- Form SOP-6A *Radiation Work Permit*

FORM SOP-6A **RADIATION WORK PERMIT (RWP)**

RWP NUMBER	
ISSUANCE DATE	
EXPIRATION DATE	

Work Description

Expected Date(s) of RWP Work:_____ **Location of RWP Work:**_____

DESCRIPTION OF WORK TO BE PERFORMED UNDER RWP
POTENTIAL RADIOLOGICAL EXPOSURE/DOSE PATHWAYS
RADIATION SAFETY WORK PRACTICES
PHYSICAL SAFETY HAZARDS

RWP Worker Information and Training Documentation

Name	RWP Training Attendance	Signature	Anticipated Tools and Equipment
	☐		
	☐		
	☐		
	☐		
	☐		
	☐		
	☐		
	☐		
	☐		
	☐		
	☐		

Personal Protective Equipment and Radiological Monitoring Requirements:

Personal Protective Equipment Requirements				
Head	Cloth Hat ☐	Hard Hat ☐	Safety Glasses ☐	Safety Goggles ☐
Body	Work Clothes ☐	Paper Suit ☐	Washable Coveralls☐	
Hands	Cloth Gloves ☐	Surgical Gloves ☐	Heavy Rubber Gloves ☐	
Feet	Work Shoes ☐	Shoe Covers ☐	Cloth Boots ☐	Rubber Boots ☐

Monitoring Requirements			
Item	Pre	During	Post
Survey			
Alpha	☐	☐	☐
Beta	☐	☐	☐
Gamma	☐	☐	☐
Air Samples			
Breathing Zone	☐	☐	☐
Radon Progeny	☐	☐	☐
Dosimetry			
OSL or Digital Electronic Dosimeter	☐	☐	☐
Other ☐:			

RWP Authorization and Documentation Review

RWP AUTHORIZATION SIGNATURE (RSO)	DATE
RWP REVIEWER SIGNATURE (ARSO OR WTP MANAGER)	**DATE**
COMMENTS/NOTES:	

Attachments:

- Radiological Contamination Survey Data
- Occupational Radiation Exposure Monitoring Data
- Project/Task Work Plan or other written description (if applicable)

SOP-7 AUDITS AND INSPECTIONS

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO) Authorized Users Radiation Protection Plan

1 PURPOSE

This standard operating procedure (SOP) describes inspections and audits of implementation of the Radiation Protection Plan (RPP) and associated procedures for water treatment plant (WTP) operations at the former Schwartzwalder Mine near Golden, Colorado (Site). The objectives of audits is to ensure that radiation protection requirements are optimized for current radiological conditions and WTP operations, and that radiological exposures, doses, contamination, and any releases of radioactive materials are kept "as low as reasonably achievable" (ALARA) in accordance with the facility's ALARA policy as defined in the RPP. The objectives of inspections are to ensure compliance with the requirements of the RPP and applicable regulations through proper implementation of associated SOPs that are designed to ensure compliance with these requirements.

2 DEFINITIONS

Inspection: An inspection is an onsite examination of current radiological/physical conditions, proper function of RI field equipment, systems, and engineering controls, and adherence to RPP requirements and procedures as required by regulatory compliance obligations.

Audit: An audit is the process of verifying that regulatory compliance obligations have been met (including inspections), and that the design and scope of the RPP is optimized for current radiological conditions and the operational scope to ensure that radiological exposures, doses, contamination, and releases of residual radioactive materials are properly controlled and maintained at levels that are ALARA below regulatory limits or release criteria.

ALARA: For the purposes of the RPP for WTP operations, ALARA means making every reasonable effort to maintain radiological exposure and contamination levels as low as reasonably achievable below applicable regulatory limits, consistent with the purpose for which the activity is undertaken, and taking into account the state of technology and economics of improvements in relation to benefits to public health, safety, and the environment.

3 SCOPE

This procedure applies to WTP workers and handling of licensed radioactive materials as needed under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). RPP specifications and procedures for WTP operations at the Site are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations).

4 RESPONSIBILITY

- **Radiation Safety Officer (RSO):** Ensures proper implementation of the RPP and associated SOPs, compliance with license conditions, and compliance with applicable CDPHE Regulations, based in part on monthly Site visits for RSO audits of RPP records and conduct of monthly gamma surveys of workplace areas within and outside of the WTP building. Verifies proper implementation based on review of RPP and SOP documentation and related data (e.g., instrument quality control testing, contamination release surveys, occupational exposure monitoring data and other information provided in RWP documentation packets). Identifies regulatory and/or technical deficiencies, develops corrective actions, and evaluates the effectiveness of the RPP for keeping radiological exposures, doses, and contamination at levels that are ALARA. Develops an Annual RPP Review Memorandum for review by the licensee (DRMS) that summarizes annual occupational doses to WTP workers as applicable for nonroutine RWP activities, along with monthly audit findings during seasonal WTP operations and the results of any CDPHE inspections. The Annual RPP Review Memorandum will also provide any recommendations for improvements in radiation protection approaches and procedures.
- **Authorized Users (AUs):** Responsible for completing all required training and for proper implementation of RPP requirements and the specifications of applicable RWPs and SOPs. This includes documentation and retention of all RPP-related records and data until license termination. Assists the RSO as needed for monthly RSO audits and generation of Annual RPP Review Memorandums.

5 PROCEDURE

5.1 EQUIPMENT AND MATERIALS

- Form SOP-7A (Monthly RSO Audit Checklist) (Attachment)
- Radiological survey instrument for quarterly workplace gamma measurements
- Access to all RPP and SOP records and documentation

5.2 MONTHLY RSO AUDIT AND SITE VISITS

The RSO or Alternate RSO (ARSO) for WTP operations shall conduct monthly onsite audits of compliance with the requirements of the RPP and associated SOPs, and for consistency with applicable license conditions and CDPHE Regulations. Monthly RSO audits will be conducted in accordance with SOP-7 (*Audits and Inspections*). These audits shall only be conducted during months in which WTP operations are conducted. The Monthly RSO Audit Checklist form (Form SOP-7A *Monthly RSO Audit Checklist*) as provided in Attachment 1 will be completed and signed by the project RSO or ARSO and retained with other RPP records until license termination.

5.3 ANNUAL RPP REVIEW MEMORANDUM

Consistent with Part 4.5.3 of CDPHE Regulations, the RSO will generate an Annual RPP Review Memorandum for the licensee (DRMS) that summarizes annual occupational doses to WTP workers (where applicable for nonroutine RWP activities), along with monthly audit findings during seasonal WTP operations and the results of any CDPHE inspections. The Annual RPP Review Memorandum will also provide any recommendations for improvements in radiation protection approaches and procedures.

