



Field Operating Procedure

BIOASSAY PROCEDURE

000-BAP-01

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

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Date

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1.0 PURPOSE

To assess inhaled, ingested, or absorbed radioactive materials in order to evaluate airborne exposure and surface concentration control measures.

To verify that radioactive material controls will maintain internal exposures As Low As Reasonably Achievable (ALARA).

2.0 PROCEDURE

2.1 Definitions

The following is a listing of definitions of terms that will be referred to in this procedure:

- 2.1.1 **Bioassay** - Any technique to determine a quantity of radioactive material within the human body or within organs of the body.
- 2.1.2 **Multi-Channel Analyzer (MCA)** - A composite of electronic equipment which can detect, identify and quantify gamma ray emitting radioactive material.
- 2.1.3 **Contractor** - A company under contract to perform bioassay analysis.
- 2.1.4 **NRC** - Nuclear Regulatory Commission
- 2.1.5 **NRC Form 4** - The official record of previous exposure history which indicates deep dose, shallow dose, eye dose, and the committed dose equivalent (CDE) due to internally deposited radionuclides, and total effective dose equivalent (TEDE).
- 2.1.6 **Derived Air Concentration (DAC)** - That concentration of an airborne radionuclide which, if inhaled for 40 hours per week for 50 weeks per year will cause a total effective dose equivalent (TEDE) of 5 Rem or a committed dose equivalent (CDE) to an organ of 50 rem.
- 2.1.7 **Gamma Radiation** - One of the several kinds of ionizing radiation that is emitted from radioactive material. Gamma radiation is electromagnetic, a single packet of gamma energy is called a photon having no charge or mass.
- 2.1.8 **Beta Radiation** - One of several kinds of ionizing radiation that is emitted from radioactive material. Beta particles are electrons having a + or - charge with the mass of an electron. The quantification of beta emitters in the body must be determined from urinalysis or fecal samples.
- 2.1.9 **Alpha Radiation** - One of several kinds of ionizing radiation that is emitted from radioactive material. Alpha particles are Helium nuclei and have a +2

charge. The quantification of alpha emitters in the body must be determined from urinalysis or fecal samples.

2.2 Upon Hire or at the start of a project

2.2.1 Determine whether the radiation worker has had previous radiation exposure history using the Nuclear Regulatory Commission (NRC) Form 4 or equivalent.

2.2.2 If the worker has a previous history, and internal exposure was not documented, obtain a urine analysis or whole body count as described in this procedure.

2.2.3 No bioassay or body count is necessary for individuals with no previous radiation exposure history.

NOTE: Bioassay analysis documents previous radioactive material intake to establish a baseline.

2.3 Routine, Non-Routine Air Samples

2.3.1 Air samples are to be taken and analyzed using facility procedures.

2.3.2 Air samples that identify activity concentrations above Radiation Survey Procedure, "Action Levels", shall have additional analysis performed.

2.3.2.1 Isotopic determination using a Multi Channel Analyzer (MCA) or absorption methods and a Radiological Health Handbook or other documentation of radionuclide emissions.

2.3.2.2. Isotopic quantification using a MCA or other quantification methods and Radiological Health Handbook or other documentation of radionuclide emissions.

2.3.3 If air sample quantity is less than 0.10 times the derived air concentration (DAC) value listed in 10 Code of Federal Regulations (CFR) 20, no action is necessary.

2.3.4 If an air sample is taken before personnel entry and data is equal to or greater than 0.5 of the DAC value listed in 10 CFR 20, engineering controls or as a last resort, respiratory protection equipment as specified in the Radiation Work Permit (RWP) may be warranted.

2.3.5 If an air sample is taken during or after personnel entry into a radioactive airborne contamination area and the air sample data is equal to or greater than 0.5 of the DAC value listed in 10 CFR 20, and no respiratory protection equipment was used, a bioassay sample should be taken if it is likely that 4

DAC hours of exposure occurred. Ten DAC hours will lead to a TEDE of 4 DAC-hours * 2.5 millirem (mrem/DAC-hour) = 10 mrem.

2.4 Routine Bioassay Program

2.4.1 Routine whole body counts or urine analysis are conducted on personnel who will work with radioactive materials in order to verify that radiation protection program controls protect individuals working with radioactive materials from internal depositions of airborne radioactive material and ingestion or absorption of radioactive materials on surfaces.

2.4.2 Urine analysis shall be required for all radiation personnel entering areas controlled due to surface contamination in excess of prescribed limits.

2.4.2.1 Urine samples will consist of at least 10 milliliters. Samples for the purpose of this procedure shall be taken only for the determination of internal radioactive or hazardous materials.

2.4.2.2 Urine samples shall be labeled on the bottle with, as a minimum, the information on Attachment 1, the name of the project or facility, indicate an entry or exit sample and the date of sampling, the name of the individual providing the sample, the social security number (SSN) of that person, and the date of birth of that person. Attach the form to the bottle so that it will not easily become detached.

2.4.2.3 Using 400-CP-402, Sample Chain of Custody (COC), record all information to ensure control of and proper analysis of the sample(s).

2.4.3 Whole body counts shall be required when working with gamma emitters for which urine analysis is a poor indicator of exposure.

2.4.3.1 Whole body counts will be conducted with particular concern to the gamma energy range of interest for radionuclides used on the job and at the project site.

2.4.3.2 Documentation of whole body count results will include a written review by the project or facility radiation.

2.5 Emergency Bioassay Procedures

2.5.1 Immediate Evaluation

2.5.1.1 If there is radioactive material on or around the face, nose or mouth, take a nasal smear. Count the nasal smear on a portable survey instrument to determine if decontamination is needed.

2.5.1.2 Determine whether the radionuclides are beta, gamma, alpha, or combination emitters per Section 2.3.2 of this procedure.

2.5.1.3 If contamination is a pure alpha or beta particle emitter, a urine analysis is necessary. This is because these radiations will not penetrate the body or a detector wall for quantification.

2.5.1.3.1 Collect at least 10 milliliters of urine, recording the individuals name, collection date, social security number, and collection time on the bottle.

2.5.1.3.2 Collect one sample for each effective half-life duration for the radionuclides of interest, for three consecutive effective half-lives. This collection frequency determines radionuclide clearance rate.

2.5.1.3.3 Forward the urine samples to an analysis laboratory contractor. Forward all information as stipulated in contract or as necessary for analysis to be completed.

2.5.1.4 If contamination is a gamma emitter, analyze by performing a whole body count or arranging for a body count at a certified laboratory or contractor.

2.5.1.5 Receive bioassay results from contractor.

2.5.1.6 Include quantity of deposition, as determined by the laboratory, and the calculated committed dose equivalent and total effective dose equivalent in the worker's exposure file.

2.5.1.7 The project or company Radiation Safety Officer shall review all documentation associated with the accidental exposure and develop a report for the individual's file to indicate internal and external dose equivalent.

3.0 RECORDS

Documentation initiated per this procedure will be maintained and controlled per in accordance with the project work plan and Document Control procedures.

All records of exposure, internal and external are legal and personal and must be controlled as such.



Field Operating Procedure
RADIOLOGICAL NON-CONFORMANCE REPORTS

000-NCR-01

Revision 1

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1.0 PURPOSE

The purpose of this procedure is to define Up-Side Radiological Survey, LLC [(USRS) hereinafter referred to as "the Company"] requirements for the reporting (both by telephone and written) of radiological regulatory nonconformance situations occurring at client facilities when Company radioactive materials license is used.

This procedure has been written to comply with Title 10 Part 20 of the Code of Federal Regulations (10 CFR 20), "Standards for Protection against Radiation." This procedure was developed using the guidance provided in the following documents:

- NUREG-1556, Volume 18, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Service Provider Licenses," and
- NUREG-1556, Volume 11, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Licenses of Broad Scope."

This procedure is tied to the Company's radioactive material license. The NRC must approve any proposed changes or revisions to this procedure before the changes are implemented.

The License Radiation Safety Officer (RSO) is responsible for updating this procedure. Approval authority rests with the Radiation Safety Committee.

2.0 SCOPE

This procedure applies to all Company operations where Company radioactive material license is used to possess radioactive material.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 License Radiation Safety Officer

The RSO is responsible to ensure that appropriate regulatory notifications are judiciously made concerning potential incidents of noncompliance and that these potential incidents and their associated notifications are accurately documented and that the documents are properly retained.

3.1.2 Project or Task Manager

The Project Manager (PM) is responsible to ensure that incidents requiring regulatory notification by this procedure are promptly identified and reported to the RSO. The PM shall ensure that the facts surrounding the event and subsequent notifications and corrective actions are accurately and thoroughly documented.

3.1.3 Project Personnel

If an individual observes, or has knowledge of a potential incident of noncompliance then the individual is responsible to promptly report this information to the Project Health Physicist (PHP) and the PM.

3.2 General Provisions

This section identifies nonconformance situations that require NRC notification. The RSO is the Company individual designated to make these notifications. If the RSO is unavailable the senior line manager that is cognizant of the event shall make the required notifications. The RSO, PHP, and PM shall be familiar with these nonconformance situations so that notifications are not delayed. The notifications are made by telephone, by written report, or both as indicated in the following text and summarized in Table 1 using the following contact information:

- The NRC Headquarters Operations Center telephone number is (301) 816-5100 or (301) 951-0550
- The NRC Headquarters Operations Center mailing address is USNRC, Division of Incident Response Operations, Washington, D.C. 20555- 0001.

The content of written reports shall be consistent with the applicable requirements set forth in 10 CFR 20, Subpart M - Reports.

Immediate NRC notification is required when any event involving byproduct, source, or special nuclear material possessed by the Company 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 Sieverts) or more
 - A lens dose equivalent of 75 rems (0.75 Sieverts) or more
 - A shallow-dose equivalent to the skin or extremities of 250 rads (2.5 Gray) or more
- 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 (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

The NRC shall be notified within 24 hours of discovery of any event involving loss of control of licensed material possessed by the Company that may have caused, or threatens to cause, any of the following conditions:

- An individual to receive, in a period of 24 hours:
 - A total effective dose equivalent exceeding 5 rems (0.05 Sieverts); or
 - A lens dose equivalent exceeding 15 rems (0.15 Sieverts); or
 - A shall-dose equivalent to the skin or extremities exceeding 50 rems (0.5 Sieverts); 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 in excess of one occupational annual limit on intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

The RSO, with the assistance of the PM, shall prepare any report filed with the NRC pursuant to this section so that names of the individuals who have received exposure to radiation or radioactive material are stated in a separate and detachable part of the report.

Reports made in response to the requirements of 10 CFR 20.2202 shall be made as follows:

- Licensees having an installed Emergency Notification System shall make the reports required by paragraphs (a) and (b) of 10 CFR 20.2202 to the NRC Operations Center in accordance with 10 CFR 50.72; and
- All other licensees shall make the reports required by paragraphs (a) and (b) of 10 CFR 20.2202 by telephone to the NRC Operations Center (301) 816-5100.
 - Verbal notifications shall include (1) the caller's name and call back number, (2) a description of the event, including date and time, (3) the exact location of the event, (4) the isotopes, quantities, and chemical and physical form of the licensed material involved, and (5) any personnel radiation exposure data available.
 - Written reports shall include (1) a description of the event, including the probable cause and the manufacturer and model number (if applicable) of any equipment that failed or malfunctioned, (2) the exact location of the event, (3) the isotopes,

quantities, and chemical and physical form of the licensed material involved, (4) date and time of the event, (5) corrective actions taken or planned and the results of any evaluations or assessments, and (6) the extent of exposure of individuals to radiation or to radioactive materials without identification of individuals by name.

Table 1
Time Table for NRC Notification of Select Radiological Incidents

Radiological Event	Telephone Notification	Written Notification	Regulatory Requirement
Theft of loss of material	Immediate	30 days	10 CFR 20.2201(a)(1)(i)
Whole body dose greater than 25 rem (0.25 Sieverts)	Immediate	30 days	10 CFR 20.2202(a)(1)(i)
Lens dose greater than 75 rem (0.75 Sieverts)	Immediate	30 days	10 CFR 20.2202(a)(1)(ii)
Skin or extremity dose greater than 250 rads (2.5 Grey)	Immediate	30 days	10 CFR 20.2202(a)(1)(iii)
Whole body dose greater than 5 rems (0.05 Sieverts) in 24 hours	24 hours	30 days	10 CFR 20.2202(b)(1)(i)
Skin or extremity dose greater than 50 rems (0.5 Sieverts) in 24 hours	24 hours	30 days	10 CFR 20.2202(b)(1)(iii)
Lens dose greater than 15 rem (0.15 Sieverts)	24 hours	30 days	10 CFR 20.2202(b)(1)(ii)
Whole body dose greater than 5 rems (0.05 Sieverts)	None	30 days	10 CFR 20.2203(a)(2)(i)
Whole body dose to embryo/fetus greater than 0.5 rems (0.005 Sieverts)	None	30 days	10 CFR 20.2203(a)(2)(iii)
Dose to individual member of the public greater than 100 millirems (1 milliSieverts)	None	30 days	10 CFR 20.2203(a)(2)(iv)
Defect in equipment that could create a substantial safety hazard	2 days	30 days	10 CFR 21.21(d)(3)(i)
Filing petition for bankruptcy under 11 United States Code	None	Immediately after filing petition	10 CFR 30.34(h)
Expiration of license	None	60 days	10 CFR 30.36(d)
Decision to permanently cease licensed activities at entire site	None	60 days	10 CFR 30.36(d)
Decision to permanently cease licensed activities in any separate building or outdoor area that is unsuitable for release for unrestricted use	None	60 days	10 CFR 30.36(d)
No principle activities conducted for 24 months at the entire site	None	60 days	10 CFR 30.36(d)
No principle activities conducted for 24 months in any separate building or outdoor area that is unsuitable for release for unrestricted use	None	60 days	10 CFR 30.36(d)
Event that prevents immediate protective actions necessary to avoid exposure to radioactive materials that could exceed regulatory limits	Immediate	30 days	10 CFR 30.50(a)
Equipment is disabled or fails to function as designed when required to prevent radiation exposure in excess of regulatory limits	24 hours	30 days	10 CFR 30.50(b)(2)

Unplanned fire or explosion that affects the integrity of any licensed material or device, container, or equipment with licensed material	24 hours	30 days	10 CFR 30.50(b)(4)

3.3 Administrative Records

Radiological Control records are to be maintained as required by 100-AP-103, Radiological Records.

4.0 GUIDANCE

Discovery - The completion of the documentation first identifying the existence of a deviation or failure to comply.

Immediate report – Each licensee shall notify the NRC as soon as possible but not later than 4 hours after the discovery of an event.

Notification - The telephonic communication to the NRC Operations Center or written transmittal of information to the NRC Document Control Desk.

5.0 REFERENCES

<i>Number</i>	<i>Title</i>
10 CFR 20	<i>Standards for Protection Against Radiation</i>
10 CFR 21	<i>Reporting of Defects and Noncompliance</i>
10 CFR 30	<i>Rules of General Applicability to Domestic Licensing of Byproduct Material</i>
10 CFR 50	<i>Domestic Licensing of Production and Utilization Facilities</i>
100-AP-103	<i>Radiological Records</i>



Field Operating Procedure
AUDITS, ASSESSMENTS, AND OVERSIGHT

100-AP-101

Revision 1

Approved By:



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President

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1.0 PURPOSE

The purpose of this procedure is to define the Up-Side Radiological Survey, LLC [(USRS) hereinafter referred to as "the Company"] radiation protection requirements for the audit program when Company radioactive material license, Nuclear Regulatory Commission (NRC) No. 09-29309-01, is used to work with or around radioactive material.

This procedure has been written to comply with Title 10 Part 20 of the Code of Federal Regulations (10 CFR 20), "Standards for Protection against Radiation." This procedure was developed using the guidance provided in the following documents:

- NUREG-1556, Volume 18, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Service Provider Licenses," and
- NUREG-1556, Volume 11, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Licenses of Broad Scope."

This procedure is tied to the Company's radioactive material license. The NRC must approve any proposed changes or revisions to this procedure before the changes may be implemented.

The License Radiation Safety Officer (RSO) is responsible for updating this procedure. Approval authority rests with Radiation Safety Committee.

2.0 SCOPE

This procedure applies to all Company operations where the Company radioactive material license is used to possess radioactive material.

An annual audit shall include (dependent upon size and extent of the radiation protection program); non-conformance reports; corrective actions; status reports and audits; incident investigation reports; ALARA program development and implementation; effluent releases; personnel qualification and radiation safety training; and performance of the Radiation Safety Officer.

3.0 MAINTENANCE

3.1 Responsibilities

3.1.1 License Radiation Safety Officer

The RSO is responsible to ensure that the following radiation safety objectives are met:

- A management audit shall be performed on Company's radiation protection program on an annual basis. The management audit may include an evaluation of both corporate and project activities, as appropriate. The RSO shall normally serve as the auditor's point of contact for management audits.
- An internal audit shall be performed on each project's radiation protection program on an annual basis; the RSO or designee shall serve as the auditor for internal audits.
- Assessments shall be performed in the manner and frequency prescribed by the RSO to ensure that the radiation protection program is functioning properly.
- Each audit assessment shall be properly documented and retained.

3.1.2 Project Manager

The Project Manager (PM) is responsible to ensure that funding is available to perform an audit of the project radiation protection program at least once during the course of the project and at a frequency not to exceed 12 months for long-term projects. When notified that their project is to be audited the PM shall ensure that the following actions are completed:

- Identify a project point of contact for the audit and provide contact information for this individual to the auditor.
- Transmit pertinent information to the auditor including the project organizational chart with positions and names and a copy of each project specific plan and/or procedure that contains radiation protection program guidance.
- Provide the auditor with an office that includes an internet connection and telephone.
- A project conference room should be reserved for audit activities for the duration of the audit.

The PM shall ensure that project resources are available to support assessments as prescribed by the RSO.

3.1.3 Project Health Physicist

The Project Health Physicist (PHP) is appointed to a project by the RSO with the concurrence of the PM. The PHP shall normally be designated as the auditor's point of contact for project radiation protection program audits. The PHP is responsible to perform assessments in the manner and frequency prescribed by the RSO.

3.2 Performance of Audits

3.2.1 Conduct of Audits

1. The auditor shall provide written notice of the intent to perform an audit. The written notice is ideally delivered at least ten working days before beginning the audit.
2. Each audit shall consist of an examination of selected aspects of license conditions, operational activities and applicable regulatory requirements using Form 100-AP-101a, Audit Checklist. Audits shall be conducted such that a comprehensive review and inspection of all activities are performed since the last audit.
3. A pre-audit briefing shall be conducted with the appropriate corporate and/or project management personnel to describe the purpose and scope of the audit, and the procedure to be followed. This may include the RSO, department managers, project managers, etc.
4. The audit shall consist of items specified on the checklist and include, but not be limited to:
 - Review of records
 - Observing operations
 - Review of corrective actions
 - Follow-up audit items
 - Interviews with personnel
 - A daily briefing of management regarding the progress of the audit.
5. When necessary, the scope of the audit may be expanded by the auditor to fully evaluate a finding or observation. This expansion may be in addition to, but not in place of checklist items required by the RSO.
6. Findings must be recorded and be objective, factual and verifiable. Copies of nonconforming documents shall be made when possible. Findings involving a specific procedure shall identify the procedure. Unless findings are willful violations of procedures or license, or a threat to employees, public, or environment, individuals shall not be identified
7. Those findings that present an imminent radiological control and safety threat or hazard shall be identified to the PM, PHP, and RSO immediately. Immediate corrective action shall be taken by the PM, PHP, and RSO as appropriate.

8. Upon completion of the audit, the auditor shall conduct a post-audit briefing with the appropriate corporate and/or project management personnel to communicate a summary of observations, findings, and recommendations.

3.2.2 Audit Report

1. The auditor shall, within twenty (20) business days after completing the audit, prepare an audit report and forward it to the audit point of contact.
2. The audit report shall include the following information: date of audit, name of person(s) who conducted audit, persons contacted by the auditor(s), areas audited, audit findings, corrective actions, and follow-up.
3. Management audit reports shall be reviewed and approved by the RSO within twenty (20) business days of receipt from the auditor.
4. Internal audit reports shall be reviewed and approved by the RSO or designee within twenty (20) business days of receipt from the auditor.

3.2.3 Audit Responses

The manager responsible for the project or program audited shall prepare a formal response to each audit finding and recommendation within twenty (20) working days of receipt of the audit report. The responses shall correspond to the numerical system used in the audit report.

3.2.4 Response Review

1. The RSO or designee shall review audit responses for appropriateness and completeness.
2. If audit responses are not satisfactory, additional information shall be requested in writing.
3. If audit responses are satisfactory, the RSO/Designee shall issue a memo to the responsible manager closing the audit.
4. Records shall be closed out and forwarded for retention upon completion of all required corrective actions and closeout of the audit.

3.3 Records

All audit documentation is to be retained in accordance with the requirements in 100-AP-103 Radiological Records. Records of audits are to include: date of audit, name of person(s) who conducted the audit, persons contacted by the auditor(s), areas audited, audit findings, corrective actions, and follow-up.

4.0 GUIDANCE

Audit - A review of the radiation protection program to accomplish the following radiation safety objectives:

- Verify compliance with license requirements, regulatory requirements, corporate procedures, and project specific plans and procedures.
- Identify and correct unsatisfactory performance and programmatic weaknesses
- Identify areas for improvement.

Management Audit – An audit that is performed by an individual or group that is above the level of the RSO, or by an independent organization that is not directly associated with the radiation protection program such as the corporate Quality Assurance group.

Internal Audit – An audit performed by the RSO or designee.

Assessments - Project specific observations performed by designated radiation protection personnel to evaluate the program's effectiveness and personnel performance when measured against procedures, policies, industry standards and regulatory requirements. Assessments are performed at the project level in the manner and frequency prescribed by the RSO.

5.0 REFERENCES

<i>Number</i>	<i>Title</i>
10 CFR 20	<i>Standards for Protection Against Radiation</i>
NUREG-1556, Vol. 18	<i>"Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Service Provider Licenses"</i>
NUREG-1556, Vol. 11	<i>"Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Licenses of Broad Scope"</i>
700-AP-701	<i>ALARA Program</i>

6.0 ATTACHMENTS

101-AP-101a Audit Checklist



Field Operating Procedure
RADIOLOGICAL RECORDS

100-AP-103

Revision 1

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1.0 PURPOSE

The purpose of this procedure is to define Up-Side Radiological Survey, LLC [(USRS) hereinafter referred to as "the Company"] requirements for the maintenance and retention of radiological protection records generated at client facilities when Company radioactive materials license is used.

