VISTA Technologies, Inc.
Radiation Safety Program

PROCEDURE - 24

RECORDS AND REPORTS

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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

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

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

RECORDS AND REPORTS

1. RECORDS OF RADIATION SAFETY PROGRAM

Vista will maintain records of the radiation safety program, including:

- Provisions of the program; and
- Audits and other reviews of program content and implementation.

The licensee will retain these records until the Nuclear Regulatory Commission (NRC) terminates the license requiring the records at which time the records will be sent to the NRC.

2. RECORDS OF SURVEYS

Vista will maintain records showing the results of ionizing radiation surveys and calibrations required by Section 20.1501 and 20.1906(b) of 10 CFR 20. Vista will retain these records until the Nuclear Regulatory Commission NRC terminates the license requiring the records at which time the records will be sent to the NRC.

Vista will retain each of the following records until the NRC terminates the license requiring the record:

- Records of the results of surveys to determine the dose from external sources and used, in the absence of or in combination with individual monitoring data, in the assessment of individual dose equivalents. This includes those records of results of surveys to determine the dose from external sources and used, in the absence or combination with individual monitoring data, in the assessment of individual dose equivalents required under the standards for protection against radiation in effect prior to January 1, 1994; and
- Records of the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose. This includes those records of the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose required under the standards for protection against radiation in effect prior to January 1, 1994; and
- Records showing the results of air sampling, surveys, and bioassays required by Section 20.1703(a)(3).1.(i) and (ii) of 10 CFR 20. This includes those records showing the results of air sampling, surveys, and bioassays required under the standards for protection against radiation in effect prior to January 1, 1994; and
- Records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment. This includes those records of the results used to evaluate the release of radioactive effluents to the environment required under the standards for protection against radiation in effect prior to January 1, 1994.

3. DOCUMENTATION OF PRIOR EXPOSURES

For those individuals for whom monitoring is required, determination of current year exposure at other facilities is required by Section 20.1502 and 20.2104 of 10 CFR 20. To document the determination of current year exposures, the individual to be monitored must provide an NRC Form 4 signed by the individual or a written statement that includes the names of all facilities that provided monitoring for occupational exposures to radiation during the current year and an estimate of the dose received. Verification may be documented with:

- An NRC Form 5, for each listed monitoring period; or
- Electronic, telephone, or facsimile transfer of dose data provided by licensees listed on the written statement; or
- A NRC Form 4 countersigned by a licensee or current employer.

In addition, 10 CFR 20.2104(a)(2) requires that licensees attempt to obtain the records of lifetime cumulative exposure radiation dose. To demonstrate compliance with this requirement, the individual to be monitored may provide a written statement of the cumulative lifetime dose or an up-to-date NRC Form 4 signed by the individual.

If Vista is unable to obtain a complete record of an individual's current and previously accumulated occupational dose to ionizing radiation, Vista will assume:

- In establishing administrative controls under 10 CFR 20 for the current year, that the allowable dose limit for the individual is reduced by 1.25 Rems (12.5 mSv) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; and
- That the individual is not available for planned special exposures.

Vista will retain the exposure records on NRC Form 4 until the NRC terminates each license requiring this record. Vista will retain records used in preparing NRC Form 4 for 3 years after the record is made. This includes records required under the standards for protection against radiation in effect prior to January 1, 1994.

4. RECORDS OF PLANNED SPECIAL EXPOSURES

For each use of the provisions of section 20.1206 of 10 CFR 20 for planned special exposures, Vista will maintain records until the NRC terminates the license requiring the records. At that time Vista will transfer the records to the NRC. The records will describe:

- The exceptional circumstances requiring the use of a planned special exposure;
- The name of the management official who authorized the planned special exposure and copy of the signed authorization;
- What actions were necessary;
- Why actions were necessary;
- How doses were maintained As Low As Reasonably Achievable (ALARA); and

- What individual and collective doses were expected to result, and the doses actually received in the planned special exposure.

5. EXPOSURE RECORD KEEPING REQUIREMENTS

5.1. Personnel Dosimetry: Administration and Record Keeping

The purpose of this personnel dosimetry administration and record keeping procedure is to describe the method to be utilized for the administration and record keeping of personnel dosimeter at Vista project work sites.

This procedure describes the personnel-monitoring program using dosimeters to provide a legal record of an individual's external radiation exposure history. The administration and record keeping is intended to provide an accurate record of personnel exposure in compliance with 10 CFR 20. This procedure is also intended to aid health physics personnel in maintaining personnel exposures ALARA. Individual exposure history files will be maintained current.

Applicable references for this procedure are:

- 10 CFR 20, "Standards for Protection Against Radiation";
- NRC Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure Data"; and
- ANSI N136, "Practice for Occupational Radiation Exposure Record Systems".