Annual RPP Review Memorandums are subject to CDPHE inspection and will be retained with other RPP records until license termination.

5.4 PERIODIC CDPHE INSPECTIONS

CDPHE is expected to conduct periodic inspections of licensed activities and the RPP for WTP operations at the Site under the DRMS license (CO 1332-01). Generally these inspections occur every 1 to 5 years, and are announced to the licensee in advance of the planned inspection date. Either the RSO or ARSO must attend CDPHE inspections in person to answer questions and provide documentation of data and information produced under the RPP and associated SOPs.

6 RECORDS

Documentation of inspection and audit results shall be maintained with other RPP records until license termination.

ATTACHMENT:

Form SOP-7A (*Monthly RSO Audit Checklist*)

Form SOP-7A (Monthly RSO Audit Checklist)

Former Schwartzwalder Mine
Monthly RSO Audit Checklist
Water Treatment Plant Operations

Auditor: _____

Date performed: _____

Outstanding action items:

Summary of findings, deficiencies, and corrective actions:

RSO Signature: _____

ARSO Signature (if applicable): _____

ALARA

	Yes	No	N/A
1. Any spills or releases of radioactive materials?			
2. Designated User available to oversee RPP activities in the work area?			
3. Equipment available to support RPP and SOP requirements?			
4. Are project personnel following Radiation Safety Work Rules?			
5. Any upcoming activity or facility changes that may affect radiation safety?			

Notes/Comments:

Postings

	Yes	No	N/A
1. RML 1332-01 and CDPHE regulation?			
2. Current Designated User List with date of most recent training?			
3. Emergency Contact List?			
4. CDPHE Inspection Reports?			
5. Notices to Employees including notices of violations (NOVs)?			
6. Radioactive material warning signs on restricted areas and temporary exclusion zones?			

Notes/Comments:

Instrumentation and Equipment

	Yes	No	N/A
1. Check sources inventory accurate?			
2. Check source storage location secured?			
3. Available instruments within calibration?			
4. DUs trained on instrument calibration and function check requirements?			
5. Active instruments responding within expected QC tolerance limits?			
6. Radiological measurement parameters (e.g., efficiency, MDA, etc.) correct?			
7. Equipment labeled properly (Calibration date, efficiency, flow rate, etc.)?			

Notes/Comments:

Occupational Exposure Monitoring

	Yes	No	N/A
1. RWP required occupational radiation monitoring is being performed?			
2. RWP required dosimeters properly used and stored?			
3. RWP required BZ air samplers calibrated and used properly?			
4. RWP required particulate or radon progeny air sampling conducted and documented?			
5. RWP required Bioassays result in below 5 µg/L uranium detection limit?			
6. RWP Forms and documentation reviewed (as necessary)?			

Notes/Comments:

Surveys – Equipment and Surface Contamination

	Yes	No	N/A
1. Equipment in calibration and function checked prior to use?			
2. Survey results below limits?			
3. Measurements consistent with SOP (location(s), types of measurements)?			
4. Appropriately calculated parameters used (e.g., efficiency)?			
5. Equipment Contamination Survey Forms (Form SOP-3A) complete and reviewed?			
6. Monthly gamma survey of WTP completed?			

Notes/Comments:

Surveys – Personnel Contamination Surveys

	Yes	No	N/A
1. Equipment in calibration and function checked prior to use?			
2. Parameters calculated consistent with SOP (e.g., ALARA goal)?			

3. Surveys below limits?
4. Personnel Contamination Survey Forms (Form SOP-3B) complete and reviewed?

Notes/Comments:

Air Monitoring

Yes	No	N/A

1. Occupational Air Sampling Forms (Form SOP-4A) complete and reviewed?
2. Occupational BZ Air sampling equipment calibrated per SOP?
3. Air filter sample measurement parameters properly calculated (efficiency, MDC, etc.)?
4. Radon Progeny Air Sampling Forms (Form SOP-4B) complete and reviewed?
5. Radon sample collection times, count times, and elapsed times consistent with SOP?

Notes/Comments:

Radiation Work Permits (RWPs)

	Yes	No	N/A
1. Review any open and/or recently closed RWPs?			
2. Training to RWPs current and documented?			
3. Active RWPs posted in the designated field office?			
4. Dosimetry, bioassay, and BZ air monitoring requirements followed?			
5. Dose calculations correct and consistent with SOPs?			

Notes/Comments:

Radiation Safety Training

	Yes	No	N/A
1. Hazard Recognition Forms current and reviewed?			
2. Designated user list current?			
3. Radiation Safety Training documentation current and reviewed?			
4. Personnel qualifications or training records current and reviewed?			

Notes/Comments:

IX and RO Media Handling

	Yes	No	N/A
1. IX media and RO membranes are contained in IX vessels or DOT approved containers?			
2. WTP radioactive materials stored in the restricted area or temporary exclusion zone?			
3. IX media and/or RO membranes have been surveyed for shipping?			
4. Analytical data in support of radiation protection and control reviewed?			
5. CoC forms for samples submitted complete and reviewed?			
6. Shipping papers completed and reviewed?			

Notes/Comments:

SOP-8 SPILL RESPONSE AND REPORTING

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO) Authorized Users Radiation Protection Plan

1 PURPOSE

This standard operating procedure (SOP) describes the response to spills, leaks, or other unplanned releases of radioactive materials associated with water treatment plant (WTP) operations at the former Schwartzwalder Mine near Golden, Colorado (Site). It also describes documentation and regulatory reporting requirements under the Radiation Protection Plan (RPP) for water treatment at the Site.

2 SCOPE

This SOP applies to WTP operations under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). RPP specifications and procedures for WTP operations are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations).

Radioactive materials associated with WTP operations include contaminated influent mine water, residual solids and dissolved radionuclides associated with uranium mining sorbed to water filtration or treatment media used for reverse osmosis (RO) or ion exchange (IX) treatment systems, and RO reject water (brine) prior to disposal in the mine pool deep inside flooded underground mine workings.

This SOP is focused on managing unplanned releases of radioactive materials at the Site and does not comprehensively address emergency response procedures for unplanned releases involving chemical or physical hazards that pose immediate health and safety risks. Procedures for responding to the latter types of emergencies are provided in emergency response sections of the overall Heath and Safety Plan (HASP) for the Site.

