VISTA Technologies, Inc.
Radiation Safety Program

PROCEDURE - 13

CONTROL OF EXPOSURES TO IONIZING AND NON-IONIZING RADIATION

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ABBREVIATIONS AND ACRONYMS

α	-	Alpha
ß	-	Beta
γ	-	Gamma
μ	-	Micro
^{241}Am	-	Americium-241
^{137}Ce	-	Cesium-137
^{234}Pa	-	Protactinium-234
^{210}Pb	-	Lead-210
^{210}Po	-	Polonium-210
^{214}Po	-	Polonium-214
^{218}Po	-	Polonium-218
^{232}Pu	-	Plutonium-232
^{226}Ra	-	Radium-226
^{228}Ra	-	Radium-228
^{219}Rn	-	Radon-219 (Actinium Series)
^{220}Rn	-	Radon-220 (Thorium Series)
^{222}Rn	-	Radon-222 (Uranium Series)
^{89}Sr	-	Strontium-89
^{90}Sr	-	Strontium-90
^{230}Th	-	Thorium-230
^{232}Th	-	Natural Thorium
^{238}U	-	Uranium-238
μCi	-	MicroCurie
μCi/hr	-	MicroCuries per hour
μCi/ml	-	MicroCuries per milliliter
μM	-	Micrometer
μR/hr	-	MicroRoentgen per hour
μg/mg	-	Microgram per milligram
ALARA	-	As low as reasonably achievable
ALI	-	Annual limit on intake
ANSI	-	American National Standards Institute
APR	-	Air-purifying respirator
Bq	-	Becquerel
Bq/m^3	-	Becquerels per cubic meter of air
BZ	-	Breathing Zone
C	-	Coulomb
C/kg	-	Coulombs per kilogram
CDE	-	Committed Dose Equivalent
CEDE	-	Committed Effective Dose Equivalent

CFR	-	Code of Federal Regulations
Ci	-	Curie
CIH	-	Certified Industrial Hygienist
CFM	-	Cubic feet per minute
CLIA	-	Clinical Laboratories Improvement Act
CLP	-	Contract Laboratory Program
cm	-	Centimeter
cm/sec	-	Centimeters per second
cpm	-	Counts per minute
CPR	-	Cardiopulmonary resuscitation
CSE	-	Certified Safety Executive
(D)	-	Duplicate count
DAC	-	Derived air concentration
DAC-h	-	DAC hours
DCA	-	Double Contingency Analysis
DDE	-	Deep Dose Equivalent
DI	-	De-ionized water
DOT	-	U.S. Department of Transportation
dm^2	-	Square Decimeter; one square decimeter equals 100 square centimeters
dpm	-	Disintegrations per minute
dpm/cm^2	-	Disintegrations per minute per square centimeter
dpm/dm^2	-	Disintegrations per minute per square decimeter
dps	-	Disintegrations per second
DRD	-	Direct reading dosimeter
DU	-	Depleted uranium
EPA	-	U.S. Environmental Protection Agency
eV	-	Electronvolt
FE	-	Feces sample
FIDLER	-	Field instrument for detection of low energy radiation
FR	-	Filter ratio
FSP	-	Field Sampling Plan
ft^2	-	Square foot
γ	-	Gamma ray
GA	-	General area
GeLi	-	Germanium - Lithium
G-M	-	Geiger-Mueller
GMC-H	-	Mine Safety Appliances Company, full-facepiece, dual ..combination filter cartridges for an APR
GPD	-	Gaseous Diffusion Plang
h	-	hours
He-3	-	Helium Three (3)

HEPA	-	High efficiency particulate air
HNO_3	-	Nitric acid
HP	-	Health Physics
hr	-	Hour
HS	-	Hot spot (radiation)
HSP	-	Site-specific Health and Safety Plan
HWP	-	Hazardous Work Permit
ICRP	-	International Commission on Radiological Protection
ID	-	Identification
IDLH	-	Immediately dangerous to life or health
IDW	-	Investigation derived waste
IP	-	Ionization potential
IVC	-	Independent verification contractor
keV	-	Kiloelectronvolt
kg	-	Kilogram
LANL	-	Los Alamos National Laboratory
lpm	-	Liters Per Minute
MCA	-	Multi-channel analyzer
MDA	-	Minimum detectable activity
meV	-	Millielectronvolt
m	-	Meter
m^2	-	Squared Meters
m^3	-	Cubic meters
mCi	-	MilliCurie
MSHP	-	Manager, Vista Safety and Health Program
mil	-	1/1000 inch
ml	-	Milliliter
mm	-	Millimeter
mR	-	MilliRoentgen
mR/hr	-	MilliRoentgens per hour
mrem	-	Millirem
mrem/hr	-	Millirems per hour
MSA	-	Mine Safety Appliances Company
MSDS	-	Material Safety Data Sheet
MSHA	-	Mine Safety and Health Administration
NaI	-	Sodium iodide
NCA	-	Nuclear Criticality Analysis
NCS	-	Nuclear Criticality Safety
NCRP	-	National Council on Radiation Protection and Measurements
NEA	-	Nuclear Energy Agency
NIST	-	National Institute of Science and Technology

