VISTA Technologies, Inc.
Radiation Safety Program

PROCEDURE - 9

MEDICAL MONITORING

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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

NIOSH	-	National Institute for Occupational Safety and Health
n. o. s.	-	Not otherwise specified
NPDES	-	National Pollutant Discharge Elimination System
NRC	-	U.S. Nuclear Regulatory Commission
NS	-	Nose swipe
NTIS	-	National Technical Information Service
NVLAP	-	National Voluntary Laboratory Accreditation Program
OHSO	-	On-Site Health and Safety Officer
ORNL	-	Oak Ridge National Laboratory
ORPO	-	On-Site Ionizing Radiation Protection Officer
OSHA	-	U.S. Occupational Safety and Health Administration
pCi	-	PicoCurie
pCi/gm	-	PicoCuries per gram
pCi/l	-	PicoCuries per liter
P.E.	-	Professional Engineer
PF	-	Protection Factor
PIC	-	Pocket Ionization Chamber
PM	-	Project Manager
PMT	-	Photomultiplier Tube
PPE	-	Personal Protective Equipment
PRP	-	Potentially Responsible Party
PRS	-	Portable ratemeter/scaler
PVC	-	Polyvinyl chloride
QA	-	Quality assurance
QC	-	Quality control
R	-	Roentgen
RA	-	Restricted (radiation) area
rad	-	Radiation absorbed dose
RAS-1	-	Kurz air sampling pump flow calibration kit
REM	-	Roentgen equivalent man
RHSC	-	Radiation Health and Safety Committee
RSO	-	VISTA Radiation Safety Officer
RWP	-	Radiation work permit
SAP	-	Sampling and Analysis Plan
SCBA	-	Self-contained breathing apparatus
SRD	-	Self-reading dosimeter
TODE	-	Total Organ Dose Equivalent
TLD	-	Thermoluminescent dosimeter
TWA	-	Time-weighted average

1. MEDICAL MONITORING

The following sections discuss the Vista medical surveillance program, and the Vista ionizing and non-ionizing radiation protection bioassay program.

2. MEDICAL SURVEILLANCE PROGRAM

The Vista comprehensive medical surveillance program for its employees, as presented in the Vista Safety and Health Program (VSHP), is designed to protect Vista personnel from potential hazards associated with exposure to toxic and hazardous chemicals, as well as physical and biological agents encountered in the work environment at Vista project work sites

Through diligent implementation of the Vista medical surveillance program, the Project Manager (PM) will be able to verify every employee's medical status at any time to determine compliance with Occupational Health and Safety Administration (OSHA) medical and respiratory protection standards. The goal of Vista is the prevention of any deleterious health effects caused by uncontrolled occupational health hazards that may be found at Vista project work sites.

The purposes of the Vista medical surveillance program for its employees are as follows:

- To determine that employees are medically fit for specific work tasks at Vista project work sites;
- To identify individuals who may be at increased risk to health hazards at Vista project work sites and to limit their field activities to reduce their risk;
- To determine that employees are medically fit to use a respirator and other Personnel Protective Equipment (PPE); and
- To detect the early onset of symptoms and/or deleterious health effects that might be related to occupational exposure to health hazards at Vista project work sites through annual or biannual medical examinations or as needed.

All provisions of the medical surveillance program given in the VSHP will be diligently carried out at all Vista project work sites.

2.1. Radiation Protection Bioassay Program

A key element of the Vista Radiation Safety Program (VRSP) is the provision of bioassay procedures, where needed, to ensure the health and safety of workers who may be potentially exposed to ionizing radiation hazards. The bioassay procedure applies to all Vista project work sites where the potential exists for workers' exposure to ionizing radiation from radioactive materials and/or radioactive contamination.

The following sections discuss purpose, scope, necessary supplies, urinalysis sampling frequency, collection instructions, bioassay sample routing log, action levels, and sample shipment for the Vista Bioassay Program.

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

2.1.1. Purpose

The purpose of this Procedure is to describe the bioassay requirements, sampling criteria, action levels, and shipping instructions. Bioassay procedures, the post-exposure monitoring technique of determining the radionuclide content of urine or excreta, is based on the time of exposure, the physical nature of the radionuclide of interest, and known physiological processes.

2.1.2. Scope

The bioassay program provides for monitoring the internal deposition of radioactive materials in the body. Personnel who enter and work on a Vista project work site with the potential for exposure to radioactive materials and/or radioactive contamination will be evaluated at regular intervals using established bioassay techniques to verify that ionizing radiation protection controls are adequate and radiation exposure is ALARA at Vista project work sites. Based on the evaluation, corrective action will be required.