5.2. Determination of Monitoring Requirements

Monitoring is required if an adult is likely to receive in 1 year a dose greater than 10 percent of any applicable limit. Guidance on evaluating the need to provide monitoring is provided in NRC Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses."

5.3. Necessary Supplies

- National Voluntary Laboratory Accreditation Program (NVLAP) approved dosimetry.
- "NRC-4 Equivalent Form, Occupational External Radiation Exposure History," shown as Attachment 15.
- "NVLAP personnel Dosimeters Issue Information Form," shown as Attachment 48.
- "NVLAP personnel Dosimeters Record Form," shown as Attachment 49.
- "Request for and Approval to Exceed Ionizing Radiation Personnel Exposure Limits Form," shown as Attachment 50, if applicable.
- Clipboard and pen.

5.4. Specific Instructions

All personnel will be issued NVLAP approved dosimetry equipment, if required, by the Vista On-site Radiation Protection Officer (ORPO) or On-site Healthy and Safety Officer (OHSO), indicated by ionizing and non-ionizing radiation surveys performed by the Vista Health Physicist (HP),

ORPO or OHSO.. The dosimeter will be issued following completion of site orientation and before entry into a Restricted Area (RA) on a Vista project work site. In addition to the dosimeter, all personnel entering a controlled area must complete the bioassay requirements except for casual visitors as described in Procedure 9 "Ionizing Radiation Protection Bioassay Program" section.

- Nuclear Regulatory Commission-4 Equivalent Form, "Occupational External Radiation Exposure History," shown as Attachment 15.

All personnel will be required to complete a NRC Form 4 or equivalent. This form will be used to obtain reports of past radiation exposure history (if any). The Vista ORPO will review this form when completed.

- Issuance of NVLAP Approved Dosimetry at Vista Project Work Sites

All permanently assigned site personnel will be issued a NVLAP approved dosimeter. A Personnel NVLAP approved dosimeter record will be completed for each individual issued a dosimeter badge. All dosimeter badges, when not in use, will be stored together with a control dosimeter at a Vista project work site control point. This supply of badges will be kept with the control dosimeters, except when in use.

Visitors will be issued a dosimeter as deemed necessary by the Vista ORPO taking into consideration radiation and contamination levels, duration of visit, and other pertinent information. Visitors may be exempt from the requirements of the bioassay and training programs at the discretion of the Vista ORPO, provided the visit is a "one-time" occurrence and the location to be visited is unexcavated or has very low potential for airborne contamination.

All dosimeters will be exchanged and processed monthly or as required by the PM. The need or priority evaluations on personnel exposures will be determined by the Vista ORPO depending on the suspected potential exposure. Exposure data will be submitted to the Vista ORPO for review.

In the event a dosimeter is lost, a calculated dose will be determined for an individual's exposure record using the form shown as "Airborne Contamination Exposure Report Form," Attachment 51. For those individuals wearing a Pocket Ionization Chamber (PIC) or Personal Dosimeter (PD), the PIC or PD reading may be used for the evaluation. Results from co-workers and calculations of individual dose through reconstruction of the event leading to the potential exposure will be reviewed during the evaluation.

A visitor dosimeter will be issued only to one individual and not re-issued to subsequent visitors. The Vista ORPO will record any unusual occurrences or conditions that may relate to personnel dosimetry data in the "comments" column of the form shown as "Personnel Dosimeters Record Form," Attachment 49.

Personnel Ionizing Radiation Exposure Limits

External exposures to the whole body will be limited to:

- 1250 mrem in any 12-week (quarterly) period;
- 5000 mrem per year;
- Written approval from the Vista RSO will be required to exceed these exposure limits; and
- Approvals to exceed administrative limits will be initiated by the Vista ORPO using the form shown as "Request for and Approval to Exceed Ionizing Radiation Personnel Exposure Limits Form," Attachment 50.

- Individual Personnel Dosimetry Records
  - Individual exposure files will be maintained by Vista for all personnel, considered "radiation workers", who are monitored for external and/or internal radiation exposure; and
  - Copies of records shown on the following Attachments will be forwarded to the Vista RSO for inclusion in the individual's exposure file.
- NRC-Form 4, "Occupational External Radiation Exposure History," shown as Attachment 15.
  - "NVLAP Approved Dosimetry Issue Information Form," shown as Attachment 48.
  - "NVLAP Approved Dosimetry Record Form," shown as Attachment 49.
  - "Request for and Approval to Exceed Ionizing Radiation Personnel Exposure Limits Form," shown as Attachment 50.
  - The personnel dosimeter dosimetry record form shown as Attachment 49 will be initialed for all subcontractor personnel working at the Vista project work site. The records will then be forwarded by the Vista ORPO and to the Vista RSO for inclusion into the radiation exposure history files.

6. IONIZING AND NON-IONIZING RADIATION EXPOSURE RECORDS

A confidential Occupational Exposure History file is maintained for each employee or visitor who may be or is exposed to ionizing and non-ionizing radiation health and safety hazards or radioactive materials during the discharge of assigned duties.