This procedure is necessary because complete and accurate radiation protection records are necessary to:

- Provide information used to protect individuals from radiation exposure.
- Evaluate the effectiveness of the radiation protection program.
- Demonstrate compliance with regulations and requirements; and
- Defend the radiation protection program against unwarranted litigation.

This procedure is tied to the Company's radioactive material license. The NRC must approve any proposed changes or revisions to this procedure before the changes may be implemented.

The License Radiation Safety Officer (RSO) is responsible for updating this procedure. Approval authority rests with the Radiation Safety Committee.

2.0 SCOPE

This procedure applies to all Company operations where Company radioactive material license is used to possess radioactive material.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 License Radiation Safety Officer

The RSO is responsible to ensure that methods or procedures are available to field projects to accomplish the following radiation safety objectives:

- Ensure that a records retention system is in place for each project; and
- Ensure that project personnel are informed of and practice proper radiological protection record preparation and retention.

3.1.2 Project or Task Manager

The Project Manager (PM) is responsible to ensure that adequate storage is available for radiological records.

3.1.3 Project Health Physics Personnel

Health Physics personnel are responsible to generate, store, safeguard and disposition radiological records in accordance with this procedure.

3.2 Creation of Radiological Records

Radiological records are to be accurate and legible. The records shall incorporate the following requirements:

- Radiological survey records shall be completed in the same shift that the survey is performed;
- Radiological records shall include the identification of the facility, specific location, function and process;
- Radiological records shall include the signature or other identifying code of the preparer and date;
- Entries in radiological records shall be legibly written in black or blue indelible ink;
- Corrections to radiological records shall be identified by a single line-out, initiated and dated; and
- Radiological records shall include a supervisory review documented by the signature of the reviewer.

Once a record has been created, reviewed and signed by the appropriate supervisor, the record is considered complete and is not to be modified without procedural guidance for the change (e.g., modifications to RWPs are governed by procedure). Subsequent errors identified in a completed record shall be corrected by creating a supplemental record that includes traceability for the correction.

3.3 Records Retention

Radiation protection records are to be retained as required by the following sections of 10 CFR 20:

- §20.2101, General provisions;
- §20.2102, Records of radiation protection programs;
- §20.2103, Records of surveys;
- §20.2104, Determination of prior occupational dose;

- §20.2105, Records of planned special exposures;
- §20.2106, Records of individual monitoring results
- §20.2107, Records of dose to individual members of the public;
- §20.2108, Records of waste disposal; and
- §20.2110, Form of records.

A duplicate set of radiological dosimetry records, along with a database, is to be maintained at a central location as determined by the RSO.

3.4 General Provisions

Each record required by this procedure shall be legible throughout the specified retention period. The record shall be the original or a reproduced copy or a microfilm provided that authorized personnel authenticate the copy or microfilm and that the microfilm is capable of producing a clear copy throughout the required retention period. The record shall also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records, such as letters, drawings, and specifications, are to include all pertinent information, such as stamps, initials, and signatures. Adequate safeguards are to be maintained against tampering with and loss of records. Records containing information covered under the Privacy Act are to be secured in locked cabinet when not in use. Access to records is to be controlled as required by 29 CFR 1910.1020, Access to Employee Exposure and Medical Records.

3.5 Radiological Units

Unless otherwise specified, the quantities used in the records required by this program are to be clearly indicated in special units of curie, rad, roentgen, or rem, including multiples and subdivisions of these units.

Shipping manifests shall use the International System of Units (SI) or both SI and the special units described above.

3.6 Individual Monitoring

3.6.1 Monitoring Records

The results of individual external and internal dose monitoring that are performed (whether required or not) shall be recorded at least annually. Monitoring records shall be maintained on NRC Form 5 or in clear and legible records containing all of the information required by NRC Form 5. These records shall be maintained

until NRC or Agreement State-license termination. The records shall incorporate the following requirements:

- Be sufficient to evaluate compliance with internal and external exposure requirements.
- Be sufficient to provide dose information necessary to complete reports as required by 10 CFR 30.
- Data necessary for future verification or reassessment of the recorded doses shall be recorded; and
- Individual monitoring records that are identified with a specific individual shall be readily available to that individual.

Reasonable efforts shall be made to obtain complete records of prior years occupational internal and external doses. If complete records documenting previous occupational dose during the year cannot be obtained, a written estimate signed by the individual shall be accepted to demonstrate compliance.

3.6.2 Other Monitoring Information

The following "other information" shall be documented and maintained:

- Results of area monitoring (whether radiation or radioactivity is found or not);
- Results of dosimetry, surveys, air sampling/monitoring and bioassay resulted used to determine individual doses. The results for airborne radioactivity evaluations include:
 - Measured airborne radioactivity concentrations in general areas and breathing zones;
 - Supporting parameter, including collection efficiency, flow rate, duration of sampling, correction factors, and filter medium;
 - Individual DAC-hour calculations, when performed; and
 - Linkage of air sample results to individuals in the area, when monitoring results are to be used for individual dose assessment or exposure control.
- Results of monitoring for the release and control of material and equipment. The records of released property are to include:
 - A description or identification of the property;
 - The date of the last radiation survey;

- The identity of the organization and the individual (including signature) who performed the monitoring operation;
 - The type and identification number of monitoring instruments;
 - The results of the monitoring operation; and
 - The identity of the recipient of the released material
- Results of maintenance and calibration performed on instruments and equipment; and
- Results of monitoring and documentation of approval for planned special exposures.

3.7 Environmental Release Records

Records developed are to include information and data necessary to identify and characterize releases of radioactive material to the environment. Records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment shall be retained until the NRC or Agreement State terminates each pertinent license requiring the record.

3.8 Administrative Records

Administrative records to be maintained include the following:

- Training records.
- Actions taken to maintain occupational exposures as low as reasonably achievable (ALARA).
- Facility design and control actions taken to maintain exposures ALARA.
- The results of internal audits and other reviews of program content and implementation.
- Written declarations of pregnancy, including the estimated date of conception.
- Changes in equipment, techniques, and procedures and guidelines used for monitoring.
- Sealed source leak check results and inventory records.

4.0 GUIDANCE

Radiological Protection Record – Any survey report, dosimetry result, or administrative document that is generated to satisfy documentation requirements in Title 10, Part 20 of the Code of Federal Regulations (10 CFR 20).

5.0 REFERENCES

<i>Number</i>	<i>Title</i>
10 CFR 20	<i>Standards for Protection Against Radiation</i>
29 CFR 1910.1020	<i>Access to Employee Exposure and Medical Records</i>



Technical Operating Procedure

**QUALITY CONTROL FOR HEALTH PHYSICS
COUNTING EQUIPMENT AND SYSTEMS**

200-IP-200

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

REVISION HISTORY

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1.0 PURPOSE

The purpose of this procedure is to establish the necessary actions to provide a quality control program for laboratory counting equipment. This program shall include, but not be limited to, the following:

- a) Establish the necessary actions to determine operating voltages for alpha, beta and gamma sensitive detectors.
- b) Establish the necessary actions to provide well-determined background data for alpha, beta and gamma counting systems.
- c) Establish the necessary actions to evaluate the statistical reliability of various alpha, beta, and gamma counting systems by use of the Chi-squared test.
- d) Establish the necessary actions to prepare statistical control charts to monitor the stability of counting systems and their associated backgrounds
- e) Establish the necessary actions to determine and utilize "*a priori*" minimum detectable count rates and minimum detectable activities for each laboratory counting system.
- f) Establish the necessary actions to determine and utilize reporting and "less than" levels for each laboratory counting system.
- g) Provide for the proper documentation of the above actions.

This procedure specifically excludes multi-channel counting and/or spectrographic systems.

2.0 SCOPE

This procedure will be used by Up-Side Radiological Survey, LLC (USRS) personnel and its subcontractors for the quality control testing and evaluation of portable radiation and contamination survey meters for field use. This procedure is intended to provide general instructions for preparing radiation and contamination survey meters and instruments for field operations.

3.0 PRECAUTIONS, LIMITATIONS, AND PREREQUISITES

3.1 Precautions and Limitations

3.1.1 Exercise care to keep all counting equipment clean and dry.

3.1.2 Exercise caution when handling or using radioactive sources.

3.1.3 The sources used for standardization and/or evaluation of counting systems may be deposited on special media (swabs, filter paper, etc.). They may be very fragile and shall be handled with care to avoid flaking or decomposition of the mount. Do not attempt to remove these sources from their planchettes or holders. Do not wipe radioactive surfaces of sources.

3.1.4 Plated sources shall be handled only by the edges.

- 3.1.5** Damaged sources or sources with damaged coverings are no longer traceable in calibration and shall not be used for quantitative calibration.

3.2 Prerequisites

- 3.2.1** The instrument or system shall be allowed to warm up and stabilize prior to testing.
- 3.2.2** Gas flow detectors shall be properly flushed, and the proper flow established prior to testing, according to manufacturer specifications.
- 3.2.3** Calibration sources used for standardization or system evaluation shall be traceable, and certification shall be on file at corporate and the specific project.
- 3.2.4** Prerequisites appropriate to each sub-section of Section 7.0 below are placed at the beginning of each sub-section.

4.0 CALIBRATION

Calibration shall be completed on an annual frequency in accordance with the applicable instrument calibration procedure.

5.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for monitoring compliance with this procedure and training personnel in the use of the radiation and contamination survey meters and instruments quality control and testing. The Project Manager will be responsible for performing periodic surveillance of the quality control and testing of instruments and ensuring that the instruments are calibrated at specified intervals, ensuring that records pertaining to the instrument are maintained on file throughout the duration of the project and copies retained in the permanent project file, and reviewing documentation generated by the use of this procedure.

Health Physics Supervisor - The Health Physics Supervisor is responsible for ensuring that all personnel assigned the task of performing quality control and testing of radiation and contamination survey meters and instruments are familiar with this procedure and are adequately trained with the specific instrument being used to perform surveys. The Health Physics Supervisor is responsible for ensuring that a copy of this procedure is available at the job site.

Health Physics Technician - The Health Physics Technician(s) are responsible for being qualified by training and experience to perform the requirements of this procedure, notifying the Health Physics Supervisor of any unsafe or unusual conditions observed during operation of the instrument, and implementation of this procedure.

6.0 PROCEDURE DETAILS

6.1 FREQUENCY

Quality control testing and evaluation shall be performed semi-annually (± 15 days), unless exceptions to this frequency are made in the specific Instrument Operation and Calibration Procedure.

The routine frequency may be extended by up to one additional month with written approval of the USRS Site Radiation Safety Officer or his/her designee.

In addition to the routine frequency of performance, quality control testing and evaluation shall be performed under the following conditions:

- a) Prior to placing a new counting system into service.
- b) After any major repair or alteration to the counting system or detectors.

NOTE:

The following sub-sections (6.2, 6.3, 6.4, etc) may be performed individually and separately from the body of this procedure if such action is required by a specific Instrument Operation and Calibration Procedure. The prerequisites listed for that specific sub-section must be documented as having been completed and the complete documentation package must be prepared with the sub-sections NOT being performed marked as Not Applicable.

6.2 DETECTOR VOLTAGE PLATEAU

NOTE:

This section is required for fixed scaler/counting systems only.

Ensure that the counting system is set up for operation according to the applicable Instrument Operation and Calibration Procedure and/or the manufacturer's technical literature.

Obtain a radiation source with a known counting rate in the region of 1,000 to 3,000 counts per minute (cpm).

Record the following information on the Plateau Data Sheet, Form USRS-HPQA-001 or equivalent form.

- a) Scaler / Counter ID Number.
- b) Detector ID Number, if external/separate.
- c) Source ID Number.

Place the source in the detector chamber.

Set the high voltage adjustment of the counting system to the lowest possible setting.

NOTE:

DO NOT exceed the manufacturer's limitations or restrictions on voltage for either the detector or the power supply.

Gradually increase the high voltage until a rapid increase in count rate is obtained. Note the high voltage setting.

Reduce the high voltage to approximately 100 volts below the noted increase point.

Obtain, and record on the Plateau Data Sheet, a series of one minute counts at appropriate voltage increments, usually equal increments of 20 to 50 volts are convenient, until EITHER no further voltage increase is possible OR a second sharp increase in count rate is noted.

Using the Voltage Plateau Graph, plot a curve of count rate (vertical axis) versus voltage (horizontal axis).

Record the following on the Voltage Plateau Graph, Form USRS-HPQA-002 or equivalent form.

- a) Scaler / Counter ID Number.
- b) Detector ID Number, if external/separate.
- c) Source ID Number.

The relatively flat portion of the plot is the plateau. The correct operating voltage is located one-third to one-half the distance up the plotted plateau. Pick a point

within this range with a convenient value of high voltage. Use whole numbers, if possible a multiple of 10, only.

Record this operating voltage on the Voltage Plateau Graph.

Perform the following:

- a) Enter the date, time, and printed name of the individual performing the test on both the data sheet and the graph sheet.
- b) Sign both the data sheet and the graph sheet.

The plateau data and graph MAY be submitted to the USRS Site Radiation Safety Officer or his/her designee at this time for review. Review should be performed at this time if:

- a) Any of the data were anomalous, or
- b) The entire Quality Control evaluation is not being performed at this time.

6.3 DETERMINATION OF SYSTEM BACKGROUND

Prior to performing this step, a valid voltage plateau, or operating voltage must have been determined and documented.

Ensure that the counting system is set up for operation according to the applicable Instrument Calibration and Use Procedure and/or the manufacturer's technical literature.

Record the following information on the Background Data Sheet, Form USRS-HPQA-003 or equivalent spreadsheet.

- a) Scaler / Counter ID Number.
- b) Detector ID Number, if external/separate.
- c) Source ID Number.

Data Accumulation

- a) Place a clean, empty planchette in the sample holder.
- b) Insert the sample holder in the detector chamber.
- c) Set the instrument for a timed count of 1 minute.
- d) Count the empty planchette.

- e) Record the total counts on the Background Data Sheet Form USRS – HPQA003.

NOTE:

The instrument/system may remain in service, using the "old" background during the accumulation of data for the new determination of background. The repetitive counts may be accumulated over several days, however all counts shall be completed within 10 days of the initial count.

Repeat d) nine additional times.

Remove the empty planchette from the detector chamber.

Calculations:

- a) Total the values of the individual counts. Enter the value in the Total box on the data sheet.
- b) Divide the total by the number, 10, of determinations and enter this value in the Mean Count, \bar{x} , box on the data sheet.
- c) Subtract the mean count, \bar{x} , from each of the individual counts. Enter the values found in the column labeled $(x - \bar{x})$ on the data sheet.
- d) Square each of the deviations, $(x - \bar{x})$, and enter the values found in the column labeled $(x - \bar{x})^2$ on the data sheet.
- e) Total the values of the squared deviations column, and enter this value in the Sum of Squares, box on the data sheet.
- f) Divide the Sum of Squares, by nine (9). Enter this value in the Variance, box on the data sheet.
- g) Extract the square root of the Variance, and enter the value in the Standard Deviation (σ) (Counts), box on the data sheet.
- h) The Background Count Rate $\pm 2\sigma$ is the acceptable background range.
- i) Enter the background range in the appropriate blocks of Form USRS-013 or USRS-013A.
- j) Perform the following:

- a. Enter the date, time, and (printed) name (of the individual performing the test) on the Background Data Sheet.
 - b. Sign the data sheet.
- k) The Background data MAY be submitted to the cognizant Health Physics Technical Supervisor at this time for review. Review should be performed at this time if:
 - a. Any of the data were anomalous, or
 - b. The entire Quality Control evaluation is not being performed at this time.

6.4 CHI-SQUARE TEST OF RELIABILITY FOR FIXED SCALERS/COUNTERS (MODEL 2929 DUAL CHANNEL SCALER, PROTEAN GAS PROPORTIONAL COUNTER)

A valid voltage plateau, or operating voltage, must have been determined and documented. A well determined background value also needs to be obtained and documented.

Ensure that the counting system is set up for operation according to the applicable Instrument Calibration and Use Procedure and/or the manufacturer's technical literature.

Obtain a NIST Traceable Standard Source with isotopic content appropriate to the detector being evaluated.

- a) The source should be of sufficient activity to yield a counting rate of 1,000 to 50,000 cpm.
- b) The source should not exceed 50,000 cpm.

Record the following information on the Chi-squared Data Sheet, Form USRS-HPQA004 or equivalent spreadsheet:

- a) Scaler / Counter ID Number.
- b) Detector ID Number, if external/separate.
- c) Source ID Number.

Place the source in the detector chamber.

Collect twenty (20) counts of one (1) minutes duration each. Record the results, in counts per minute, in the column labeled "Gross cpm, C_G ".

Subtract the background count rate, C_b , from each count to obtain the net count rate. Record the results in the column labeled "Net cpm, C_i ".

Calculations:

- a) Sum the twenty C_i values and record the result in the box labeled:

$$\text{SUM} = \text{_____} \sum C_i$$

- b) Divide the total by 20 and record the result obtained in the box labeled:

$$\text{Mean } (\bar{C}) = \text{_____} (C_i/20)$$

- c) Subtract the mean count rate, \bar{C} from each of the C_i values, recording the results in the column, $(C_i - \bar{C})$.

- d) Square each of the $(C_i - \bar{C})$ values obtained, record the results in the column labeled, $(C_i - \bar{C})^2$.

- e) Sum the twenty $(C_i - \bar{C})^2$ values and record the results in the box labeled:
Sum of Squares = $\sum (C_i - \bar{C})^2$

- f) Calculate the Chi-squared value by dividing the Sum of Squares " $\sum (C_i - \bar{C})^2$ " by the mean count rate \bar{C} and record the results in the box labeled Chi-Squared Value (C^2).

- g) The Chi-Squared value should be between 10.11 and 30.14. If the C^2 value is NOT between 10.11 and 30.14, THEN notify the USRS Site Radiation Safety Officer or his/her designee prior to continuing.

Perform the following:

- a) Enter the date, time, and (printed) name (of the individual performing the test) on the Chi-squared Data Sheet.
- b) Sign the data sheet.
- c) The Chi-squared data MAY be submitted to the USRS Site Radiation Safety Officer or his/her designee at this time for review. Review should be performed at this time if:
- a. Any of the data were anomalous, or
 - b. The entire Quality Control evaluation is not being performed at this time.

6.5 CHI-SQUARE TEST OF RELIABILITY FOR PORTABLE SCALERS / COUNTERS (MODEL 2350-1, 2360'S WITH VARIOUS ATTACHED DETECTORS)

A valid voltage plateau, or operating voltage, must have been determined and documented. A well determined background value also needs to be obtained and documented Form USRS-HPQA003.

Ensure that the counting system is set up for operation according to the applicable Instrument Calibration and Use Procedure and/or the manufacturer's technical literature.

Obtain a NIST Traceable Standard Source with isotopic content appropriate to the detector being evaluated.

- a) The source should be of sufficient activity to yield a counting rate of 1,000 to 50,000 cpm.
- b) The source should not exceed 50,000 cpm.

Record the following information on the Chi-squared Data Sheet, Form USRS-HPQA004 or equivalent spreadsheet:

- a) Scaler / Counter ID Number.
- b) Detector ID Number, if external/separate.
- c) Source ID Number.

Place the source in the detector chamber.

Collect twenty (20) counts of one (1) minutes duration each. Record the results, in counts per minute, in the column labeled "Gross cpm, C_G ".

Subtract the background count rate, C_b , from each count to obtain the net count rate. Record the results in the column labeled "Net cpm, C_i ".

Calculations:

- a) Sum the twenty C_i values and record the result in the box labeled:

$$\text{SUM} = \sum C_i$$

- b) Divide the total by 20 and record the result obtained in the box labeled:

$$\text{Mean } (\bar{C}) = (C_i/20)$$

- c) Subtract the mean count rate, \bar{C} from each of the C_i values, recording the results in the column, $(C_i - \bar{C})$.
- d) Square each of the $(C_i - \bar{C})$ values obtained, record the results in the column labeled, $(C_i - \bar{C})^2$.
- e) Sum the twenty $(C_i - \bar{C})^2$ values and record the results in the box labeled:
Sum of Squares = $\sum (C_i - \bar{C})^2$
- f) Calculate the Chi-squared value by dividing the Sum of Squares " $\sum (C_i - \bar{C})^2$ " by the mean count rate \bar{C} and record the results in the box labeled Chi-Squared Value (C^2).
- g) The Chi-Squared value should be between 10.11 and 30.14. If the C^2 value is NOT between 10.11 and 30.14, THEN notify the USRS Site Radiation Safety Officer or his/her designee prior to continuing.

Perform the following:

- a) Enter the date, time, and (printed) name (of the individual performing the test) on the Chi-squared Data Sheet.
- b) Sign the data sheet.
- c) The Chi-squared data MAY be submitted to the USRS Site Radiation Safety Officer or his/her designee at this time for review. Review should be performed at this time if:
 - a. Any of the data were anomalous, or
 - b. The entire Quality Control evaluation is not being performed at this time.

6.6 COUNTING SYSTEM EFFICIENCY FOR FIXED SCALERS/COUNTERS COUNTERS (MODEL 2929 DUAL CHANNEL SCALER, PROTEAN GAS PROPORTIONAL COUNTER)

A valid voltage plateau, or operating voltage, must have been determined and documented. A well determined background value also needs to be obtained and documented Form USRS-HPQA003. A successful Chi-squared test has been performed and documented.

Ensure that the counting system is set up for operation according to the applicable Instrument Calibration and Use Procedure and/or the manufacturer's technical literature.

Non-routine isotopes

- a) In addition to the routine frequency of determination, counting system efficiencies **SHOULD** be determined when isotopes with energies significantly different from the calibration energy must be analyzed.

Enter the following information on the Efficiency Data Sheet Form USRS HPQA05 or equivalent spreadsheet:

- a) Scaler / Counter ID Number.
- b) Detector ID Number, if external/separate.
- c) Source ID Number.
- d) The sources present total activity in dpm.
- e) The mean counting rate, c, of the source.

Calculations:

- a) Complete the following calculation on the Efficiency Data Sheet:

$$E = \frac{\text{Gross cpm} - \text{Net (background) cpm}}{(\text{Source Total Activity in dpm})}$$

NOTE:

Non-routine sources and/or geometry should be calculated only at the direction of the Health Physics Technical Supervisor or designee.

Alpha Channel

- a) Obtain a 47 mm diameter Th-230 or equivalent reference source greater than 1,000 dpm.
- b) Place the source in the detector chamber and count for a period of one minute.
- c) Determine the net count rate from the source.
- d) Determine the specific efficiency, E

NOTE:

Detection efficiencies for different sample types (i.e., geometry, mass, etc.) must be calculated separately.

e) Calculation:

$$E = \frac{\text{Average cpm} - \text{Background cpm}}{\text{Source Activity in dpm}}$$

f) Record the result on the data sheet.

