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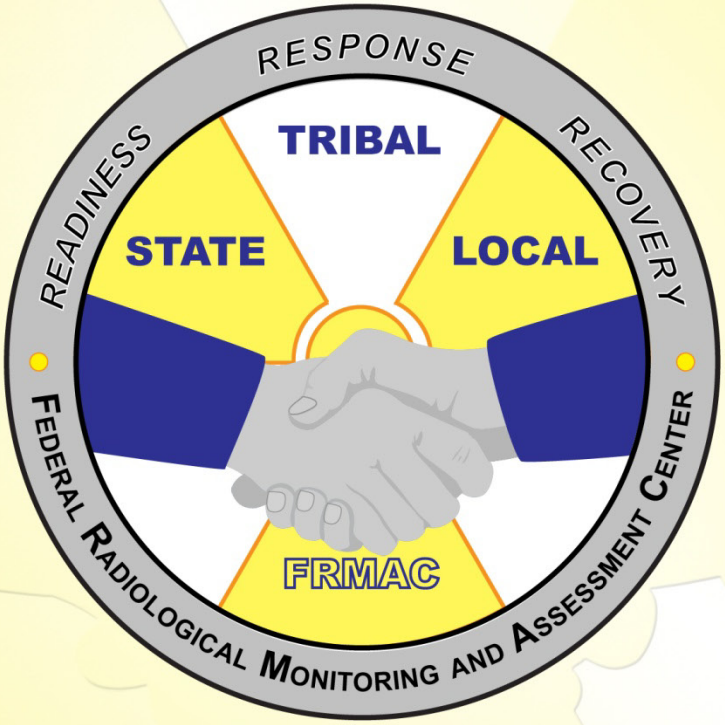
Federal Radiological Monitoring and Assessment Center

Health and Safety Manual



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FEDERAL RADIOLOGICAL MONITORING AND ASSESSMENT CENTER

Health and Safety Manual

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FRMAC HEALTH AND SAFETY MANUAL
REVISION HISTORY

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May 2001	Radiological Emergency Response Health & Safety Manual DOE/NV/11718—440	Complete Rewrite
March 2012	Federal Radiological Monitoring and Health and Safety Manual DOE/NV/25946--	Complete Review

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CONTENTS

Appendices

OVERVIEW

Scope

The FRMAC Health and Safety Manual is the document that implements radiological health and safety protection plans for the Federal Radiological Monitoring and Assessment Center (FRMAC) and complies with all applicable regulations. There is, however, very little applicable formal guidance available, particularly for Chapter Two (Health Physics). Therefore that chapter is based upon radiological protection regulations (29 CFR 1910.120, 10 CFR 20 and 10 CFR 835 where applicable), as well as Federal Guidance for the Response to Nuclear Detonation (January 2009), NCRP-138, NCRP Commentary 19, the Environmental Protection Agency Protective Action Guide (EPA PAG) Manual, and the IAEA Manual for First Responders to a Radiological Emergency (2006).

Contents

This manual provides health and safety (H&S) guidance for emergency response operations. It is organized in sections that define each aspect of H&S Management for emergency responses. The sections are as follows:

- Responsibilities
- Health Physics
- Industrial Hygiene
- Safety
- Environmental Compliance
- Medical
- Record Maintenance

Each section gives guidance on safety processes and procedures to be followed when performing work, and what is expected of managers and participants.

Copies of generic forms used to facilitate or document activities during an emergency response are available in a separate appendix. These forms ensure consistency in creating useful real-time and archival records and help to prevent the loss or omission of information.

Health and Safety Training

Responders are expected to arrive fully trained. In the event of an emergency, there will be little time available to provide training to participants, and it is not advisable to send untrained workers into the field. All organizations that deploy personnel to an emergency response should establish a

Deployment Authorization Program that tracks personnel's training and medical qualifications for deployment. This recommendation is especially true for personnel who may deploy outside the continental United States (OCONUS).

All responders need basic health and safety awareness-level training; i.e., being able to identify, respond to and report potential hazards. Workers having unescorted access to controlled areas or the potential to receive exposure to ionizing radiation during escorted or unescorted visits to controlled areas require additional training based upon:

- The nature of the hazards in area(s) to which the individual will be granted access and the nature of the work to be performed.
- The type and complexity of protective actions that the individual might be expected to undertake in the areas to be entered.
- A determination with regard to whether or not the individual will be under constant escort or supervision.
- The individual's previous education, training, and experience in working with applicable materials and in the vicinity of applicable hazards.

Determination of specific training needs is made by conducting a review of available training records and/or interview(s) by designated Health and Safety staff.

Typical radiation safety training should include the following topics, to the extent appropriate to each individual's prior training, work assignments, and degree of exposure to potential radiological hazards:

- Basic radiological fundamentals, basic terminology, types of radiation and their hazards
- Risks of exposure to radiation and radioactive materials, including prenatal radiation exposure.
- Radiation protection techniques, such as controlling the exposure to radiation and controlling contamination.
- Methods of avoiding radiation contact through the use of protective clothing.
- Physical design features, administrative controls, limits, policies, procedures, and other measures implemented to control exposures to radiation and radioactive materials, including both routine and emergency actions.
- Individual responsibilities for implementing as low as is reasonably achievable (ALARA) measures.

Application

This manual describes how radiological health and safety plans are implemented during FRMAC deployments and is to be used during emergency response (ER) activities and when preparing for

deployment. All management personnel should study the manual prior to deployment in order to be prepared to provide instruction to responders. It is suggested that all other deployed H&S personnel should also review the manual during the deployment process.

It is important that all personnel understand the definition of dose limits so that team members are prepared to take the necessary actions to prepare for the limits. The circumstances and protocol for exceeding these limits are also defined. Managers can also provide the guidance required to address the needs of supporting operations.

This manual also addresses hazards that may be encountered resulting from FRMAC-related activities during a response to a release of radiological material with a focus on radiological controls and minor considerations of other hazards present during FRMAC activities.

The FRMAC Health & Safety group would integrate with the ICS Safety Division. It is anticipated that the Unified/Incident Command Safety Officer will focus on multi-hazard scenarios where dominant hazards are non-radiological. In these situations, other Chemical and/or Biological response teams would take the lead, with FRMAC providing radiological support.

Summary

This manual is a tool to provide information to all responders and emergency planners and is suggested as a starting point for all organizations that provide personnel/assets for radiological emergency response. It defines the safety requirements for the protection of all emergency responders. The intent is to comply with appropriate regulations or provide an equal level of protection when the situation makes it necessary to deviate. In the event a situation arises which is not addressed in the manual, an appropriate management-level expert will define alternate requirements based on the specifics of the emergency situation. This manual is not intended to pertain to the general public.

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1.0 RESPONSIBILITIES

1.1 Health and Safety Responsibilities

A Health and Safety (H&S) Manager will be assigned for all FRMAC response activities. The H&S Manager is responsible for the health and safety of all personnel involved in FRMAC operations. This section outlines the tasks associated with ensuring the health and safety of personnel throughout the duration of deployment.

The H&S Manager reports to the senior FRMAC official and coordinates all H&S issues. The H&S Manager, or designee, is also required to monitor and present the status of health and safety issues at the beginning of each shift and during shift safety briefings.

The H&S Manager is responsible for keeping the FRMAC Director and FRMAC Manager current regarding work conditions. The H&S Manager is also responsible for coordinating Health and Safety Plans with the Safety Officer in Unified/Incident Command. It is imperative that the FRMAC's activities are compliant, and not in conflict with, the overall Site Safety Plan.

1.2 Hazard Assessments

Hazard Assessments are used to identify radiological, industrial hygiene, safety, and medical conditions, and are used to plan and control work as well as inform responders about work area conditions. A *Hazard Checklist* (see Appendix A) provides a standard reference for the hazard identification process. All personnel shall be briefed on the hazards associated with operations.

1.3 Site Health and Safety Plan

An H&S Plan will be developed for each deployment. Depending on the circumstances at the site, the plan may be as brief or complex as the situation warrants. The plan should identify hazards associated with the specific deployment and methods to mitigate those hazards.

The *Emergency Response Health and Safety Plan* (Appendix A) is a valuable template to be used upon arrival. This initial H&S Plan can be expanded or rewritten for a longer-term and/or more complex response.

1.4 Daily Health and Safety Communications

Field teams will be briefed on a daily basis prior to the start of work. A daily Safety Summary will be prepared for situations where shift schedules, work locations or other requirements interfere with attending or holding routine safety briefings. The Safety Summary would include highlights from the site Health and Safety Plan (HASP) and other pertinent information (e.g.weather, operations center

dose rates, etc). A recognized H&S representative will conduct the briefing, and all responders for each shift are required to attend. The type of information to be included in the briefing includes:

Scope of work to be performed

Monitoring needs will vary depending on the emergency, the responding organization(s), and local emergency responders. The staff of the responding organization(s) may be required to operate in a wide variety of settings (in vehicles, in public facilities) and perform various functions, such as:

- Sample collection
- Area monitoring
- Monitoring in vehicles
- Personnel surveys
- *In situ* measurements

Conditions of the deployment location

Personnel should be aware of local surroundings. Weather conditions should be reported to personnel at regular intervals and as changing conditions warrant. Personnel should be briefed on local flora and fauna and any hazards they present.

Existing radiological, chemical, biological or other hazards need to be communicated to monitoring teams. It allows responders to be prepared for encountering any expected or possible circumstances such as:

- Climate (weather)
- Biohazards (snakes, ticks, poisonous plants, etc.)
- Expected radiological contaminants/levels
- Expected chemical contaminants/levels
- Possibility of terrorist activity and use of weapons of mass destruction
- Traffic expected (is the area evacuated?)
- Response of local population

Personal Protective Equipment (PPE)

A PPE briefing will be presented to the field teams prior to potential hazard exposure. The briefing will include a discussion of the type of PPE (such as anti-contamination [anti-c] clothing and/or respiratory protection) to be used for each hazard and instructions on when to don and doff PPE.

Dosimetry

Field teams will be briefed on dosimetry requirements prior to any potential radiation exposure and an H&S representative will ensure personnel have the appropriate dosimetry, such as:

- Whole body dosimetry

- Supplemental dosimetry
- Neutron dosimetry
- Extremity dosimetry

In addition, personnel should have available:

- Material and equipment for Bioassay
- Material and equipment for Personal air sampling

Special hazard mitigation requirements

Once existing or expected hazards are identified, the methods required to mitigate these hazards must also be communicated and provided. Work/rest regiments for hot or cold conditions should be identified and obeyed. Special clothing requirements for weather conditions should be identified and provided. Local climate conditions should be announced (e.g., roads that flood, roads that freeze, etc.). Traffic conditions and roads to be avoided based on traffic, climate, hazardous, and/or radiological conditions should also be noted, and include:

- Road safety
- Heat/cold/climate safety

Hold points/ turn-back points

Turn-around or hold points will be established when the hazard exceeds the level of prescribed protection. Points shall be established for field teams where additional control (such as gloves/boots, anti-c's, or respiratory protection) will be required. The H&S Manager will determine turn-around points based on expected conditions and risk involved, such as:

- Turn-back levels for radiological, chemical, heat/cold, etc.
- Call in points
- Access control points

Emergency Procedures

All personnel need to be made aware of emergency response procedures. This includes general reporting of fires or accidents and any unusual activities. Monitoring teams also need to understand proper handling of contaminated persons or materials.

Debriefing

Debriefing of participants should be incorporated into the daily routine (at the end of each shift) to identify hazards that should be discussed in the next shift's safety briefing.

1.5 Develop Task Health and Safety Summary

Develop H&S summary for specific tasks (e.g., ICS-204 form).

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2.0 HEALTH PHYSICS

2.1 Radiation Protection: Dose Limits

Several references address dose limits for response personnel during an emergency. Unfortunately, the definition of when an emergency begins and ends is very rarely included. The FRMAC Health and Safety Working Group has adopted the following dose guidance limits and early "phase" definitions taken from a *Manual for First Responders to a Radiological Emergency* (IAEA – ERP-2006) and EPA PAG (EPA-400-92R). This means that the dose acquired by an individual during the emergency would not count toward their occupational dose until Type 4 Tasks are being conducted. With regards to FRMAC, Type 4 Tasks begin to occur at approximately the same time management of the FRMAC transitions to the EPA (see Nuclear Radiological Incident Annex to the National Response Framework). The H&S Manager, or designee, is responsible for assuring personnel understand and work within these requirements.

Safety is the number one consideration in rescue and recovery operations. Management staff shall weigh actual and potential risks against the benefits to be gained. No individual shall be required to perform rescue actions that might involve substantial personal risk. Each individual authorized to perform emergency activities likely to result in doses exceeding 5 rem shall be appropriately trained and briefed beforehand on the known or anticipated hazards. Table 2.1 provides a summary of dose limits.

Table 2.1 – Task Based Dose Guidance for Emergency Workers

Tasks	Total Effective Dose Guidance (rem)
Type 1 Life saving actions	25
Type 2 Prevent serious injury Avert a large collective dose Prevent development of catastrophic conditions	10
Type 3 Short term recovery operations Implement urgent protective actions Monitoring and sampling	5
Type 4 Longer term recovery operations Work not directly connected with an accident	Occupational dose guidance

2.1.1 Emergency Dose Guidance

Type 1, 2 and 3 activities are considered emergency activities. Every possible effort should be made to adhere to occupational dose limits during these activities. If a person's combined emergency and occupational dose exceeds 5 rem (normal occupational dose limit), it is expected that the individual would be removed from potentially receiving any further dose during that calendar year.

The senior management official, or designee, must concur with any planned dose that exceeds the occupational limit. Early dose limits of 5 rem for basic work activities, 10 rem for protecting major property, and 25 rem for lifesaving or protecting large populations, are recommended only for emergency situations. In special circumstances, a dose in excess of 25 rem may be authorized by the Incident Commander and/or Unified Command. Note that dose received from lifesaving activities would generally be considered acute dose and is therefore not measured in rem. Additional dose guidance for first responders can be found in NCRP 138 and NCRP Commentary 19. A summary of values is found in Table 2.1.1 below.

Table 2.1.1 – Task Based Dose Guidance for First Responders

Tasks	NCRP 138 NCRP Commentary 19
Life-saving actions	50 Rad
Fire fighting Medical treatment	Turnback Level: 10 R/hr Perimeter Level: 10 mR/hr
Prevent serious injury Prevent development of catastrophic conditions	
Non-emergency activities	Occupational dose

2.1.2 Occupational Dose Limits

Type 4 activities from Table 2.1 above are considered occupational in nature and subject to occupational dose limits. The annual maximum allowable sum of external and internal dose (Effective Dose [E]) for a radiological worker is 5 rem. An administrative limit of 1.25 rem will be used. This administrative limit corresponds to the OHSA 1.25 rem per quarter dose limit. The H&S Manager may set lower administrative limits, based upon on-scene conditions. Examples of additional dose limits include 15 rem for the lens of the eye and 50 rem for the extremities, skin, thyroid, and other organs. The H&S Manager must review any dose above the administrative limit.

All response activities are considered to be occupational dose unless specifically designated as emergency activities. All responders with the potential to exceed 100 mrem will require dose monitoring. Responders will be asked to provide an estimate of annual year-to-date dose when dosimetry is requested. FRMAC H&S will follow up with the individual's home organization to obtain dose of record.

2.1.3 General Personnel Dose Limits

General personnel who have not completed appropriate training to perform radiological work are administratively limited to an annual dose of 0.1 rem.

2.1.4 Pregnant Worker Policy

A dose limit of 0.5 rem for the gestation period, or 0.05 rem per month, is established for pregnant radiation workers who have declared their pregnancy to the H&S Manager in writing. The employee will be counseled regarding the risk of radiation dose to the fetus. The Pregnancy Declaration (see Appendix A) shall be used to document the declaration of pregnancy. The Declared Pregnant Worker Policy will be briefed during each field team briefing, as applicable.

Table 2.2 – Summary of Dose Limits

Type of Dose		Annual Limit
Radiological Worker*:	Whole body (internal[1] + external)	5 rem
Radiological Worker*:	Lens of eye	15 rem
Radiological Worker*:	Extremity (hands/arms below the elbow; feet/legs below the knees)	50 rem
Radiological Worker*:	Any organ or tissue[2] (other than lens of eye) and skin	50 rem
Declared Pregnant Worker:	Embryo/Fetus	0.5 rem (gestation period)
Minors/students under age 18:	Whole body (internal + external)	0.1 rem
Visitors** and public:	Whole body (internal + external)	0.1 rem

* Radiological workers are employees authorized to have unescorted access to radiological areas.

** Applies to visitors who have not been trained and must be escorted.

1. Internal dose to the whole body shall be calculated as committed effective dose equivalent. The committed effective dose equivalent is the resulting dose committed to the whole body from internally deposited radionuclides over a 50-year period after intake.
2. The annual limit of dose to "any organ or tissue" is based on the committed dose to that organ or tissue resulting from internally deposited radionuclides over a 50-year period after intake plus any external effective dose equivalent to that organ during the year.

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

2.2 Radiation Protection Policy: Dosimetry

Any participant with the potential to receive a dose in excess of 0.1 rem for the response period is required to participate in the dosimetry program. The type of dosimetry required will depend on the situation at the site of deployment.

For a FRMAC response, National Voluntary Laboratory Accreditation Program (NVLAP) or U.S. Department of Energy Laboratory Accreditation Program (DOELAP) dosimetry will be available to all participants. FRMAC will provide a dose report to each participant's home organization after the conclusion of the individual's activities. A responder has the option to wear their home organization's dosimeter in addition to, or instead of, the FRMAC-issued dosimeter. If an individual chooses to only wear their organization's dosimetry, they would need to have dose of record information available to FRMAC for FRMAC-related activities. Each participant should follow their home organization's policy regarding the wearing of dosimetry.

2.2.1 External Dosimetry

Whole body dose resulting from gamma radiation will typically be measured through the use of TLDs and Direct Reading Dosimeters (DRDs). Some response organizations may use optically stimulated luminescent (OSL) dosimeters or film. Dosimeters will be provided and issued by the H&S staff. DOELAP-accredited neutron dosimeters will be issued to an individual if there is a potential to receive a neutron dose in excess of 0.1 rem. DOELAP accredited extremity dosimeters will be issued when an extremity dose has the potential to exceed whole body dose. Electronic dosimeters (EDs) with the capability to alarm at preset dose levels will be used when a potential exists for doses above 1 R/hr or 0.5 R cumulative dose per shift, unless directed otherwise by H&S staff.

The TLDs and DRDs will be issued and exchanged only by the H&S staff at designated locations. Personnel must provide their name, social security number, home organization, and estimated year-to-date TEDE to the H&S staff. Key information, including the identification number of the dosimeter issued and the time/date, will be recorded on the Pocket Dosimeter Issue Log or the Personnel TLD Data Sheet (see Appendix). All of this information will be controlled as Personally Identifiable Information (PII),

Guidance for wearing an external dosimetry device includes:

- The whole-body dosimeter must be worn on the chest area on or between the waist and the neck unless otherwise instructed by H&S personnel. Care should be taken that the dosimeter is worn properly, with the beta window facing away from the body.
- The dosimeter is to be worn only by the individual to whom it was issued.
- Lost, damaged, or contaminated dosimeters must be reported immediately to the H&S staff. If a participant discovers that his/her dosimeter is missing while in a radiological area, he/she shall immediately notify the team leader and report the missing dosimeter to the H&S Manager. An estimate of the person's dose will be performed and a new dosimeter will be issued by H&S.
- Dosimeters must be returned or exchanged at the time designated by the H&S Manager, upon request, or at the end of the operation.

Upon return of the dosimeters, H&S staff must log in the time/date of return. The TLDs will be sent to the DOELAP accredited responsible laboratory for processing. Direct-reading dosimeters must be returned and read at the end of each shift by the H&S staff. The dose data shall be recorded for each individual. If a participant's DRD indicates a dose over 0.5 rem, the H&S staff member recording the result must immediately notify the H&S Manager. Dose-of-record will be tracked by the processing laboratory, while initial dose estimates will be tracked by the FRMAC H&S staff.

2.2.2 Internal Dosimetry

Bioassay Assessment Methods

Bioassay is the term used to describe the assessment of the quantity of radioactive material present in the body. There are currently two types of bioassay measurements employed in nuclear industries: *in vivo* and *in vitro*. *In vivo* bioassay involves counting the living tissue. *In vitro* involves counting an excreted sample, such as urine. Personnel shall submit bioassay samples (urine and fecal samples) and participate in bioassay monitoring (whole body or lung counting) at the frequency specified by the bioassay program.

Bioassays may be required during general operations or may be initiated in response to an occurrence to determine if there has been an intake of radioactive material. Bioassay sampling may be requested to provide follow up to a known intake in order to quantify the intake and to monitor the status of the radioactivity to refine the dose assessment.

Whether or not bioassay is warranted is usually based on the following, though bioassay may be requested as a precautionary measure at the discretion of H&S staff in the field:

- How much material was released and what is the respirable fraction?
- How long was the person in an airborne radioactivity area?
- Were respiratory protection and anti-contamination measures employed?

Identifying which bioassay technique to use is determined by knowing the type of contamination present in a particular work area. Contamination control measures must be stringent during collection, handling, and analysis of bioassay samples. Cross-contamination can cause erroneous assumptions and inaccurate dose assessments.

In Vivo Measurements

In vivo techniques consist of direct measurements of gamma or X-radiation emanating from the body. Because participants will be arriving from multiple deployment points, obtaining *in vivo* baseline bioassays will often be impractical. However, this method is very useful for any radionuclide which emits (or has daughters which emit) photons of sufficient energy to escape the body. The photon fluence must be large enough for measurement in a reasonable time period, even though the quantity of material in the organ is very small.

In vivo measurements may also be useful for thyroid, wound, or post-intake whole-body counting. Whole body counts, lung counts, thyroid counts, and biological sampling should be performed as soon as practical after a suspected intake of a photon emitter. Some examples of appropriate non-routine *in vivo* bioassays are:

- Lung counts following a suspected intake of thorium, uranium or any of the transuranics (though not as sensitive as analysis of bioassay samples)
- Whole body counts for detecting most gamma-emitting fission and activation products
- Thyroid counts for suspected radioiodine uptakes

The *in vivo* method is possible only for those radionuclides emitting penetrating radiation, (e.g., Co-60 and Cs-137) or bremsstrahlung, (e.g., P-32 and Sr-90). Many radionuclides (Na-22, Fe-59, Co-60, Zn-65, Rb-86, Sr-85, Te-132, I-131, Cs-137, Ba-140, Ce-144, Au-198, U-235, Np-239, and Am-241) emit electromagnetic radiation of sufficient energy to be measured by external counting. Acquiring measurements in this way is often more acceptable to the person undergoing testing than providing samples of excreta, although this does require the person to be absent from work during the period of measurement.

In Vitro Measurements

The amount of material present in the body is estimated using the amount of materials present in excretions or secretions from the body. Qualitative or quantitative samples could include urine, blood, breath, sputum, sweat, saliva, hair, nasal discharges, tissue, and feces. Fecal bioassays are typically used for alpha-emitting radionuclides if a lower minimum detectable activity is required. However, due to the rapid deployment, acquiring fecal samples may also be impractical.

Urine bioassays will be the sampling method of choice for most applications. As a default, a one-liter (or 24-hour) sample should be collected prior to exposure to contaminants (as practical), every two weeks and at the conclusion of activities. Sampling frequencies can be adjusted, based upon the unique circumstances. A urine bioassay may be required for detection of pure beta-emitters such as Sr-90 and Sr-89.

Performing calculations require knowledge and use of metabolic models, which allow sample activity to be related to activity present in the body. The resulting dose calculations used to quantify committed and effective dose equivalents are estimates, representing an “average”. This is due partly to use of default values for measurements that cannot be readily made (such as mass of particular organs, volumes of particular fluids, metabolism rate, etc.) in lieu of actual values for each individual involved.

2.3 Air Monitoring

Since committed dose equivalent (CDE) and committed effective dose equivalent (CEDE) are generally dominated by the inhalation pathway component, dose estimates can be made by using air-

sampling data. Air monitoring is performed to assess airborne contaminants. Though directed primarily toward monitoring of airborne radiological contaminants, much of this section also applies to toxicological hazards.

Monitoring of airborne radioactivity should be conducted to characterize potential exposure conditions, verify the effectiveness of any engineering and administrative controls, and estimate daily CEDE and/or CDE from inhaled radionuclides. It is important to note that the CEDE and CDE are not normally determined from air sampling analysis data, unless other information, such as bioassay data, is unavailable, inadequate, or internal dose estimates based on representative air concentration values are demonstrated to be as, or more, accurate.

The primary goal of the air monitoring program is to determine if the level of protection provided to the worker is sufficient to minimize the internal dose equivalent. Allowable concentration values, such as derived air concentrations (DACs), are used as an index of the degree of control needed and achieved. Documented measurements of the airborne radioactivity concentrations are required to demonstrate that satisfactory control is achieved and maintained.

For some operations, Personal Air Samplers (PAS), sometimes called breathing zone area (BZA) samplers, may yield the most useful data for estimating dose. When counting samples caution should be taken to account for radon and thoron progeny present on samples. Results may be influenced for several days until the radon and thoron progeny decays. While the effect is significant for any sample, it is particularly a problem when analyzing for radionuclides with low DACs such as ^{239}Pu.

Air sampling should be considered when the potential exists for air concentration intake results to exceed 2% of the annual limit of intake (ALI) (40 DAC-hours). Other reasons to sample are:

- To determine the need for respiratory protection of workers
- To assist in determining the type and frequency of bioassay measurements needed for a worker to provide an estimate of worker doses for situations where bioassay measurements may not be available or their validity is questionable.

PAS, high-volume area air samplers, or continuous air monitors (CAMs) may be used to measure the concentration of airborne radioactive material.

PAS generally yield the most representative data for estimating personnel doses. High-volume area samples will yield better statistical results than PAS (greater volume sampled). However, they may not be good indicators of airborne radioactivity in a person's breathing zone. This is especially true in outdoor environments where air patterns cannot be accurately predicted. Breathing zone air monitoring should be performed continuously in areas where workers are likely to exceed 100 mrem during the event. Breathing zone air monitoring is used to identify possible internal dose risks for workers and the need for follow-up bioassay measurements.

Grab-air sampling is used for temporary or non-routine (e.g., emergency response) situations and as a backup for other types of air sampling in the event of equipment failure. Portable air sampling equipment is typically used for operations requiring a grab sample. Sample flow rates may vary depending upon the specific application, but should always allow collection of a sample volume adequate to ensure that the minimum detectable activity of the sampling and counting system is no greater than concentrations which result in intakes exceeding 2% of the ALI(40 DAC-hours).

The PAS are small, portable, battery-powered devices which sample the air in the breathing zone of the worker's environment, reducing the degree to which the samplers may interfere with a worker's activities. Some characteristics are:

- The device contains a small battery-powered pump that is calibrated to a flow rate approximately 2.5 liters per minute, the breathing rate of a worker performing light activity.
- The sampling line terminates in a filter cassette, which contains the filtration medium for the radioactive particulate contaminants.
- The sample filter cassette is attached as near as possible to the breathing zone of the individual, typically on the lapel or upper quarter of the torso.

High Volume/Flow Rate Samplers

High volume/flow rate samplers provide an estimate of the airborne radioactivity concentration at a particular location in a short period of time. Portable high-flow rate samplers are used to collect airborne aerosols on a filter paper (filtration) or on a greased planchet (impaction). Portable high-flow rate samplers can also be used to collect radioiodine samples using activated charcoal cartridges (adsorption) as long as the maximum flow rate of the cartridge is not exceeded or a correction factor is used. These samplers do not have installed detectors and the sample must be removed from the sampler and analyzed on separate analysis equipment. The high volume/flow rate samplers may:

- Provide a routine "slice-of-time" estimate of the general area airborne radioactivity
- Verify boundaries of areas posted for airborne radioactivity
- Monitor the airborne radioactivity related to a specific work activity.

High volume samplers typically use flow rates of at least 10 cubic feet per minute (cfm). Although these samplers are noisy and not intended for continuous duty, the higher flow rates allow for greater sensitivity.

Low Volume/Flow Rate Samplers

Low volume/flow rate samplers provide an estimate of airborne radioactivity concentrations averaged over a longer period of time at a particular location. Portable low volume/flow rate samplers are used to collect samples for aerosols on filter paper (filtration) and radioiodine on an adsorption medium, such as an activated charcoal cartridge or silver zeolite. Low volume/flow rate samplers may be used to provide average airborne radioactivity estimates over a period of time for:

- Commonly traversed areas that normally have a low probability of airborne radioactivity problems
- Areas not commonly traversed with a higher probability of airborne radioactivity problems
- Back up samples in areas where airborne radioactivity problems are discovered by other means.
- Estimating internal dose.

Low volume samplers generally have flow rates set at approximately 0.5 to 5 cfm, often matching the breathing rate of a worker performing light activity (20 liters per minute [lpm]). Although these samplers must run longer for reasonable sensitivity, they are generally quiet and can be used for continuous duty.

Portable Continuous Air Monitors (CAMs)

Portable CAMs provide an estimate of airborne radioactivity concentrations averaged over time at a particular location, and provide immediate readout and alarm capabilities for preset concentrations. These air monitors are portable low-flow rate sampling systems, containing the necessary sampling devices and built-in detection systems to monitor the activity on the filters, cartridges, planchettes, and/or chambers in the system. The system may provide a visual readout device for each type of sample medium, a recording system for data, and computer functions such as data trending, preset audible and visual alarms/warning levels, and alerts for system malfunctions. Typical CAMs provide information on alpha and/or beta/gamma particulates (filtration), radioiodine activity (adsorption), and noble gas activity (volumetric chamber or in-line detector). Portable CAMs can be utilized as:

- Monitors with alarm capabilities for areas where airborne radioactivity conditions may quickly degrade
- Trending devices in selected areas.

CAMs are useful where airflow patterns are well established, but have limited use in outdoor environments with changing airflow patterns. However, progress has been made on environmental CAMs that allow data transmission over a radio frequency (RF) link, thus permitting users to assess airborne radioactivity concentrations in real time and at a distance.

2.3.1 Assessment of Air Monitoring Needs

It is critical that the proper air sampling method and equipment be selected because the data obtained must be meaningful and accurate to adequately assign radiological control measures. Improper selection and use may incorrectly indicate a safe environment where an airborne radiological hazard exists or leads to unneeded actions where no hazard exists. There are several factors to consider when selecting an air sampling method.

The environmental conditions in the area where the sample is to be obtained

Humid conditions may preclude the use of some methods, such as paper filtration devices or charcoal canisters, because water vapor loading of the medium will change the collection efficiency and flow rate. High temperature environments may cause some samplers to overheat if run for long periods of time. Explosive gases may be present which could present an explosion hazard for samplers with electric motors not designed for such environments. Dusty areas could cause excessive sample loading, which will reduce sampler flow rates and potentially overheat the sampler. Corrosive environments may lead to the deterioration of the sampling device.