3 RESPONSIBILITY

- **Radiation Safety Officer (RSO):** Responsible for health physics advising and applicable documentation, notification, and reporting requirements for unplanned releases of radioactive materials, and development of corrective actions and oversight of implementation. Ensures that Authorized Users (AUs) are trained on this SOP and follow its provisions.
- **Authorized Users (AUs):** Responsible for notifying the RSO or Alternate RSO (ARSO) and the WTP Manager of any unplanned release of radioactive material associated with water treatment as the Site. Responsible for completion of training on this SOP and ensuring that its provisions are followed.

4 PROCEDURE

4.1 EQUIPMENT AND MATERIALS

- Cell Phone to notify WTP Manager and RSO or ARSO of any unplanned release of radioactive materials, and to take photographs of the affected area.
- Spill cleanup equipment (e.g., absorbent materials, straw waddles or spill pillows, shovels, squeegee, heavy duty plastic trash bags, drums or other containers for spill wastes, supply of clean water and hose for washdown, if appropriate, etc.).
- Appropriate personal protective equipment (PPE).
- Radiological survey instruments (e.g., Ludlum 43-93/2360 alpha/beta survey instruments and Ludlum Model 19 gamma scintillometer).
- Contamination survey form(s) for documentation of surveys of spill cleanup areas or of packages or containers used to store and/or transport radioactive materials for offsite disposal.
- Field logbook to document observations for unplanned release of radioactive materials and associated spill cleanup activities.

4.2 SPILL RESPONSE

A spill, leak, or other unplanned release of radioactive material at the WTP could involve contaminated influent mine water, residual solids and dissolved radionuclides retained by RO filters or membranes, IX system treatment media, and RO reject brine water prior to onsite disposal deep in the mine pool. This RO brine discharge disposal is "authorized by rule" by the U.S. Environmental Protection Agency Region 8 (EPA) under the agency's Underground Injection Control (UIC) Program in accordance with 40 CFR 144.24 and 144.84(a). For the purposes of the RPP and this SOP, an unplanned release of radioactive material may be categorized as an "*incidental release*" or an "*emergency release*".

An *incidental release* is described as follows:

- Access restrictions are necessary only for the area affected by the release, the incident does not pose immediate health or safety risks for WTP workers or members of the public, and it does not require notification or assistance from emergency response agencies (e.g., fire department, medics, or HAZMAT responders) to effectively and safely mitigate the release.
- The leak or spill can be quickly confined or contained by WTP personnel with existing equipment and materials, or can otherwise be addressed quickly with the assistance of a local contractor to provide any necessary system repairs or maintenance.
- Adequate trained AUs and other WTP personnel are available to safely mitigate the leak or spill and prevent or minimize exposure hazards for workers or the public.
- Potential impacts to the workplace environment are minimal and easily resolved with simple spill cleanup procedures.

An *emergency release* is described as follows:

- The release involves radioactive material that requires immediate restrictions on access to the affected area, erection of physical barriers to secure the area, and posting as a "Radiation Area" as defined in CDPHE Regulations (external dose rates > 5 mrem/hr).

- The release event has resulted in serious injury to WTP personnel.
- Adequate trained AUs and other WTP personnel and/or equipment are not immediately available to control, contain, and mitigate the release.

Local emergency response agencies are contacted by calling 911. They include the Fire Department, Law Enforcement, and Medical Emergency Response. After addressing any immediate and potentially serious threats to the health and safety of workers, WTP personnel will attempt to control and stop incidental releases of radioactive material. If the release is an emergency, call 911 immediately. All radioactive material releases that meet the definition of an "emergency" as described above will be turned over to offsite responders such as the Fire Department, medical emergency responders, and possibly HAZMAT cleanup contractors (depending on potential risks and severity of the release). Site staff will provide any assistance needed based on their training, knowledge of the materials involved, hazards, cause of the release, etc.

Procedural steps for responding to potential unplanned releases of radioactive materials associated with WTP operations are summarized below.

4.2.1 IMMEDIATE ACTIONS

1. Stop or secure the operation causing the spill (examples: upright a container, stop a pump, close a valve).
2. Warn others in the area using available means (e.g., verbal in person, radios, cellphones).
3. Isolate the affected spill area. Establish control boundaries, if possible, and identify any other hazard(s) that may be present.
4. Minimize individual exposure to the spilled material (e.g., set control boundaries distant enough to reduce exposure rates to background levels, move personnel upwind, etc.).
5. Notify the WTP Manager and RSO.
6. The RSO shall evaluate the circumstances and make a determination whether an RWP is needed to cleanup and decontaminate the area, and to provide related instruction on methods and procedures to be used, including the disposition of released material following spill cleanup.

4.2.2 RESPONSE ACTION FOR UNPLANNED RELEASES

1. Isolate and restrict access to the affected area.
2. Identify the radiological or chemical hazards that may be present in the liquid or solids, including potential chemical forms, types, and levels of contaminants. As applicable, recent analytical data for influent mine water, RO reject brine water, RO filters or membranes, or IX resin, should be reviewed, if available. These materials may contain significantly elevated levels of uranium and Ra-226 in dissolved and/or solid forms. If the spill contains hazardous chemicals, follow the HASP and guidance listed in applicable Safety Data Sheet(s) (SDS) for hazards, handling, and cleanup recommendations.
3. The RSO shall evaluate the identified radiological hazards and make a determination whether an RWP is needed to remediate and decontaminate the area and provide instruction on the methods and radiation protection procedures to be used, including the disposition of radiologically contaminated waste materials generated by spill cleanup.

4. Determine if the source of the release (e.g., a leaking container) is located within an area that has secondary containment structures (e.g., concrete curbs with the capacity to completely contain the entire source of the release) and a sump system to drain the floor and contain the released material. If it is possible that the volume of released material could overflow existing containment structures and sump system, determine its likely direction of migration and take preventive measures (using appropriate PPE) to mitigate or eliminate the potential for additional spread of the release (e.g., beyond the WTP building). This could require the erecting additional berms, creating a channel to divert flow, constructing a temporary dam, etc.
5. Once the release is contained and under control, determine the cause of the loss of containment and take corrective actions. Corrective actions may include repair of damaged container, replacement of damaged container, repair of containment berms, etc., along with procedural, administrative, or engineering control measures to prevent future recurrence.
6. Initiate cleanup procedures. The degree and urgency of the cleanup will depend on the amount of material spilled, the nature of the material, the concentrations involved, the location of the spill, secondary containment controls, and availability of cleanup equipment and supplies.
7. Assess potential exposures of Site personnel and the general public to the contaminant(s) and compare to applicable regulatory standards [e.g., annual limit on intake (ALI) for radionuclides, Permissive Exposure Limit (PEL) or Threshold Limit Value (TLV) for metals, etc.].