The Occupational Exposure History file contains the following types of information:

- Individual's full name;
- Individual's Social Security Number;
- Individual's date of birth;
- Individual's age;
- Record of occupational exposure history (furnished by previous employer prior to the individual's employment). This information will be recorded on NRC Form-4 or equivalent;
- Records used in preparing NRC Form-4 or equivalent;
- Record of occupational exposure during employment. This information will be recorded on NRC Form-4 or equivalent;
- Reports of occupational exposure received at another facility by Vista personnel while employed by Vista;

- Reports of occupational exposure received at another facility by Vista personnel while employed by Vista;
- Reports of internal exposure, with calculations used to determine dose;
- Results of whole body counts, including dates, etc.;
- Records of bioassay data including types of samples, results of analysis, etc.; and
- Reports of exposure investigations performed, including reasons for investigations and results.

The exposure monitoring records must include, when applicable:

- The deep-dose equivalent to the whole body, eye dose equivalent, shallow-dose equivalent to the skin, and shallow-dose equivalent to the extremities;
- The estimated intake or body burden of radionuclides (see Section 20.1202 of 10 CFR 20); and
- The committed effective dose equivalent assigned to the intake or body burden of radionuclides;
- The specific information used to calculate the committed effective dose equivalent pursuant to Section 20.1204(c) of 10 CFR 20;
- The total effective dose equivalent when required by Section 20.1202 of 10 CFR 20; and
- The total of the deep-dose equivalent and the committed dose to the organ receiving the highest total dose.

Vista will make entries for the records specified above at least annually. The records required under this section will be protected from public disclosure because of their personal privacy nature. The Privacy Act of 1974, Public Law 93-579, and the NRC regulations in 10CFR Part 9 protect these records. Vista will retain the records until the NRC terminates the pertinent license requiring these records per 10 CFR 30.51 "Transfer of Records to NRC".

7. BIOASSAY PROGRAM

The purpose of this bioassay program procedure is to describe the bioassay program, its sampling criteria, action levels, and shipping instructions at Vista project work sites. The bioassay program provides for monitoring the internal disposition of radioactive material. Personnel who enter and work in RAs at Vista project work sites will be evaluated at regular intervals using established bioassay techniques to verify that radiological controls are adequate and ALARA for site conditions. Based on this evaluation, re-sampling, investigation, or work restrictions may be required.

Applicable references for this procedure are:

- ANSI N13.6, "Practice for Occupational Radiation Exposure Records Systems,";
- NRC Regulatory Guide 8.22, "Bioassay at Uranium Mills,"
- ICRP Publication no. 26, "Recommendations of the International Commission on Radiological Protection,"
- ICRP Publication no. 30, Part 1, "Limits for Intakes of Radionuclides By Workers,"and

- ICRP Publication no. 54, "Individual Monitoring for Intakes of Radionuclides by Workers: Design and Interpretation,".

7.1. Necessary Supplies

- Urinalysis sample kits.
- Packaging and shipping equipment.
- "Bioassay Sample Routing Log Form," shown as Attachment 4.
- Clipboard and pen.

7.2. Specific Instructions

- Urinalysis Sampling Frequency

  - Routine Sample

All personnel who perform work at a Vista project work site in a RA will submit a urine sample prior to beginning work on the project, at scheduled intervals during site activities and after termination of the work assignment at the Vista project work site. Specific instructions for this activity will be given during the radiological orientation at each site prior to commencement of subcontractor activities. Sampling frequency will be determined by the Vista ORPO.

  - Non-routine Sampling (Operational Occurrences)

A non-routine program may be initiated at the discretion of the Vista ORPO. A non-routine program should be initiated when nasal contamination is detected, or the weekly exposure exceeds 4 DAC hours.

  - Visitors to Sites

Generally, persons visiting a Vista project work site on an infrequent basis who wish to enter a RA will be required to submit a urine sample prior to entry and upon conclusion of the visit. Exceptions to this requirement may be made by the Vista RSO or ORPO provided the location visited is unexcavated or has a very low potential for airborne contamination and the visitor is escorted by the Vista ORPO at all times.

  - 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 material.
  - Non-routine samples may be collected according to the schedule given in Procedure 9 "Urinalysis Sampling Frequency" section.

After 30 days, workers and visitors, if necessary, will be sampled according to the normal bioassay program.

- Samples will be shipped to the analytical laboratory by the fastest means possible on the day they are received from the individual. The Vista ORPO will notify the analytical 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 re-enter the controlled area. The Vista RSO will review this requirement on a case by case basis.

- Collection Instructions

  - A urine sample collected for a 24-hour period will be required depending on the type of radiological contamination found at the Vista project work site. Samples not meeting these collection instructions will not be accepted, and an immediate 24-hour re-sampling 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 the worker with instructions for collection of a sample for a 24-hour period, 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.