The physical characteristics of the area in which the sample is to be obtained

If an electrical outlet is not available, a battery-powered sampler or portable generator may be required. If portable generators are used, ground fault circuit interrupters shall be employed. Care should be taken while fueling hot generators. The generator should be turned off during refueling and a fire extinguisher should be available. When extension cords are used, care should be taken not to exceed the load capacity of the cord. Close spaces or passages may preclude the use of movable CAMs or heavy samplers.

The expected concentration level

This will determine the length of sample time and type of sampler required. Low-level concentrations will require large volumes to reduce statistical errors and meet minimum sensitivity levels of the analysis equipment. When large volume samples must be taken over a long time period, it is best to use samplers designed to run for long periods. If immediate readout of information is needed, an initial screening can be performed in the field. If not, then samples may be taken and removed to a central analysis location.

The physical state of the airborne contaminant

The sampler and sample medium required is dependent upon whether the contaminant is gas, vapor, or aerosol.

The type of survey required

The type of survey required will be dictated by the type of samples needed (breathing zone samples, routine general area samples, general work area samples, general area trending over time, etc.). This will also determine the type of equipment that is selected.

Air monitoring will be performed to monitor the workplace concentrations of airborne contaminants. Airborne contamination surveys of accessible areas will be conducted as follows:

- During any work or operation known or suspected to cause airborne contamination, such as any grinding, welding, burning, cutting, vacuuming, sweeping or use of compressed air. Decontamination work with volatile chemicals on contaminated equipment or during waste compacting operations is also included.

- During initial entry (and periodically thereafter), into any area known or suspected to contain airborne radioactivity concentrations in excess of 40 DAC-hrs.
- During initial entry (and periodically thereafter) into any area known or suspected to contain an appreciable area of loose surface contamination. Thresholds would have to be determined on a case-by-case basis and would be dependent on resuspension levels and the type of the material.
- Immediately following the discovery of a significant spill or spread of radioactive or toxic materials or any other time airborne contamination levels may have increased.
- Periodically in radiological areas where the potential for airborne radioactivity exists.

2.3.2 Representative Samples

Several factors must be considered to maximize the efficiency of airborne radioactivity detection. Self-absorption losses (e.g., dust loading) should be minimized. This is especially critical for alpha radiation detection. Air in-leakage between the sample intake and the sample collection medium should be eliminated to the greatest degree possible. Finally, the sample collection system and mechanisms within the instrument should be designed and constructed to minimize deterioration and to facilitate decontamination. This is more critical in areas with corrosive atmospheres.

When obtaining an air sample be sure to take the sample at the point of interest (the breathing zone). Depending on the source of the airborne contaminant, the concentrations within a work area can vary over several orders of magnitude. The sample taken should be representative of the air entering the nose and mouth of the individual workers since the data obtained may be used to estimate potential worker intakes. The best sampling method is to sample the air as close as possible to the breathing zone of the individual (typically on the lapel or upper quarter of the torso).

This sampling method may not always be practical and general work area sampling may be the alternative. Care must be exercised in the selection of the number and placement of the general area air samplers to ensure that the sample is as representative as possible.

2.3.3 Calibration of Air Sampling Instruments

It is anticipated that Mine Safety Appliances PAS (or equivalent) will be used. The PAS will be calibrated and inspected monthly (or in accordance with manufacturer's specifications), with maintenance being performed as needed. If other PAS are used, they will be calibrated and maintained in accordance with manufacturer's instructions. If the manufacturer does not provide calibration instructions, calibration will be performed before and after each use.

2.3.4 Counting Procedures

Filters should be counted using a scaler which allows counting of both alpha and beta types of radiation. Scalers should be operated in accordance with counting swipe samples (see Instrument

Section 2.6). Care should be taken to account for the presence of radon and thoron progeny. Three methods are possible:

1. Samples can be counted via alpha or gamma spectroscopy. This would allow the radon and thoron progeny contribution to be determined and accounted for. This solution would yield the most accurate results in the least amount of time. However it would require additional counting equipment and staff training to operate the equipment.
2. Counting could be delayed to allow for decay of the radon and thoron progeny. Though this is generally the most common solution, there is a time delay in producing useful data and it reduces sensitivity to short-lived radionuclides of interest.
3. One of several multi-count methods could be used to determine the radon and thoron progeny component of the total alpha/beta count. These methods are labor intensive, as they require multi-counts at specific time intervals. Though the radon and thoron progeny component can be determined, the statistical errors incurred can be significant.

Note: There may be occasions where the sample may be field counted in an area of elevated background radiation. For example, Consequence Management personnel, when responding to the incident at the Fukushima Daiichi nuclear power plant, were located in an area of fluctuating elevated background. The use of blank subtraction is especially important in this situation. In addition, sample uncertainty is increased and should be included in initial dose estimates.

2.3.5 Estimating Dose Based on Air Sampling Data

The analysis of the sample provides the activity of the sample at the time of the sample analysis. This value may be corrected for decay from when the sample was taken to when it was analyzed.

The sample volume must be determined from the recorded sample data (flow rates at the beginning and end of the sample, and sample time period). The conversions necessary for the desired units such as dpm/liter to µCi/cc must also be included in the basic calculation below.

The calculation would also include correction factors, as necessary, for:

- Interference of other radionuclides, such as radon and thoron daughters
- Collection efficiency
- Counter efficiency
- Self-absorption by the sample media
- Counter background
- Temperature and pressure as applied to flow rate.

Many errors are inherent or induced in the sampling analysis process and affect the accuracy of the resulting data. The operator of the sampling and analysis equipment must be aware of these points of error to ensure the resulting data is as accurate as possible. Quality assurance that is applied to all phases of the air-monitoring program will minimize many errors.

The air-monitoring program for radiological operations (occupational, not environmental) primarily consists of breathing zone area monitoring (personal air samplers) and high-volume area monitoring. Both types require some calculations to determine useful information (dose, percent DAC, etc.).

Breathing zone area monitoring is used both to determine respirator needs and to estimate committed dose. Each application requires a different type of calculation. Respirator needs are determined using the equation above. If the resulting concentration is greater than 40 DAC-hrs, then respiratory protection should be considered. Committed dose is estimated using ALI and the ratio of air sampling rate (~2.5 lpm for BZAs) to the average breathing rate of reference man (20 lpm) or ~0.1 × ALI.

$$ConversionFactor(dpm/mrem)=(ALI/5{,}000mrem)*(PASrate/breathingrate)$$

This calculation can be used to assign dose provided there is no background subtraction.

Another method of dose estimating is through the use of DAC-hrs. This estimate is most useful when estimating dose based upon air "grab" sample results. Air concentration is divided by the DAC value to determine the number of DAC-hrs. Since there is 2.5 mrem per DAC-hr, multiplying through by number hours exposure would yield dose (or dose rate if per hour). Knowledge of the isotopic mix is required for estimating dose for multiple isotopes. Once the internal-to-external dose ratio is determined, either through calculation or empirically through measurements, turn back levels can be determined and dose estimates can be made. A simple case is presented below:

For example, 4.65×10^{-2} µCi I-131 in a volume of 4.13×10^{6} ml, the dose rate would be approximately 1.2 mrem/hr (Whole-Body DAC for I-131 is 2×10^{-8} µCi/ml {from 10 CFR 835 Appendix A}). Note this method is only for estimating dose only. If estimates indicate the potential for exceeding greater 100 mrem internal dose, bioassay is indicated.

Documenting Results

The results of airborne radioactivity surveys shall be documented and retained in accordance with Section 7. Each record shall include the following (or data from which the following can be derived):

- Date and time the air sample was taken (both start and stop date/time)

- The location of the air sample
- The volume of air sampled
- The results of the sample counting
- The instrument number of the air sampler used
- The instrument number of the counter(s) used
- The name of the person obtaining the sample
- The name of the person counting the sample.

2.4 Contamination Control

Contamination control is required when either radiological or chemical contamination is detected.

2.4.1 Radiological Contamination Monitoring

In order to acquire the radiological information necessary for contamination control, there are several components to a radiological monitoring program. These include:

- Area and equipment surveys
- External personnel surveys.

2.4.1.1 Area and Equipment Surveys

Area and equipment surveys are conducted routinely both in the field and around the deployment location, to locate sources of contamination and to detect potential changes in radiological conditions. Pre-job surveys are performed prior to work in radiological areas (when practical) in order to evaluate the hazards and determine work limitations and physical safeguards. Table 2.4.3.b will be used to determine release of areas and/or equipment. The Multi-Agency Radiation Survey and Assessment of Materials and Equipment (MARSAME) can also be used to determine release criteria.

Direct instrument surveys

Various types of portable survey instrumentation are used to measure the presence of radioactive contamination on the ground, a floor or other surface. This is the only method available to detect "fixed" surface contamination; however, this method will detect removable contamination activity as well. As a result, a direct survey is often combined with a "smear" survey to determine if the surface contamination present is removable or fixed. Measurement of positive ground contamination does not warrant smear surveys to determine if contamination is removable or fixed.

Smear surveys

Smear surveys are required before the release of equipment, vehicles, etc. A disk smear is wiped over an area of 100 square cm and counted by using specific instrumentation to determine the

activity of the nuclides present. Contamination levels are specified in units of dpm/100 cm^2 after applying applicable instrument correction factors. For objects less than 100 cm^2, the units are reported as dpm/object area. Disk smears are small so they are usually used in an area of suspected contamination. An experienced surveyor can deduce where contamination is most likely to occur and survey those areas with disk smears. Disk smears are required if contamination levels are to be quantified.

2.4.1.2 External Personnel Surveys

Personnel surveys are performed whenever contamination of the body or clothing is suspected, or as required for exit monitoring. Personnel surveys may be conducted by the individual (self-monitoring) using hand-held or automated instruments, or by the H&S staff. Personnel monitoring by an H&S staff member is usually conducted whenever contamination of the body or clothing is suspected, or as required by exit monitoring when self-monitoring is not feasible (remote location) or not allowed. Portable instruments with sensitive hand-held detectors are used by personnel to identify contamination (on them) whenever contamination is suspected. Geiger-Mueller (GM) detectors are most often used for beta-gamma monitoring and scintillation detectors for alpha monitoring.

2.4.2 Methods of Contamination Control

For an emergency response, contamination control refers to both an impacted area and support resources. Field teams will have a high probability of encountering radioactive contamination. They should incorporate contamination control into their work routines to minimize their potential dose, prevent contamination of their equipment, and to reduce cross-contamination of samples. Contamination control is also an integral part of support resource operations. Operations conducted at the hotline (personnel, sample, equipment, etc.), decontamination activities, and laboratory activities can be impacted by spread of radioactive contamination.

Once radioactive material has been located, the basic goal underlying any effective contamination control program is to minimize contaminated areas and maintain contamination levels as low as reasonably achievable (ALARA).

In some situations, this is not always possible due to economic conditions and/or radiological conditions. For example, the cost of time and labor to decontaminate a location(s) may out-weigh the hazards of the contamination present. Or perhaps radiation dose rates or other radiological conditions present hazards which far exceed the benefits of decontamination. Other means of contamination control must be initiated when decontamination is not possible. Engineering control (dust control/containment), administrative procedures, and PPE are alternatives.

Good housekeeping is critical to an effective contamination control program. It involves the cooperation of all personnel and groups within the incident and response support areas. A sound preventive and corrective maintenance program can prevent the spread of radioactive material and

help to confine contamination to the smallest possible area. All material taken into or out of contaminated areas must be controlled, and H&S staff can assist with implementing controls or identifying the need for improved contamination controls.

Controlling the spread of contamination will be one of the most difficult and challenging tasks encountered. The H&S staff will assist the monitoring group with using the following basic principles of contamination control:

- Access/administrative controls
- Engineering controls
- Protective measures for personnel
- Decontamination guidance
- Preventive methods.

2.4.2.1 Access/Administrative Controls

Once contamination has been located and impacted areas have been determined, access control to these areas must be adequately established. For areas that are identified and under direct control of H&S personnel, an access control point is set up to control access between contaminated areas and non-contaminated areas. Yellow and magenta rope, chain, tape or other barriers may be used to identify the boundaries and provide a recognizable visual barrier. When the radiological conditions are severe, an H&S staff member may continuously monitor the access control point.

In circumstances where a large area is impacted, access control, as stated above, may be impractical. Radio communication and work direction to field teams will be used to control response personnel access to impacted areas. Law enforcement personnel and/or National Guard personnel may be used to restrict public access. Controls will be coordinated through the Incident Command.

All materials exiting the area shall be monitored to ensure they are below acceptable levels of contamination. All unmonitored tools and/or equipment used in a contaminated area should be placed in clean plastic bags or securely wrapped in plastic before being removed from the area and label accordingly.

Another administrative control used for the containment of contamination is to perform a routine survey in order to detect trends in the movement and/or buildup of contamination.

2.4.2.2 Engineering Controls

Containment

For tasks with very high contamination potential, a plastic tent (greenhouse or hut) can be built around the work area to confine all contamination to as small an area as possible. A portable ventilation exhaust system (such as high efficiency particulate air [HEPA]) may be used to control airflow in the work area and remove airborne contamination. Small containment devices, such as

glove boxes, glove bags, or hoods can be used to contain the contamination, depending on the nature and location of the work being performed. Drums or other approved containers can also be utilized.

Bagging

The most widely used method of containment is bagging or wrapping. Contaminated tools or equipment are placed in plastic bags, or securely wrapped in plastic, before being moved outside a contaminated area. When possible, wrapping tools or equipment prior to entry can help control contamination during use inside the contaminated area.

2.4.2.3 Personal Protective Measures

The purpose of protective clothing is to keep contamination off the skin and clothing of the workers. Protective clothing allows personnel to work in a contaminated area with removable contamination and to exit the area without spreading contamination to uncontrolled areas. The use of PPE alone will not guarantee complete elimination of personal contamination and is not a substitute for implementing proper controls, but if used properly, protective clothing will afford a high degree of protection.

All personnel entering areas containing removable contamination may be required to wear certain items of protective clothing. The type of clothing required will vary depending upon the contamination level and the nature of the work being performed. Some additional factors for the selection of protective clothing include the type and form of contamination, potential for increased levels of contamination, area of the body at risk, and competing hazards (e.g., heat stress, asbestos, etc.).

In the majority of situations, some type of respiratory protective equipment will be required for work in areas where very high contamination levels exist or airborne contamination is present.

2.4.2.4 Decontamination Guidance

Reasonable efforts should be made to decontaminate or unconditionally release items, rather than dispose of them as radioactive waste. When the risks or costs faced during item decontamination outweigh the benefits gained by decontaminating the item for reuse, the item should be disposed of properly instead.

2.4.2.5 Preventive Methods

The following are practical methods used for the prevention/control of contamination:

- Establish adequate work controls before starting tasks.
- While conducting pre-work briefs, discuss measures that will help reduce or prevent contamination spread.
- Change out gloves or protective gear as necessary to prevent cross-contamination of equipment.

- Pre-stage areas to prevent contamination from spreading outside of the work activity area.
- Cover/tape tools or equipment used during tasks to minimize decontamination after use.
- Control and minimize all material taken into or out of contaminated areas.

2.4.3 Limits

Any area in which radiation levels exceed those in Table 2.4.3a will be considered a Radiation Area and controlled accordingly. Any area in which contamination levels exceed Table 2.4.3b will be considered a Contamination Area and controlled accordingly.

Table 2.4.3a. Radiation Area Limits*

Area	Level	Distance
Radiation Area	5 mrem ≤ X ≤ 100 mrem in one hour	30 cm
High Radiation Area	100 mrem (at 30 cm)< X ≤ 500 rad in one hour (at 1 m)	30 cm, 1 m
Very High Radiation Area	X > 500 rad in one hour	1 m

*based upon 10 CFR 20 and 10 CFR 835

Table 2.4.3b. Contamination Survey Limits (for both contamination areas and release of contaminated items)*

NUCLIDE (see Note 1)	REMOVABLE (dpm/100 cm2) (see Note 2)	TOTAL Fixed & Removable (dpm/100 cm2) (see Note 3)	Hot Spot Fixed & Removable (dpm/100 cm2) (see Note 3)
U-natural, ^{235}U, ^{238}U and associated decay products	1,000 α	5,000 α	15,000 α
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{129}I, ^{125}I	20	100	300
Th-nat, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	200	1,000	3,000
ß+γ emitters (nuclides with decay modes other than α-emission or spontaneous fission) except ^{90}Sr and others noted above. Includes mixed fission products containing ^{90}Sr.	1,000 ß+γ	5,000 ß+γ	15,000 ß+γ
Tritium organic compounds, surfaces contaminated by HT, HTO and metal tritide aerosols	10,000	10,000	30,000

* From 10 CFR 835 and NRC Regulatory Guide 1.186

Note 1 The values in the above Table apply to radioactive contamination deposited on, but not incorporated into the interior of the contaminated item. Where surface contamination by both alpha-and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently.

Note 2 The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency.
NOTE: Filters used for tritium sampling should be moistened with tritium-characterized water prior to swiping. For objects with a surface area less than 100 cm^2, the entire surface should be swiped, and the activity per unit area should be based on the actual surface area. Except for transuranics, Ra-228, Ac-227, Th-228, Th-230, Pa-231, and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination.

Note 3 The levels shall be averaged over one-square meter (m^2) provided the maximum activity in any area of 100 cm^2 is less than three times the values in the table.

Note 4 For circumstances when the values in the table are not practical, the methods presented in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSSAME) should be considered.

2.4.4 Posting and Labeling

It may be impractical to post all radiological areas due to mission or size constraints. However, those radiological areas and activities routinely controlled by participants should be posted, according to applicable regulations (e.g., 10 CFR 835, 10 CFR 20, etc.). These areas may include source storage areas, laboratory areas, sample-receiving areas, hotlines, and decontamination areas. All postings should be based upon the limits found in Tables 2.4.3a and 2.4.3b (prior page). As resources increase, posting of access control points will be performed, as practical.

2.4.5 Access Control

To keep internal and external dose ALARA for all personnel, access to the radiological areas must be controlled. The following is a list of access control requirements for entries into radiological areas. These requirements are in addition to other requirements previously described. Similar access control processes will be in place for all affected areas. Access control will have to be coordinated with Incident and/or Unified Command.

2.4.5.1 Entry and Exit Requirements for Radiological Areas

- Understand and abide by all regulations and conditions for entry into radiological areas.
- Nonessential personal property items shall not be taken into radiological areas.
- Persons whose work requires regular or occasional contact with radioactive materials and have the potential to receive a CEDE of greater than 100 mrem per year, shall be monitored routinely for intakes of radionuclides by the use of bioassay and/or whole-body counting techniques.
- Smoking, eating, chewing, application of make-up or other hand-to-face contact is not allowed in radiological areas.

- Drinking is not allowed except in specified circumstances.
- Personnel must ensure they take appropriate measures to keep their doses ALARA.
- Avoid contact with potentially contaminated surfaces.
- Obey any posted, written or oral requirements including "Evacuate", "Hold Point" or "Stop Work" orders from H&S personnel.
- Handle all tools and equipment properly inside radiological areas.
- When possible, wrap or sleeve materials, equipment, hoses, etc.
- Place contaminated tools, equipment, etc. inside plastic bags when work is finished.
- Wear dosimeters when required and in the prescribed locations on the body.
- Exit immediately if a wound occurs or if dosimetry is off-scale, lost, or damaged.
- Report all injuries.
- Monitor clothing and exposed skin, as required, and report the presence of radioactive contamination.
- Place contaminated items and waste in the proper receptacles.
- Personnel should wash their hands when leaving a radiological area and prior to eating or using tobacco products.

2.4.6 Hotline Procedure

The H&S Manager will identify areas of potential contamination. A hotline will be established at the most practical location adjacent to the contamination control area. The hotline should be located where field teams can process through the hotline without the possibility of tracking contamination into “clean” areas or areas of lower contamination. A secondary hotline may be set up adjacent to the incident area to assure that no contaminated personnel, equipment, or vehicles can enter a “clean” area. When practical, the Hotline should be collocated with the Sample receipt Line. The H&S Manager, Monitoring Manager, Laboratory Analysis Manager and FRMAC Manager will determine the location of the hotline.

In order to ensure the safety of the Field Monitoring Teams and to reduce the possible spread of radioactive and/or chemical contamination, the Health & Safety Division will be responsible for oversight of Hotline operations for all FRMAC workers. Hotline staff will initially be provided from the FRMAC’s Monitoring Division, due to their experience and qualifications in Radiological Control work. As additional personnel are added to Hotline support, they should be trained, as a minimum, at the radiological worker level, with a preference of being trained at the technician level.

The placement of the hotline is crucial to execution of FRMAC’s mission. Some of the main considerations in selecting a location to set up a hotline are infrastructure accessibility, wind direction, and overall weather conditions. These parameters will drastically affect where and how the Hotline is oriented to enable the transition from the contaminated to the clean areas. Additional

Hotlines will be established by Incident and/or Unified Command for other response personnel and the general public. FRMAC Hotlines will need to be coordinated through the Site Safety Officer.

Resources, physical and topological features, and lab support is also important due to the ability of the Hotline to conduct the tasks or required activities. The potential presence of chemical/ toxicological substances may require additional PPE for health and safety reasons. The burden of the additional PPE will increase the time to complete tasks. Public sensitivity to the event will be affected by the proximity of the Hotline to other residential, commercial, or industrial areas. All these considerations need to be addressed to find the location that will provide the best access with the least amount of concerns.

In order to establish an effective hotline, buffer areas need to be established around the contaminated areas to prevent the spread of the contamination. There are three zones of concern for controlling the contamination. Zone 1 is referred to as the Contamination/Exclusion/Hot Zone. This is the area of known contamination, and is the innermost area. Zone 2 is to as the Buffer/Contamination Reduction/Warm Zone. This zone is initially clean, and allows personnel and equipment to be decontaminated as they transition from the contaminated to the clean zones. Zone 3 is referred to as the Support/Clean/Cold Zone. This is where there is no contamination and storage of clean equipment occurs. The Hotline will be in Zone 2, and act as a buffer and access control for entering and exiting Zone 1.

A hotline must be established at the most practical location, to allow ingress or egress from the Contamination Zone. The hotline should be located where field teams can process through the hotline while minimizing the possibility of tracking contamination into “clean” areas or areas of lower contamination. A secondary hotline may be set up to assist with flow control, should the event be large in nature. Multiple access points will increase manpower and monitoring equipment requirements, and must be balanced with available resources and needs of the event (or the IC/UC structure).

The hotline should be established at a location that can accommodate a field sample receipt area, decontamination equipment and associated facilities. The entire hotline operation includes personnel, vehicles, equipment, and frisking areas that are all staged to support the FRMAC teams. Depending on the size of the event, an example may be a single parking lot to several parking lots.

Hotline procedures are a combination of all the practices described in Section 2 of this manual. Exposure limits are addressed and monitored by the H&S Division. Air sampling and contamination limits are determined by the H&S Division, but will be maintained by the Monitoring Division. Health and Safety will also consult with Assessment and Monitoring to determine the contamination zone limits and the best locations for establishing access into and out of the different zones. Unified Command will be required to concur with the final boundaries of the contaminated zones. Appropriate PPE and decontamination procedures are determined by Health and Safety and

monitored by the Monitoring. The overall safety environment of the FRMAC will be the sole responsibility of the Health and Safety Manager.

Hotline procedures are established to allow FRMAC workers to effectively and safely work in a contaminated environment. The site may contain radioactive contamination only, or it may contain a mixture of chemical hazards as well. The H&S Manager needs to be able to rapidly draw on available resources to determine the potential hazards that the workers will confront. If the hazards are identified, then proper protection can be provided to all the workers.

2.4.6.1 Establishing the Hotline

Anytime there is radioactive contamination that exceeds the limits established in this manual (or other limits that supersede those found in this manual), it will be necessary to establish boundaries around that area to protect the public and prevent inadvertent spread of contamination. These boundaries will be determined by a common decision from the IC/UC Command structure and FRMAC. Once the boundaries of this zone are set, then access to and from those zones will need to be controlled.

Appendix B contains basic information for the process of establishing a hotline. The procedure is designed to walk the H&S Manager or designee through the steps and ideas needed for the hotline. It is not all-inclusive, but contains many of the generic issues that must be addressed. The hotline procedure refers back to various sections of the H&S Manual, rather than duplicating information.

The checklists can be posted or rewritten on signs or posters that will guide the field team members to and through the Hotline (see Appendix B for examples). The Hotline personnel manning the hotline will also give instructions to personnel as they enter and process through the hotline.

While Appendix B contains checklists for establishing a basic hotline, there may be a need for additional addendums for other contamination hazards. These will be added to the posted procedures.

Personnel, vehicles, and equipment can only enter the hotline through the designated entry point. Personnel will be instructed to exit the zone by turning in field samples at the Sample Receipt Table, turning in health physics instruments and equipment at the Equipment Drop-Off Table, doffing the required PPE, conducting personal monitoring, turning in TLD and/or pocket dosimeter at the Dosimetry Table, and awaiting final approval to exit the Hotline.

The hotline will be dismantled at the discretion of the FRMAC Director. The hotline may be operational through completion of remediation efforts and turnover of the site. Appendix B does not discuss the turnover process since it is outside the purview of the FRMAC workers and their responsibilities.

2.4.6.2 Personnel Surveys

Personnel will doff their protective clothing in the prescribed manner and discard them in the appropriate container. Respirators will be separated and surveyed for possible reuse. Personnel will proceed through the "frisking" area and be monitored for contamination by the hotline technician. If no contamination is detected, the person is released. If contamination is found anywhere on the person's clothing or skin, the person will be directed to the Decontamination Facility where he/she will be decontaminated by other H&S technicians. After decontamination, the person will be re-monitored and released if no contamination is detected. If the person is still contaminated, qualified personnel will initiate additional decontamination measures.

The H&S staff will have extra clothing available for personnel whose personal clothing are contaminated and have to be laundered or confiscated. The type, location, and levels of external radioactive contamination found on personnel will be documented using the Personnel Contamination Survey Sheet (Appendix A, page A-22).

All open wounds must be monitored first since contaminants can be readily absorbed into the body. Anyone with contamination in or around a wound should report to the H&S Manager for referral to the REAC/TS On-Scene Medical Director.

Next, survey the face. Facial contamination may indicate an intake of radioactive materials. If facial contamination is present, the nose and mouth should be surveyed next using cotton-tipped applicators. These surveys need to be conducted as soon as possible, preferably within 30-60 minutes of the contaminating incident. Nasal or mouth contamination might indicate the need for utilization of medical countermeasures and bioassay sampling. Anyone with facial, nose and/or mouth contamination should report to the H&S Manager for referral to the REAC/TS On-Scene Medical Director to discuss internal contamination and the potential for utilization of medical countermeasures.

Finally, the whole body should be surveyed, with special attention being paid to areas of the body that are more likely to become contaminated. Contamination on the feet (shoes) would indicate removable surface contamination on the ground or floor just traversed. The hands are extremely prone to becoming contaminated when working directly with radioactive materials.

Other body areas, which are prone to contamination, include the buttocks, knees, elbows, head and/or areas where sweat collects. In addition to these specific body areas, the surveyor should pay special attention to any area of the body and/or clothing which he or she suspects might be contaminated. Upon detecting personnel contamination, follow-up area and/or equipment surveys may be necessary to determine the source of contamination and the extent the contamination has spread, if any.

Depending on environmental conditions, the presence of radon and thoron progeny may cause elevated readings. If radon is suspected, measures should be taken to isolate the affected clothing or equipment, confirm the half-life, and store for decay below release limits.

Movement of the instrument probe over the monitored areas should proceed at a rate of ½ inch per second when using an alpha probe. This allows meter response to register as localized contaminations are encountered. During a typical beta/gamma personnel survey, the instrument probe should move over the monitored areas at a rate of approximately 2 inches per second, unless the individual has already been surveyed by a portal monitor and the hand-held survey is being done to localize and verify contamination discovered by the portal monitor. An alternate method of delaying over a surface for about two seconds, then moving the length of the probe, may also be used.

2.4.6.3 Equipment Surveys

All equipment and materials used by personnel in contaminated areas shall be monitored at the hotline before release to the public. Returning field teams will turn in their survey equipment at the Equipment Return Table at the hotline. H&S technicians will survey the equipment using hand-held instruments and/or swipes. Clean instruments will be made available for continued use. Contaminated instruments (any instrument that could lead to erroneous measurements) will be sent to the equipment decontamination area for decontamination, and equipment that exceeds the contamination limits (Table 2.4.3b) will not be released.

2.4.6.4 Vehicle Surveys

All vehicles used by the field teams or vehicles that may have encountered radioactive contamination must be surveyed at the hotline. Vehicles will be driven into a designated parking area and be surveyed by a hotline technician. The areas to be surveyed on each vehicle include: seats, floor and floor mats, steering wheel, door handles, tires, and wheel wells. More extensive monitoring may be needed, depending on the extent of contamination that is suspected.

Vehicles that are not grossly contaminated (<10 times [Table 2.4.3b]) will be released for continued use, provided the contamination present does not pose a health or dose hazard to the responders. The H&S Manager will determine these criteria. Decontamination of vehicles will be done at the designated Vehicle Decontamination Area that is part of the “hotline” operation.

At the termination of activities, and before release of vehicles to the public (such as return of rental cars), all vehicles will be surveyed and decontaminated in accordance with the agreed upon Remediation Plan.

2.4.6.5 Sample Monitoring and Control

Soil, water, and vegetation samples brought in by the field monitoring teams will be considered contaminated and be treated accordingly. Upon turning them over at the Sample Collection Table, all

samples will be surveyed and additional contamination control will be implemented, as needed, prior to delivering them to the radioanalysis lab. If any samples show surface exposure rates that exceed 2 mR/hr they will be further segregated and treated accordingly. In the lab, contamination control procedures will be used throughout the analytical process.

2.5 Personal Protective Equipment (PPE)

Personal protective equipment, as prescribed by H&S, should be selected based on known or anticipated contamination levels in the work area, anticipated work activity, worker health considerations, and regard for non-radiological hazards that may be present. Table 2.5.1 provides general guidelines for selection.

Personnel are required to wear PPE when entering areas containing contamination levels above specified limits in order to prevent contamination of skin and clothing. The selection of particular protective clothing required is dependent on radiological conditions in work areas and the nature of the job. Full protective clothing generally consists of coveralls, cotton glove liners, gloves, shoe covers, rubber overshoes and possibly a hood. There are several basic factors, which determine the type and extent of protective clothing required:

- Type and form of contamination
- Levels of contamination
- Type of work being performed.

Additional factors to consider include the potential for increased levels of contamination, the area of the body at risk, and competing hazards, (e.g., heat stress, asbestos, etc). Once the types of protection needed are established, the most efficient protective clothing must be selected from that available. The appropriate safety gear should be worn for work activities requiring additional strength, abrasion resistance, or when required by other, non-radiological, safety procedures.

2.5.1 Types of PPE

Whole body protection

Coveralls provide protection from low to moderate levels of dry contamination protection. Protection is low when body contact with contaminated surfaces is prolonged (since contamination can be ground into or through the cloth) and when the surface is wet. Wearing more than one pair of coveralls at a time can increase the degree of body protection.