4.2.3 REPORTING OF UNPLANNED RELEASES

1. The WTP Manager or RSO shall verbally notify CDPHE of unplanned releases based on the Incident Reporting criteria specified in Part 4.52 of CDPHE Regulations. DRMS shall be notified as well.
2. If notification to CDPHE is required, a written report of the incident shall be submitted to CDPHE within 30 days as required by Part 4.53 and Part 4.53.2 of CDPHE Regulations.

4.2.4 DISPOSITION OF SPILL CLEANUP WASTES

Liquid wastes from unplanned releases of water treatment system influent, treatment, or disposal processes shall be contained and subsequently transferred to the RO reject discharge system for disposal deep in the mine pool with RO reject brine water. Solid wastes generated by spill cleanup shall be containerized in drums or bins suitable for offsite transport in accordance with applicable U.S. Department of Transportation (DOT) regulations for Hazardous Class 7 Radioactive Materials. These waste streams will be securely stored in the WTP until transported for offsite disposal in accordance with the procedures described in SOP-9 (*Materials Handling, Transport, and Disposal*).

4.3 RECORDS

All records for reportable unplanned releases or spills of radioactive materials (i.e., written spill reports to CDPHE, to be developed by the RSO), along with a documented inventory of associated solid waste cleanup materials that are to be stored for eventual removal from the Site for offsite disposal, shall be retained with other RPP records until license termination.

SOP-9 MATERIALS HANDLING, TRANSPORT, AND DISPOSAL

VERSION HISTORY	DATE
Revision 0	04-2025

DISTRIBUTION
Radiation Safety Officer (RSO) Authorized Users Radiation Protection Plan

1 PURPOSE

This standard operating procedure (SOP) describes procedures for handling of radioactive materials associated with water treatment plant (WTP) operations under the Radiation Protection Plan (RPP) at the former Schwartzwalder Mine near Golden, Colorado (Site). It also describes plans and procedures for the storage, transport, and disposal of radioactive materials.

2 SCOPE

This SOP applies to WTP operations under Radioactive Materials License (RML) CO 1332-01 (Amendment 01). RPP specifications and procedures for WTP operations are designed for consistency with the requirements of radioactive materials license conditions (LCs) and corresponding radiation control regulations from the Colorado Department of Public Health and Environment (CDPHE Regulations).

Radioactive materials associated with WTP operations include contaminated influent mine water, residual solids and dissolved radionuclides associated with uranium mining contained in water filtration or treatment media used for reverse osmosis (RO) or ion exchange (IX) treatment systems, and RO reject water (brine) prior to disposal in the mine pool deep inside flooded underground mine workings.

This SOP is focused on handling of solid water treatment waste materials during IX resin change-outs or RO filter and membrane exchanges, along with storge of these licensed waste materials pending removal from the Site for offsite disposal. Transport of licensed water treatment wastes to appropriate offsite waste disposal facilities that are licensed to receive and dispose of low-level radioactive wastes of this nature, is only briefly described in this SOP because the licensee [the Colorado Division of Reclamation, Mining and Safety (DRMS)] intends to use a licensed radioactive waste materials broker to handle all aspects of offsite transport and disposal of these licensed waste materials in accordance with applicable state and federal regulations.

3 RESPONSIBILITY

- **Radiation Safety Officer (RSO):** Responsible for determination of the need to issue a Radiation Work Permit (RWP) for IX resin change-outs and RO filter/membrane exchanges, and determination of any radiation controls and monitoring deemed necessary for conducting these activities under the procedures described in this SOP. Issues and oversees implementation of RWPs where applicable, and reviews respective documentation. Ensures that pending offsite disposal, licensed radioactive water treatment waste materials are properly stored in appropriate containers within the WTP, and that these containers are appropriately posted with radiological warning signage and labeled with information on the contents. Prepares packages containing limited quantity samples of radioactive material (e.g., samples of spent water treatment media) for shipping to an offsite contract laboratory for analysis, and ensures that such samples are shipped in accordance with U.S. Department of

Transportation (DOT) regulations. Facilitates contracting, coordinating, and scheduling with a licensed radioactive waste materials broker to handle removal, transport, and offsite disposal of licensed water treatment waste materials. Assists the radioactive waste broker and DRMS with the procurement of necessary permits for offsite transport and disposal of these materials outside of the Rocky Mountain Low-Level Radioactive Waste Compact (RMLLRWC) region.

- **Authorized Users (AUs):** Responsible for completion of training on this SOP and ensuring that its provisions are followed, including water treatment media exchanges and proper storage of resulting radioactive waste materials.

4 REVERSE OSMOSIS FILTER MEDIA HANDLING

4.1 EQUIPMENT AND MATERIALS

- Heavy duty plastic filter storage waste bin (i.e., a durable, water-tight waste container)
- Heavy duty plastic storage bags
- Ziploc bag or equivalent for sample collection
- Felt-tip pen
- Replacement RO cartridge filters or membranes
- RO cap removing slide hammer, foot assembly, and bolts
- Rubber mallets, long screwdriver, other hand tools as needed
- Glycerin
- Paper towels
- Bore hole bit for filter media sampling;
- Poly-tarp/plastic sheeting;
- Radiological survey instruments and survey forms
- Required personal protective equipment (PPE)
- Radio

4.2 HEALTH AND SAFETY

Make sure equipment is properly locked and tagged out. This will include any high pressure pumps or valves that could expose the system to pressurized systems. Pressurized systems can release stored energy from pressure when loosening lids on the RO units or fittings on the pre-filter units. Loosen these covering slowly to allow pressure to release in a controlled fashion. Follow standard site safety practices when completing this procedure. Review SDS for membrane preservation chemicals (if applicable) used recently and make sure PPE is adequate. The following PPE is required for filter handling activities:

- Hard hat during overhead material handling and when overhead hazards exist
- Safety glasses
- Safety boots with boot covers, or rubber boots
- Double layer of rubber/nitrile gloves
- Tyvek coveralls (or similar full-body disposable coveralls)
- Face shield

4.3 RO MEMBRANE REMOVAL/REPLACEMENT

4.3.1 PREPARATION

1) Shutdown RO train and drain unit by opening the permeate header valves and other drain points. Pay attention to the sump pump and the level in the sump. If the sump pump is not able to keep up, close the permeate header valves to allow the pump to lower the level in the sump.
2) Put the RO train "offline"
3) Verify that the RO high-pressure pump corresponding to the unit is locked out and will not start on a remote command.
4) Close and lock out the valve that feeds the RO.
5) Verify that all required tools and equipment are present.
6) Verify that there is a waste bin that is properly set up for the used RO membranes. Verify that the path to the waste bin is clear of any obstacles.