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

  - The Vista ORPO or appointed sample coordinator will assign sample control numbers when completing the form shown as "Bioassay Sample Routing Log Form," Attachment 4. The control numbers will be in sequential order.

- Part A of the "Bioassay Sample Routing Log Form" should be completed as follows:

  - Site Name: Identify Site
  - Quantity Shipped: Number of bioassay samples listed on each form.
  - Special Instructions: Indicate any comments or instructions deemed necessary for completeness.
  - 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 codes listed on the "Bioassay Sample Routing Log Form" The required analyses are generally

found in the site-specific Field Sampling Plan (FSP) or Sampling and Analysis Plan (SAP).

Table 1 - Codes for Bioassay Sampling Routing Log Form

Total Uranium:	Code	Code
Radium-226:	Ra-226	^{226}Ra
Lead-210:	Pb-210	^{210}Pb
Polonium-210:	Po-210	^{210}Po
Thorium-230:	Th-230	^{230}Th
Transuranics	TRU	
Fission Products	Specify	
Special Nuclear Material	SNMs Specify	
Thorium-232:	Th-232	^{232}Th
Gamma Isotopic:	GeLi	
Other:	Specify	

Sample Type: List the type of bioassay sample collected.

Table 2 - Sample Type and Code

Sample Type	Code
Urine	UR
Feces	FE
Nose Swipe	NS

- Purpose: List the reason for collecting the sample.
- Copies will be distributed to the Vista RSO, Vista ORPO, and the affected worker.
- Action Levels.

Results of the bioassay program will be used to evaluate the internal dose due to the inhalation or ingestion of radioactive materials. Action levels have been identified for the purpose of carrying out supplemental evaluations for ^{226}Ra. These levels are shown in "Bioassay Requirements for Potential Exposure to Radium-226," shown as Attachment 52.

- Resample Action level

If the results of a routinely scheduled urine sample equals or exceeds the resample action level, a 24-hour sample will be collected during the following weekend.

- Investigation Action Level

If the results of a routinely scheduled urine sample equals or exceeds the investigation action level, a 24-hour sample will be collected during the following weekend. Work practices and potential exposure pathways will be evaluated.

- Work Restriction Action Level

If the results of a routinely scheduled urine sample equals or exceeds the work restriction action level, the worker's activities will be restricted immediately so as to avoid further uptake of radioactive material. A series of 24-hour re-samples will be collected over the following 3 successive weekends. Based on the results of these samples, further samples may be requested.

- 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 radiation exposure where workers demonstrate bioassay results greater than the levels given in the "Bioassay Sample Routing Log," will require investigative actions following the format given in Radiological Investigations.

For each investigation, the individual's dose commitment and corrective actions taken are to be documented in a report. The completed report is to be retained in the individual's radiation exposure history file along with data that would allow the dose commitment to be recalculated at a later date.

The report should follow the requirements given in Procedure 13 "Personal Monitoring and Dosimetry" section. Dose assignments will be based on the models presented in the references listed in Procedure 26 "References" section.

- Sample Shipment

The person responsible for sample shipment will insure 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 control sample (i.e., distilled water, non-radiation worker urine sample, etc.) should also accompany the samples to be assayed to cross-contamination has not occurred. 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.

8. DERIVED AIR CONCENTRATION-HOUR EXPOSURE RECORD

The purpose of this Derived Air Concentration-Hour (DAC-HR) exposure record procedure is to describe the techniques used to complete the DAC-HR Exposure Record used to track inhalation exposures at Vista project work sites. This procedure explains when and how to execute a DAC-HR Exposure Record, and describes the organization of the records and files.

The applicable reference for this procedure is:

- 10 CFR 20, "Standards for Protection Against Radiation,".

8.1. Specific Instruction

- DAC-HRs will be calculated when the airborne concentration of gas or air particulate radioactivity is greater than 10 percent of the DAC values published in Column 3 of Table 1 of Appendix B to 10 CFR 20; and
- DAC-HR exposure records are to be completed for each individual who is exposed to a concentration that is 10 percent of the listed DAC values.

9. AIRBORNE PARTICULATE EXPOSURE CALCULATION

Exposure to airborne contamination is calculated in units of DAC-HR based on Time-Weighted Average (TWA) radionuclide concentrations. Calculation of exposure to any airborne contamination should include all relevant measurements made during the workday, week, month, quarter year, and year to better define the TWA exposure. The following example clarifies the computation of DAC-HR.
Suppose ^{226}Ra is known to be the most restrictive radioisotope present, with a DAC value of 3E-10 microCurie per ml (μCi/ml):

1 DAC-HR = 3E-10 μCi/ml x 1 hour = 3E-10 μCi-h/ml

Consequently, the conversion factor, 1 DAC - h/3E-10 μCi-h/ml or 3.33 X E11 DAC-ml/μCi is used in DAC-HR computations.