Cloth coveralls are permeable, and so are not effective against radionuclides with high permeability properties (gases, tritium, etc.).

Water resistant coveralls provide protection from high levels of dry contamination and wet contamination. They provide limited protection from tritium and other highly permeating radionuclides (which may be transported through coveralls to the skin surface).

Disposable coveralls (e.g., Tyvek® suits) provide moderate protection from radioactive contamination and are used for work involving mixed hazards where reuse is not desirable or practical. Disposable coveralls can be torn easily, so caution must be exercised in situations that might cause rips or tears.

Workers should inspect PPE before use for tears, holes, or split seams that would diminish protection. Inspect PPE for proper operability. Any defective items should be repaired or replaced with intact PPE.

Avoid getting coveralls wet. Wet coveralls provide a means for contamination to reach skin/clothing. This is called "wicking."

Hand protection

Surgical gloves are fairly easily torn or punctured and are normally only used in light contamination work areas, which require a high degree of dexterity. Surgical gloves should be made of materials other than latex because of the possibility of creating skin allergies. An alternative is gloves made of nitrile.

Rubber gloves are lightweight and provide a good gripping capability. They are normally used in moderate to heavy contamination locations. Rubber gloves have greater puncture, abrasion, and solvent resistance, but afford a lower degree of dexterity than surgical gloves.

Leather or canvas work gloves should be worn in lieu of, or in addition to, standard gloves for work activities requiring additional strength or abrasion resistance.

Cotton glove liners may be worn inside standard gloves for comfort but should not be worn alone or considered as a layer of protection. Gloves are often taped to the sleeve of the lab coat, coveralls, plastic suit, etc. for maximum protection and are “tabbed” to permit easy removal.

Foot protection

Booties are used to protect the lower leg area (below coveralls) from contamination. Different materials such as plastic and cloth (sometimes called cloth shoe covers) are used. Plastic bags are often used as shoe covers or inner boots. The plastic bags allow easier donning and doffing of booties.

Shoe covers are worn over booties as a second layer of protection and to provide traction for the wearer. They are normally constructed of plastic or rubber and may be taped to the pants leg of the

coveralls or plastic suit depending on the level of contamination and type of job. Shoe covers and gloves should be sufficiently durable for the intended use.

Respiratory protection

Full-face masks are used to filter particulate (HEPA) radionuclides and/or radioactive iodine from the breathing air of the wearer when the surrounding atmosphere is not immediately dangerous to the life and health of the wearer. A self-contained breathing apparatus (SCBA) is used to provide a portable source of breathing air to the user when entering an unknown atmosphere or an area which may be immediately dangerous to life and health.

General Information

Supplemental pocket or electronic dosimeters should be worn outside the PPE, in a manner accessible to the worker. Workers may protect such dosimeters from contamination by placing them in an outer coverall pocket or in plastic bags or pouches.

Personal effects such as watches, rings, jewelry, etc., should not be worn during work activities. The following table provides basic guidelines for selecting personal protective equipment.

For more information on the Respiratory Protection Program refer to the Industrial Hygiene chapter (Section 3.6.1, Respiratory Protection Program).

Table 2.5.1. Guidelines for Selecting Personal Protective Equipment

WORK ACTIVITY	KNOWN OR ANTICIPATED REMOVABLE CONTAMINATION LEVELS (as per 10CFR 835)		
	LOW (< Table 2.4.3b values)	MODERATE (1-100 times Table 2.4.3b values)	HIGH (>100 times Table 2.4.3b values)
Routine “clean” area surveys and hotline frisking	Gloves and booties or shoe covers	Full set of PPE	Full set of PPE, tape openings, respirator and hood
Field Teams*	Gloves and booties or shoe covers	Full set of PPE	Full set of PPE, tape openings, respirator and hood
Laboratory operations, sample preparation and sample hotline	Lab coat, gloves and shoe covers or booties	Full set of PPE	Full set of PPE, tape openings, respirator and hood
Work with large, pressurized, or large volume liquids (liquid decontamination)	Full set of non-permeable PPE	Full set of non-permeable PPE, rubber boots	Full set of non-permeable PPE, rubber boots and outer rain suit, tape openings

***Note that Field Teams may be deployed in downgraded PPE levels when entering non-evacuated areas.**

Table 2.5.1 Notes

There are four levels of PPE

Level 1: Gloves Booties or shoe covers

Level 2: Lab coat Gloves Booties or shoe covers

Level 3: Full set of PPE

- Coveralls
- Cotton glove liners (optional)
- Outer gloves
- Booties
- Plastic bags/tyvex shoe covers
- Inner gloves (surgical, Pylox, or Nitrile)
- Hood (if required)

Level 4: Full set of PPE (airborne)

- Full set of PPE (including hood)
- Tape openings
- Respirator

2.5.2 Removal of PPE

Potentially contaminated PPE should be removed without spreading contamination and especially without contaminating the skin. Workers should be instructed not to touch the skin or place anything in the mouth during PPE removal. Instructions for PPE removal (presented below) should be posted adjacent to the personnel hotline.

Recommended Sequence for Removing a Full Set of PPE:

1. Remove exposed tape, as applicable
2. Remove rubber totes or outer shoe covers, as applicable
3. Remove outer gloves
4. Remove tape from cuffs, as applicable
5. Remove hood (if applicable)
6. Remove coveralls, inside out, touching inside only
7. Remove tape or fastener from inner shoe cover (or boot bag)
8. Remove each boot bag or shoe cover, placing shoe onto clean step-off pad or designated clean area
9. Remove respiratory protection, as applicable
10. Remove inner gloves
11. Commence whole-body frisking
12. Monitor the badge and dosimeter for contamination. The sequence for the removal of primary and supplemental dosimetry depends on where the dosimeter was worn and the potential for contamination.

2.6 Survey Instruments and Techniques

2.6.1 Survey Instruments

All instrumentation used for the health and safety of response personnel will be calibrated and maintained according to appropriate standards and guidance documents (e.g., ANSI N323). The selected instruments must be capable of detecting in the ranges and energies of the release criteria specified in Tables 2.4.3a and b. Calibration must be current and appropriate for the types, levels,

and energies of radiation encountered. Before an instrument is placed into service, H&S staff members will perform the following checks:

- Inspect the instrument for physical damage.
- Ensure that the calibration and service stickers are current.
- Perform a battery check.
- Perform a source response check according to approved procedures (e.g., manufacturer's specifications).

If during instrument checks or usage, an instrument fails to respond properly, fails the battery test, is damaged, or its calibration is expired, the H&S staff member should remove it from service immediately, tag the instrument "Out of Service" and replace it with a properly functioning instrument.

The H&S staff member must determine what items were measured by the defective instrument and repeat the surveys with a properly functioning instrument to determine if the previous surveys were accurate. This evaluation must be documented on a Radiation Survey Report Form (Appendix A, p. 126) and placed in the operational logbook.

Before release from potentially contaminated areas, all instruments should have an instrument (direct) and swipe (indirect) survey performed. The results should be recorded in a Survey Report. If the results are below detectable limits, the instrument should be returned with a copy of the Survey Report. If the results are above detectable limits, the instrument must be decontaminated and resurveyed until results are below detectable limits.

Selection of appropriate instruments depends upon the monitoring application and the exposure rates anticipated. In high exposure rate situations, or when a high degree of precision is desired, multiple instruments may be required.

2.6.2 Survey Techniques

Gamma Exposure Rate Surveys

Area survey exposure rate measurements are usually made at 1 m (approximately 3 feet) above ground level, or 30 cm (approximately 12 in.) from a surface (wall), to estimate an average exposure rate to personnel.

Beta/Gamma Contamination Surveys

Direct method beta/gamma contamination surveys are normally performed with an instrument that has a plastic scintillator or Pancake GM probe. Beta/gamma contamination surveys should be performed as close to the monitoring surface as practical, preferably ½ inch away. However, care must be taken not to damage or contaminate the window or other parts of the probe. The

instrument(s) should be wrapped in a plastic bag or cling wrap to prevent contamination, as directed. The active area of the detectors should not be covered. It is sometimes helpful to hold the probe with the fingertips extending below the bottom edge of the probe. The surveyor must be aware of the potential for contaminating the fingertips. With the appropriate probe, a meter survey is conducted by slowly passing the probe over the area or object to be surveyed. The survey should be conducted at a constant speed - approximately 2 cm/sec, while the surveyor listens for an audible response. After the peak audible response area is determined, the area should be resurveyed while viewing the scale. The scanning speed may need to be adjusted to correct for probe efficiency to isotopes of interest and probe size.

Alpha Contamination Surveys

Direct method alpha contamination surveys are normally performed with an instrument that has a scintillator (zinc sulfide [ZnS]) probe. Alpha contamination surveys should be performed as close to the monitoring surface as practical, preferably ¼ inch away. However, care must be taken not to damage or contaminate the window or other parts of the probe. It is sometimes helpful to hold the probe with the fingertips extending below the bottom edge of the probe. The surveyor must be aware of the potential for contaminating the fingertips. With the appropriate probe, a meter survey is conducted by slowly passing the probe over the area or object to be surveyed. The survey should be conducted at a constant speed - approximately 2 cm/sec, while the surveyor listens for an audible response. After the peak audible response area is determined, the area should be resurveyed while viewing the scale. The scanning speed may need to be adjusted to correct for probe efficiency to isotopes of interest, probe size.

Swipe Surveys (Indirect Method)

- A scaler is used to record the number of counts in a swipe or sample. A scaler efficiency check should be performed at the beginning of each shift for scalers used daily and also prior to using infrequently used scalers.
- Paper, glass fiber, cotton or other filters, ideally 4.25 cm or 9.0 cm, can be used as the swipe material. Flat paper water cups can be used as swipe holders.
- All swipes should be treated as potentially contaminated until they have been shown to be free of contamination through counting.
- Swipes should be numbered directly or number/label the swipe holders for later identification.
- Moderate pressure should be used to wipe a 100 cm^2 area. Swipes are then placed inside the swipe holder.
- Swipes are next counted for both alpha and beta/gamma contamination on a scaler.

Scaler Operation

If a scaler is tagged “Out of Service” subsequent to its use, the H&S staff member must determine what items were measured by the defective instrument. The H&S staff member must resurvey those items with a properly functioning instrument to determine if the previous surveys were accurate. This evaluation must be documented on a Survey Report form and in the operational logbook. Swipes should be presurveyed for gross contamination prior to placing them in a scaler to prevent scaler contamination.

Detection Limits

The detection limit of a measurement system refers to the statistically determined quantity of radioactive material or radiation that can be measured or detected at a preselected confidence level. This limit is a factor of both the instrumentation and technique or procedure being used. The two parameters of interest for a detector system with a background response greater than zero are:

Critical detection level (L_C): the response level at which the detector output can be considered "above background"

Minimum significant activity level (L_D): the activity level that can be seen with a detector with a fixed level of certainty

These detection levels can be calculated by the use of Poisson statistics, assuming random errors and systematic errors are separately accounted for, and that there is a background response. For these calculations, two types of statistical counting errors must be considered quantitatively in order to define acceptable probabilities for each type of error. Type I occurs when a detector response is considered above background when in fact it is not (associated with *LC*). Type II occurs when a detector response is considered to be background when in fact it is greater than background (associated with *LD*).

If the two probabilities are assumed to be equal, and the background of the counting system is not well known, then the *LC* and the *LD* can be calculated. The two values would be derived respectively using the equations $LC = k\sigma B$ and $LD = k^2 + 2k\sigma B$. If 5% false positives (Type I error) and 5% false negatives (Type II error) are selected to be acceptable levels, (95% confidence level), then $k = 1.645$ and the two equations can be written as:

$$L_C = 1.645\sqrt{\frac{R_B}{T_B} + \frac{R_B}{T_S}}$$

$$L_D = 2.71 + 3.29\sqrt{\frac{R_B}{T_B} + \frac{R_B}{T_S}}$$

where:

LC	=	critical detection level (count rate)	RB	=	background count rate
LD	=	a priori detection limit (minimum significant activity level [count rate])	TS	=	sample count time
			TB	=	background count time

If the sample count time (*TS*) is the same as the background count time (*TB*), then the above equations can be simplified as follows:

where:

LC	=	critical detection level (count rate)	RB	=	background count rate
LD	=	a priori detection limit (minimum significant activity level [count rate])	T	=	count time (sample and background)

Therefore, the full equations for LC and LD must be used for samples with count times differing from the background determination time (95% confidence level [CL] used). The critical detection level, LC, is used when reporting survey results. It is safe to say that to a 95% CL, samples below this value are considered background. This value is used to determine minimum count times based on release limits and airborne radioactivity levels. If the critical detection level, LC, is greater than the limits listed in Table 2.4.3.b, increase sample count time until the *LC* falls below these limits.

The minimum significant activity level, *LD*, (referred to as the LLD [Lower Limit of Detection] in some texts) is calculated prior to counting the samples. In using this value, we are saying that to a 95% CL, samples counted for at least the minimum count time, calculated using the *LD*, will be radioactive. The region between LC and LD would be considered to be potentially radioactive, but with less than 95% confidence level.

Typical applications for Health and Safety would include determining count times for contamination surveys used to determine if items can be released from contaminated areas. LC and LD would also

be needed to determine count times for air sample analysis. Additionally, LC and LD would be used to develop/modify contamination survey scanning speeds.

2.7 Decontamination

It is anticipated that all FRMAC activities will revert to occupational radiation (or HAZWOPER) conditions and regulatory oversight at some point. As such, all Health and Safety controls will have these conditions as the ultimate goal. During early response activities, EPA allows rinsate to drain via normal runoff conditions (e.g., letter dated September 17, 1999) at the approval of Incident/Unified Command. As an example, a commercial carwash may be a good location for an initial decontamination station. Obviously, conditions due to a nuclear detonation would render many decontamination methods in this section impractical, but general principles for minimizing the spread of contamination should still be considered and implemented, as practical.

Procedures for the decontamination of personnel, equipment, and vehicles have been established for the hotline operation. While written for radiological decontamination, the methods in this section also apply to toxicological decontamination. The Contamination Control Chief has authority over the decontamination process. Decontamination will continue until levels are below Table 2.4.3.b values or alternate values have been agreed upon by responsible parties. Hotline processing will follow a general priority as follows:

1. Life threatening conditions (generally not decontaminated at the hotline)
2. Non-life threatening injuries/conditions (may or may not require decontamination)
3. Personnel wearing SCBA with low air
4. Team Leaders
5. High Value/Sensitive/classified items
6. All other personnel
7. Equipment

2.7.1 Decontamination Planning

A decontamination plan should be developed for all responses. Details of the plan will vary according to varying factors involved in the response (resources, location, type of contaminant, etc), however, the general principles outlined below will form the basis for decontamination planning.

2.7.2 Personnel Decontamination

Hotline Decontamination

Hotline decontamination personnel shall:

1. Notify the hotline decontamination supervisor when personnel decontamination is necessary.
2. Wear personal protective clothing when performing decontamination.

3. Survey the person with portable health physics instruments to determine the location and extent of non-uniform dose to the skin due to radioactive contamination.
4. Remove loose contamination on clothing by applying tape to the area and lifting it off. Removal of affected clothing should be also considered.
5. Mask off the affected area and cleanse it with moistened towel (i.e., Kimwipes™, Wet wipe) (general washing risks the spread of contamination) if the contamination is localized. Tepid (lukewarm) water should be used, if possible.
6. Wash large-area skin contamination with soap and water, using a portable shower if necessary.
7. Follow the decontamination procedures until contamination levels are undetectable or until further decontamination efforts result in less than a 25% reduction in contamination levels, unless medical personnel or the hotline decontamination supervisor determines that further actions would cause bodily harm.

   Note: For a Nuclear Detonation, modified levels would be used.
8. Survey the personnel performing the decontamination at the end of the operation to ensure that they have not become contaminated.
9. Record all skin contaminations. Notify the H&S Manager immediately if skin contamination levels, due to beta/gamma products, are greater than 10,000 dpm/100cm^2. When establishing hotline criteria, final screening levels need to be converted to values that can be directly measured (readout) by the instruments used.
10. Complete the Personnel Contamination Survey Sheet (Appendix A, p. 126).

Handling Contaminated Injured Personnel

Special decontamination procedures and considerations should be provided in case of a medical emergency. Decontamination procedures shall not be implemented if they may aggravate or cause more serious health effects. However, prompt life-saving first aid and conference with the On-Scene Medical Director or designee will determine the appropriate decontamination procedures in these special cases. The rule of thumb will be Life before Radiological Controls.

1. Individuals with minor injuries should be decontaminated, except for the wound(s), before removal to a medical facility (as practical). Notify the On-Scene Medical Director or designee.
2. Medical attention for more serious injuries will have priority over personnel decontamination.
3. In cases of serious injury, activate the emergency medical services (EMS) system by dialing 911. Hotline personnel should inform EMS personnel and the medical facility of the radiological condition of the patient during their removal from the accident site.
4. Hotline personnel shall take steps to limit or prevent the spread of contamination during transfer of the victim as well as at the medical facility. This is often accomplished either by removing contaminated clothing or covering contamination with a clean sheet or blanket. However, preventive measures should be commensurate with the severity of the injury.

5. Health and Safety personnel from the hotline may accompany the contaminated victim in the ambulance to an appropriate hospital.

External or Internal Personnel Contamination

When personnel are found to have detectable external contamination on skin or clothing, notify the H&S Manager immediately. The contaminated person shall be directed to the designated personnel decontamination area for decontamination. Decontamination measures include:

1. Removing loose contamination on clothing by applying tape to the area and lifting it off
2. Removing contaminated articles of clothing and segregating them for laundering or disposal
3. Gently washing contaminated areas of skin with soap and lukewarm water
4. Rinsing thoroughly with water

If internal contamination is suspected (counts in wounds or contamination found in the facial area with positive swabs from the nose and/or mouth).

1. Survey a separate cotton-tipped applicator swabbing from each the left naris, right naris and mouth.
2. Notify the On-Scene Medical Director or designee of the suspicion of internal contamination with information from surveys of contaminated wounds, nostrils and mouth.

Hotline personnel may request the following:

1. A urine sample, or fecal sample after decontamination
2. Whole-body and/or thyroid counting

In addition, personnel's dosimeter holders should be decontaminated and their TLDs should be turned in for processing. Also if air samplers were used in the work area, the filters should be checked for radioactive contamination.

Confiscation of Contaminated Personal Property

1. Decontamination of personal clothing should be attempted by using tape to pick up particle matter on clothing or with soap and water.
2. Personal clothing will not be released until readings are non-detectable or below applicable limits, indicated by the readings from a portable health physics frisking instrument.
3. Replacement clothing will be provided to enable the individual to return to quarters if the personal clothing cannot be released.
4. Bag the contaminated personal items and provide a receipt of contents to the individual.
5. Label the bag with the type and level of radioactive contamination present.
6. Contaminated personal items are decontaminated or stored for decay of radioactivity.
7. Personal items will be kept secured until the items are returned to the individual or their home organization or disposed of as radiological waste.

8. Final deposition of personal items will be based upon the policy the individual's home organization.

2.7.3 Vehicle, Equipment, and Instrument Decontamination

A decontamination area should be set up next to the Hotline for equipment and vehicle decontamination. The "pit" should be excavated to be lower than surrounding ground level. A watertight material should line the "pit." Water pumps should be available to both spray contaminated equipment and vehicles, and remove contaminated rinsate. Trenching can be used to move rinsate away from the decontamination area and to reduce mud.

Vehicles should be decontaminated by washing with soap and water or some other type of cleaning agent. The interior of the vehicles must be hand-washed, but the exterior can be cleaned using a high-pressure wash if such a system is available. Vehicles should be resurveyed and released for continued use if clean. Vehicles that cannot be decontaminated should be segregated and taken out of service. In special situations, and as approved by the H&S Manager, contaminated vehicles may be put back into service for use only in contaminated areas.

Instruments and equipment returning from the field are surveyed at the Hotline. Contaminated equipment will be immediately segregated and sent to the Equipment Decontamination Area. Health & Safety decontamination personnel will question the owners/users to determine the correct method for decontaminating equipment. Washing with soap and water will usually be sufficient to decontaminate the equipment. Decontaminated equipment and instruments will be resurveyed and, if clean, be released for continued use. Instruments that cannot be decontaminated will be taken out of service and stored in a designated area.

Site Preparation

1. A pit should be built so that water migrates to one pick-up point and is large enough to containerize the water until it is pumped out. The pit should be excavated to be lower than the surrounding ground level.
2. Removing water can be done concurrently with decontamination, if available, or post decontamination if necessary.
3. The pit needs to be lined with a heavy plastic. The plastic needs to be able to handle the equipment being moved in and out without tearing.
4. A pumping system, complete with a filter system and holding tanks, will be needed. Water pumps should be available to spray contaminated equipment and vehicles and to remove contaminated rinsate.
5. The area should be fenced and posted as a Contamination Area. Decontamination areas should be large enough to hold the entire piece of equipment.

6. A survey area (the same size as the decontamination area) should be established adjacent to the decontamination area, with access directly from the decontamination area to the survey area. The survey area should be posted as a "Contamination Area" when necessary.

Decontamination Process

1. Equipment is brought into the decontamination area.
2. Equipment is surveyed and contaminated locations marked.
    a. Note: Workers will wear appropriate personal protective clothing when performing decontamination.
3. Decontamination methods used are from least abrasive (intrusive) to most abrasive (intrusive).
4. Power Wash using warm water, if available.
5. Use liquid citrus cleaner and soft brush - water rinse.
6. Use "Tide" and stiff brush - water rinse.
7. Wire brush the equipment.
8. Electrical wire wheel brush.
9. The equipment is rinsed after each step, then allowed to dry, and is resurveyed.
10. Repeat the routine as necessary with increasing abrasion.
11. Move the equipment into the confirmation survey area when survey results are below release criteria.
12. Equipment or vehicles that cannot be decontaminated will be segregated and taken out of service. In special situations, and as approved by the H&S Manager, contaminated vehicles may be put back into service for use only in contaminated areas.

Confirmation Survey

1. After decontamination is completed, the equipment is moved into the confirmation survey area.
2. Post the area as a *Contamination Area* until the post survey verifies otherwise.
3. If the confirmation survey detects contamination, move the equipment back into the decontamination area and repeat the process.
4. Once the equipment is below release criteria, remove the equipment.
5. If no contamination was found during any of the confirmation surveys, the posting may be removed.
6. If contamination was found on the equipment during the confirmation surveys, the confirmation survey area (ground) should be resurveyed and decontaminated (as necessary) and then the posting removed.

2.7.4 Laundry Handling

It is anticipated that disposable personal protective clothing will be used for short-term operations. Laundering anti-contamination clothing should be considered for longer operations.. Bag anti-contamination clothing and securely tape the tops of the bags at the hotline location. Tag laundry bags with labels stating the type and level of contamination, date and location of collection, and surveyor's name. For operations of short duration, hold the laundry bags at the hotline location. During long-term operations, send the bags to a local provider, a DOE facility, or a set up a decontamination laundry in the field.

2.8 Plans and Calculations for Turn-Back Levels and Dose Estimates

A responsibility of the Health and Safety Division is to develop a variety of response-specific plans. In particular, the site *Health and Safety Plan* requires the calculation of turn-back levels. Calculation methods found in the FRMAC Assessment manual can be used to determine radiological turn-back levels. Listed below are factors that should be considered when calculating turn-back levels and early planning assumptions.

- All levels need to be expressed in the units consistent with field teams' instrument read out capabilities.

- Care should be taken when determining resuspension factors for internal dose calculations. Resuspension factors for worker protection are for the snapshot in time that workers would be exposed and therefore would generally NOT include weathering. An exception is operations conducted with precipitation. Values used should be the currently measured resuspension value or higher, based upon the workers expected activity. For example, if the worker's activity generates dust, the resuspension factor should be raised accordingly.

- When available, actual measurement and/or sample data should be used instead of default values, such as ground roughness, resuspension and particle size.

- Decay would need to be considered on a case-by-case basis. Short-lived radioisotopes are generally not an issue as they would be decayed prior to FRMAC arrival. An exception would be in the case of a nuclear detonation or if FRMAC is deployed in advance of an incident.

- Use of respiratory protection and use of potassium iodine.

- The effect of geometry (e.g. - ground roughness) on exposure rate would be difficult to assess for field team activities. As example, an individual may be kneeling or bent over to collect a sample, increasing ground roughness factor, but decreasing distance loss. Care should be taken in deciding if a ground roughness factor should be included.

- Occupancy factors can vary from that used for the general population. A reduction factor of 1/3 is often used to represent that an individual will not be at the turn-back level continuously.

- Not all organizations will adopt FRMAC dose guidance. Teams comprised of individuals from organizations that do not adopt FRMAC dose guidance will need to comply with the standard operating procedures of their home organization and advise the Health and Safety Manager of these procedures. Not all teams would need to be governed by universal turn-back guidance. Teams may operate in different sectors and turn-back levels should be established to keep dose ALARA.

- Turn-back guidance from other non-radiological hazards must be taken into account and promulgated for all FRMAC activities.

2.8.1 Turn-Back Limits for Weapon Scenario

Turn-back levels will always be based on some type of "marker" measurement. For a weapons type accident, the "marker" measurement would be plutonium and/or americium deposition. This would be a measurement of activity per unit area, commonly $\mu Ci/m^2$. The measurement is typically taken using a FIDLER or Violinist type instrument, but could also include in situ gamma spectrometry or alpha contamination measurements. The following equations demonstrate how to determine turn-back levels based upon ground deposition measurements.

Example of a default weapon scenario

Initial assumptions**:**

- 1.25 rem administrative level for responders

- Assume $10e^{-6}$ s^{-1} resuspension rate. Note that this should be constant and alter day-by-day based upon measured values and expected conditions (e.g., work activities expected to produce dust)
- Seven days (one week) per responder at 8 hr/day*
- Assume an occupancy factor of 1/3
- Calculated value is based on time-weighted-average, not maximum
- Individual's exposure over time (days) can be controlled
- Use most conservative ALI of 0.006 µCi
- Use Assessment Manual Default Mix (30 year age)
- ^{241}Am values from FIDLER or Violinist System will be used (May also want to include total alpha dpm/100cm^2).

Conc ~ $2.0x10^{-11}$ µCi/ml. Assuming a resuspension factor of 10^{-6}:

Turn back ~ 20 µCi/m^2, 1000 µCi/m^2 with a full-face respirator (60 µCi/m^2 and 3000 µCi/m^2 if including an occupancy factor of 1/3).

Can vary based upon:

- Age (mixture) of weapon material
- Measured or arid resuspension factors
- Dose estimates from Personal Air Sampler (PAS) Data.

Personal Air Samplers can be used to estimate a person's dose due to inhalation. The following is a sample dose estimate for a default weapon scenario.

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*__Note:__ These factors may not be appropriate depending upon the situation. However, expected exposure time and the fact that the dose is integrated, and not constantly at the maximum rate, should be factored into calculations.

Initial assumptions:

- Use most conservative ALI of 0.006 μCi
- Assume 20 lpm breathing rate
- Use Assessment Manual Default Mix (30 year age)
- Total alpha values will be used
- Personal Air Sampler rate of 2.5 lpm
- Assume counting results in dpm

AF → filter activity in dpm

Note: Must correct for radon/thoron progeny or allow sample to decay.

2.8.2 Sample Bioassay Plan for Weapons Scenario

Methodologies and purposes of bioassay sampling have been discussed previously. The following is a sample bioassay plan for a weapon scenario:

- Collect a 1-liter (or 24-hour) baseline urine sample before any potential exposure.
- Collect a 24-hour urine sample every 7 days or at the conclusion of response.
- Collect a 24-hour urine sample if air sampling indicates a E greater than 200 mrem.
- Follow-up urine or fecal sampling may be required.

Note: The plan is based upon Urinalysis MDA of 0.006 pCi/sample. This would yield a minimum detectable dose (MDD) of approximately 1 rem.

2.8.3 Turn-Back Limits for Beta/Gamma

Initial assumptions:

- 1.25 rem administrative level for responders
- Both a rate and integrated dose value is determined.
- Seven days (one week) per responder at 8 hr/day*[*]
- Inhalation from resuspension is small (Note: Will change based upon isotopic mix)
- Assume a factor of three increase because an individual's exposure over time (days) can be controlled and reduced, if necessary*.

[*] **Note:** These factors may not be appropriate depending upon the situation. However, expected exposure time and the fact that the dose is integrated, and not constantly at the maximum rate, should be factored into calculations.

Assuming a responder will be available for 7 days, then approximately 200 mrem per day will reach their investigation level. If no Iodine is available for breathing, only exposure rates are used. A factor of three for the exposure rate (since an individual will not be exposed at a continuous rate), would yield a turn-back rate of 600 mR/hr.

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3.0 INDUSTRIAL HYGIENE

3.1 Overview

Emergency events involving hazardous materials may pose a multitude of health and safety hazards to responders, any one of which could result in serious injury or death. These hazards are a function of the nature of the event site as well as a consequence of the work being performed. Several factors distinguish the environment of an emergency event site from other occupational situations involving hazardous materials. The major factor is the uncontrolled condition of the site. Hazardous substances that do not endanger human health and safety when contained and properly handled may pose a severe threat to responders and the general public during emergencies.

Responders are not only subject to the hazards of direct exposure to hazardous materials, but also to dangers posed by the disorderly physical environment of the emergency event site and the stress of working in protective clothing. The combination of all these conditions results in a working environment that is characterized by numerous and varied hazards which:

- May pose an immediate danger to life or health
- May not be immediately obvious or identifiable
- May vary according to location and the task being performed
- May change as emergency activities progress.

Information about the event site will be obtained by the Consequence Management Home Team (CMHT), through direct contact with site personnel and relayed to the response team. A hazard analysis will be conducted during transit time to the site. Safety hazards, such as confined spaces, unstable structures, traffic, extreme temperatures, water, fire, etc., all need to be identified to the fullest extent possible, prior to arrival at the site. A general checklist (Hazard Checklist [Appendix A, p. 124]) has been developed to identify such hazards. This checklist is intended for use while in transit to the site. The H&S Manager will have the responsibility to acquire the appropriate information for the checklist and to assist in developing a plan for the initial on-site investigation.

Biological, chemical, physical, and confined space hazards may be encountered during deployment. Anticipated biological hazards may include viral, bacterial, fungal, and parasitic agents. Interaction with certain mammals, reptiles, insects, and poisonous plants is also a concern. Chemical hazards may include toxic metals (e.g., beryllium, lead), asbestos, solvents, corrosives, fuels, sealants, compressed gases, and cryogenics. Anticipated physical hazards may include temperature extremes, non-ionizing radiation, and elevated noise levels.

In approaching a site, the H&S Manager is responsible for evaluating the hazards present to determine which ones must be controlled in a prioritized basis. As work progresses, conditions change, and new information becomes available. These controls and procedures must be adapted to

the changing conditions. The H&S Manager will consult with the On-Scene Medical Director or designee to determine medical information related to chemical, biological and other hazards that should be disseminated to FRMAC personnel. The H&S Manager will share information and coordinate safety response activities with the Site Safety Officer as soon as the overall Incident Command System is established.

