Greater Radiological Dimensions, Inc.
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Description: Radiological Material Work Plan

Prepared for: Merani Hospitality, Inc.

Project Location: 401, 402 and 430 Buffalo Avenue Site
Niagara Falls, New York, BCP Site No. C932164

1.0 Purpose:

The purpose of this Work Plan and associated support documents, including the Technical Approach and Radiological Health and Safety Plan (attached), is to present the means and methods that will be required to address on-Site elevated radiological soil / fill, and provide radiological technical support, screening and oversight of the investigation and removal of elevated radiological material on the 401, 402, and 430 Buffalo Avenue, Niagara Falls, New York Site (Site).

This radiological work plan and associated radiological support documents have been prepared in association with the NYSDEC Brownfield Cleanup Program (BCP) work plan prepared by TurnKey Environmental Restoration, LLC and Benchmark Environmental Engineering and Science, PLLC. GRD is solely responsible for the contents of this work plan.

Greater Radiological Dimensions Inc. (GRD), a Licensed Radiological Material Handling Company (New York State Department of Health Radioactive Materials License # C5514), will provide radiological oversight for the investigation, pre-screening, remedial excavation, minimization, segregation and off-site transportation of radiologically-impacted soil / fill wastes for off-site disposal at an approved disposal facility.

2.0 Background:

Based on the location of the Site within an area of Niagara Falls New York that is recently known to contain historic slag material which exhibits elevated levels of naturally-occurring radioactive material (NORM) and technologically-enhanced,

naturally-occurring radioactive material (TENORM), radiological screening of the Site was recommended by the NYSDEC to be completed as part of the BCP activities. The environmental and pre-demolition investigation (TurnKey, August 2014) indicated areas of the 401 Buffalo Avenue parcel contain elevated radiological material above background levels, with readings as high as 40,000 counts per minute (cpm) being recorded in the pool area.

The 402 and 430 Buffalo Avenue parcels were previously part of the National Bisquit / Shredded Wheat Factory, and based on the former commercial / industrial use of this portion of the Site, a gamma walkover screening of the entire parcel is planned during the Remedial Investigation (RI) of the Site.

Any elevated radiological material that is planned to be removed during remedial and / or redevelopment activities will be handled in accordance with this work plan and associated technical documents.

3.0 Screening of Potential Radiologic Material:

During intrusive activities, it will be necessary to pre-screen the areas and determine if elevated radiological material is present above the established background. Prior to excavation a radiological technician (Rad Tech) will perform a gamma walkover of the surface area, utilizing a Ludlum Model #2221 Detector paired with a #44-10 sodium iodide probe. Utilizing the results of the gamma walkover; along with visually screening; the rad tech will determine when and how often to scan buckets during excavation.
If elevated activity is found to be approaching the NYSDEC established threshold of separation, the technician will then scan each bucket until levels are at or below background. The threshold is typically determined to be at or near 1.5 to 2 times background; this threshold has previously been used on the properties per the NYSDEC. Therefore, the threshold for the Site would be 12,000-14,000 cpm.

Any material above the threshold will be segregated to the radiological-contaminated lay-down area. A contaminated material lay-down area will be established and appropriately posted. This area will have a plastic under-lay and will be covered with poly sheeting at all times. For more specific means, methods and requirements refer to the Radiation Health and Safety Plan.

Radiological general area air monitoring will be completed during the excavation and handling of elevated radiological material. General air monitoring will be completed in addition to the BCP Community Air Monitoring Plan.

the following procedure for Radiological general area air monitoring will be utilized:

Three (3) F&J low-volume air monitors will be placed waist high within 20 feet of the excavation at upwind, down wind and cross wind of excavation / load out area. The monitors will run during all excavation / load out activities and the filter cartridges will be collected daily.

The 47mm filters will be counted immediately for any excessive levels, then held for 5 days for radon decay, then recounted with a Ludlum model #2929 alpha / beta filter counter or equivalent. The results of air monitoring data will be reported using the guidance in NRC Regulatory Guide 8.25 (attached). All Air Sample data will be compared with the derivative air concentrations (DAC) that are the most conservative for the contaminants expected to be present. Radioactive contaminants in Appendix B of New York's State Sanitary code # "10 NYCRR part 16-ionizing radiation" will be used to assess the exposure potentials, as appropriate.

All instruments will be calibrated in accordance with regulatory guidance and subjected to daily quality checks to ensure proper operating condition and functionality. The data will be recorded on field survey forms and reviewed by senior radiological staff.

4.0 Oversight/Rad Support of Load Out, Shipping and Disposal of Contaminated Material:

With the approval from the NYSDEC and the acceptance of sample results from the approved off-site disposal facility and the facility's state regulatory agency, the radiological -contaminated material will be loaded into the appropriate shipping containers for off-site transportation by licensed radiological transporter and disposal at registered disposal facility. GRD will provide a certified waste shipper if needed who will ensure that all of the necessary permits and state regulatory requirements are fulfilled. The trucks will be lined with poly and covered (tarped). A dose rate survey of the trailer and cab will be performed, with a Bicron µR meter, in order to determine the dose rate in (µr / hr). The tires will be pre-scanned prior to leaving the Site, and if levels are more than two times the background, the tires will be decontaminated utilizing water prior to being released from the excavation site. Decon materials will be containerized for off-site disposal. Details are provided in the support documents.

Once the load out of contaminated material has been completed, all associated equipment will be scanned and released. A pre- and post-gamma walkover survey of the radiological-contaminated staging area will be performed.

5.0 Reporting:

Daily field logs will be utilized to record daily activities, screening results and sampling, and equipment usage and calibration results. Additional documentation,

including: radiological waste characterization sample results, disposal facility applications and approvals, off-site transporter licenses, radiological worker training certifications, and disposal manifests and tonnage reports will be provided in the close out documents.

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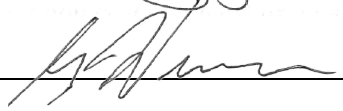
Greater Radiological Dimensions Inc. 1527 Ridge Road , Lewiston, NY 14092	
LOCATION: 401, 402 and 430 BUFFALO AVENUE Site **Niagara Falls New York BCP Site No. C932164**	

TECHNICAL APPROACH

Prepared By	**Stuart Pryce** **Project Manager / Sr. Technician**	
Approved By:	**George Weissenburger** **Program Manager / Sr. Technician**	

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The anticipated scope of consultant work is as follows:

- Provide radiation health and safety consulting.
- Obtain Radioactive Materials license coverage for Merani Hospitality, Inc. (Merani), and Turnkey Environmental Restoration, LLC (TurnKey) and Benchmark Environmental Engineering and Science, PLLC (Benchmark), their subcontractors, for this project.
- Write a Contaminated Materials Handling Plan (CHMP) for the project. A draft copy of the CMHP must be submitted to Merani, or designated subcontractor, for review and comment. The following is a suggested CHMP outline:

Introduction

- Protection of Workers and General Public
  - General Concepts
  - General Radiation Protection Methodologies
  - Personal Protective Equipment
  - Contamination Control
  - Fugitive Dust Control
  - Instrumentation
  - Contamination Release Limits
- Excavation and Management of Soils and Slag
  - General
  - Radiation Field Screening Procedures
  - Segregation and Transport of Radiologically Contaminated Materials
  - Contaminated Material Staging Area
- Decontamination of Equipment
- Emergency Event Guidelines
- Site Worker Radiation Safety Training Requirements
- Radiological Documentation
  - Screened Material
  - Excavation Actions
  - Training
  - Equipment Decon
  - Project Personnel Contact Information
- References
- Training Outline
- Glossary of Terms

Radioactively Contaminated Materials Handling Plan for the Project

Introduction

Greater Radiological Dimensions, Inc. (GRD) has contracted to provide radiation health and safety consulting, radiation monitoring, and job-site field surveys.

GRD shall be responsible only for radiation-related support services, including radiation related consulting, monitoring, surveying and minor decontamination within radiation control areas for this project. The non-radiological aspects of the project shall be the responsibility of Merani and their designated subcontractors, including ,excavation and utility installation (and attendant health and safety), non-radioactive air monitoring, dust control, disposal and re-use of non-radiologic excavated materials and waste.

GRD will prepare relevant Radiation Work Permits (RWPs), Radiation Standard Operating Procedures (RSOPs), and Radiation Health and Safety Plans (RHASPs). It is the responsibility of Merani and/or its subcontractors to prepare all other relevant plans.

Protection of Workers and General Public

General Concepts

In summary, GRD will take measures to minimize exposure to ionizing radiation for the general public, Merani, and associated contract works, and GRD workers and associated contract employees. General methodologies and rules are described in more detail below.

The overarching philosophy/methodology for protection is As Low As Reasonably Achievable (ALARA), whereby workers keep any received dose ALARA through formal procedures and sound work practices, including monitoring and personal protective equipment – PPE, as described below.

General Radiation Protection Methodologies

General Rule for Safe Use of Radioactive Material

The radiation dose received by any person from external or internal exposure to ionizing radiation in a radiation installation (a controlled area in which radioactive material or machines generating ionizing radiation or both are used) must be held to the lowest possible value consistent with effective use of the installation. Exposure of personnel, and the general public, to ionizing radiation, must never exceed the legal maximum permissible values. Control of ionizing radiation exposure is based on the assumption that any exposure involves some risk. However, occupational exposure within accepted limits represents a very small risk compared to the other risks voluntarily encountered in other work environments. The policy of GRD is to maintain occupational exposures of individuals within allowable Radiation Exposure Guides. The individual and collective dose to workers is maintained As Low As Reasonably Achievable (ALARA). ALARA is a part of the normal work process where people are working with ionizing radiation. Management at all levels, and in all areas, as well as each individual worker, must take an active role in minimizing this radiation exposure. Disposal of all radioactive waste must be in accordance with procedures contained in GRD's Radiation License. The radiation dose received by any person from external and/or internal exposure to ionizing radiation in a non-controlled area must be held as close to natural background levels as possible. Exposure to the general public from any operation must never exceed the annual legal maximum permissible exposure level of 100 mRem per year above the natural background level. Legal maximum permissible dose levels are those specified in the current edition of the New York State Department of Health Sanitary Code, Chapter I, Part 16, Ionizing Radiation: and in Title 10, Part 20, of the Code of Federal Regulations (10 CFR 20), Radiation Protection. These two reference materials contain definitions of terms used in this document. Federal and State regulations shall be considered as a

part of GRD's procedures outlined within this document.

GRD shall employ the following methods/procedures for ensuring radiation protection of workers and the general public:

- General and specific RWPs (radiation work permits) are written for a 6-month period and will be reviewed and revised as conditions change. Specific RWPs are written for jobs that are outside the scope of work covered in a general RWP.
- Procedures in RWPs will be followed.
- Employ personnel monitoring – Thermoluminescent Detector (TLD) bioassays; TLD's to be worn between neck & waist.
- Control of area access by posting radiation areas.
- Materials sampling.
- Use of a log book to track work activities.
- Performance of RWP surveys, which accompany the RWP.
- If needed, buffer areas shall be placed at egress points from contaminated areas.
- Keep access egress logs.
- Slag is a heavy material, but airborne material arising from slag has been shown not to be an issue from historical data from other BCP Site(s) in Niagara Falls, New York.
- Instrumentation to be calibrated yearly by a commercial service.
- Instruments are set up to +/- 2 sigma measurement tolerances.
- Daily source checks of all instruments are to be performed and recorded on daily performance sheets.
- Source jigs will be performance checked to obtain appropriate use geometry.
- Loose contamination surveys shall be performed using swipes for 100 cm2 area. LAWs (large area wipes) can also be used to detect loose contamination as another method of radiation surveying. In this case, a cloth, such as maslin, is used in place of 100 cm2 swipes.100 cm2 swipes will be counted on instrumentation that can detect beta, gamma, and alpha emitters.
- Direct contamination surveys will be performed by scanning with instrumentation that detects beta, gamma, and alpha.
- Equipment surveys that pertain to any material or equipment in a controlled area shall be performed on a weekly basis.
- Equipment surveys will be performed for equipment that will remain on the job site, if it is being released from controlled areas.
- Gamma walk-over survey of all accessible areas fo the BCP Site will be comeplted prior to intrusive activities
- Excavation surveys shall be performed, in areas of the Site that have been identified as elevated during previous assessment or during the walk-over survey, during excavation activities.
- Collection of radiologic waste characterization samples for disposal approval, as required.
- Personnel surveys/monitoring of personnel shall be performed on a schedule set by the RWP.
- All surveys will be available for workers to review conditions and will also be included in RWP packages.
- Conditional release surveys will be performed when materials and equipment are leaving a controlled area.
- An unconditional release survey is performed when equipment is being released from the job site. Equipment surveys are also required when maintenance is performed on equipment.

- All surveys shall be documented.

Personal Protective Equipment (PPE)

Use and Selection of Protective Clothing

PPE will be selected based on the contamination levels in the work area and the anticipated work activity, ALARA and safety considerations, and consideration of non-radiological hazardous materials that may be present. Surfaces are considered radiologically contaminated if above Table 4 levels.

PPE provided will be in good condition and free of chemical or radioactive contamination and may include the following items at the discretion of the RSO:

- Full Set Coveralls (TyvekTM or cotton)
- Cotton glove liners
- Rubber or chemical resistant gloves
- Shoe covers
- Protective overshoes
- Hood (TyvekTM or cotton)

Protective clothing and equipment selected for project tasks will be described in the GRD RHASP, together with procedures for donning and removing PPE without spreading contamination or contaminating the worker. The necessary PPE for a task will be specified by the RWP.

Use and Selection of Respiratory Protection Devices

GRD's documented respiratory protection program details specific procedures for respiratory usage, fit, cleaning, and so forth. Engineering control measures will be provided to limit the concentrations of radioactivity in air to levels below those that constitute an airborne radioactivity area to the extent feasible. When this level is not feasible, other methods such as administrative controls and respiratory protection will be employed to limit the potential for intake of radioactive material.

Only respiratory protection equipment that is tested and certified by the National Institute for Occupational Safety and Health (NIOSH) will be used. Protection factors listed in Appendix A of 10 CFR 20 will be used in the assessment of potential radioactive material intake. Selection of appropriate respiratory protection devices will be designated within either the HASP or the RWP. At a minimum, respiratory protection devices will be selected so that a protection factor greater than the multiple by which peak concentrations or airborne radioactivity exceed the values specified in Appendix B of 10 CFR 20 is not exceeded. Only respiratory protection equipment that has been specifically certified for emergency use by NIOSHI Mine Safety and Health Administration (MSHA) will be used as emergency devices. Whenever respiratory protection will be used at a site, the following additional minimum requirements will be met:

Air sampling for radiation will be performed to identify the potential hazard, permit proper equipment selection, and estimate exposures. Surveys and bioassays, as appropriate, will be performed to evaluate actual intakes. Respirators will be tested for operability immediately prior to each use. Written procedures will be available regarding selection, fitting, issuance, maintenance, medical testing and testing of respirators (including testing for operability prior to each use), supervision and training of personnel, monitoring (including air sampling and bioassays), and recordkeeping.