Below is an example of a workweek for John R. Doe. Even though he worked 46 hours, the 40-hour DAC workweek would apply.

John R. Doe/Mechanic Time Card

Table 3 - Sample Time Card

Work Areas	1	2	3	4	5
MONDAY	2.0		8.0		
TUESDAY		8.0	2.0		
WEDNESDAY					8.0
THURSDAY	8.0		2.0		
FRIDAY				8.0	
TOTALS	10.0	8.0	12.0	8.0	8.0

Below are the Weekly Airborne ^{226}Ra Measurements

Area No. 1 TWA Activity = 6.7 E-11 μCi/ml
Area No. 2 TWA Activity = 1.2 E-11 μCi/ml
Area No. 3 TWA Activity = 9.4 E-11 μCi/ml
Area No. 4 TWA Activity = 1.7 E-11 μCi/ml
Area No. 5 TWA Activity = 2.9 E-11 μCi/ml

Mr. Doe's daily weekly exposure to our airborne ^{226}Ra would be calculated as below.

MONDAY (2 hours, Area 1) = 2 hours x 6.7 E-11 µCi/ml = 1.34 E-10 µCi-h/ml
(8 hours, Area 3) = 8 hours x 9.4 E-11 µCi/ml = 7.52 E-10 µCi-h/ml
His daily total = 1.34 E-10 + 7.52 E-10 = 8.86 E-10 µCi-h/ml

DAC-HR for Monday = 8.86 E-10 µCi-h/ml x 3.3 E9 $\frac{\text{DAC-ml}}{\mu\text{Ci}}$ = 2.95 DAC-HR

TUESDAY (8 hours Area 2) = 8 hours x 1.2 E-11 µCi/ml = 9.60 E-11 µCi-h/ml

Daily Total = 2.84E-10 µCi-h/ml

DAC-HR for Tuesday = 2.84 E-10 x 3.33 x E9 = 0.95 DAC-HR

WEDNESDAY (8 hours, Area 5) = 8 hours x 2.9E-11 µCi/ml = 2.32E-10 µCi-h/ml

Daily Total = 2.32E-10 µCi-h/ml

DAC-hr for Wednesday = 2.32 E-10 x 3.33 x E9 = 0.77 DAC-hr

THURSDAY (8 hours, Area 1) = 8 hours x 6.7 E-11 µCi/ml = 5.36 E-10 µCi-h/ml
(2 hours, Area 3) = 2 hours x 9.4 E-11 µCi/ml = 1.88 E-10 µCi-h/ml

Daily Total = 7.24E-10 µCi-hr/ml

DAC-HR for Thursday = 7.24 E-10 x 3.33 x E9 = 2.41 DAC-HR

FRIDAY (8 hours, Area 4) = 8 hours x 1.7 E-11 µCi/ml = 1.36 E-10 µCi-h/ml

Daily Total = 1.36E-10 µCi-h/ml

DAC-HR for Friday = 1.36 E-10 x 3.33 E9 = 0.45 DAC-h

Mr. Doe's weekly exposure would be as follows: Monday's daily total + Tuesday's daily total + Wednesday's daily total + Thursday's daily total + Friday's daily total.
DAC-HR for the week = 2.95 + 0.95 + 0.77 + 2.41 + 0.45 = 7.53 DAC-HR

This format would be carried out monthly, quarterly, and annually to quantify the workers annual exposure.

Airborne exposure data for each individual will be recorded on the form shown as "Airborne Contamination Exposure Report Form," Attachment 51, and the form shown as "Airborne Contamination Exposure Area Sampling Averages Calculation Data Sheet Form," Attachment 31. Air exposure data will be maintained according to date, location, and time worked in exposure area.

Copies of forms will be provided to the PM at the end of the site health physics monitored activities. The forms shown as Attachments 31 and 51 will be completed for any occupational exposure exceeding 10 percent of the DAC.

These documents will be maintained in the employees exposure record files as part of his or her medical records. The form shown as "Airborne Contamination Exposure Area Sampling Averages Calculation Data Sheet Form," Attachment 31, is used to calculate the TWA for area airborne activity. This form will be filed in the project site files.

The Vista ORPO will review the airborne exposure records for each individual on a weekly basis. In situations where intakes (by inhalation) of greater than 4 DAC-HR are suspected to have occurred in a 7-day period, non-routine bioassay samples will be collected in accordance with Procedure 9"Urinalysis Sampling Frequency" section.

10. RECORDS

10.1. Records of Dose to Individual Members of the Public

Vista will maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public. Vista will retain these records until the NRC terminates the license requiring these records per 10 CFR 30.51 at which they are sent to the NRC.

10.2. Records of Surveys

The results of ionizing and non-ionizing radiation, contamination, and airborne activity surveys will be recorded in the Vista project files. A copy of these reports will be retained in the health and safety files in the Vista San Antonio office.