4.3.2 REMOVAL OF END CAPS

7) Don proper PPE (e.g., Full body Tyvek coveralls, boot covers, double layer of gloves, face shield).
8) Remove the plastic permeate headers (example shown in Figure 1). Take care when removing these as they can be fragile and troublesome to duplicate should they break.
9) Remove each individual cap by first pulling out the tab on the individual retaining ring (see orange arrow in Figure 2) and removing the ring completely.
10) Note: There was a slide hammer and foot assembly provided with the plant (See Figure 3). This tool aids in removing the cap.
11) Thread the bolts for the slide hammer (Figure 3) into the threaded holes in the cap (See blue arrows in Figure 2).
12) Remove the cap by sliding the hammer toward yourself multiple times until you feel the cap loosen. There may be liquid present in the vessel and prior to fully removing the end cap, keep it loosely inserted. This will allow you to control the flow of water out of the vessel.

4.3.3 MEMBRANE REMOVAL

For proper function, membranes can only be inserted and removed in one direction. Membranes should only be pushed and there should be no need to pull membranes.

13) Don appropriate PPE (e.g., full-body Tyvek coveralls, boot covers, double layer of rubber or nitrile gloves, face shield).
14) Once the membrane has been pushed to a sufficient level, the operators should be able to remove the membrane from the vessel. Additional care should be taken to handle the membranes with the hands only, limiting contact with the forearms and other parts of the Tyvek suit. The weight of removed membranes can vary so be sure to ask for additional assistance if the membrane being removed proves to be too heavy.

Figure 1: Plastic Permeate Headers to be Removed

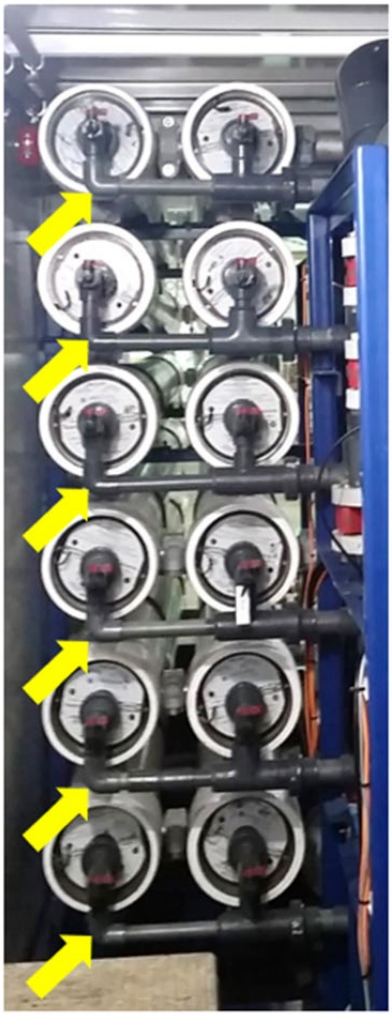


Figure 2: Typical RO Endcap

Figure 3: Typical Slide Hammer and Foot Assembly

15) Once removed, the membrane should be carried over to the sump and placed in such a way to drain any excess water still in the membrane.

16) Once the membrane is finished draining, the membrane should be placed in the membrane waste bin.

17) The above steps (12-15) should be repeated until all of the membranes are removed from the desired vessel(s).

4.3.4 CLEANING RO VESSELS

If the empty vessel contains residual solids, the vessel will require cleaning. A 7-8" foam ball will be covered in cloths and have string wrapped around it to act as a pig.

18) Once the pig and string are set up, the string should be fed through the vessel.

19) An operator will pull the string to drag the pig through the vessel to clean the inside walls.

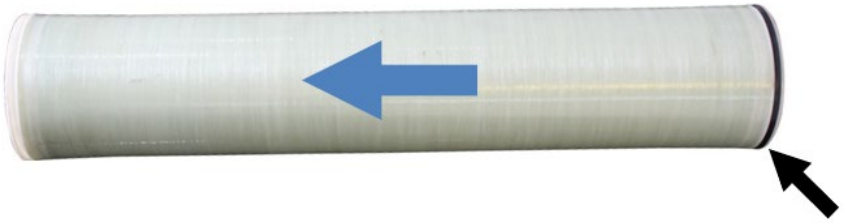
20) All rags and contaminants should be placed in the appropriate waste compartments.

4.3.5 MEMBRANE EXCHANGE

The feed side of the membrane (the side with the black gasket – see Figure 4) must always be closest to the operator pushing the membrane. Match the direction of the arrow in Figure 4 with the flow direction in the vessel. Note that for Stage 2, the direction in which the membranes should be pushed changes.

It is very important to note that the location of each membrane should be recorded with each membrane's serial number. This will maintain consistent data and help with troubleshooting during upset operation. The serial number will be unique for each membrane and contain at least 8 characters in some combination of letters and numbers.

Figure 4: RO Membrane Load/Flow Direction



Membranes are loaded in the exact same way they are removed. Verify that a generous amount of water-based lubricant (e.g. glycerin) is applied to each gasket and that a membrane interconnector (Figure 5) is inserted between each membrane. Also verify that permeate port adapters are on each end cap and that a thrust cone is on each effluent side end cap next to the fourth membrane. Figure 6 shows a typical thrust cone and permeate port adapter.

Figure 5: Typical Membrane Interconnector

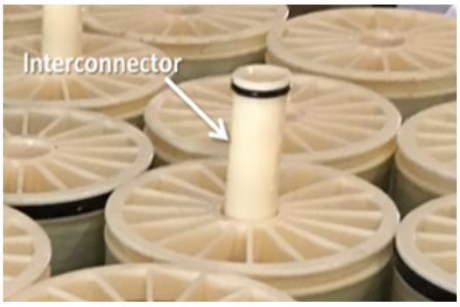
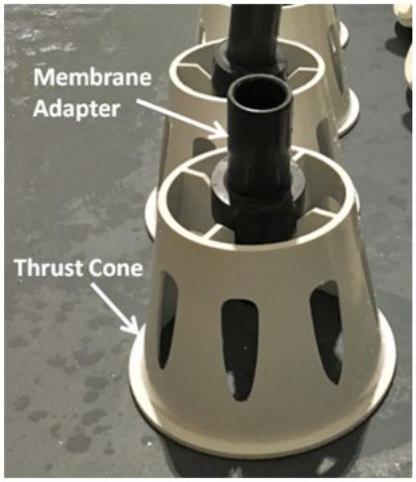


Figure 6: Typical Thrust Cone and Permeate Port Adapter



If unloading membranes to winterize, make sure all membranes are bagged and sealed in plastic bags. Leave the endcaps off to allow system to dry. If loading membranes, make sure all connections are secure, and put the RO skid back online.