U^{nat}	-	Natural uranium
UR	-	Urine sample
U.S.	-	United States
VISTA	-	Vista Technologies, Inc.
VSHP	-	VISTA Safety and Health Program
VRSP	-	VISTA Radiation Safety Program
WL	-	Working Level
WP	-	Work Plan

CONTROL OF EXPOSURES TO IONIZING AND NON-IONIZING RADIATION

The basic methods used to control exposure include personal monitoring; evaluation of the radiological conditions; posting areas; specifying proper precautions; health physics support; extra controls for high radiation areas; updating personnel exposure records; and evaluating exposure records to determine where exposure reduction is warranted. One of the most important control measures is the individual worker's knowledge, ability and willingness to minimize his or her radiation exposure.

The following sections discuss personal monitoring and dosimetry, personal exposure investigations, internal exposure control, air monitoring, swipe sampling, a high efficiency particulate air ventilation system and engineering controls for airborne radioactive contamination.

1. PERSONAL MONITORING AND DOSIMETRY

The Vista Radiation Safety Officer (RSO) and Vista On-Site Radiation Protection Officer (ORPO) are responsible for ensuring that Vista's personnel are appropriately monitored for exposure to ionizing radiation. Each individual working at Vista project work sites in a Controlled Area (CA) or in radiation areas will wear the dosimeter devices as specified by the Vista RSO, or based on site-specific ionizing radiation survey results.

A CA is any area, designated by the Vista RSO, established to control personnel exposures to radioactive materials and/or radioactive contamination within the area and to prevent the spread of radioactive contamination out of the area. The Vista RSO will advise subcontractors of the presence of radioactive materials and/or radioactive contamination that may be present at a Vista project work site.

Vista will specify the requirement for work assignments involving potential exposure to radioactive materials and/or radioactive contamination through the Health and Safety Plan (HSP) and/or issuance of a Radiation Work Permit (RWP). Personnel may be issued appropriate personal monitoring devices consisting of one or more of the following types: Thermoluminescent Dosimeters or any NVLAP approved dosimetry, which is read monthly or on a project-specific basis, Pocket Ionization Chamber (PIC) which can be read real time, or a Self-Reading Dosimeter (SRD) which can be read at any time. The determination of the need for any NVLAP approved dosimetry or SRDs for a specific project will be made by the Vista RSO, based on site history and potential risk for exposure to ionizing and non-ionizing (neutron) radiation.

Any NVLAP approved dosimetry measure the external ionizing radiation hazard posed to personnel by ß particle γ ray and neutron radionuclide emitters. An NVLAP approved dosimeter will be assigned to each person who is potentially exposed to ionizing radiation health and safety hazards when performing activities in CAs. When the facility issues an NVLAP approved dosimeter to Vista personnel, the facility is responsible for evaluating the dosimeter response, maintaining permanent records, and providing a copy of dosimeter results to the Vista RSO.

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation.

PIC's may be required on the advice of the Vista RSO for a particular Vista project work site depending on known site conditions, history of use, and the potential for the presence of radioactive materials and/or radioactive contamination at a Vista project work site.

Vista is obligated to evaluate the ionizing radiation exposure data to verify that exposures are maintained at ALARA levels and will furnish a summary exposure report to each participating Vista employee yearly. Issued dosimetry should meet the requirements of the National Voluntary Laboratory Accreditation Program (NVLAP).

At the discretion of the Vista RSO, both NVLAP and PICs may be required for certain potential ionizing radiation exposures at a Vista project work site. PICs may be used in conjunction with NVLAP approved dosimetry to provide real-time exposure results for controlling exposures to ALARA levels. Field measurements with NVLAP approved dosimetry and PICs are used to estimate the dose accumulated over a period of time in the work area.

Should unexpectedly high doses result from certain field activities, operations will shut down according to specific action levels and administrative control measures that will be implemented to limit ionizing radiation exposures. Field measurements with PICs only should be performed when the potential exists for a radiation worker to exceed the following:

Table 1.1-1 - Exposure and Dose Rate

EXPOSURE	DOSE RATE
Whole Body	2.5 mrem/hour (0.025 milliSievert/hour)
Skin	10.0 mrem/hour (0.100 milliSievert/hour)
Extremities	20.0 mrem/hour (0.200 milliSievert/hour)

Dose estimates will be recorded daily in a logbook for each person working in areas exceeding these action levels. When field dose estimates based on ionizing radiation survey results indicate that an individual has received 100 mrem (1 milliSievert), the individual's dosimetry equipment will be immediately processed. At a minimum, NVLAP approved dosimetry will be processed on a monthly basis and recorded in the individual's cumulative (quarter, year) dose history. These ionizing radiation dose control procedures are designed to keep exposures at ALARA levels.