The surveys provide information that may be used to:

- Demonstrate compliance with applicable regulations;
- Allow reconstruction of situations and conditions relating to matters of ionizing radiation, contamination, and airborne activity levels at some later date;
- Indicate radiological trends;
- Support design and engineering criteria;
- Generate a general pool of information for research or other projects;
- Demonstrate that sealed sources are not leaking by performing removable contamination surveys on them twice a year; and
- Provide worker education tools.

10.3. Records Tamper Indicating Devices (TIDS)

Status of all TIDS shall be maintained for any material(s) package which potentially made consist of removable contamination levels above 60,000 DPM or if the materials contain airborne contaminants exceeding 10 of the DAC, for that material(0), as listed in Table 1 of Appendix B 10 CFR 20.

10.4. Radioactive Material Records

Records are maintained showing receipts, shipments, and inventories of radioactive material.

11. REPORTS

The following sections discuss annual reports to workers and requests for reports by a former worker.

11.1. Annual Reports to Workers

Workers may see their occupational exposure files at any convenient time. In addition, workers will receive annual reports of their ionizing radiation exposures. The content of the report is specified in Procedure 11 "Exposure Investigation" section.

11.2. Request for Reports by a Former Worker

At the written request of a former worker, Vista will furnish that worker, or his or her authorized agent, a report of his or her exposure to ionizing radiation health and safety hazards or radioactive material in accordance with NRC Regulation 10 CFR 20. These reports should be furnished within 30 days from the time the request is made, or within 30 days after the worker's exposure has been determined, whichever is later.

11.3. Reports of Theft or Loss of Licensed Material

(a) Telephone Reports:

Vista will report by telephone as follows to the NRC Operations Center (301)816-5100:

- Immediately after its occurrence becomes known to Vista, any lost, stolen, or missing licensed material in an aggregate quantity equal to or greater than 1,000 times the quantity specified in Appendix C to 10 CFR 20 under such circumstances that it appears to Vista that an exposure could result to persons in unrestricted areas; or
- Within 30 days after the occurrence of any lost, stolen, or missing licensed material becomes known to Vista, all licensed material in a quantity greater that 10 times the quantity specified in Appendix C to 10 CFR 20 that is still missing at this time.

(a) Written Reports:

Vista is required to make a written report within 30 days after making the telephone report setting forth the following information:

- A description of the licensed material involved, including kind, quantity, and chemical and physical form;
- A description of the circumstances under which the loss or theft occurred;
- A statement of the disposition, or probable disposition, of the licensed material involved;

- Exposures of individuals to radiation, circumstances under which the exposure occurred, and the possible total effective dose equivalent to persons in unrestricted areas;
- Actions that have been taken, or will be taken, to recover the material; and
- Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss or theft of licensed material.

The original written report will be sent to:

U.S. NRC
Document Control
Washington, D.C.

CC:

U.S. NRC Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, Texas 76011

11.4. Notification of Incidents

(a) Immediate Notification

Vista will immediately report any event involving byproduct, source, or special nuclear material possessed by Vista that may have caused or threatens to cause any of the following conditions:

- An individual to receive a total effective dose equivalent of 25 Rems (0.25 Sv) or more;
- An individual to receive an eye dose equivalent of 75 Rems (0.75 Sv) or more;
- An individual to receive a shallow-dose equivalent to the skin or extremities of 250 Rads or more; or
- The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake five times the annual limit on intake.

(a) 24-hour Notification

Vista will, within 24 hours of discovery of the event, report any event to the NRC Operations Center (301) 816-5100 involving loss of control of licensed material possessed by Vista that may have caused, or threatens to cause, an individual to receive, in a period of 24 hours:

- A total effective dose equivalent exceeding 5 Rems (0.05 Sv);
- An eye dose equivalent exceeding 15 RemS (0.15 Sv); or
- A shallow dose equivalent to the skin or extremities exceeding 50 Rems (0.5 Sv) .

Twenty-four-hour notification is also required if the release of radioactive material, inside or outside of a restricted area resulted in an individual receiving an intake in excess of one occupational annual limit on intake.

Telephonic notification to the NRC will be followed by an original written report ~~within 30 days to:~~

U.S. NRC
Document Control Desk
Washington, D.C. 20555

CC:

U.S. NRC Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, Texas 76011

(a) Vista will prepare any report filed with the commission pursuant to this section so that name of individuals who have received exposure to radiation or radioactive material are stated in a separate and detachable part of the report.