Perform the following:

- a) Enter the date, time, and (printed) name (of the individual performing the test) on the Efficiency Data Sheet.
- b) Sign the data sheet.
- c) The Efficiency data MAY be submitted to the USRS Site Radiation Safety Officer or his/her designee at this time for review. Review SHOULD be performed at this time if:
 - a. Any of the data were anomalous, or
 - b. The entire Quality Control evaluation is not being performed at this time.

Beta Channel

- a) Obtain a 47 mm diameter Tc-99 or equivalent reference source greater than 1,000 dpm.
- b) Perform Steps Alpha Channel (b) through (f).

6.7 INSTRUMENT EFFICIENCY FOR PORTABLE SCALERS/COUNTERS (MODEL 2350-1, 2224'S, 2221'S, AND 2360'S WITH GAS PROPORTIONAL, SCINTILLATION, AND SODIUM IODIDE DETECTORS)

Determination of Instrument Efficiency (ϵ_i) for Alpha and Beta Surface Activity Measurements

The instrument efficiency (ε) is the ratio between the net count rate (in cpm) of the instrument and the surface emission rate of the efficiency check source for a specified geometry. The surface emission rate is the 2π particle fluence that is affected by both the attenuation and backscatter of the radiation emitted from the efficiency check source.

The following equation is used to calculate the instrument efficiency in counts per particle:

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\pi} \left(W_A / S_A \right)}$$

Where,

R_{S+B} = the gross count rate of the efficiency check source, measured in cpm
 R_B = the background count rate in cpm
 $q_{2\pi}$ = the 2π surface emission rate of the calibration source (NIST traceable)
 W_A = the active area of the probe window in square centimeters (cm²)
 S_A = the area of the source in cm²

Note: This equation assumes that the dimensions of the efficiency check source are sufficient to cover the window of the instrument detector. If the dimensions of the efficiency check source are smaller than the detector's window, set W_A equal to the dimensions of the efficiency source (i.e., set the quotient of W_A and S_A equal to 1).

Instrument efficiency determined during calibration shall be used for all instruments and radiation and contamination survey meters that are to be used for alpha and beta surveys for field operations. Instrument efficiency is dependent upon energy of the incident radiation. Multiple energy-specific instrument efficiencies may be determined when isotopes with significantly varying energies are analyzed.

A valid voltage plateau, or operating voltage, must have been determined and documented. A well determined background value also needs to be obtained and documented Form USRS-HPQA003. A successful Chi-squared test has been performed and documented.

Ensure that the counting system is set up for operation according to the applicable Instrument Calibration and Use Procedure and/or the manufacturer's technical literature.

Non-routine isotopes

- a) In addition to the routine frequency of determination, counting system efficiencies SHOULD be determined when isotopes with energies significantly different from the calibration energy must be analyzed.

Enter the following information on the Efficiency Data Sheet Form USRS HPQA05 or equivalent spreadsheet:

- a) Scaler / Counter ID Number.
- b) Detector ID Number, if external/separate.
- c) Source ID Number.
- d) The sources present 2π emission rate in alphas/min, betas/min, or gammas/min.
- e) The mean counting rate, c , of the source.

Alpha Measurements

- a) Obtain a Th-230 or equivalent reference source greater than 1,000 dpm
- b) Place the source in the appropriate location and distance from the active window of the detector.
- c) Determine the net count rate from the source.
- d) Determine the specific instrument efficiency, ε_i
- e) Calculation:

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\pi} (W_A/S_A)}$$

Where,

R_{S+B} = the gross count rate of the efficiency check source, measured in cpm
 R_B = the background count rate in cpm
 $q_{2\pi}$ = the 2π surface emission rate of the calibration source (NIST traceable)
 W_A = the active area of the probe window in square centimeters (cm^2)
 S_A = the area of the source in cm^2

- f) Record the result on the data sheet.

Perform the following:

- a) Enter the date, time, and (printed) name (of the individual performing the test) on the Efficiency Data Sheet.
- b) Sign the data sheet.

- c) The Efficiency data MAY be submitted to the USRS Site Radiation Safety Officer or his/her designee at this time for review. Review SHOULD be performed at this time if:
 - a. Any of the data were anomalous, or
 - b. The entire Quality Control evaluation is not being performed at this time.

Beta Measurements

- a) Obtain a 47 mm diameter Tc-99 or equivalent reference source greater than 1,000 dpm.
- b) Perform Steps Alpha Measurements (b) through (f).

6.8 DETERMINATION OF TOTAL EFFICIENCY (ϵ_T) FOR ALPHA AND BETA SURFACE ACTIVITY MEASUREMENTS (MODEL 2350-1, 2224'S, 2221'S, AND 2360'S WITH GAS PROPORTIONAL, SCINTILLATION, AND SODIUM IODIDE DETECTORS)

The total efficiency (ϵ_t) is determined during calibration and is defined as the ratio between the net count rate (in counts per minute (cpm)) of the instrument and the surface emission rate of the calibration source for a specified geometry. The surface emission rate is the 2π particle fluence that is affected by both the attenuation and backscatter of the radiation emitted from the calibration source.

The following equation is used to calculate the total efficiency:

$$\epsilon_t = \epsilon_i * \epsilon_s$$

Where,

- ϵ_i = the instrument efficiency (count per particle)
- ϵ_s = the contaminated surface efficiency (particle per disintegration)

Surface Efficiency (ϵ_s) for Surface Activity Measurements

The surface efficiency term is used to determine the 4π total efficiency for a particular surface and condition. Suitable values are based on the radiation and radiation energy, and are primarily impacted by the backscatter and self-absorption characteristics of the surface on which the contamination exists in the field. Backscatter is most affected by the energy of the radiation and the density of the surface material. Self-absorption characteristics or attenuation are also a function of the radiation's energy and surface condition. Surfaces typically encountered in the field include concrete, wood, dry wall, plaster, carpet, and

metal. Surface conditions include both physical effects, such as scabbled concrete, and the effect of surface coatings, i.e., dust, paint, rust, water, and oil.

In the absence of experimentally determined surface efficiencies, ISO-7503-1 and NUREG 1507, provide conservative recommendations for surface efficiencies. ISO-7503-1, recommends a surface efficiency of 0.5 for maximum beta energies exceeding 0.5 MeV, and to use a surface efficiency of 0.25 for beta energies between 0.15 and 0.4 MeV and for alpha emitters. NUREG-1507 provides surface efficiencies based on studies performed primarily at ORISE. In general, NUREG-1507 indicates that the ISO rule-of-thumb for surface efficiencies are conservative, particularly for beta-emitting radionuclides with end-point energies between 0.25 MeV and 0.4 MeV.

6.9 PERFORMANCE TEST FOR FIXED SCALERS/COUNTERS (MODEL 2929 DUAL CHANNEL SCALER, PROTEAN GAS PROPORTIONAL COUNTER)

A valid voltage plateau, or operating voltage, must have been determined and documented. A well determined background value also needs to be obtained and documented Form USRS-HPQA003. A successful Chi-squared test has been performed and documented.

Background Check

- a) Remove any source or sample from the detector tray.
- b) Place the appropriate clean blank in clean counting planchette.
- c) Lock the drawer closed.
- d) Perform a 10 minute timed background count.
- e) Divide the total counts for the alpha and beta-gamma channels by ten (10) to obtain results in cpm.
- f) Record the Alpha and Beta-Gamma results in cpm, in the respective columns on the Daily Background and Efficiency Form USRS-013, USRS-013A, USRS-013B, or USRS-013AB.
- g) Compare each background to its background and & range.
- h) If either background rate exceeds its limits, clean the sample drawer and recheck background.
- i) If either background remains out of range, remove the instrument from service and arrange for repair. Notify Health Physics Supervision.

NOTE:

It is permissible to use the Protean's control check and/or limit abilities for steps Alpha Source Check and Beta Source Check

Alpha Source Check (Th-230 or equivalent)

Retrieve from storage the check source identified in the 'SOURCE ID#' space at the top of form USRS-013, USRS-013A, or USRS-013AB.

Place the source in an empty counting planchette.

Open the sample drawer and place the source/planchette in the sample tray.

Close and lock the drawer in the count position, and perform a 1-minute timed count, record the results on Form USRS-013, USRS-013A or USRS-013AB.

Record the result of the source count in the "SOURCE COUNTS" (cpm) column of the form.

If the net response is within 10% of the source activity multiplied by the efficiency of the instrument, initial the "Initials" column of Form USRS-013, USRS-013A, or USRS-013AB.

Beta Source Check (Tc-99 or equivalent)

Repeat the steps of Section 7.9.3 using the beta check source specified in the 'SOURCE ID#' space at the top of form USRS-013, USRS-013A, or USRS-013AB.

Record the data in the applicable columns of Form USRS-013, USRS-013A or USRS-013AB.

Initial USRS-013, USRS-013B, or USRS-013AB in the appropriate columns. Initial the Performance Test Daily Check Sticker.

Return the check sources to their designated storage locations.

Determination of MDC for Fixed Scalers/Counters (Model 2929 Dual Channel Scaler, Protean Gas Proportional Counter)

- a) A valid voltage plateau has been performed and documented for those instruments or systems with a variable high voltage capability.
- b) A well determined background is available, unless an exception is made in the specific instrument procedure.

- c) A successful Chi-squared test has been performed and documented.
- d) Counting efficiency for the appropriate emission has been determined and documented.
- e) The daily checks have demonstrated that the instrument is in statistical control; OR; where directed by specific procedure, a daily working background has been determined.

Calculation:

Calculate MDC by performing a count of a paired blank for counting time equal to the sample counting time. A paired blank means a sample which is identical, chemically and physically, to the samples to be counted, except that no isotope is present (e.g., for smear samples a smear of a clean surface could be used as a paired blank for smears of potentially contaminated surfaces).

MDC may be calculated from the following formula:

$$MDC(dpm) = \frac{3 + 4.65\sqrt{C_B * T_B}}{E * T_B}$$

Where,

C_B = Background Counts for the paired blank (cpm)
 T_B = Sample Count Time for the paired blank (Minutes)
 E Instrument Efficiency for the isotope expected, expressed as a decimal

Record the MDC value for the appropriate channel (beta-gamma and alpha) on form USRS-006 or equivalent spreadsheet.

6.10 DETERMINATION OF DETECTION SENSITIVITY – STATIC AND SCAN MINIMUM DETECTABLE CONCENTRATION (MDC) FOR PORTABLE SCALERS/COUNTERS (MODEL 2350-1, 2224'S, 2221'S, AND 2360'S WITH GAS PROPORTIONAL, SCINTILLATION, AND SODIUM IODIDE DETECTORS)

Static MDC

The static MDC is the level of radioactivity, on a surface, that is practically achievable by the overall measurement process. The conventional equations below are used to calculate the instrument MDC in dpm per 100 cm².

$$MDC = \frac{3 + 4.65\sqrt{C_B}}{\epsilon_i \epsilon_s \frac{W_A}{100 \text{ cm}^2} T_B}$$

Where,

C_B	=	Background counts in time T_B (min)
T_B	=	Background counting time (min)
ε_i	=	the instrument efficiency (count per particle)
ε_s	=	the contaminated surface efficiency (particle per disintegration)
W_A	=	the area of the detector window (cm^2)

If the background and sample are counted for different intervals the following equation is used calculate the MDC in dpm per 100 cm^2 .

$$MDC = \frac{3 + 3.29 \sqrt{R_B T_{S+B} \left(1 + \frac{T_{S+B}}{T_B} \right)}}{\varepsilon_i \varepsilon_s \frac{W_A}{100 \text{ cm}^2} T_{S+B}}$$

Where,

R_B	=	background count rate (cpm)
T_B	=	background counting time (min)
T_{S+B}	=	sample counting time (min)
ε_i	=	the instrument efficiency (count per particle)
ε_s	=	the contaminated surface efficiency (particle per disintegration)
W_A	=	the area of the detector window (cm^2)

Scanning Minimal Detectable Count Rate, (MDCR)

The minimum detectable number of net source counts in the scan interval, for an ideal observer, can be arrived at by multiplying the square root of the number of background counts (in the scan interval) by the detectability value associated with the desired performance (as reflected in d') as shown in equation below:

$$MDCR = d' \sqrt{b_i} \times 60/i$$

Where,

d'	=	index of sensitivity (α and β error) – MARSSIM Table 6.5
b_i	=	number of background counts in scan time interval (count)
i	=	scan or observation interval (s)

Scan MDC

The scan MDC is determined from the minimum detectable count rate (MDCR) by applying conversion factors that account for detector and surface characteristics and surveyor efficiency. As discussed below, the MDCR accounts for the background level, performance criteria (d'), and observation

interval. The observation interval during scanning is the actual time that the detector can respond to the contamination source. This interval depends on the scan speed, detector size in the direction of the scan, and area of elevated activity.

The scan MDC for building structure surfaces is calculated using the following formula:

$$\text{Scan MDC} = \frac{MDCR}{\varepsilon_i \varepsilon_s \frac{W_A}{100 \text{ cm}^2}}$$

Where,

MDCR=	discussed previously
T _B =	background counting time (min)
ε _i =	the instrument efficiency (count per particle)
ε _s =	the contaminated surface efficiency (particle per disintegration)
W _A =	the area of the detector window (cm ²)

6.11 MAINTENANCE

No special storage requirements.

Electronic maintenance (except external adjustments and cable replacements) shall be performed by a Health Physics Instrumentation Technician or by the manufacturer or an approved vendor.

7.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

- 7.1 Form USRS-013 Ludlum Model 2929 Daily Background and Efficiency
- 7.2 Form USRS-013A Alpha Counting Scaler Daily Background and Efficiency
- 7.3 Form USRS-013B Beta Counting Scaler Daily Background and Efficiency
- 7.4 Form USRS-013AB Dual Channel Scaler Daily Background and Efficiency
- 7.5 Calibration Data Sticker
- 7.6 Daily Performance Test Check Sticker

8.0 REFERENCES

- 8.1** Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575, EPA 402-R-97-016
- 8.2** The Health Physics and Radiological Health Handbook 1992, Shleien, Revised Edition
- 8.3** NUREG/CR-5849 "Manual for Conducting Surveys in Support of License Termination"
- 8.4** NUREG-1505 "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys"
- 8.5** NUREG-1507 "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions"

9.0 ATTACHMENTS

None



Technical Operating Procedure
OPERATION OF LUDLUM MODEL 19
SURVEY METER

200-IP-201

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019

Date

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1.0 SCOPE

This procedure sets forth the specific requirements to be used for the operation and calibration of the Ludlum Model 19 Survey (Micro-R Meter) for use on Up-Side Radiological Survey, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to provide instructions for the operation and calibration of the Ludlum Model 19 Micro-R Meter.

3.0 REFERENCES

- 3.1** 10 CFR 20, "Standards for Protection Against Radiation"
- 3.2** ANSI/ANS-3.1 – 2014, Selection, Qualifications and Training of Personnel for Nuclear Power Plants
- 3.3** Manufacturer's instruction manual for the Ludlum Model 19 Micro-R Meter
- 3.4** ANSI N323 – 1997, Instrument Test and Calibration

4.0 PRECAUTIONS, LIMITATIONS

4.1 Precautions

- 4.1.1** Due to very low response ranges on the Model 19 only the 5,000 Micro-R (μR) scale can be calibrated to an actual source reading. All other scales will be calibrated to pulse generator.
- 4.1.2** These detectors are not guaranteed light tight when outside of their instrument cases.
- 4.1.3** Due to the very low response ranges this instrument should not be used in areas where elevated (>5 mrem/hr) radiation fields are anticipated.
- 4.1.4** When using this instrument in a known, or suspected contaminated area, seal the instrument and protective media (i.e. plastic poly) to prevent contamination of the instrument.

4.2 Limitations

- 4.2.1** The operation of the Model 19 depends on the condition of the battery. Therefore, the battery check should be performed before each use and periodically during use to ensure proper operation.
- 4.2.2** Calibration shall be performed semi-annually, after maintenance is performed, if the instrument fails the performance test or if proper operation is in question.

- 4.2.3** A daily performance test is required when this instrument is in use.
- 4.2.4** This is a gamma ray/photon exposure rate survey instrument only. Due to the non-linear detection efficiency of the sodium iodide detector, the term exposure rate is used loosely in the sentence.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

5.1.1 USRS Radiological Field Operations Manager

- 5.1.1.1 Implementation of this procedure.
- 5.1.1.2 Periodic reviews of adherence to the requirements of this procedure.
- 5.1.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform requirements of this procedure.

5.1.2 Health Physics Supervisors

- 5.1.2.1 Perform periodic surveillance of the use and maintenance of the instrument.
- 5.1.2.2 Ensure the instrument is calibrated at specified intervals.
- 5.1.2.3 Ensure that records pertaining to the instrument are maintained on file throughout the duration of the project and copies retained in the permanent project file.

5.1.3 Health Physics Technicians

- 5.1.3.1 Performance of the requirements in section 6.1, and 6.3 of this procedure.
- 5.1.3.2 Documentation of all records in this procedure.
- 5.1.3.3 Notification to Health Physics Supervision of any unsafe or unusual conditions observed during operation of the instrument.

5.1.4 Health Physics Instrument Personnel

- 5.1.4.1 Perform the requirements of section 6.2, 6.3, and 6.4 of this procedure.

5.2 Qualifications

- 5.2.1** Health Physics Technicians shall be qualified in accordance with the requirements of ANSI 3.1 – 2014 to operate this instrument for any of the following: surveys, radiation work permits and job coverage.
- 5.2.2** Junior Health Physics and Decontamination Technician may operate this instrument under direct supervision of the Health Physics Technician meeting the requirements of section 5.2.1.

6.0 PROCEDURE

6.1 Operation

- 6.1.1** Verify that the instrument has a valid Calibration Data Sticker, is not out of calibration, and the daily performance test has been completed and initialed on the Daily Performance Test Check Sticker. If the performance test has not been completed, have a Health Physics Technician perform the test (Section 6.3).
- 6.1.2** Inspect the instrument for any obvious physical damage that could interfere with its proper operation. It should include inspecting for loose, damage knobs, buttons, broken or damaged meter movement/displays, dented or corroded instrument cases, punctured/deformed probe/probe window(s). Particular attention should be given to cables and connectors, since these components frequently become damaged or worn. Any instrument or detector having a questionable physical condition shall not be used until properly corrected.
- NOTE:** The Model 19 detector is a scintillation solid attached to a fragile glass photomultiplier tube with a glass wall. The thickness of this wall is similar to that of the light bulb. If the detector is subjected to shock the tube will break and disabled the detector.
- 6.1.3** Perform a battery check by pressing the “BAT” button on the meter with the instrument selector switch turned to an “on” scale position. Ensure that the meter needle is within the “BATTERY” area on the meter face.
- 6.1.4** If unsatisfactory results are obtained, refer to Reference 3.1.3 for replacement of the batteries and repeat the check. The instrument shall display a satisfactory battery check prior to each use.

NOTE:

If entering a limited visibility area to perform a survey, check the meter face by depressing the "L" Button.

- 6.1.5** If the instrument fails any of the above checks, remove it from service, notify Health Physics Supervision, and arrange for repair of the meter.

- 6.1.6** Set the audio response switch to the “ON” position.
- 6.1.7** Set the F/S selector switch to the appropriate setting. (F: Fast, 4 second response time, erratic needle deflection S: Slow, 22 sec response time, stable needle deflection).
- 6.1.8** Set the range selector switch to an appropriate range for the activity being investigated. When entering an area of unknown radiation levels always enter the area the highest scale (5000 $\mu\text{R/hr}$) and scale down until an upward meter deflection is observed.

NOTE:

$$1 \mu\text{R/hr} = .001 \text{ mrem/hr}$$

- 6.1.9** The instrument’s case is constructed with three dimples on the bottom front end of the case. These dimples represent the detector crystal centerline. This area of the instrument should be held closest to the source of activity when performing surveys.
- 6.1.10** Read the meter after sufficient response time (i.e., the meter needle is relatively stable) changing ranges as necessary for the activity encountered. If the meter is used for an extended period of time, check the battery condition periodically to ensure proper operation.
- 6.1.11** On completion of instrument use, Sections 6.1.2 and 6.1.3 should be performed to ensure the instrument is still functioning properly. If the instrument fails either portion, notify Health Physics Supervision and arrange for instrument repair.

6.2 Calibration

6.2.1 Equipment needed:

6.2.1.1 Calibrated Eberline MP-2 or equivalent traceable to N.I.S.T.

6.2.1.2 Calibrated Shepherd Model 28-B Calibrator or equivalent traceable to N.I.S.T.

6.2.2 Initiate the Instrument Service Record - Ludlum Model 19 Form USRS – 008 by completing Section 1. Attach the old calibration data sticker to the new USRS–008 form.

6.2.3 Perform the following checks. If necessary, complete the “As Found Data” and arrange for repair before proceeding. Record your findings in the remarks section of the form or USRS – 008.

- 6.2.3.1 Check the physical condition of the instrument for defects that could affect instrumentation operation and record results on form USRS–008.
- 6.2.3.2 Perform a battery check, replace if necessary in accordance with the reference 3.1.3. Record results on form USRS–008.
- 6.2.3.3 Depress the reset switch to see that the meter returns to zero from any deflection. Record as “SAT” or “UNSAT” in section 2 of USRS–008.
- 6.2.3.4 Change the F/S switch (FAST/SLOW) between positions and verify the instrument’s meter responds accordingly. Record as “SAT” or “UNSAT” on USRS–008.
- 6.2.3.5 Switch the audio “ON” and verify that the speaker works. Record as “SAT” or “UNSAT” on USRS–008.

6.2.4 Determine exposure rates to be used as follows:

- 6.2.4.1 Select from the calibration curve of the model 28–5A source (Or equivalent) two exposure rate values for the high scale. These values should be approximately 20% and 80% of the full-scale value.
- 6.2.4.2 Determine the required values for the four lower sales, which will be pulse calibrated by reducing exposure rates selected on high scale by the appropriate factors (i.e. reduced by a factor of 10 when going from 5000 to 500 scale).

6.2.5 Determine the “AS FOUND” reading for the High scale as follows:

- 6.2.5.1 Ensure that the selector switch is at the desired scale position.
- 6.2.5.2 Expose the properly centered detector to each selected exposure rate.
- 6.2.5.3 Record the reading in the “AS FOUND” column on USRS– 008.

6.2.6 Determine the “AS FOUND” reading for the lower scales, which are calibrated by pulse generator, as follows:

- 6.2.6.1 Disconnect the detector jacks from the circuit board.
- 6.2.6.2 Connect the pulse generator to the detector jacks on the circuit board.
- 6.2.6.3 Set the pulse height to between 60 and 100 milli-volts negative.