Radioactive Contamination Control

The best way to control the spread of radioactive contamination is to prevent it from occurring. However, in virtually any environment, this is impossible. Therefore, the next best solution is to delineate and enforce boundaries beyond which contamination will not be permitted. Access should be limited to as few points as possible to minimize the possibility of undetected contamination being carried out of the area. These boundaries should enclose the smallest area possible and should be monitored to ensure that no contamination can escape. Monitoring should include, but not be limited to, surveys of all personnel and equipment entering and leaving the contaminated areas, the entry and exit areas, and any boundaries that are not solid (i.e. any rope boundaries, turnstiles, gates, doorways, etc.).

At the entrance points, it is also helpful to have a buffer zone with a step-off pad that will allow personnel entering and exiting the contaminated area a place to don or to remove anti-contamination (Anti-C) clothing and to frisk themselves for contamination before their entrance or exit. This buffer zone should be surveyed frequently to ensure that it is maintained contamination-free. If this area is the only egress from the contaminated area, and it is clean, then the likelihood that contamination will spread beyond that point is remote.

The boundaries of entry points to any contaminated area should be clearly marked and posted with the requirements for entry. This may include Anti-C clothing, respirators, or only protective gloves (PPE). There should also be a supply of the proper clothing available at the entrance to the area and waste cans in which to dispose of the clothing upon exiting. Finally, there should be a person present in the vicinity of the entrance/exit point to ensure that proper frisking and logging is performed and to deal with any problems that may arise.

Much of radiological contamination control is similar to chemical contamination control. The best way to prevent personal contamination is to avoid coming in contact with any source of contamination. If this is not possible, then one should carefully dress in Anti-C clothing that is appropriate for the nature and amount of contamination that is present. Upon exiting an area, one should remove any of the potentially-contaminated clothing and perform a personal survey to ensure that there was no leakage of contamination past the protective clothing. Anything that comes in contact with a piece of contaminated material such as the ground, a fence, a truck tire, an excavator bucket, etc., should be treated as contaminated and either left in the contaminated area, placed in a bag to prevent the spread of contamination from that object to other areas, or decontaminated and removed from the area.

Some additional Guidance for contamination control has been provided by the US NRC (Nuclear Regulatory Commission); e.g., IE Circular No. 81-07: Control of Radioactively Contaminated Material". Excerpts relevant to this Project are shown below. Items and material should not be removed from the restricted area until they have been surveyed or evaluated for potential radioactive contamination by a qualified* individual. Personal effects (e.g., notebooks, tools, flashlights, etc.) which are hand carried need not be subjected to the qualified individual survey or evaluation, but these items should be subjected to the same survey requirements as the individual possessing the items. Contaminated or radioactive items and materials must be controlled, contained, handled, used, and transferred in accordance with applicable regulations.

The contamination monitoring using portable survey instruments or laboratory measurements should be performed with instrumentation and techniques (survey scanning speed, counting times, background radiation levels) necessary to detect 5000 dpm/100 cm2 total and 1000 dpm/100 cm2 removable beta/gamma contamination. Instruments should be calibrated with radiation sources having consistent energy spectrum and instrument response with the radio nuclides being measured. If alpha contamination is suspected appropriate surveys and/or laboratory measurements capable of detecting 100 dpm/100 cm2 fixed and 20 dpm/100 cm2 removable alpha activities should be performed.

A qualified individual is defined as a person meeting the radiation protection technician qualifications of Regulatory Guide 1.8, Rev. 1, which endorses ANSI N18.1, 1971.

In evaluating the radioactivity on inaccessible surfaces (e.g., pipes, drain lines, and duct work), measurements at other appropriate access points may be used for evaluating contamination provided the contamination levels at the accessible locations can be demonstrated to be representative of the potential contamination at the inaccessible surfaces. Otherwise, the material should not be released for unrestricted use.

Federal, State, and Municipal regulations for the control of radioactive contamination shall be considered and followed as a part of GRD's procedures. GRD shall employ the following methods / procedures for contamination control:

- All areas identified as containing radioactive contaminants shall be surrounded by posting ropes.
- Buffer areas will be identified per RWPs.
- Access and egress logs shall be kept. Workers shall initial the logs upon entrance and exit and will be frisked appropriately at egress points.
- Workers shall sign the RWP to acknowledge that each worker has read and understands the radiological conditions, PPE that they will wear, and will follow any special instructions stated in the RWP.
- PPE shall be worn per the approved RWP.
- Conditional release surveys on equipment that will remain on site shall be conducted on a weekly basis and the results documented.
- Unconditional release surveys of equipment to be leaving the site shall be performed and documented in accordance with the Section 2.2 guideline in DOE 10CFR 835.
- Materials will be bagged and appropriately tagged.
- Laydown areas will be established and appropriately posted.
- Laydown areas will have a plastic underlayment on the ground for material to lay on; such contaminated material will be covered at all times.
- Contaminated material will be placed in lined trucks and transported to laydown areas; no posting on trucks will be required at the job site.
- A bag at the egress will be in place where all PPE shall be deposited.

  Excavators or equipment used in controlled areas that have contamination above release criteria will either have to stay in controlled area or be decontaminated by established procedures. The decontamination method that is most effective and efficient on excavator buckets and tires is water-based washing, which is performed in a controlled area. After washing and drying, the equipment is then surveyed and the results documented. If the ground is contaminated during such operations, contaminated material / soil will be contained and captured.
- Any contaminants arising from a decontamination operation with be captured and contained.
- Unloading of contaminated material at laydown areas will require the presence of a radiation technician to ensure truck and other equipment tires are free of contamination and that all postings are returned to their original locations, so that areas remain controlled.
- Radiation technicians will control the course of excavations and can serve as a posting in some cases.
- Continuous radiation-monitoring coverage and intermittent coverage will be provided by technicians, depending on job situations and conformance with the RWP.
- Buffer areas always will accompany contamination areas.
- Conditional release surveys will be performed when equipment, tools, or machinery are leaving controlled areas / contamination and will be remaining on site.
- Unconditional release surveys will be performed for material or equipment leaving the Project site.

- Contaminated material will be placed in lined trucks and covered if transported on public roads.

Fugitive Dust Control

General

It should be the responsibility of the excavation and construction contractor to provide fugitive dust emissions control at the job site. Some suggested control measures, such as the erection of screens/barriers/enclosures, covers on piles, covers on trucks, water sprays, latex- binder sprays, and chemical conditioning. Such control measures can be found in US EPA Document EPA/540/2-85/003, Nov 1985, "Dust Control at Hazardous Waste Sites".
GRD will be responsible for the monitoring of dust for radiation. GRD will control dust stirring and emissions by its monitoring personnel by appropriate measures.

Merani Responsibility

Regulations call for the demolition contractor to prepare a Fugitive Dust Suppression Plan coupled with a Community Air Monitoring Program. Elements of this submittal will be consistent the NYSDOH Generic Community Air Monitoring Plan. The elements of this submittal should include:

- Description of dust suppression techniques to be employed during site activities including excavation, demolition and earthwork.
- Description of particulate monitoring techniques and frequency, instrumentation and analytical methods.
- Location of monitoring points.
- Record keeping of meteorological data.
- Action levels, corrective actions, and stop work levels.
- Quality Assurance / Quality Control Plan.
- Demolition, Excavation, and Construction Work Plans
- Identification of the qualified professional who prepared the plan.

During construction of the Project, water or other dust-suppression substances approved by local, state and federal regulators will be used to control dust along public roads as well as Project access roads as needed throughout the duration of construction activities. Globe and its contractors will require reduced vehicle speed on unpaved roads. The enforcement of reduced vehicular speed within the Project boundary will reduce the amount of fugitive dust that would be generated by passing construction traffic.

Instrumentation

GRD's suite of instruments includes personnel dosimeters, radiation survey meters, alpha/gamma detectors, and sample counting meters. Specific instruments include:

Ludlum 2221 w/44-10 Gamma detector Ludlum M-12w/44-9 Beta-gamma frisker Ludlum M-12 Alpha frisker
Ludlum M-19 Gamma dose rate meter
Ludlum 2360 w/43-89 Alpha-beta frisk
Ludlum M-12w/43-5 Alpha frisker
Ludlum 2241w/w44-38 Beta /Gamma dose rate meter
Ludlum 2929w/43-10-1 Alpha-beta-gamma smear & filter counter
Ludlum 2221w/44-1 Gamma detector with Trimble GPS.

Table 1 lists further details about these instruments.

Table 1: GRD Radiation Detection Instruments

Type	Number Available	Radiation Detected	Sensitivity Range	Use
Gamma detector	5	Gamma	0-500 kcpm	Gamma-walkover surveys.
Gamma detector with GPS	1	Gamma	0-500 kcpm	Gamma-walkover surveys, using GPS.
Beta-gamma frisker	2	Beta, gamma	0-500 kcpm	Personal frisking; field surveys.
Gamma dose rate meter	1	Gamma	0-5 mR/hr	Surveys
Alpha Beta frisker	2	Alpha, beta	0-500 kcpm	Personal frisking, field surveys.
Alpha frisker	2	Alpha	0-500 kcpm	Personal frisking, field surveys.
Beta /Gamma dose rate meter	1	Beta, gamma	0-200 mR/hr	Surveys.
Alpha-beta-gamma counter	1	Alpha, beta, gamma	0-9,999,999 cpm	Smear & filter counting.

Instrument calibrations will be performed by a commercial calibration service and calibrations will be performed by persons licensed to perform such services by the US Nuclear Regulatory Commission or an Agreement State. A copy of this license will be kept on file with calibration certificates. GRD will do no in-house calibrations. However, GRD will source-check instruments

before use (with radiation-permit exempt sources). GRD, Inc. will require that the calibration service follow the guidance and documentation provided in Appendix B of New York State Radiation Guide 1.7 (July 2006) and provide the appropriate Survey Meter Calibration Reports. GRD will employ radiation-permit-exempt 'check sources' to check / verify the operation of survey meters / instruments whenever such devices are used. Check sources are Tc-99, Cs-137, and Po-210.

Calibration Report

Calibration reports from the commercial service will adhere to the documentation provided in Appendix B of New York State Radiation Guide 1.7 (July 2006).

Contamination Release Limits

Radiological contamination survey, documentation, and labeling requirements will be established for all property / material released from an RCA (Radiation Control Area). All equipment, materials, and property used in an RCA established for contamination control will be considered as potentially contaminated and will not be released to an uncontrolled or unrestricted area until they have been surveyed and meet criteria established by the RSO.

Excavation and Management of Soils

General

GRD will be responsible for providing radiation health and safety support to in-field operations to ensure that workers and the general public are adequately protected from radiation hazards. Such work includes close support for construction and utility workers, radioactive air monitoring, and surveys of excavated / removed material, stored materials, equipment, and materials and equipment to be taken offsite. GRD will prepare its own radiation work permits, health and safety plans, and standard operating procedures. Merani or its chosen contractors shall be responsible for preparing such permits and plans for their respective work topics.

Radiological (rad) removal work surveys, monitoring, and decontamination shall be performed under the direct supervision of GRD personnel in conformance with GRD's Site-Specific Radiological Safety Plan. Such a plan shall be approved by the NYSDEC and the NYSDOH (e-mail correspondence is sufficient).

Radiation Field Screening Procedures Radiation Surveys

Radiological monitoring and surveys of radiation exposure levels, contamination, and airborne radioactivity will be conducted to:

- Characterize workplace conditions and detect changes in those conditions;
- Verify the effectiveness of physical design features, engineering and process controls, and administrative control procedures,
- Demonstrate regulatory compliance;
- Detect the gradual buildup of radioactive material;
- Identify and control potential sources of personnel exposure; and
- Identify areas requiring postings.
- Monitoring will be performed only by trained and qualified personnel and will be conducted as specified by the project RSO.
- Minimally, radiological surveys will be conducted. Once per shift at entrance or exit points, between contamination areas and clean areas; Daily in RCAs; Weekly in radiation and / or contamination areas; and Weekly in clean areas.

The radiological field measurements will be performed throughout the project. The surveys will focus on the primary radiological contaminants of concern. A gamma scan of the soils surrounding Project excavation activities (out to 15 meters beyond the work area) will be performed to document the status prior to and following groundbreaking/excavation. Radiation detection and measurement instrumentation will be selected based on the type and quantity of radiation to be measured. The instruments used for direct measurements will be capable of detecting the radiation of concern to minimum detectable concentrations (MDCs). The instrumentation to be used by the GRD project team is provided in Table 1. Scan MDCs for various radionuclides are listed in NUREG-1507, Table 6.4 for a scan speed of approximately 1 meter per second. The radionuclides that will be measured are primarily natural uranium and Ra-NUREG -1507, Table 6.4 in the subject reference lists scan MDCs for a 2"×2" NaI(Tl) scintillation detector of 80 and 2.8 picocuries per gram (pCi/g) for natural uranium and Ra-226, respectively. Daily instrument quality control (QC) checks will be documented and performed before and after each day's work.

Static alpha, static alpha + beta, removable alpha, removable beta, and direct gamma exposure rate measurements will be carried out periodically. Instrumentation will be the same instrument types that will be used during pre-excavation surveys. More than one survey instrument will be used for static alpha, and static alpha + beta measurements. Approximately two to four separate areas encompassing excavation paths will be selected and within each area two to four measurements of each (static alpha, static alpha + beta, removable alpha, removable beta, and gamma exposure) will be obtained at unique locations within the area. It is expected that static measurement count times will be about one minute each unless otherwise directed by the RSO to achieve lower detection limits. Soil samples should be collected at three locations and analyzed to determine the concentrations of naturally occurring radionuclide (U-234, U-235, U-238, Ra- 226, Th- 230, Th-232, and Th-228).

Gamma scans will be performed on areas out to 15 meters beyond the work area to establish the existing radiological conditions. This data will establish the comparison for post-surveys to insure excavation activities do not radiologically contaminate other areas and to prevent contamination from outside areas from contaminating the excavation debris. Gamma scans of the areas will be performed using a 2"x 2" NaI (Tl) detector (Ludlum Model 44-10 detector or equivalent) with a 2350-1 data logger or equivalent. Surveys will be performed moving the detector in a serpentine pattern at a speed of no greater than 1 meter per second, covering at least 50% of the area. The surveys will identify posted areas and areas of elevated radioactivity in the soils.

Radiation-Related Air Sampling

General area and personal air sampling (if required) will be conducted in accordance with the guidance in NRC Regulatory Guide 8.25. Air sampling will be employed when necessary to determine whether confinement or suppression of radioactive material is effective, to determine required workplace administrative controls, to estimate worker intakes, and to determine what personal protective equipment (PPE) is appropriate.

General area and/or perimeter air sampling for airborne radioactivity will be conducted with low-volume air samplers F and J Model LV-1 or equivalent (0-100 1pm). The low-volume samplers will use 47mm filters and will be counted on a Ludlum model 2929 sample counter or equivalent, for alpha and beta immediately to determine any excessive levels. The filters will be changed daily. Following a 5 day hold time for radon decay, where the potential for airborne radioactivity is above background levels, the sample will be counted again to determine the actual activity without radon progeny contribution.