11.5 Reports of Exposures, Radiation Levels, and Concentrations of Radioactive Material Exceeding the Constraints or Limits

(a) Reportable Events

Vista will submit a written report within 30 days after learning of any of the following occurrences:

- Any incident for which notification is required in the 10 CFR 20.2202;
- Doses in excess of the occupational dose limits for adults, minors, embryo/fetus of a declared pregnant women, members of the public and any applicable limit of the license pursuant to 10 CFR 20, Subpart C, or ALARA Constraints for air emissions established under 20.1101(d) of 10 CFR 20;
- Levels of radiation or concentrations of radioactive material in restricted areas in excess of any applicable limit of the license or an unrestricted area in excess of 10 times any applicable limit set forth in 10 CFR 20.2203; or
- For licenses subject to the provision of EPA's generally applicable environmental radiation standards in 40CFR Part 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.
- Abnormal status of any Tamper Indicating Device (TID).

(a) Contents of Report

Vista reports will contain a minimum of the following:

- Describe the extent of exposure of the individuals to radiation and radioactive material including: estimates of each individuals dose; levels of radiation and concentrations of radioactive material involved; cause of the elevated exposure; dose rates, or concentrations, and corrective steps; and
- Each occupationally overexposed individuals name, Social Security Number, and Date of Birth. The report must be prepared in a separate and detachable part of the report.

11.6. Reports of Planned Special Exposure

Vista will report to the Commission any exposures of an individual occupationally exposed individual, pursuant to the provisions of 20.2203, 20.2204, and 20.2205 of 10 CFR 20.

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. Ne: ______________ 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		

Attachment 15

NUCLEAR REGULATORY COMMISSION-4 EQUIVALENT FORM "OCCUPATIONAL EXTERNAL RADIATION EXPOSURE HISTORY"

See Attached Instructions

Identification

1. Name (Print-Last, First, and Middle)	2. Social Security Number:
3. Date of Birth (Month, Day, Year)	4. Age in Full Years

Occupational Exposure-Previous History

5. Previous Employment Involving Radiation Exposure. Last Name and Address of Employer.	6. Dates of Employment From-To	7. Periods of Exposure	8. Whole Body (REM)	9. Record or Calculated (Insert one)
10. Remarks				11. Accumulated Occupational Dose Total:

12. Calculations-Permissible Dose Whole Body	13. Certification: I certify that the exposure history in columns 5, 6, and 7 is correct and complete to the best of my knowledge and belief.
A) Permissible Accumulated Dose = _____ REM	_____ Employee's Signature Date
B) Total Exposure to Date (From Item 11) = _____ REM	_____ Site Name and Number
C) Unused Part of Permissible Accumulated Dose (A-B) = _____ REM	14. Name of Current Employer

Attachment 15

NUCLEAR REGULATORY COMMISSION-4 EQUIVALENT FORM "OCCUPATIONAL EXTERNAL RADIATION EXPOSURE HISTORY"

If you have previously worked in a radiation environment and have been monitored for radiation exposure, print (or type) the following information in ink:

Block No.	Complete as Follows
1	Enter your last name, first name, and middle initial.
2	Enter your social security number.
3	Enter your date of birth (month, day, year).
4	Enter your age as of your last birthday
5	Enter the name and full mailing address of each site and previous employer at which you received occupational radiation exposure. If there were no such employments, enter the word "None".

Note: It is very important for you to list the facility or institution that maintains your exposure records. For example, if you were employed by XYZ Construction Co. to work at the Salem Nuclear Power Plant, list Salem Power Plant since the plant maintains your records.

6	List the dates of each employment shown in Block 5.
7	Enter the dates of the exposure period, if applicable.
8-11	Leave Blank
12	Read certification statement. Sign and date completed forms. Enter Site name.
13	Leave blank.
14	Enter the name of your current employer.

Attachment 15

NUCLEAR REGULATORY COMMISSION-4 EQUIVALENT FORM "OCCUPATIONAL EXTERNAL RADIATION EXPOSURE HISTORY"

SUBJECT: Request for Radiation Exposure Report Records

Please forward the radiation exposure reports of record (e.g., TLD/film badge results) and any bioassay results for

_____	_____
Print Name	Social Security Number
_____	_____
Military Branch of Service (if applicable)	Service Number (if applicable)
_____	to _____

Sincerely,

RELEASE

I hereby give my permission for _____ to release my radiation exposure records and any pertinent bioassay results incurred prior to my employment on a site. Please forward this information to:

Attachment 31

AIRBORNE CONTAMINATION EXPOSURE AREA SAMPLING AVERAGES CALCULATION DATA SHEET FORM

Site Name: _____ Sampling Area: _____ Date: _____

Completed By: _____ QC By: _____ Contaminant: _____

Analytical Techniques: _____ TWA Activity = ____pCi/ml ____pCi/l ____Working Levels (WL)

Results for the month of _____ MPC = _____

Sample Date	Sample Identification	Sample Results	Sample Area Average (1x2x3x4) % MPC

Sample Area Averages

(1) = Daily (2) = Weekly

(3) = Monthly (4) = Quarterly

Type: L = Lapel Sample A = Area Sample

Exposure calculated from these averages

Note: Transmit a copy of the form with all (1x2x3x4)