The following sections discuss the proper location for wearing dosimeter devices, official exposure determination, and lost or damaged NVLAP approved dosimetry or PICs.

1.1. Proper Location for Wearing Dosimeter Devices

Unless directed otherwise, dosimetry equipment will be worn on the front of the body adjacent to each other between the neck and the waist, usually in the chest area. When circumstances are such that other parts of the body may receive significantly greater doses, the individual may be instructed to wear the dosimeters in a more representative place, or additional dosimeter devices may be required.

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Personnel should not allow their PICs to exceed 3/4 full scale regardless of prescribed allowable exposure, without the readings being recorded and having the dosimeters recharged. The readings shall be immediately recorded and the PIC's recharged if ¾ full scale is exceeded because the PIC may have exceeded its saturation regime and thus record a lesser reading than actually received. Readings greater than 3/4 full scale are usually inaccurate. Precautions should be taken to prevent the radioactive contamination of personal monitoring devices when entering and working in contaminated areas. Dosimeters will be monitored for radioactive contamination prior to being removed from the controlled area, if there is a reason to suspect that they may have become contaminated.

1.1. Official Exposure Determination

The official and permanent record of the accumulated external dose received by a Vista individual is obtained from the monthly interpretation of the NVLAP approved dosimetry.

1.2. Lost or Damaged NVLAP Approved Dosimetry

Individuals should immediately notify the Vista ORPO if they lose or damage their dosimetry. A thorough search will be made for any dosimeter reported lost. An individual whose dosimetry has been lost or damaged and whose exposures are being investigated will be excluded from work in locations where radioactive materials and/or radioactive contamination may be present until cumulative doses have been determined by the Vista ORSO, ORPO or RSO and a new NVLAP approved dosimetry or PIC has been issued.

2. PERSONAL EXPOSURE INVESTIGATIONS

If a situation occurs involving the suspected or known exposure of personnel to ionizing radiation in excess of permissible limits specified in 10 CFR 20, the situation must be promptly investigated and exposures evaluated. This may require special bioassays, ionizing radiation surveys, air samples, and/or NVLAP approved dosimetry badge analyses. The Vista ORPO or management will investigate each occurrence and will determine the following:

- Dose equivalents to the whole body from external irradiation greater than 100 mrem (0.003 Sievert) in a calendar quarter;
- Bioassay results that exceed the levels specified in Vista's RSP Procedure 9, Section 2.7.3 "Work Restriction Action Level"; and
- Other occurrences that warrant investigation in the judgment of the Vista On-Site Health and Safety Officer (OHSO) or Vista On-Site Radiation Protection Officer (ORPO).

The report of the personal exposure investigation to the Vista ORPO and/or management will include the following data:

- Description of the work task in progress;
- Methods and procedures of how the overexposure was determined and assessed;
- Time and date of overexposure;

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- Conditions under which the overexposure occurred;
- Names of personnel involved, together with previous exposure records; and
- Recommendations for corrective measures to prevent similar overexposure.

3. INTERNAL EXPOSURE CONTROL

The preferred method of reducing exposure to airborne radioactivity is by use of engineering controls, process controls, containment of sources of airborne radioactivity, ventilation and filtration equipment, plus the control of surface radioactive contamination. When airborne concentrations become a problem, eliminating or reducing the airborne radioactivity should be considered first. When such controls are not feasible or cannot be applied, the use of respiratory protection equipment may be appropriate. In general, the use of respirators is less desirable in providing protection from inhalation than is the use of proper process control and ventilation.

For work involving significant levels of radioactive contamination, or processes such as cutting or grinding, containment enclosures and local filtered exhaust ventilation should be used to minimize or control airborne radioactivity. When this is not feasible, respirators should be used.

The following sections discuss radioactive contamination control and evaluation of internal exposures.

3.1. Radioactive Contamination Control

The primary concern in controlling radioactive contamination is to protect personnel from inhalation, ingestion, or absorption of radioactive materials and/or radioactive contamination into the body and to prevent the spread of radioactive contamination to other areas. The basic radioactive contamination control methods used at Vista project work sites are summarized below:

- Delineating and posting contaminated areas;
- Control of work, traffic, and movement of materials and equipment into and out of a controlled area;
- Proper selection, use and disposal of Personal Protective Equipment (PPE);
- Prohibition of eating, drinking, chewing, and smoking in areas where radioactive materials and/or radioactive contamination exists;
- Use of NVLAP approved dosimetry and PICs;
- Radioactive contamination monitoring by means of smears, portable radiation survey instruments, and air samplers;
- Establishment of administrative limits for radioactive contamination, and maintenance of contamination levels within these limits;
- Radioactive decontamination of personnel, areas, and equipment;
- Collection and proper disposal of radioactive solid, liquid, and airborne waste;
- Use of removable protective coatings of polyethylene sheeting, absorbent paper, and other temporary linings, on and around work areas;
- Use of temporary High Efficiency Particulate Air (HEPA) filtered ventilation in localized work areas;

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- Use of proper radioactive-water-collection equipment in localized work area;
- Proper wrapping and/or tagging of radioactive materials upon removal from areas contaminated with radioactive materials;
- Minimization of exposure to known sources of radioactive materials and/or radioactive contamination; and
- Provision of proper shielding for γ ray sources.