- 6.2.6.4 Set the selector switch to the high scale.
- 6.2.6.5 Adjust the pulse rate until the required value for 20% of the high scale is indicated.
- 6.2.6.6 For each lower scale, reduce the pulse rate by the appropriate factor (i.e. reduce by a factor of 10 when going from 5000 scale to the 500 scale).

NOTE:

On the Model 19 when switching from the 500 scale to the 250 scale or the 50 scale to the 25 scale, decreasing the pulse rate by 50% is accomplished by decreasing the mini-pulse base switch setting by 50%.

- 6.2.6.7 Record the readings in the “AS FOUND” column on USRS – 008.
 - 6.2.6.8 Repeat steps 6.2.6.4 through 6.2.6.7 for approximately 80% of the scale.
 - 6.2.6.9 Remove the pulse generator and connect the detector to the circuit board.
- 6.2.7** Place the selector switch to the high scale.
- 6.2.7.1 Connect an electrostatic voltmeter or equivalent to the connections on the circuit board.
 - 6.2.7.2 Measure the high voltage at the detector connection and record the high voltage in the “AS FOUND” column on USRS– 008.
- 6.2.8** With the selector switch in the “OFF” position, to determine if the meter movement is on zero (0).
- 6.2.8.1 If the meter movement read zero proceed to section 6.2.9.
 - 6.2.8.2 If the meter movement is not on zero, turn the mechanical zero screw on the meter face until the meter movement reaches zero.
- 6.2.9** If the “AS FOUND” readings observed in section 6.2.6 fall within the $\pm 10\%$ tolerance limit and the mechanical zero was not adjusted, record the ratings in the “AS LEFT” column on USRS-008. If better accuracy is desired, steps 6.2.11, 6.2.12, and 6.2.13 maybe performed.
- 6.2.10** If any of the “AS FOUND” readings observed in section 6.2.5 and 6.2.6 do not fall within the $\pm 10\%$ tolerance limit or if the mechanical zero was adjusted, proceed to step 6.2 .11.

6.2.11 Determine the detector operating voltage as follows:

- 6.2.1 1.1 Expose the instrument to approximately 1 mr/hr field.
- 6.2.1 1.2 Decrease the high voltage until there is a marked decrease in the exposure rate indicated on the meter.
- 6.2.11.3 Increase high voltage in approximately 50-volt increments and plot a voltage vs. indicated exposure rate plateau until there is a significant increase in exposure rate as indicated on the meter. Do not increase the voltage more than 1,200 volts.
- 6.2.11.4 Set the voltage in the middle of the plateau.
- 6.2.11.5 Measure the high voltage and record as the “AS LEFT” voltage on the USRS-008.

6.2.12 Calibrate the high scale to the required value as follows:

- 6.2.12.1 Position instrument so that the effective center of the detector will be in the source beam when the sources exposed.
- 6.2.12.2 Expose the detector to the selected exposure rate to give 80% of the full scale response, (4,000 μ R/hr).
- 6.2.12.3 Adjust calibration control until the reading is within $\pm 10\%$ of the required value.
- 6.2.12.4 Expose the detector to the selected exposure rate to give 20% of full scale response, (1,000 μ R/hr).
- 6.2.12.5 Adjust the calibration control, if necessary to obtain the reading to within $\pm 10\%$ of the required value.
- 6.2.12.6 Record the observed value for each selected position in the “AS LEFT” column on USRS– 008.
- 6.2.12.7 If the instrument cannot be adjusted to $\pm 10\%$ of the required value, remove the instrument from service, notify Health Physics Supervision, arrange for repair of instrument.

6.2.13 Adjust each scale that is to be calibrated to the pulse generator as follows:

- 6.2.13.1 Set selector switch to the high scale.
- 6.2.13.2 Adjust the pulse generator until the required value selected for approximately 80% of full scale.

- 6.2.13.3 Set the selector switch to the next range to be checked and reduce the pulse rate by the appropriate factor.
- 6.2.13.4 Adjust the calibration control until the reading is within $\pm 10\%$ of the tolerance limit.
- 6.2.13.5 Repeat steps 6.2.13.3 and 6.2.13.4 for each lower scale.
- 6.2.13.6 Repeat steps 6.2.13.1 through 6.2.13.3 for approximately 20% of the full scale.
- 6.2.13.7 Record the final observed value for each selected position in the "AS LEFT" position on USRS– 008.
- 6.2.13.8 If the instrument cannot be adjusted to read within $\pm 10\%$ of the required value, remove the instrument from service, notify Health Physics Supervision and arrange for instrument repair.
- 6.2.13.9 Disconnect the pulse generator and reconnect the detector.
- 6.2.13.10 Reassemble the unit.

6.2.14 Determine Performance Test Data

- 6.2.14.1 Obtain a 5 μCi Cs-137 button source and record the serial number on USRS – 008.
- 6.2.14.2 Switch the instrument to the appropriate range and obtain a source reading on contact. Record the observed reading on USRS – 008.
- 6.2.14.3 Calculate the performance test range, $\pm 10\%$ of the source reading, and record results on USRS-008.

6.2.15 If the above calibration steps are completed satisfactory, attach a completed Calibration Data Sticker and Performance Test Daily Check Sticker to the instrument. Complete form USRS–008 as appropriate.

6.3 Performance Test

- 6.3.1** Perform a performance test on the instrument and record all data on form USRS–003, Performance Test Log Sheet.
- 6.3.2** Obtain the performance test source designated by the Performance Test Daily Check Sticker on the instrument.
- 6.3.3** Record the information for each section of form USRS-003.

- 6.3.4** Examine the instrument for any obvious physical damage, which could interfere with its proper operation.
- 6.3.5** Verify that the instrument has a current Calibration Data Sticker and Performance Testing Daily Check Sticker.
- 6.3.6** Perform a battery check by turning the selector switch to the 5,000 $\mu\text{R/hr}$ scale and depressing the “BATT” button, if the unit does not read in the “BATTERY” area, replace the batteries.
- 6.3.7** Expose the center of the detector to the designated source. If the reading is within the designated range for the source, proceed to step 6.3.9. If the instrument fails record “F” for “FAIL” on USRS–003 and remove the instrument from service for repair or calibration.
- 6.3.8** If the instrument fails any portion of the performance test, log the instrument as failing on the Performance Test Log Sheet, remove from service, and notify Health Physics Supervision.
- 6.3.9** If the instrument passes the performance test, record “P” for “PASS” on form USRS–003, then initial Performance Test Daily Check Sticker on instrument and initial Performance Test Log Sheet.

NOTE:

Due to the extremely low ranges incorporated in the instrument, only the high scales may be performance tested to an actual source reading.

6.4 Maintenance

- 6.4.1** No special storage requirements.
- 6.4.2** Electronic maintenance shall be performed by a Health Physics Instrumentation Technician or by the manufacturer or a approved vendor.
- 6.4.3** All maintenance shall be performed in accordance with the manufacturers’ specifications.
- 6.4.4** If re-calibrating is not required, performance test the instrument as per Step 6.3 prior to returning the instrument to service.

7.0 Records

The following records will be generated and retained in a permanent project file as a result of using this procedure.

- 7.1** Form USRS–008 Instrument Service Record – Ludlum Model 19
- 7.2** Form USRS–003 Daily Instrument Performance Test Log Sheet
- 7.3** Calibration Data Sticker
- 7.4** Daily Performance Test Check Sticker

8.0 FORMS AND EXHIBITS

- 8.1** Forms
 - 8.1.1** USRS–008, Instrument Service Record – Ludlum Model 19
 - 8.1.2** USRS–003, Daily Instrument Performance Test Log Sheet
- 8.2** Exhibits
 - 8.2.1** Performance Test Daily Check Sticker
 - 8.2.2** Calibration Data Sticker


					USRS, LLC							
					Daily Instrument Source Check							
Instrument Serial Number												
Probe Serial Number												
Calibration Date												
Month (Circle One)					Technician Initial & Date							
J	F	M	A	M	J	J	A	S	O	N	D	
1	2	3	4	5	6	7						
8	9	10	11	12	13	14						
15	16	17	18	19	20	21						
22	23	24	25	26	27	28						
29	30	31										

EXHIBIT 8.2.2

Calibration Data Sticker

Survey Meter Calibration

Model _____ Serial No. _____

***Range within 10% unless noted**

X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____

Ded. Ck. Source S/N _____

Act. _____ Reads _____

Cal. Date _____ Due Date _____

Calibrated by _____

LUDLUM MEASUREMENTS, INC.
Sweetwater, Texas (915) 235-5494



Technical Operating Procedure

**OPERATION AND CALIBRATION OF
LUDLUM MODEL 2929
SCALER**

200-IP-202

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019

Date

REVISION HISTORY

Revision (Date)	Rev. No	Prepared By	Description of Changes	Affected Pages
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1.0 SCOPE

This procedure sets forth the specific requirements to be used for the operation and calibration of the Ludlum Model 2929 Dual Channel Scaler and the Ludlum Model 43-10-1 Alpha-Beta-Gamma Detector for use on Up-Side Radiological, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to provide instructions for the operation and calibration of the Ludlum Model 2929 Dual Channel Scaler and the Ludlum 43-10-1 Alpha-Beta-Gamma Detector in accordance with requirements specified in Reference 3.1.4.

3.0 REFERENCES

3.1 References

- 3.1.1 Project/Site Health and Safety Plan
- 3.1.2 Project/Site Detailed Work Procedure
- 3.1.3 ANSI/ANS-3.1 – 2014, Selection, Qualifications and Training of Personnel for Nuclear Power Plants
- 3.1.4 Manufacturer's instruction manual(s) for the Ludlum Model 2929 Dual Channel Scaler and Ludlum Model 43–10-1 Alpha-Beta-Gamma Sample Probe
- 3.1.5 ANSI N323 – 1997, Instrument Test and Calibration
- 3.1.6 300-SP-301, Radiation and Contamination Surveys
- 3.1.7 400-CP-404, Control of Radioactive Material

4.0 PRECAUTIONS, LIMITATIONS

4.1 Precautions

- 4.1.1 In the event of loss of power to the instrument, the Ludlum Model 2929 shall require a performance test.
- 4.1.2 The user should verify that the sample activity does not cause a count rate in excess of 1,000 counts per minute (cpm) the pancake probe GM detector prior to inserting the sample into the counter to prevent contaminating the probe service area.
- 4.1.3 Unless the sample tray drawer is locked closed, the probe will receive no high-voltage and the instrument will register no counts. The scaler will cycle through the counting process regardless of the sample tray drawer position.

4.1.4 All sources and samples shall be controlled in accordance with Reference 3.1.7.

4.2 Limitations

4.2.1 The Ludlum Model 2929 is semi-portable and requires 110 volt line current to operate.

4.2.2 Only thin samples of diameter no larger than 2" (5cm) may be counted on the instrument.

4.2.3 Calibration shall be performed annually, after maintenance is performed, if the instrument fails the performance test or if its proper operation is in question.

4.2.4 The instrument shall be performance tested daily when in use per Section 6.4.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

5.1.1 USRS Radiological Field Operations Manager

5.1.1.1 Implementation of this procedure.

5.1.1.2 Periodic reviews of adherence to the requirements of this procedure.

5.1.1.3 Ensures by training and experience Health Physics Technicians are qualified to perform requirements of this procedure.

5.1.2 Health Physics Supervisors

5.1.2.1 Perform periodic surveillance of the use and maintenance of the instrument.

5.1.2.2 Ensure the instrument is calibrated at specified intervals.

5.1.2.3 Ensures that records pertaining to the instrument are maintained on file throughout the duration of the project and copies retained in the permanent project file.

5.1.3 Health Physics Technicians

5.1.3.1 Performance of the requirements in section 6.1, and 6.4 of this procedure.

5.1.3.2 Documentation of all records in this procedure.

- 5.1.3.3 Notification to Health Physics Supervision of any unsafe or unusual conditions observed during operation of the instrument.

5.1.4 Health Physics Instrument Personnel

- 5.1.4.1 Perform the requirements of section 6.2, 6.3, and 6.4 of this procedure.

5.2 Qualifications

- 5.2.1 Health Physics Technicians shall be qualified in accordance with the requirements of ANSI/ANS-3.1 – 2014 to operate this instrument for any of the following: Surveys, Radiation Work Permits and Job Coverage.

- 5.2.2 Junior Health Physics and Decontamination Technicians may operate this instrument under supervision of the Health Physics Technician meeting the requirements of section 5.2.1.

6.0 PROCEDURE

6.1 Operation

- 6.1.1 Verify that the instrument has a valid Calibration Data Sticker Label and is not out of calibration, and the performance test has been completed and initialed on the Performance Test Daily Check Sticker. If the performance test has not been completed, have a Health Physics Technician perform the test (Section 6.4).

- 6.1.2 Inspect the instrument for any obvious physical damage which could interfere with its proper operation. It should include inspecting for loose, damage knobs, buttons, broken or damaged meter movement/displays, dented or corroded instrument cases, punctured/deformed probe/probe window(s). Particular attention should be given to cables and connectors, since these components frequently become damaged or worn. Any instrument or detector having a questionable physical condition shall not be used until properly corrected.

- 6.1.3 Perform counting of smears and air samples:

- 6.1.3.1 Place the sample in a clean planchet with the suspected radioactive material up.
- 6.1.3.2 Place the planchet in the sample drawer and push the drawer fully into the detector unit.
- 6.1.3.3 Lock the drawer in place by using the lever on the side of the detector housing.
- 6.1.3.4 Activate the count for the pre-selected period by pressing the “count” button.

- 6.1.3.5 Air samples should be counted for a minimum of 10 minutes.
- 6.1.3.6 Smears should be counted for a minimum of one minute, depending on the desired sensitivity for the count.
- 6.1.3.7 Upon completion of the count period, obtain the total counts in the Alpha and Beta-Gamma channel displays and record this data on the USRS-006 form.
- 6.1.3.8 Remove the sample from the detector unit by unlocking and pulling out the drawer.
- 6.1.3.9 Repeat Steps 6.1.3.1 through 6.1.3.8 for the remaining samples to be counted.
- 6.1.3.10 MDA shall be calculated and recorded in accordance with section 6.4.4.

6.2 Calibration

6.2.1 Equipment needed:

- 6.2.1.1 Calibrated electrostatic voltmeter or equivalent traceable to N.I.S.T.
- 6.2.1.2 Calibrated Eberline minipulser or equivalent traceable to N.I.S.T.
- 6.2.1.3 Th-230 reference source greater than 10,000 dpm traceable to N.I.S.T.
- 6.2.1.4 TC-99 reference source greater than 10,000 dpm traceable to an N.I.S.T.

6.2.2 Initiate the Instrument Service Record - Ludlum Model 2929/43-10-1 (USRS-009) by completing Section 1. Attach the old calibration data sticker to the new USRS-009 form.

6.2.3 Check the physical condition of the instrument for defects that could affect instrument operation. If necessary, complete the "As Found Data" and arrange for repair before proceeding to record your findings on USRS-009.

6.2.4 Steps 6.2.4.1, 6.2.4.2, and 6.2.4.3 should be performed only upon initial calibration or repair, which may affect the scaler for proper operation of the scaler in question.

6.2.4.1 Amp/Disc Board Calibration

- (a) Apply a negative pulse of 10 mV amplitude to the DETECTOR input of the Model 2929. A count rate that is greater than 25,000 cpm should be used.

- (b) Connect an oscilloscope probe to the AMP OUT connector located on the back panel of the Model 2929.
- (c) Adjust the GAIN control located internally to and on the right-hand side of the instrument for positive pulse amplitude of 250 mV (at the AMP OUT connector). This amplitude has been decreased from the initial value of 400 mV.
- (d) This completes the amplifier gain calibration. The optimum amplifier gain should be 25 V/V.

6.2.4.2 B-G Threshold and Width Calibration

- (a) Apply a negative pulse of 200mV amplitude.
- (b) Attach an oscilloscope probe to pin 7, U5 (CD4098) and adjust B–G THS WIDTH (R6) for a 5 microsecond (μ s) wide negative volt pulse.
- (c) Move the oscilloscope probe to pin 9, U5 (CD4098) and adjust B–G WIN WIDTH (R5) for a 10 microsecond (μ s) wide positive 5-volt pulse.
- (d) Now move the oscilloscope to pin 9, U6 (CD4098) and apply a negative pulse of 4mV amplitude.
- (e) Adjust B-G THS (R3) until negative 5 volt pulses just appear.
- (f) Apply a negative pulse of 50mV amplitude and adjust B-G WIN (R2) until negative 5-volt pulses just disappear.
- (g) Apply a negative pulse of 175mV amplitude and adjust ALPHA THS (R4) until a 5-volt positive pulse appears at pin 6 of U6 (CD 4098).

NOTE:

Steps (a), (b), and (c.) above do not normally require pre-adjustment. These steps may be accomplished without the use of oscilloscope by using the audio speakers.

Beta–Gamma audio should only be present for any applied pulse amplitude from 4mV to 50mV. Alpha audio should only be preset for a pulse amplitudes 175mV and above.

6.2.4.3 High Voltage Power Supply Calibration

- (a) Using a high voltage meter of at least 100 Mega Ohm input impedance, adjust the front panel HV control for 1,000 VDC at the DETECTOR connector.
- (b) Adjust R5 (brd 5170–011-00) for a front panel meter reading of 1 Kilovolt (Note: If adjustment is necessary, a 10-pin extender board will be required).
- (c) With no detector attached, turn the HV dial to maximum (fully clockwise) and adjust R13 for 1,500 Volts (higher limits may be necessary depending upon the type of detector being used).

6.2.5 Counter verification

- 6.2.5.1 Connect an Eberline minipulser or equivalent to the input connector of the Model 2929. Increased the minipulser amplitude enough to make the Model 2929 count and use the pulse inputs signified on USRS-009 as the inputs. Record your findings on USRS – 009.
- 6.2.5.2 If the readings are within the acceptance ranges, record the “AS FOUND” readings as the “AS LEFT” readings. If the readings are out of specification, then disposition the unit for repair. Note accordingly, in the remarks section of USRS-009 zero, your findings.

6.3 Counter Quality Control Checks

Quality control testing and evaluation approval shall be performed semi-annually (± 15 days). The routine frequency may be extended by up to one additional month with the written approval of the USRS Radiation Safety Officer. In addition to the routine frequency of the performance, quality control testing and evaluation shall be performed under the following conditions:

- a. Prior to placing a new counting system to service.
- b. After any major repair or alteration to the counting system or detectors.

6.3.1 Detector Voltage Plateau

- 6.3.1.1 Obtain a radiation source with known counting rate in the region of 1,000 to 20,000 counts per minute (cpm)
- 6.3.1.2 Record the following information on the Plateau Data Sheet, form USRS–QA01 or equivalent form:
 - a. Scaler/counter ID Number

b. Detector ID Number, if external/separate

c. Source ID Number

6.3.1.3 Place the source and the detector chamber.

6.3.1.4 Set the high-voltage adjustment of the counting system to the lowest possible setting.

NOTE:

DO NOT exceed the manufacturer's limitations or restrictions on voltage for either the detector or the power supply.

6.3.1.5 Gradually increase the high-voltage until a rapid increase in count rate is obtained. Note the high-voltage setting.

6.3.1.6 Reduce the high-voltage to approximately 100 volts below the noted increased point.

6.3.1.7 Obtain, and record on the Plateau Data Sheet, a series of one minute counts at appropriate voltage increments, usually equal increments of 20 to 50 volts are convenient, until EITHER no further voltage increase is possible, OR a secondary sharp increase in the count rate is noted.

6.3.1.8 Using the Voltage Plateau Graph, plot a curve of count rate (vertical axis) versus voltage (horizontal axis).

6.3.1.9 Record the following on the Voltage Plateau Graph, form USRS-QA02 or equivalent form.

- a. Scaler/counter ID number
- b. Detector ID number, if external/separate
- c. Source ID number

6.3.1.10 The relatively flat portion of the plot is the plateau. The correct operating voltage is located one-third to one-half the distance up the plotted plateau. Pick a point within this range with a convenient value of high-voltage. Use whole numbers, if possible multiple of 10, only.

6.3.1.11 Record this operating voltage on the Voltage Plateau Graph.

6.3.1.12 Perform the following:

- a. Enter the date, time and printed name of the individual performing the test on the both the data sheet in the graph sheet.

- b. Sign both the data sheet and the graph sheet.

6.3.1.13 The plateau data and graph MAY be submitted to the USRS Radiation Safety Officer at that this time for review. Review should be performed at this time if:

- a. Any of the data were anomalous, or
- b. The entire Quality Control evaluation is not being performed at this time.

6.3.2 Determination of System Background

6.3.2.1 Prerequisites

A valid voltage plateau or operating voltage has been determined and documented.

6.3.2.2 Record the following information on the Background Data Sheet, form USRS– QA03 or equivalent spreadsheet:

- a. Scaler/counter ID Number
- b. Detector ID Number, external/separate
- c. Source ID Number

6.3.2.3 Data Accumulation

- a. Place a clean, empty planchet in the sample holder
- b. Insert the sample holder and detector chamber
- c. Set the instrument for a timed count of one minute
- d. Count the empty planchet
- e. Record the total counts on the background data sheet form USRS-QA03 or equivalent spreadsheet.

NOTE:

The instrument/system may remain in service, using the "old" background during the accumulation of data for the new determination of background. The repetitive counts may be accumulated over several days, however all count shall be completed within 10 days of the initial count.

6.3.2.3 Repeat Section 6.3.2.3 nine (10 total counts) additional times.

6.3.2.4 Remove the empty planchet from the detector chamber.

6.3.3 Calculations:

- a. Total the values of the individual counts. Enter the value in the Total box on the data sheet.
- b. Divide the total by the number, 10, of determinations. Enter this value in the mean count, \bar{x} , box on the data sheet.
- c. Subtract the mean count, \bar{x} , from each of the individual counts. Enter the values found in the column labeled $(x - \bar{x})$ on the data sheet.
- d. Square each of the deviations, $(x - \bar{x})$. Enter the values found in the column labeled $(x - \bar{x})^2$ on the data sheet.
- e. Total the values of the squared deviations column and enter this value in the Sum of Squares, box on the data sheet.
- f. Divide the sum of squares, by nine (9). Enter this value in the Variance, box on the data sheet.
- g. Extract the square root of the Variance and enter the value in the Standard Deviation (σ) (Counts), box on the data sheet.
- h. The Background Count Rate $\pm 2\sigma$ is the acceptable background range.
- i. Enter the background range in the appropriate blocks of Form USRS-013 or USRS-013A.
- j. Perform the following:
 1. Enter the date, time, and (printed) name (of the individual performing the test) on the Background Data Sheet.
 2. Sign the data sheet.
- k. The Background data MAY be submitted to the cognizant Health Physics Technical Supervisor at this time for review. Review should be performed at this time if:
 1. Any of the data were anomalous, or
 2. The entire Quality Control evaluation is not being performed at this time.