High-volume air samplers are those with sufficient flow rate to achieve a minimum detectable activity (MDA) of 10% of the applicable DAC in an 8-hour shift. Air sample filters will be analyzed on site for gross alpha and gross beta in accordance with written procedures. In work

zones with a potential for short-term airborne excursions, representative breathing zone samples will be collected in the immediate vicinity of work being performed to determine whether the area is an airborne radioactivity area requiring additional work controls or to assess the worker's intake of airborne radioactive materials. When required to estimate worker intakes, representative personal air sampling from a member of each field team working in radiologically contaminated areas will be conducted for airborne radioactivity in the breathing zone. The data will be compared with the DACs that are the most conservative for the contaminant(s) expected to be present to gauge employee exposure potential. DACs for radioactive contaminants in Appendix B to 10 NYCRR 16 will be used to assess exposure potentials, as appropriate.

Segregation and Transport of Radiologically Contaminated Materials

Excavated soil will be examined/monitored in the field by GRD personnel for radioactive contamination. Radioactively contaminated soil shall be placed in a temporary laydown area for storage and further monitoring. Merani or other contractor personnel will examine excavated or stored soil/materials for other potential contamination (e.g., chemicals). An on-site competent person will evaluate soil intended for off-site reuse for consistency with regulations. "Clean" excavated soil will be temporarily staged for characterization, if necessary.
It is currently anticipated that affected soil may be live-loaded (after appropriate screening) into vehicles for transport and disposal (or reuse) off site, presuming approval is previously received from the facility accepting the waste.

A separate Transportation and Disposal Plan will be prepared by GRD for the subject Project. The Transportation and Disposal Plan purpose is to aid the assigned project staff in performing transportation related work, assuring that compliance with motor carrier, federal, state and local regulations are understood and adhered to applicable transportation activities performed by employees and lower tier subcontractors. The project team shall implement the Transportation and Disposal Plan in accordance with existing procedures to ensure that the transportation of hazardous materials on-site and off-site is performed in accordance with applicable federal, state and local rules and regulations.

Unless otherwise indicated, the following codes, standards, laws, and regulations establish the minimum requirements for transportation-related work:

- 10 CPR 830- Nuclear Safety Management
- 10 CFR 835- Occupational Radiation Protection
- ICAO/IATA- Dangerous Goods Regulations
- ISO 9001- Quality Management Standard
- FMCSR- Federal Motor Carrier Safety Regulations
- NYCRR- New York Codes, Rules, Regulations
- TDEC Rule 1200-1-7
- Title 29 CFR 1910- Occupational Safety and Health Standards
- Title 40 CFR 61, 262-263 and 700-789
- Title 49 CFR, 100-185, 325 and 355-399

Radiologically Contaminated Material Staging Area

Prior to the start of any excavation or Site clearing work, a subsurface clearance review of the Site will be conducted. Support facilities including an equipment/vehicle decontamination pad and equipment staging areas will be prepared at the Site. Additionally, staging areas for the temporary storage of excavated "clean" soil, or any affected soil that will not be live-loaded for off-site transport and disposal, will be constructed adjacent to excavation areas. Soil staging areas will be constructed with a double layer of 6-mil polyethylene sheeting bermed at the sides with hay bales or equivalent material of similar mass and shape. Staged excavated soil will be covered at the end of each work day and during moderate or heavy precipitation events. These facilities will meet the requirements established in the RHASP for the Exclusion Zone, "Clean" excavated soil will be temporarily staged for characterization, if necessary.

It is currently anticipated that affected soil may be live-loaded (after appropriate screening) into vehicles for transport and disposal (or reuse) off site, presuming approval is previously received from the facility accepting the waste.

Decontamination of Equipment

Equipment decontamination area(s) will be established at predetermined locations as required. These areas will be available for the cleaning of light and heavy equipment (tracked construction equipment, vehicles, etc.) used during radiological excavation and remediation activities. In- place cleaning may include rinsing and/or dry, gross cleaning. If wet decontamination methods are used, water will be captured and containerized for characterization and disposal. All equipment will be evaluated for removable radioactive contamination before leaving the facility.

Equipment will not be demobilized from the Site until it has satisfied an outbound radiological survey and is free released. Once completed, the equipment and support materials can be returned to the rental company or shop location as appropriate.

Surface contamination levels presented in Table 2 will be used to determine if a piece of equipment is contaminated with radioactive materials. When decontamination is necessary, decontamination will be performed using techniques that are appropriate based on site-specific conditions. Generally, dry decontamination methods such as high-efficiency particulate air (1-1EPA) vacuuming or wipe-downs are preferred when facilities for the collection of radiological contaminated wastewater are not in place. If adequate facilities exist for the collection of such fluids, it may be appropriate to use a wet decontamination technique. Additional decontamination methods in extreme conditions include sand or abrasive blasting. Specific decontamination procedures and requirements shall be made under the direction of the RSO.

Emergency and Abnormal Event Guidelines

Details on the site-specific radiological emergency procedures are provided in the RHASP. All site personnel will be instructed in their emergency responsibilities and the emergency procedures. An emergency hospital is identified in the RHASP and maps to this facility are readily available. Merani/site contractors will require their own HASP, with included emergency procedures. Both HASPS shall be shared with all personnel.

Radiological Documentation

GRD shall only be responsible for records pertaining to radiation surveys, monitoring, individual exposures, and limited decontamination of excavated material. Records associated

with radiation surveys and measurements performed to support activities associated with D&D of a site and equipment are:

- Name of the person making the evaluation and recording the results;
- Date of the survey;
- Instrument serial number used for surveys and measurements;
- Results obtained: and
- Applicable review.

Records for Individuals

GRD will record contamination levels observed and procedures followed for incidents involving contamination of individuals. The record should include name of individuals involved, description of work activities, calculated dose, probable causes (including root causes), steps taken to reduce future incidents of contamination, times and dates, and the surveyor's signature. Records to be maintained include the following (as available):

- Doses received by individuals, for whom monitoring was required during previous employment.
- Doses received by individuals for whom monitoring was required:
- Dose assessments for individuals for whom bioassay was performed:
- Doses to the embryo/fetus of a declared pregnant employee:
- Written declarations of pregnancy;
- Written withdrawal of declaration of pregnancy.

RSP records will be maintained to document compliance with regulatory requirements and the exercise of due diligence in the control of radiological hazards for the protection of employees, members of the public, and the environment. These records will be transferred to the project file at the conclusion of the project.

Screened Material Records

During field screening of material, all results will be documented in a GRD daily log. Results will then be inputed into a computer generated GRD radiological survey form.

Excavation Actions Records

GRD shall only be responsible for records of radiation surveys, monitoring, and limited decontamination of excavated material. Excavation activities will be documented on a GRD daily log, Results will then be inputted into a computer generated GRD radiological survey form, which includes a map of areas of excavation and activity for all materials.
Radiological surveys will be documented on a survey map with areas of elevated (greater than two times the area background) exposure rates (or count rates) clearly marked. Areas of elevated activity will be reviewed by the RSO.

Training Records

All GRD employees and anyone working in contaminated areas, must have an 8-hour. radiation worker class. At the end of training, a test will be administered, the results of which will be kept on file. A certificate issued upon completion of training. (test /training approved by NYDOH)

Equipment Decontamination Records

All equipment to be used in contaminated areas will be documented on an incoming GRD survey form. All outgoing equipment will be surveyed and documented in the same manner. Equipment requiring decontamination will have a pre- decontamination survey performed. A post decontamination survey will also be documented.

Training Outline

Training in radiation protection will be under the aegis of Greater Radiological Dimensions, LLC of Lewiston, NY. GRD, Inc. confirms that it will follow the model procedure for training and instruction that is shown in Appendix A of the New York State Department of Health Radiation Guide 1.7 (July 2006). An outline of key GRD training is summarized below. Periodic radiological safety training is necessary to ensure that all individuals understand the general and specific radiological hazards, their responsibility to GRD, Inc. and the public for safe handling of radioactive materials, and to maintain their individual radiation exposure ALARA. The appropriate degree of training for each individual will be established based on the nature of the job assignment (i.e. the location where the work will be performed, the hazards associated with that particular area, and the methods used to perform the work). Workers will be categorized as General Workers (those who do not frequent the Controlled Radiation Zone (CRZ) and typically do not work with radiation or radioactive materials), or Radiation Workers (those who do). General Workers will not have unescorted access to the CRZ. Visitors may be exempted from training requirements provided that he/she is escorted, has received a safety briefing, and has written authorization from the RSO or designee.Each worker who is categorized as a Radiation Worker will receive a minimum of 8 hours classroom training prior to initial assignment if they have no prior experience in equivalent radiological work. The purpose of the training is to teach proper methods for working with radiation and handling radioactive materials, to discuss the effects of radiation to explain the risks of occupational exposure, and to identify the specific hazards associated with the operations to be conducted.

The following topics will be covered:

Radioactive materials and radiation;
Biological effects of radiation;
Risks of occupational exposure;
Exposure limits;
ALARA, minimizing exposure (time distance, and shielding);
Personnel dosimetry;
Protective clothing and equipment (PPE);
Radiation detection — operation, calibration, and use;
Contamination control;
Decontamination;
Responsibilities of radiation workers;
Federal and State Regulations and License provisions for the protection of personnel from radiation and radioactive material;
Emergency response;
Radiation exposure reports available to workers;
Respiratory protection program;
Radiation work permits (RWPs).

Workers with documented prior radiological work experience need receive only as much training as is necessary to ensure a level of competence comparable with trained workers.
Reciprocity will be established with radiation worker qualification through other nuclear facility training programs. Qualifications of the trainer shall be a minimum of five (5) years operational radiation protection experience plus 40 hours of formal training in radiation protection. The training session is followed by a written test which must be passed (80% pass rate) before unescorted access is allowed to the RCA. Records of required training are maintained in each worker's file. The RSO may authorize individuals to challenge any training requirement and demonstrate the requisite level of knowledge in radiation safety by successfully completing a written exam and demonstration of practical factors. Hands-on training should be used for newly trained individuals without prior radiation work experience to ensure understanding and proficiency in radiation safety practices.

Quality Control (QC)

QC measures shall be conducted and documented, ensure specifications and requirements are being met, and review and approve any additional procedures or plans required, and training records. Health & Safety Training Certificates and proof of medical certifications as described in reference (a) will be provided for all GRD employees and Benchmark Turnkey and its subcontractors to upon request.

Glossary of Terms

Absorbed Dose (D) – Energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. The units of absorbed dose are the rad and the gray (Gy).

Airborne Radioactivity Area – Area where the measured concentration of airborne radioactivity above natural background exceeds a peak concentration of 1 derived air concentration (DAC) or 12 DAC-hours during the hours a worker is present during one week.
Any discarded material that is not recycled and does not meet the definition of a hazardous waste, as defined in 40 CFR 261. A subset of non-hazardous waste includes Special Waste.

As Low As Reasonably Achievable (ALARA) – An approach to radiological control or a process to manage and control exposures to the work force and to the general public at levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations.

Bioassay – Measurement of radioactive material deposited within or excreted from the body. This process may include whole body and organ counting as well as collection of urine and fecal samples. Contaminated Area – An area in which radioactive contamination is present that exceeds removable levels presented in Table 3.

Committed Dose Equivalent (HT,50) – The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by a person during the 50-year period following the intake.

Committed Effective Dose Equivalent (HE,50) – The sum of the products of the weighting factors

applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50}=\Sigma w_T x H_{T,50}$).

Controlled Area – An area to which access is controlled in order to protect personnel from exposure to radiation and radioactive materials. An area in which the existing or potential radiation and radioactivity levels are above normal background but are less than that designating a radiological area or a restricted area.

Derived Air Concentration (DAC) – The concentration of a radionuclide in air that, if breathed over the period of a work year (2000 hours), would result in the annual limit on intake being reached.

Disintegration per Minute (dpm) – The rate of emission by radioactive material as determined by correcting the counts per minute observed by a detector for background, efficiency, and counting geometry associated with the instrument.

Dose – A generic term for the amount of energy deposited in body tissue due to radiation exposure. Technical definitions for dose terms necessary for various exposure calculations and recordkeeping purposes include the following:

Dose Equivalent (HT) – The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and Sievert (Sv).

Effective Dose Equivalent (HE) – The sum of the products of the dose equivalent to the organ or tissue (HT) and the weighting factors (WT) applicable to each of the body organs or tissues that are irradiated (HE = SWT x HT) and the committed dose equivalent to an individual organ or tissue (for internal exposures).

Fixed Contamination – Radioactive material that cannot readily be removed from surfaces by nondestructive means such as causal contact, wiping, brushing, or washing.

Frisking – Process of monitoring personnel for contamination.

GRD – Greater Radiological Dimensions, Inc.

Hazardous Material – A substance or material that the DOT has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and is designated as hazardous under Section 5103 of Federal Hazardous Materials Transportation Law (49 U.S.C. 5103). The term includes temperature sensitive materials, materials designated as Hazardous in the Hazardous Materials Table (see 49 CFR 172.101), and materials that meet the defining criteria for hazard classes and divisions in part 173 of subchapter C of this chapter.
Hazardous Waste – A waste that exhibits one or more of the characteristics of hazardous waste in 40 CFR 26I , Subpart D.

Hazardous Work Permit (HWP) – Permit that identifies Hazardous conditions and health and safety hazards, establishes worker protection and monitoring requirements, and also contains specific approvals for radiological work activities. The HWP serves as an administrative process for planning and controlling radiological work where a Hazardous and informing the worker of the radiological, health, and safety issues.

Health Physics – The practice of radiological protection or radiation safety.

HASP – Health and Safety Plan. A plan included in investigation or cleanup work plans which outlines protective measures for site workers and the community during investigation or cleanup activities

High Radiation Area – An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent to or in excess of 100 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

IRM – Interim Remedial Measures, An IRM is a discrete set of planned actions for both emergency and non-emergency situations that can be conducted without the extensive investigation and evaluation of a Remedial Investigation / Feasibility Study (RI / FS).

Internal Dose – The portion of the dose equivalent received from radioactive material taken into the body.

Low-Level Radioactive Waste – A radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, byproduct material [as defined in Section 1 le.(2) of the Atomic Energy Act of 1954, as amended], or naturally occurring radioactive material (including technically enhanced naturally occurring radioactive material (TENORM)). [Adapted from Nuclear Waste Policy Act of 1982, as amended]

Material – Refers to anything being moved, removed or transported. This includes, but is not limited to, chemical and / or radiological contaminated materials, discarded material, equipment, material to be recycled, supplies, samples, and / or waste.

Occupational Dose – The dose received by a person during employment in which the person's assigned duties involve exposure to radiation and to radioactive material. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research plans, or as a member of the public.

Optically Stimulated Luminescence Dosimeter (OSL) – Radiation detection and measuring device used to record the radiological exposure of personnel or area to certain types of radiation.

Personnel Dosimetry – Devices designed to be worn by a single person for the assessment of dose equivalent such as film badges, optically stimulated luminescence dosimeters, thermoluminescent dosimeters, and pocket ionization chambers.

Personnel Monitoring – Systematic and periodic estimate of radiation dose received by personnel during work hours.