Note:
All Personal Protective Equipment (PPE) clothing, such as, smocks, Anti-Cs , and underclothing shall be cleaned in a laundry facility certified for radioactive contaminated clothing. This laundry facility could be an existing on-site facility, or it could be an off site facility. The laundry services could be subcontracted out to on-site facilities , and/or use other funding mechanisms, such as for, off-site facilities."

"A cost-benefit analysis could be performed to determine the most cost-effective choice between laundering (either on-site or off-site) contaminated clothing, or simply buying PPE clothing and throwing them away (as contaminated material) after only one usage."

3.2. Evaluation of Internal Exposures

Bioassay techniques are used to evaluate the amount of radioactive material contained in the body. These measurements are normally made at routine intervals to evaluate the effectiveness of the respiratory and radioactive contamination control programs.

The internal dose evaluation program must be adequate to demonstrate compliance with the dose limits established by 10 CFR 20. Where feasible, the internal dose evaluation will be sensitive enough to verify that internal exposures have remained below the administrative limits provided in Vista's RSP Procedure 8, Section 2 "Annual Dose Equivalent Limits." Analysis of excreta samples must be performed by a laboratory that is licensed by the U.S. Department of Health and Human Services under the Clinical Laboratories Improvement Act (CLIA).

When the period of uptake of radioactive material is known, or can be determined from successive analyses, calculations will be developed to relate the activity measured to the total dose received from internal radioactivity.

Where feasible, urine analysis is generally the method for measuring internal radioactivity. Fecal sample analysis and whole-body counting may also be conducted as specified by the Vista RSO. Baseline bioassays and whole body counts will be reviewed by the Vista RSO for evidence of previous ionizing radiation exposure.

Routine bioassay will be performed on all field personnel working in controlled areas with the frequency based on the potential for internal ionizing radiation exposure. Factors considered in determining an individual's potential for internal ionizing radiation exposure include the following:

- Type of field work (e.g., sampling/remediation versus inspection) and duration in a controlled area; and

- Specific types of radioactive materials and/or radioactive contamination for potential exposure.

Routine bioassays are required of field personnel having the potential for uptake. Diagnostic bioassays are used when there is reason to suspect an individual may have received a significant internal deposition of radioactive materials and/or radioactive contamination. Diagnostic bioassays are performed when it is suspected that Vista administrative limits have been exceeded. Results of the diagnostic bioassay can be used to estimate the individual's committed effective dose equivalent.

In-Vivo (at the work site) Health Physics (HP) instrumentation is necessary to make real-time (or near real-time) bioassays for anomaly or emergency situations. This instrumentation could detect many internal contaminants, such as, radioisotopes of iodine and tritium. Example of an on-site (in-vivo) HP instrumentation is a Liquid Scintillation Counter (LSC). In-Vitro (away from the work site) HP instrumentation is used for making scheduled and normal bioassays, and whole body counts;

Baseline bioassay, and whole body counts are needed for all new Vista employees who might be exposed to ionizing and non-ionizing nuclear radiation. Termination bioassays are performed on all potentially exposed field personnel who are exiting the program. The termination bioassay usually consists of excreta sampling and analysis. At the discretion of the Vista OHSO or Vista ORPO, a whole body count will be performed.

When bioassay results indicate significant internal radioactivity as defined in Vista's RSP Procedure 9, Section 2.1 "Radiation Protection Bioassay Program," the Vista RSO will determine if follow-up action is required. Based on the amount of activity involved and other circumstances, the courses of action may require follow-up bioassays and/or removal of the individual from work in radioactive contaminated areas.

Prevention of ingestion is mainly a matter of good personal hygiene and observing standard rules, such as not eating, drinking, or smoking in potentially contaminated areas. Observing hands for radioactive contamination and routine washing before eating or leaving the contaminated areas are mandatory safety rules. Open cuts or abrasions or accidental injections allow entry of radioactive materials into the body's bloodstream. When open cuts or sores exist, handling contaminated material is prohibited.

Smoking, eating, drinking, chewing gum or tobacco, and other activities that result in hand-to-mouth contact or ingestion of radioactive materials are prohibited in a CA. A CA is any area established for the purposes of controlling personnel exposures to ionizing radiation and radioactive contamination within the area and to prevent the spread of contamination out of the area.

Prevention, by cleanliness and constant monitoring, is the first priority to internal ionizing radiation exposure. The determination of the amount of radioactive material potentially entering and subsequently remaining in the body is determined by ionizing radiation dose. Determination of radiation exposure is usually done post-facto by urinalysis.