The buddy system (a minimum of two people per entry) will be used for all on-site work. This is to minimize the risk of a person being injured and not having back-up support. Internal communications will be available for all situations, ensuring that emergency rescue and general work-site evaluations can be determined, resulting in appropriate action. Incident Command will ensure the availability of emergency medical support and the location of the nearest trauma center.

3.2 Biological Hazards

Biohazards, such as insects, poisonous plants, snakes, mice infected with Hantavirus, etc., may be encountered during responses. Personnel should avoid biohazards whenever possible (not take samples in tall grass, avoid animals (dead or alive), and animal droppings, etc). Personnel should also be cautious when taking samples around animals (wild or domestic), such as cattle, dogs, etc. Any potential or suspect exposures to hazards should be reported to the H&S Manager as they are discovered. Appropriate safeguards will be instituted so that exposure to these hazards will be minimized.

In addition to Hantavirus, the following animal- or insect-vector hazards should be considered; e.g., Rocky Mountain Spotted Fever, Lyme Disease, Deer Fly Fever, Bubonic Plague and Coccidioidomycosis (Valley Fever). Unfortunately, these diseases are often delayed in onset and initially emulate less severe common conditions; e.g., a cough or cold, low-grade temperature and chills, influenza and sinus conditions. The onset of symptoms may not occur until after the deployment has been completed. During each day's safety briefing, it is imperative that the responders be made aware of the biological hazards associated with the response area at the time of the response. If symptoms occur after the deployment is complete, responders should inform their physician of their recent work and the deployment biological hazards.

Bio-warfare agents may also be present in responding to a terrorist event. No immediate health effects are expected and it may take 2 days to a week for flu-like symptoms to develop. If multiple numbers of responders simultaneously display flu-like symptoms obtain medical assistance immediately. Sources of bio-warfare agents usually involve water in the form of beverages, mists, aerosols, or human-to-human transmission from coughing or sneezing. The primary route of uptake is inhalation but ingestion may also be a viable pathway. If bio-warfare agents are present, then responders must utilize appropriate PPE such as level A suits with self-contained breathing apparatus.

General Precautions

Do not feed or harass wild animals that may carry rabies or other diseases. Avoid ticks and other small insects that may carry disease by:

- Wearing clothing that has long sleeves and closes at the wrists, collar, and ankles
- Using insect repellant on exposed skin and clothing
- Examining the skin daily for ticks.
- Wearing light-colored clothing (makes ticks easier to find).

Reduce the hazard of snakebite by avoiding locations where snakes are likely to be found (under debris piles, shrubs, or rocks; under parked cars). If snakebite occurs, keep the victim calm, elevate the bite area, and summon medical assistance.

3.3 Chemical Hazards

Preventing exposure to toxic chemicals that are involved in the emergency event or present in the environment is of primary concern. These chemical substances may be in a gaseous, liquid, or solid form. They can enter the unprotected body by inhalation, skin absorption, ingestion, or through a puncture wound.

Chemical exposures are generally divided into two categories: acute and chronic. Symptoms resulting from acute exposure usually occur during or shortly after exposure to a sufficiently high concentration of a chemical. Chronic exposure generally involves exposure to low concentrations of chemicals over a long period of time, (weeks to months). The concentration required to produce health effects varies from chemical to chemical. During emergency response work, acute exposure is the primary concern.

The effect of hazardous chemicals may be temporary and reversible, or permanent and result in disability or death. Some chemicals may cause obvious symptoms such as burning, coughing, nausea, tearing eyes, or rashes. Other toxins may cause health damage without any such warnings (carbon monoxide, beryllium, asbestos, lead). Health effects, such as cancer or respiratory disease, may not become manifest until several years or decades after exposure.

In addition, some toxic chemicals may be colorless and/or odorless, may dull the sense of smell, or may not produce any immediate or obvious physiological sensations. Thus, a responder's senses or feelings cannot be relied upon in all cases to warn of potential toxic exposure. That is why it is essential to rely on available instrumentation and knowledge of the potential hazards rather than instincts alone.

The effects of exposure depend on the chemical, its concentration, route of entry, the duration of exposure, and personal factors such as age and level of fitness. The most consequential route of exposure for emergency responders is inhalation. The lungs are extremely vulnerable to chemical

agents. Even substances that do not directly affect the lungs may pass through lung tissue into the bloodstream, where they are transported to other vulnerable areas of the body. Respiratory protection is extremely important if the atmosphere at the emergency event site contains toxic chemicals or gases. Although HEPA-filtered respirators provide protection from radioactive and chemical particulates, they do not provide protection against gases and vapors. Specific chemical protective respirator filters or supplied-air respirators may need to be used in these circumstances.

Direct contact of the skin and eyes to hazardous substances is another significant method of exposure. Some chemicals directly injure the skin. Others pass through the skin into the bloodstream where they are transported to vulnerable organs. Abrasions, cuts, heat, and moisture accelerate absorption into the skin. The eyes, nose, and other mucous membranes are particularly vulnerable because airborne chemicals can accumulate and dissolve in their moist surface. Wearing proper protective equipment and minimizing contact with liquid and solid chemicals can help protect against skin and eye injury through incidental contact.

The Occupational Safety and Health Administration (OSHA) has established a Hazard Communication (HazCom) Program for identifying hazardous chemicals in the workplace and communicating information about these hazards to employees. Key elements of the HazCom Program include identifying the hazards, assessing their consequences (material safety data sheets [MSDS]) and container labels), and training employees on how to protect themselves. The initial Hazard Assessment should identify the hazards. An MSDS will be available on site for all chemicals carried by the response team. Information on how to obtain additional MSDS information will also be readily available. All responders are expected to have received the appropriate hazard communication program training prior to deployment. The parent organization is expected to provide hazard communication program training in accordance with 29 CFR 1910.1200 for field operations.

3.3.1 Personal Monitoring

Monitoring and sampling will identify potential exposure to hazards. Personal air sampling will be done in accordance with OSHA requirements and the National Institute of Occupational Safety and Health (NIOSH) recommendations. Due to sample analysis turnaround times, direct reading instrumentation; e.g., electrochemical sensors, photo-ionization detectors and colorimetric detector tubes are preferred over indirect sampling.

Calibrate all organic-vapor analyzers, combustible gas and oxygen meters, sound-level meters, and personal sampling pumps before and after use, according to manufacturer's instructions. Document calibration data on the forms used to record measurements or on specific calibration forms provided by the response organization. Where possible, equipment calibrations should be traceable to National Institute of Standards and Technology or other nationally recognized standards.

3.3.2 Chemical Exposure Limits

Define personnel exposure limits for hazardous materials encountered during an emergency response incident as follows:

Emergency Response Exposure Limits

Emergency Response Planning Guideline (ERPG) values have been established by the American Industrial Hygiene Association (AIHA) as guidance on appropriate levels for emergency responders. During the early response and up to the time when cleanup and site restoration begin ERPG-2 levels will serve as exposure limits. These values are defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective actions. ERPG-2 values have been defined for a number of toxic materials by the AIHA.

When ERPG values are not available then the H&S Manager will develop exposure values based on NIOSH recommendations, MSDS limits, or similar hazardous materials.

Clean-up and Site Restoration Exposure Limits

Once the accident has advanced beyond the emergency response phase into the long term operational phase of clean-up and site restoration, the most conservative of the occupational exposure limits (Permissible Exposure Limits – PELs) established by OSHA or the American Conference of Governmental Industrial Hygienists (Threshold Limit Values [TLVs]) will be used.

Exceeding Established Exposure Limits

When extremely unsafe conditions may pose a significant hazard to the local population and environment if not handled in a timely and appropriate manner, it may be necessary for an individual or small group of individuals to exceed established exposure limits for specific operations. Inform individuals of the risks involved when they volunteer for these operations. Caution must be used in these instances to ensure that the individual(s) do not enter conditions that are immediately dangerous or life threatening and that all proper controls are utilized. The FRMAC Director must grant permission in writing for individuals to exceed established exposure limits.

3.4 Physical Hazards

Physical hazards include acoustic, electromagnetic, ergonomic, mechanical, and thermal agents that may be detrimental to health. Because tissue penetration, target organs, health effects, and individual susceptibility vary greatly, corresponding exposure limits must be interpreted by individuals adequately trained and experienced in this type of evaluation. Certain physical hazards such as heat stress have been noted as significant problems during emergency response exercises and need special

attention. Confined spaces or oxygen deficient atmospheres are often not identified and are significant hazards in that they can lead to immediate injury or death.

3.4.1 Thermal Stress: Heat

Heat disorders arising from high temperatures, PPE, non-acclimatization, etc. can affect the amount of work responders can do, the manner in which they do it, and lead to serious health problems. Heat stress is a common problem and evaluation of it in a field response is not simple. People can only function efficiently and safely in a very limited body temperature range (core temperature). Fluctuations exceeding 2° or 3°F impair performance remarkably. Larger fluctuations can lead to death.

Heat stress is the combined heat load on the body from metabolic heat production and external environmental factors, which include air temperature and water vapor content, radiant heat, air movement, and the use of PPE. Heat stroke is the most serious of the heat-related illnesses because of its potential to be life threatening or result in irreversible damage. Heat stroke is caused by exposure to an environment in which the body is unable to cool itself sufficiently. It is characterized by a loss of mental acuity, dizziness, and a cessation of sweating. It is critical to undertake emergency cooling of the body even when medical help is on the way.

Although heat cramps are debilitating, the condition is easily reversed with proper medical treatment. The cramps result from exposure to high temperature for a relatively long period of time, particularly if accompanied by heavy exertion due to a loss of salt and moisture from the body. Signs and symptoms that generally occur include pain or muscle spasms in the legs, hands, feet, or abdomen.

Heat exhaustion can also result from physical exertion in a hot environment but can easily be reversed by drinking fluids and resting in a cool place. Signs of heat exhaustion are a mildly elevated temperature, pallor, weak pulse, dizziness, profuse sweating, and cool, moist skin.

The following measures and actions will be used to help control heat stress:

- Adequate drinking water must be made available to responders and they must be reminded to frequently drink small amounts, (8 ounces every 15 – 20 minutes). The water should be reasonably cool and must be close to the working area so the responders have ready access to it. Responders must be encouraged to drink more than the amount required to satisfy thirst, since thirst is not an accurate indicator of adequate fluid replacement.
- For responses that last more than a few days, electrolyte replacement may also be necessary. Commercially available sports drinks or 1 g salt mixed into 1 liter of water provides adequate electrolyte replacement.

- A work/rest regimen based on Heat Stress Monitoring or Wet Globe Bulb Temperature (WGBT) readings must be established. Recommendations for these work/rest recommendations are available in the ACGIH TLV Booklet.
- Cooling suits or ice vests can be provided to be worn beneath protective garments to assist in cooling the body.
- Personal protective equipment use should be assessed from a risk perspective to determine an appropriate level of protection versus risk. This is particularly true of encapsulating suits and respirators.

3.4.2 Thermal Stress: Cold

Hypothermia conditions, including loss of body heat and frostbite, can represent life-threatening conditions. Fatal exposures to cold have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important factor is the fall in the body's core temperature. Exposure to extreme cold for a short period of time may cause severe injury to skin tissues, particularly the ears, nose, fingers and toes. Local injury resulting from cold is included in the generic term of frostbite. Frostbite injuries should be given medical attention as soon as possible to prevent tissue loss and, in some cases, the loss of extremities. Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature.

Symptoms are usually exhibited in five stages:

1. shivering;
2. apathy, listlessness, sleepiness, and cooling of the body;
3. unconsciousness, glassy state, slow pulse, and slow respiration;
4. freezing of the extremities; and finally,
5. death.

Cold stress is proportional to the total thermal gradient between the skin and the environment since this gradient determines the rate of heat loss from the body. When vasoconstriction is no longer adequate to maintain body heat balance, shivering becomes an important mechanism for increasing body temperature because it results in increased metabolic heat production. Two factors that influence the development of cold injury are ambient temperature and wind velocity. Wind chill describes the chilling effect of moving air in combination with low temperatures. For instance, 10°F with a 15 mile per hour (mph) wind is equivalent in chilling effect to no wind at -18°F.

Since water conducts heat 25 times better than air, care must be taken to ensure that responders remain dry. This is particularly a concern when responders remove outer layers of protective clothing exposing perspiration soaked clothing and skin. Dry and warm clothes such as gloves, footwear, coats and blankets need to be available.

Thermal socks, long cotton or thermal underwear, layers of clothing, and other cold weather gear can aid in the prevention of hypothermia. Warm, sweet, non-alcoholic drinks shall be available. If it is anticipated that operations will continue for an extended time period, work rotations, and acclimatization methods shall be practiced. Work protocols, and cold stress indices are available in the ACGIH TLV Booklet.

3.4.3 High Noise Areas

Any area that has a noise level of 85 decibels (dBA) time-weighted average or higher is a hazardous noise area. Responders working for extended periods of time must wear hearing protection in these areas. Prior to entry, the location of high noise areas will be communicated to responders. Cumulative daily noise exposure will be estimated and responders will be required to wear hearing protection (ear plugs, muffs, or both) when the 8-hour time-weighted average exposure exceeds the 85 dBA threshold. Entry into areas with noise levels above 140 dBA is not permitted even with double hearing protection. A sound level meter will be available to evaluate noise levels. The exposure criteria found in the ACGIH TLV booklet will serve as guidance during all activities. As a rule of thumb, if personnel have to raise their voice to talk to someone one foot away, the area is a hazardous noise area. Contact the H&S Manager for noise monitoring and hearing protection.

3.4.4 Non-Ionizing Radiation (LASERS, UV, IR, MWFR Sources)

Encountering non-ionizing radiation hazards are not expected during typical responses. However, intense electromagnetic fields may be experienced around some types of operational equipment, such as microwave transmitters, operational aircraft, and laser equipment. Whenever the potential for non-ionizing radiation is identified, field-monitoring personnel will isolate the area, inform the H&S Manager, and post warning signs. The H&S Manager will notify appropriate personnel of the hazard and provide instruction for any other necessary measures to be taken. Exposure to non-ionizing radiation will be evaluated per the ACGIH TLV and the Institute of Electrical and Electronics Engineers C95.1-1991 requirements.

3.5 Confined Spaces or Oxygen Deficient Areas

Confined spaces will not be entered without an evaluation of potential chemical and physical hazards and a written entry procedure. Entry into confined spaces or oxygen deficient areas can result in immediate injury or death if not done appropriately. Confined spaces or oxygen deficient areas are commonly found in pits, sewers, tanks, or areas where large quantities of gases are stored or used. Structures that have recently burned may also be oxygen deficient. These spaces must not be entered by responders without first performing appropriate monitoring for oxygen, carbon monoxide, explosive gas, and hydrogen sulfide concentrations. If entry is imperative, SCBA must be used. The H&S Manager will provide guidance and monitoring equipment in accordance with 29 CFR 1910.146, Permit Required Confined Spaces.

3.6 Personal Protective Equipment

Personal Protective Equipment consists of three components: standard safety equipment, special equipment (fall protection, water safety, electrical safety, high noise areas, etc.), and respiratory equipment. The H&S Manager is responsible for ensuring this program is implemented.

Standard Safety Equipment

All non-office employees are expected to arrive on-site with appropriate clothing, closed-toed shoes, and safety glasses designed to meet the current ANSI standard Z87.

Special PPE

Activity-specific PPE such as full body harnesses for fall protection, life vests for over/on water work, linesman's gloves for work within close proximity to high voltage sources, ear plugs for high noise areas, steel-toed shoes for lifting operations, and hard hats for construction areas, are to be provided by the response organization. An assessment shall be conducted by the H&S manager prior to starting the specific task. The general checklist shall be completed, which identifies specific tasks and any special PPE requirements necessary.

Respiratory Protective Equipment

Respirators shall be used in accordance with the OSHA standard 29 CFR 1910.134 "Respiratory Protection."

3.6.1 Respiratory Protection Program

To comply with the Federal Respiratory Protection Standard (29 CFR 1910.134) as required by OSHA, the following program has been established to ensure the protection of all employees from respiratory hazards through the proper use of respirators. Respirators are to be used only where engineering control of respiratory hazards is not feasible, while engineering controls are being installed, or in emergencies.

3.6.1.1 Types of Respirators

Full face air purifying respirators (APRs) are designed to be used in areas where an airborne contaminant exposure has exceeded its designated OSHA PEL or ACGIH TLV, while not exceeding a chemical's "immediately dangerous to life or health" (IDLH) concentration. They must be used with appropriate cartridges (i.e., organic vapor, acid gas, chlorine, ammonia, and HEPA).

Powered air purifying respirators will also be available. They must be used in conjunction with HEPA cartridges, for airborne lead, silica, metals, asbestos or other airborne particulate that is considered a potential health concern to humans. These respirators cannot be used in IDLH or potential IDLH environments.

Self Contained Breathing Apparatus will be used when there is evidence suggesting that an airborne contaminant (or combination of airborne contaminants) is present in a quantity that exceeds the IDLH for that particular contaminant(s). Appropriate communication, such as radio or hand signals, need to be established prior to conducting work in SCBAs. Hand signals should only be used when visual contact by personnel can be maintained.

3.6.1.2 User Qualification Summary

All employees who have the responsibility to wear respirators shall be medically qualified in accordance with 29 CFR 1910.134 (b)(10). Before being allowed to wear a respirator, each person must have successfully completed a fit-test, within the last 12 months, for the type of respirator (manufacturer, model and size) to be worn.

Respirator selection will be completed by H&S professionals as part of the Hazard Assessment. The following list provides the basic expectations for respirator fitness.

1. Only certified respirators will be selected and used.
2. Field personnel are expected to be medically qualified by their home organization, fit-tested, and trained prior to deployment. If absolutely necessary, medical qualification, fit testing, and training can be done in the field.
3. Employees will not be assigned to tasks requiring the use of respirators unless a physician at their home organization has determined that they are physically able to perform the work and use the equipment.
4. The user should have been instructed and trained in the proper use of respirators and their limitations. The respirator user must also be satisfactorily fit-tested before wearing the respirator.
5. Respirators will not be worn when conditions prevent a good face seal. Employees who are required to wear respirators will not have facial hair that interferes with the face seal of the respirator. Also the absence of one or both dentures can seriously affect the fit of a face piece.
6. Respirators will be assigned to individual workers for their exclusive use.
7. If respirators are to be reused in the field, they should be cleaned and disinfected after each use by the respirator user. Respirators will be stored in a clean and sanitary location. Filters will be replaced according to the manufacturer's instructions.
8. It is not anticipated that personnel will use supplied air respirators.
9. Appropriate surveillance of work area conditions and degree of employee exposure or stress will be maintained.

3.6.1.3 Respirator Inspection and Field Testing Instructions

Employees shall conduct an inspection of the respirator prior to each use by performing the following checks on the respirator components. If any problems are discovered a new respirator will be issued and the damaged one will be returned to H&S for replacement.

1. **Headbands**: Check to see that headbands still have their elasticity. Inspect for breaks or tears in the material and make sure all cups, fasteners, and adjusters are in place and working properly.
2. **Face piece**: Check the face piece for dirt, cracks, tears, or holes. Inspect the shape of the face piece for possible distortion that may occur from improper storage. Make sure the rubber is flexible and not unbending or brittle. Check the aluminum yoke for cracks.
3. **Inhalation and exhalation valves**: Check for cracks, tears, distortion, dirt, or buildup of material between the valve and valve seat.
4. **Cartridge holders**: Check to make sure gaskets are in place and check for cracks and any damage to threads.
5. **Cartridges and filters**: Cartridges and filters must be clean. Never try to clean a filter or cartridge by washing or using compressed air. Inspect filters and cartridges for dents, scratches, or other damage, particularly in the metal sealing bead around the bottom.

3.6.1.4 Respirator Cleaning and Maintenance

Each user will be responsible for the respirator(s) that has been assigned to him/her for the specific emergency response. It is the responding organization's responsibility to provide each user with a respirator that is clean and ready for use. It is the user's responsibility to keep the assigned respirator in a clean and operable condition so that the respirator can be used at any time. The responding organization will provide cleaning kits or cleaning supplies for respirator maintenance. In addition, each user shall store the respirator in a bag or compartment ensuring that the respirator is properly protected from weather conditions, contaminants and any other elements that may compromise the performance of the respirator.

3.6.2 Protective Clothing

Field teams are expected to wear a long-sleeved shirts and high-topped, closed-toed shoes. If required by the H&S Manager, personnel deployed in the field must wear PPE. This could be minimal protection such as gloves and shoe covers, or it could be as complete as coveralls, inner and outer gloves, inner and outer boots, hoods, and respirators. Additionally, hearing protection such as earplugs and/or muffs may be required. The H&S Manager, in consultation with the supervisor, will determine the type of PPE needed for each area in the event.

3.7 Sanitation

Provisions will be made for toilet facilities, hand washing facilities (with hot and cold water and soap), break/dining areas, and drinking water. Trash collection and pest control will be provided as necessary.

3.7.1 Toilet Facilities

The following table outlines guidelines presented in 29 CFR 1910.141 establishing requirements for toilet facilities.

Number of participants	Minimum number of toilets
1 to 15	1
16 to 35	2
36 to 55	3
56 to 80	4
81 to 110	5
111 to 150	6
Over 150	1 additional fixture for each additional 40 employees.

3.7.2 Water Supply for Hand Washing, Decontamination, and Human Consumption

Adequate potable water should be supplied for drinking, washing, and decontamination purposes. Water or wet wipes will be supplied at hand washing stations accompanying toilet facilities. Bottled water or drinking fountains must be readily available to responders during working hours.

3.7.3 Food and Beverage Consumption

Food and beverage will not be consumed in any area exposed to radiological contamination or other hazardous material. Eating and drinking must take place outside of the defined contamination area. Receptacles will be provided to dispose of food and beverage not consumed. The receptacles will be emptied daily.

4.0 SAFETY

4.1 General Safety Guidance

Required site-specific activities may present a broad range of safety hazards and concerns to all responders and participants involved. The H&S Manager will gather information and develop a safety guide specifically addressing the deployment site requirements. This information will be disseminated during the site safety briefing and at the badging location. The H&S Manager, or designee, will conduct periodic Hazard Assessments in order to update hazard identification and the H&S Plan.

Additionally, all participants have a role to play in protecting themselves and their fellow employees. Any participant may identify hazards at any time and make recommendations or request assistance to help ensure participant safety at all times. If a serious safety problem is observed, employees will stop all activities immediately and contact a member of the H&S staff. Following is an initial checklist for on-site safety:

- Prior to beginning any work task, check the area to determine what problems or hazards may exist.
- Uneven surfaces, holes, or sharp objects are likely to be present and caution must be taken when walking in unfamiliar areas.
- If an activity might endanger fellow workers or nearby equipment or materials, the necessary steps must be taken to safeguard and protect people and materials.
- The H&S requirements for each work task must be reviewed with the lead task person prior to starting work. No one is required to perform a work task that may result in injury or illness to themselves or to others.
- Workers must become familiar with, understand, and follow emergency procedures.
- The team leader is responsible for maintaining proper H&S conditions for the work area. Any hazardous conditions, unsafe acts, or unsafe equipment must be reported to the supervisor and/or the H&S Division.
- Obey all warning signs and tags (such as “Keep out,” “No Smoking,” “Eye Protection Required,” “Authorized Personnel Only,” etc.).
- Electrical cords, hoses, and leads shall be protected or elevated. They must be elevated, covered and/or cleared away from walkways and other locations where they may be damaged or create tripping hazards.
- Horseplay is strictly prohibited.

- Certain tasks require use of PPE, such as respirators, eye protection, safety belts, hearing protection, and foot protection. When personal protective equipment is specified, its use is mandatory.
- All participants must notify the H&S Manager and their supervisors immediately of all job-related injuries, illnesses, vehicle or property damage accidents, and near-miss incidents.
- Personnel identified as fork truck operators shall attend a qualification course or re-qualification course and carry on their person the proof of qualification.
- Only trained and qualified electrical workers will be allowed to perform work on electrical equipment, components, and systems.
- Responders shall maintain a valid state driver's license or a commercial driver's license with the proper endorsements and current medical certificate, (when warranted), in their possession for the size of the vehicle to be operated. Licenses must be from the state in which responders are gainfully employed, or claim permanent residence. Responders shall know and follow all local and state traffic regulations.
- Responders working at locations where they are exposed to fall hazards four feet (1.2m) above the floor or ground shall be protected from falls. Participants shall be protected by the installation of standard guardrails and toe boards or the participants shall wear and use a safety harness and lanyard or self-retracting lifelines.
- Trailers and mobile equipment using internal combustion engines, or containing hazardous materials shall not be used near doorways, windows, garage door openings, or fresh-air intake ventilation systems. See the Safety and/ or Industrial Hygiene Manager for assistance with the staging of this equipment.

4.2 Scope of Operations

Operations in which explicit safety concerns are addressed include:

- Setup operations
- Aircraft operations
- Vehicle operations
- Field team operations
- Night operations.

4.2.1 Setup Operations

Primary concerns during setup are centered on unloading palletized cargo and staging of equipment, and include the following:

- All tripping hazards will be clearly marked or guarded.
- Qualified personnel will closely monitor electrical hazards during setup.

- Staging of laboratory trailers will be done in a manner that minimizes the hazards associated with generator emissions.
- All participants need to be aware of motorized equipment operating in the area.

4.2.2 Helicopter Operations

Complete regulations regarding the use of helicopters can be found in 29 CFR 1910.183 *Helicopters*. General guidance includes the following:

- A predetermined helicopter landing-zone will be identified.
- Passengers should receive a safety briefing from helicopter operators including safety features and equipment, their location on the individual aircraft, and emergency information cards before taking off.
- Passengers and ground crew members approaching helicopters shall stay in a crouched position, and shall be in clear view of the pilot while approaching or departing a helicopter.
- Passengers and ground crew should approach/depart from the FRONT of the helicopter ONLY when signaled by the pilot, and should NEVER walk under or around the tail.
- Loose fitting clothing, hats, hard hats, or other gear, which might be caught in rotor downwash must be secured or removed within 100 feet of operating helicopters.
- Only authorized participants will be permitted within 100 feet of the helicopter. Other personnel must be accompanied by a flight crewmember.
- During helicopter landing and takeoff operations, all participants are to maintain a clear distance of at least 100 feet from the helicopter.
- Passengers and ground crew shall wear hearing protection (including communications headsets or helmets) at all times around operating helicopters.
- Passengers shall generally assist the pilot in watching for other traffic or ground obstacles as directed by the pilot.

4.2.3 Vehicle Operations

- All vehicle occupants shall wear seat belts.
- Vehicle operators shall follow all local and state traffic regulations.
- When in the area of pedestrian traffic, drivers shall maintain a maximum speed limit of 10 mph, except in emergency situations.
- Drivers will have headlights on at all times.
- Hazard flashers will be used during those field operations requiring low speeds or frequent stopping.
- Smoking is not permitted in any vehicle.

- No one is allowed to ride outside of any moving vehicle, including forklifts, pickup truck beds, backhoe buckets, etc.
- Drivers are not allowed to use cell phones while vehicles are in motion.

4.2.4 Field Team Operations

- When conducting field team operations, participants will observe a buddy system at all times.
- Field teams will be cognizant of their surroundings and watch out for harmful plants and animals.
- Field teams shall be in communication with the operations center.

4.2.5 Night Operations

- During night operations, lighting is essential and will be provided.
- Everyone must be especially careful during all aspects of night operations to avoid unforeseen or unanticipated hazards.
- Teams conducting night operations will be limited to essential personnel for that specific operation only, to avoid risk to other responders and participants.
- Safety personnel will be on duty during night operations to provide assistance as needed.
- When walking along or across any roadways, all personnel involved in night operations will look out for vehicle traffic. Reflector traffic vests will be provided and worn as required.

4.3 Guidance for Frequently Encountered Situations

Guidance is provided below on frequently encountered situations, however the subjects are not all inclusive. It is anticipated that the majority of emergency response activities will comply with OSHA general trade and construction standards as found in 29 CFR 1910 and 1920. Any deviations based upon the emergency situation must be appropriately approved and documented.

Lockout/Tagout

During investigative activities, personnel may encounter a piece of equipment that will need to be investigated. Contact with electrical or mechanical equipment shall require personnel to follow lockout/tagout procedures. Appropriate lockout/tagout procedures may require the services of maintenance personnel or local utilities. These services can be arranged when needed.

Electrical Hazards

Electrical hazards need to be identified prior to the start of work. Typical electrical hazards include working near power lines, worn out cords, working with wet electrical equipment, and poor or inadequate grounding. A qualified electrical worker shall complete any electrical repairs or work that requires any direct contact with an electrical source. Electrical protective equipment, such as

linesmen gloves and rubber mats, will be used by personnel to protect themselves from possible direct contact with any electrical hazards.

Lightning

Individuals will need to stay alert to the potential of severe weather, especially lightning. The signs of an oncoming thunder and lightning storms are typically towering clouds with a "cauliflower" shape, dark skies and distant rumbles of thunder or flashes of lightning. Individuals should not wait for lightning to strike nearby before taking cover. They should seek a large, enclosed building when a thunder or lightning storm threatens. If in a car with a hard top, individuals stay inside and keep windows rolled up. The 30 30 rule should be used: People should take appropriate shelter when they can count 30 seconds or less between lightning and thunder and remain sheltered for 30 minutes after the last sound of thunder.

When someone is struck by lightning, get emergency medical help as soon as possible. A person struck by lightning may appear dead, with no pulse or breath. Often the person can be revived with cardio-pulmonary resuscitation (CPR). CPR should be attempted immediately. Those who are injured, but conscious should be attended to next. Common injuries from being struck by lightning may include burns, wounds and fractures.

Fall Protection

Fall protection will be used whenever personnel are required to position themselves 4 feet or more above ground level.

Construction Sites

Construction sites have a variety of hazards, besides those specifically identified in this H&S Manual. Uneven grading; slip, trip and fall hazards; overhead objects; and poor lighting represent a threat to personnel safety. Appropriate lighting will be available so personnel can recognize these hazardous situations and avoid injury.

Heavy Traffic

Any work near or on heavily trafficked areas will require safeguards such as illumination, reflective day-glow traffic vests, and caution signs. Blocking an intersection, entire road, or lane will require the assistance of the local municipality (i.e., police department, fire department, etc.). A designated individual will have the responsibility to ensure that the appropriate precautions have been taken.

Work In or Near Water

Working within the proximity of waterways (rivers, oceans and lakes) can result in hypothermia and drowning. Working slowly and cautiously is necessary, and requires team pre-planning. Fall protection equipment and procedures may be necessary. The senior management official will have the responsibility to decide whether these controls are required.

Work Involving Fire

Personnel will not enter into an environment where there is active fire or recently extinguished flames. Personnel may enter a fire-damaged facility only after the professional firefighting unit and team has approved the scene for entry and determined the oxygen content of air in the facility is acceptable. Personnel will strictly adhere to any procedures or commands the firefighting personnel specify.