2.1.3. Necessary Supplies

- Urinalysis Sample Kits
- "Bioassay Sample Routing Log Form," shown as Attachment 4

2.1.4. Urinalysis Sampling Frequency

The following sections discuss routine sampling and non-routine sampling due to operational occurrences for workers, and special procedures as a visitor to a Vista project work site.

2.1.4.1. Routine Sampling

All personnel who perform work at a Vista project work site with the potential for exposure to radioactive materials and/or radioactive contamination will be required by the Vista Radiation Safety Officer (RSO) or the Vista On-Site Radiation Protection Officer (ORPO) to submit a urine sample prior to beginning work on the project, periodically during intrusive project site activities, and after work activities are completed.

Instructions for this activity will be given during the radiological orientation at each Vista project work site prior to commencement of activities. Additional sampling frequency will be determined by the Vista RSO.

A non-routine sampling program may be initiated at the discretion of the Vista RSO, and implemented by the Vista ORPO. A non-routine program should be initiated when the weekly exposure exceeds 10 DAC-hr. The action level for initiation of non-routine sampling is determined using the following equation:

$$TWA = (DAC/PF) \times 0.10$$

Where TWA is the 8-hour time-weighted average concentration that is the action level; DAC is the derived air concentration value specified in 10 CFR 20 for the radionuclide of interest. PF is the respiratory protection factor and equals 1 if no respirator is worn.
Non-routine or "spot" samples will be requested when there is reason to suspect that an employee may have sustained an internal deposition of radioactive materials. Non-routine samples may be collected according to the following schedule:

Table 2-1 - Sample Collection Schedule

INCIDENT	TIME
Sample 1	within hours (baseline)
Sample 2	Day 1 to 2
Sample 3	Day 3 to 4
Sample 4	Day 7 to 8
Sample 5	Day 15 to 16
Sample 6	Day 29 to 30

After 30 days, the individual will be sampled according to the normal bioassay program. Samples will be shipped by the fastest means possible on the day they are received from the individual. The Vista RSO or ORPO will notify a Nuclear Regulatory Commission (NRC) licensed radiochemical laboratory when and how a shipment has been made.

After a non-routine bioassay sequence has been initiated, the subject worker(s) will not be allowed to reenter the controlled area. The Vista RSO or ORPO will review this requirement on a case-by-case basis, and will inform the PM of individual restrictions.

2.1.4.2. Visitors to Project Sites

Any person visiting a Vista project work site on an infrequent basis, who wishes to enter an area under radioactive contamination control, may be required to submit a urine sample prior to entry. Exceptions to this requirement may be made by the Vista ORPO or his designee provided the location to be visited is unexcavated or has a very low potential for airborne radioactive contamination, and the visitor is escorted by the Vista ORPO or his designee at all times.

2.1.5. Collection Instructions

A sample volume of 100 milliliters (ml) or 200 ml collected over a 24-hour period will be required depending on the type of radioactive contamination found at the Vista project work site. Samples that do not meet this requirement will not be accepted, and an immediate 24-hour resample will be initiated. The original sample submitted will not constitute a part of the resample volume, and will be discarded.

Samples will not be collected on-site. Urine sample kits will be provided to workers with instructions for a 24-hour voiding prior to beginning work at the Vista project work site. Sample kits will be issued and returned to the personnel monitoring station. Sample collection instructions are described on the label attached to each sample bottle. The termination or final urine sample

should be collected at least 48 hours, but not more than 96 hours, after leaving the Vista project work site.

2.1.6. Bioassay Sample Routing Log

The Vista ORPO will assign sample control numbers when completing the Bioassay Sample Routing Log (similar to a Chain of Custody form). The control numbers will be in sequential order. The Bioassay Sample Routing Log, Attachment 4, will be completed as follows:

Table 2-2 - Instructions to Complete Bioassay Sample Routing Log

Vista Project Site Name	Identify Site.	
Quantity Shipped	Number of bioassay samples listed on each form.	
Special Instructions	Indicate any comments or instruction deemed necessary for completeness.	
Laboratory	Name of the laboratory performing the bioassay sample analysis.	
Employee Name	Include the full name of each individual.	
Employee Social Security Number:	Include social security number of each individual.	
Organization:	Include the employer or affiliation of each individual.	
Date Collected:	The date the bioassay sample was collected.	
Collection Time:	Give the time sample collection started and stopped.	
Analyses Requested:	List analyses requested using the following codes	
	Total:	
	Uranium:	U
	Tritium	H-3 ^{3}H
	Radium-226:	Ra-226 ^{226}Ra
	Lead-210:	Pb-210 ^{210}Pb
	Plutonium	Pu
	Polonium-210:	Po-210 ^{210}Po
	Thorium-230:	Th-230 ^{230}Th
	Thorium-232:	Th-232 ^{232}Th
	Fission Products:	
	Gamma Isotopic:	
	Urine	UR
	Feces	FE
	Nose Swipe	NS
Purpose:	List the reason for collecting the sample.	
Sample Type:	List the type of bioassay sample collected	
Copies will be distributed to the Vista RSO, PM, Vista ORPO, and the affected worker.		