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4. AIR MONITORING

Personnel air monitoring protocols are implemented during field activities to measure the concentration of radioactive contaminants within the breathing zone of the workers for the following purposes:

- To determine whether the respirator specified for a specific task is providing adequate protection against the hazard;
- To document the types of airborne radioactive contaminants to which Vista personnel may have been exposed;
- To compare results of alternative ALARA control practices in selecting the most appropriate action for the task evaluated; and
- To alert the health and safety staff of a need for a routine or non-routine bioassay program.

Lapel-type air samplers (personnel sampling) and high and low-volume air samplers (general area sampling) are used to collect air samples for subsequent analysis for radioactive contaminants. Perimeter air monitoring may be performed at the boundary of the CA to verify that personnel, in adjoining areas are not receiving exposures above regulatory guide limits.

Air samplers may be placed at specific downwind and upwind locations during the course of certain intrusive field activities with subsequent analysis for specific radionuclides. Results are compared to applicable administrative guidelines with corrective actions instituted when concentrations exceeding these guidelines are indicated. Corrective actions to control airborne dust levels may include the use of water sprays and limiting vehicle speeds.

Long-term air monitoring also may be conducted with personal air sampling pumps and appropriate filter and subsequent counting by an appropriate detector. Detailed guidance on air sampling is provided in Vista's RSP Procedure 16 "Air Radiological Sampling."

5. SWIPE SAMPLING

A "swipe" sample may be taken to determine the presence of radioactive contamination and whether or not the radioactive contamination is likely to rub off, resulting in inhalation, ingestion, or possibly dermal exposure. A swipe sample is made by rubbing a dry 1 ¾-inch diameter cloth-sampling smear (D.A. Services, Inc., Defensap® smears or equivalent) over the area in question, and monitoring it with an appropriate ionizing radiation survey instrument.

6. HIGH EFFICIENCY PARTICULATE AIR VENTILATION AND ENGINEERING CONTROLS FOR AIRBORNE RADIOACTIVE CONTAMINATION

6.1.Scope

This procedure defines and establishes the guidelines and mode of operation of engineering controls including High Efficiency Particulate Air (HEPA) filtered portable ventilation units to be used on Vista Project Work Sites.

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation.

6.2.Purpose

This procedure provides instructions for the set-up, use and maintenance of portable HEPA ventilation units and other engineering controls for airborne radioactive materials for Vista project work sites.

6.3.References

- Vista's RSP Procedure 18 "Site Access Control and Radiation Work Permits",
- Vista's RSP Procedure 16 "Air Radiological Sampling;"
- Manufacturer's instruction/technical manual(s) for the Model/Type of equipment used; and
- ANSI Standards.
- R.D. Sachs. "Guidelines For Nuclear Criticality Safety (NCS) At Stone And Webster." Formal (Peer Reviewed) Stone and Webster Engineering Corporation (SWEC) Engineering Report. Denver (Englewood), CO
- S. Love. "Guidelines For Nuclear Criticality Safety (NCS) Upgrade Activities At The Portsmouth Gaseous Diffusion Plant (GDP)." Lockheed Martin Energy Systems Division Internal Report. Oak Ridge National Laboratory (ORNL). Oak Ridge. TN
- N.L. Pruvost and H.C. Paxton. "Nuclear Criticality Safety Guide." LANL Report No. LA-12808. Los Alamos National Laboratory (LANL). Los Alamos. NM

6.4.Precautions

The following precautions should be observed:

- HEPA filtered ventilation units and containments shall be used whenever feasible prior to the use of respiratory protection devices.
- HEPA filters may become highly radioactive during their use. Always survey HEPA filters for external dose rates and leakage of surface activity before maintenance.
- Never handle the HEPA filters by placing your hands on the filter facing. This will damage the filter, greatly reduce the collection efficiency, and increase the possibility of contamination spread.
- Ensure that any ducting installed in/on the HEPA exhaust is free of internal loose radioactive contamination.
- Whenever possible use a diffuser on the HEPA exhaust when an exhaust hose is not being used.
- Ensure the HEPA filter unit has been performance tested with industry accepted practices.
- Perform frequent contact gamma surveys on the filter housing, particularly after initial system startup.
- Avoid sharp bends in the flexible ducting that may create pressure drops through the system.
- Airborne activity levels at the discharge must be monitored routinely for personnel protection. If the airborne activity in the discharge exceeds the limits in Vista's RSP Procedure 16 "Air Radiological Sampling" the area shall be posted in accordance

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with the provisions of that Procedure and an evaluation shall be made to determine the desirability of isolating the ventilation system.

- A nuclear criticality analysis shall be performed anytime that the **POTENTIAL** for a nuclear criticality accident could exist. This could occur particularly in Decontamination and Decommissioning (D&D) projects in which enclosures (for example, pipes, tubes, bottles, tanks, etc.) are under consideration for liquid cleaning."

"The Nuclear Criticality Analysis (NCA) could use peer reviewed open literature criticality information, such as, standards and other documents [1, 2, 3,]. The nuclear criticality analysis could (and sometimes must) use computer simulations using validated neutron and/or gamma transport computer codes."