4.4 CARTRIDGE FILTER REMOVAL/REPLACEMENT

4.4.1 PREPARATION

1) Make sure equipment is properly locked and tagged out.
2) Put plastic tarps on the floor around the area where the changeout will occur.
3) Shutdown RO train and put the RO train "offline".
4) Close the red hand valves before and after the cartridge filter housing.
5) Verify that the drain line at the bottom of the cartridge filter housing is routed to the sump.
6) Once verified, open the drain valve at the bottom of the cartridge filter housing and the bleed valve at the top of the housing to empty the water to the sump and to allow air to enter the housing.
7) Verify that all required tools and replacement filters are present. Each housing has 12 cartridge filters.
8) Verify that there is a waste bin that is properly set up for the used cartridge filters. Verify that the path to the waste bin is clear of any obstacles.

4.4.2 REMOVING USED CARTRIDGE FILTERS

9) Don appropriate PPE (e.g., full-body Tyvek coveralls, boot covers, double layer of rubber or nitrile gloves, face shield).
10) Once the housing has stopped draining, remove the hose from the bleed valve at the top of the housing.
11) Loosen the screws that are securing the lid to the rest of the housing. There are 8 present per housing. Once loose, move the teeth to the side so that the lid can be removed.
12) Remove the lid and place it in a clean location. Clean the lid with any paper towels/wipes if necessary.
13) There will be a plate which is resting on top of the old cartridge filters and is secured in place with 2 rods and nuts. Remove the nuts from the rods to free the plate. Remove the plate. Clean the parts with any paper towels/wipes if necessary.
14) Remove the used cartridge filters from the housing. Place the used cartridge filters in a drum to allow any water to drain from the cartridge filters. Repeat the process until the housing is empty.

4.4.3 INSTALLING NEW CARTRIDGE FILTERS

15) Take a new cartridge filter and place it inside the housing. The section with the gaskets is placed at the bottom of the housing and the triangular section of the cartridge filter will go on top (placed the same way that the old cartridge filters were within the housing). Repeat the process until all 12 cartridge filters are in the housing.
16) With all cartridge filters within the housing, line up the plate such that all the cartridge filters fit within the holes cut in the plate and the 2 rods holding the plate in place. It is recommended to have a long screwdriver to guide the filters into the correct holes in the plate.

17) Once in place, secure the plate by placing the nuts on the 2 securing rods. It is important to tighten the nuts to the same resistance to ensure uniform pressure on the top of the cartridge filters.

18) Once secured, plate the lid on top of the housing and align the teeth such that the lid is secured to the body of the housing. Tighten all of the screws using the screwdriver (or any other tool which allows for efficient tightening).

19) Reconnect the bleed valve hosing located on the lid of the cartridge filter canister. Leave the valve open as it will need to be opened in the next section of this SOP.

20) Close the drain valve at the bottom of the cartridge filter housing.

4.4.4 REMOVING AIR AND RO START-UP

21) Open the red hand valve before cartridge filter housing. Allow the feed water to enter the housing until the bleed off hosing is showing a consistent flow of water without any air.

22) Once it is confirmed that there is no air in the cartridge filter housing, open the red hand valve after the cartridge filter housing to allow water to flow to the RO. Close the bleed valve.

23) Place the RO in "Fill" and verify that there is no air present in the cartridge filters and RO.

24) Start-up the RO per normal operations.

25) Clean up the area and properly dispose of any waste that may be present.

4.5 SAMPLING OF SPENT RO FITER MEDIA

Spent RO membranes shall be representatively sampled during each membrane replacement event. RO membranes from the two treatment trains (a total of 48 individual membranes) may be exchanged in stages, and a representative selection of spent membrane stages from each train will be sampled during each exchange event. This may include selection of membranes from the front, middle, or end of each train, depending on which stages of membranes in the RO trains require replacement. With respect to cartridge filters, there are four filter housings, two for each RO treatment train. Cartridge filters may be replaced on a weekly to monthly basis as needed throughout the operational treatment season (usually occurring over an operational period of approximately 22 weeks between June and October). Canister filters shall be representatively sampled twice per year, for example once during the first filter exchange of the operating season, and once during the last filter exchange of the operating season.

Once RO filter media have been sampled, the remainder of the media (filters and membranes) must be bagged in heavy-duty plastic trash bags and sealed for storage inside a spent filter media waste storage bin in a Restricted Area within the facility until removal from the Site for offsite disposal. Part 4.30.1 of CDPHE regulations requires each container of radioactive material to be posted with the radiation symbol prescribed in Part 4.27 and the words "CAUTION, RADIOACTIVE MATERIAL". In addition, the container must be labeled to include: 1) information on the radionuclides present (e.g., natural uranium and associated decay products), 2) an estimate of the quantity of radioactivity (if known), and 3) the type of materials in the container (e.g., spent water treatment filter media).

This procedure should be scheduled in accordance with the sampling schedule for RO filter/membrane exchanges as described above. Do not complete any of these steps without a water treatment plant operator present. This is a list of steps to take for collecting filter media samples.

1. After removing and draining as described in Section 4.3.3, place the RO membrane in the plastic storage bag within the RO filter media waste bin.
2. Use a bore hole bit to cut through the RO membrane casing in the middle and at both ends; continue to drill through membrane layers.
3. Pull out mesh filter layers with needle-nose plyers while cutting unbroken strands with a construction knife.
4. Collect the sampled filter media in a Ziploc bag or equivalent, and label with the following:
    a. Sample name
    b. Date
    c. Time
5. Seal storage bag and ensure the outside surface is completely dry using a paper towel.
6. Place another storage bag into the secondary containment container and stage near the RO cartridge filters.
7. Slowly pull the RO cartridge filter out of the vessel and place within the storage bag.
8. Use a bore hole bit to cut a section from the middle and both ends of the RO cartridge filter.
9. Collect filter layers in a sample collection bag and label with the following:
    a. Sample name
    b. Date
    c. Time
10. Seal storage bag and ensure the outside surface is completely dry using a paper towel.
11. Remove equipment; and re-secure top opening cover on column.
12. Perform area contamination surveys according to SOP-3 (*Radiological Contamination Surveys*) and document.
13. Decontaminate as necessary to meet unrestricted release criteria.
14. Remove and place disposable PPE in radiological waste storage bin.
15. Remove boundary areas around work space.

