
**VISTA Technologies, Inc.
Radiation Safety Program**

PROCEDURE - 9
MEDICAL MONITORING



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List of Attachments

Attachment Number

Name of Attachment

4

Bioassay Sample routing Log Form

ABBREVIATIONS AND ACRONYMS

| | | |
|-------------------|---|---------------------------------------|
| α | - | Alpha |
| β | - | 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 |
| μ Ci | - | MicroCurie |
| μ Ci/hr | - | MicroCuries per hour |
| μ Ci/ml | - | MicroCuries per milliliter |
| μ M | - | Micrometer |
| μ R/hr | - | MicroRoentgen per hour |
| μ g/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 Plant |
| 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.

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 than 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 than 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

SAMPLE TYPE

Urine – UR
Feces – FE

Nose Sample

PURPOSE

Initial – IN
Final – FN

Routine – RT
Resample – RS
Special – SP

ANALYSIS

Total Uranium – U
Radium 226 – ²²⁶RA

Lead 210 – ²¹⁰Pb
Polonium – 210 – ²¹⁰Po
Thorium – 230 – ²³⁰Th
Thorium – 232 – ²³²Th
Fission Products
Special Nuclear Material
Transuranics

DATA BASE USE ONLY

Data Entered: _____

Entered By: _____

Checked By: _____

INSTRUCTIONS

1. Field shall complete Part A
 - a. Send a copy to the Onsite Radiation Protection Officer
 - b. Maintain a copy onsite
 - c. Send original with samples