2.1.7. Action Levels

Results of the bioassay program will be used to evaluate the internal dose in workers due to the inhalation or ingestion of radioactive materials and/or radioactive contamination. Action levels have been identified for the purpose of carrying out supplemental evaluations for each radionuclide.

The action levels are different for each radionuclide. Normally if an air sample quantity is less then 0.10 times the DAC value listed in 10 CFR 20, no action is necessary.

If an air sample indicates DAC value equal to or greater then 0.5 listed in 10 CFR 20, engineering controls are required. At a minimum, use of respiratory protection equipment as specified in the Radiation Work Permit (RWP), should be instigated. A bioassay sample should be taken if it is likely that 4 DAC hours of exposure has occurred when an air sample is taken, during or after entry into and RA, equals to or is greater than 0.5 of the DAC value listed in 10 CFR 20.

2.1.7.1. Resample Action Level

If the results of a routinely scheduled urine sample equals or exceeds the action level per the site specific Quality Assurance Program (QAP), a 24-hour resample will be collected during the following weekend.

2.1.7.2. Investigation Action Level

If the results of a routinely scheduled urine sample equals or exceeds the investigation action level per the site specific QAP, a spot sample will be collected during the following 16 off-duty hours.

2.1.7.3. Work Restriction Action Level

If the results of a routinely scheduled urine sample equals or exceeds the work restriction action level per the site specific QAP, the worker's activities will be restricted immediately so as to avoid further uptake of radioactive materials and/or radioactive contamination. A spot sample will be collected during the following 16 off-duty hours, and a 24-hour resample will be collected over the following 3 successive weekends. Based on the results of these samples, further samples may be requested

2.1.7.4. Investigations

Unusual radiological events will be investigated to determine the cause and to prevent the recurrence in keeping with the ALARA program. Instances of internal ionizing radiation exposure where workers demonstrate bioassay results greater than the action levels for the given radionuclide, will require investigative actions. For each investigation, the individuals dose commitment, and the corrective actions taken, are to be documented in a report. The completed report is to be retained in the individual's ionizing radiation exposure history file along with data that would allow the dose commitment to be recalculated at a later date.

2.1.8. Sample Shipment

The Vista RSO, HP or ORPO will ensure that all lids are securely taped to the bottle with plastic tape and that each sample bottle is individually packaged in a plastic bag. Sample bottles will be packed in appropriate shipping cartons with sufficient packing material to ensure safe transportation to the radiochemical laboratory. A copy of the Bioassay Sample Routing Log will accompany the sample shipment. Samples will be shipped to the radiochemical laboratory within 24 hours after receipt by the Vista RSO, HP or ORPO.

ATTACHMENTS

Attachment 4

BIOASSAY SAMPLE ROUTING LOG FORM

FIELD-Part A

CONTROL NO: ________________

Contract Task Order No.: ____________________

Quantity Shipped: ______________ Site Name: ____________________________ Date Shipped: _________________

Special Instructions: ____

____

Laboratory: ____

Address: ____

____

Laboratory-Part B

Date Received: _______________

W.O. No: ___________________

Received By: _______________________

Name Last, First, MI	Employee Social Security No.	Organization	Collection Date	Collection Time		Analyses Requested	Sample Type	Purpose	Lab No.	Projected Completion Date
				Start	Stop					

Attachment 4

BIOASSAY SAMPLE ROUTING LOG FORM

SAMPLE TYPE	PURPOSE	ANALYSIS	DATA BASE USE ONLY	INSTRUCTIONS
Urine – UR	Initial – IN	Total Uranium – U	Data Entered: _____	1. Field shall complete Part A
Feces – FE	Final – FN	Radium 226 – ^{226}RA	Entered By: _____	a. Send a copy to the Onsite Radiation Protection Officer
Nose Sample	Routine – RT	Lead 210 – ^{210}Pb	Checked By: _____	b. Maintain a copy onsite
	Resample – RS	Polonium – 210 – ^{210}Po		c. Send original with samples
	Special – SP	Thorium – 230 – ^{230}Th		
		Thorium – 232 – ^{232}Th		
		Fission Products		
		Special Nuclear Material		
		Transuranics		