6.3.4 Chi-Squared Test of Reliability

6.3.4.1 Prerequisites

- a. A valid voltage plateau, or operating voltage, has been determined and documented.
 - b. A well determined background value has been obtained and documented.
- 6.3.4.2 Ensure that the counting system is set up for operation according to the applicable Instrument Calibration and Use Procedure and/or the manufacturer's technical literature.
- 6.3.4.3 Obtain a NIST Traceable Standards Source with isotopic content appropriate to the detector being evaluated.
 - a. The source should be of sufficient activity to yield a counting rate of 1000 to 50,000 counts per minute.
 - b. Source should not exceed 50,000 counts per minute.
- 6.3.4.4 Record the following information on the Chi-Squared Data Sheet, form USRS-QA004 or equivalent spreadsheet:
 - a. Scaler/Counter ID Number
 - b. Detector ID Number, if external/separate.
 - c. Source ID Number.
- 6.3.4.5 Place the source in the detector chamber.
- 6.3.4.6 Collect twenty (20) counts of one (1) minute duration each. Record the results, in counts per minute, in the column labeled "Gross cpm, C_G ".
- 6.3.4.7 Subtract the background count rate, C , from each count to obtain the net count rate. Record results in the column labeled "Net cpm, C_I ".
- 6.3.4.8 Calculations:
 - a. Sum the twenty C_I values and record the results in the box labeled.
$$\text{SUM} = \sum C_I$$
 - b. Divide the total by 20 and record the result obtained in the box labeled:
$$\text{MEAN } (\bar{C}) = (C_I / 20)$$

- c. Subtract the mean count rate, \bar{C} from each of the C_i values, recording the results in the column, $(C_i - \bar{C})$.
- d. Square each of the $(C_i - \bar{C})$ values obtained, record the results in the column labeled, $(C_i - \bar{C})^2$.
- e. Sum the twenty $(C_i - \bar{C})^2$ values and record the results in the box labeled:

$$\text{Sum of Squares} = \Sigma (C_i - \bar{C})^2$$

- f. Calculate the Chi-Squared value by dividing the Sum of Squares " $\Sigma (C_i - \bar{C})^2$ " by the mean count rate \bar{C} and record the results in the box labeled Chi-Squared Value(C^2).
- g. The Chi-Squared value should be between 10.11 and 30.14. If the C^2 value is not between 10.11 and 30.14, THEN notify the USRS Site Radiation Safety Officer or his/her designee prior to continuing.

6.3.4.9 Perform the following:

- a. Enter the date, time and (printed) name (of the individual performing the test) on the Chi-Squared Data Sheet or equivalent spreadsheet.
- b. Sign the data sheet.
- c. The Chi-Squared data MAY be submitted to the USRS Site Radiation Safety Officer or his/her designee at this time for review. Review should be performed at this time if:
 1. Any of the data were anomalous, or
 2. The entire Quality-control evaluation is not being performed at this time.

6.3.5 Counting system efficiency

6.3.5.1 Prerequisites

- a. A valid voltage plateau, or operating voltage, has been determined and documented.
- b. A well determined background value has been obtained and documented.

- c. A successful Chi-squared test has been performed and documented.

6.3.5.2 Non-routine Isotopes

- a. In addition to the routine frequency of determination, counting system efficiencies SHOULD be determined when isotopes with energy significantly different from the calibration energy must be analyzed.

6.3.5.3 Enter the following information on the Efficiency Data Sheet form USRS–QA05 or equivalent spreadsheet:

- a. Scaler/Counter ID Number
- b. Detector ID Number.
- c. Source ID Number.
- d. Sources present total activity in dpm.
- e. The mean count rate, \bar{c} , of the source.

6.3.5.4 Calculation:

- a. Complete the following calculation on the Efficiency Data Sheet or equipment spreadsheet:

NOTE:

Non-routine sources and/or geometry should be calculated only at the direction of the Health Physics Technical Supervisor or designee.

$$E = \frac{\text{Gross cpm} - \text{Net(background)cpm}}{(\text{Source Total Activity in dpm})}$$

6.3.5.5 Alpha Channel

- a. Obtain a 47 mm diameter for Th-230 or equivalent reference source greater than 1,000 dpm.
- b. Place the source in the detector chamber and count for a period of one minute.
- c. Determine the net count rate from the source.
- d. Determine the specific efficiency, E .

NOTE:

Detection efficiencies for different sample types (i.e., geometry, Mass., etc.) must be calculated separately.

- e. Calculation:

$$E = \frac{\text{Average cpm} - \text{Background cpm}}{\text{Source Activity in dpm}}$$

- f. Record the result on the data sheet.

6.3.5.6 Perform the following:

- a. Enter the date, time and (printed) name (of the individual performing) the test on the Efficiency Data sheet or equivalent spreadsheet.
- b. Sign the data sheet.
- c. The Efficiency data MAY be submitted to the USRS Site Radiation Safety Officer or his/her designee at this time for review. Review should be performed at this time if:
 1. Any of the data were anomalous, or
 2. The entire Quality Control evaluation as not being performed at this time.

6.3.5.7 Beta Channel

- a. Obtain a 47 mm diameter Tc-99 or equivalent reference source greater than 1,000 dpm.
- b. Perform steps 6.3.5.5 (b) through (f).

6.4 Performance Test

6.4.1 Prerequisites

- a. A valid voltage plateau, or operating voltage, has been determined and documented.
- b. A well determined background value has been obtained and documented.
- c. A successful Chi-squared test has been performed and documented.

6.4.2 Background Check

- 6.4.2.1 Remove any source or sample from the detector tray.
- 6.4.2.2 Place the appropriate clean blank in clean counting planchet.
- 6.4.2.3 Lock the drawer closed.
- 6.4.2.4 Perform a 10 minute timed background count.
- 6.4.2.5 Divide the total counts for the alpha and beta-gamma channels by ten (10) to obtain results in CPM.
- 6.4.2.6 Record the Alpha and Beta-Gamma results in CPM, in the respective columns on the Daily Background and Efficiency Form USRS-013, USRS-013A, USRS-013B, or USRS-013AB or equivalent spreadsheets.
- 6.4.2.7 Compare each background to its background and range.
- 6.4.2.8 If either background rate exceeds its limits, clean the sample drawer and recheck background.
- 6.4.2.9 If either background remains out of range, remove the instrument from service and arrange for repair. Notify Health Physics Supervision.

NOTE:

It is permissible to use the Protean control check and/or limit abilities for steps 6.4.3 and 6.4.4.

6.4.3 Alpha Source Check (Th-230 or equivalent)

- 6.4.3.1 Retrieve from storage the check source identified in the 'SOURCE ID#' space at the top of form USRS-013, USRS-013A, or USRS-013AB or equivalent spreadsheets.
- 6.4.3.2 Place the source in an empty counting planchet.
- 6.4.3.3 Open the sample drawer and place the source/planchet check in the sample tray.
- 6.4.3.4 Close and lock the drawer in the count position, and perform a 1-minute timed count, record the results on Form USRS-013, USRS-013A or USRS-013AB or equal at spreadsheets.
- 6.4.3.5 Record the result of the source count in the "SOURCE COUNTS" (CPM) column of the form.

- 6.4.3.6 If the net response is within 10% of the source activity multiplied by the efficiency of the instrument, initial the “Initials” column of Form USRS-013, USRS-013A, or USRS-013AB or equivalent spreadsheets.

6.4.4 Beta Source Check (Tc-99 or equivalent)

- 6.4.4.1 Repeat the steps Section 6.4.3 using the beta check source specified in the “SOURCE ID#” space at the top of form USRS-013, USRS-13B, USRS-13AB or equivalent spreadsheets.
- 6.4.4.2 Record the data in the applicable columns of form USRS-013, USRS-013B, USRS-013AB or equivalent spreadsheets.
- 6.4.4.3 Initial USRS-013, USRS-013B, USRS-013AB or equivalent spreadsheets in the appropriate columns. Initial the Performance Test Daily Check Sticker.
- 6.4.4.4 Return the check sources to their designated storage locations.

6.4.5 Determination of MDC

6.4.5.1 Prerequisites

- a. A valid voltage plateau has been performed and documented for those instruments or systems with the variable high-voltage capability.
- b. A well-determined background is available, unless an exception is made in the specific instrument procedure.
- c. A successful Chi-squared test has been performed and documented.
- d. Counting efficiency for the appropriate emission has been determined and documented.
- e. The daily checks have demonstrated that the instrument is in statistical control; OR; where directed by specific procedure, a daily working background has been determined.

6.4.5.2 Calculation

- a. Calculate MDC by performing a count of a paired blank for counting time equal to the sample counting time. A paired blank means a sample, which is identical, chemically and physically, to the samples to be counted, except that no isotope is present (e.g. for smear samples a smear of a clean

surface could be used as a paired blank for smears of potentially contaminated surfaces).

6.4.5.3 MDC May be calculated from the following formula:

$$MDC (dpm) = \frac{3 + 4.65\sqrt{C_B * T_B}}{E * T_B}$$

where:

C_B = Background Counts for the paired blank (CPM)

T_B = Sample Count time for the paired blank (Minutes)

E = Instrument efficiency for the isotope expected, expressed as a decimal

6.4.5.4 Record the MDC value for the appropriate channel (beta-gamma and alpha) on form USRS-006 or equivalent spreadsheet.

6.5 Maintenance

6.5.1 No special storage requirements.

6.5.2 Electronic maintenance (except external adjustments and cable replacements) shall be performed by a Health Physics Instrumentation Technician, or by the manufacturer, or an approved vendor.

7.0 RECORDS

- 7.1** Form USRS-009 Instrument Service Record-Ludlum Model 2929/43-10-1
- 7.2** Form USRS-013 Ludlum Model 2929 Daily Background and Efficiency
- 7.3** Form USRS-003 Daily Instrument Performance Test Log Sheet
- 7.4** Calibration Data Sticker
- 7.5** Daily Performance Test Check Sticker

8.0 FORMS AND EXHIBITS

8.1 Forms

- 8.1.1** Form USRS-009 Instrument Service Record-Ludlum Model 2929/43-10-1
- 8.1.2** Form USRS-013 Ludlum Model 2929 Daily Background and Efficiency
- 8.1.3** Form USRS-003 Daily Instrument Performance Test Log Sheet
- 8.1.4** Form USRS-006 Smear Counting Analysis Report
- 8.1.5** Form USRS-QA01 Plateau Data Sheet
- 8.1.6** Form USRS-QA02 Voltage Plateau Graph
- 8.1.7** Form USRS-QA03 Background Data Sheet
- 8.1.8** Form USRS-QA04 Chi-Squared Data Sheet
- 8.1.9** Form USRS-QA05 Efficiency Data Sheet

8.2 Exhibits

- 8.2.1** Daily Performance Test Check Sticker
- 8.2.2** Calibration Data Sticker

EXHIBIT 8.2.1

Performance Test Daily Check Sticker


					USRS, LLC Daily Instrument Source Check							
Instrument Serial Number												
Probe Serial Number												
Calibration Date												
Month (Circle One)					Technician Initial & Date							
J	F	M	A	M	J	J	A	S	O	N	D	
1		2		3	4		5		6		7	
8		9		10	11		12		13		14	
15		16		17	18		19		20		21	
22		23		24	25		26		27		28	
29		30		31								

EXHIBIT 8.2.2

Calibration Data Sticker

Survey Meter Calibration

Model _____ Serial No. _____

***Range within 10% unless noted**

X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____

Ded. Ck. Source S/N _____

Act. _____ Reads _____

Cal. Date _____ Due Date _____

Calibrated by _____

LUDLUM MEASUREMENTS, INC.
Sweetwater, Texas (915) 235-5494



Technical Operating Procedure

PREPARATION OF PORTABLE RADIATION AND CONTAMINATION SURVEY METERS AND INSTRUMENTS FOR FIELD USE

200-IP-203

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

REVISION HISTORY

Revision (Date)	Rev. No	Prepared By	Description of Changes	Affected Pages
October 2018	0	D DeLong	New Issue	All
May 2019	1	D DeLong	Remove Disclaimer / Periodic Review	All

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1.0 PURPOSE

This procedure is used to specify the general requirements for preparing portable radiation and contamination survey meters and instruments for use at field locations.

2.0 SCOPE

This procedure will be used by Up-Side Radiological Survey, LLC (USRS) personnel and its subcontractors for the preparation of portable radiation and contamination survey meters for field use. This procedure is intended to provide general instructions for preparing radiation and contamination survey meters and instruments for field operations.

3.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for monitoring compliance with this procedure and training personnel in the use of the radiation and contamination survey meters and instruments. The Project Manager will assist in the interpretation of results obtained during surveys. The Project Manager will also be responsible for performing periodic surveillance of the use and maintenance of instruments and ensuring that the instruments are calibrated at specified intervals, ensuring that records pertaining to the instrument are maintained on file throughout the duration of the project and copies retained in the permanent project file, and reviewing documentation generated by the use of this procedure.

Health Physics Supervisor - The Health Physics Supervisor is responsible for ensuring that all personnel assigned the task of operating radiation and contamination survey meters and instruments are familiar with this procedure and are adequately trained with the specific instrument being used to perform surveys. The Health Physics Supervisor is responsible for ensuring that a copy of this procedure is available at the job site.

Health Physics Technician - The Health Physics Technician(s) are responsible for being qualified by training and experience to perform the requirements of this procedure, notifying the Health Physics Supervisor of any unsafe or unusual conditions observed during operation of the instrument, and implementation of this procedure.

4.0 DEFINITIONS AND ABBREVIATIONS

Acceptance Range – A range of values that describes an acceptable instrument checkresult. An acceptance range is typically determined by adding ± 20 percent or $\pm 2\sigma$ to the expected value.

Calibration Sticker – A label affixed to a properly calibrated instrument. The calibration sticker may be applied by the calibration facility or by the end user. The calibration sticker should indicate the date through which the calibration is valid.

Chi-Square Test – A probability density function that gives the distribution of the sum of the squares of a number of independent random variables each with a normal distribution with zero mean and unit variance, that has the property that the sum of two or more random variables with such a distribution also has one, and that is widely used in testing statistical hypotheses especially about the theoretical and observed values of a quantity and about population variances and standard deviations. This test is used to evaluate the operation of an instrument, generally upon return from calibration.

Check Log – A form or series of forms, which are used to document that an instrument was checked prior to usage in the field. Check logs can consist of multiple pages and must contain at least one page identifying the instrument. At least one page must also specify the parameters (source, geometry, etc.) used for the daily check. Space shall be provided to document the daily tests in the log. The log should be designed so as to clearly associate the required verifications with the signature or initials of the individual performing the check and date of each check.

Instrument Efficiency – A measure of the response (counts) obtained with a particular instrument when exposed to a known fluence of radioactive particles. Instrument efficiency has units of counts per particle.

5.0 PROCEDURE DETAILS

5.1 CALIBRATION

Instrument calibrations shall be performed using measuring and test equipment and National Institute of Standards and Technology (NIST) traceable sources. Calibrations will be performed at an accredited calibration laboratory. Calibration will be performed in accordance with the equipment manufacturers' manuals. Properly calibrated instruments shall be marked with a calibration sticker and include an accompanying calibration certificate.

Calibration shall be performed annually (± 15 days) or on a schedule consistent with the manufacturer's recommendation if more restrictive. The routine frequency may be extended by up to one additional month with written approval of the Project Manager, or designee. However, the frequency of calibration may not be extended when instruments are being used for surveys of record (i.e. Final Status Surveys, Characterization Surveys, etc.) In addition to the routine frequency of performance, calibration shall be performed under the following conditions:

- Prior to placing a new instrument into service.
- After any major repair or alteration to the instrument or detector.

5.2 GENERAL CONSIDERATIONS

Determination of instrument background, chi-square testing and instrument efficiency should be conducted in a controlled environment. This typically will consist of a secured office or lab area located in a non-impacted area and which is known to be free of contamination. Testing jigs or apparatus may be employed as necessary to ensure that consistent, reproducible geometries are used, particularly during repeated measurements.

Table 1 gives suggested geometries to use for the most common instrument types to be used during field activities. Alternate geometries can be used provided that they are more appropriate for the intended usage of the instrument.

TABLE 1
SUGGESTED GEOMETRIES FOR BACKGROUND MEASUREMENTS
AND SOURCE CHECKS

Measurement	Instrument/Detector Combinations	Probe Location
Exposure Rate	Ludlum Model 19 MicroR Meter or equivalent with integral NaI 1"x1" detector	contact ^a
Gamma	Ludlum Model 2350-1/2221 with Ludlum Model 44-1O or equivalent detector	4 inches (10cm) above ground surface/source
Beta/Gamma	Ludlum Model 3 portable survey meter with Ludlum Model 44-9 G-M probe or equivalent	¼ inch above ground surface/source
Alpha/Beta	Ludlum Model 2360 or equivalent portable survey meter with Ludlum Model 43-37, 43-68, 43-89 or equivalent detector	¼ inch above ground surface/source

Notes:

^a Field readings with exposure rate instruments are conducted at 1 meter; background determination, chi-square test and operational checks are typically performed at a more convenient distance. Geometry should be documented as appropriate on the relevant data forms and logs.

G-M - Geiger-Muller

5.3 DETERMINATION OF INSTRUMENT BACKGROUND

The determination of an instrument specific background is an optional procedure which may be employed at discretion of the subcontractor. There is no regulatory requirement that necessitates the determination of background for each instrument. Instrument background determination is typically performed in a controlled environment and usually consists of a

series of repeated background measurements that are statistically analyzed to obtain an expected range of valid background values. The established instrument background range can be used as a means of performing daily operation checks.

Instrument background determinations, when necessary, are considered valid for as long as the instrument has been properly maintained per the requirements of this procedure. If instrument backgrounds are required, a new background determination should be performed following each calibration.

When determining instrument background, the appropriate approved subcontractor's procedures shall be followed; however, any specific instructions for background determination in governing work-specific documents shall have precedence.

When required, background determinations will be documented on an approved form or as specified in work planning documents. The form should include the following information at a minimum:

- Identification information (i.e. model and serial numbers) for the instrument and detector
- Conditions used for determination (geometry, radiation type, operating voltage, etc.)
- Date and time of determination
- Identification and signature or initials of technician
- Identification and signature of reviewers

The end result of a background determination should be to obtain an acceptance range for subsequent background checks.

5.4 CHI-SQUARE TEST

When chi-square tests are required by work-specific documents, the appropriate approved subcontractor's procedures shall be followed; however, any specific instructions for chi-square testing in governing work specific documents shall have precedence. When required, chi-square tests shall be performed annually (± 15 days), following calibration, or if there is reason to suspect that the instrument calibration may no longer be valid (i.e. inability to obtain a valid range of chi-square values).

Chi-square tests shall be performed with NIST traceable sources with isotopic content appropriate to the detector being evaluated and the anticipated

contaminants in the survey area. The source should be of sufficient activity to yield a counting rate of 1000 to 50,000 counts per minute (cpm). The source should not exceed 50,000 cpm.

Chi-squared tests shall be documented on form USRS-008.

The chi-square test procedure will produce a chi-squared value (χ^2) which should be between 10.11 and 30.14. Failure to obtain a chi-squared value in this range indicates a problem with either the instrument or the methodology used to perform the chi-square test and requires further investigation. The Health Physics Supervisor should be notified of the failure to assist in planning a course of action.

5.5 INSTRUMENT EFFICIENCY FOR PORTABLE INSTRUMENTS

The instrument efficiency (ε_i) is the ratio between the net count rate (in cpm) of the instrument and the surface emission rate of the efficiency check source for a specified geometry. The surface emission rate is the 2π particle fluence that is affected by both the attenuation and backscatter of the radiation emitted from the efficiency check source.

The following equation is used to calculate the instrument efficiency in counts per particle:

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\pi} \left(\frac{W_A}{S_A} \right)}$$

Where,

R_{S+B} = the gross count rate of the efficiency check source, measured in cpm
 R_B = the background count rate in cpm
 $q_{2\pi}$ = the 2π surface emission rate of the calibration source (NIST traceable)
 W_A = the active area of the probe window in square centimeters (cm^2)
 S_A = the area of the source in cm^2

Note: This equation assumes that the dimensions of the efficiency check source are sufficient to cover the window of the instrument detector. If the dimensions of the efficiency check source are smaller than the detector's window, set W_A equal to the dimensions of the efficiency source (i.e., set the quotient of W_A and S_A equal to 1).

Instrument efficiency determined during calibration shall be used for all instruments and radiation and contamination survey meters that are to be used for alpha and beta surveys for field operations. Instrument efficiency is dependent upon energy of the incident radiation. Multiple energy-specific instrument efficiencies may be determined when isotopes with significantly varying energies are analyzed.

5.6 OPERATION CHECK

An operation check for each instrument should be performed at the beginning of each workday that a particular instrument is used. The operations check should include the following checks at a minimum:

- Check that instrument calibration is still valid (date on sticker not yet passed)
- Check the instrument (including the probe) for physical defects (knobs, displays, cables, connectors, mylar windows, etc.)
- Check of instrument battery (per manufacturers' instructions)
- Source check (should give consistently reproducible results with same source)

Failure of any of the above checks shall result in the instrument being removed from active service until the condition can be addressed. The Project Manager should be notified of any instrument failing an operations check for reasons other than failure of a battery check. In cases of battery check failure, the battery should be replaced and the check repeated.

The specified checks should each be performed every day and documented on a new line of the check log. A separate check log shall be maintained for each instrument. The check log shall contain the following information at a minimum:

- Identification information (i.e., model and serial numbers) for the instrument and detector
- Conditions used for the check (geometry, radiation type, etc.)
- Source ID number
- Verification of current calibration
- Verification of physical condition
- Verification of battery check
- Verification that source check is in acceptance range
- Date of operational check
- Signature or initials of technician
- Identification and signature of reviewer

Of the required information given above, only the verifications, date and signature or initials need to be completed on a daily basis. The remaining information can be completed once and kept in the check log with the additional pages for daily checks, provided that none of the information changes. If the information changes, then a new check log should be started.

5.7 MAINTENANCE

Instruments shall be stored in areas, which prevent damage by movement, accumulation of moisture or dust. Detector covers shall be used for storage when practical.

Instrument maintenance (except external adjustments and cable or mylar window replacements) shall be performed by the manufacturer or an approved vendor.

6.0 RECORDS

Records that result from this procedure may include forms that document background determinations, chi-square tests, instrument efficiency and check logs. Record forms shall be obtained from approved subcontractor procedures or specified in work-specific procedures.