High Explosives

Personnel will not enter into any environment where high explosives have been identified or suspected to be present. If, during entry into an area-of-concern, personnel identify any such substance, all members are required to leave the area and report the findings to the senior management official. Handling, disarming, detonation, removal, etc., will be performed by a trained explosive ordinance disposal team, which is associated with a branch of the United States Military or the municipal police or fire department.

Cryogenic Use

The use of cryogenics can present several hazards, from skin burns to asphyxiation. Typical hazards found in FRMAC operations are from the use of liquid nitrogen to cool high-purity germanium detectors. General precautions are described below.

Adequate ventilation is required to ensure an oxygen deficient atmosphere will not result for a large release/spill of liquid nitrogen. Appropriate cryogenic PPE is required and should be inspected prior to use. This would include; wearing cryogenic insulated gloves, face shield or eye protection covering to the side of the face, long sleeved shirt or coat, steeled toed shoes, and ankle length pants. Clear paths should be ensured before transporting open cryogenic materials. The containers need to be carried upright. Care should be taken to avoid detector discharge. The valve must be off and the filter warmed to a sufficiently high temperature before moving the hose from the dewar.

Pressurized Vessels

Work near or involving pressurized vessels, such as reactors, compressed gas bottles, boilers, etc. needs to be approached with extreme caution. These pieces of equipment, impacted by incidental forces contributing to the emergency, could cause serious injury from instantaneous pressure-release. It is important that these containers are thoroughly examined for damage by pressure vessel experts before actual contact is made. Should damage be noted, personnel are required to communicate to the senior management official and request appropriate action to be taken.

4.4 Emergencies

If emergency medical, fire, and/or other emergency response support services are needed to respond to an incident, lights and sirens will normally be used to provide visual and audible warning signals.

If participants see or hear lights or sirens, they will clear the area so that emergency crews may conduct their operations.

Participants in need of emergency assistance while in the field should:

1. Call "911" or use the radio and say "Mayday-Mayday-Mayday," and
2. State the nature of the emergency and their location, so that emergency medical, fire, and police personnel can be dispatched to their location.

If there is a medical emergency, dial 911 to activate the emergency medical services (EMS) system immediately. Medical assistance will generally be available on site for minor injuries or illnesses. Emergency assistance information will be disseminated at the safety briefing. Then notify the On-Scene Medical Director or designee and the H&S Manager of the need for assistance. Refer to the H&S Plan or Participants' Guide for phone numbers and guidance.

4.5 Evacuations and Shelter

The site Health and Safety Plan (HASP) and/or daily safety summaries will include information on personnel notification procedures, shelter locations, evacuation routes and rally points in case local evacuations or sheltering-in-place becomes necessary. Team leaders are responsible for evacuated personnel accountability.

Upon establishing the FRMAC, the H&S Manager will coordinate with the FRMAC Director and/or Incident Command to determine notification and evacuation procedures in the event that the entire FRMAC needs to be evacuated (mass evacuation).

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5.0 ENVIRONMENTAL COMPLIANCE

5.1 Waste Identification Overview

Field operations may result in the generation of two basic types of waste: solid waste which includes hazardous waste, radioactive waste, and mixed hazardous/radioactive waste; and waste water.

It is essential to identify the potential wastes that could be generated at each response site in order to comply with federal and state regulations which govern their management and disposal. This identification will be based upon the contaminants at each site and the chemicals and other materials used by the response team. By identifying potential wastes prior to mobilization to the site, the H&S manager will be able to select the appropriate containers for the wastes and arrange in advance for necessary permits or approvals.

Title 40 CFR 262.11 requires the person generating a solid waste to determine if the waste is hazardous. Generally, wastes should be characterized prior to or upon generation. This means that by the time the material becomes a waste, on-site personnel should know the proper handling and disposal method for the waste. Wastes that are not characterized before they are created may require extensive research in order to properly characterize them. In this event, the waste must be managed as a hazardous or mixed waste (depending upon the radiological status) until a definite determination is made. Typically, wastes accumulated as a part of a radiological emergency response will not be characterized prior to generation and will require research to be characterized.

An area or areas should be designated in which wastes may be stored during field operations. If the waste is a hazardous waste, it must be managed in accordance with the applicable regulations of 40 CFR 262 (Generator Standards). In addition, an emergency permit may be obtained for managing hazardous waste generated from an emergency response action as provided by 40 CFR 270.61 (Emergency Permits). Each container or location for different types of waste (solid, hazardous, or radioactive) must be clearly marked. Containers holding hazardous waste should have the words "Hazardous Waste" clearly marked on the container. As a best management practice, each container should be clearly labeled or marked with the contents (i.e., radioactive waste, solid waste, etc.). This gives some assurance that waste will be segregated and managed correctly and could reduce waste management activities.

All waste should be compatible with the storage container and secondary containment should be provided for waste containers. Secondary containment should be able to hold 110% of the total volume stored to ensure containment in the event of an accident. Secondary containment could take the form of an over-pack container, a small pit lined with plastic, a containment structure, or a spill pallet. Hazardous and radioactive waste requires additional documentation to assure that the waste is properly managed. Information to be maintained includes: time, date, and location of accumulation,

container identification, type of waste, name of person managing the waste, quantity and volume of waste, survey readings such as radiation or swipe results, and any sampling or analysis that has been done. This information can be maintained in field or waste management logbooks that will be maintained indefinitely. Subsequent additions of waste to the same container should be logged separately with the date and volume recorded.

It is imperative that records be kept for all containers of waste for several reasons. The Environmental Protection Agency requires that waste generators track hazardous waste containers, and tracking low-level waste containers is a best management practice. These records assist in determining length of accumulation time, which is a critical piece of information in hazardous waste regulations. Also, in the event of personnel changes, the records will provide continuity for the waste management process.

5.2 Types of Waste

Solid Waste

Title 40 CFR 262.2 defines solid waste as discarded items from the home or workplace. Items disposed of as solid waste are ordinary household trash, office trash, and cafeteria waste. Responsibility for management and disposal of solid waste generally falls to the state or municipality. Each state or local government has its own laws defining which wastes are eligible for disposal as regular trash. Often special permission is required for disposal of industrial waste or any waste not generated in a household. The H&S Manager will make arrangements for trash disposal within a week of mobilizing on site. Large, heavy-duty trash bags and/or trash receptacles should accompany the field team or should be purchased upon arrival at the site.

Hazardous Waste

Title 40 CFR 262.2 defines a Hazardous Waste. Generally, hazardous waste is defined as solid waste that is either listed in the federal regulations or that exhibits one of four characteristics described in the federal regulations (40 CFR 261.24-33). States have the option of designating additional wastes as hazardous waste. Typical hazardous wastes that could be generated on a project are acids and other laboratory wastes, fuels, spill residues, spent solvents, expired or unwanted chemicals, and lead-contaminated items. Hazardous waste must be managed at the point of generation and cannot be transported away from that point without a special license and a hazardous waste manifest. If a field crew generates hazardous waste, it must be placed into a leak-proof container with a tight-closing lid. The container must be made from a material that is compatible with the waste. For example, corrosives should not be accumulated in metal containers, and organic solvents should not be stored in plastic containers. Consult the corresponding material safety data sheet (MSDS) for further information on product compatibility.

Some wastes may have alternate management, transportation, and disposal requirements under the Resource Conservation and Recovery Act (RCRA). Examples may include used oil and other petroleum products, antifreeze, grease, biological items, and lead batteries.

The H&S Manager will make special arrangements for disposition of these items with the local government or the owner of the items.

Up to 55 gallons of properly managed hazardous waste may be accumulated without any time limit for treatment/disposal. Once 55 gallons has accumulated, the generator of the waste must either transfer it to a permitted treatment, storage, or disposal, facility, or may keep it for another 90 days, if certain conditions apply. The manager of the waste must receive proper training; prepare, distribute, and implement emergency contingency plans; and inspect the waste weekly.

Radioactive Waste

Federal regulations and DOE Orders govern management and disposal of radioactive waste. Radioactive waste generated at field sites may include anti-c clothing, other PPE, rags, compactable trash, tools, sampling equipment and residue, filters, sources, contaminated soil, and decontamination fluids. These items must be placed in a container with a label indicating the contents and the known or suspected radiological contaminants. The H&S manager will make arrangements for disposition of these items with the owner of the material.

Mixed Radioactive/Hazardous Waste

Mixed waste is managed as hazardous and radioactive waste. Mixed waste is extremely difficult to dispose of, so field teams must strive to prevent the accidental mixing of waste streams. For example, chlorinated solvents should not be used for cleaning items in radioactive areas. If the mixture of hazardous and radioactive waste is unavoidable (for example, the radioactive contamination of lead shielding), the field teams should make every effort to minimize the amount generated.

Waste Water

State or local governments govern the disposal of wastewater. The disposal of domestic wastewater (household-type wastewater) generally does not require any special permits. The disposal of industrial wastewater often does require a permit, which is issued by the authority that manages the treatment works. Besides domestic sewage, wastewater from field operations could be generated as a result of laboratory operations, decontamination of equipment and personnel, and contamination of storm water or other existing water source. The best solution for wastewater disposal is discharge to a local treatment facility, but this depends upon the cooperation of local authorities. A permit to discharge may mandate pre-treatment of water to eliminate or reduce certain contaminants. If a discharge permit cannot be obtained, the water must be containerized or impounded, and other treatment/disposal options investigated.

5.3 Protection of Resources

Responder teams must take extra care to protect the environment when on any assignment. Spill prevention and minimal disturbance of natural areas are especially important. Spill prevention applies to product storage areas as well as wastewater, sewage, petroleum products in equipment reservoirs, and waste containers. The spillage of any of the aforementioned substances may prompt a written or verbal report to the regulatory authorities. Immediately after the release, the following information must be documented:

- The date and time of the release
- The released substance
- The amount of release
- The affected media, and
- Containment and clean-up efforts.

The H&S Manager will determine which authorities or agencies should receive the report. The submittal of additional information, site cleanup, and reporting may be required, depending upon the amount and nature of the release.

6.0 MEDICAL

6.1 Overview

The need for and availability of medical support will vary depending on the type, size, and location of the emergency response. In some cases, the response may be large enough to have a staff physician or nurse. In all cases, procedures must be identified for attending to major and minor injuries or illnesses. Patient transport methods and medical facility availability need to be briefed to all participants when each responding organization arrives at the site.

Each participant must be medically cleared by their home organization's Medical Director, or designee, that they are physically qualified to perform the tasks that may be required. This shall be attested to in the form of a written document, which shall include any limitations, special needs, medications or conditions for each participant. Any limitations, special needs, medications or conditions need to be reported to the individual's organizational on-site lead, the H&S Manager and the Medical Director or designee.

There could be several different medical organizations present at the FRMAC. One typical organization would be Radiation Emergency Assistance Center/Training Site (REAC/TS) Emergency Response Teams (ERT). Each REAC/TS ERT consists of a Physician, a Nurse/Paramedic (or Paramedic) and a Health Physicist. The senior Physician on the ERT(s) will typically function as the On-Scene Medical Director. In his/her absence, the senior Nurse/Paramedic may function as the On-Scene Medical Director.

The prime mission of REAC/TS' ERT(s) is to provide medical, nursing, paramedical and health physics support to healthcare institutions and local providers involved with care of real or perceived victims of a radiological or nuclear incident. Just-in-time radiation medicine training can be provided to local healthcare institutions and/or practitioners at their request. A secondary mission is to provide medical, nursing, paramedical and health physics support to management and personnel of a deployed FRMAC.

The REAC/TS' ERT will report to the H&S Manager when operating as a part of FRMAC. When supporting medical centers directly, the will report through the Senior Energy Official to IC/UC. REAC/TS will establish standing medical care orders for REAC/TS personnel. REAC/TS ERTs report to the senior Physician and ultimately to the REAC/TS Director. The function of the REAC/TS team in conjunction with the H&S staff is as follows:

- Provide advice and consultation regarding medical and related health physics issues following real or perceived radiological or nuclear incidents.
- Provide advice and assistance regarding the health and safety of the team.

- Provide emergency medical evaluation and treatment to personnel when necessary.

6.2 Reporting Requirements

- All injuries will be reported to the On-Scene Medical Director or designee and to the H&S Manager when they occur.
- Individuals with any significant conditions, limitations and/or special requirements should inform his/her home organization Medical Director, the On-Scene Medical Director and the H&S Manager.
- Personnel who take medication on a routine basis should bring at least a fourteen-day supply when deployed. Personnel with pre-existing, potentially serious medical conditions (i.e., cardiac problems, recent surgery, etc.) should fully inform the On-Scene Medical Director, or designee, of the situation. A detailed medical history is usually not required. If a concern exists regarding the ability of a participant to work on the site, their organization's Medical Director, or designee, will be consulted for an opinion.

6.3 Response Procedures

6.3.1 Medical Emergencies at the Operations Center

- If able, injured or sick personnel should report promptly to the On-Scene Medical Director or designee.
- If an injured or sick person is discovered, help should be summoned immediately and the On-Scene Medical Director, or designee, should be notified.
- If a deployed individual is discovered to have a life- or limb-threatening injury or illness, call 911 for emergency medical services (EMS) system support with an ambulance immediately. If necessary, the On-Scene Medical Director, or designee, may activate the EMS system or refer the victim to a local physician or hospital for further evaluation and/or treatment.

6.3.2 Medical Emergencies in the Field

All response personnel should be trained and prepared to perform first aid. Response personnel should be prepared to voluntarily perform first aid and to assist others during emergencies through the following actions:

- Check for hazards in the area, call for help, make sure the uninjured remain safe, and safely attend to the injured person.
- Do not move an injured person unless the person’s life is threatened and it is safe to approach the victim.
- Provide first aid. If necessary, call 911 for emergency medical services (EMS) system assistance.

- If activation of the EMS system is not deemed necessary, have the injured person seen by the On-Scene Medical Director or designee regardless of how minor the injury.
- As soon as possible, report the emergency to the H&S Manager and On-Scene Medical Director or designee.

6.3.3 Management of Radiologically-Contaminated Injured Persons

- At the discretion of the On-Scene Medical Director, or designee, and based on the victim's medical status, decontamination may be done at the accident scene, in the treatment area, or in a hospital.
- When decontamination is needed, the H&S Manager will arrange health physics assistance for the medical team, as needed.
- When appropriate, the on-Scene Medical Director or designee may advise the H&S Manager regarding recommendations for prophylactic use of potassium iodide (KI) and/or other medical countermeasures.

6.3.4 On-Site Medical Monitoring (Entry Team)

Entry team personnel (for SCBA only) should be medically monitored before and after entry, according to the response organizations policy. Typical medical monitoring may include blood pressure, pulse rate and body temperature (oral), and body. There are numerous factors which affect allowable ranges; therefore, each individual must be evaluated on a case-by-case basis by the On-Scene Medical Director or designee and the H&S Manager.

The following typical values are provided only as an initial guideline:

- Max Blood Pressure: 140 systolic/90 diastolic
- Max Pulse Rate: 100 beats per minute
- Body Temperature: (Maximum) 99.2 degrees F{37.3 degrees C}
  (Minimum) 98.0 degrees F {36.7 degrees C}
  or +/- 0.6 deg. F. from normal
- Body Weight Loss: 1.5% (rule of thumb)

6.3.5 Routine Sick Call and Non-Emergency Medical Needs

A location will be identified where personnel may report for sick call to FRMAC medical staff. If there is no medical staff present at the FRMAC, arrangements will be made for personnel to be transported to an appropriate medical facility for evaluation and/or treatment.

If medical staff are present, personnel with non-emergency health problems can be examined and advised or treated. They may be referred to local physicians or health care facilities at the discretion of the On-Scene Medical Director or designee.

Note: Based upon lessons learned from the Fukushima Daiichi response, extra effort may be required to establish connectivity to local medical facilities in supporting non-emergency medical support. Foreign medical facilities and US military installations may have increase processing requirements.

6.3.6 Potassium Iodide (KI) Guidance

Radioactive iodines are produced during the operation of nuclear power plants and during the detonation of nuclear weapons. Exposure to I-131 and other radioisotopes of iodine by inhalation of contaminated air or ingestion of contaminated food or milk can lead to radiation injury of the thyroid. The population at risk is individuals 40 years of age and younger. There is limited benefit in providing KI to individuals over 40 years of age. To be most effective KI should be taken within a few hours before or after exposure to inhaled or ingested radioiodine.

The following is a summary of recommendations promulgated by the FDA. ***All medical treatments, such as those described below, should be in accordance with On-Scene medical consultation and advice.*** In the event emergency workers 40 years of age or younger may be exposed to situations where there exists the potential to receive a dose to the thyroid of 25 rem, KI could be considered in accordance with the EPA PAGS. The recommended dose of KI should be administered in accordance with FDA dosage guidelines. Some individuals may be allergic to KI and therefore they should not take KI and should be excluded from those missions where they would be subject to large exposure to radioiodine. The decision to take KI is a personal one and is therefore voluntary. KI is not a substitute for other ALARA procedures and should not be used in lieu of other practices to reduce or minimize exposure.

6.4 References

First responders or others needing specific radiation emergency medical guidance should refer to CDC's Radiation Emergency Medical Management site (**http://www.remm.nlm.gov/**), Planning Guidance for Response to a Nuclear Detonation (**http://www.afrri.usuhs.mil/outreach/pdf/planning-guidance.pdf**) and the Radiation Emergency Assistance Center/Training Site (**http://orise.orau.gov/reacts/**).

7.0 RECORD MAINTENANCE

7.1 Overview

Health and Safety records shall be maintained to document the H&S aspects of an exercise or incident response. Records will be maintained in accordance with applicable regulations (e.g., 10 CFR 835, 10 CFR 20, etc.). Generated records should be high quality, readily accessible, and managed/updated for the prescribed retention period. Records should be handled in a manner that protects personal privacy.

7.2 Records Management Program

The types of H&S records generated for an exercise or call-out will be clearly defined. An appropriate records management program shall ensure that audit-defendable records and reports are controlled from cradle to grave (creation, distribution, use, arrangement, storage, retrieval, media conversion, and disposition).

When radiological and/or industrial hygiene services (i.e., dosimetry and laboratory analyses) are purchased, there should be a clear, prior, written agreement regarding records responsibility during the performance of the services. Records of the results should reside in the custody of both organizations.

Protection of PII

The backbone for Personally Identifiable Information (PII) for the Department of Energy is protected as "**Official Use Only**" based on Exemption 6 (Personal Privacy) of the FOIA. PII is a subset of the OUO information that requires additional protection due to its utility in facilitating identity theft. As stated in DOE Order 471.3, OUO information under exemption 6 must be unclassified and must meet the following criteria:

Has the potential to cause damage to private individuals if disseminated to people who do not need the information to perform their jobs or other DOE-authorized activities.

Exemption 6, Personal Privacy protects information that could cause the individual involved personal distress or embarrassment-for example, personnel records, health records, or security records.

The definition of PII is based on NNSA policy document 14.1-C as defined by Office of Management and Budget (OMB). PII is personal information that is associated to an individual such as social security number; place of birth; date of birth; mother's maiden name; biometric records, fingerprint, Iris scan, DNA; medical history, previous diseases, metric information, weight, height,

BP; criminal history; employment history, ratings, disciplinary actions; financial information, credit card numbers, bank account numbers; and security clearance history.

Access to PII information is allowed only on a need-to-know basis. The person who has authorized possession, knowledge, or control of the PII information is responsible for determining the recipient's need-to-know, in order to perform authorized activities. All electronic access requires advance approval and is subject to specific authentication requirements.

FRMAC will handle personally identifiable information as OUO. This includes radiation and chemical exposure information (dosimetry, monitoring results, medical monitoring data, bioassay results, etc.). Access will be permitted only on a need-to-know basis. Information concerning an individual's exposure or medical information shall be made available to that individual, upon request, consistent with the Privacy Act of 1974.

7.3 Record Keeping Standards

Health and Safety records (i.e., radiological and industrial hygiene records) shall be accurate and legible. The records should:

- Identify the facility, specific location, general function, and process
- Be legible — entries should be typewritten or printed clearly in black ink
- Contain initialed and dated corrections identified by a single line strike-out
- Identify the preparer (signature or other identifying code) and the date prepared.

7.4 Participant Records

Participants should provide any prior radiation exposure information. Current-year dose information should be gathered to ensure compliance with applicable exposure regulations. Participant information provided to the H&S Manager or designee should also include social security number, date of birth, home organization with address, home address, and any assigned identification numbers.

Records of radiation doses shall be maintained. These records shall be sufficient to evaluate compliance with applicable dose limits. If dosimetry was going to be required during activities, final dose reports for participants shall be forwarded to their home organizations. A copy of the dosimetry data should be maintained as part of H&S activity records.

7.5 Health and Safety Monitoring Records

Health and safety may require the performance of radiation and/or chemical surveys that include area surveys, airborne activity assessments, and contamination surveys to determine existing conditions in a given location.

- Health and safety is interested in the following data elements from surveys:
- Date, time, and purpose of the survey
- Location or personnel surveyed
- Name of surveyor or analyst
- Pertinent information needed to interpret the survey results
- Equipment number
- Resulting data recorded in units consistent with data collected.

7.6 Instrumentation and Calibration Records

All radiological instrumentation records should be completed and maintained in accordance with ANSI N323. Industrial Hygiene and Safety instruments should be calibrated according to the manufactures specifications. Calibrations for fixed, portable, and laboratory equipment shall be maintained by the supplying organization and records should be available. Records should include calibration frequency, calibration methodology, calibration dates, and National Institute of Science and Technology mandated traceability of calibration.

7.7 Records Retention

At the conclusion of activities, records shall be maintained in accordance with established rules or regulations regarding record-retention requirements. Health and safety records will be transferred to DOE for retention. Personnel dosimetry records and medical records have a 75-year retention requirement.

Records shall be stored in a manner that will protect them from physical damage caused by temperature extremes, moisture, biological infestation, electromagnetic fields, excessive light, stacking, theft, and vandalism.

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APPENDIX A
FORMS, CHECKLISTS, PLANS, AND LOGS

The documents within this Appendix were current at the time of publication. However, they are subject to continuing review and change based on input received from emergency response planners and participants. Some of these documents may require multiple copies or carbons. If multiple copies are required, individual form will list the destination of each copy. Please consult the FRMAC website **at www.nv.doe.gov/programs/frmac** for any updates to these documents.

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Federal Radiological Monitoring and Assessment Center

HEALTH AND SAFETY PLAN

Version: _____ _____

Date: _____

Location: _____ _____

Approved by:

_____	_____
Health and Safety Manager	**Date**
_____	_____
Name/Title	**Date**
_____	_____
Name/Title	**Date**
_____	_____
Name/Title	**Date**

A. Site Description

Working name of site: _____

_____

Location: _____

_____

Surrounding population: ☐ industrial ☐ residential ☐ rural ☐ urban

☐ unpopulated ☐ other/more details: _____

Topography: _____

_____

Primary Hazards:

☐ Chemical Exposure
☐ Fire/Explosion
☐ Oxygen Deficiency
☐ Confined/Enclosed Space Entry
☐ Ionizing Radiation
☐ Biological Hazards
☐ Safety Hazards
☐ Heat Stress
☐ Cold Exposure
☐ Noise

☐ Other: _____

Path of radiological or other hazardous material dispersion: _____

_____

Plume has been noted on the site map: ☐ Yes ☐ No

B. Work Plan and Entry Objectives

1. All operations shall be conducted in accordance with procedures established during field team briefings, in attached plans, and in *the FRMAC Health and Safety Manual.*
2. Daily entry objectives may include documenting site monitoring, sample collection, and related activities. Detailed objectives will be developed daily and will be described during the field team safety briefing.

C. Staff Organization and Responsibilities

Site Safety Briefings/Meetings

1. All personnel, employees, contractors, and subcontractors shall be provided with an initial site safety briefing to communicate the nature, level, and degree of hazards expected on site.
2. Personnel will also receive regular briefings before and after each shift and when significant changes are made in the work procedures or safety plans. The Health and Safety Manager or designee shall hold these site safety meetings/briefings. At a minimum these meetings will describe the work to be accomplished, discuss safety procedure changes, and note any items which need to be communicated to other personnel. General safety training topics should also be covered based on points raised in previous meetings and safety plan attachments.

The **FRMAC Director** is responsible for direct management of FRMAC operations.

Name: _____ Phone: _____

The **Health and Safety (H&S) Manager** is responsible for the health and safety of FRMAC responders. The responsibilities of the Health and Safety Manager include (but are not limited to):

- coordination of all safety and health concerns for the entire work site
- keeping this plan current, and
- Liaison with site safety officers from other organizations.

The Health and Safety Manager for this incident is:

Name: _____ Phone: _____

The Public Affairs Officer is responsible for communication with the media.

Name: _____ Phone: _____

Other key officials:

_____

Name/Title/Organization Phone

_____

Name/Title/Organization Phone

_____

Name/Title/Organization Phone

D. Site Control Information

1. Anyone entering or departing an impacted area, shall report to the Monitoring Manager or designated representative.
2. No person shall enter the site without subscribing to this or another applicable Health and Safety plan.
3. The buddy system is mandatory for all field-monitoring teams.
4. Training
   - Personnel shall be adequately trained to perform their assigned tasks safely.
   - All personnel entering the impacted area shall be fully informed about potential hazards and applicable procedures at the site.
5. Personnel monitoring required for entry to impacted areas include:

Dosimetry:

☐ Personal Dosimeter (TLD) ☐ Self-Reading Dosimeter (EPD or PIC)

Other monitoring:

☐ Personal Air Sampling

☐ Bioassay (type, frequency, etc.) _____

_____

_____

6. A map, which includes the location of applicable items such as: zone boundaries, washing, toilet/hygiene facilities, first aid equipment, fire extinguishers, command posts, equipment staging/storage, eating/rest areas, and locations of identified hazards, will be provided.

E. Hazard Evaluations

A chemical hazard evaluation shall be made as part of each work plan. Generic hazardous substance information sheets (MSDSs) are attached, as applicable.

Environmental monitoring for radiological or chemical hazards shall be conducted. Monitoring equipment shall be calibrated and maintained in accordance with the manufacturer's instructions.

Type of Monitoring		**Frequency**		
☐ Radiation	☐ continuous	☐ hourly	☐ daily	☐ other:
☐ Combustible Gas	☐ continuous	☐ hourly	☐ daily	☐ other:
☐ Oxygen	☐ continuous	☐ hourly	☐ daily	☐ other:
☐ PID	☐ continuous	☐ hourly	☐ daily	☐ other:
☐ WBGT / heat stress	☐ continuous	☐ hourly	☐ daily	☐ other:
☐ Noise	☐ continuous	☐ hourly	☐ daily	☐ other:

Other chemical specific monitors (colorimetric/electronic)

Type of Monitoring		**Frequency**		
chemical:	☐ continuous	☐ hourly	☐ daily	☐ other:
chemical:	☐ continuous	☐ hourly	☐ daily	☐ other:
chemical:	☐ continuous	☐ hourly	☐ daily	☐ other:
chemical:	☐ continuous	☐ hourly	☐ daily	☐ other:
chemical:	☐ continuous	☐ hourly	☐ daily	☐ other:
chemical:	☐ continuous	☐ hourly	☐ daily	☐ other:

F. General Safe Work Practices

Depending on the circumstances, any or all of the safe work practices listed below will be adhered to while on site. Place a check next to those that are appropriate for this deployment and add any additional ones that may be required.

☐ **BUDDY SYSTEM:** The buddy system shall be observed inside the work area. Personnel must work within sight of their assigned partner at all times. The site supervisor shall assign a partner as personnel check in.

☐ **FIRES:** Each manned response area shall have at least 1 each of the following:

- a fully charged Class A fire extinguisher for ordinary fires,
- a fully charged Class B fire extinguisher for liquid fires.

The above items shall be maintained in a readily accessible location and clearly labeled.

☐ **LIGHTING**: Fixed or portable lighting shall be maintained for dark areas or work after sunset to ensure that sufficient illumination is provided. (Table H-120.1 of CFR 1910.120(m) for minimum illumination intensities.)

☐ **LIGHTNING**: Abide by the 30/30 rule for lightning.

☐ **WORK NEAR WATER:** All personnel working in boats, on docks, or generally within 10 feet of water deeper than 3 feet, shall wear approved Personal Floatation Devices (PFDs) or work vests.

☐ **HEAT STRESS**: The site safety and health supervisor shall follow the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines in determining work/rest periods. Fluids shall be available at all times and encouraged during rest periods.

☐ **COLD STRESS:** The site safety and health supervisor shall follow the ACGIH guidelines in determining work/rest periods. Workers shall be provided with adequate warm clothing, rest opportunities, and exposure protection. Warm and/or sweet fluids shall also be available during rest periods.

☐ **HIGH NOISE LEVELS:** Hearing protection shall be used in high noise areas (exceeding 85 dBA--generally where noise levels require personnel to raise their voices to be heard) or where designated by an H&S Representative.

☐ **ELECTRICAL HAZARDS:** Electrical hazards are designated on the site map, and shall be marked with suitable placards, barricades, or other appropriate warning.

☐ **TRAP HAZARDS:** Open manholes, pits, trenches, or similar hazards are noted on the site map. The site safety supervisor shall ensure that these locations are periodically checked during the day.

☐ **CARBON MONOXIDE**: Equipment operators shall ensure that personnel do not linger or work near exhaust pipes.

☐ **UV LIGHT EXPOSURE:** Sunscreens of protection factor 15 (or greater) and UV tinted safety glasses shall be made available for response personnel as needed.

☐ **HELICOPTER OPERATIONS:** Pilots shall provide a safety briefing to all passengers.

☐ **MOTOR VEHICLES**: Drivers shall maintain a safe speed at all times, and shall not be allowed to operate vehicles in a reckless manner. Seat belts will be worn. Vehicles should pull off road to take measurements.

☐ **ALL TERRAIN VEHICLES (ATV's):**

Drivers shall maintain a safe speed at all times, and shall not be allowed to operate vehicles in a reckless manner. ATV drivers shall not operate ATVs outside of areas and lanes specified by the Health and Safety Manager.

☐ **DRUM HANDLING & HEAVY LIFTING:**

- Drums and containers must be handled in accordance with 29 CFR 1910.120. Containers must be labeled and constructed in accordance with EPA (40 CFR 264-265, and 300), and DOT (49 CFR 171-178) regulations.
- Temporary holding/staging areas for drums and containers containing waste materials shall be constructed to contain spillage, runoff, or accidental releases of materials.
- Manual lifting and handling of drums and/or containers shall be kept to a minimum. Mechanical devices, drum slings or other mechanical assisting devices designed for that purpose shall be used whenever possible.

☐ **CONFINED SPACES:** Confined spaces will not normally be entered by response personnel. If a confined space must be entered or hotwork conducted in a confined space, a specific confined space entry work plan and confined space work authorization checklist will be developed for that operation.

Flora & Fauna Awareness: The following listed items represent the types of dangers that may be associated with the plants, insects, and animals native to the area of deployment. The H&S Manager will get the information to determine the specific dangers faced in the particular area covered by the site-specific plan.