4.5.1 SHIPPING OF FILTER MEDIA SAMPLES

An Authorized User for WTP operations shall collect, bag, label, and document samples of water treatment filter media as described above. The RSO shall be responsible for shipping the samples to the contract laboratory. Strict Chain of Custody (COC) protocols shall be followed to provide an accurate written record that traces the possession of individual samples from the time of collection in the WTP to the time of acceptance at the laboratory. The COC record also will be used to document all samples collected and the analyses requested. The RSO will record the following information on the laboratory provided COC record:

- Project name
- Sample type (e.g., solids sorbed to water treatment filter media)
- Name and signature of sampler
- Destination of samples (laboratory name)
- Sample identification number
- Date and time of collection
- Number and type of containers filled, if applicable

- Analysis requested, including a requirement for reporting in activity concentrations by weight (i.e., the lab must obtain the wet or dry weight each sample of filter media prior to laboratory analysis)
- Sample designation (grab or composite)
- Signatures of individuals involved in custody transfer, including the date and time of transfer
- Project contact and phone number

The RSO shall ship samples to the contract laboratory in accordance with applicable DOT regulations (49 CFR 173) based on an expectation that respective packages are likely to exceed exempt concentration and consignment limits specified in 49 CFR 173.436 and will thus require shipping under UN2910 protocols for excepted packages containing limited quantities of Class 7 radioactive materials. Additional information on sample shipping requirements is provided in Section 6.1 of this SOP, along with SOP-1 (*Radiation Protection Training*) and SOP-3 (*Radiological Contamination Surveys*).

5 ION EXCHANGE RESIN HANDLING

5.1 EQUIPMENT AND MATERIALS

- Resin media transfer pump, hoses and fittings
- Solution decant pump, hoses and fittings
- IBC tote or equivalent DOT storage container
- New or Replacement IX Resin Media
- Forklift
- Fine mesh hose screen
- Bag/sock filter
- Hand tools
- Poly tarp/plastic sheeting
- HEPA Vacuum
- Rope or straps
- Required PPE

5.2 HEALTH AND SAFETY

Energized systems can release stored energy from pressure when loosening lids on the external bag/sock filter units or flanged fittings on the IX treatment vessels. Loosen these covering slowly to allow pressure to release in a controlled fashion. Follow standard site safety practices when completing this procedure. Do not enter the IX vessel or any other confined space without a confined space permit. The following personnel protective equipment is required for IX resin handling activities:

- Hard hat during overhead material handling and when overhead hazards exist
- Safety glasses
- Safety boots or rubber boots
- Rubber/nitrile gloves
- Tyvek coveralls

5.3 UNLOADING MEDIA FROM IX TREATMENT SYSTEM VESSELS

1. Isolate the treatment system vessel from the water supply system.
2. Set-up boundary areas (poly-tarp/plastic sheeting) around work-space.
3. Don proper personnel safety equipment (PPE).
4. Remove the secured cover from upper opening of vessel.
5. Stage the transfer pump near the IX vessel.
6. Stage IBC tote near vessel to receive removed resin media and water.
7. Connect appropriate hoses from transfer pump to IX vessel flange fittings to allow for resin media removal.
8. Place one hose end on to the IX vessel fittings and place other hose end into the resin tote opening.
9. Start/Stop the transfer pump as necessary to move the resin media and water from the IX vessel in to the resin tote.
10. During pump operation, open water valve(s) located on the IX vessel and adjust water flow as necessary to move the media resin with water into tote.
11. Stop transfer pump and close water valves on IX vessel when tote is full. Tote will have resin and the water used to move the resin.
12. Let resin media settle out in tote.
13. Place suction end of water decant pump hose into tote, hose is equipped with a fine mesh screen and is designed to prevent any resin from being removed from tote.
14. Place discharge hose from the water decant pump and route to the building floor sump. As a secondary measure place this discharge hose through a bag/sock filter to capture any resin that could be pumped out when decanting the water from the tote. Water collected in building sump is contained and pumped back to the treatment process.
15. Repeat above steps as needed until resin has been removed from the vessel and minimal water remains in the tote.
16. Flush hoses and equipment with water after media is removed from IX vessel.
17. Check for evidence of resin residue on equipment, hoses and in bag/sock filter etc., if resin is noticed rinse out and place into tote or back into IX vessel.
18. Disassemble resin transfer equipment.
19. Perform visual inspection of work area looking for indication of resin spillage, use HEPA vacuum or other appropriate method to cleanup up affected area as needed.
20. With forklift move resin tote to storage area in building.
21. If new or replacement resin is being loaded into vessel, skip to the next section; otherwise, continue with step 22.
22. remove equipment; and re-secure top opening cover on vessel.
23. Perform area contamination surveys and document.
24. Decontaminate as necessary to meet unrestricted release criteria.
25. Remove and place disposable PPE in plastic bag inside radiological waste storage bin.
26. Remove boundary areas around work space.

5.4 LOADING REPLACEMENT MEDIA INTO IX TREATMENT SYSTEM VESSELS

New resin or stripped resin may be utilized for loading back into the vessels. New resin is packaged in supersack containers and stripped resin is packaged in IBC totes.

1. When new resin is being used:

a) Secure the supersack container onto wooden pallet using straps to prevent its movement. Pallet is designed to allow the resin to be emptied from the bottom of the supersack. Stripped resin, when used, is contained in IBC totes.

b) Using a forklift, raise pallet with supersack container and position over top opening in vessel making sure supersack bottom chute is just inside vessel opening, open chute and empty resin into vessel. Resin is normally moist, but some dusting could occur.

2. When IBC tote packaged resin is being used:
   a) Position tote on forklift so the totes lower drain fitting is accessible.
   b) Raise tote next to opening in IX vessel, attach one end of hose to lower tote fitting and the other end into opening on vessel. Open tote lower valve.
3. Using water hose, dampen resin, and then slurry resin from tote into IX vessel until tote is empty.
4. Secure the vessel top opening cover.
5. Check for spillage of resin on equipment, hoses etc., if resin is noticed rinse out and place into tote or back into IX vessel. A HEPA vacuum can also be utilized for cleanup of resin.
6. Perform area contamination surveys and document.
7. Decontaminate as necessary to meet free release criteria.
8. Remove and store personnel protection equipment.
9. Remove boundary areas around work space.
10. Perform personal contamination surveys, decontaminate as needed and document survey results.