Qualified Shipper – Personnel or subcontractor qualified to identify and classify material, determine packaging requirements, complete shipping papers and perform pre-shipment reviews. The minimum qualifications for the qualified shipper is at least three (3) years of experience in hazardous materials shipping activities with advanced training in transportation covering air, highway, and rail shipment of hazardous materials, and including radioactive materials, hazardous waste and mixed waste.

QC – Quality Control. Quality control is a process by which entities review the quality of all factors involved in a project or production operation.

Radiation – Ionizing radiation that includes alpha particulate, beta particulate, X-rays, gamma

rays, neutrons, and other particulates capable of producing ions.

Radiation Area – An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent or in excess of 5 mrem in 1 hour at 30 cm from the source of radiation or from any surface that the radiation penetrates.

Radioactive Material Area – A controlled area or structure where radioactive material is used, handled, or stored.

Radioactive Waste – Any garbage, refuse, sludge, and other discarded material, including solid, liquid, semisolid, or contained gaseous material, that must be managed for its radioactive content.

Radiological Controlled Areas (RCA)- Includes Radioactive Materials Areas, Radiation Areas, Contamination Areas, or Airborne Radioactivity Areas.

Radiological Work Permit (RWP) – Permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The RWP serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological, health and safety issues.

Radiological Worker – Worker whose job assignment requires work on, with, or in the proximity of radiation-producing machines or radioactive materials. A radiological worker has the potential of being exposed to more than 100 mrem per year, which is the sum of the dose equivalent from external irradiation and the committed effective dose equivalent from internal irradiation.

Record – A completed document or other media that provides objective evidence of an item, service, or process.

Recyclable Material – A material that can be used, reused, or reclaimed. A material is used or reused if it is either: I) employed as an ingredient (including use as an intermediate) in an industrial process to make a product: or 2) employed as a substitute for a commercial product. A material is reclaimed if it is processed to recover a useable product or if it is regenerated *Removable*

Contamination – Radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.

SOP - Standard Operating Procedure. A prescribed procedure to be followed routinely; usually containing work-specific instructions and / or rules.

Special Waste – A waste that is difficult or dangerous to manage and may include bulky or industrial waste.

Survey – An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other source of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Total Effective Dose Equivalent (TEDE) – The sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Total Organ Dose Equivalent (TODE) – The sum of the deep dose equivalent (for external

Transportation-Related Work – Includes, but is not limited to, identifying, classifying, containerizing, marking, labeling, placarding, preparing shipping papers, offering for shipment, or transporting materials as a result of work performed pursuant to this project.

Unrestricted Area – An area designated by the Nuclear Regulatory Commission (NRC) or Agreement State as being an area to which access is neither limited nor controlled by an NRC or Agreement State licensee.

Waste Acceptance Criteria – The technical and administrative requirements that a waste must meet to be accepted at a storage, treatment or disposal facility.

References

NYS Radiation Material Handling License # C5514, issued to Greater Radiological Dimensions, Inc., March 21, 2012.
10 CPR 830- Nuclear Safety Management
10 CFR 835- Occupational Radiation Protection
ICAO/IATA- Dangerous Goods Regulations
ISO 9001- Quality Management Standard
FMCSR- Federal Motor Carrier Safety Regulations
NYCRR- New York Codes, Rules, Regulations
TDEC Rule 1200-1-7
Title 29 CFR 1910- Occupational Safety and Health Standards
Title 40 CFR 61, 262-263 and 700-789
Title 49 CFR, 100-185, 325 and 355-399

Project Personnel Contact Information

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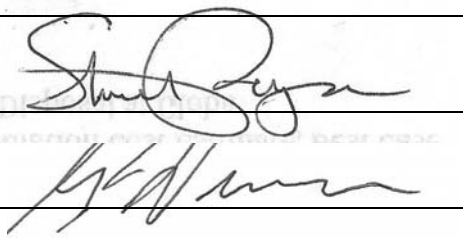
Greater Radiological Dimensions, Inc. 1527 Ridge Road Lewiston, NY 14092	Document: GRD-TI-001
LOCATION: 401 , 402 , 430 BUFFALO AVENUE Site **Niagara Falls, New York BCP Site No. C932164**	

RADIOLOGICAL SAFETY PLAN

Prepared By	**Stuart Pryce** **Project Manager / Sr. Technician**	
Approved By:	**George Weissenburger** **Program Manager / Sr. Technician**	

1. Scope

1.1. Purpose

This document establishes the basis for the radiological controls to be implemented during the performance of work at any client's facility. Operations are subject to the conditions of the applicable Radioactive Materials License and the requirements of applicable regulations. The requirements and guidelines in this document were developed to ensure workers are afforded a safe work environment, to provide a compliant Radiation Protection Program, and to maintain occupational and environmental exposure to ionizing radiation "As Low As Reasonably Achievable" (ALARA).

1.2. Applicability

This document applies to all GRD, Inc. employees, contractors, subcontractors, and visitors at any licensed facility or job site.

1.3. Policy

GRD, Inc. places its highest priority on ensuring the safety and health of its employees and neighbors and protecting the environment. This priority extends to all areas affected by site operations. GRD, Inc. is committed at all levels to implementing a Radiation Protection Program based on the highest standards.

1.4. Responsibilities

1.4.1 The Radiation Safety Officer (RSO) is responsible for ensuring compliance with this Plan, associated procedures, and GRD, Inc. Radioactive Materials License. He has the authority to direct all aspects of the Radiation Protection Program and to ensure compliance with required regulations. The RSO is organizationally independent from operations and has the authority and responsibility to stop any activity which is not conducted in a safe manner or in compliance with the license, applicable regulations, and procedures.

1.4.2 Radiological Safety Technicians (RST) are responsible for determining, by sampling and measurement, compliance with this document. An RST has the authority to stop work if he/she suspects the initiation or continuation of the activity will result in either imminent danger to a worker or a violation of program requirements.

1.4.3 All site personnel are responsible for compliance with the requirements of the Radiation Protection Program and implementation procedures. All personnel have the responsibility and authority to stop work through their supervisor if considered unsafe.

1.5. Quality Assurance

1.5.1 Periodic audits (at least annually) of the Radiation Protection Program will be made during the course of operations to ensure compliance with this document. Audit schedules for individual activities will be identified considering the ALARA, regulatory, and safety reviews in accordance with implementing procedures.

1.5.2 Key elements of Quality Assurance include:

- Conducting Pre-construction quality control meetings
- Performance of daily quality control checks;
- Daily inspection of site, materials, equipment and construction progress;
- Conduct process and materials audits and quality control tests;
- Tracking and documentation of performance versus standards;
- Development of corrective actions;
- Provision of continuing support;
- Maintain "as-built" drawings current with field changes

1.6. Implementation

The provisions of this document will be implemented through radiological safety procedures. These procedures are working documents and will be updated and modified as changes in facilities, equipment, regulations and conditions change.

2. Worker Training In Radiation Protection

2.1. Radiological Safety Training Requirements

2.1.1 Periodic radiological safety training is necessary to ensure that all individuals understand the general and specific radiological hazards, their responsibility to GRD, Inc. and the public for safe handling of radioactive materials, and to maintain their individual radiation exposure ALARA.

2.1.2 The appropriate degree of training for each individual will be established based on the nature of the job assignment (i.e. the location where the work will be performed, the hazards associated with that particular area, and the methods used to perform the work). Workers will be categorized as General Workers (those who do not frequent the Controlled Radiation Zone (CRZ) and typically do not work with radiation or radioactive materials), or Radiation Workers (those who do). General Workers will not have unescorted access to the CRZ. Visitors may be exempted from training requirements provided that he/she is escorted, has received a safety briefing, and has written authorization from the RSO or designee.

2.2. Basic Radiological Safety Training

2.2.1 Each worker who is categorized as a Radiation Worker will receive a minimum of 8 hours classroom training prior to initial assignment if they have no prior experience in equivalent radiological work. The purpose of the training is to teach proper methods for working with radiation and handling radioactive materials, to discuss the effects of radiation to explain the risks of occupational exposure, and to identify the specific hazards associated with the operations to be conducted.

2.2.2 The following topics will be covered:

- Radioactive materials and radiation;
- Biological effects of radiation;
- Risks of occupational exposure;
- Exposure limits;
- ALARA, minimizing exposure (time distance, and shielding);
- Personnel dosimetry;
- Protective clothing and equipment (PPE);
- Radiation detection - operation, calibration, and use;
- Contamination control;
- Decontamination;
- Responsibilities of radiation workers;
- Federal and State Regulations and License provisions for the protection of
- Personnel from radiation and radioactive material;
- Emergency response;
- Radiation exposure reports available to workers;
- Respiratory protection program;
- Radiation work permits (RWPs).

2.2.3 Workers with documented prior radiological work experience need receive only as much training as is necessary to ensure a level of competence comparable with trained workers. Reciprocity will be established with radiation worker qualification through other nuclear facility training programs. Qualifications of the trainer shall be a minimum of five (5) years operational radiation protection experience plus 40 hours of formal training in radiation protection. The training session is followed by a written test which must be passed (80% pass rate) before unescorted access is allowed to the RCA. Records of required training are

maintained in each worker's file. The RSO may authorize individuals to challenge any training requirement and demonstrate the requisite level of knowledge in radiation safety by successfully completing a written exam and demonstration of practical factors. Hands-on training should be used for newly trained individuals without prior radiation work experience to ensure understanding and proficiency in radiation safety practices.

3. Radiation Surveys

3.1. General

3.1.1 Radiation surveys are performed as necessary to ensure personnel do not exceed radiation exposure limits and to meet requirements for posting Radiation, High Radiation, and Very High Radiation Areas. These surveys are performed to determine whether abnormal radiation levels exist and to determine the extent and magnitude of radiation levels. The surveys in this section shall be the minimum performed.

3.1.2 Radiation surveys shall be performed whenever operations are performed that might be expected to change existing radiation levels. Examples of such operations include movement or removal of shielding, radioactive waste processing, and relocation of radioactive materials.

3.1.3 Temporary boundaries (e.g., rope boundaries) of radiation areas shall be surveyed weekly to ensure radiation areas do not extend beyond posted boundaries.

3.1.4 Gamma surveys shall be performed at least weekly in posted radiation, high radiation (if accessible), and radioactive material storage areas. Very high radiation areas shall be surveyed upon entry or when a change of conditions warrant.

3.1.5 When highly radioactive equipment (i.e., contact radiation level greater than 100 mrem/hr) is moved, gamma surveys should be performed in spaces surrounding work areas (including the spaces above and below them if applicable) where personnel are likely to be exposed to radiation.

3.1.6 Potentially contaminated ducts, piping, and hoses outside the RCA shall be surveyed at least monthly when in use or at least annually when not in use (e.g., deactivated systems) for gamma radiation.

3.1.7 Beta-gamma surveys of ventilation system filters shall be performed whenever maintenance work or filter change-out is performed.

3.1.8 Other surveys should be performed as necessary to control personnel exposure to gamma, beta, and alpha radiation. Such surveys should include: (1) a gamma survey during initial entry into a confined space containing potentially radioactive piping; (2) gamma surveys in spaces where significant radiation levels might exist from adjacent operating equipment; (3) alpha, beta/gamma measurements when personnel might come in contact with surfaces contaminated with alpha and beta-emitting radioactive material.

3.1.9 Surveys shall be conducted when performing operations which could result in personnel being exposed to small intense beams of radiation. These operations include maintenance which requires the removal of shielding, or opening shipping/storage containers of radioactive equipment. When surveying are as or equipment where intense small beams of radiation could be present, an instrument should be used with an audible response (e.g., earphones). The probe is moved at a speed which is determined by considering the size of the probe, the instrument response time, the possible intensity of the beam, and the general dose rates in the area. For equipment with complex shield designs, RSTs and workers should be briefed on the equipment design so that the areas most likely to have small beams can be given special attention.

3.1.10 Gamma radiation surveys shall be performed weekly on a revolving basis in the areas of the work site where radioactive materials are not stored or handled. The survey should consist of a scan of accessible areas, offices, lunchrooms, etc. Unrestricted areas adjacent to the restricted area boundary shall be surveyed on a weekly basis. The survey shall consist of measurements taken at 50 foot intervals around the entire perimeter.

3.2. Contamination Surveys for Material Release

3.2.1 Material that is removed from the RCA will be surveyed for surface contamination. Only material which meets the requirements of GRD, Inc.'s free release criteria will be allowed to exit the RCA without

restriction. Material not meeting the free release criteria must be transferred directly to another RCA and/or packaged and labeled for storage or shipment prior to release from the RCA.

3.3. Normal Survey Plan

3.3.1 A free release survey shall be conducted by first surveying the item for removable contamination. The smears shall be counted using an appropriate portable survey instrument. To obtain better sensitivity for radionuclides with very restrictive release limits, a low background laboratory instrument may be used.

3.3.2 A fixed contamination survey is subsequently performed on the item using an appropriate portable survey instrument. The scan rate should not exceed 1 inch per second. The entire surface of the item to be released shall be surveyed. For greater sensitivity where required, a scaler equipped detector can be used along with a statistically valid survey plan approved by the RSO.

3.4. Special Survey Plan

3.4.1 For large amounts of homogeneous material with known history, and the material is either (a) not been exposed to contamination, (b) only suspected of being contaminated, or (c) decontaminated with a method that removes the entire surface area that was contaminated; a special survey plan may be used that surveys less than 100 percent of the surface area. This plan must be specific to the material surveyed and specify a detailed sample and survey plan. This survey plan must be approved by the RSO.

4. ALARA Program

4.1. Minimizing Radiation Exposure

4.1.1 GRD, Inc. shall maintain personnel radiation exposure ALARA. A continuing effort is required to meet this goal by developing and implementing improvements to work procedures and work performance.

4.1.2 All work shall be performed in the RCA under the direction of an approved procedure, approved work instruction, or RWP

4.1.3 Individual work procedures shall specify applicable actions (e.g. mockup training, use of temporary shielding, or removal of equipment from high radiation areas) to be used to minimize radiation exposure while working.

4.1.4 Supervisory personnel and radiological safety personnel shall ensure that personnel are not lingering unnecessarily in radiation areas.

4.1.5 Before entering the RCA, a worker shall receive specific job training and/or briefings necessary to enable him/her to perform his/her work with minimum radiation exposure. Examples include mockup training for specific jobs or periodic briefings by supervisory personnel for routine work.

4.1.6 Radiation levels shall be identified by the use of signs which clearly show the areas with the high and low radiation levels.

4.1.7 GRD, Inc. maintains records of the cumulative radiation exposure involved in performing work and establishes ALARA goals as necessary to improve methods to minimize personnel radiation exposure in future work.

4.2. Plans, Procedures and work instructions

4.2.1 Major work shall be performed under the guidance of a task specific plan, procedure, work instruction, or RWP. Determination of the need for specific approved plans, procedures, work instructions, or permits shall be made by the OM, the RSO, and the Quality Assurance Manager.

4.2.2 Plans, procedures or work instructions may describe the task, radiological conditions, or radiological controls, and shall be approved by the RSO or designee. A RWP will supplement the above with specific contamination or exposure control measures, monitoring requirements, and work instructions.