☐ Insect Stings	Bee (European and Africanized), hornet, or wasps
☐ Poisonous spiders	Black widow, brown recluse, scorpions, tarantula
☐ Ticks	Carriers of Rocky Mountain spotted fever and Lyme disease
☐ Animal Bites	Skunks, prairie dogs, foxes, bats, dogs, cats, raccoons, and horses may not necessarily be life threatening but bites or scratches may pose an infection hazard, and/or rabies, as well as problems associated with open wounds.
☐ Snake Bites	Rattlesnakes, water moccasins, and coral snakes
☐ Poisonous Plants	Poison ivy, oak, or sumac

General Precautions

☐ During morning safety briefings, provide information on the location of hazards and how to deal with problems.

Personnel should be provided with the following, as needed:

☐ long-sleeve clothing ☐ insect repellent ☐ snake leggings

☐ Personnel should inspect each other for ticks and signs of infected bites during breaks when working in designated areas.

☐ Personnel with severe allergies must work in areas away from known/suspected hazards.

☐ Personnel with allergies to bee stings or other insect bites should notify their supervisors and the Health and Safety Manager when reporting on this site. They should also carry emergency antidotes on them whenever possible. Supervisors on site should be prepared to deal with the medical emergencies that may result when personnel with allergies receive bites or stings.

Additional areas of concern: _____

_____

_____

G. Personal Protective Equipment (PPE)

The following PPE ensembles shall be used while on site. Circle the required level.

Location	Team/Task	Level			
_____	Monitoring Teams	☐	☐	☐	☐
_____	Decontamination Teams	☐	☐	☐	☐
_____	Hotline Teams	☐	☐	☐	☐

Additional PPE Requirements:

Location	Team/Task	Level
_____	_____	_____
_____	_____	_____
_____	_____	_____

Notes: _____

_____

_____

_____

H. Emergency Procedures

1. *When an on-site emergency occurs, personnel shall not reenter the area or restart work until:*
   - the condition resulting in the emergency has been investigated by supervisory personnel, and has been corrected
   - hazards have been reassessed
   - personnel have been briefed on any changes in the operation and site safety plan
   - Hospitals listed in the communications section (Section I) have been contacted
     Note: *The emergency hospital must agree to take radiological patients*
   - Fire departments listed in the communications section have been contacted.
   - Ambulance services listed in the communications section have been contacted. Note those which will take radiological emergencies.
   - Police forces listed in the communications section have been notified.
2. *Emergency Medical Procedures*
   - Contact designated EMT
   - Do not attempt to move seriously injured personnel, call for an ambulance to come to the injured person.
   - The closest hospital for regular emergencies is: _____ (see communications section for phone number)
   - The closest hospital for radiological emergencies is: _____ (see communications section for phone number)
   - Contact ATSDR (404) 639-0615 (24 hours) for chemical exposure emergencies.
   - Contact REAC/TS (865) 576-3131 (24-hour line: (865) 576-1005) for radiological exposure emergencies.
3. *Emergency Fire Procedures*
   - DO NOT attempt to fight fires other than small fires. A small fire is generally considered to be a fire in the early stages of development, which can readily be extinguished with personnel and equipment in the immediate area in a few seconds.
   - You MUST notify proper personnel and call the fire department if the fire cannot be put out quickly. Do not take extraordinary measures to fight fires.

4. *Evacuation Procedure*

EVACUATION NOTIFICATION

Field Elements: _____

Technical Operations Center(TOC): _____

PRIMARY EVACUATION ROUTE

Field Elements: _____

TOC: _____

SECONDARY EVACUATION ROUTE

Field Elements: _____

TOC: _____

ASSEMBLY POINT

Field Elements: _____

TOC: _____

I. Communication Methods

1. General Signals

SIGNAL	MEANING
Thumbs up	I'm OK / I agree
Thumbs down	I don't agree
Hands across throat	I'm out of air / trouble breathing
Grab a hand/arm	I'm out of air / trouble breathing
Hands on head	I'm out of air / trouble breathing

2. Radio Communications

Working:
frequency: _____channel: _____ VHF ☐ UHF ☐ CB ☐ Other ☐

Working:
frequency: _____channel: _____ VHF ☐ UHF ☐ CB ☐ Other ☐

3. Phone Communications

FRMAC Director:

Voice/phone: _____ Fax: _____

Cellular: _____ Pager: _____

Health and Safety Manager:

Voice/phone: _____ Fax: _____

Cellular: _____ Pager: _____

Radiation Emergency Assistance Center and Training Site (REAC/TS):

Phone number: (865) 576-3131 24 hour line:(865) 576-1005

Agency for Toxic Substance and Disease Registry (ATSDR):

24 hour line (voice): (404) 639-0615 Fax: (404) 639-0655

Police: _____

Fire: _____

Ambulance/EMT/Hospital: _____

Other numbers: _____

J. Attachments

The following are attachments that may be required, depending on the needs and circumstances at the site. If other forms or attachments are required, add those to the list. Then place a checkmark on the line in front of the pertinent plans for this site.

- ☐ Turn Back Levels (Turn Around Levels)
- ☐ Health and Safety Air Monitoring Plan
- ☐ Bioassay Plan
- ☐ Contamination Control Plan (area surveys, personnel surveys, etc.)
- ☐ Decontamination Plan
- ☐ Survey Plan
- ☐ Hotline Plan (sample, personnel, equipment, etc.)
- ☐ Others: _____

_____
Name of plan

_____
Name of plan

_____
Name of plan

_____
Name of plan

Rev. October 2011

HEALTH & SAFETY PLAN B

ICS Compatible
Site Safety and Health Plan

Table of Forms

FORM NAME	FORM #	USE	REQUIRED	OPTIONAL	ATTACHED?
Emergency Safety and Response Plan	A	Emergency response phase (uncontrolled)	X		
Site Safety Plan	B	Post-emergency phase (stabilized, cleanup)	X		√
Site Map	C	Post-emergency phase map of site and hazards	X		√
Emergency Response Plan	D	Part of Form B, to address emergencies	X		√
Air Monitoring Log	E	To log air monitoring data	X*		√
Personal Protective Equipment	F	To document PPE equipment and procedures	X*		√
Decontamination	G	To document decon equipment and procedures	X*		√
Site Safety Enforcement Log	H	To use in enforcing safety on site		X	√
Worker Acknowledgement Form	I	To document workers receiving briefings		X	√
Form A Compliance Checklist	J	To assist in ensuring HAZWOPER compliance		X	√
Form B Compliance Checklist	K	To assist in ensuring HAZWOPER compliance		X	√
Drum Compliance Checklist	L	To assist in ensuring HAZWOPER compliance		X	√
Other:					√
Attach 4 - Heat Stress		Specific Hazard Attachment			√
Attach 12 - Ionizing Radiation		Specific Hazard Attachment			√
Radiological Personnel Decontamination Procedure		Supplement to Form G			√

** Required only if function or equipment is used during a response*

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Emergency Safety and Response Plan

Page 1 of 2

EMERGENCY SAFETY and RESPONSE PLAN

1. Incident Name

2. Date/Time Prepared

3. Operational Period

4. Attachments: **Attach MSDS for each Chemical**

5. Organization IC:

Safety:

Group Supv:

Entry Team:

Backup Team:

Decon Team:

6. Physical Hazards and Protection

☐ Confined Space ☐ Noise ☐ Heat Stress ☐ Cold Stress ☐ Electrical ☐ Animal/Plant/Insect ☐ Ergonomic ☐ Ionizing Rad ☐ Slips/Trips/Falls ☐ Struck by
☐ Water ☐ Violence ☐ Excavation ☐ Biomedical waste and/or needles ☐ Fatigue ☐ Other (specify)

Major Tasks	Entry Permit	Ventilate	Hearing Protection	Shoes (type)	Hard Hats	Clothing (cold wx)	Life Jacket	Work/ Rest (hrs)	Fluids (amt/time)	Signs and Barricade	Fall Protect	Post Guards	Flash Protect	Work Gloves	Other

7. Agent

Hazards

☐ Explosive
☐ Flammable
☐ Reactive
☐ Biomedical
☐ Toxic

☐ Radioactive
☐ Carcinogen
☐ Oxidizer
☐ Corrosive
Specify Other:

Target Organs

Eyes ☐ Nose ☐ Skin ☐ Ears ☐
Central Nervous System ☐
Respiratory ☐ Throat ☐ Lungs ☐
Heart ☐ Liver ☐ Kidney ☐
Blood ☐ Lungs ☐ Circulatory ☐
Gastrointestinal ☐ Bone ☐
Other:

Exposure Routes

☐ Inhalation
☐ Absorption
☐ Ingestion
☐ Injection
☐ Membrane

PPE

Type of PPE

☐ Face Shield
☐ Eyes
☐ Gloves
☐ Inner Suit
☐ Splash Suit
☐ Level A Suit
☐ SCBA ☐ APR
SAR
Cartridges
☐ Fire Resistance

8. Instruments

☐ O2
☐ CGI
☐ Radiation
☐ Total HCs
☐ Colorimetric
☐ Thermal
☐ Other

Action Levels	Chemical Name:	LEL/UEL %	Odor Thresh Ppm	Ceiling/ IDLH	STEL/TLV	Flash Point/ Ignition Pt (F or C)	Vapor Pressure (mm)	Vapor Density	Specific Gravity	Boiling Point F or C

Form SSP-A:

Page of

Rev. October 2011

Emergency Safety and Response Plan

Page 2 of 2

10. Site Map. Include: Work Zones, Locations of Hazards, Security Perimeter, Places of Refuge, Decontamination Line, Evacuation Routes, Assembly Point, Direction of North

11. Decontamination:
Instrument Drop Off ☐
Outer Boots/Glove Removal ☐☐
Suit/Gloves/Boot Disposal ☐
Specify:
Suit Wash ☐
Decon Agent: Water ☐☐
Other ☐
Bottle Exchange ☐
Outer Suit Removal ☐☐
Inner Suit Removal ☐☐
SCBA/Mask Removal ☐☐
SCBA/Mask Rinse ☐
Inner Glove Removal ☐☐
Work Clothes Removal ☐☐
Body Shower ☐
Intervening Steps ☐Specify:

12. Potential Emergencies
Fire ☐
Explosion ☐
Other ☐
Evacuation Alarms:
Horn ☐ # Blasts ☐
Bells ☐ #Rings ☐
Radio Code ☐
Other:
Emergency Prevention and Evacuation Procedures:
Safe Distance

13. Communications: Radio? ☐ Phone? ☐ Command #: Tactical #: Entry #:

14. Site Security
Personnel Assigned
Procedures:
Equipment

15. Emergency Medical
Personnel Assigned
Procedures:
Equipment

16. Prepared By:
17. Date/Time Briefed:

Form SSP-A:
Page of

Rev. October 2011

Site Safety Plan

Page 1 of 4

CG ICS SITE SAFETY PLAN (SSP) HAZARD ID/EVAL/CONTROL	1. Incident Name SLTC Radiation Exercise	2. Date/Time Prepared 25 July, 2007 1300	3. Operational Period 0800-2000	4. Safety Officer (include method of contact) TBD
5. Supervisor/Leader TBD	6. Location and Size of Site 8660 S Sandy Pkwy Sandy, UT ~4 acre	7. Site Accessibility Land☒ Water☐ Air ☐ Comments:	8. For Emergencies Contact: 911	9. Attachments: Attach MSDS for each Chemical Attach-12 - Ionizing Radiation Attach-4 Heat Stress
10. Job Task/Activity	Hazards* ⇨	Potential Injury and Health Effects	Exposure Routes	Controls: Engineering, Administrative, PPE
Sampling	External Radiation	Deterministic Radiation Effects (see Attach 12 -Ionizing Radiation) Stochastic Radiation Effects (see Attach 12 -ionizing Radiation)	Inhalation ☐ Absorption ☐ Ingestion ☐ Injection ☐ Membrane ☐ Ext. Radiation ☒	Alarming Electronic Personal Dosimeter Alarm Setpoints/Turnback: Dose Rate = 100 mrem/h Dose = 100 mrem Area monitoring with Thermo RO-20
Sampling	Internal Radiation	Deterministic Radiation Effects (see Attach 12-Ionizing Radiation) Stochastic Radiation Effects (see Attach12 -Ionizing Radiation)	Inhalation ☒ Absorption ☐ Ingestion ☒ Injection ☐ Membrane ☐	PPE (see SSP-F): Tyvek Nitrile Gloves Glove liners Over-boots PAPR w/ p-100 Personnel monitoring with Ludlum Model-3
Sampling	Heat Stress	Heat Stress (see Attach-4 Heat Stress)	Inhalation ☐ Absorption ☐ Ingestion ☐ Injection ☐ Membrane ☐ N/A ☒	Minimize time in direct sun, utilize canopy Limit 1 entry/worker/operational period Rest area in conference room A Drink 5-7 oz. water every 15-20 minutes Physiological screening CorTemp monitoring Cooling vests
Sampling	Slips/Trips/Falls	Physical Injury (contusions, lacerations, fractures, etc.)	Inhalation ☐ Absorption ☐ Ingestion ☐ Injection ☐ Membrane ☐ N/A ☒	Maintain awareness of surroundings Rubber overboots
Decon	External Radiation	Deterministic Radiation Effects (see Attach 12-Ionizing Radiation) Stochastic Radiation Effects (see Attach 12 -Ionizing Radiation)	Inhalation ☐ Absorption ☐ Ingestion ☐ Injection ☐ Membrane ☐ Ext.Radiation ☒	Alarming Electronic Personal Dosimeter Alarm Setpoints Dose Rate = 100 mrem/h Dose = 100 mrem
11. Prepared By: Jeffrey Lodwick	12. Date/Time Briefed:	***HAZARD LIST**: Physical/Safety, Toxic, Explosion/Fire, Oxygen Deficiency, Ionizing Radiation, Biological, Biomedical, Electrical, Heat Stress, Cold Stress, Ergonomic, Noise, Cancer, Dermatitis, Drowning, Fatigue, Vehicle, Diving		**Form SSP-B:** Page 1 of 4

Rev. October 2011

Site Safety Plan

Page 2 of 4

CG ICS SITE SAFETY PLAN (SSP) HAZARD ID/EVAL/CONTROL	1. Incident Name SLTC Radiation Exercise	2. Date/Time Prepared 11 July, 2007 15:23	3. Operational Period 0800-2000	4. Safety Officer (include method of contact) TBD
5. Supervisor/Leader TBD	6. Location and Size of Site SLTC, 5 acre	7. Site Accessibility Land☒ Water☐ Air ☐ Comments:	8. For Emergencies Contact: 911	9. Attachments: Attach MSDS for each Chemical Attach-12 - Ionizing Radiation Attach-4 Heat Stress
10. Job Task/Activity	Hazards* ⟹	Potential Injury and Health Effects	Exposure Routes	Controls: Engineering, Administrative, PPE
Decon	Internal Radiation	Deterministic Radiation Effects (see Attach 12-Ionizing Radiation) Stochastic Radiation Effects (see Attach 12-Ionizing Radiation)	☒☐☒☐☐☐ **Inhalation** **Absorption** **Ingestion** **Injection** **Membrane** **Ext. Radiation**	PPE (see SSP-F): Tyvek Nitrile Gloves Glove liners Over-boots Contamination monitoring of ICP & decon area with Ludlum Model-3 minimum every operational period
Decon	Heat Stress	Heat Stress (see Attach-4 Heat Stress)	☐☐☐☐☐☒ **Inhalation** **Absorption** **Ingestion** **Injection** **Membrane** N/A	Minimize time in direct sun, utilize canopy Limit 1 entry/worker/operational period Rest area in conference room A Drink 5-7 oz. water every 15-20 minutes Physiological screening CorTemp monitoring Cooling vests
Decon	Slips/Trips/Falls	Physical Injury (contusions, lacerations, fractures, etc.)	☐☐☐☐☐☒ **Inhalation** **Absorption** **Ingestion** **Injection** **Membrane** N/A	Maintain awareness of surroundings Rubber overboots
Equipment Decon	Internal Radiation	Deterministic Radiation Effects (see Attach 12-Ionizing Radiation) Stochastic Radiation Effects (see Attach 12-Ionizing Radiation)	☐☐☒☐☐☐ **Inhalation** **Absorption** **Ingestion** **Injection** **Membrane** N/A	PPE (see SSP-F): Nitrile Gloves Overboots Cotton Work Coveralls Contamination monitoring of ICP & decon area with Ludlum Model-3 minimum every operational period
Equipment Decon	External Radiation	Deterministic Radiation Effects (see Attach 12-Ionizing Radiation) Stochastic Radiation Effects (see Attach 12-Ionizing Radiation)	☐☐☐☐☐☒ **Inhalation** **Absorption** **Ingestion** **Injection** **Membrane** **Ext. Radiation**	Alarming Electronic Personal Dosimeter Alarm Setpoints Dose Rate = 100 mrem/h Dose = 100 mrem
11. Prepared By: Jeffrey Lodwick	12. Date/Time Briefed:	***HAZARD LIST**: Physical/Safety, Toxic, Explosion/Fire, Oxygen Deficiency, Ionizing Radiation, Biological, Biomedical, Electrical, Heat Stress, Cold Stress, Ergonomic, Noise, Cancer, Dermatitis, Drowning, Fatigue, Vehicle, Diving		**Form SSP-B:** Page 2 of 4

Rev. October 2011

Site Safety Plan

Page 3 of 4

CG ICS SITE SAFETY PLAN (SSP) HAZARD ID/EVAL/CONTROL	1. Incident Name SLTC Radiation Exercise	2. Date/Time Prepared 11 July, 2007 15:23	3. Operational Period 0800-2000	4. Safety Officer (include method of contact) TBD
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10. Job Task/Activity	Hazards* ⇨	Potential Injury and Health Effects	Exposure Routes	Controls: Engineering, Administrative, PPE
Equipment Decon	Slips/Trips/Falls	Physical Injury (contusions, lacerations, fractures, etc.)	☐☐☐☐☐☐☒ Inhalation Absorption Ingestion Injection Membrane N/A	Maintain awareness of surroundings Rubber overboots
Equipment Decon	Heat Stress	Heat Stress (see Attach-4 Heat Stress)	☐☐☐☐☐☐☒ Inhalation Absorption Ingestion Injection Membrane N/A	Minimize time in direct sun, utilize canopy Rest area in conference room A Drink 5-7 oz. water every 15-20 minutes
Wipe and Air Sample Analysis	Internal Radiation	Deterministic Radiation Effects (see Attach 12-Ionizing Radiation) Stochastic Radiation Effects (see Attach 12-Ionizing Radiation)	☐☐☒☐☐☐ Inhalation Absorption Ingestion Injection Membrane N/A	PPE (see SSP-F): Nitrile Gloves Cotton Coveralls Contamination monitoring of ICP & decon area with Ludlum Model-3 minimum every operational period
Wipe and Air Sample Analysis	External Radiation	Deterministic Radiation Effects (see Attach 12-Ionizing Radiation) Stochastic Radiation Effects (see Attach 12-Ionizing Radiation)	☐☐☐☐☐☐☒ Inhalation Absorption Ingestion Injection Membrane Ext. Radiation	Alarming Electronic Personal Dosimeter Alarm Setpoints Dose Rate = 100 mrem/h Dose = 100 mrem Dose rate survey of samples prior to removing samples from decon area
Wipe and Air Sample Analysis	Heat Stress	Heat Stress (see Attach-4 Heat Stress)	☐☐☐☐☐☐☒ Inhalation Absorption Ingestion Injection Membrane N/A	Minimize time in direct sun, utilize canopy Rest area in conference room A Drink 5-7 oz. water every 15-20 minutes
11. Prepared By: Jeffrey Lodwick	12. Date/Time Briefed:	***HAZARD LIST**: Physical/Safety, Toxic, Explosion/Fire, Oxygen Deficiency, Ionizing Radiation, Biological, Biomedical, Electrical, Heat Stress, Cold Stress, Ergonomic, Noise, Cancer, Dermatitis, Drowning, Fatigue, Vehicle, Diving		**Form SSP-B:** Page 3 of 4

Rev. October 2011

Site Safety Plan

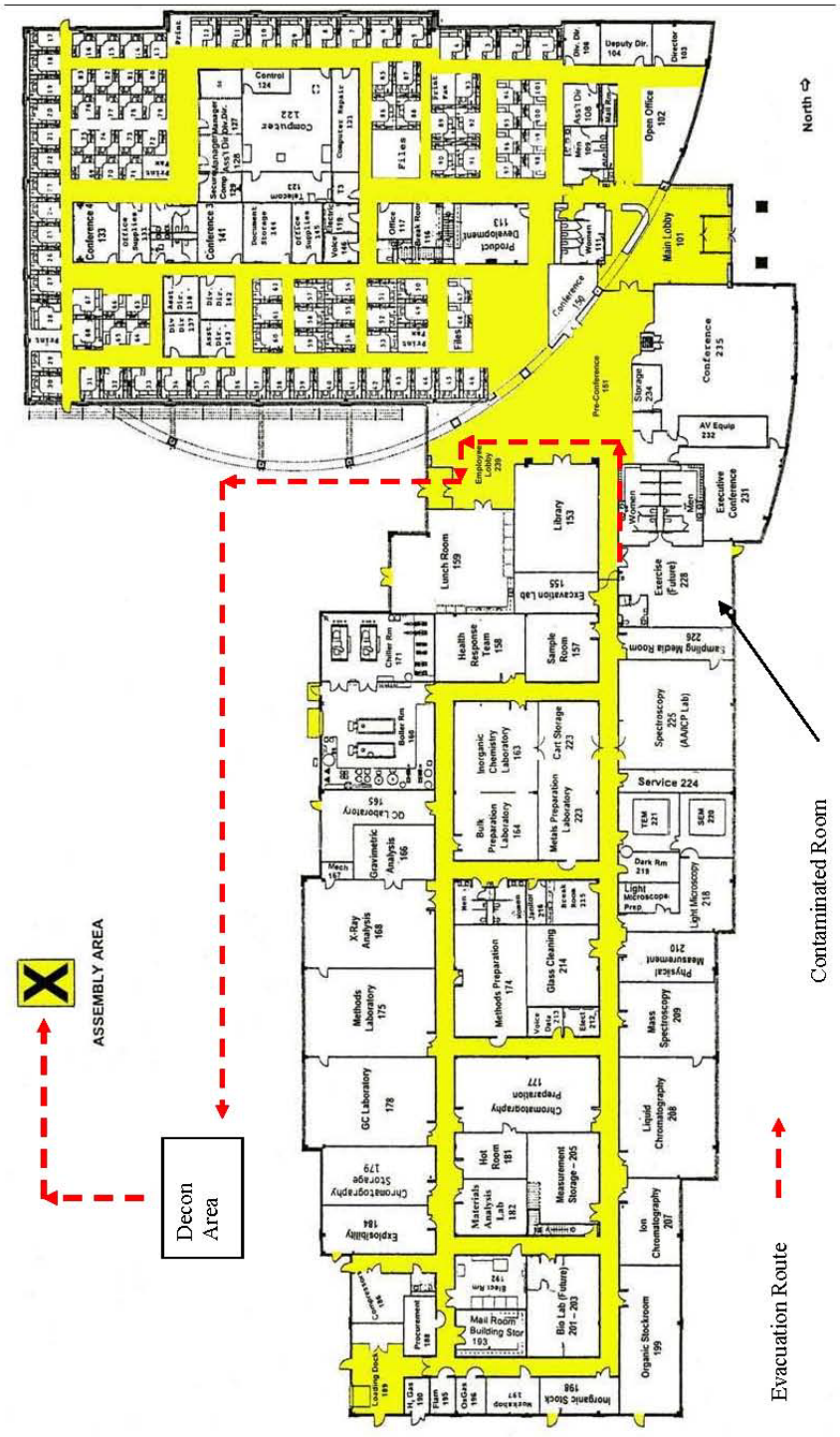
CG ICS SITE SAFETY PLAN (SSP) HAZARD ID/EVAL/CONTROL	1. Incident Name SLTC Radiation Exercise e	2. Date/Time Prepared 11 July, 2007 15:23	3. Operational Period 0800-2000	4. Safety Officer (include method of contact) TBD
5. Supervisor/Leader TBD	6. Location and Size of Site SLTC, 5 acre	7. Site Accessibility Land☒ Water☐ Air ☐ Comments:	8. For Emergencies Contact: 911	9. Attachments: Attach MSDS for each Chemical Attach-12 - Ionizing Radiation Attach-4 Heat Stress
10. Job Task/Activity	Hazards* ⇨	Potential Injury and Health Effects	Exposure Routes	Controls: Engineering, Administrative, PPE
Sampling Decon Equipment Decon Wipe and Air Sampling	Electrical	Electrocution Death	☐☐☐☐☐☐☒ Inhalation Absorption Ingestion Injection Membrane N/A	Use portable GFCI for all electrical devices
			☐☐☐☐☐☐☐ Inhalation Absorption Ingestion Injection Membrane N/A	
			☐☐☐☐☐☐☐ Inhalation Absorption Ingestion Injection Membrane N/A	
			☐☐☐☐☐☐☐ Inhalation Absorption Ingestion Injection Membrane N/A	
			☐☐☐☐☐☐☐ Inhalation Absorption Ingestion Injection Membrane N/A	
11. Prepared By: Jeffrey Lodwick	12. Date/Time Briefed:	***HAZARD LIST**: Physical/Safety, Toxic, Explosion/Fire, Oxygen Deficiency, Ionizing Radiation, Biological, Biomedical, Electrical, Heat Stress, Cold Stress, Ergonomic, Noise, Cancer, Dermatitis, Drowning, Fatigue, Vehicle, Diving		**Form SSP-B:** Page 3 of 4

Rev. October 2011

Site Map

CG ICS SSP: SITE MAP	1. Incident Name Radiation Exercise	2. Date/Time Prepared 25 July, 2007 13:00	3. Operational Period 0800 - 2000	4. Safety Officer (include method of contact) TBD
5. Supervisor/Leader TBD	6. Location and Size of Site 8660 S Sandy Parkway Sandy, UT 84070 ~4 acre	7. Site Accessibility Land☒ Water☐ Air ☐ Comments:	8. For Emergencies Contact: 911	9. Include: - Work Zones - Locations of Hazards - Security Perimeter - Places of Refuge - Decontamination Line - Evacuation Routes

10. Sketch of Site:



11. Prepared By: Jeffrey Lodwick	12. Date/Time Briefed:	**HAZARD LIST**: Physical/Safety, Toxic, Explosion/Fire, Oxygen Deficiency, Ionizing Radiation, Biological, Biomedical, Electrical, Heat Stress, Cold Stress, Ergonomic, Noise, Cancer, Dermatitis, Drowning, Fatigue, Vehicle, Diving	**Form SSP-C:** Page 1 of 1

Rev. October 2011

CG ICS SSP: EMERGENCY RESPONSE PLAN	1. Incident Name Radiation Exercise	2. Date/Time Prepared 25 July, 2007 13:00	3. Operational Period 0800 - 2000	4. Safety Officer (include method of contact) TBD
5. Supervisor/Leader TBD	6. Location and Size of Site 8660 S Sandy Parkway Sandy, UT 84070 ~4 acre	7. For Emergencies Contact: 911		8. Attachments: **INCLUDE ICS FORM 206 and EMT Medical Response Procedures**
9. Emergency Alarm (sound and location)	10. Backup Alarm (sound and location)	11. Emergency Hand Signals	12. Emergency Personal Protective Equipment Required:	
Building fire alarm: Audible alarm plus visual strobes Any emergancy: air horn at command shelter, 3 short blasts	2 way radios: "Code red", follwed by specific description of emergency, such as "man down", "evacuate", etc.	Personal emergency hand signals while wearing PPE: Both hands placed at throat in choking gesture Evacuation Signal: Wave both hands above head with arms fully extended	Emergency blanket for "burrito-wrap" prior to transport in emergency vehicle. Oasis coveralls for redressing injured personnel who are contaminated, if possible. Rescue sled at decon area	

13. Emergency Notification Procedures	14. Places of Refuge (also see site map form 208B)	15. Emergency Decon and Evacuation Steps	16. Site Security Measures
1. Notify Operations Chief using two-way radio 2. Call 911 for additional assistance as necessary	Assembly Area in parking lot	1. 2 decon station personnel designated as emergency backups for site entry and rescue operations 2. Utilize sled to perform evacuation and emergency decon of non-ambulatory personnel 3. Emergency decon of non-ambulatory personnel requiring immediate medical attention: Cut and remove PPE, wrap individual in blanket and transport to medical facility 4. Emergency decon of non-ambulatory personnel but no immediate medical attention required: (decon personnel assist as necessary) remove PPE, , redress in clean Oasis coveralls or alternative, then proceed to assembly area or evacuate site as directed. Frisk when in safe area. 5. Emergency decon of ambulatory personnel: Remove PPE as normal, redress in clean oasis coveralls or alternative. Proceed to assembly area or evacuate site as directed. Frisk when in safe area	None

17. Prepared By: Jeffrey Lodwick	18. Date/Time Briefed:	**HAZARD LIST**: Physical/Safety, Toxic, Explosion/Fire, Oxygen Deficiency, Ionizing Radiation, Biological, Biomedical, Electrical, Heat Stress, Cold Stress, Ergonomic, Noise, Cancer, Dermatitis, Drowning, Fatigue, Vehicle, Diving	**Form SSP-D:** Page 1 of 1

Air Monitoring Log

CG ICS SSP: AIR MONITORING LOG	1. Incident Name Radiation Exercise	2. Date/Time Prepared: 25 July, 2007 13:00	3. Operational Period 0800 -2000	4. Safety Officer (include method of contact) TBD	
5. Site Location 8660 S Sandy Pkwy Sandy, UT 84070	6. Hazards of Concern ^{137}Cs (as CsCl)	7. Action Levels (include references): MPC = $6x10^8$ uCi/ml-air (Class S), 29 CFR 1910.1096 DAC = $7x10^8$ uCi/ml-air (Class D, Stochastic), 10 CFR 835 Appendix A Dose = 1.25 rem/quarter, 29 CFR 1910.1096		8. Weather: Temperature: 90 Precipitation: none Wind: calm Relative Humidity: ~20% Cloud Cover: 0%	
9. Instrument, ID Number Calibrated? Indicate below.	Monitoring Person Name(s)	Results (units)	Location	Time	Interferences and Comments
10. Safety Officer Review:		Potential Health Effects: Bruise/Lacerations, Organ Damage, Central Nervous System Effects, Cancer, Reproductive Damage, Low Back Pain, Temporary Hearing Loss, Dermatitis, Respiratory Effects, Bone Breaks, Eye Burning			**Form SSP-E:** Page 1 of 1

Rev. October 2011

CG ICS SSP: PERSONAL PROTECTIVE EQUIPMENT	1. Incident Name Radiation Exercise	2. Date/Time Prepared 25 July, 2007 13:00	3. Operational Period 0800 - 2000	4. Safety Officer (include method of contact) TBD
5. Supervisor/Leader TBD	6. Location and Size of Site 8660 S Sandy Pkwy Sandy, UT 84070 ~4 acre	7. Hazards Addressed: Ionizing radiation Cs-137 as CsCl		8. For Emergencies Contact: 911