"All NCAs shall use the Double Contingency Analysis (DCA) method, with nine (9) independent criticality control parameters. The nine independent criticality control parameters are listed immediately below."

"Independent nuclear criticality control parameters:

1.Geometry
2.Density/Concentration
3.Enrichment (uranium and/or plutonium)
4.Moderation
5.Mass
6.Neutron Reflection
7.Temperature
8.Volume
9.Neutron Absorber (i.e., poison)"

"The DCA method involves varying, for abnormal scenario conditions, only one (of the nine above) control parameters at a time. If, for example, the volume (refer to No. 8. above) is changed to a more abnormal configuration, then the other eight nuclear criticality control parameters must be held constant. If all abnormal control parameter scenarios are criticality safe, then no action is necessary. However, if any criticality control parameter scenarios(s) are not criticality safe (that is, a nuclear criticality accident could occur), then administrative and/or engineering controls shall be used for these scenario(s) to ensure criticality safety."

6.5.Limitations

The following limitations should be observed:

- The HEPA pre-filter must be in position prior to using the unit.
- Routing HEPA exhaust air samples shall be performed at the discretion of the Vista ORPO in accordance with Vista's RSP Procedure 16 "Air Radiological Sampling"

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- The use of HEPA filtration units, when exposure to loose fissile special nuclear material contaminants is anticipated requires a preliminary engineering evaluation prior to their use.
- At no time should the filtration module be operated with all the dampers closed. Damage to the motor and filters may result.
- Ensure that the small mesh screen of the pre-filter is in the downstream direction (closest to the HEPA filter) to preclude dislodging of filter media. Damage to the motor or filter may result.
- Ensure the HEPA unit motor is rotating in the proper direction prior to use. A decrease in unit efficiency will result if the unit motor is not rotating in the proper direction.
- Hose type collectors on HEPA filters on installed facility units shall never be used as vacuum cleaners for loose debris.

6.6.Responsibilities

The Vista ORPO is responsible for:

- Implementing this procedure and periodically (in accordance with Vista policy) reviewing adherence to the requirements of this procedure.
- Coordinating with the Vista RSO or designee to evaluate and review the effectiveness of the HEPA filtered ventilation units and other engineering controls.
- Reviewing and approving data generated by the use of this procedure.
- Ensuring personnel using this procedure comply with all procedural requirements.
- Ensuring the use of HEPA filtered ventilation and other engineering controls are referenced on the RWP.
- Performing the requirements of this procedure.
- Completing all required records and submit them for review to the RSO.
- Ensure that HEPA units are properly posted when placed in service.

6.7.Procedure

6.7.1. Pre-Operational Checks for any HEPA filtered Ventilation Unit

> NOTE: Frequent changes of the pre-filter will extend the life of the HEPA filter. The pre-filter shall be changed when the 30-cm reading from any surface is 25 mR/hr or there is any indication of flow restriction.

The following checks will also be performed:

- Check and change the pre-filter prior to startup, if necessary.
- Ensure the unit has been performance tested with industry accepted practices.

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- Ensure the unit(s) are in good physical condition.
- The electrical cords shall be checked for breaks or cuts in the insulation.
- Ensure that any inlet/outlet flex ducting used has good integrity (e.g., no holes or tears).
- Drain and capture accumulated water in the pre-filter sump by operation of the ball valve located under the sump if applicable.
- Ensure that all isolation blast gates are closed and/or sealed with plastic wrapping prior to moving the unit(s) to prevent loss of any of the housed contaminants.

6.7.2. Filtration Setup

The procedure for filtration setup follows:

- Obtain the filter unit(s), connectors and ducting to be used for the job.
- Locate the HEPA unit in an area that will not impede access to or egress from the job site if possible. Do not block fire lanes or restrict fire escape routes.
- Ensure that the exhaust flow will not create any airborne radioactivity. Use ducting and/or diffusers if applicable.
- Whenever possible, avoid placement of the HEPA unit in a Contaminated Area.
- Adjust dampers to provide the desired flow path during system operation. Ensure that at least one damper is open at all times when the system is operating, to avoid damage to the motor and filter elements.
- When ventilating a collapsible containment, ensure an adequate filtered intake is available to prevent collapse of the containment. The intake should be closed when the ventilation system is off.
- Complete the top section of Attachment 62.

6.7.3. HEPA Operation

The HEPA operation procedure follows:

a) Arrange the unit in the configuration desired. Any combination of two duct connections may be used.
b) Energize the unit to provide ventilation.
c) Adjust the duct dampers as necessary to suit the flow requirements.
d) Check the 0-10" water gauge/differential pressure magnehelic or equivalent gauge to ensure the differential pressure is below the limits posted on the ventilation housing. Readings above 5" Water (H_20) indicate a plugged filter.
e) Check the contact radiation dose rates on the filter unit at least once every 4 hours while the unit is in use. Document on Attachment 62.
f) Initiate an air sample at the HEPA exhaust after the initial start-up and every four hours thereafter during work activities, which may cause elevated airborne concentrations to ensure the filtration unit is working properly. Elevated airborne concentrations may indicate the filter is loaded and is no longer effective.