4.2.3 A pre-job ALARA briefing shall be held prior to beginning work performed under a plan, procedure, work instruction, or RWP to ensure all personnel understand the task, radiological conditions, and radiological controls.

4.3. Radiological Work Permit (RWP)

4.3.1 The RWP is an administrative mechanism to inform personnel of area radiological conditions, entry/exit requirements and specific work requirements that may apply to the task being performed. The RWP shall be used to maintain occupational radiation exposure ALARA, to minimize the spread of contamination, and to provide for augmented monitoring and surveillance where required. A description of the task to be performed and the radiological conditions associated with the work shall be recorded on the RWP. Also specified are the protective measures, dosimetry, and training required by personnel entering the designated area.

4.3.2 A standing RWP is used to govern activities in areas where hazards have been well characterized and radiological conditions are relatively stable. This includes routine activities such as tours and inspections, radiological surveys, and "light work" activities covered by procedures. Standing RWPs must be approved by the RSO or designee and the OM, and are reissued 011 an annual basis. Specific task RWPs are generally issued for the duration of the activity to be performed.

4.3.3 An RWP shall be obtained for all work activities that involve occupational radiation exposure or the potential spread of contamination. This includes activities not specifically covered by an approved plan, procedure or work instructions that are performed in any of the following conditions:

- Entry into a posted Radiation, High Radiation, or Very High Radiation Area;
- Entry into a posted Contamination or Airborne Radioactivity Area;
- Any work within the RCA or on contaminated or potentially contaminated equipment or surfaces;
- Maintenance work that would require the breaking of any process line, tank, vessel, or enclosure containing radioactive material that may become loose or airborne during the task

4.3.4 Signs indicating the need for the RWP shall be conspicuously posted at the entrances to areas were the RWP is required.

4.3.5 It is the responsibility of supervisors proposing to conduct work activities within required areas to initiate the issue of the RWP.

4.3.6 The RST shall complete the RWP after discussion of proposed work activities with the supervisor and performance of appropriate surveys.

4.3.7 Prior to beginning work, the RST shall conduct a pre-job ALARA. Briefing with all personnel working under the RWP. Items discussed shall include work scope, radiological conditions, dosimetry and protective clothing requirements, limiting conditions including stay times and hold points, and emergency actions. All personnel to perform work shall sign the RWP signature form to indicate an understanding of the requirements. Personnel added to the RWP after initiation of work shall be briefed by the RST prior to starting work and shall sign the RWP signature form.

4.3.8 During work under the conditions of a RWP, if radiological conditions change, or the scope of work is changed or expected to change, another RWP will be required and a pre-job ALARA briefing held.

4.3.9 The RST shall determine the type and degree of radiological monitoring required for a specific task. This determination should be based on the potential for radiation exposure or contamination spread and the experience of the personnel conducting the work.

4.3.10 An RWP shall be terminated by the initiator one year from the date of its initiation, or at the completion of the task, whichever comes first. If the work must be continued, a new RWP shall be initiated with the appropriate approvals, briefings, and documentation.

4.3.11 The RSO or designee shall ensure an indexed RWP log is maintained. The RWP log shall include: RWP #, date of issuance, date of termination and reason for RWP (work scope).

4.3.12 The RSO or designee shall ensure that all RWPs are terminated within the time allotted by paragraph 8.3.8 above, and shall ensure copies of all terminated R\VPs are maintained in the facility file throughout the duration of the activities.

5. **Access Control and Restricted Areas**

5.1. General Access

5.1.1 Restricted Areas are maintained for purposes of protecting members of the public against undue risk from exposure to radiation or radioactive materials. Radiation levels at the facility are controlled such that an individual at the Restricted Area boundary could not receive a dose in excess of2 mrem in any hour from external sources, or a cumulative exposure of 100 mrem in a year. Within the Restricted Area are the RCA and support areas. All visitors and vendors must enter the site through the administrative area where a visitor access log is maintained. Visitors are escorted in the RCA.

5.1.2 The RCA may include Radiation, High Radiation, Very High Radiation, Contamination, Airborne Radioactivity, and approved Radioactive Material Storage Areas as appropriate. Access control to the RCA shall be provided via the RW'P process and a formal access control point. The RCA boundary shall consist of engineered barriers and administrative controls which prevent access by unauthorized personnel, and ensure that authorized personnel have received appropriate training arid qualification. The access control requirements are applicable to all employees, contractors and visitors who may have need to enter this area.

5.2. Radiological Areas and Postings

5.2.1 Radiological areas are maintained at various locations inside the RCA, as required. Radiological areas include and will be posted as follows.

• Radiation Area is an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 5mrem in an hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. To mark such areas, signs shall be conspicuously posted; signs shall contain the conventional magenta three bladed symbol on yellow background and the words "CAUTION RADIATION AREA"; signs are permitted to state the general area radiation level. In addition, "DOSIMETRY REQUIRED" and "RWP REQUIRED" may be posted. No loitering is allowed in these areas.

• High Radiation Area is an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 100 mrem in an hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. Such areas shall be posted and locked or guarded. The requirement to lock or guard a posted high radiation area does not apply to tanks or voids posted as high radiation areas if entry requires the removal of complex closures. Positive control shall be established for each individual entry into a high radiation area and shall be established in such a way that no individual is prevented from leaving the high radiation area. Prior to locking an unoccupied high radiation area, the area shall be inspected to ensure that no personnel remain inside. No loitering or entry by unauthorized personnel shall be allowed in these spaces. High radiation areas shall be conspicuously posted at entrances into the area. Signs shall contain the conventional magenta three-bladed symbol on yellow background and the words "CAUTION: HIGH RADIATION AREA". In addition, "CONTACT RADIATION SAFETY PRIOR TO ENTRY" shall be posted.

• Very High Radiation Area is an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 meter from a radiation source or from any surface that the radiation penetrates. Signs shall contain the conventional magenta three-bladed symbol on yellow background and the words: "GRAVE DANGER, VERY HIGH RADIATION AREA". In addition to the control requirements described above for a High Radiation Area, access and security controls for very high radiation areas shall be implemented to ensure an individual cannot gain unauthorized access.

NOTE: PRIOR WRITTEN APPROVAL FROM THE RSO AND QA MANAGER IS REQUIRED FOR ENTRY INTO VERY HIGH RADIATION AREAS.

• Airborne Radioactivity Area is an area where airborne radioactive material exists in concentrations in excess of the derived air concentrations (DACs) specified in Table 1, column 3 of Appendix. B to 10 CFR 20 *(OAC 3701:1-38- 12, Appendix* C, *Table* 1), or to such a degree that an individual in the area without respiratory protection could exceed during a week, an intake of 0.6% of the ALI or 12 DAC-hours. Signs shall be posted at entrances to areas where airborne radioactivity levels exceed or have the potential to

exceed these levels. These signs shall contain the conventional three-bladed magenta symbol on yellow background and the words "CAUTION: AIRBORNE RADIOACTIVITY AREA." The requirements to wear respiratory equipment may also be included on the sign along with the anti-contamination clothing requirements.

• Contamination Area is an area having loose (removable) contamination on exposed surfaces greater than 1000 dpm/100 cm2 beta-gamma activity or 20 dpm/100 cm2 alpha radioactivity. Signs shall be posted at entrances to areas where surface contamination levels exceed or have the potential to exceed these levels. These signs shall contain the conventional three-bladed magenta symbol on yellow background and the words "CAUTION: CONTAMINATION AREA." The requirements to wear anti-contamination clothing or perform personal contamination surveys may also be included on the sign.

• Radiologically Controlled Area (RCA) is an area to which access can be controlled for radiation exposure or contamination control purposes. An RCA typically serves as a buffer around a contamination or radiation area and provides access control for personnel, equipment and material monitoring. Signs shall be posted at entrances to these areas which contain the conventional three-bladed magenta symbol on yellow background and the words "CAUTION: RADIOLOGICALLY CONTROLLED AREA."

• Radioactive Material Storage Area is an area where radioactive material is used or stored in amounts exceeding 10 times the quantity of such material specified in appendix C to 10 CFR 20 *(OAC 3701:1-38-18, Appendix A).* Entrances to areas where radioactive materials are handled or stored that meet this criteria shall be posted with signs having the conventional magenta three-bladed symbol on yellow background and the words "CAUTION: RADIOACTIVE MATERIAL." This posting is in addition to posting required for other radiological areas.

5.2.2 An Access Control Point is a location on the perimeter of a restricted area, or the RCA through which all entries and exits are made. Precautions are taken at the appropriate access control point to prevent the inadvertent exposure to radiation or the spread of contamination to adjacent uncontaminated areas. The dimensions and material requirements of an access control point depend on the type of work to be performed, the number of personnel involved, and the location of the work.

5.3. Temporary Shielding

5.3.1 Since incorrect installation, unauthorized movement, or removal of temporary shielding can result in large changes in work area radiation levels and subsequent radiation exposure, control of temporary shielding is essential.

5.3.2 Temporary shielding installation and removal should be controlled by written instructions. These instructions shall specify locations and amounts of temporary shielding.

5.3.3 After installation, temporary shielding shall be inspected and surveys conducted to ensure it is properly located.

6. **Controlling Airborne Radioactivity**

6.1. General

6.1.1 The primary reason for control of airborne radioactivity is to minimize internal radiation exposure resulting from inhalation of airborne radioactive materials. An intake of radioactive material is measured in units of DAC-hours (DAC multiplied by hours of exposure), which is directly proportional to CEDE.

6.1.2 Radioactivity in the form of particulates, gases, or both can become airborne through sources such as (1) radioactive system leaks, (2) grinding or welding a contaminated component, (3) decontamination operations, (4) disturbing surface contamination deposited on a work surface, (5) improper use of a containment enclosure, (6) inadequate vacuum cleaner and ventilation system control, (7) inadequate application of procedures for venting and draining radioactive systems or components, (8) damage or detects in instrumentation calibration or check sources, and (9) radon from radium sources or from trace amounts of natural radium impurities in construction materials.

6.1.3 Engineering controls shall be used, to the extent practical, to reduce the potential for the release of airborne radioactivity. These -include agents that fix loose contamination, HEPA-filtered ventilation, local exhaust ventilation, containments, decontamination, and wrapping, as required.

6.1.4 Airborne radioactivity monitoring provides a record of ambient airborne radioactivity in the work place, a tool to assess worker intakes, verify required posting, and evaluate the adequacy of engineered and administrative controls for maintaining exposure ALARA.

6.1.5 The RSO will prescribe the continuous or periodic sampling required to detect and evaluate the levels of airborne radioactivity in work areas and exhaust air systems in accordance with this section and Reference 2.1.7. Air sampling is required for activities where an individual is likely to receive in one year, an intake in excess of 10% of the applicable ALL Representative air samples are collected and intakes tracked and controlled such that personnel exposure complies with 10 CFR § 20.1502 *(OAC 3701:1-38-12)* requirements. Continuous air monitoring systems with local and remote alarm capability are provided where the potential for airborne radioactivity is higher during maintenance or off-normal conditions. Portable air samplers and/or personal breathing zone air samplers are used as necessary to monitor specific work activities.

6.1.6 It should be noted that this monitoring is primarily concerned with the control of particulate airborne activity. Certain unique situations with noble gases may be encountered, and will require special monitoring techniques.

6.1.7 Routine bioassays may be performed to supplement air monitoring data for workers where normal operating conditions would result in an intake of radioactive material in excess of 10% of the applicable ALI in 10 CFR 20 *(OAC 3701:1-38).* Routine bioassays include baseline measurements prior to exposure, termination measurements at termination of employment or change in work status, and periodic measurements (as determined 011 a site specific basis to meet 10 CFR § 20.1204 *(OAC 3701:1-38-12)* requirements). Special monitoring bioassays will be performed on a case-by-case basis in the event of unusual or unexpected monitoring results at the discretion of the RSO. Examples of situations that may require special monitoring include: the presence of unusually high levels of facial or nasal contamination, entry into airborne radioactivity areas without appropriate exposure controls, loss of system or container integrity, a CAM alarm, or incidents that result in contamination of wounds or other skin absorption.

6.1.8 Unplanned individual exposures with estimated intakes greater than 0.02 Annual Limit on Intake (ALI) will be investigated. Individual intakes greater than 0.1 ALI will be investigated using follow-up bioassay measurements and available work place monitoring data.

6.2. Limits for Airborne Radioactivity

6.2.1 The administrative limit for occupational exposure to airborne radioactivity is 8 DAC hours in anyone day. The DAC values are found in table 1 of appendix B to 10 CFR 20 *(OAC 3701:1-38-12, Appendix* C *Table* 1). Site specific administrative control levels for occupational exposure to airborne radioactivity are given in Section 6.1.3.

6.2.2 Engineering controls should be designed and operated in such a manner that personnel are not routinely exposed to airborne radioactivity levels that may require use of respiratory protection equipment

6.2.3 Investigation Levels. Any measurement which indicates the airborne radioactivity concentration to be in excess of 2% of the applicable DAC shall be investigated to determine the cause of the airborne radioactivity levels. Appropriate controls shall be implemented to maintain the airborne radioactivity levels ALARA.

6.3. Requirements for Controlling Personnel Exposure to Airborne Radioactivity

6.3.1 Personnel exposure to airborne radioactivity is controlled using fixatives, ventilation, containments or respiratory protection equipment for work in areas with high levels of surface contamination (e.g., >100,000 dpm/100 cm2 beta-gamma, >2000 dpm/100 cm2 alpha) because of the likelihood that this surface contamination could be resuspended. In some circumstances, respiratory equipment might be necessary in areas where surface contamination exists at lower levels due to the nature of the work.

6.3.2 Engineered controls shall be used to the maximum extent practicable to prevent personnel from being exposed to airborne radioactivity above the administrative control levels in Section 6.1.3. These controls are

recommended during radiological work which has been known to cause or is expected to cause airborne radioactivity, and will be provided for in the RWP.

6.3.3 The need for personnel to wear respiratory protection equipment where airborne radioactivity is likely to exceed 25% of the DAC in table 1 of appendix B of 10 CFR 20 *(OAC 3701:1-38-12, Appendix* C *Table* 1) shall be evaluated and documented prior to area entry. Worker efficiency with respiratory protection equipment will be considered in areas with elevated external radiation in order to maintain the TEDE ALARA.

6.3.4 Personnel shall not be exposed to airborne radioactivity such that their daily intake exceeds 8 DAC-hours without prior approval of the RSO.

6.3.5 Signs shall be posted at entrances to airborne radioactivity areas. The requirements for respiratory protection equipment shall also be included on the sign with the anti-contamination clothing requirements where appropriate.

6.3.6 When personnel not wearing respiratory equipment may be exposed to airborne radioactivity above the limits of Section 10.2, ventilation and/or containment should be provided which will capture airborne particulate radioactivity U1 a controlled ventilation system with a high efficiency particulate au' (HEP A) filter. Other controls such as the use of loose fitting prefabricated drapes, ventilated shrouds, ventilated glove-bags, the use of fixatives, or misting may reduce ambient airborne radioactivity to a level that would preclude the use of respiratory protection.