9. Equipment:				10. References Consulted:
PAPR w/ p-100				
Tyvek				
Nitrile gloves				
Glove liners				
Overboots				

11. Inspection Procedures: (see previous page)	12. Donning Procedures: (see previous page)	13. Doffing Procedures: See Decon Paln Form SSP-G (see previous page)	14. Limitations and Precautions (include maximum stay time in PPE): Limitations: (continued) 2. Heat Stress: EXIT HOT ZONE AND PROCEED TO DECON IMMEDIATELY UNDER ANY SYMPTOMS OF HEAT STRESS, SUCH AS THE FOLLOWING: a. High body temperature or heart rate as indicated by CorTemp system (monitored by medical/safety staff) b. Fainting c. Muscle spasms d. Pale/flushed complexion e. Extreme weakness f. Headache g. Nausea h. Vomiting i. Pale/flushed complexion j. Mental confusion

15. Prepared By:	16. Date/Time Briefed:	Potential Health Effects: Bruise/Lacerations, Organ Damage, Central Nervous System Effects, Cancer, Reproductive Damage, Low Back Pain, Temporary Hearing Loss, Dermatitis, Respiratory Effects, Bone Breaks, Eye Burning	**Form SSP-F:** Page 1 of 2

Rev. October 2011

Decontamination

CG ICS SSP: **DECONTAMINATION**	1. Incident Name Radiation Exercise	2. Date/Time Prepared 25 July, 2007	3. Operational Period 0800 - 2000	4. Safety Officer (include method of contact) TBD
5. Supervisor/Leader TBD	6. Location and Size of Site 8660 S. Sandy Pkwy, Sandy, UT ~ 4 acre	7. For Emergencies Contact: 911		8. Hazard(s) Addressed: Radiological, Heat Stress, Slips/trips/falls

9. Equipment:	Chairs		10. References Consulted:
3-Chamber DAT	Tarps		
Waste containers	HEPA Vac		
Ludlum Model 3 w/ 44-9 pancake probe	Oasis Suits		
Tables			

1. Avoid dusty areas in Hot Zone. Avoid brushing up against walls, equipment, furniture, or any surfaces. Avoid sitting, kneeling, or lying down. 2. Change gloves between individual samples. 3. Avoid billowing effect when removing suit in Decon; cut suit open with scissors if necessary. 4. All used disposable PPE to be placed in yellow waste bags and tied closed.	12. Decon Diagram See attached *Radiation SRT Radiological Personnel Decontamination Procedure* Minimum 2 decon attendants in gloves and boot covers.	13. Decon Steps See attached *Radiation SRT Radiological Personnel Decontamination Procedure*

14. Prepared By:	15. Date/Time Briefed:	Potential Health Effects: Bruise/Lacerations, Organ Damage, Central Nervous System Effects, Cancer, Reproductive Damage, Low Back Pain, Temporary Hearing Loss, Dermatitis, Respiratory Effects, Bone Breaks, Eye Burning	**Form SSP-G:** Page 1 of 1

Rev. October 2011

Site Safety Enforcement Log

CG ICS SSP: **ENFORCEMENT LOG**	1. Incident Name Radiation Exercise	2. Date/Time Prepared 25 July, 2007	3. Operational Period 0800 - 2000	4. Safety Officer (include method of contact) TBD	
5. Supervisor/Leader TBD	6. For Emergencies Contact: 911			7. Attachments: none	
8. Job Task/Activity	Hazards	Deficiency	Action Taken	Safety Plan Amended?	Signature of Supervisor/Leader
9. Prepared By:	10. Date/Time Briefed:	**HAZARD LIST**: Physical/Safety, Toxic, Explosion/Fire, Oxygen Deficiency, Ionizing Radiation, Biological, Biomedical, Electrical, Heat Stress, Cold Stress, Ergonomic, Noise, Cancer, Dermatitis, Drowning, Fatigue, Vehicle, Diving			**Form SSP-H:** Page 1 of 1

Rev. October 2011

Worker Acknowledgement Form

CG ICS SSP WORKER ACKNOWLEDGEMENT FORM	1. Incident Name	2. Site Location:	3. Attachments:	
4. Type of Briefing	5. Presented By:		6. Date	7. Time
Safety Plan/Emergency Response Plan ☐ Start Shift ☐ Pre-Entry ☐ Exit ☐ End of Shift ☐ Specify Other:				
8. Worker Name (Print)	Signature*		Date	Time

** By signing this document, I am stating that I have read and fully understand the plan and/or information provided to me.*

SSP-I: Worker Acknowledgement
Page 1 of 1

Rev. October 2011

Compliance Checklist

Page 1 of 3

CG ICS Emergency Response Plan 1910.120 COMPLIANCE CHECKLIST	1. Incident Name	2. Date/Time Prepared	3. Operational Period	4. Site Supervisor/Leader	5. Location of Site
Cite: 1910.120	Requirement(sections that duplicate or explain are omitted)		ICS Form	[4]	Comments
(**q**)(1)	Is the plan in writing?		SSP-A	☐	
(1)	Is the plan available for inspection by employees?		N/A	☐	Performance based
(**q**)(2)(i)	Does the plan address pre-emergency planning and coordination?		SSP-A	☐	
(ii)	Does it address personnel roles?		SSP-A	☐	
(ii)	Does it address lines of authority?		SSP-A	☐	
(ii)	Does it address communications?		SSP-A	☐	
(iii)	Does it address emergency recognition?		SSP-A	☐	
(iii)	Does it address emergency prevention?		SSP-A	☐	
(iv)	Does it identify safe distances?		SSP-A	☐	
(iv)	Does it address places of refuge?		SSP-A	☐	
(v)	Does it address site security and control?		SSP-A	☐	
(vi)	Does it identify evacuation routes?		SSP-A	☐	
(vi)	Does it identify evacuation procedures?		SSP-A	☐	
(vii)	Does it address decontamination?		SSP-A	☐	
(viii)	Does it address medical treatment and first aid?		SSP-A	☐	
(ix)	Does it address emergency alerting procedures?		SSP-A	☐	
(ix)	Does it address emergency response procedures		SSP-A	☐	
(x)	Was the response critiqued?		N/A	☐	Performance based
(xi)	Does it identify Personal Protection Equipment?		SSP-A	☐	
(xi)	Does it identify emergency equipment?		SSP-A	☐	
(**q**)(3)(ii)	All the hazardous substances identified to the extent possible?		N/A	☐	Performance based
(ii)	All the hazardous conditions identified to the extent possible?		N/A	☐	Performance based
(ii)	Was site analysis addressed?		N/A	☐	Performance based
(ii)	Were engineering controls addressed?		N/A	☐	Performance based
(ii)	Were exposure limits addressed?		N/A	☐	Performance based
(ii)	Were hazardous substance handling procedures addressed?		N/A	☐	Performance based
(iii)	Is the PPE appropriate for the hazards identified?		N/A	☐	Performance based
(iv)	Is respiratory protection worn when inhalation hazards present?		N/A	☐	Performance based
(v)	Is the buddy system used in the hazard zone?		N/A	☐	Performance based
(vi)	Are backup personnel on standby?		N/A	☐	Performance based
(vi)	Are advanced first aid support personnel standing by?		N/A	☐	Performance based
(vii)	Has the ICS designated safety official been identified?		SSP-A	☐	
(vii)	Has the Safety Official evaluated the hazards?		N/A	☐	Performance based
(viii)	Can the Safety Official communicate with IC immediately?		N/A	☐	Performance based
(ix)	Are appropriate decontamination procedures implemented?		N/A	☐	Performance based

Form SSP-J

Rev. October 2011

Compliance Checklist

Page 2 of 3

CG ICS SSP: 1910.120 COMPLIANCE CHECKLIST	1. Incident Name	2. Date/Time Prepared	3. Operational Period		
Cite: 1910.120	Requirement		ICS Form	[4]	Comments
(**c**)(7)	Employees informed of potential hazard occurrence?		SSP-B	☐	
(**c**)(8)	Properties of each chemical made aware to employees?		SSP-B	☐	
(**d**)(1)	Appropriate site control procedures in place?		IAP, SSP-B	☐	
(**d**)(2)	Site control program developed during planning stages?		IAP, SSP-B	☐	
(**d**)(3)	Site map, work zones, alarms, communications addressed?		IAP, SSP-B	☐	
(**g**)(1)(i)	Engineering, admin controls considered?		SSP-B	☐	
(iii)	Personnel not rotated to reduce exposures?		N/A	☐	
(**g**)(5)(i)	PPE selection criteria part of employer's program?		N/A	☐	Responsibility of employer
(ii)	PPE use and limitations identified?		SSP-F	☐	
(iii)	Work mission duration identified?		SSP-F	☐	
(iv)	PPE properly maintained and stored?		N/A	☐	Responsibility of employer
(vi)	Are employees properly trained and fitted with PPE?		N/A	☐	Responsibility of employer
(vii)	Are donning and doffing procedures identified?		SSP-F	☐	
(viii)	Are inspection procedures properly identified?		SSP-F	☐	
(ix)	Is a PPE evaluation program in place?		SSP-F	☐	
(**h**) (3)	Periodic monitoring conducted?		SSP-E	☐	
(**k**)(2)(i)	Have decontamination procedures been established?		SSP-G	☐	
(ii)	Are procedures in place for contamination avoidance?		SSP-G	☐	
(iii)	Is personal clothing properly decomned prior to leaving the site?		SSP-G	☐	
(iv)	Are decontamination deficiencies identified and corrected?		SSP-H	☐	
(**k**)(3)	Are decontamination lines in the proper location?		SSP-C	☐	
(**k**)(4)	Are solutions/equipment used in decon properly disposed of?		N/A	☐	
(**k**)(6)	Is protective clothing and equipment properly secured?		N/A	☐	
(**k**)(7)	If cleaning facilities are used, are they aware of the hazards?		N/A	☐	
(**k**)(8)	Have showers and change rooms provided, if necessary?		N/A	☐	
(**l**)(1)(iii)	Are provisions for reporting emergencies identified?		SSP-D	☐	
(iv)	Are safe distances and places of refuge identified?		SSP-B and C	☐	
(v)	Site security and control addressed in emergencies?		SSP-D	☐	
(vi)	Evacuation routes and procedures identified?		SSP-D	☐	
(vii)	Emergency decontamination procedures developed?		SSP-D	☐	
(ix)	Emergency alerting and response procedures identified?		SSP-D	☐	
(x)	Response teams critiqued and followup performed?		SSP-H	☐	
(xi)	Emergency PPE and equipment available?		SSP-D	☐	
(**l**)(3)(i)	Emergency notification procedures identified?		SSP-D	☐	
(ii)	Emergency response plan separate from Site Safety Plan?		SSP-D	☐	
(iii)	Emergency response plan compatible with other plans?		SSP-D	☐	
(iv)	Emergency response plan rehearsed regularly?		SSP-D	☐	
(v)	Emergency response plan maintained and kept current?		SSP-H	☐	
1910.165(**b**)(2)	Can alarms be seen/heard above ambient light and noise levels?		N/A	☐	
(**b**)(3)	Are alarms distinct and recognizable?		N/A	☐	

Form SSP-K: Page 2

Rev. October 2011

Compliance Checklist

Page 3 of 3

CG ICS SSP: 1910.120 COMPLIANCE CHECKLIST	1. Incident Name	2. Date/Time Prepared	3. Operational Period		
Cite: 1910.165	Requirement		ICS Form	[4]	Comments
(**b**)(4)	Are employees aware of the alarms and are they accessible?		SSP-D	☐	
(**b**)(5)	Are emergency phone numbers, radio frequencies clearly posted?		206	☐	
(**b**)(6)	Signaling devices in place where there are 10 or more workers?		IAP	☐	
(**c**)(1)	Are alarms like steam whistles, air horns being used?		IAP	☐	
(**d**)(3)	Are backup alarms available?		IAP	☐	
1910.120(m)	Are areas adequately illuminated?		IAP	☐	
(**n**)(1)(i)	Is an adequate supply of potable water available?		IAP	☐	
(ii)	Are drinking water containers equipped with a tap?		IAP	☐	
(iii)	Are drinking water containers clearly marked?		IAP	☐	
(iv)	Is a drinking cup receptacle available and clearly marked?		IAP	☐	
(**n**)(2)(i)	Are non-potable water containers clearly marked?		IAP	☐	
(**n**)(3)(i)	Are their sufficient toilets available?		IAP	☐	
(**n**)(4)	Have food handling issues been addressed?		IAP	☐	
(**n**)(6)	Have adequate wash facilities been provided outside hazard zone?		IAP	☐	
(**n**)(7)	If response is greater than 6 months, have showers been provided?		IAP	☐	
4. Prepared By:					**Form SSP-K: Page 3**

Rev. October 2011

Drum Compliance Checklist

CG ICS SSP: 1910.120 DRUM COMPLIANCE CHECKSHEET	1. Incident Name	2. Date/Time Prepared	3. Operational Period	4. Safety Officer (include method of contact)	
5. Supervisor/Leader	6. Location and Size of Site	7. For Emergencies Contact:		8. Note: tanks and vaults should also be treated in the same manner as described below [1910.120(j)(9)]. Many can also pose confined space hazards.	
9. Cite: 1910.120 (Cites that duplicate or explain requirements are omitted)	Requirement			[4]	Comments
(j)(1)(ii)	Drums meet DOT, OSHA, EPA regs for waste they contain, including shipment?			☐	
(iii)	Drums inspected and integrity ensured prior to movement?			☐	
(iii)	Or drums moved to an accessible location (staging area) prior to movement?			☐	
(iv)	Unlabelled drums treated as unknown until properly identified and labeled?			☐	
(v)	Site activities organized to minimize drum handling?			☐	
(vi)	Employers properly warned about the hazards of moving and handling drums?			☐	
(vii)	Suitable overpack drums are available for addressing leaking and ruptured drums?			☐	
(viii)	Leaking materials from drums properly contained?			☐	
(ix)	Are drums that cannot be moved, emptied of contents with transfer equipment?			☐	
(x)	Are suspect buried drums surveyed with underground detection system?			☐	
(xi)	Are soil and covering material above buried drums removed with caution?			☐	
(xii)	Is the proper extinguishing equipment on scene to control incipient fires?			☐	
(j)(2)(i)	Are airlines on supplied air systems protected from leaking drums?			☐	
(ii)	Are employees at a safe distance, using remote equipment, when handling explosive drums?			☐	
(iii)	Are explosive shields in plane to protect workers opening explosive drums?			☐	
(iv)	Is response equipment positioned behind shields when shields are used?			☐	
(v)	Are non-sparking tools used in flammable or potentially flammable atmospheres?			☐	
(vi)	Are drums under extreme pressure opened slowly & workers protected by shields/distance?			☐	
(vii)	Are workers prohibited from standing and working on drums?			☐	
(j)(3)	Is the drum handling equipment positioned and operated to minimize sources of ignition?			☐	
(j)(5)(i)	For shock sensitive drums, have all non-essential employees been evacuated?			☐	
(ii)	For shock sensitive drums: is handling equipment provided with shields to protect workers?			☐	
(iii)	Are alarms that announce start/finish of explosive drum handling actions in place?			☐	
(iv)	Are continuous communications in place between the drum handling site & command post?			☐	
(v)	Are drums under pressure properly controlled for prior to handling?			☐	
(vi)	Are drums containing packaged laboratory wastes treated as shock sensitive?			☐	
(j)(6)(i)	Are lab packs opened by trained and experienced personnel?			☐	
(ii)	Are lab packs showing crystallization treated as shock sensitive?			☐	
(j)(8)(ii-iii)	Are drum staging areas manageable with marked access and egress?			☐	
(iv)	Is bulking of drums conducted only after drum contents have been properly identified?			☐	
10. Prepared By:				**Form SSP-L:**	

Rev. October 2011

1. Bioassay Sample Form (Front)

Bioassay Sample Form

Last Name: _____ First Name: _____ Middle I _____

S.S.N./P.I.N. _____ Organization: _____

Address: _____

Date (dd-mm-yyyy): _____ AWP Number: _____

Sample Media: ___ Urine ___ Fecal ___ Thyroid ___ Lung

___ Wound ___ WBC ___ Nasal ___ Other (specify): _____

_____

Sample Number: _____ Time (hhmm) _____

Comments: _____

Sample Type: ___ Baseline ___ Routine ___ Post-Work ___ Other _____

Analysis: _____

_____

_____

_____

_____

_____

_____

_____

Time/Date of Sample Collection: Begin: _____ End: _____

Chain of Custody

Relinquished By (Signature)	Date/Time (Relinquished)	Date/Time (Received)	Received By (Signature)

CONTAINS PRIVACY ACT INFORMATION

May-2003

Rev. October 2011

2. Breathing Zone Air Sample Spreadsheet

RADIOLOGICAL SURVEY REPORT- 8/27/09

Form **BREATHING ZONE AIR (BZA) SPREADSHEET** Rev. 03

FRM-0108F Page of

Millipore filter with 1.0 efficiency. DACs (µCi/mL) based on:			*α: Pu-239 (M)*	*5.00E-12*	*β: Sr-90 (S)*	*7.00E-09*
Survey or Tracking #						
Name						
Employee #						
BZA #						
BZA Cal Due						
RWP #						
Work Package/TWD #						
Date Sampled (mm/dd/yyyy)						
Time Start Sampler (HH:MM)						
Time Stop Sampler (HH:MM)						
Starting flow rate (lpm)						
Ending flow rate (lpm)						
Run time (min) =						
Volume (liters) =						
Alpha Bkgd (cpm)						
OR Alpha Bkgd in dpm						
Alpha effic. (decimal)						
Beta Bkgd (cpm)						
OR Beta Bkgd in dpm						
Beta effic. (decimal)						
Sample count time (min)						
Bkgd count time (min)						
Date Counted (mm/dd/yyyy)						
Time counted (HH:MM)						
Repirator Protection Factor						
Counting Instrument #						
Cal. Due (mm/dd/yyyy)						
Net Alpha sample (cpm)						
Calc. Alpha sample (dpm)						
OR, as read Net Alpha dpm						
Net Beta sample (cpm)						
Calculated Beta sample (dpm)						
OR, as read Net Beta dpm						
Decision level Alpha (DAC-h)						
Alpha DAC-h						
Decision level Beta (DAC-h)						
Beta DAC-h						

Prepared by (print):	Signature:	Date:
Other Preparer or 1st Reviewer (print):	Signature:	Date:
Reviewed by (print):	Signature:	Date:

When completed, this may be subject to the Privacy Act. All times must be entered using a 24-hr clock (i.e., 15:32).

Rev. October 2011

2a. Breathing Zone Air Sample Instructions

Instructions

1. Enter the nuclide of concern for α and β and their associated DAC values (μCi/mL) in row 1. If the nuclides are unknown, assume Pu-239 class M (α, 5E-12 μCi/mL) and Sr-90 class S (β, 7E-9 μCi/mL).
2. **IF** the nuclide of concern has changed (and thus the DAC values) for any employee, **THEN** a new copy of the form must be used.
3. Complete rows 2-8 by entering the survey or tracking #, employee's name, employee #, BZA ID (serial number, etc.), BZA calibration due date, RWP #, and work package/TWD #.
4. Enter the date and time (24 hour format) the BZA was started and the starting flow rate in liters per minute.
5. When the worker leaves the area or the BZA is turned off for any reason, record the date, time, and ending flow rate.
6. Calculate the elapsed time (in minutes) that the worker was in the area by subtracting ending time from starting time (automatic on electronic form).
7. Calculate the average flow rate (in liters per minute) for that entry (automatic on electronic form).
   Average flow rate = (starting flow + ending flow)/2.
8. For each subsequent re-entry, repeat steps 1-7. The elapsed time and average flow for each leg could be calculated later.
9. Calculate the total flow (in liters) through the BZA (automatic with the electronic form).
   Total flow = Average flow × elapsed time
10. Record the counting instrument data on the form (normally a Tennelec) including the instrument ID, cal due date, α and β background (either in dpm or cpm) and efficiencies (decimal), and the length of time the background and the sample are counted.
11. Record the date and time of the count and the results (in dpm or cpm) on the form.
12. Select the appropriate respiratory protection factor. If the Protection Factor is not specified, use 1 for worker not wearing any respirator, 50 for an APR, and 1000 for a PAPR.
13. Calculate the decision level (L_D) in units of DAC-hr for the alpha and beta using the equation,

$$L_D = \frac{1.645\sqrt{\left(R_B \times \left(\frac{1}{T_S} + \frac{1}{T_B}\right)\right)}}{E_{\alpha,\beta}} \times \frac{1}{2.22E6} \times \frac{1}{DAC} \times \frac{T_R}{60} \times \frac{1}{V \times 1000} \times \frac{1}{PF}$$

Where: R_b = background count rate (in cpm), T_s = count length of sample (in minutes), T_b = count length of background (in minutes), $E_{\alpha,\beta}$ = detection efficiency (decimal), DAC = the DAC value in step 1, T_R = total run time of the BZA (in minutes), V = total volume in liters, and PF = the respiratory protection factor. IF the detector produces R_b in dpm, THEN $E_{\alpha,\beta}$ = 1. The calculation is automatically performed on the electronic form.

14. Count the BZA filter and record the net dpm.
15. Calculate the DAC-hr for alpha and beta by using the equation,

$$\text{DAC-hr} = \frac{S_A}{2.22E6} \times \frac{1}{V \times 1000} \times \frac{T_R}{60} \times \frac{1}{DAC} \times \frac{1}{PF}$$

Where: S_A = activity on filter (in dpm), V = total volume in liters, T_R = total run time of the BZA (in minutes), DAC = the DAC value in step 1, and PF = the respiratory protection factor. The calculation is automatically performed on the electronic form.

16. Print one hardcopy per every employee on the form and send originals to Dosimetry Scientist.

Rev. October 2011

3. CMRT / FRMAC Breathing Zone Air Sampler (BZA) Operator Aid

- Obtain BZA, Hose, Cassette and New Filter
    - Use tweezers to install new filter into the cassette.
    - Insure the blue paper separator is not with the filter.
    - Insure the black gasket is in the cassette holder top
    - Do not over tighten the cassette holder
- Attach cassette to lapel of wearer (Shirt Collar)
- Attach pump to belt
- Press ON/OFF to start pump
- Wait for the pump to complete a self test and to stabilize to the desired flow rate. (Typical 2.0 lpm)
- Note the Start Time and Flow Rate.
- To pause the pump run time Press PAUSE/HOLD.
- Press PAUSE/HOLD to resume run time.
- When departing from the area Press ON/OFF to stop the run time and pump
- Turn pump into designated Field Team Member to process the filter.

Receiving and processing the filter paper

- A Field Team Member will be assigned responsibility to receive the BZA filters count on a scaler and complete the Radiological Survey Report – Breathing Zone Air (BZA) Spreadsheet NSTec form FRM-0108F 8/27/09.
- Follow the Instruction on the back of the form.
- Up to 6 people can be put on one FRM-0108F. A new form will be created for each day.
- If the pump was issued to a team, record each team members name in the other columns.
- The Health & Safety division will maintain an electronic copy of each FRM-0108F.
- Record the required information on a draft paper version of FRM-01008F until you have access to a computer and the Electronic FRM-0108F is available.
- As the team turns in the BZA filter record the following information before the team departs.
    - Row 1 Name (Full Name of Each Team Member using that BZA)
    - Row 2 Employee # (Record the Employee # or Org Name of each Team Member)
    - Row 3 BZA #
    - Row 4 BZA Cal Due Date
    - Row 5 Date Sampled (mm/dd/yyyy)
    - Row 6 Time Start Sampler (HH:MM) (Estimate Start and Stop Time from Total Run Time)

3. CMRT / FRMAC Breathing Zone Air Sampler (BZA) Operator Aid (cont'd)

  - Row 7 Time Stop Sampler (HH:MM) (Estimate Start and Stop Time from Total Run Time)
  - Row 8 Starting Flow Rate (lpm)
  - Row 9 Stop Flow Rate (lpm)
  - Row 18 Respirator Protection Factor (1 – no Respirator, 50 – APR, 1,000 PAPR)
- Using tweezers remove the filter paper and place into a paper coin envelope used for smears.
  - Label the envelope with the name and date of the filter.
- At this time you can release the Team
- Charge the BZA battery for the next use.
  - A fully charged battery will give you over 17 hours of use.
  - 14 hrs are required for a full battery charge
- Take the filter to a Ludlum 2929 swipe counter
  - Row 10 Alpha background (cpm or dpm)
  - Row 11 Alpha efficiency (decimal)
  - Row 12 Beta background (cpm or dpm)
  - Row 13 Beta efficiency (decimal)
  - Row 14 Sample Count Time
  - Row 15 Background Count Time (Default count time is 10 min)
  - Row 16 Date Counted (mm/dd/yyyy)
  - Row 17 Time Counted (HH:MM)
  - Row 19 Counting Instrument # (Serial Number of the L2929)
  - Row 20 Cal Due Date (mm/dd/yyyy)
  - Row 21 Net Counts Alpha Sample (cpm)
  - Row 22 Net Counts Beta Sample (cpm)
- The remaining rows will be calculated on the electronic spreadsheet.
- Print a Hard copy. Print & sign your Prepared by.
- Turn in the completed spreadsheet to the Health & Safety Manager or designee to review the DAC levels.

Rev. October 2011

4. Dosimeter TLD Issue Form
(Occupational Radiation Exposure Information)
(page 1 of 3)

WHEN COMPLETED THIS DOCUMENT CONTAINS PRIVACY ACT INFORMATION

NSTec Form FRM-0851	OCCUPATIONAL RADIATION EXPOSURE INFORMATION	08/05/09 Rev. 01 Page 1 of 3

The following information is provided pursuant to public Law 93-579 (The Privacy Act of 1974) for individuals completing this form. Title 10 Code of Federal Regulations Part 835 – OCCUPATIONAL RADIATION PROTECTION, requires collection of occupational radiation exposure records. Its purpose is to allow for accurate recording and tracking of the individual's annual and lifetime occupational radiation exposure. The routine use which can be made of this information is to inform DOE and other regulatory organizations of any radiation exposure which might be received by the individual. The effect of failure to provide the requested information may be denial of monitoring and entry to the facility.

Organization Code ☐ Non-NSTec Employee ☐ NSTec Employee ☐ TLD To Be Issued On A One-Time Basis ☐ Routine Issue Issue Date: TLD # Issued _____ Issued By _____ ☐ Combination (Beta/Gamma/Neutron) ☐ Single (Beta/Gamma)

PERSONAL INFORMATION

PRINT FULL NAME (Last, First, MI) _____ Employee Number _____ Gender ☐ Male ☐ Female Date of Birth (mm/dd/yy) ___/___/___

Social Security or Passport Number _____ Date of Passport _____ Country of Origin (passport only) _____

Home Address _____ Apt. No. _____ City _____ State _____ Zip Code _____

Home Phone Number _____

EMPLOYER COMPANY NAME _____ Work Phone Number _____

Business Mailing Address _____ Division/Group _____ Mail Stop _____ City _____ State _____ Zip Code _____

National Security Technologies LLC CONTACT NAME _____ Division/Group _____ Mail Stop _____ Work Phone Number _____

EXPOSURE INFORMATION

Have you received medical treatment in the ***past month*** with radioactive material? ☐ Yes ☐ No If Yes, what? _____

Have you been monitored for internal or external occupational radiation exposure during the ***current calendar year***? ☐ Yes ☐ No

IF YES, ENTER ***CURRENT CALENDAR YEAR*** DOSE DATA BELOW (OR ESTIMATES) AND ***COMPLETE PAGE 2***.

Whole body (DD) _____ rem Lens of Eye (LDE) _____ rem Skin or Extremity (SD) _____ rem

Internal (CED) _____ rem Organ Dose (CD) _____ rem Whole Body plus Internal (TED) _____ rem

Have you ever been monitored for internal or external occupational radiation exposure in previous years? ☐ Yes ☐ No IF YES, ***COMPLETE PAGE 3.***

TRAINING INFORMATION

1. Training is not required if you are a member of an escorted tour sponsored and escorted by a qualified tour leader. _____ Tour Date(s)
   _____ Escort (Name)
2. Radiological training completed. Proof of radiological training must be furnished with this request to obtain an NTS dosimeter.
   ☐ NTS GERT ☐ Radiological Worker I (RWI) ☐ Radiological Worker II (RWII) Date of Training _____

Date(s) of visit: Start Date: _____ End Date: _____

This exposure information is correct and complete to the best of my knowledge. I have read and understand the instructions for care and use of dosimetry.

Signature _____ Date: _____

4. Dosimeter TLD Issue Form
(Occupational Radiation Exposure Information)
(page 2 of 3)

WHEN COMPLETED THIS DOCUMENT CONTAINS PRIVACY ACT INFORMATION

NSTec Form FRM-0851	OCCUPATIONAL RADIATION EXPOSURE INFORMATION	08/05/09 Rev. 01 Page **2** of **3**

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

FACILITY NAME: ______ MONITORING DATES (From) ______ (To) ______ TED ______ rem
FACILITY ADDRESS: ______ ______ ______ ______
Street City State Zip Code

USE ADDITIONAL FORMS AS NECESSARY

This is to certify that the information and statements are correct and complete to the best of my knowledge. I authorize the facilities named above to release my radiation exposure records to National Security Technologies[LLC].

I recognize that this form will be copied for request of occupational radiation exposures from other facilities.

Signature: ______ **Date:** ______

(Reference: 10 CFR 835, OP-0441.011)

4. Dosimeter TLD Issue Form
(Occupational Radiation Exposure Information)
(page 3 of 3)

WHEN COMPLETED THIS DOCUMENT CONTAINS PRIVACY ACT INFORMATION

NSTec Form FRM-0851	OCCUPATIONAL RADIATION EXPOSURE INFORMATION	08/05/09 Rev. 01 Page **3** of **3**

REIRS Records Release Form for an Organization

Pursuant to 5 U.S.C. 552a(e)(3), enacted into law by Section 3 of the Privacy Act of 1974 (Public Law 93-579), the following statement is furnished to individuals who supply information to the U.S. Nuclear Regulatory Commission on the REIRS Records Release Form. This information is maintained in a system of records designated as NRC-27 and described at 67 Federal Register63793 (October 15, 2002), or the most recent Federal Register publication of the NRC's "Republication of Systems of Records Notices" that is available at the NRC Public Document Room, 11555 Rockville Pike, Rockville, Maryland, or located in NRC's Agency - wide Documents Access and Management System (ADAMS).

To be completed by Monitored Individual

I hereby authorize the release of my radiation exposure records from the U.S. Nuclear Regulatory Commission to the requesting organization identified below. Please provide this organization with any and all radiation exposure information that is maintained electronically within the REIRS database. I understand that these records need to be reviewed and certified by me, the monitored individual, prior to being considered as a valid dose record.

Printed name of monitored individual: _____

Signature of monitored individual: _____

Date signed: _____

To be completed by Radiological Health

Requesting Organization: _____

I hereby certify that I have confirmed the monitored individual's identity and signature on this release form.