5.5 IX TREATMENT SYSTEM VESSEL MAINTENANCE

Routine minor maintenance on the IX treatment system pertains mainly of inspecting piping valve screens for plugging, back-flushing piping, and exchanging the bag/sock filters. In these instances rubber gloves are to be worn. Exchanged bag/sock filters are placed into heavy duty plastic bags and stored inside radiological waste storage bins within the Restricted Area.

6 RADIOACTIVE MATERIALS TRANSPORTATION AND DISPOSAL

Any radioactive material that is not exempt from classification as a Class 7 radioactive hazardous material under U.S. Department of Transportation (DOT) regulations (49 CFR 173) based on the exempt concentration and consignment limits specified in 49 CFR 173.436, is subject to applicable DOT transportation regulations.

6.1 SHIPPING LIMITED QUANTITY SAMPLES OF RADIOACTIVE MATERIALS

Training – As indicated in the RPP and in SOP-1 (*Radiation Protection Training*), any Site personnel involved in offsite shipping of samples containing non-exempt quantities of radioactive materials from the Site (e.g., samples of spent water treatment media) shall complete HAZMAT Worker training every three (3) years and retain documentation of this training pursuant to U.S. Department of Transportation (DOT) regulations in 49 CFR Part 12.704.

Shipping Container – Ship samples in a suitable "excepted package" container that is durable enough to reasonably assume when filled with samples it will arrive at its destination intact. Excepted packaging is used for transport of limited quantities of samples containing naturally occurring uranium or thorium in waste materials that can be classified as either Low Specific Activity (LSA) materials or Surface

Contaminated Objects (SCO). Excepted packaging must meet the general requirements below for all packaging types:

GENERAL DESIGN REQUIREMENTS (49CFR §173.410)	GENERAL STANDARDS (ALL PACKAGES) (10 CFR §71.43)
Package can be easily handled and properly secured	Under "Normal conditions of transport":
Lifting attachment has a safety factor of three	- be no loss or dispersal of radioactive contents; - no significant increase in external surface radiation levels; and - no substantial reduction in the effectiveness of the packaging
External surface is free from protruding features and easily decontaminated	
Outer layer will avoid pockets or crevices	
Added features will not reduce the safety of the package.	In still air at 38°C (100°F) and in the shade:
Withstand the effects of "normal conditions" of transport	No accessible surface of a package would have a temperature exceeding 50°C (122°F) in a nonexclusive use shipment, or 85°C (185°F) in an exclusive use shipment.
Construction materials will be physically and chemically compatible	
Valves through which the contents could escape will be protected against unauthorized operation	

Select an excepted package shipping container of appropriate size to minimize unnecessary void space after sample placement, and fill remaining void space, as necessary to minimize sample bag movement and potential leakage. If the container has a drain plug it must be secured in closed position.

Sample Bags and/or Sample Containers – Sample bags or sample containers should not leak or break during shipment. Ziploc type bags can be used as long as the bag is sealed tight. It is recommended that all samples of water treatment media be double-bagged to minimize the potential for leakage or spillage. Avoid glass containers as they have the potential to break during shipment.

Package Surveys – The procedure for radiological contamination surveys for shipping packages containing samples of spent water treatment media under DOT regulations and protocols for UN2910 limited quantity, excepted package shipping (per 49 CFR 173.421 and 173.422), is detailed in SOP-3 (*Radiological Contamination Surveys*). The UN2910 package survey form (Form SOP-3B) shall be completed and retained with other RPP records until license termination.

Package Labeling – The outside of the container must be marked with a UN2910 label (example below), and should include the language "*Radioactive Material, Excepted Package – Limited Quantity of Material*". The only package marking/labeling requirement for this UN number is having the label placed on top of the box. Dangerous Goods HAZMAT paperwork is NOT required.

Laboratory Chain-of-Custody Form – A completed chain-of-custody (COC) form shall accompany all samples sent to the contract laboratory. NOTE: Each lab has its own COC form. Use the appropriate lab-specific COC for the lab being shipped to. Each shipping container should have its own COC placed inside of a plastic Ziplock baggie on top of the samples prior container closure so that it is readily visible and available upon receipt by the lab.

Custody Seal – When the shipping container is loaded and ready to ship, place a custody seal on the shipping container in such a manner that the container cannot be opened without breaking the seal. Custody seals may be obtained from the analytical laboratory to be used for sample analysis.

Ship the Container – Ship the container via FedEx or UPS. NOTE: Indicate on the shipping form or label that Dangerous Goods are included. The FedEx labels and online label have an option under Special Services to identify the shipment as having Dangerous Goods. Indicate that Dangerous Goods are packed as Inaccessible, which is to say they are not required to be accessible.

6.2 SHIPPING AND DISPOSAL OF RADIOACTIVE WASTE FROM WATER TREATMENT OPERATIONS

As indicated in the RPP, the licensee (DRMS) intends to utilize a licensed radioactive waste broker to remove from the Site all solid waste materials generated by WTP operations for transport to an offsite disposal facility, and to do so in accordance with all applicable state and federal regulations. This commitment includes compliance with applicable DOT regulations for transport of Class 7 radioactive material, as well as Colorado transportation regulations (Part 17). The licensed radioactive waste broker will assist DRMS with obtaining a required permit with the Rocky Mountain Low-Level Radioactive Waste Board for export of radioactive materials from the RMLLRWC region. In addition, the licensed radioactive waste broker will take interim possession and responsibility for the radioactive waste material until disposal at an appropriately licensed offsite disposal facility is arranged and completed. A copy of the acceptance paperwork for receiving and taking permanent possession of the waste at the disposal facility must be sent to the Rocky Mountain Low-Level Radioactive Waste Board to close out the export permit.

7 RECORDS

An inventory of licensed radioactive water treatment waste materials stored in appropriate containers within Restricted Areas of the WTP must be tracked and documented with pertinent information including:

- Estimated volume of solid waste materials in each container (e.g., cubic yards)
- A description of the wastes (e.g., spent water treatment filtration media, or spent IX resin).
- Description of the radiological contents in each container (e.g., uranium and associated decay products)
- If known, an estimate of the total amount of radioactivity stored in each container (e.g., based on sampling data if available, along with estimated mass of the materials, e.g., kilograms).

The training and all survey data and reporting records associated with this SOP (including the waste inventory records described above) shall be maintained with other RPP records until license termination.