7.0 REFERENCES

NONE

8.0 ATTACHMENTS

USRS Survey Quality Control Checklist

SURVEY QUALITY CONTROL CHECK LIST

Item No.	Requirement	Comment	SAT	UNSAT	N/A
1.	Verify technicians are qualified to perform survey for the survey instrument systems being used				
2.	Verify the appropriate SOP/work instruction is identified for performing the survey				
3.	Verify the approved survey control document(s) specifies detectors, meters, and scan speeds				
4.	Verify instrument calibration is current				
5.	Verify backgrounds have been taken for instrumentation				
6.	Verify daily instrument response check is performed, documented, and results are within range				
7.	Verify detector is set at the correct distance from surface being scanned per Work Plan				
8.	Verify instrument scan speed complies with the Work Plan				
9.	Verify system being used to document survey measurement locations complies with the Work Plan				
10.	Verify correct data logger/scaler/ratemeter/ detector is being used for the survey, as specified in the Work Plan				
11.	Verify instrumentation mating/matching ID numbers (detector must be mated with its assigned meter)				
12.	Verify voltage settings for the detector agree with manufacturer's recommendations				
13.	For gas flow instruments, verify the inflow and outflow rates are essentially equal and correct				
14.	Verify that chi-square test and results have been completed and are within range				
15.	Check the instrument (including detector) for physical defects of the knobs, displays, cables, connectors, Mylar windows, and dented/damaged enclosure				
16.	Verify data logger/ratemeter/scaler high voltage per manufacturer's instructions				
17.	Verify data logger/ratemeter/scaler battery per manufacturer's instructions				

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Name (Printed):

Signature:

Date:



Technical Operating Procedure
OPERATION OF LOW VOLUME AIR SAMPLERS

200-IP-204

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

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Date

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1.0 SCOPE

This procedure sets forth the specific requirements to be used for the operation of low-volume air samplers used on Up-Side Radiological Survey, LLC (USRS) field projects.

2.0 PURPOSE

The purpose of this procedure is to provide instructions for the operation, and use, of low-volume air samplers in accordance with requirements specified in Reference 3.1.3.

3.0 REFERENCES

3.1 References

- 3.1.1 ANSI/ANS-3.1 – 2014, Selection, Qualifications and Training of Personnel for Nuclear Power Plants
- 3.1.2 USRS Field Operating Procedure 300-SP-302, Air Sampling and Analysis
- 3.1.3 Technical Manual for the Low Volume Air Sampler
- 3.1.4 USRS Field Operating Procedure 400-CP-404, Control of Radioactive Material

4.0 PRECAUTIONS, LIMITATION

4.1 Precautions

- 4.1.1 Do not operate air samplers in an explosive environment unless the air sampler is specifically certified and designated for such use.
- 4.1.2 Ensure the power switch is in the “off” position prior to plugging any air sampling devices into electrical outlets.
- 4.1.3 Air samplers shall be considered internally contaminated and controlled in accordance with reference 3.1.4.

4.2 Limitations

- 4.2.1 Calibration shall be performed annually, after maintenance is performed, or if the air sampler proper operation is in question.
- 4.2.2 Calibration shall be performed by the manufacturer or qualified vendor only.
- 4.2.3 True flow is center of the rotometer ball reading.
- 4.2.4 Some rotameters are calibrated in liters per minute (LPM) vice cubic feet per minute (CFM). 1 CFM = 28.32 LPM

4.2.5 Air samplers shall be operated in accordance with this procedure and reference 3.1.2.

4.2.6 Only F & J TEDA impregnated (or equivalent) charcoal cartridges shall be used during operation of air samplers.

4.2.7 Only F & J Model FP47 type (or equivalent) filters should be used for particulate air sampling.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

5.1.1 The USRS Radiological Field Operations Manager (Project Manager) is responsible for:

5.1.1.1 Implementation of this procedure.

5.1.1.2 Periodic reviews of adherence to the requirements of this procedure.

5.1.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

5.1.2 Health Physics Supervisors are responsible to:

5.1.2.1 Perform periodic surveillance of the use and maintenance of the air sampler.

5.1.2.2 Ensure the air samplers are calibrated at specified intervals.

5.1.2.3 Ensure that records pertaining to use and maintenance of air samplers are maintained on file throughout the duration of the project and copies retained in the permanent project file.

5.1.3 Health Physics Technicians are responsible for:

5.1.3.1 Performance of the requirements of this procedure.

5.1.3.2 Documentation of all records in this procedure.

5.1.3.3 Notification to Health Physics Supervision of any unsafe or unusual conditions observed during operation of the air sampler.

5.2 Qualifications

5.2.1 Health Physics Technicians shall be qualified in accordance with the requirements of ANSI/ANS-3.1 – 2014 to operate this air sampler.

- 5.2.2** Junior Health Physics and Decontamination Technicians may operate this air sampler under supervision of a Health Physics Technician meeting the requirements of section 5.2.1.

6.0 PROCEDURE

6.1 Operation

6.1.1 Preparation

- 6.1.1.1 Upon receipt of the air sampler from the manufacturer or qualified vendor, complete form USRS-028 and place a copy with the air sampler.
- 6.1.1.2 Verify that the instrument has a valid Calibration Data Sticker, Exhibit Label #USRS- ASC.
- 6.1.1.3 Inspect the air sampler for any obvious physical damage.
- 6.1.1.4 Air sampling equipment should be prepared prior to entering work areas in order to minimize potential contamination of equipment.
- 6.1.1.5 Check for adequate power supply prior to entering the work area.
- 6.1.1.6 Some low volume air samplers are provided with a six and one-quarter amp fuse for overload protection. Check the fuse located near the on/off power switch prior to air sampler operation. Replace if necessary.

6.2 Sample Collection

- 6.2.2.1 Air samples shall be collected in accordance with the provisions of reference 3.1.2.
- 6.2.2.2 Loaded a new particulate and a new charcoal cartridge (if applicable) into the sample holder. Particulate filter should be placed “fuzzy” side in (away from the flow). Charcoal cartridge should be placed in the sampler with the airflow indicator facing toward the pump.

NOTE:

An inspection of the sample holder should be made prior to the placing of the filter(s) in the holder. Ensure all O-rings are in place prior to use of the sample holder.

- 6.2.2.3 Connect the sample holder to the air sampler inlet connection via the quick disconnect coupling. Ensure the sample holder “clicks” into position.
- 6.2.2.4 Place the air sampler in a position that is appropriate for the area to be sampled.
- 6.2.2.5 Turn on the air sampler and observe the flow rate. Using the Calibration Data Sticker (Label # USRS-ASC) as a reference; adjust the flow rate by rotating the flow adjustments knob at the bottom of the airflow regulator to the desired flow rate. Clockwise movement increases flow; counterclockwise movement decreases flow.
- 6.2.2.6 Record the sample start date/time and flow rate on the appropriate forms in accordance with the provisions of reference 3.1.2.
- 6.2.2.7 Run the sampler until a volume indicated in Reference 3.1.2 has been collected.
- 6.2.2.8 Upon collection of the desired volume, observe the flow rate to ensure it has not changed significantly, and turn off the air sampler.
- 6.2.2.9 Record the stop time and flow rate on the appropriate forms in accordance with the provisions of Reference 3.1.2.
- 6.2.2.10 Remove the filter and cartridge (if applicable) from the sample holder and place them in an envelope or bag taking care not to cross contaminate the filter and cartridge.
- 6.2.2.11 Count the filter(s) in accordance with the provisions of Reference 3.1.2.

6.3 Maintenance

6.3.1 No special storage requirements

6.3.2 Electrical repair of this instrument shall be performed by the manufacturer or an approved vendor only.

7.0 RECORDS

The following records will be generated and retained in the permanent project file as result of using this procedure.

7.1 USRS-028, Instrument Service Record – Low Volume Air Sampler

7.2 USRS-ASC, Calibration Data Sticker

8.0 FORMS

8.1 USRS-028, Instrument Service Record – Low Volume Air Sampler

8.2 USRS-ASC, Calibration Data Sticker (Label)



Technical Operating Procedure
OPERATION OF HIGH VOLUME AIR SAMPLERS

200-IP-205

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019

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1.0 SCOPE

This procedure sets forth the specific requirements to be used for the operation of high-volume air samplers used on Up-Side Radiological Survey, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to provide instructions for the operation, and use, of High-Volume Air Samplers in accordance with requirements specified in Reference 3.1.3.

3.0 REFERENCES

3.1 References

- 3.1.1** ANSI/ANS-3.1 – 2014, Selection, Qualifications and Training of Personnel for Nuclear Power Plants
- 3.1.2** USRS Field Operating Procedure 300-SP-302, Air Sampling and Analysis
- 3.1.3** Technical Manual for the F & J Specialty Products Model H-9400 High Volume Air Sampler
- 3.1.4** USRS Field Operating Procedure 400-CP-404, Control of Radioactive Material

4.0 PRECAUTIONS, LIMITATION

4.1 Precautions

- 4.1.1** Do not operate air samplers in an explosive environment unless the air sampler is specifically certified and designated for such use.
- 4.1.2** Ensure the power switch is in the “off” position prior to plugging any air sampling devices into electrical outlets.
- 4.1.3** Air samplers shall be considered internally contaminated and controlled in accordance with reference 3.1.4.

4.2 Limitations

- 4.2.1** Calibration shall be performed annually, after maintenance is performed, or if the air sampler proper operation is in question.
- 4.2.2** Calibration shall be performed by the manufacturer or qualified vendor only.
- 4.2.3** Air samplers shall be operated in accordance with this procedure and Reference 3.1.2.

4.2.4 Some gauges are calibrated in liters per minute (LPM) vice cubic feet per minute (CFM). 1 CFM = 28.32 LPM

4.2.5 Only F & J Model FP-4.0 (4 inch) type (or equivalent) filters should be used for particulate air sampling.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

5.1.1 The USRS Radiological Field Operations Manager (Project Manager) is responsible for:

5.1.1.1 Implementation of this procedure.

5.1.1.2 Periodic reviews of adherence to the requirements of this procedure.

5.1.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

5.1.2 Health Physics Supervisors are responsible to:

5.1.2.1 Perform periodic surveillance of the use and maintenance of the air sampler.

5.1.2.2 Ensure the air samplers are calibrated at specified intervals.

5.1.2.3 Ensure that records pertaining to use and maintenance of air samplers are maintained on file throughout the duration of the project and copies retained in the permanent project file.

5.1.3 Health Physics Technicians are responsible for:

5.1.3.1 Performance of the requirements of this procedure.

5.1.3.2 Documentation of all records in this procedure.

5.1.3.3 Notification to Health Physics Supervision of any unsafe or unusual conditions observed during operation of the air sampler.

5.2 Qualifications

5.2.1 Health Physics Technicians shall be qualified in accordance with the requirements of ANSI/ANS-3.1 – 2014 to operate this air sampler.

- 5.2.2** Junior Health Physics and Decontamination Technicians may operate this air sampler under supervision of a Health Physics Technician meeting the requirements of section 5.2.1.

6.0 PROCEDURE

6.1 Operation

6.1.1 Preparation

6.1.1.1 Upon receipt of the air sampler from the manufacturer or qualified vendor, complete form USRS-029 and place a copy with the air sampler.

6.1.1.2 Verify that the instrument has a valid Calibration Data Sticker.

6.1.1.3 Inspect the air sampler for any obvious physical damage.

6.1.1.4 Air sampling equipment should be prepared prior to entering work areas in order to minimize potential contamination of equipment.

6.1.1.5 Check for adequate power supply prior to entering the work area.

6.1.2 Sample Collection

6.1.2.1 Air samples shall be collected in accordance with the provisions of reference 3.1.2.

6.1.2.2 Load a new 4" particulate filter into the filter holder by unscrewing (counter-clockwise) the outer retaining ring on the filter holder. Particulate filter should be placed "fuzzy" side in (away from the flow). After filter is centered in the filter holder, screw back on the outer retaining ring (clockwise). Hand tighten only.

NOTE:

An inspection of the filter holder should be made prior to the placing of the filter in the holder. Ensure the mesh-backing screen is in place and not damaged. Ensure the flow gauge is not damaged and is securely fit into the air sampler exhaust port.

6.1.2.3 Place the air sampler in a position that is appropriate for the area to be sampled.

6.1.2.4 Turn on the air sampler and observe the flow rate on the gauge. Using the Calibration Data Sticker (Label # USRS-ASC) as a reference, record the sample start date/time and flow rate on the

appropriate forms in accordance with the provisions of Reference 3.1.2.

- 6.1.2.5 Run the sampler until a volume indicated in Reference 3.1.2 has been collected.
- 6.1.2.6 Upon collection of the desired volume, observe the flow rate to ensure it has not changed significantly, and turn off the air sampler.
- 6.1.2.7 Record the stop time and flow rate on the appropriate forms in accordance with the provisions of Reference 3.1.2.
- 6.1.2.8 Remove the filter from the sample holder and place them in an envelope or bag taking care not to cross contaminate the filter.
- 6.1.2.9 Count the filter in accordance with the provisions of Reference 3.1.2.

6.2 Maintenance

6.2.1 No special storage requirements

6.2.2 Electrical repair of this instrument shall be performed by the manufacturer or an approved vendor only.

7.0 RECORDS

The following records will be generated and retained in the permanent project file as result of using this procedure.

7.1 USRS-029, Instrument Service Record – High Volume Air Sampler

7.2 USRS-ASC, Calibration Data Sticker Label

8.0 FORMS

8.1 USRS-029, Instrument Service Record – High Volume Air Sampler

8.2 USRS-ASC, Calibration Data Sticker



Technical Operating Procedure

OPEN WINDOW GAMMA SCANNING USING LUDLUM MODEL 2350-1 WITH LUDLUM MODEL 44-10 DETECTOR

200-IP-206

Revision 1

Approved By:



Victor Letourneaut
President

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Date

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Daryl DeLong
Radiation Safety Officer

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1.0 SCOPE

The purpose of this procedure is to specify methods and requirements for conducting consistent radiological surveys and ensuring the proper documentation of acquired data. This standard operating procedure (SOP) has been developed to conduct open window gamma radiological surveys using a Ludlum Model 2350-1 (or equivalent) with Ludlum Model 44-10 detector (or equivalent).

Adherence to this procedure will provide reasonable assurance that the open window gamma scanning surveys performed have reproducible and defensible results. Guidance for control of radiation exposures provided in this procedure is in accordance with the as low as reasonably achievable (ALARA) philosophy.

This procedure will be used by Up-Side Radiological Survey, LLC (USRS) personnel and its subcontractors to perform gamma radiation surveys.

2.0 PURPOSE

This procedure provides guidelines for the performance and documentation of open window gamma scanning surveys performed by USRS personnel using the Ludlum Model 2350-1 (or equivalent) with Ludlum Model 44-10 detector (or equivalent).

This procedure will provide information related to system set-up (configuration), initial quality assurance (QA)/quality control (QC) testing, operation, data management, and limitations. This SOP is applicable to the towed array system containing the equipment specified in this document. The system will be constructed, operated, and maintained in accordance with this SOP.

3.0 DEFINITIONS

Activity – The rate of disintegration (transformation) or decay of radioactive material. The units of activity for the purpose of this procedure are picocuries per gram (pCi/g) for soil.

Contamination – Deposition of radioactive material in any place it is not desired, particularly where its presence may be harmful. The harm may be actual exposure to individuals, or release of the material to the environment or general public. Contamination may be due to the presence of alpha particle, beta particle, or gamma ray emitting radionuclides.

Controlled Area – Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials and/or to prevent the release of radioactive materials to the uncontrolled areas.

Radiation Work Permit (RWP) – A document generated in accordance with the RWP Standard Operating Procedure to provide:

- A description and scope of the work to be performed;
- The anticipated radiological conditions in the work area;
- The radiological limits of applicability for the RWP. If radiation levels exceed limits, all survey activities must be stopped and a new RWP or a modification to the existing RWP must be made;
- The protective measures to be employed during the work to protect the worker(s);
- The period of time the RWP is valid;
- Special instructions to workers and Health Physics Technicians during the course of work; and
- The proper approvals required to begin work.

Uncontrolled Area – An uncontrolled area is any area where access is not controlled for radiological purposes.

4.0 RESPONSIBILITIES

The Project Manager (PM), Health Physics Supervisor, and Health Physics Technicians (HPTs) are responsible for ensuring compliance of this procedure.

4.1 Project Manager

The PM is responsible for the overall implementation of and compliance with this procedure during field operations. The PM shall conduct periodic reviews, via personal observation of personnel conducting radiation and contamination surveys, to ensure adherence to the requirements of this procedure.

4.2 Health Physics Supervisor

The Health Physics Supervisor who is located on-site is responsible for ensuring that personnel performing the tasks required by this procedure are properly assigned. The Health Physics Supervisor is responsible for ensuring that personnel conducting radiation and contamination surveys are familiar with the requirements of this SOP and have access to and understand the contents/requirements of the RWPs. The Health Physics Supervisor reviews the results of surveys generated by the use of this SOP.

4.3 Health Physics Technicians

The HPTs shall be responsible for the performance of the requirements of this procedure and documentation of work performed. The HPTs shall ensure compliance with this and any other referenced plans and procedures.

5.0 PROCEDURE DETAILS

5.1 General

Open window gamma scanning surveys are performed to identify areas with measurable radiation, and assess the intensity and shape of areas of observed, elevated radiation.

Survey results will be provided with measurement data, and an approximation of the location of the survey (to the nearest survey lane or row). After review of the data, any anomalies must be brought to the attention of the Health Physics Supervisor who will determine if the operating and safety conditions contained in the existing RWP are still valid. Depending upon the nature of the situation the Health Physics Supervisor may stop work. In all case the health Physics Supervisor will notify the Project Manager in a timely manner.

5.1.1 Equipment Required

An RWP is needed to perform the mobile gamma survey. The RWP may be general in nature to perform radiological surveys in a specific area.

One Ludlum Model 44-10 2" x 2" inch (or equivalent) sodium iodide (NaI) gamma scintillation detector (in calibration).

Ludlum Model 2350-1 or equivalent (in calibration).

Laptop (Tough Book equivalent).

5.1.2 Initial Set-up

Instruments used to perform gamma radiation and contamination surveys shall be calibrated, operated, and maintained in accordance with manufacturer's procedures. Steps to be completed during the initial set-up phase include the following:

- Remove the detector, data loggers, detector cables, Laptop (1 unit), power connectors (12 volt DC) cables from packaging.
- Visually inspect all equipment for damage.
- Connect the detector to the Ludlum Model 2350-1 using the correct BnC or other connector (do not force connection).
- The detectors should be used in a position so that the bottom of the detector is 4-inches from the surface being surveyed.
- Data loggers batteries will be replaced once battery voltage of the Ludlum Model 2350-1 reaches 5.0 Volts.
- Verify all connections are tightened.

5.1.3 Initial QA/QC Setup

An initial QA/QC check is required prior to daily use of the instrument at the project site. This initial check is to verify proper systems operations.

The initial QA/QC survey will be conducted as follows:

- Ensure the system is fully operational and the meter & detector are powered on and operational.
 - Find a location suitable for conducting the initial test. This location should be free from elevated radioactivity and flat. Background locations will be provided by the client upon recommendation of the health physics supervisor.
 - Lay out the boundary of the initial background test area. The size of the test area should be at least 30 foot by 30 foot.
 - Ensure there are no radioactive sources in the immediate vicinity of the test area.
 - Set up data logger to collect data on a 3-second recycling interval, with data-logged output.
 - Hold the detector in a serpentine (S-shaped) pattern over the area at a rate not to exceed 0.3 meters per second, with a detector height of 4 inches. Begin logging data on 2350-1 (or equivalent). Perform 1-minute static counts at designated background locations.
 - Calculate the average background using the data collected.
 - Perform calculations to determine average background, and standard deviation of background. Provide calculations and data to the client as directed.
- Perform the initial Cs-137 source measurement:
 - Ensure all sources, with the exception of the Cs-137 source, have been removed from the immediate area where the initial test is being performed.
 - Ensure the same calibration source is used throughout the project.
 - As above, collect data as specified in Initial Background Setup.
 - Calculate the average background area using the data collected.
 - Calculate one, two and three standard deviations using the data collected. Other details regarding source check determination are provided in procedure 200-IP-203, *Preparation of Survey Instruments for Field Use*.

5.1.4 Operation of the Ludlum Model 2350-1 with Ludlum Model 44-10 Detector

The unit will be source checked daily in accordance with procedure 200-IP-203, *Preparation of Survey Instruments for Field Use*.

The survey area will be determined in the field prior to beginning the survey.

If scanning rows of debris, the layers will be no more across than 3 feet for single pass scans and 5 feet for two pass scans.

The operator will scan at a rate of 0.2 to 0.3 meters per second (not to exceed 0.3 meters per second), with the detectors set at 10 centimeters (4-inches) above the ground surface. Operators will monitor the response of the survey meter audible response utilizing headphones.

The operator will flag any area that exceeds an investigation or action level provided in the appropriate work plan.

Data logging measurements will be collected.

The scan data will be collected at a 3-second time interval necessary to obtain the measurements required for adequate sample density, and to preclude any time circuitry errors within the 2350-1. The recycle interval will have counts recorded every second. The (EPROM) is pre-programmed by Ludlum, the manufacturer of the NaI detectors.

Ensure all measurement results are recorded in total counts (counts per 3 seconds [CP3S]).

5.1.5 Data Collection and Storage and Processing

The data collected by the radiation monitoring equipment will be collected and stored by the laptop.

NOTE: THE FOLLOWING STEPS MAY BE USED AS DIRECTED ON A PROJECT

The operator transmits the data to for GIS support (post-processing of GPS data) if necessary.

GIS correlates the data, providing positioning only corrections based on the daily CORS data. This step is referred to as post-processing GPS data. **At no time is the radiological data (CP3S) modified or disassociated with a GPS point.** GIS also provides the data in several grid layouts (NAD83 and LAT/LONG, or as otherwise directed).

GIS provides a rough map that satisfies the requirements of the technical memorandum. This rough map is archived, but never directly used for biased

sampling determination. The rough map shows tolerance of corrected GPS data (typically within 15cm accuracy 98% of the time).

GIS transmits the data to RSRS via FTP site.

USRS transmits data to Client Radiation Safety Office Representative or to Client's GIS Support for correlation.

GIS Support takes data and uploads to Geodatabase, and assigns location code to towed array data, including identifying closest related sampling points to towed array measurement. Client's GIS Support retransmits data to USRS.