Printed name of Requestor: _____

Signature of Requestor: _____

Date signed: _____

Requestor Phone#: _____

Requestor FAX#: _____

Request ID Number: _____

This is the REIRS Request ID number that is generated when you submit the request form and is required in order to process your request.

Rev. October 2011

5. Dosimeter (TLD) Issue Log

NSTec

RADIOLOGICAL HEATH

When filled in this form contains Privacy Act Information.

DOSIMETRY ISSUE LOG

ISSUE/RETURN LOCATION: _____ **DATE:** _____ **DOSIMETER TYPE:** ☐ Combination ☐ Single

Name of Individual Receiving Dosimetry (Last, First, MI)	Social Security #	Old (Return) Dosimeter Number	New (Issue) Dosimeter Number

WRITE LEGIBLY, COMPLETE ALL INFORMATION!

Dosimeter Issuer Name	Dosimeter Issuer Signature	Date of Signature

FRM-0748 (11/06)

Rev. October 2011

6. Pocket Dosimeter Issue Log

POCKET DOSIMETER ISSUE LOG

Name	Team Number	Social Security Number	Dosimeter ID Number	Date / Time Issue	Date / Time Return	Initial Reading (mR)	Return Reading (mR)

Privacy Act Statement: The information on this form is protected by the Privacy Act of 1974. The purpose of requesting this information is to conduct dose tracking. This information will be used by the U.S. Department of Energy, Nevada Operations Office, its contractors, and the home organization of the participant. Failure to provide this information will result in not receiving a dose assessment or proper dose tracking.

May-2003

Rev. October 2011

7. Electronic Dosimeter PD-10i Operator Aid

The SAIC PD-10i is a self reading electronic dosimeter. The dosimeter measures photon radiation (gamma and x-rays) and provides Dose Measurements; Dose Rate Measurements and Dose/Rate Alarm functions .It is insensitive as a dose rate meter at background level. There is a long lag time between reading changes as one moves in and out of an elevated dose area. **It is not a Health Physics rate meter or Radiation Pager.**

OPERATIONAL VERIFICATION

Installing the Battery

Install battery as indicated (+ end down) (If removing battery, wait for 5 sec. before reinstalling battery)

Figure I. Installation of AA battery in a PD-10i dosimeter

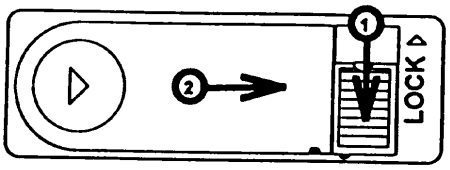


Figure II. Locking the battery compartment

Turning the Instrument ON and SETTING OPTIONS

Two buttons operate all the functions for this unit.

The **Black (RUN)** button and the **Gray (MODE)** button

Push the **Black (RUN)** button to turn the unit ON**.**

The unit will perform a self test. During the self test, the unit will display the Dose Alarm, Rate Alarm and other Alarm set points. **Note:** The Alarm settings appear in this order:

Total dose (R or mR) (Default setting is 100 mR)

Dose rate (R/ or mR/h) (Default setting is 500 mR/h)

Stay time (minutes) (Default setting is 240 minutes)

Chirp mode (Chirps at X amount of gamma per unit time) (Default setting is 1 mR)

Push the Gray (MODE) button to cycle between following displays

DOSE (total accumulated dose since the last reset)

DOSE RATE (from background level to 500 R/h)

Stay Time left

NOTE: If either of these is flashing then the set dose alarm or dose rate alarm has been exceeded.

RESET ACCUMULATED DOSE

Press and hold **Gray (MODE)** button until you see (rES) on screen

Release the button when the (rES) symbol appears.

SETTING ALARMS

Before any changes can be made to the alarms settings, the unit needs to be in IdL.

To get there Press and hold the **Black (RUN)** button then tap the **Gray (MODE)** button until the display reads Idl**.**

Press the **Gray (MODE)** again to get to the first unit to be set, the Dose Alarm mode.

To change the values to set the alarms at the required settings, do as follows:

* Use **Gray (MODE)** button to move from character to character L to R
* Use **Black (RUN)** button to change the character, unit of measure or move decimal points

When the desired alarm setting has been entered, hold down **Gray (MODE)** and press **Black (RUN)** once, this will take you to next alarm settings

DOSE RATE ALARM, as above use the **Gray (MODE)** and **Black (RUN)** buttons to set this and the Stay Time and Chirp Rate settings

To Exit, hold down **Gray (MODE)** button and press the **Black (RUN)** button once.

PD-10i is now operating as per your specification

Note: Use the **Gray (MODE)** to scroll through the data when in operate mode.

SHUTTING DOWN THE PD10i

Press and hold the **Black (RUN)** button, then press and release the **Gray (MODE)** button until IdL is displayed, then press the **Black (RUN)** button and the unit should turn off. Or, if this does not work remove the battery, wait 5 seconds, then replace it.

At the end of the shift record the reading on a Pocket Dosimeter Issue Log.

Rev. October 2011

8. Initial Hazard Checklist

Date: _____

Location: _____

Type of Response (Brief Explanation):_____

_____

Hazards	Yes	No	Description (if yes)
Confined Spaces	☐	☐	_____
Lockout/Tagout	☐	☐	_____
Electric/Power lines	☐	☐	_____
Work near Heavy traffic	☐	☐	_____
Work on/near Water	☐	☐	_____
Temperature Extremes	☐	☐	_____
Open Flames or Fire	☐	☐	_____
Any Explosive materials	☐	☐	_____
Pressurized Vessels	☐	☐	_____
High Noise Areas	☐	☐	_____
Airborne Contaminants	☐	☐	_____
Biohazard Concerns	☐	☐	_____
Non-Ionizing Radiation	☐	☐	_____

Radiation Levels:

Exposure Rates _____

Surface Contamination Levels _____

Airborne Radioactivity Levels _____

Additional Remarks:

_____

_____

_____

_____

Rev. October 2011

9. Medical Monitoring of Entry Team

MEDICAL MONITORING OF ENTRY TEAM

NAME: _____

CASE: _____ CASE #: _____

DATE/TIME: _____ EXPOSURE RISK: ___HIGH ___MED ____LOW

PROTECTIVE EQUIPMENT: _____

SUBSTANCE(S) INVOLVED: _____

CONCENTRATION/LENGTH OF EXPOSURE: _____

MEDICAL TESTING: _____

COMMENTS: _____

PRE-ENTRY MEDICAL MONITORING

WEIGHT: _____ TEMPERATURE: _____ METHOD: _____

PULSE: _____ BLOOD PRESSURE: SYSTOLIC___/DIASTOLIC_____METHOD: _____

MONITORING CONDUCTED BY: _____

POST-ENTRY MEDICAL MONITORING

WEIGHT: _____ TEMPERATURE: _____ METHOD: _____

PULSE: _____ BLOOD PRESSURE: SYSTOLIC___/DIASTOLIC_____METHOD: _____

MONITORING CONDUCTED BY: _____

Privacy Act Statement: The information on this form is protected by the Privacy Act of 1974. The purpose of requesting this information is to conduct medical monitoring of entry teams. This information will be used by the U.S. Department of Energy, Nevada Operations Office, its contractors and the home organization of the participant. Failure to provide this information will result in not receiving medical monitoring and could preclude participation on the entry team.

May-2003

Rev. October 2011

10. Personnel Contamination Sheet

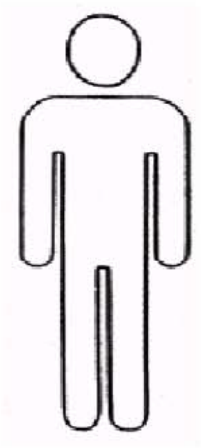
Personnel Contamination Survey Sheet

Name: _____ Date / Time: _____ Team: _____

Instrument Type: _____ Number: _____ Bioassay Collected: ☐ Yes ☐ No

Mark contamination locations on the diagrams below

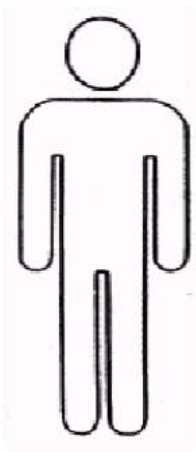
FRONT



Measurements:

1 _____
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____
9 _____

BACK



Measurements:

1 _____
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____
9 _____

Comments: _____

_____

_____

Monitored By: _____ **Instrument:** Type: _____ Number: _____

May-2003

Rev. October 2011

11. Personnel TLD Data Sheet

PERSONNEL TLD DATA SHEET

Event	TLD #	Latitude	Longitude	Deployed		Retrieved	
				Date/Time (military)	Initials	Date/Time (military)	Initials
Local Description							
Name	Last			First		Middle	
Mailing Address				City		State	Zip Code
☐							
Phone Number (with Area Code)		Social Security Number *		Date of Birth (MM/DD/YYYY)		Sex	
						F ☐ M ☐	
Remarks (Issues/Retrieval)							

CHAIN OF CUSTODY		
Relinquished By	Received By	Transit Numbers
Relinquished By	Received By	Transit Numbers
Relinquished By	Received By	Transit Numbers
Relinquished By	Received By	Transit Numbers

* SSN: Health and Safety (H&S) requires that Social Security Number information be provided. This information is held in strict confidence; it is not released.

Original to Data Center Yellow Copy to Health & Safety Pink Copy to Individual

Rev. October 2011

12. Radiation Survey Report

RADIATION SURVEY REPORT Number_____ Page _____of _____

Surveyor(s):	Date:	Time:
Signature: Supervisor:		

Results ☐ N/A	Results ☐ N/A	Results ☐ N/A	Results ☐ N/A	Results ☐ N/A
Type No.	Type No.	Type No.	Type No.	Type No.
Efficiency / MDA	Efficiency / MDA			
Alpha	Alpha			
Beta	Beta			
Count Time	Count Time			
Tritium CF	Tritium CF			

PURPOSE:

ALL READINGS MEET UNRESTRICTED RELEASE LIMITS? ☐ YES ☐ NO

Number of Points	TIME	DESCRIPTION OF SURVEY	Results 1	Results 2	Results 3	Results 4	Results 5
			Type	Type	Type	Type	Type
			Unit	Unit	Unit	Unit	Unit
			☐ Portable Instrument	☐ Portable Instrument	☐ Portable Instrument	☐ Portable Instrument	☐ Portable Instrument
			☐ Removable DPM/100cm^2	☐ Removable DPM/100cm^2	☐ Removable DPM/100cm^2	☐ Removable DPM/100cm^2	☐ Removable DPM/100cm^2
		BACKGROUND ALL READINGS RECORDED ARE NET ABOVE					

Comments:

Follow Up Required? ☐ YES ☐ NO

Footnotes:

Rev. October 2011

13. Scaler Efficiency Worksheet

FRMAC Scaler Efficiency Worksheet

Location: _____ Instrument Type: _____ ID Number: _____

Alpha Source Type: _____ Number: _____ **Beta Source** Type: _____ Number: _____

User	**Time**	**Date**	**Source dpm**		**BKG cpm**		**Source cpm**		**%efficiency**		**Conversion factor**		**Release Limits (cpm)**		**MDA (dpm)**	
Last Name			α	β	α	β	α	β	α	β	α	β	α	β	α	β

$$MDA = \frac{2.71}{sampletime} + 3.30\sqrt{\frac{BKG(cpm)}{BKG(time)}\left(1 + \frac{BKG(time)}{Sample(time)}\right)} \Big/ efficiency$$

March-2010

Rev. October 2011

14. Pregnancy Declaration

PREGNANCY DECLARATION

Memorandum

Date:

To:

From:

Subject: Pregnancy Declaration

This is to inform you, as my supervisor, of my pregnancy or my intention to become pregnant. This form also provides me with information concerning the effects of radiation exposure to the unborn child. The signing of this document and release of this information are done solely in the interest of protecting my unborn child.

The reason for informing you of my intention to become pregnant is to prevent an unwanted, exposure from occurring before I become aware that I am pregnant.

I understand the possible effects of ionizing radiation exposure to the unborn child as stated in paragraphs A and B of this section. The following information comes from *Radiation Protection Guidance to Federal Agencies for Occupational Exposure Approval of Environmental Protection Agency Recommendations* Vol., 52 No. 17 Tuesday, January 27, 1987,and addresses the effects of radiation on children who were exposed while in the womb.

A. Not only may the unborn be more sensitive than adults to the induction of malformations, cancer, and hereditary effects, but recent studies have drawn renewed attention to the risk of severe mental retardation from exposure of the unborn during certain periods of pregnancy. The risk of less severe mental retardation appears to be similarly elevated. Although it is not yet clear to what extent the frequency of retardation is proportional to the amount of dose (the data available at occupational levels of exposure are limited), it is prudent to assume that proportionality exists.

B. The recommendations also incorporate guidance for limiting exposure of the unborn as a result of occupational exposure of the female workers. It has long been suspected that the embryo and fetus are more sensitive to a variety of effects of radiation than are adults. Although our knowledge remains incomplete, it has now become clear that the unborn are especially subject to the risk of mental retardation from exposure to radiation at a relatively early phase of fetal development. Available scientific evidence appears to indicate that this sensitivity is greatest during the period near the end of the first trimester and the beginning of the second trimester of pregnancy, that is the period of from 8 weeks to about 15 weeks after conception. Accordingly, when a worker has declared her pregnancy, guidance recommends not only that the total exposure of the unborn be more limited than that of adult workers but that the monthly rate of exposure be further limited in order to provide additional protection. Due to the incomplete state of knowledge of the transfer of radionuclides from the mother to the unborn (and the resulting uncertainty in dose to the unborn), in those few work situations where intake of radionuclides could normally be possible it may also be necessary to institute measures to avoid such intakes by pregnant women in order to satisfy these recommendations.

PREGNANCY DECLARATION (cont.)

I understand that the possible risks, my rights, possible limitations and responsibilities are as follows:

1. The health protection objectives of this guidance for the unborn should be achieved in accordance, with the health provisions of Title VII of the Civil Rights Act of 1964, ad amended, with respect to discrimination in employment practices. The guidance applies only to situations in which the worker has voluntarily made her pregnancy known, in writing to her employer.

   Protection of the unborn may be achieved through such measures as temporary job rotation, worker self-selection or use of protective equipment. The guidance recognizes that protection of the unborn is a joint responsibility of the employer and the worker. As a result, temporary arrangements necessary to modify exposures may be made. The responding organization will make such arrangements in a manner that allows minimization of the impact to the worker.

2. The responding organization further recognizes that while they share concern for the protection of unborn children of their employees, it is also the decision of the Supreme Court of the United States in UAEW v. JOHNSON CONTROL, INC._U.S._111S. Ct. l 196, 113, 1 Ed.2d 158 (March 20, 1991) that:

   > "Decisions about the welfare of future children must be left to the parents who conceive, bear, support and raise them rather than to employers who hire those parents."

3. The Civil Rights Act of 1964, as amended, provides that "It shall be an unlawful employment practice for an employer (1) to fail or refuse to hire or to discharge any individual, or otherwise to discriminate against any individual with respect to his compensation, terms, conditions, or privileges of employment, because of such individuals…sex…; or (2) to limit, segregate, or classify his employees or applicants for employment in any way which would deprive or tend to deprive any individual of employment opportunities or otherwise adversely affect his status as an employee, because of such individual's…sex…" [42 U.S.C. 2000e-2(a)]. The Pregnancy Discrimination Act. Or 1978 defines "because of sex" to include because of or on the basis of pregnancy, childbirth, or related medical conditions [42 U.S.C. 2000e(k)].

4. The radiation dose equivalent that my unborn child shall receive from conception until birth (the entire gestation period) shall be limited to 0.5 rem (500 mrem), unless pregnancy declaration occurs after this limit has been exceeded.

5. My unborn child is further limited to an equivalent radiation exposure rate of 0.05 rem (50 mrem) per month. This is to prevent further fluctuations above a uniform monthly exposure rate that would satisfy the limiting value.

6. I shall exchange my dosimeter on a monthly basis to ensure compliance to the monthly administrative limit.

PREGNANCY DECLARATION (concluded)

7. If the radiation dose to my unborn child is determined to have already exceeded 0.5 rem by the time I notified you by signing this Declared Pregnancy Notification Form, I agree to be assigned to tasks where additional occupational exposure is unlikely.

8. Once the pregnancy is concluded, or at such time as I wish to revoke my pregnancy declaration, I shall notify you by signing a Pregnancy Condition Form, so I can resume my normal duties.

Employee:

Printed Name	Signature	SSN

Privacy Act Statement: *The information on this form is protected by the Privacy Act of 1974. The purpose of requesting this information is to minimize risks to an unborn child/children in the womb. This information will be used by the U.S. Department of Energy, Nevada Operations Office, its contractors, and the employing agency of the mother. Failure to provide this information could result in our inability to limit the exposure to the unborn child.*

Responding Organization Representative:

Printed Name	Signature

Home Organization Representative:

Printed Name	Signature

Rev. October 2011

APPENDIX B
HOTLINE PROCEDURES

Radioactive Contamination data will be obtained from the early responders, Field Monitoring Teams, and available aerial assets. Results will be analyzed to determine Zone 1 boundary.

1. Once this boundary is approved by Unified Command, FRMAC management will establish the number and locations of the Hotlines. These will be dependent upon the work required and the number of personnel that need access.
2. Obtain air samples of Zone 2, especially in potential Hotline areas. As possible, air samples should be acquired upwind, downwind, near Zone 1 boundaries and where chemical hazards may be encountered.

   These samples along with other available data will help determine the level of PPE required (including respiratory protection). Requirements for respiratory protection are contained in Section 2.5 of the H&S Manual. Typically, hotline personnel wear PPE the same as or one level less than the Field Monitoring Teams.
3. Determining the location of the Hotline, will be dependent on:
   a. Accessibility(roads):
   b. Prevailing/current wind direction and overall weather conditions:
   c. Available Resources (phone, power, water, Emergency Services access, etc):
   d. Physical and topological features of the site (e.g., drainage):
   e. Air dispersion calculations and air sample results:
   f. Other physical, chemical, toxicological substances present:
   g. Size of area to accommodate required elements (clean and contaminated vehicle parking, equipment storage, laboratory analysis, and decontamination area):
   h. Avoidable dose due to proximity to GZ:
   i. Proximity to other residential, commercial, or industrial areas:
   j. Distance to Lab support for samples:
   k. Other mission-essential tasks or responders requiring hot line:
4. Once the site has been identified, the Hotline Supervisor will assist in establishing the Zone boundaries and the Hotline by clearly delineating the Zones and transitions in the Hotline. Appendix Figure B-1 gives a concept of the areas needed to establish a viable Hotline with appropriate sections for monitoring and decontamination.
5. Determine if external Dosimetry is needed to monitor dose. Dosimetry policy is determined by Section 2.2 of this manual and will be documented in the Health and Safety Plan.

Monitoring and Sampling. Verification of site control procedures are needed to prevent the spread of contamination. The surrounding areas in Zone 3 and high traffic areas in Zone 2 require periodic surveys, to monitor for contamination that may be carried from the contaminated areas to Zone 3. This may require the boundaries of Zone 2 to be extended outward, until decontamination cleanup can commence. Air samples and direct reading instruments are needed to monitor for particulate

dispersion. Recommended air sampling stations are upwind, in Zone 3 by support facilities, in Zone 2, in Zone 1, and downwind. Air monitoring will be governed by Section 2.3 of this manual.

6. Contamination Control will be governed by Section 2.4 of this manual. It will be used to minimize and monitor the spread of radioactive contamination from Zone 1 through Zone 2, and prevent the contamination from reaching Zone 3.

7. Personnel Protective Equipment. Personnel must wear PPE when emergency response events involve known or suspected contaminants. PPE is referenced in Section 2.5 of this manual. The event Health and Safety Plan will state the levels of PPE protection.

   The levels of protection are as follows:

   a. Level A: Must be worn when the highest level of respiratory, skin, and eye protection is needed. (Fully encapsulated and SCBA)
   b. Level B: Must be worn when the highest level of respiratory protection is needed but a lesser level of skin protection is needed. (Single/Double Anti-Cs and SCBA)
   c. Level C: Must be worn when criteria for using Air-Purifying Respirators are met. (modified Single/Double Anti-Cs and APR).
      i. Level C1: Gloves Booties or shoe covers
      ii. Level C2: Lab coat Gloves Booties or shoe covers
      iii. Level C3: Full set of PPE (No Respirator)
         1. Coveralls
         2. Cotton glove liners (optional)
         3. Outer gloves
         4. Booties
         5. Plastic bags/tyvex shoe covers
         6. Inner gloves (surgical, Pylox, or Nitrile)
         7. Hood (if required)
      iv. Level C4: Full set of PPE (airborne)
         1. Full set of PPE (including hood)
         2. Tape openings
         3. Respirator
   d. Level D: Should be worn only as a work uniform and not on any site with respiratory or skin hazards. It provides no protection against chemical hazards.

8. Prebriefing of the Field Monitoring Teams will occur prior to deployment into the contaminated zones by the Monitoring and H&S staff. The briefings will be included in the Health and Safety Plan briefing section.

9. Personal equipment and Vehicle Decontamination should proceed in accordance with Section 2.7 of this manual. Personal decontamination can be as simple as cleaning a few square centimeter of loose contamination to a full decontamination shower. The level of decontamination will be determined by the Hotline personnel. Vehicles cleared by Hotline

personnel, that are to be returned to the general public, need to be recorded on Radiation Survey Forms.

10. Completed Radiation Survey Reports will be maintained by Hotline personnel, but will be reviewed by H&S staff to ensure contamination is contained in the appropriate zones. A daily review will minimize possible spread of radioactive contamination.

11. Sample Hotline Doffing Checklist:
    a. Review work in the field to determine if exposure to chemical HAZMAT material was possible; if so, alert the Hotline personnel to obtain "mixed waste" (radioactive and HAZMAT) disposal drums.
    b. Remove exposed tape, as applicable
    c. Remove rubber totes or outer shoe covers, as applicable
    d. Remove outer gloves
    e. Remove tape from cuffs, as applicable
    f. Remove hood (if applicable)
    g. Remove coveralls, inside out, touching inside only
    h. Place disposable gloves/coveralls in disposal drums, and cloth gloves/coveralls in designated laundry drums.
    i. Remove respiratory protection, as applicable
    j. Remove tape or fastener from inner shoe cover (or boot bag)
    k. Remove each boot bag or shoe cover, placing shoe onto clean step-off pad or designated clean area
    l. Remove inner gloves
    m. Commence whole-body frisking. Use Decon Shower as needed to remove contamination.
    n. Commence monitoring for possible chemical contamination.
    o. Monitor the badge and dosimeter for contamination. The sequence for the removal of primary and supplemental dosimetry depends on where the dosimeter was worn and the potential for contamination.

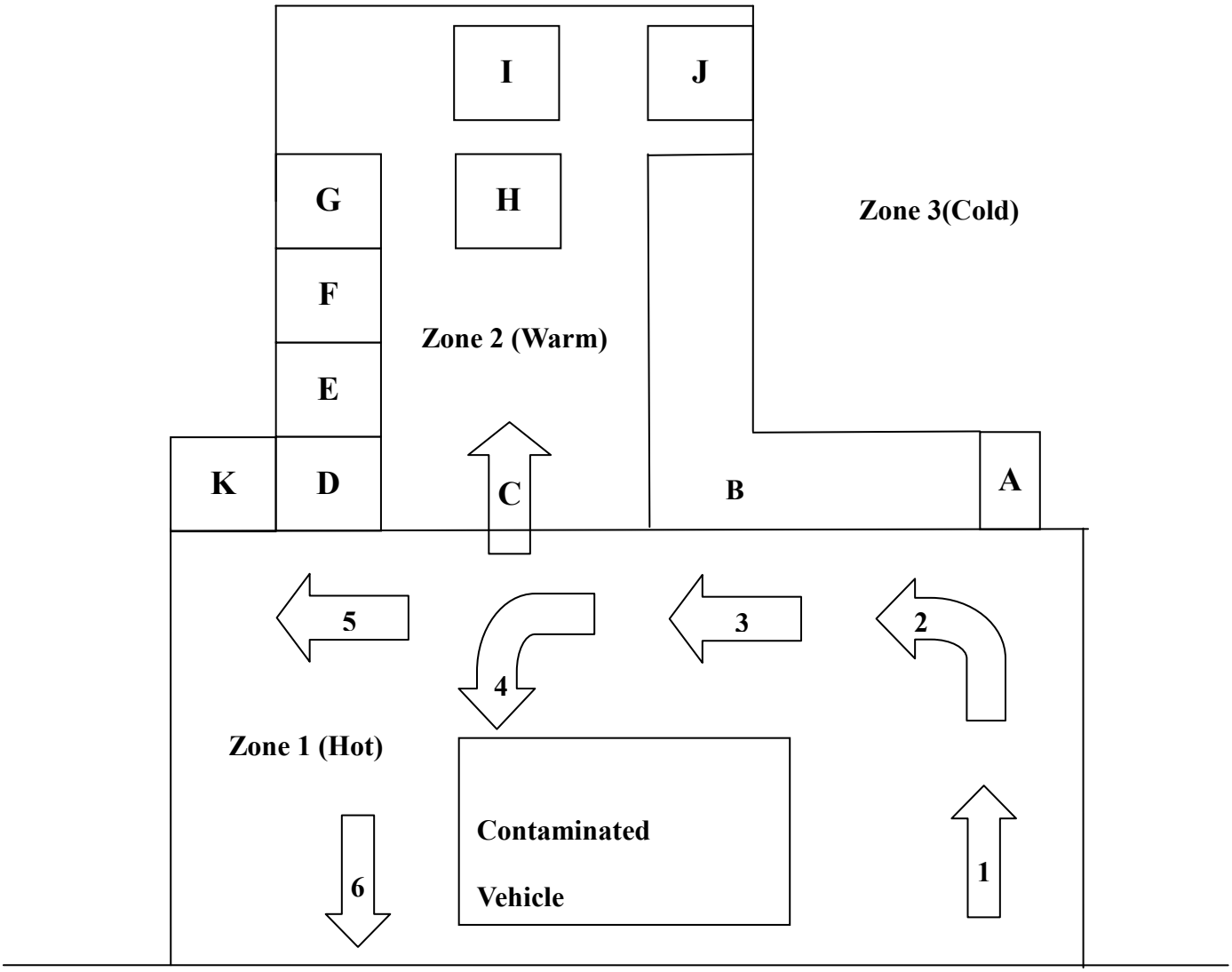
Legend for Sample Hotline Flow Control Diagram

Diagram of Sample Hotline Process for Vehicles

1	Entrance – Hold for Instructions from Hotline Personnel
2	Sample Receipt Dropoff
3	Equipment/Meters Dropoff
4	Vehicle Holding Point – For Parking in Contaminated Vehicle Parking area until next usage or until ready for Decon
5	Vehicle Holding Point – For survey and decon prior to exit from Zone 1
6	Returning to the field

Diagram of Sample Hotline Process for Personnel

A	Sample Receipt Dropoff, Survey, and Decon
B	Equipment/Meters Dropoff, Survey, and Decon
C	Personnel Entrance – Hold for Instructions from Hotline Personnel
D	Tape, Trash, and Boot Covers
E	Respirators
F	Outer Coveralls and Gloves (if applicable)
G	Inner Coveralls, Gloves, Tape, Trash, Inner Boot Bags
H	Step-off Pad
I	Portal Monitor or survey station
J	Decon Shower
K	Vehicle Decontamination Station



Contaminated Area of Zone 1

Appendix Figure B-1. Sample Hotline Flow Control Diagram

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REFERENCES

Information contained in FRMAC manuals (cited below) may be valuable for reference purposes during an emergency. These manuals are available to the public on the NNSA/NSO Website:

http://www.nv.doe.gov/nationalsecurity/homelandsecurity/frmac/default.htm

FRMAC Operations Manual. This provides an overview of the operations and functions of the FRMAC during the early phase so that each participant can understand the individual tasks and their interface with the overall mission. The internal working operations are described from initial notification and the collection of data to the final distribution of data to the states(s) and the Coordinating Agency.

FRMAC Assessment Manual, Volumes 1, 2 & 3. Provides methods to easily relate field data to the potential for exceeding early health effects thresholds, protective action guides (PAGs), and Emergency Worker Limits. The manual also provides methods to estimate dose.

FRMAC Monitoring Division Manual, Volumes 1 and 2. This manual was written for those personnel who will be called upon to provide technical data, input, and decisions.

FRMAC Laboratory Analysis Manual. This manual provides guidance for radiochemical analysis of samples collected during a radiological emergency to provide scientifically defensible data of acceptable quality.

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ACRONYMS

AIHA	American Industrial Hygiene Association
ALARA	as low as reasonably achievable
ALI	annual limit of intake
Anti-c	anti-contamination
APR	air purifying respirator(s)
ARG	Accident Response Group
BZA	breathing zone area
CAM	continuous air monitors
CDE	committed dose equivalent (ICRP 30)
CEDE	committed effective dose equivalent (ICRP 30)
cfm	cubic feet per minute
CL	confidence level
cm	centimeters
CRCPD	Conference of Radiation Control Program Directives
DAC	derived air concentrations
dBA	decibels
DOE	U.S. Department of Energy
DOELAP	U.S. Department of Energy Laboratory Accreditation Program
dpm	disintegrations per minute
DRD	direct reading dosimeters
(E)	Effective Dose (ICRP 60)
ED	electronic dosimeter(s)
EPA	Environmental Protection Agency
ER	emergency response
ERPG	Emergency Response Planning Guideline
FRMAC	Federal Radiological Monitoring and Assessment Center
GM	Geiger-Mueller
H&S	Health and Safety
HazCom	Hazard Communication
HEPA	high efficiency particulate air
(H_t)	Equivalent Dose (ICRP 60)
IDLH	immediately dangerous to life or health
ICS	Incident Command Structure
KI	potassium iodide
L_C	critical detection level
L_D	minimum significant activity level

LLD	lower limit of detection
lpm	liters per minute
m	meter
MARSAME	Multi-Agency Radiation Survey and Assessment of Materials and Equipment
MDA	minimum detectable activity
MDD	minimum detectable dose
mph	mile per hour
mR	milliRoentgen
mrem	millirem
MSDS	material safety data sheets(s)
NIOSH	National Institute of Occupational Safety and Health OSHA Occupational Safety and Health Administration
NVLAP	National Voluntary Laboratory Accreditation Program
OSL	optically stimulated luminescent
PAG	Protective Action Guide
PAPR	powered air purifying respirator(s)
PAS	personal air samplers
PEL	permissible exposure limit(s)
PPE	personal protective equipment
RAD	Radiation Absorbed Dose
RAP	Radiological Assistance Program
R	Roentgen
REAC/TS	Radiation Emergency Assistance Center/Training Site
RF	radio frequency
SCBA	self-contained breathing apparatus
T_B	background count time
TEDE	total effective dose equivalent
TLD	thermoluminescence dosimeter
TLV	Threshold Limit Value(s)
T_S	sample count time
WGBT	wet globe bulb temperature
ZnS	zinc sulfide


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