- HEP A filters shall be installed in the ventilation exhaust from radioactive work areas in which work in progress could cause the discharge of airborne radioactivity to the environment.
- HEPA filters shall be installed in the exhaust from contamination containments to prevent personnel from being exposed to high airborne radioactivity.
- HEP A filters shall be installed in vacuum cleaners used for decontamination of loose surface contamination.

6.3.7 Positive pressure air purifying respirators, air supplied masks, hoods, or suits may be worn for work where airborne radioactivity is expected to be significant. Self contained breathing apparatus will be utilized for very significant airborne radioactivity concentrations.

6.4. Elevated Airborne Radioactivity Response

6.4.1 Elevated airborne radioactivity associated with operations can result from many causes. It can be indicated by a CAM alarm, retrospectively by a portable or personal air sample exceeding the applicable limit of Section 10.2, or by visual observation of a radioactive system leak or rupture. General methods for controlling personnel exposure to airborne radioactivity are contained in Section 10.3. An appropriate response to elevated airborne radioactivity is given below:

6.4.2 Immediate Action. Operations identified to be the cause of elevated airborne radioactivity shall be stopped until adequate control is established. Unessential personnel shall be evacuated from the affected area. Essential personnel shall don respiratory protection in accordance with Section 6.7. Unfiltered ventilation from the affected spaces shall be secured. Ventilation systems which contain high efficiency filters in exhaust ducts need not be secured. The extent of the airborne radioactivity should be determined by sampling the affected area and adjacent areas using p0l1abie air samplers. If the elevated airborne radioactivity is indicated by alarm of a CAM monitoring a ventilation exhaust or a work area, the instrument should be checked to ensure the alarm is not the result an electrical transient. Gamma radiation levels at the CAM should be measured to determine if the CAM alarm was caused by high radiation levels external to the CAM. Supplementary actions need not be taken if the alarm is determined to be a false alarm.

6.4.3 Supplementary Action. Supplementary actions are carried out to facilitate recovery operations and the return of the plant to normal status. Sampling and analysis shall be performed to identify the source of the airborne radioactivity. In order to minimize the need for respiratory protection equipment, and reduce personnel exposures to airborne radioactivity, consideration shall be given to ventilating the facility with additional HEPA filtered ventilation systems. Gamma surveys of ventilation filters and ducts as well as surface contamination in the vicinity should be performed to facilitate recovery. When resuming operations, portable air samples are used to confirm the cause of elevated airborne radioactivity has been corrected.

Evacuated personnel should be monitored for contamination and decontaminated as necessary. Personnel exposed to elevated airborne radioactivity shall be evaluated for intake in accordance with Section 6.1.

6.4.4 Reports - A report of any occurrence involving elevated airborne radioactivity (above the limits of Section 6.2) in areas occupied by personnel not wearing respiratory equipment shall be made in accordance with Section 17. This report shall include the results of monitoring personnel for internally deposited radioactive material as required.

6.5. Monitoring for Airborne Radioactivity

6.5.1 The method used for monitoring airborne radioactivity shall have a Minimum Detectable Activity (MDA) equal to or less than 10% of the applicable DAC. Refer to Reference 2.1.7 for MDA calculations.

6.5.2 Airborne particulate surveys shall be performed with portable air samplers whenever airborne radioactivity levels above the limits of Section 6.1 are suspected.

6.5.3 Personnel air samplers (lapel type) shall be used whenever portable sampling cannot be positioned in such a manner to be representative of the breathing zone of the worker. Examples would include large work areas with intervening structures, components, etc., or activities which require the worker to be mobile.

6.5.4 Records of airborne radioactivity measurements are required for regulatory purposes. The records shall be maintained legibly and retained in the on site file in accordance with Section 17.0. These records should include at least the following information:

- Date and time of sample and measurement
- Location
- Reason for sample
- Sampling equipment and counting Instrument used
- Results of most recent efficiency, MDA, and background measurements
- Airborne radioactivity in µCi/ml
- Signature of RST
- Signature of persons reviewing records.

6.6. Air Sample Analysis

6.6.1 When handling air samples collected from areas known or suspected of containing airborne radioactivity care should be taken to prevent the spread of contamination and cross contamination of samples taken. If significant short lived radionuc1ide concentrations are expected, the samples shall be counted initially and then decay counted to determine the actual long-lived radioactivity.

6.6.2 Counting Activities. Low background automatic alpha/beta counting systems are used for screening and gross activity analysis. Spectroscopy is used to identify a particular radionuclide in an air sample. All systems used for air sample analysis shall be set up and operated in accordance with manufacturer's instruction.

6.6.3 Calculation of Airborne Radioactivity Concentration. Airborne radioactivity concentration is typically recorded in units of mCi/ml, and reported as a percentage of the applicable DAC. In order to calculate concentration, it is necessary to accurately determine the volume of air sampled and the radioactivity deposited on/in the air sample filter media. Additionally, due to unique characteristics of the filter media such as collection efficiency, self-adsorption, and flow rate, correction factors may be necessary to accurately calculate concentration.

6.6.4 Determination of DAC-Hours. A DAC-hour is a mathematical expression of intake, derived by dividing the measured concentration of radioactive material in air by the respective DAC for the radionuclide in question, and then, multiplying by the number of hours of exposure to that radionuclide. One ALI can be expressed as 2000 DAC-hours, which is equivalent to a CEDE of 5 rem.

6.6.5 An individual's expected intake in DAC-hours should be estimated during the work planning process by considering measured air concentrations, the expected stay time in the work area, and the nature of the activity. In the interest of maintaining radiation exposure ALARA, stay times, the use of engineered or administrative controls including respiratory protection, and the methods used to conduct the work activity can be optimized in order to minimize overall dose. A record of intake in DAC-hours shall be recorded in

order to demonstrate compliance with conditions of 10 CFR 20 (*OAC 3701:1-38*). Records shall be maintained in accordance with 10 CFR 20.2103 (*OAC 3701:1-38-20*) and section 17.0.

7. **Use of Respiratory Protection Equipment**

7.1. General

7.1.1 Table 1 of appendix B to 10 CFR 20 (*OAC 3701:1-38-12 Appendix C, Table 1*) lists the ALIs and DACs for occupational exposure to radioactive materials. GRD, Inc. is committed to design of processing facilities and control of work in such a manner as to maintain CEDE ALARA. However, when process or other engineering controls are not practical to control airborne radioactive materials below those contained in the definition of an airborne radioactivity area, intakes may be limited by use of respiratory protection equipment.

7.1.2 The RSO or designee is responsible to ensure that the qualification requirements are met and documented for personnel using respiratory protection equipment. A copy of this document shall be maintained by the RSO or designee in the on-site file.

7.1.3 The use, cleaning and inspection requirements for respiratory protection equipment shall be accordance with Reference 2.1.11.

7.1.4 No person shall wear a respiratory protection device for a period of more than four consecutive hours without a one ham break and for more than a total of six hours in any one day.

7.2. High Efficiency Particulate Air CHEPA) Filter Requirements

7.2.1 HEPA filtered systems shall be tested prior to use following each set up and after each filter change. Acceptance criteria is a transmission of 0.03% or less dioctylphthalate (DOP) (or use of equivalent testing methodology) particulate per applicable DOP test procedure.

7.2.2 Great care shall be used in installing HEPA filters to assure the filter material separators are in the vertical position, tight seals are made around the edges of the filters, and that filters are not damaged during installation. Minor damage will greatly reduce the efficiency of these filters.

7.2.3 Used filters shall be disposed of as radioactive waste since loose surface contamination could be present on interior pleats.

7.2.4 Instructions in manufacturers' manuals shall be followed for use and filter change-out.

7.3. Portable Ventilation System

7.3.1 A portable ventilation system can be constructed by adapting a portable blower with a HEPA filter. Such a system can be used during maintenance or an elevated airborne radioactivity condition to reduce airborne radioactivity without contaminating installed ventilation systems.

7.3.2 A vacuum cleaner with installed HEPA filter can also be used effectively to reduce airborne radioactivity in a space by re-circulating the air in the space through the high efficiency filter. Such a system must be tested prior to use as per Section 6.8.1.

7.4. Release of Airborne Radioactivity to the Environment

7.4.1 Releases of airborne radioactivity to the environment may require an Environmental Protection Agency (EPA) permit and/or a State Air Quality Control Permit. Required permitting and limits shall be evaluated prior to each project at a customer's facility. Such releases shall be evaluated for compliance with regulatory requirements (EPA, State, etc.) and the evaluation documented.

7.4.2 Airborne effluents should be controlled when possible through wet scrubbing and/or HEPA filtration of the exhaust. Monitoring is conducted by taking a representative sample at the exhaust stack during all periods of processing operation, and measuring for selected radionuclide. Processing of radioactive materials shall be stopped immediately if these systems are in-operative.

7.4.3 The site specific requirements for environmental monitoring may include air monitoring stations. The licensee requirements for the type and frequency will be followed. Analysis of these samples is performed to demonstrate compliance with Subpart D-Radiation Dose Limits for Individual Members of the Public of 10 CFR 20 dose limits (*OAC 3701:1-38-13*). Specific environmental monitoring guidelines are provided in Section 16.

8. **Surface Contamination Control**

8.1. General

8.1.1 It is the intention of GRD, Inc. to maintain generally accessible areas free of contamination. Office areas and other areas outside the RCA will be maintained to keep surface contamination levels as low as possible, but in no case greater than the unrestricted release criteria in Appendix B.

8.1.2 Surface contamination levels in the RCA will be maintained ALARA to facilitate optimum access for operations, use of personal protective equipment, and dose reduction in accordance with established plans, procedures and instructions. Should there be an increase in contamination outside the RCA, it will be investigated by the RSO or designee. Procedures to prevent recurrence will be implemented. Radioactive contamination of surfaces (such as floors, equipment, clothing and skin) may result from work operations, leaks of radioactive fluids, or gradual precipitation of airborne radioactive contamination onto exposed surfaces. The primary reason for limiting surface contamination is to minimize possible ingestion or inhalation of radioactive materials. In addition, surface contamination is limited to minimize transfer of radioactive materials to the environment beyond the control of GRD. In case of very high levels of surface contamination, control of external radiation exposure from this contamination may be necessary. Surface contamination is divided into two classes in this section: (1) loose contamination can be removed from surfaces with relative ease and may be readily dispersible, and (2) fixed contamination remains on affected surfaces and is not further reduced by normal non-destructive decontamination techniques. Areas where loose contamination levels exceed the applicable limits in Appendix B are posted and controlled as a Contamination area. The controls shall include conspicuous boundaries, restricted access, step-off pads, protective clothing requirements, and monitoring upon exit. A typical method for determining levels of loose contamination is to wipe the surface in question (usually a 100 sq. cm area) with a dry adsorbent material using moderate pressure, and then measuring the wipe for radioactivity. Levels of fixed contamination on a surface is determined by placing a radiation detector in direct contact with the surface, and either making a static measurement or scanning the surface by moving the detector slowly.

8.1.3 Contamination control procedures should be considered in planning and performance of all jobs. A dedicated set of "hot tools" should be used in the RCA to avoid the necessity to transfer the equipment across a contamination control boundary. When using clean tools or equipment in contaminated areas, the use of plastic sleeves or strippable paint to prevent contamination or facilitate decontamination is warranted. The extent of the contamination control procedures used should be commensurate with the amount of radioactive material being handled, and the nature of the task.

8.2. Surface Contamination in Uncontrolled Areas

8.2.1 Surface contamination levels for uncontrolled surfaces should be kept as low as possible. Areas where contamination exceeds established limits shall be either decontaminated in a timely manner, or painted or otherwise sealed to prevent the spread of contamination.

8.2.2 Acceptable surface contamination levels in uncontrolled areas are dependent upon (1) radionuclides being processed in the facility (2) applicable regulatory requirements, and (3) facility operating parameters.

8.2.3 Limits for loose and fixed contamination are usually dictated in the "NRC or Agreement State Radioactive Materials License, are based on the release limits found in Appendix B.

8.3. Surface Contamination in Radiologically Controlled Areas

8.3.1 The RCA is established, among other things, as a formal boundary to prevent the uncontrolled spread of radioactive materials. This boundary serves as the point at which certain precautions are taken, including training, protective clothing, and monitoring to prevent a worker from unknowingly contaminating his/her self, and transferring the contamination to the uncontrolled area. The RCA serves as a buffer between the more contaminated areas and those that are not contaminated. Significant levels of fixed contamination may exist in these areas; however, loose contamination levels are maintained to established limits.

8.3.2 Areas where surface contamination exceeds the established limits, areas "where equipment or materials are handled with exposed parts exceeding these levels, and areas where activities may cause contamination in

8.3.3 excess of the limits in Appendix B shall be designated as Contamination Areas (CA) until such areas, equipment, or materials have been adequately sealed or decontaminated to meet these limits. CAs may be established on a more permanent basis to facilitate operations. The CA boundary will serve as the initial and primary boundary to prevent the spread of contamination.

8.3.4 Access to a CA shall be limited by the conditions of a RWP to allow only personnel with appropriate anti-contamination clothing, monitoring equipment, and participation in the internal dosimetry program to enter. Choice of appropriate anti-contamination clothing is discussed in Section 12.1.

8.3.5 Personnel with open wounds shall not enter CA without prior approval of the RSO or designee. Open wounds shall be adequately protected from contamination prior to a person working in these conditions.

8.3.6 Entrances to CA shall be posted conspicuously with signs, stating the access restrictions, requirements for anti-contamination clothing and masks, levels of loose surface contamination and radiation dose rates. If the entrance to a CA and the step-off pad cannot be positioned at an existing barrier (door), magenta and yellow rope barriers or equivalent shall be used to mark the affected area clearly.

8.3.7 Smoking, eating, drinking and chewing shall not be permitted in CAs. Prescription medications may be taken under approved and controlled conditions. This provision is essential to minimize the possibility of transferring contamination from the hands or other areas to the mouth. For the same reason, hands should be kept away from the face, nose, mouth, and ears while in a CA.

8.3.8 Where operations such as grinding or machining are being performed without containment on contaminated components or equipment, the area of the operations shall be considered subject to the spread of loose contamination. The area shall be posted as a CA until such time as the work can be completed, the area surveyed, and down-posted.

8.3.9 Where surveys for loose contamination have not been made, but contamination is suspected, the area shall be posted as a CA pending the results of contamination surveys.

8.3.10 Levels and extent of loose surface contamination inside a CA shall be limited to control possible re-suspension of radioactive materials, to reduce airborne radioactivity, to reduce the potential for the spread of contamination, to simplify subsequent decontamination, and to minimize personnel radiation exposure.

8.3.11 Personnel leaving a CA shall (a) remove their outer anti-contamination clothing and (b) monitor or be monitored for surface contamination where background levels of radiation will permit.