USRS interprets data. If necessary, biased sampling is chosen based on:

- a. Scan data measurements
- b. Proximity to other sampling locations, including systematic sampling locations.
- c. Total variation on pads (i.e., if 3 non-closely located towed array measurements are in range of Background Plus 2-3 Sigma with remainder of pad at <1 sigma above background, then elevated locations are sampled even if they did not exceed 3-sigma investigation level).

USRS provides biased sampling locations to Client's GIS Support and to CAD for issuance of field sampling maps.

Upon receipt of sample data, the scan data, GIS map showing relative intensity of elevated measurements and locations of sample collection points, sampling results, and any field sampling figure are transmitted to client.

5.1.6 System Shutdown and Temporary Storage

At the conclusion of each day's activities (and after the Health Physics Supervisor has received and accepted the data) the unit will be shutdown as follows;

- Visually inspect the unit by doing a careful walk around. Note any items of significance and report them to the Health Physics Supervisor.
- Power down the Ludlum 2350-1 (or equivalent) unit and connect trailer to electrical power for recharging.
- Visually inspect the detectors to ensure they are free from dirt/dust/grime. Clean as needed.
- Store instrumentation in a safe and secured area.

6.0 REFERENCES

10 CFR 20 Standards for Protection Against Radiation

NUREG-1507 Minimum Detectable Concentration/Activities for Typical Radiation Survey Instruments for Various Contaminants and Field Conditions

NUREG-5480.11 Radiation Protection for Occupational Workers

USRS SOP 400-CP-401, *Issue and Use of Radiation Work Permits*

USRS SOP 200-IP-203, *Preparation of Survey Instruments for Field Use*

Trimble GPS Manual

Ludlum Model 2350-1 Manual

7.0 Records

The following records will be generated and retained in a permanent project file as a result of using this procedure.

7.1 Form USRS–008 Instrument Service Record – Ludlum Model 2350-1

7.2 Form USRS–003 Daily Instrument Performance Test Log Sheet

7.3 Calibration Data Sticker

7.4 Daily Performance Test Check Sticker

8.0 FORMS AND EXHIBITS

8.1 Forms

8.1.1 USRS–008, Instrument Service Record – Ludlum Model 2350-1

8.1.2 USRS–003, Daily Instrument Performance Test Log Sheet

8.2 Exhibits

8.2.1 Performance Test Daily Check Sticker

8.2.2 Calibration Data Sticker

EXHIBIT 8.2.1

Performance Test Daily Check Sticker


					USRS, LLC Daily Instrument Source Check							
Instrument Serial Number												
Probe Serial Number												
Calibration Date												
Month (Circle One)							Technician Initial & Date					
J	F	M	A	M	J	J	A	S	O	N	D	
1	2	3	4	5	6	7						
8	9	10	11	12	13	14						
15	16	17	18	19	20	21						
22	23	24	25	26	27	28						
29	30	31										

EXHIBIT 8.2.2

Calibration Data Sticker

Survey Meter Calibration

Model _____ Serial No. _____

***Range within 10% unless noted**

X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____
X	_____	<input type="checkbox"/>	*	_____

Ded. Ck. Source S/N _____

Act. _____ Reads _____

Cal. Date _____ Due Date _____

Calibrated by _____

LUDLUM MEASUREMENTS, INC.
Sweetwater, Texas (915) 235-5494



Field Operating Procedure
RADIATION AND CONTAMINATION SURVEYS

300-SP-301

Revision 1

Approved By:



Victor Letourneaut
President

July 17 ,2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019

Date

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1.0 PURPOSE

The purpose of this procedure is to specify methods and requirements for consistent radiological surveys and documentation of acquired data.

Adherence to this procedure will provide reasonable assurance that the surveys performed have reproducible results. Guidance for control of radiation exposures provided in this procedure is in accordance with the as low as reasonably achievable (ALARA) philosophy.

This procedure will be used by Up-Side Radiological Survey, LLC (USRS) personnel and its subcontractors to perform radiation and contamination surveys.

2.0 SCOPE

This procedure provides guidelines for the performance and documentation of radiation and contamination surveys performed by USRS personnel.

3.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for the overall implementation and compliance with this procedure during field operations. The Project Manager shall conduct periodic reviews, via personal observation of personnel conducting radiation and contamination surveys, to ensure adherence to the requirements of this procedure.

Health Physics Supervisor - The Health Physics Supervisor is responsible for ensuring that personnel performing the tasks required by this procedure are properly assigned. The Health Physics Supervisor is responsible for ensuring that personnel conducting radiation and contamination surveys are familiar with the requirements of this SOP and have access to a copy of the Radiation Work Permits (RWP). The Health Physics Supervisor reviews the results of surveys generated by the use of this SOP.

Health Physics Technician - The Health Physics Technician(s) shall be responsible for the performance of the requirements of this procedure and documentation of work performed. The Health Physics Technician(s) shall ensure compliance with this and any other referenced procedure.

4.0 DEFINITIONS AND ABBREVIATIONS

Activity - The rate of disintegration (transformation) or decay of radioactive material. The units of activity for the purpose of this procedure are disintegrations per minute (dpm) for loose and fixed surface contamination, picocuries per gram (pCi/g) for soil, or microcuries per milliliter ($\mu\text{Ci/ml}$) for airborne contamination.

Contamination - Deposition of radioactive material in any place it is not desired. Contamination may be due to the presence of alpha particle, beta particle or gamma ray emitting radionuclides.

Controlled Area - Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials and/or to prevent the release of radioactive materials to the uncontrolled areas.

Exposure Rate – For the purposes of this SOP, is the amount of radiation (exposure) delivered at a given point per unit time. Typical units are microrentgen per hour ($\mu\text{R/hr}$).

Fixed Contamination - Radioactive contamination that is not readily removed from a surface by applying light to moderate pressure when wiping with a paper or cloth disk swipe, or masslin.

Minimum Detectable Activity (MDA) - For purposes of this procedure, MDA for removable radioactive contamination is defined as the smallest amount of sample activity that will yield a net count with a 95 percent confidence level based upon the background count rate of the laboratory counting instrument used.

Minimum Detectable Concentration (MDC) - For purposes of this procedure, MDC is the *a priori* activity level that a specific instrument and technique can be expected to detect 95 percent of the time for portable survey instruments.

Radiation Work Permit (RWP) - A document generated in accordance with 400-CP-401 to provide:

- A description and scope of the work to be performed.
- The existing radiological conditions in the work area.
- The radiological limits of applicability for the RWP, if radiation levels exceed limits then a new RWP or a modification to the existing RWP must be made.
- The protective measures to be employed during the work to protect the worker(s)
- The period of time the RWP is valid
- Special instructions to workers and Health Physics Technicians during the course of work
- The proper approvals required to begin work

Removable Surface Contamination - Radioactive contamination that is readily removed from a surface by applying light to moderate pressure when wiping with a paper or cloth disk swipe, or masslin.

Uncontrolled Area - An uncontrolled area is any area where access is not controlled for radiological purposes.

5.0 PROCEURE DETAILS

5.1 GENERAL

Radiation surveys are performed to identify radiation areas, measure the exposure rate, and assess the intensity and shape of those areas to determine control requirements at the worksite.

Contamination surveys are conducted to detect loose surface contamination and fixed contamination. Loose surface contamination is normally detected indirectly by a swipe sample or wipe performed on the item or surface of interest. Fixed contamination levels are measured directly.

Survey results, locations, and any unusual conditions shall be documented and described on Attachments 1 and 2, Radiation/Contamination Survey Form and Radiation/Contamination Survey Supplement, respectively.

When performing surveys, express readings as the actual observed number. Do not report "<MDA" or "<Bkg". When background corrections are made, results may be expressed as negative numbers as applicable.

5.1.1 DISCUSSION

Radiation and contamination surveys shall be performed on an as-needed basis. The need for performing a survey is identified by, but not limited to the following conditions:

- A RWP is needed to perform an approved job.
- A condition exists where radiological data are needed.
- An investigation is required due to abnormal conditions or indications.
- An ongoing job requires a survey to update radiological postings and / or an RWP.
- As required to support *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; NUREG-1575) based survey activities.

5.1.2 PLANNING AND PREREQUISITES

Instruments used to perform radiation and contamination surveys shall be operated in accordance with their operation procedure. Steps to be completed during the planning phase include the following:

- Obtain and review appropriate work planning documents.
- Obtain appropriate survey instruments and prepare the instruments for use.

- Obtain the necessary forms, swipes, and any protective clothing that will be used during the survey.

Prior to entering an area to perform a survey, each radiation detection instrument shall be:

- Battery Checked
- Checked for obvious physical damage
- Quantitatively response-checked daily, prior to use.
- Checked to ensure that the instrument calibration is current.

If any of the above conditions are unsatisfactory, the instrument shall be tagged out of service and not used.

5.2 PROCEDURE PROCESS

5.2.1 EXPOSURE SURVEYS

When entering posted or suspected high radiation areas, or unknown areas, the instrument range selector switch (if applicable) shall be selected to the highest range and moved down through the lower ranges until the meter indicates on scale.

Always survey a sufficient number of locations to determine average and maximum general area and contact radiation levels.

A Ludlum Model-19 or equivalent should be used for performing exposure rate surveys for gamma radiation. The instrument should be operated in accordance with the manufacturer-supplied operations manual and any applicable requirements from work specific documents. Care should be taken to ensure that the instrument has been allowed to stabilize between individual measurements.

When performing general area exposure rate surveys:

- Attempt to determine the source of radiation fields.
- Record the highest level as the general area exposure rate.
- Perform contact exposure rate measurements with the detector within 1 inch of the surface to be surveyed.
- Perform surveys at approximately 1 meter (waist level) from the surface to establish posting requirements for the area.
- Verify the exposure rates of known hot spots.

5.2.2 REMOVABLE CONTAMINATION SURVEYS

5.2.2.1 Removable Contamination Swipe

The following guidance shall be used unless an approved site-specific work plan directs otherwise. Specific survey instructions will be prepared and provided in work specific documents for radioisotopes requiring unusual sampling techniques, such as tritium (^3H).

5.2.2.2 Swipe Surveys

1. Label or number swipes as necessary to identify each swipe.
2. Wipe the swipes over approximately 100 square centimeters (cm^2 [16 square inches]) of the surface to be sampled.
3. Apply moderate pressure.
4. Exercise care on rough surfaces so as not to tear the swipes.
5. Exercise care on wet surfaces so as not to degrade the swipes. Ensure that surfaces are not submerged in water and that cloth swipes or similar are used on wet/damp surfaces.

When surveying an area:

1. Obtain swipes from sample points, which are representative of the average and maximum contamination levels in the area, as identified during preliminary surveys. These areas could include:
 - a. Areas of high traffic
 - b. On and under benches or tables
 - c. Beneath piping and components
 - d. On accessible wall surfaces
 - e. On piping and significant components
 - f. Near drains, sumps and low spots
2. Swipe floor and component surfaces, which display evidence of (potentially) contaminated water leakage.
3. Ensure contamination is not spread to clean areas when obtaining swipes.

When surveying equipment:

1. Obtain swipes on large surfaces.
2. Obtain swipes in cracks or crevices where contamination may have settled.
3. Obtain swipes on openings to internal surfaces.
4. Handle swipes in a manner that will prevent cross-contamination such as by placing each swipe in a separate envelope.

5.2.2.3 Counting Swipes

A Ludlum Model 2929 scaler with a Model 43-10-1 ZnS(Ag) scintillation probe (or equivalent) will be used for field operations.

1. Count the swipes in accordance with the operating procedure for the instrument.
2. Record swipe results in dpm/100 cm².
3. Store/archive used swipes as radioactive material until directed otherwise.

5.2.2.4 Removable Contamination Surveys Using Large Area Wipes (LAWs)

Large-area contamination surveys using LAWs are appropriate for monitoring the radiological cleanliness of non-contaminated areas or equipment, to track area decontamination progress, or for initially verifying that surfaces are free from contamination.

There are no specific requirements concerning the amount of area to be wiped when performing LAWs. The area wiped should be determined based on the use of the survey data and the dust loading of the LAW material.

5.2.2.5 Performing LAWs

Use masslin, oil-impregnated cloths, or equivalent media to perform LAWs. Select an appropriate collection material and method based upon the survey conditions such as wet surfaces, rough surfaces, heavily soiled area and oily and greasy surfaces.

1. Label or number the cloths, as necessary, to assist in determining the location of the sample.
2. Determine the size of the area to be sampled based on the results of the survey.
3. Wipe the collection media over the surface using moderate pressure by hand, with a masslin mop, or other approved techniques.

5.2.2.6 Evaluating LAWs

1. Allow wet swipe to dry prior to counting.

2. Scan the swipe with an appropriate field instrument in an area with a low background.
3. Hold the detector within ½ inch of the swipe and move the detector over the swipe at a maximum rate of 1 inch per second.
4. If any indication of an increased count rate is noted, pause to allow the meter reading to stabilize.
5. If the swipe reading is indistinguishable from background, consider the surveyed surface to be free from contamination. If the LAW reading is greater, conduct further surveys to isolate the boundaries of the contamination.
6. Dispose of used LAW media as radioactive waste.

5.2.3 SURVEYS FOR FIXED ALPHA/BETA CONTAMINATION

Fixed contamination surveys are used to obtain indications of fixed contamination levels on surface areas, pieces of equipment, or tools for characterization and/or release surveys. Fixed contamination surveys are also performed to assess if residual contamination is present greater than the release criteria for the radionuclide(s) of concern.

A Ludlum Model-2360/43-68 or equivalent should be used for performing fixed contamination surveys for alpha and beta radiation.

5.2.3.1 Scan Measurements

1. When surveying for fixed alpha/beta contamination, the probe should be held within 1/4 inch or less from the surface being surveyed. The movement rate of the detector probe should be 1 inch per second or slower.
2. When performing direct scan surveys of objects, surfaces, materials, equipment, etc., static measurements should be performed frequently to ensure the detection of residual activity.
3. Whenever practical, 100 percent of accessible areas being surveyed should be direct scan surveyed, unless the applicable work planning document indicates otherwise.
4. Scan ranges are documented as the range from the lowest measurement to the highest measurement observed.

5.2.3.2 Static Measurements

1. Count time for conducting static measurements will be dependent upon the isotope of concern and the MDA for the instrument being used.

2. Static measurements should be performed as required by a work planning document or frequently enough to ensure the detection of residual activity.
3. When taking a static measurement for fixed alpha/beta contamination, the probe should be held within 1/4 inch or less from the surface being surveyed.
4. Results should be reported in units of net counts per minute (cpm) above background or dpm/100 cm².
5. The following formula should be used for converting direct probe readings in cpm to dpm/100 cm²:

$$A_S = \frac{R_{S+B} - R_B}{\varepsilon_i \varepsilon_s \frac{W_A}{100 \text{ cm}^2}}$$

where,

- A_S = total surface activity (dpm/100 cm²)
 R_{S+B} = the gross count rate of the measurement in cpm
 R_B = the background count rate in cpm
 ε_i = the instrument efficiency (counts per particle)
 ε_s = the contaminated surface efficiency (particles per disintegration)
 W_A = the physical area of the detector window (cm²)

In the absence of experimentally determined surface efficiencies, ISO-7503-1 and NUREG-1507, provide conservative recommendations for surface efficiencies. ISO-7503-1, recommends a surface efficiency of 0.25 for alpha emitters. NUREG-1507 provides surface efficiencies based on studies performed primarily at Oak Ridge Institute for Science and Education (ORISE).

5.2.4 GAMMA SURVEYS

A Ludlum Model-2350-1/44-10 or equivalent should be used for gamma radiation surveys.

A single detector or an array of detectors may be used to perform gamma scans.

5.2.4.1 Scan Measurements

1. Set the audio response switch to the “on” position.
2. If a single detector is used, traverse a path at a maximum speed of approximately 0.5 meters per second and slowly move the detector assembly in a serpentine (S-shaped) pattern, while maintaining the detector approximately 10 cm (4 inches) from the area being surveyed.

3. If a detector array is used, it will be pushed or pulled in a straight line with the detector centers positioned approximately 30 cm apart.
4. Scan ranges should be recorded from the lowest reading to the highest reading noted.
5. If data logging is being performed, the scan data will be collected at the time interval necessary to obtain the measurements required for the survey.
6. Measurement results are recorded in cpm.

5.2.4.2 Static Measurements

1. Static photon measurements require positioning the detector assembly approximately 10 cm (4 inches) above the surface and completing a stationary 60-second survey.
2. Static measurements should be performed as required in the applicable work planning document or frequently enough to ensure the detection of residual activity.
3. Record results in cpm.

6.0 RECORDS

Radiation/Contamination Survey Form

Radiation/Contamination Survey Supplement

Survey Log

7.0 REFERENCES

<i>Number</i>	<i>Title</i>
10 CFR 20	<i>Standards for Protection Against Radiation</i>
ISO-7503-1	<i>Evaluation of Surface Contamination</i>
NUREG-1507	<i>Minimum Detectable Concentration/Activities for Typical Radiation Survey Instruments for Various Contaminants and Field Conditions</i>
NUREG-5480.11	<i>Radiation Protection for Occupational Workers</i>
NUREG-1575	<i>Multi-Agency Radiation Survey and Site Investigation Manual</i>
400-CP-401	<i>Issue and Use of Radiation Work Permits</i>

8.0 ATTACHMENTS

Forms provided in this section illustrate the minimum requirements for their respective subject matter. Alternative documents or electronic data logging may be used providing the information is presented in a clear and concise manner and the content meets or exceeds the information required to complete these documents.

Attachment 1, Radiation/Contamination Survey Form

Attachment 2, Radiation/Contamination Survey Supplement

Attachment 3, Survey Log

ATTACHMENT 1 – RADIATION/CONTAMINATION SURVEY FORM

DATE:	TIME:	INSTRUMENTATION USED				
SURVEY NUMBER:	Model Inst/Det.	Serial Number	Calibration Due Date	% Efficiency	MDC/MDA (dpm/100cm ²)	Background (dpm/100cm ²)
LOCATION:						
SURVEYOR:						
REVIEWED BY:						
RSO/RTM:						
Isotopes of Concern:						
Description or drawing:						
Routine (Daily / Weekly / Monthly) <input type="checkbox"/> Non-routine <input type="checkbox"/>				All radiation readings in $\mu\text{r/hr}$ unless otherwise noted. #.....denotes swipe location or fixed α/β readings. #.....denotes G/A radiation readings. # / #.....denotes contact / 1 meter radiation readings. *.....denotes highest radiation reading on contact. Δ.....denotes static location.		

ATTACHMENT 2 - RADIATION/CONTAMINATION SURVEY SUPPLEMENT

SURVEY NUMBER:								
SURVEYOR:					LOCATION:			
Location	Exposure Rate (μ R/hr)		Fixed + Removable			Removable		Comments
	Contact	1 Meter	Gamma (cpm)	Alpha dpm/probe	Beta/Gamma dpm/probe	Alpha dpm/100cm ²	Beta/Gamma dpm/100cm ²	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
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24								
25								
Reviewer			Date/Time:		RSO/RTM		Date/Time:	

Project:

Location:

Reviewed/Approved By: _____

RSO/PM

Date



Field Operating Procedure
AIR SAMPLING AND ANALYSIS
300-SP-302

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019

Date

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1.0 SCOPE

This document provides guidelines for the selection, operation, and documentation of the results of air samples performed on Up-Side Radiological Survey, LLC (USRS) projects. The same basic method is used for both occupational samples (such as high-volume job related samples and personal air samples), and for ambient environmental air samples.

2.0 PURPOSE

The purpose of this procedure is to provide procedural guidance to ensure a) optimum and adequate protection of workers; b) conformance with sound health physics and radiological safety practices; and c) compliance with 10 CFR 20 and DOE Order 5480.11.

3.0 REFERENCES AND DEFINITIONS

3.1 References

- 3.1.1 DOE Order 5480.11, Radiation Protection for Occupational Workers
- 3.1.2 10 CFR 20, Standards for Protection Against Radiation
- 3.1.3 USRS Procedure 400-CP-409, Radiological Posting and Access Control
- 3.1.4 USRS Procedure 400-CP-408, Selection and Use of Respiratory Protection
- 3.1.5 NUREG 0041, Manual of Respiratory Protection Against Airborne Radioactive Materials
- 3.1.6 ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities
- 3.1.7 Regulatory Guide 8.25, Air Sampling in the Workplace
- 3.1.8 USRS Procedure 200-IP-204, Operation of Low Volume Air Sampler
- 3.1.9 USRS Procedure 200-IP-205, Operation of High Volume Air Samplers
- 3.1.10 USRS Procedure 200-IP-202, Operation and Calibration of the Ludlum Model 2929 Dual Channel Scaler

3.2 Definitions

- 3.2.1 **ALI (Annual Limit of Intake)**- Value of intake of a given radionuclide in a year by an adult worker that would result in a committed effective dose equivalent H_{E50} of 5 rems (0.05Sv) or a committed dose equivalent H_{T50} of 50 rems (0.5Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in References 3.1.1 and 3.1.2).

- 3.2.2 Breathing Zone**- That region adjacent to the worker's mouth and nostrils from which air is drawn into the lungs while he/she performs his/her assigned work. Air taken from this region will represent the air the worker is breathing while he/she works. The samples collected to assess breathing zone concentrations normally are within 12" of the nostrils.
- 3.2.3 Grab Sample** - A random, single sample taken over a short period of time (dependent upon flow rate) are based upon the minimum volume required.
- 3.2.4 Lapel Sampler**- A battery operated portable air sampler with a sample collector fastened near the breathing zone.
- 3.2.5 Marinelli Beaker**- A plastic or glass container used to sample for liquids or gases. These containers only contained 500 ml.
- 3.2.6 DAC (Derived Air Concentration)** - The concentration of a given radionuclide in air which, if breathed by an adult worker for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2m³ of air per hour), results in an intake of one ALI. DAC values can be found in References 3.1.1 and 3.1.2.
- 3.2.7 DAC-Hour** – The product of the concentration of radioactive material and air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that nuclide, in hours. Of facility may take 2,000 DAC-hours to represent one ALI.
- 3.2.8 Monitor**
- 3.2.8.1 To measure an airborne radioactive constituent or gross content of radioactive material continuously or at a frequency that permits an evaluation of the concentration over an interval of time.
- 3.2.8.2 and instrument or device used to take measurements.
- 3.2.9 Particle**- An aggregate of molecules forming a solid or liquid ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).
- 3.2.10 Representative**- Indicates the quality and characteristics of the entire volume from which a sample is drawn.
- 3.2.11 Sample**- A representative portion of an atmosphere of interest, or one or more separated constituents from a representative portion of an atmosphere.
- 3.2.12 Vapor**- The gaseous form of materials that are liquids or solids at room temperature. Distinguished from non-condensable gases.