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g) If the air concentration in the area being ventilated is known, a decontamination factor may be determined as follows:

DF = Suction Concentration (μCi/ml) / Discharge Concentration (μCi/ml)

a) A Decontamination Factor (DF) of less than 25 indicates the HEPA filter is not working properly and should be replaced.
b) Complete Attachment 62.

6.7.4. Pre-filter Replacement

The pre-filter replacement procedure follows:

a) Unfasten the latches securing the pre-filter chamber cover and remove the cover.
b) Attach a poly bag around the chamber opening and secure with tape.
c) Reach into the pre-filter chamber through the poly bag and pull the pre-filter out into the bag.
d) Seal the pre-filter in the poly bag by gathering the bag at the attached end and securing with tape.
e) Cut through the taped joint leaving the end of the poly bag taped to the pre-filter chamber opening.
f) Place the used pre-filter (contained within its poly bag) aside for disposal.
g) Place a clean pre-filter inside a new poly bag.
h) Attach the poly bag containing the new pre-filter around the pre-filter opening and secure it with tape at a point below the first bag.
i) Remove the poly bag remnant from the pre-filter chamber opening and place inside the new bag.
j) Insert the pre-filter into the chamber, remove the poly bag and reinstall the cover.

6.7.5. HEPA Filter Replacement

The HEPA filter replacement procedure includes the following:

NOTE: Prior to replacing a HEPA filter, wipe down the internal transition surfaces. This will help reduce the spread of loose contamination during the filter changeout.

a) Move the filtration unit into a suitable controlled area, (i.e., a containment tent with ventilation controls). Loosen inlet transition mounting bracket bolts at the base of the transition.
b) Loosen clamp strap assemblies, disengage the T-bolts from their anchor rackets and pivot the transition forward only enough to insert a poly sheet over the upstream face of the HEPA filter.

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation.

c) Insert a poly sheet into the gap between the inlet transition frame and the HEPA filter face. Poly sheet should be of sufficient size to cover the HEPA filter face and overlap onto all four sides.

> NOTE: Exercise caution while inserting the sheet to preclude dislodging any contaminants which may be present on the filter face. Do not allow banging on housing while filter frame is not sealed shut.

d) Fold the poly sheet onto the top and sides of the HEPA filter frame and secure with tape.
e) Fold the bottom flap of poly sheet up against the HEPA filter and temporarily hold in place with tape.
f) Pivot the inlet transition out of the way, slide HEPA filter forward and seal with bottom flap of poly to the HEPA filter with tape.
g) Lift the HEPA filter off and place it into a poly bag. Seal the bag with tape and survey the filter for dose rate. Document Dose Rate on Attachment 62 in the Remarks section.
h) Clean gaskets prior to applying the silicone grease by wiping down the gasket's surface. Apply a thin even coating of silicone grease (Dow Corning Molykote III or equivalent), to the HEPA filter gasket surfaces prior to assembly to prevent filter gaskets from sticking to sealing surfaces after being compressed for long periods.

> NOTE: Ensure the HEPA filter is inserted in the proper direction by noting the direction arrow on the filter housing.

i) Insert a new HEPA filter on the platform, position transition by engaging and tightening the T-bolt clamp assemblies.
j) Tighten the mounting bracket bolts.

6.7.6. Engineering Controls

Always have materials immediately available to ensure that you have established negative pressure in the work area (i.e., smoke tubes, masslin strips, etc.).

When using HEPA units with glove bags or containments, ensure that you have adequate inlet flow, to avoid collapsing the containment. The inlet shall be filtered and placed at the opposite end of the containment from the ventilation inlet.

In large containments, (i.e. Permacon tents), you should take air samples periodically at the opposite end of the tent from where the HEPA hose intake is affixed, to ensure adequate air volume turnover and to monitor for areas of higher airborne concentration.

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation.

In rooms, enclosures, or containments where HEPA ventilation is used, a minimum of 4 air changes per hour is required for proper ventilation. (One air change every 15 minutes).

NOTE: Room, enclosure, or containment volume can be calculated by multiplying the length by the height by the width of the room or containment.

$$\text{Volume} = L \times H \times W = CV$$

The number of air changes per hour can be calculated from the room volume and ventilation system flow rate as follows:

$$CPH = CV\ (60\ \text{min/hr}) \ / \ CFM\ (\text{Flow rate})$$

Where,
CPH = Changes Per Hour
CV = Room Volume

7. SPILL PROCEDURES

The decision to implement a major spill procedure instead of a minor spill procedure depends on many incident-specific variables such as the number of individuals affected, other hazards present, likelihood of spread of contamination, and types of surfaces contaminated as well as the radiotoxicity of the spilled material. The ORPO shall be notified immediately upon any spill occurrence .The final Procedure implemented will be determined at the discretion of the ORPO, using the following definitions of major and/or minor spill.