8.4. Methods for Controlling Surface Contamination

8.4.1 The most effective means of controlling radioactive surface contamination is containment at the source through the use of ventilated enclosures around contaminated items to keep the radioactive material inside. Containments can be simple drapes, tents, or pans, or elaborate pre-fabricated glove-bags or large walk-in enclosures. Containments should be used as much as practical when working on the surfaces or components which have been exposed to radioactive materials. Plastic sheet, bags, or easily decontaminated containers may be used to enclose clean material and prevent contamination of clean items inside the enclosure. The following specific requirements shall be followed when working or handling contaminated equipment and materials.

8.4.2 Workers shall have been trained on the use of containments and instructions for using containment enclosures shall be readily available during work planning.

8.4.3 Containment enclosures shall be inspected prior to use to determine if they are properly constructed and ready for use. Enclosures shall then be marked to certify this inspection was completed. Personnel using containment enclosures shall inform radiological safety personnel of any damage to containment enclosures which occurs during work. When a containment enclosure is damaged or is unfit for use, the enclosure shall be conspicuously tagged to prevent its inadvertent use by personnel unaware of the problem until repaired. Containment enclosures shall not be removed or altered without approval of the RSO or designee.

8.4.4 Ventilation should be controlled during operations involving radioactivity to prevent spreading the radioactive contaminants through an area or to the environment. The basic methods of controlling contamination by ventilation are by providing clean supply air into the contaminated work area and by providing filtered local exhaust ventilation close to the work, or from a containment enclosure erected

around it. The exhaust capability should always exceed the supply including discharges from pneumatic tools.

8.4.5 HEPA filters (and HEPA system pre-filters) may become contaminated so that handling a used filter may spread contamination. Therefore, great care should be exercised when removing used filters. Contaminated used filters are normally removed by the bag-out method into plastic bags.

8.4.6 A buildup of detectable levels of surface contamination can occur through the deposition of radioactive material from the air without having significant levels of airborne radioactivity. Therefore, all process ventilation exhaust ducts or ventilation system ducts from radioactive work areas should be considered potentially contaminated. When opening these potentially contaminated systems, they should be surveyed and decontaminated as practical for similar reasons, if a portable exhaust blower is used in a contaminated space, surface contamination should be checked on surfaces exposed to the filtered exhaust of this blower.

8.4.7 When HEPA filters are installed in ventilation systems for radiological areas, labels should be prominently affixed verifying proper installation of the filters. These labels should be located so that they are destroyed when the filters are removed. HEPA filtered ventilation systems shall be tested in accordance with Section 10.8.

8.4.8 Potentially contaminated air that has not passed through a high efficiency filter should not be discharged to locations occupied by personnel or where supply ventilation can return it to an occupied area.

8.4.9 Consideration should be given to controlling contamination which has been collected in ventilation equipment and systems not normally used for radiological work, i.e. HVAC systems, and in particular those systems in adjacent spaces which may have become contaminated during a spill Prior to work on these items, radiation measurements should be taken, the items treated as contaminated, and radiological control precautions established to prevent spreading contamination.

8.5. Method for Measuring Surface Contamination

8.5.1 A rate meter with a thin window probe (G-M) or equivalent will detect radioactive beta-gamma surface contamination on materials and personnel by slowly scanning the probe held within about *1/2* inch of the surface. Alpha-emitting contamination is normally monitored using a sensitive proportional or scintillation detector. An instrument and detector should be used that has a MDA for contamination measurements of < 90% of the applicable limit with a goal of <10% of the limit. If background levels are higher than will permit the above stated NIDA, equipment or personnel to be monitored for release shall be relocated to an area of lower radiation levels or the area or instrument detector shielded to lower background levels. A reading of 100 cpm above background indicates excess contamination.

8.6. Method for Monitoring Personnel Contamination

8.6.1 Personnel monitoring (frequently referred to as "frisking" when done with a handheld instrument) shall be performed when exiting CAs or RCAs. Monitoring of personnel for surface contamination is typically done with all automated portal type personnel contamination monitor established at a formal control point.

8.6.2 Monitoring of personnel by taking swipes for loose surface contamination on the skin or clothing shall not be done since swipes may tend to imbed radioactive particles. Special circumstances may require the use of adhesive tape to remove contaminated particles for measurement.

8.6.3 When personnel have been adequately trained in frisking procedures, self monitoring will be permitted; however, frisking may be performed by a RST.

8.6.4 If facial contamination is detected, or it is suspected that radioactive material have been taken into the body even though no facial contamination is evident, the RSO or designee shall be notified and the individual monitored for internal radioactivity. Measurements of the radioactivity of nose and throat swabs may be used. Decontamination shall be performed in accordance with Section 13.4.

8.7. Frequency of Surveys for Monitoring Areas for Surface Contamination

8.7.1 Minimum site specific contamination survey requirements are dictated by the NRC or Agreement State Radioactive Materials License, and detailed in Reference 2.1.14.

8.7.2 Routine contamination surveys shall be performed at a frequency commensurate with the risk of loss of surface contamination control for the area in question. In the interest of ALARA, contamination surveys in High or Very High Radiation Areas are done only upon entry, or when a change of conditions dictates.

8.7.3 Sealed source leak testing, if required, will be performed in accordance with Reference 2.1.3.

8.7.4 Operations such as the following also require surveys:

- Decontamination and release of equipment
- Inspection or maintenance on components and piping which are associated with radioactive or potentially radioactive systems
- Areas where radioactive liquid leaks have occurred or where airborne radioactivity has exceeded the concentrations of Section 10.2. Surveys are required to determine the need for anti-contamination clothing and to determine the extent of contaminated areas
- Upon initial entry into tanks or voids potentially contaminated radioactive materials and when opening ventilation exhaust ducting from radioactive material work areas
- In addition, any normally uncontaminated system which is suspected of containing radioactive materials shall be surveyed when opened for inspection, maintenance or repair. Contamination control procedures should be used until the portion of the system being worked on is proven to be uncontaminated. Water drained or flushed from these systems shall be treated as radioactive and sampled as appropriate;
- Contamination surveys should be performed in plenums downstream of HEP A filters during routine filter replacement, to determine radioactivity buildup in ducts downstream of filters;
- Prior to replacing filters on HVAC ducts serving a radiological work area, filters should be surveyed to determine if radioactivity is present;
- Surveys for contamination fixed in paint should be performed prior to removal of paint in potentially contaminated areas. These surveys should be performed by counting paint scrapings for gross activity;
- Surveys to support RWP development or work planning.

8.8. Records of Contamination

8.8.1 Records of surface contamination surveys shall be maintained in the on site files throughout the duration of the operations in accordance with Section 17.0

8.8.2 Any occurrence which results in loose surface contamination greater than the applicable site specific free release limits for uncontrolled areas shall be reported in accordance with Section 17.0.

8.8.3 Any spread of contamination in the RCA or CAs which results in work being stopped for more than four hours or takes more than four hours to clean up shall be reported in accordance with Section 17.0.

8.8.4 Records of surface contamination surveys shall be retained in the on site file throughout the duration of the operations file in accordance with Section 17.0.

9. **Anti-Contamination Clothing and Equipment**

9.1. General

9.1.1 Anti-contamination clothing (Anti-Cs) is used to help prevent personal skin and clothing contamination, and the spread of radioactive materials outside the RCA or CAs. Anti-contamination clothing is required when either surface contamination or airborne radioactivity levels exceed prescribed limits.

9.2. Requirements for Wearing Anti-Contamination Clothing

9.2.1 The RSO or designee in consultation with other safety disciplines shall determine the appropriate requirements for Anti-Cs and shall so note on the applicable RWP. The recommended type of Anti-Cs for various applications and radiological conditions are provided in Reference 2.1.10. In addition, miscellaneous equipment used for the control of exposure to radioactive materials is described.

9.3. Donning and Doffing of Anti-Contamination Clothing

9.3.1 It may be necessary to remove personal clothing before putting on Anti-Cs for comfort when working in high temperature spaces. Typically, a modesty garment is worn from the change facility to and from the donning/doffing point for the Anti-Cs.

9.3.2 Anti-Cs shall be inspected by the wearer prior to donning to ensure the garment is free of rips, tears, missing buttons, or malfunctioning zippers. Damaged clothing shall not be worn.

9.3.3 Used Anti-Cs shall be removed at the appropriate step-off pad in a manner that will preclude personal skin or clothing contamination and the spread of contamination across the boundary. Used Anti-Cs shall be deposited in the appropriate receptacle upon doffing.

10. **Radioactive Decontamination**

10.1. General

10.1.1 Decontamination may be required for components, tools and equipment, work areas, clothing or personnel. Each of these subjects as well as alternatives to decontamination is discussed in this section. These include, in some case, storage for decay, disposal without decontamination, or restricted use without complete decontamination. By the very nature of decontamination process, the generation of secondary waste materials must be considered. Volumes of both solid and liquid wastes shall be minimized. Unauthorized chemicals shall not be used. These may cause difficulties in waste processing. Most radioactive contamination can be removed by normal cleaning. Wiping with a damp rag soaked with an appropriate cleaning agent will usually provide satisfactory decontamination.

10.1.2 If large variations in surface contamination levels exist on highly contaminated surfaces, cleaning shall be from less contaminated toward more contaminated areas to prevent radioactivity from being spread to less contaminated areas. Cleaning solutions and cloths used in these decontamination operations shall be disposed of as radioactive waste. During decontamination operations, precautions shall be taken to limit the spread of contamination, such as by taking care not to splash solutions, by properly wearing anti-contamination clothing, and by wearing masks as necessary" Filtered ventilation may be required to minimize the possibility of contamination being inhaled by personnel performing the decontamination.

10.2. Decontamination of Tools and Equipment

10.2.1 In decontaminating tools and equipment, appropriate radiological control shall be used to prevent the spread of contamination, and to control airborne radioactivity, and radiation exposure. The following applies to the decontamination of tools and equipment.

10.2.2 Tools and equipment which may be used again in contaminated areas may be temporarily stored in the contaminated area or in a "hot tool locker" without decontamination if proper radiological controls and procedures are used. If certain tools are to be used solely in CAs, these tools should be durable and distinctively marked to indicate they are always treated as potentially contaminated.

10.2.3 In some cases, the need for decontaminating tools may be minimized by taping some portions, such as the handles, prior to use and stripping off the contaminated tape after use. Large tools are often wrapped in plastic instead of tape. These tools need to be swiped or frisked at completion of decontamination to verify the effectiveness of the treatment.

10.2.4 Heavily contaminated tools can spread surface contamination. Therefore: such tools should be partially decontaminated as may be necessary several times throughout a work shift. Heavily contaminated tools can be readily identified without taking swipes by measuring their radiation level The purpose of decontaminating these tools will usually be to reduce their radiation levels rather than to remove all loose surface contamination.

10.2.5 When only a few tools require decontamination, wiping with cloths soaked in an approved decontamination solution is a convenient, effective procedure. This method is also useful when only a portion of a tool is contaminated. A disadvantage of wiping procedures is the potentially large amount of solid radioactive waste produced.

10.2.6 Mechanical decontamination methods, such as using abrasives which remove some of the surface of the tool, can be useful in special circumstances where contamination is not removed by chemical cleaning. In such cases, control of possible airborne radioactivity is essential.

10.2.7 In decontaminating oily or greasy tools or equipment, consideration should be given to the fact that oil or grease may inhibit waste processing or disposal only decontamination solutions approved by the RSO or designee may be used.

10.3. Decontamination of Areas

10.3.1 Contaminated areas shall first be isolated and radioactive materials then removed while being careful to avoid spreading contamination. In some cases, tape may be used to lift loose contamination from surfaces. If contamination levels are not sufficiently reduced, use of solvents (non-hazardous to prevent mixed waste), strong chemicals, or mechanical removal of some of the surface may be necessary. The areas shall be surveyed by approved methods prior to release to ensure surface contamination is below the established limits. On painted or covered surfaces, if washing will not remove the contamination, the paint or covering shall be removed. During the process of paint removal, control of airborne and surface contamination from dust and paint chips will be necessary.

10.3.2 Contaminated areas should be decontaminated as soon as practical to minimize spread of contamination and to facilitate removal before the contamination is fixed on the surface. If high radiation levels from the contamination contribute significantly to personnel radiation exposure during cleanup, it may be desirable to decontaminate the most heavily contaminated area first.

10.4. Decontamination of Clothing

10.4.1 Anti-contamination clothing shall be laundered and surveyed before reuse to minimize the possibility of spreading radioactive contamination to the wearer. This requirement does not apply to disposable Anti-Cs.

10.5. Decontamination of Personnel

10.5.1 Decontamination of personnel shall be performed within an established RCA (unless otherwise approved by the RSO or designee).

10.5.2 The objectives of skin decontamination are to remove as much of the radioactive material as practicable in order to reduce the skin dose rate and to prevent the ingestion or inhalation of the material An over-aggressive skin decontamination effort must be avoided since it may injure the natural barriers in the skin and so increase absorption.

10.5.3 Reports of skin contamination shall be made in accordance with the requirements of Section 17.

11. **Radioactive Waste Handling**

11.1. Packaging Radioactive Materials

11.1.1 Radioactive materials shipped for disposal or to another location shall be appropriately packaged and treated as required by USDOT, applicable federal and state regulations, and applicable disposal site criteria. Shipping shall be performed by the RSO or designee, or a Shipper/Broker in accordance with applicable plans, procedures, and/or instructions. The specific radioactive material handling and packaging requirements will be identified in operations procedures.

11.2. Radioactive Material Storage

11.2.1 Storage of radioactive materials will be in accordance with all applicable license requirements and, at a minimum, all radioactive material storage areas will be posted. Access to these areas will be controlled to prevent unauthorized access, unauthorized removal of radioactive material, and to minimize radiation exposure.

11.3. Fire Protection Practices

11.3.1 Proper selection of a fire resistant storage area for radioactive material will minimize release of radioactivity to the environment in the event of a fire. However, the following additional fire protection practices shall be considered for storage of radioactive material to minimize the possibility of a fire and spread of contamination in the event of a fire.

- Storage of radioactive material in fire-resistant containers or spaces is desirable to minimize contamination spread. In addition, containers of highly flammable radioactive materials shall be stored in areas segregated from other storage to reduce the risk: of spreading a fire. These areas will be approved by the RSO or designee.
- Smoking shall not be permitted in radioactive material storage areas.
- An up-to-date inventory of locations where radioactive materials are stored shall be available to personnel who might be called to fight a fire in such areas. This list shall also identify unusual hazards which may be present.

• Periodic inspections of radioactive material storage areas shall be made to identify fire hazards. Deficiencies shall be promptly corrected.

• Combustible materials shall be minimized inside radioactive material storage areas and should not be stored next to surrounding walls.

• Welding, burning, or other operations which may cause a fire shall not be conducted inside or next to radioactive material storage areas without prior authorization of the RSO or designee.

11.4. Contamination Control

11.4.1 Storage locations should be considered potentially contaminated. Personnel in these areas, particularly if they handle contaminated material, shall wear Anti-Cs commensurate with the task. Reasonable care shall be taken in packaging and storing contaminated items to prevent the spread of contamination and to ensure that entry to areas where such storage is permitted does not result in the contamination of personnel or other areas.