Attachment 48

PERSONNEL THERMOLUMINESCENT DOSIMETER ISSUE INFORMATION FORM

Site Name: _____ Date Shipped: _____

Site No. and Activity: _____ Shipped Via: _____

Recorded by: _____ QTR _____ Year _____ Page _____ of _____

BADGE NO.	NAME	SOCIAL SECURITY NUMBER	DATE OF BIRTH	CONTRACTOR	ISSUE DATE	RETURN DATE	CODE	COMMENTS

Codes: 1. Not Used 2. Badge Lost Badge Type: _____

Attachment 49

PERSONNEL DOSIMETER RECORD FORM

Name	Social Security Number	Site	Sex	Birthdate

Home Address	Contractor	Contractor's Address

Dosimeter Number	Date Issued	Date Returned	Penetrating		Non-Penetrating		Comments
			Period	ACC	Period	ACC	

Attachment 50

REQUEST FOR AND APPROVAL TO EXCEED IONIZING RADIATION PERSONNEL EXPOSURE LIMITS FORM

Name: _____

Organization: _____

Address: _____

_____

Social Security Number: _____

Date of Birth: _____

Project: _____

Date: _____

Approval is requested to exceed the administrative limit, _____

m/rem per (Calendar Quarter, Year) to new limit of,_____

m/rem per (Calendar Quarter, Year) for the period, _____

Requested by On-Site Radiation Protection Officer

_____

Approved by Health and Safety Program Manager

_____

CC: Individual's Exposure History File
Project Office

Attachment 51

AIRBORNE CONTAMINATION EXPOSURE REPORT FORM

Site: _____
Name: _____ SS #: _____ Company: _____
Occupation: _____ Completed By: _____
QC BY: _____ Contaminant: _____
(A) MPC: _____ _____WL _____µCi/ml _____pCi/l

Date	Work Area	(B) Hours in Area	(C) Area TWA Activity	(D) Protection Factor	(E) Daily Area Exposure Total	(F) Cumulative Exposure	(G) % MPC

(B)-Time in hours individual worked in area
(C)-TWA-Time Weighted Average in WL pCi/l or µCi/ml

(E)-Activity (µCi/l or WL x B x Ci/l)
(F)-Summation of (E)

(G)-F/H x 100 = % MPA

(Per NIOSH #87-116 Dated 9/87)
Protection Factor (D)
No Respirator = 1
Half-Face = 10
Full Face = 50

Bioassay Information

Sample Required?
Yes____ No____

Date acquired: _____

Code MPC Used

(1) Daily
(2) Weekly
(3) Monthly
(4) Quarterly

(H) Cumulative MPC's
(1) Daily = % x (A) = _____
(2) Weekly = 40 x (A) = _____
(3) Monthly = 168 x (A) = _____
(4) Quarterly = 504 x (A) = ____

Attachment 52

BIOASSAY REQUIREMENTS FOR POTENTIAL EXPOSURE TO RADIUM-226

	Bioassay Analysis	Routine Sampling Frequency	Required MDA (1)	Resample Action Level (1)	Investigation Action Level (1)	Work Restriction Action Level
Radium-226	Urinary Ra	Quarterly	0.25	0.50 pCi/l	1.0 pCi/l	2.0 pCi/l

1. All values are in units of pCi/l.
2. The work restriction level of 2.0 pCi/l for Ra-226 represents an effective committed dose equivalent of 1 rem if an acute uptake occurred 45 days before sampling, or about 0.1 rem if the acute uptake occurred 7 days before sampling.

NRC FORM 4
(9/1998)
10 CFR PART 20

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0005 **EXPIRES: 09/30/2001**

CUMULATIVE OCCUPATIONAL DOSE HISTORY

1. NAME (LAST, FIRST, MIDDLE INITIAL)	2. IDENTIFICATION NUMBER	3. ID TYPE	4. SEX: MALE ☐ FEMALE ☐	5. DATE OF BIRTH (MM/DD/YYYY)

6. MONITORING PERIOD (MM/DD/YYYY - MM/DD/YYYY)	7. LICENSEE NAME	8. LICENSE NUMBER	9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUTINE ☐ PSE ☐

11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

6. MONITORING PERIOD	7. LICENSEE NAME	8. LICENSE NUMBER	9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUTINE ☐ PSE ☐

11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

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6. MONITORING PERIOD	7. LICENSEE NAME	8. LICENSE NUMBER	9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUTINE ☐ PSE ☐

11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

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11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17 TEDE	18. TODE

6. MONITORING PERIOD	7. LICENSEE NAME	8. LICENSE NUMBER	9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUTINE ☐ PSE ☐

11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

19 SIGNATURE OF MONITORED INDIVIDUAL	20. DATE SIGNED	21. CERTIFYING ORGANIZATION	22. SIGNATURE OF DESIGNEE	23. DATE SIGNED