Major spill:

- Any more than one person is contaminated (i.e., more than 60,000 cpm recorded at one meter from any body surface. The reading should be taken using 2 cm x 2 cm scintillation detector in a restricted but not radiation area).
- More than a 120,000 cpm reading is made at one meter from the spill.
- Spread of contamination has occurred or likely to occur.

Minor spill:

- No person receives surface contamination to any degree.
- Less than a 60,000 cpm reading taken at one meter from the spill.
- Spread of contamination is contained.

For some spills of short-lived radionuclides the best spill procedure may be restricted access pending complete decay.

Vista will also assemble a spill kit that contains:

6 pairs disposable gloves, 1 pair housekeeping gloves

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation.

2 disposable lab coats
2 paper hats
2 pairs shoe covers
1 roll absorbent paper with plastic backing
6 plastic trash bags with twist ties
"Radioactive Material" labeling tape
1 china pencil or marking pen
3 prestrung "Radioactive Material" labeling tags
Supplies for 10 contamination wipe samples
Instructions for "Emergency Procedures"
Clipboard with one copy of Radioactive Spill Report Form
Pencil

Utilize Attachment 91, Radioactive Spill Report and Attachment 92, Radioactive Spill Contamination Survey Form.

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation.

7.1.Procedure for Minor Spills of Liquids and Solids

7.1.1. Notify persons in the area that a spill has occurred.

7.1.2. Prevent the spread of contamination by covering the spill with absorbent paper.

7.1.3. Clean up the spill using disposable gloves and absorbent paper. Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Also put contaminated gloves and any other contaminated disposable material in the bag.

7.1.4. Survey the area with a low-range radiation detector survey meter. Check the area around the spill. Also check your hands, clothing, and shoes for contamination.

7.1.5. Report the incident to the Vista RSO and ORPO.

7.1.6. The Vista ORPO will follow up on the cleanup of the spill and will complete the Radioactive Spill Report (Attachment 91) and the Radioactive Spill Contamination Survey (Attachment 92).

7.2.Procedure for Major Spills of Liquids and Solids

7.2.1. Clear the area. Notify all persons not involved in the spill to vacate the room

7.2.2. Prevent the spread of contamination by covering the spill with absorbent paper, but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.

7.2.3. Shield the source if possible. This should be done only if it can be done without further contamination or a significant increase in radiation exposure.

7.2.4. Close the room and lock or otherwise secure the area to prevent entry.

7.2.5. Notify the Vista RSO and ORPO immediately.

7.2.6. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with mild soap. If contamination remains, induce perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.

7.2.7. The Vista ORPO will supervise the cleanup of the spill and will complete the Radioactive Spill Report (Attachment 91) and the Radioactive Spill Contamination Survey (Attachment 92).

7.2.8. Possibly send contaminated persons to nearest local hospital. Follow Emergency Management (EM) Procedure No. 26.

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation.

ATTACHMENTS

Attachment 62

PORTABLE H.E.P.A. VENTILATION OPERATING LOG

Unit Serial Number: _____

Location/Project Used: _____

Set Up By: _____ Date: _____

Placed in Service By: _____ Date: _____

Start Up Data: _____

_____

Magnahelic: _____ "Water"

Contact Exposure Rate: _____ mR/hr

30 cm Exposure Rate: _____ mR/hr

INDICATE ANY DAMPER POSITION OTHER THAN FULL OPEN:

IN-USE DATA: (Every 4 hours while in use)					
DATE	TECH SIGNATURE	TIME	MAG " H_20 (MAX IS 5"H_20)	CONTACT	30cm. Max is 100mR/hr
Remarks:					

Attachment 91

RADIOACTIVE SPILL REPORT

The spill occurred at _____:_____ am / pm on _____-_____-_____ room _____.

Instrument used to check for personnel contamination:
Meter model:_____ Meter Serial No._____ Probe model:_____ Probe Serial No._____

Personnel Present	Personnel Contamination Results
_____	_____
_____	_____
_____	_____
_____	_____

*On the back of this sheet, indicate any personnel decontamination, additional monitoring, or care instituted.

Survey the spill area to identify hot spots, then begin decontamination. When finished, conduct a postcleaning contamination wipe-test.

Radioisotopes present or suspected in the spill:

_____ mCi of _____ as _____

_____ mCi of _____ as _____

_____ mCi of _____ as _____

Give a brief description of the accident:

_____

_____

_____

_____

_____

Give a brief description of followup actions taken to prevent recurrence: _____

_____

_____

Name:_____

Date:_____

Attachment 92

RADIOACTIVE SPILL CONTAMINATION SURVEY FORM

The spill occurred at _____:_____ am pm on ____-____-____ at _____. Decontamination completed at _____:_____ am pm

SURVEY SKETCH	10c	Pre-clean mR/hr	Post-Clean dpm/ mR/hr	Post-Clean dpm/ 100cm^2

NAME:_____