11.5. Radiation Exposure Control

11.5.1 Storage of radioactive materials can result in possible personnel radiation exposure in the storage area and surrounding areas. Facilities should store radioactive material so as to minimize the radiation exposure of personnel entering or working in the area and of personnel in surrounding spaces. Radiation surveys of the storage area and of spaces immediately around the storage area shall be performed to ensure proper posting of radiation areas and prevent inadvertent exposure of personnel in the storage space or surrounding spaces. When necessary, temporary shielding should be used to reduce radiation levels.

11.6. Outdoor Storage

11.6.1 Radioactive materials shall be stored where they are protected from adverse weather. Radioactive material shall not be stored outside the Restricted Area. Outdoor storage is only permitted in a covered storage area with a permanent roof, or during short periods to accommodate loading or unloading as required. It is important that packaged materials be stored in a manner that permits periodic monitoring of the area and adjacent containers to ensure there is no release of radioactive materials.

11.7. Minimize Radioactive Material in Storage

11.7.1 In order to minimize the complexities of accounting for a large amount of radioactive material and the possibility of losing radioactive material, it shall be consolidated in as few areas as practical and the amount of radioactive material in storage shall be minimized.

11.8. Labeling of Radioactive Material

11.8.1 Each container of radioactive material shall bear a durable clearly visible label which identifies the radioactive contents (radionuclides present, quantity of radioactivity present, material description, date for which the activity was estimated, and radiation levels), and depicts the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL". Exceptions include the following:

• The quantity of radioactive material is less than the amounts listed 111 Appendix C 10 CFR 20 *(OAC 3701:1-38-18, Appendix A)*

• The material is continuously attended by a trained radiation worker

• The material is in transport and is packaged and labeled in accordance with DOT regulations;

• The material is contained in installed process equipment such as piping, tanks, transfer equipment, and treatment units.

• Empty containers which are used or intended to be used for the packaging or handling of radioactive materials will be clearly marked "EMPTY", and any radioactive markings defaced or removed from any container released off-site for unrestricted use.

11.9. Shipping Radioactive Materials

11.9.1 All shipments or transfers of radioactive material over public areas (i.e., public highways, waterways, airways, etc.) including shipments made with private or government vehicles, must comply with appropriate USDOT, federal, state, and local transportation regulations.

11.9.2 Shipments of radioactive material shall be performed in accordance with established plans, procedures, and/or instructions. Records of radioactive material transfer shall be maintained in the permanent site files by the RSO or designee.

11.10. Contaminated Equipment Repair. Maintenance and/or Storage

11.10.1 Equipment which has been used in the nuclear industry may require repairs, maintenance, or storage. All work of this nature is performed per *RWPs* and plans, procedures and instructions as required.

11.11. Actions and Reporting in Case of Loss of Radioactive Material

11.11.1 If radioactive material associated with GRD operations is suspected of being lost, immediately notify the RSO and OM and conduct a search for the lost material. A primary purpose of this search is to ascertain that no persons will receive inadvertent internal or external radiation exposure from this material.

12. Radioactive Waste Management

12.1. General

12.1.1 Working with radioactive material can frequently lead to contamination of structures and equipment, protective equipment and clothing, and material used in decontamination. If any of the contaminated material cannot be used further, it becomes radioactive waste. Waste minimization consists of three primary objectives; (1) source reduction, (2) recycling, and (3) volume reduction. Waste minimization must be practiced on levels of the company, from top-level management down to the worker. Training programs, procedures, and work practices will be reviewed annually for waste minimization practices.

12.2. Source Reduction

12.2.1 Source reduction activities are those which reduce or eliminate the production of radioactive waste, or seek to reduce the volume or amount of clean material that comes in contact with radioactive material. Examples include:

- Taking care to 110tstore radioactive materials with non-radioactive materials
- Removal of packaging from clean material before taking the material into the
- RCA, or bringing the minimum amount of clean material into the RCA necessary to perform a task
- Taking care to not bring clean tools, equipment or material into the RCA unless a contaminated tool, equipment or material is not already available
- Taking care not to touch a contaminated surface or allow clothing, tools, or other equipment to do so;
- Confining radioactive material and contamination to as small an area as practical to minimize the decontamination effort later
- Avoiding the use of disposable liners, drip pads or plastic floor covers in the RCA. Do use smooth non-porous surfaces that can be easily decontaminated
- Minimizing loose surface contamination levels and airborne contamination levels to prevent inadvertent contamination of adjoining areas and equipment
- Choosing decontamination methods that generate the smallest total waste volume
- Preventing spills of contaminated materials.

12.3. Recycling

12.3.1 Recycling is using, reusing or reclaiming material that would become radioactive waste and aims to delay the point at which there is no further use for contaminated equipment or material Some strategies include:

- Returning contaminated waste generated at the site while processing a customer's material to the customer;
- Recycling contaminated laundry by using it in first stage decontamination of highly contaminated areas
- Using contaminated wood for cribbing inside burial boxes
- Choosing decontamination methods that recycle or regenerate the cleaning media
- Reusing contaminated equipment or areas with as little decontamination between jobs as practical, cross contamination and dose considerations taken into account

12.4. Volume Reduction

12.4.1 Volume reduction is reducing the waste volume to the minimum practical and is not strictly waste minimization, but is essential to conserve disposal site resources. Work practices will consider the following strategies;

- Packing material in burial containers to reduce void space to a minimum
- Cutting or segmenting of odd shapes to facilitate packing
- Using compaction for compressible material
- Evaporation of liquids as much as practical before disposal.

13. **Personnel Monitoring and Bioassay**

13.1. External Dosimetry Program

13.1.1 For purposes of monitoring exposure to radiation, personnel dosimetry shall be provided to an individual likely to exceed 10% of the limits in -Section 6.1.1. The specific monitoring requirements for personnel radiation exposure for all GRD .activities is determined and approved by the RSO. Reference 2.1.8 provides the procedure for the issue and processing of dosimetry, and the recording of personnel radiation exposure for all personnel working at the site.

13.1.2 All individuals shall wear appropriate personnel dosimetry for RCA entry Visitors or contract workers shall be issued personnel dosimetry (TLD or SRD) for Radiation Area entry and shall not be allowed access to High Radiation Areas or Airborne radioactivity Areas. Specific requirements for a particular work activity shall be communicated to personnel in the ALARA briefing conducted in accordance with Reference *2.1A.* The RSO may allow access by Visitors or Contractors to an RCA provided continually monitored by a Radiation Worker with appropriate monitoring and/or dosimetry.

13.2. Thermoluminescent Dosimetry (TLD) or Optically Stimulated Luminescent (OSL) Dosimetry

13.2.1 TLDs or OSLs shall be the dosimetry of record and shall be worn on the frontal area of the torso between the neck and the waist. TLD's will be processed and evaluated by a dosimetry processor who holds current accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) for the radiation(s) most closely approximating the type of radiation(s) to which individuals are exposed. Normal issue TLDs or OSLs will be worn to assess whole body deep and shallow dose. If dose to the extremities or the lens of the eye is anticipated to exceed 10% of the limits in Section 6.1.1, special TLDs or OSLs will be issued.

13.2.2 In situations where beta radiation is significant, the lens of the eye shall receive special consideration. Personnel shall be shielded from the beta radiation using masks or eye protection (safety glasses), and/or anti-contamination clothing. If the beta radiation cannot be shielded, methods for controlling beta radiation exposure shall be evaluated and implemented to maintain exposures ALARA.

13.2.3 Certain radioactive isotopes commonly given for medical diagnostic purposes can result in measurable radiation levels for some period after receiving the administration. The dose received from this administration is exempt from regulation. All individuals shall notify the RSO if they have received such treatment. In such a situation, the person may be restricted from wearing dosimetry until the medical isotope is eliminated from the body to the extent that it will not affect TLD or OSL measurements. The purpose of the restriction is to avoid including radiation exposure from the medical isotope to that received from occupational sources.

13.2.4 Such personnel shall also be restricted from entering areas requiring monitoring for contamination until the medical isotope is eliminated from the body to the extent that it will not affect personnel monitoring equipment. In such situations, the RSO and the OM shall determine an appropriate work assignment for the individual until the restriction can be released.

13.2.5 Lost or damaged dosimetry shall be reported to the RSO.

13.2.6 Personnel dosimetry records for an individual shall be made available to an authorized requestor and to the individual upon written request. This information will be readily available to enable an individual to keep track of their own exposure.

13.3. Self-Reading Dosimeters (SRDs)

13.3.1 In addition to the TLD, SRDs shall be worn to monitor radiation exposure in certain circumstances. SRD's shall be worn in accordance with the applicable RWP. The following circumstances shall require SRD:

• All personnel entering a Radiation or High Radiation shall be monitored by a SRD WOl11 at the same location on the body as the TLD. The above does not preclude the use of SRDs for other exposure monitoring.
• Additional SRDs may be required if the location of the maximum dose on the body is not certain.
• Typically, devices used as SRDs include pocket ionization chambers or electronic dosimeters.

13.3.2 SRD Records. The RSO or designee shall maintain a log of all SRD results between routine TLD read-out cycles. Before an SRD is re-zeroed, the measured radiation exposure is recorded. The individual's monthly, quarterly and/or yearly exposure totals are determined. The individual is thereby prevented from inadvertently exceeding the administrative control levels

13.3.3 Reading SRDs. SRDs shall be read by the wearer prior to entering High Radiation or Very High Radiation Areas and periodically thereafter to maintain their own radiation exposure ALARA. To prevent an off-scale reading, dosimeters shall be read, re-zeroed, and doses recorded whenever the reading exceeds three-fourths of full scale. When a pocket dosimeter reading is off-scale or a dosimeter is lost under conditions such that an elevated exposure is possible, the person's TLD shall be processed immediately and the person restricted from work in radiological areas until their exposure bas been determined. The RSO or designee shall notify the OM for appropriate work assignment for the individual during the restriction.

13.3.4 SRD Testing Requirements. SRDs in use shall be tested at least every six months to ensure accuracy. If dosimetry performance is suspected to be unacceptable due to excessive drift or fails in use, the RSO shall initiate action to correct the problem.

13.4. Internal Dosimetry Program

13.4.1 The site internal dosimetry requirements for specific activities will be determined and approved by the RSO. Reference 2.1.9 provides the procedure for the internal radiation monitoring of individuals, submittal of bioassay samples, and the types and applications of various measurements. Specific requirements for a particular work activity shall be communicated to personnel during the ALARA briefing.

13.4.2 Internal radiation monitoring shall be performed when an individual is likely to receive an intake of radioactive material in excess of 10% of the Annual Limits on Intake (ALIs) as defined in 10 CFR § 20.1003 *(OAC 3701:1-38-12).* All personnel with the intake potential as defined above shall participate in the internal radiation monitoring program. Monitoring shall consist of baseline, routine, diagnostic, and termination bioassay sampling and/or in-vivo counts as determined to be appropriate by the RSO. Additionally, suspected intakes of radioactive materials as may be indicated by a positive routine bioassay, significant personnel contamination, elevated airborne radioactivity, or an ingestion of radioactive material shall be investigated by internal monitoring. Waivers of internal monitoring requirements may be granted by the RSO for contractors and visitors, provided the basis for the waiver is documented. Access restrictions for contractors and visitors are given in Section 6.1.7 above. Minors and declared pregnant women who are likely to receive in one year a CEDE in excess of 10% of the applicable limits in 10 CFR 20 *(OAC 3701:1-38)* shall participate in an internal monitoring program.

13.4.3 The following techniques for internal radiation monitoring shall be employed by the RSO or designee depending upon the workplace contaminant and conditions, and the nature of the activity:
• Air Sampling - Concentrations of radioactive materials in air in work areas may be used in lieu of bioassay measurements to determine internal exposure if the bioassay data is unavailable, inadequate, or the air sampling data is
demonstrated to be more accurate.
• Bioassay - An estimate of the amount of internal exposure can be calculated by measuring the quantity of radionuclides in bodily excreta (collections of
urine, feces, etc.) and relating the excretion rate to body burden by the use of biokinetic models.
• In-vivo counting - An estimate of the amount of internal contamination by gamma emitting radionuclides is obtained by measuring the gamma radiation emitted from the body and analyzing the pulse height spectrum. This technique can also be used to measure the bremsstrahlung from energetic beta emitters.

13.4.4 Each occupational intake of radioactive material that is confirmed by a positive bioassay shall be investigated and an estimate of the initial intake calculated using standard retention models.

13.4.5 For a confirmed intake, the CEDE will be determined and entered in the individual's exposure record. An intake resulting in a CEDE of greater than 0.1 rem will require an investigation to determine cause and identify corrective actions. .A. CEDE of greater than 0.5 rem will result in a restriction from radiological areas pending completion of the investigation and an exposure evaluation.

13.4.6 Procedures for the collection of in-vitro bioassay samples are found in Reference 2.1.9. The services of an accredited laboratory will be used to perform the analysis of samples. In-vivo counting shall be performed by an approved vendor.

13.4.7 All reports of internal radiation monitoring shall be maintained on site in a readily retrievable file in accordance with Section 17.0. Copies of these reports shall be made available to the monitored individual upon written request, as required by Section 17.0.

13.4.8 Exposure Records. The RSO or designee shall maintain records of personnel exposure and shall forward those records and data as required by 10 CFR 20 (OA C 3701: 1-38).Occupational exposure records are recorded on NRC Form 5 or equivalent. GRD will demonstrate compliance with the requirements of 10 CFR 20 (OAC 3701:1-38) by summing external and internal doses. Any recorded eye dose, skin dose, or planned special exposure dose will be maintained separately. Dose evaluation reports are prepared, maintained, and submitted per 10 CFR 20 (OAC 3701:1-38) and provided to workers per 10 CFR 19.13 (OAC 3701:1-38-10).

NEW YORK STATE DEPARTMENT OF HEALTH

RADIOACTIVE MATERIALS LICENSE

Pursuant to the Public Health Law, Part 16 of the New York State Sanitary Code, Industrial Code Rule 38, and in reliance on statements and representations heretofore made by the licensee designated below, a license is hereby issued authorizing radioactive material(s) for the purpose(s), and at the place(s) designated below. The license is subject to all applicable rules, regulations, and orders now or hereafter in effect of all appropriate regulatory agencies and to any conditions specified below.

1. NAME OF LICENSEE	3. LICENSE NUMBER
FEIN 45-0917795 Greater Radiological Dimensions, Inc. Phone (937) 260-3533	C5514 4. EXPIRATION DATE March 21, 2022
2. ADDRESS OF LICENSEE	5a. REFERENCE b. AMENDMENT NO.
1527 Ridge Road Lewiston, New York 14092	**DH 11-1048** -

6. Radioactive Materials (elements in mass number)	7. Chemical and/or physical form	8. Maximum quantity licensee may possess at any one time
A. Any	A. Any, as potentially or known contaminated materials	A. Any, as present at client site(s)

9. Authorized use.

Condition 6.A.:

For use incident to providing radiation protection and general health physics support to clients, as authorized under this license and approved by the Department, and in accordance with the documents referenced in Condition 11 of this license.

10. A. The Radiation Safety Officer (RSO) for this License is George Weissenburger.

B. Licensed material shall be used by, or under the supervision of, George Weissenburger, by persons with the training and experience described in Condition 16 of the License.