4.0 PRECAUTIONS, LIMITATIONS

- 4.1** Avoid unnecessary contamination of survey instruments through the use of plastic coverings and care in handling. Do not cover the air intakes or exhausts on air samplers.
- 4.2** Avoid unnecessary exposure when conducting air monitoring surveys by utilizing good ALARA practices.
- 4.3** Air samplers shall be operated in accordance with their operation and calibration procedure.
- 4.4** Air samplers used in confined spaces may ignite explosive gases. Extreme care shall be exercised including prior sampling of the atmosphere for explosive gas and Oxygen content.
- 4.5** Samples should not be taken in such a manner as to contaminate the sample filter with materials, which are not airborne, or by sucking up loose contamination from surfaces near the sampling head. Caution should be used to minimize producing airborne material by the exhaust of the sampler.
- 4.6** The instrument(s) (Ludlum Model 2929 or equivalent) used to screen air samples shall be designated by Health Physics Supervision.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

5.1.1 USRS Radiological Field Operations Manager (Project Manager) shall be responsible for:

- 5.1.1.1 Implementation of this procedure.
- 5.1.1.2 Periodic reviews of adherence to the requirements of this procedure.
- 5.1.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.
- 5.1.1.4 Periodic review of air sample data to verify effectiveness of engineering controls and the USRS respirator program.

5.1.2 Health Physics Supervisors shall be responsible for:

- 5.1.2.1 Assignment of Health Physics Technicians performing this procedure.

- 5.1.2.2 Reviewing and approving documentation generated by the use of this procedure.

5.1.3 Health Physics Technicians shall be responsible for:

- 5.1.3.1 Performance of the requirements of this procedure.
- 5.1.3.2 Adherence to other procedures referenced.
- 5.1.3.3 Documentation of all work performed under this procedure.

5.1.4 Employees shall be responsible for:

- 5.1.4.1 Notifying Health Physics prior to the start of any work under an RWP requiring respiratory protection.
- 5.1.4.2 Notifying Health Physics prior to entering any areas posted: "Airborne Radioactive Area".

5.2 Qualifications

5.2.1 Health Physics Technicians shall be qualified in accordance with the requirements of ANSI/ANS-3.1 – 2014 to perform air monitoring and subsequent calculations.

5.2.2 Health Physics Technicians shall be qualified in accordance with procedures in the operation of equipment required to perform air monitoring.

5.2.3 Junior Health Physics/Decontamination Technicians shall perform air sampling and counting only under direct supervision of a Health Physics Technician meeting the requirements of Section 5.2.1 and 5.2.2 of this procedure.

6.0 PROCEDURE

6.1 Prerequisites

6.1.1 USRS shall use, to the extent practicable, process or other engineering controls (e.g., containment or ventilation) to control the concentration of radioactive material in air.

6.1.2 Air Monitoring

Ambient air monitoring shall be performed in areas with the potential to exceed 10% of any derived air concentration (DAC) [See References 3.1.1 and 3.1.2]. Ambient air monitoring may be performed using portable air samplers or air monitoring systems. Ambient air monitoring shall be placed in strategic locations to detect and evaluate airborne contamination at work locations. Data obtained from air monitoring shall be used for assessing the control of airborne radioactivity

in the workplace and may be used to evaluate the dose equivalent to radiation workers from internal sources.

- 6.1.3** Air monitoring systems shall be routinely calibrated and maintained, and should be capable of measuring one DAC when averaged over 8 hours.

6.1.4 Background Air Samples

Background air sampling should be performed in areas where work activities are not being performed. Consideration should also be made in sampling the work area prior to work starting in the area. The data obtained from these samples should be used as a baseline for work area ambient and breathing zone air samples.

6.2 Discussion

A comprehensive air-sampling program is essential to evaluate the hazards associated with work situations involving radioactive materials. In many instances, air sampling Data can also provide the basis for development and evaluation of control procedures and can indicate whether or not operational changes are necessary to provide adequate protection for the worker. In conjunction with a respiratory protection program, air-sampling data is necessary to define the air concentration levels so that the proper respiratory protective equipment can be selected. Since respiratory protection factors vary over several orders of magnitude, it is very important that an initial estimate be made of the air concentration levels, relative to specified regulatory limits. Thus, adequate protection can be provided while unnecessary inconvenience to the worker wearing a respirator is minimized. Air sampling programs may also be designed to estimate the release of contaminants to the general work area and to the outside environment.

- 6.2.1** An air-sampling program directly related to respiratory protection should:

- 6.2.1.1 Provide an estimate of the potential intake of airborne radioactive materials and resulting exposure of the individual worker.
- 6.2.1.2 Provide data to assist in the selection of respiratory protective equipment that would provide adequate protection under exposure conditions.
- 6.2.1.3 Provide data for control of long-term exposure workers.
- 6.2.1.4 Provide documentation of personnel exposures for legal or regulatory purposes.
- 6.2.1.5 Identify and characterize the contaminants and their sources.

- 6.2.1.6 Provide data for determining the requirements for engineering or administrative controls.
- 6.2.1.7 Indicate the continuing effectiveness of existing controls, and warn of deterioration of control equipment or operating procedures.
- 6.2.1.8 Provide a record of long-term trends showing variations in contaminate levels.
- 6.2.1.9 Continuously measure the level of airborne contaminants in and above work areas and warn of release of airborne contaminants to the outside environment.

6.2.2 Consideration in Air Sampling

An air-sampling program must be designed and operated so that the data obtained are directly and meaningfully related to the problem of concern. As part of a respiratory protection program, the air-sampling procedures must take into account:

- 6.2.2.1 The physical and chemical state of the contaminate.
- 6.2.2.2 Aerodynamic size characteristics of airborne particulates.
- 6.2.2.3 Range of contaminant concentration.
- 6.2.2.4 Environmental conditions such as temperature.
- 6.2.2.5 Sampler location relative to the worker and the source of contamination.
- 6.2.2.6 Instrument operating and response characteristics.
- 6.2.2.7 Instrument portability.
- 6.2.2.8 Sensitivity of the associated analytical procedures relative to the specified concentration limits and quantity of material sample.

6.3 General

6.3.1 Preparation and General Requirements for Airborne Radioactivity Surveys

- 6.3.1.1 Air may be sampled for various types of radioactive material (particulates, radio-iodine's, radio-gases, or tritium).
 - 6.3.1.1.1 Particulates are normally collected on paper filter material.

- 6.3.1.1.2 Radio-iodine's are normally collected by charcoal cartridges.
- 6.3.1.1.3 Radio-gases are normally collected as a fixed trapped volume of air.
- 6.3.1.1.4 Tritium is normally collected by bubbling air through water.
- 6.3.1.2 Air sampler and equipment.
 - (a) Select calibrated instrumentation appropriate for the survey to be performed.
 - (b) Performance check instrument(s) (as applicable) in accordance with the operation calibration procedures.
 - (c) Obtain other items needed, such as filters, bubblers or radio-gas chambers.
- 6.3.1.3 Punch-Outs
 - (a) Analyzing punched out portions of filters too large to count in available instruments will not pose difficulties for accuracy or precision.
 - (b) A filter ratio (FR) factor of 3.0 should be used for 4" diameter filters cut out to fit into the sampling tray of a Ludlum Model 2929 or equivalent for counting purposes.
- 6.3.1.4 Survey Documentation
 - (a) Obtain necessary air sample filter(s) and any other material required to provide the necessary sample data.
 - (b) The following data is normally required for each air sample and is recorded on Form USRS-030 or equivalent spreadsheet.

NOTE:

Air sample documentation may be done on a computer generated (if available) Form EQUIVALENT TO USRS-030.

N/A should be recorded for items, which are not applicable to the particular sample.

- Type of sample; General area (GA), or breathing zone (BZ).
- Purpose of sample; that is routine or non-routine, and special if non-routine.
- A brief description of the test being performed.
- RWP number the sample was obtained for, if available.
- Sample location.
- Sampler model and serial or ID number.
- Sample start date and time.
- Sample start flow rate.
- Sample stop flow rate and vacuum, if applicable.
- Sample average flow rate, as CFM or LPM.
- Total sampling time; as days, hours, or minutes as appropriate.
- Any specific sample analysis required (e.g., gamma or alpha isotopic).
- If samples are collected in a sub-atmospheric area, the pressure in psia.
- The name(s) of the individual(s) starting and stopping the sample.

6.3.1.5 Air sample packaging considerations.

- (a) Particulate filters of different air samples should be placed in a separate envelope, poly bag, or other suitable container to ensure no possibility of cross-contamination.
- (b) Charcoal cartridges and the upstream particulate filter should be placed in a clear poly bag or equivalent.
- (c) Tritium bubblers should be placed in a clear poly bag or equivalent, and other tritium sampling items placed in another bag.

- (d) Radio-gas sample chambers should be placed in a clear poly bag or equivalent.

6.3.1.6 During collection and handling of air samples, caution must be used to prevent the samples from being contaminated by other sources of radioactive material.

6.3.1.7 Notify the Health Physics Supervisor of any unusual airborne radiological conditions identified, such as dust, smoke or chemicals.

6.4 Types of Air Samples

6.4.1 Low-Volume and High-Volume Air Samples

6.4.1.1 Low-volume air samples are at a flow rate of 1 CFM (28.32 LPM) to 5 CFM (141.6 LPM).

6.4.1.2 High volume air samples are at a flow rate of 10 CFM (283.2 LPM) to 30 CFM (849.6 LPM).

6.4.2 General Area (GA) airborne surveys provide data representative of the air in an area, building, or room. GA surveys normally provide the data used for determining if an area is an Airborne Radioactivity Area for implementing posting and access controls. Using a low-volume air sampler, the minimum volume for GA air samples should be 100 ft³ (2,832 liters).

- (a) GA samples are normally taken on a routine basis, including predetermined times and locations.
- (b) GA samples should be taken at between 3 to 6 feet above floor level.
- (c) Samples may be taken in a short period of time over a period of time varying from an hour up to one or more days, generally known as “continuous sample”.
- (d) Samples are normally obtained and analyzed as a minimum for particulates by gross alpha, beta-gamma counting.

6.4.3 Breathing Zone (BZ) airborne surveys provide data representative of the air that worker would be breathing during a particular task. The minimum volume for BZ air samples is 50 ft³ (1,416 liters).

- (a) BZ samples are normally taken as a minimum during the time when the highest concentrations of radioactive material are expected to be present.
- (b) BZ samples may be taken at any time to document low, high, and average concentrations of airborne radioactive material.

- (c) Samples are normally taken in a position which would be representative of the air which would be breathed by a worker, regardless if a respirator is being worn or not. The samples should be taken within a circumference of 12 inches of the worker's head, if possible.
- (d) Samples are normally analyzed for particulates.

6.4.4 Grab and Continuous Samples and Samplers.

- (a) Grab samples are taken with a high volume sampler. The minimum volume required for grab samples using a high-volume sampler should be 100 ft³ (4,248 liters).
 - Grab samples represent the concentrations during the relatively short period of sampling time and may be useful to estimate Peak concentrations if this type of data is required.
 - Continuous samples are normally taken with low-volume air samplers due to the long run times involved. The minimum volume for continuous air samples should be 100 ft³ (2,832 liters).
 - Continuous samples represent the concentrations during a relatively long period of sampling time and are used to estimate average concentrations.
 - Continuous samples are not normally used where airborne concentrations are expected to vary significantly during the time period of interest.
- (b) Either grab or continuous samples may be representative of areas where airborne concentrations are not expected to vary significantly over time period of interest.

6.5 Sampling and Analysis for Radioactive Noble Gases

6.5.1 Obtain a 500 ml Marinelli Baker.

- 6.5.1.1 Ensure the beaker is free of contamination or that a background count of the beaker has been performed.
- 6.5.1.2 Ensure petcocks are free to be open/closed.
- 6.5.1.3 Fill the beaker with de-ionized water, if available, or tap water, if not and replace the top.

6.5.2 At the sample location:

- 6.5.2.1 Remove the Marinelli beaker top and pour water from the beaker.

- 6.5.2.2 Replace top securely.
- 6.5.2.3 Ensure petcocks are closed.
- 6.5.3 The chamber is to be analyzed for gamma isotopic as soon as possible after sampling to minimize error due to noble gas loss by diffusion or decay.
- 6.5.4 Perform Step 6.8.4.8 (a) and (b) of this procedure when noble gas isotopic results exceed 10% of the DAC value.
- 6.6 Sampling and Analysis for Radio-iodine
 - 6.6.1 Obtain a low volume air sampler with a particulate filter and charcoal cartridge arrangement.
 - 6.6.2 At the sampling location(s):
 - 6.6.2.1 Start the air sampler.
 - 6.6.2.2 Sample time should be such that a minimum volume of 100 ft³ (2,832 liter).
 - 6.6.2.3 At the end of the sampling period, stop the sampler.
 - 6.6.2.4 Send the filter/and charcoal cartridge for gamma isotopic analysis.
 - 6.6.2.5 Request results of the analysis are expressed in $\mu\text{Ci/ml}$ and percent DAC.
 - 6.6.3 Perform Step 6.8.4.8 (a) and (b) of this procedure when radioiodine results exceed 10% of the DAC value.
- 6.7 Sampling and Analysis for Tritium or Carbon-14
 - 6.7.1 Obtain sample pump and tritium bubble or sampling system.
 - 6.7.1.1 Sampling pump.
 - 6.7.1.2 Midget bubbler, with 25 ml of demineralized water.
 - 6.7.1.3 Filter to remove particulate material from air sample.
 - 6.7.1.4 Assemble sampling system with filter upstream of bubbler and bubbler upstream of pump.
 - 6.7.2 At sampling location:

- 6.7.2.1 Start the pump; and if flow rate is adjustable, adjust flow rate as indicated on the sampling pump or for a gentle bubbling action in bubbler.
 - 6.7.2.2 Sample time should be such that a minimum air volume of 10 liters (0.35 ft³) is sampled.
 - 6.7.2.3 Send the sample to an approved the laboratory for analysis.
 - 6.7.2.4 Request a liquid scintillation analysis for Tritium and/or C-14.
 - 6.7.2.5 The results of the analysis are expressed in $\mu\text{Ci/ml}$ and percent of DAC.
- 6.7.3** Perform step 6.8.4.8 (a) and (b) of this procedure when Tritium or Carbon-14 results exceed 10% of the DAC value.
- 6.8** Sampling and Analysis for Radioactive Particulate Material
- 6.8.1** Obtained the air sampler and filter(s) to be used.
- 6.8.1.1 The filter is to be a F&J FP-47 (Low Volume) and F&J FP-4.0 (High Volume) particulate filter, or filter of equivalent efficiency and characteristics.

NOTE:

If the sampling head is designed for both a particulate filter and a charcoal cartridge and the sample is for particulate only, a dummy or spacer charcoal cartridge may be required to be inserted into the sampling head to ensure proper fit of the particulate filter and to duplicate calibration conditions. Refer to the sampler's calibration documentation for applicability. High-volume air samplers shall not be used with the spacer cartridge.

- 6.8.1.2 Install the filter in the sampling head with the "fuzzy side" facing outward.
- 6.8.2** At the sampling location:
- 6.8.2.1 Select flow rate and determine time required for the needed volume of air.
 - (a) High Volume 100 ft³

(b) Low Volume 100 ft³

6.8.2.2 Start the air sampler.

6.8.2.3 At the end of the sampling period, stop the sampler.

NOTE: In the event the required volume of air sample cannot be taken, the sample, regardless of volume, is still valid.

6.8.2.4 Remove the filter at the designated location, and identify and package the sample.

6.8.3 Particulate Sampling Techniques

6.8.3.1 Grab samples are taken with a high-volume sampler. The minimum volume required for grab samples using a high-volume sampler should be 100 ft³ (4,248 liters).

- (a) Grab samples represent the concentrations during the relatively short period of sampling time and may be useful to estimate peak concentrations if this type of data is required.
- (b) Continuous samples are normally taken with low-volume air samplers due to the long run times involved. The minimum volume for continuous air samples is 100 ft³ (2,832 liters).
- (c) Continuous samples represent the concentrations during the relatively long period of sampling time and are used to estimate average concentrations.
- (d) Continuous samples are not normally used where airborne concentrations are expected to vary significantly during the time period of interest.

6.8.3.2 Lapel Sampling

- (a) Attach the sampling apparatus to the users hip or waist with a belt.
- (b) The sample head is secured in the “lapel” area.
- (c) Secure the tubing and sample head with tape and/or clips.
- (d) At the sampling location turn the sampling pump on.
- (e) Complete Form USRS-035 with the following information:

- Name of Wearer and SSN#
 - Sample ID#
 - Date/Time On
 - Flow Rate CFM/LPM
- (f) At the end of the sampling period turn the sampling pump off.
- (g) Complete Form USRS-035 with the following information:
- Date/Time Off
 - Total volume Ft.³/Liters
- (h) The Health Physics Technician shall ensure that the worker being issued the sampler is instructed as to follow the requirements below:
- Refrain from tampering with the pump or the sample head.
 - Leave the work area if the sampler fails, and note stop time.
 - Contact an HP representative for assistance at completion of work.

NOTE:

Due to the low volume of lapel breathing zone air samples, the Minimum Detectable Activity (MDA) on gross counting equipment is usually insufficient to determine 10% DAC for unknown isotopes for screening purposes. In the event it is desired to screen these breathing zone samples, a high-volume air sample may be placed within 2 feet of the most restrictive breathing zone (highest expected concentration). This sample may be used to screen the lapel samples.

- 6.8.3.3 Air particulate samples are to be analyzed as a minimum for gross alpha and beta-gamma counting using A Ludlum Model 2929 Dual Channel scaler or equivalent instruments.

6.8.3.4 Air particulate samples should be initially counted within fifteen (15) minutes (if feasible) of the end of the sampling period.

6.8.3.5 Air particulate samples shall be counted for a period of five minutes.

6.8.4 Air Sample Analysis of Particulate Filters

6.8.4.1 Upon completion of sampling, use Form USRS–030 or equivalent and perform the sample analysis in the order of the steps on the USRS–030.

6.8.4.2 Place the air sample filter inside the sampling tray with the “fuzzy” side facing up towards the detector.

NOTE:

If a high-volume air sample filter is to be counted, using a hole punch, cut out the center portion of the filter and place the cut out portion of the filter in the sampling tray with "fuzzy" side facing up towards the detector.

6.8.4.3 Count sample for a 10-minute period.

6.8.4.4 Upon completion of the counting period, calculate and record the alpha activity (unless no alpha counts are present) then calculate the beta activity using the instructions on Form USRS-030 or equivalent.

NOTE:

The following Criteria may be used when evaluating air sample results.

- (a) Contamination levels and physical characteristics.
- (b) Work activities in the area/re-suspension probability.
- (c) Historical data/isotopic information.
- (d) Background air sample data.

6.8.4.5 If the calculated air activity does not exceed 10% of the DAC value of the radionuclide(s) of concern, no further analysis is required and the sample may be discarded at the discretion of Health Physics Supervision.

- 6.8.4.6 If the calculated air activity exceeds 10% of the DAC value of the radionuclide(s) of concern.
- (a) Report this information to Health Physics Supervision immediately.
 - (b) Allow the sample to decay for a 3-hour period (if feasible) and recount the sample in accordance with the instructions on form USRS-030 or equivalent and steps 6.8.4.2 through 6.8.4.4 of this procedure.
- 6.8.4.7 Following the 3-hour decay period, if the calculated air activity does not exceed 10% of the DAC value of the radionuclide(s) of concern, no further analysis is required and the sample may be discarded at the discretion of Health Physics Supervision.
- 6.8.4.8 if the calculated air activity exceeds 10% of the DAC value of the radionuclide(s) of concern.
- (a) Report this information to Health Physics Supervision immediately.

7.0 RECORDS

Air Sample Identification Record

Personal Air Monitoring Log

8.0 FORMS AND EXHIBITS

Equivalent forms may be used by the direction of the Health Physics Supervisor on a project by project basis.

ATTACHMENT 1
AIR SAMPLE IDENTIFICATION RECORD

Project/Location: _____

Page ____ of ____

Sample ID	Date	Location	Start Time	Stop Time	Air Sampler ID	Sample Volume	Count Results α ($\mu\text{Ci/ml}$)	Count Results β ($\mu\text{Ci/ml}$)	%DAC	Counter ID

DAC
 $\mu\text{Ci/ml}$
ID

derived air concentration
microcurie per milliliter
identification number

α alpha
 β beta

**ATTACHMENT 2
PERSONAL AIR MONITORING LOG**

Name of Wearer	Sampler ID #	Date	Time On / Time Off	Flow Rate cfm /lpm	Total Volume ft ³ / Liters	Activity α (μCi/ml)	Activity β (μCi/ml)	Percent DAC

cfm	cubic feet per minute	lpm	liters per minute
DAC	derived air concentration	μCi/ml	microcurie per milliliter
Ft ³	cubic feet	α	alpha
ID	identification number	β	beta



Field Operating Procedure

GENERAL SAMPLING

300-SP-303

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

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1.0 SCOPE

This procedure sets forth the methods for collecting miscellaneous samples on Up-Side Radiological Survey, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to provide methods for collecting miscellaneous samples and methods of analysis.

3.0 REFERENCES

- 3.1** Project/Site Health and Safety Plan
- 3.2** Project/Site Detailed Work Procedure
- 3.3** NUREG/1575-MARSSIM, Multi Agency Radiation Survey and Site Investigation Manual
- 3.4** NUREG/CR-5512, Residual Radioactive Contamination From Decommissioning
- 3.5** USRS Procedure; 400-CP-402, Sample Chain of Custody
- 3.6** USRS Procedure; 300-SP-304, Surface Soil Sampling
- 3.7** USRS Procedure; 300-SP-305, Sediment Sampling
- 3.8** USRS Procedure; 300-SP-306, Water Sampling
- 3.9** USRS Procedure; 200-IP-202, Operation and Calibration of the Ludlum Model 2929 Dual Channel Scaler

4.0 EQUIPMENT

- 4.1** Equipment is chosen based on the type of material to be sampled. The following list represents some possibilities.
 - 4.1.1** Paint sampling: heat gun, paint stripper solution, hammer and chisel.
 - 4.1.2** Drain or pipes: Plumber's snake, swabs.
 - 4.1.3** Residues: towels, scoops.
 - 4.1.4** Concrete or asphalt: core bores, hammer and chisel.
 - 4.1.5** Record forms and sample log book (if used).

5.0 RESPONSIBILITIES

5.1 USRS Radiological Field Operations Manager (Project Manager)

5.1.1 Implementation of this procedure.

5.1.2 Periodic reviews of adherence to the requirements of this procedure.

5.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

5.2 Health Physics Supervisors

5.2.1 Assignment of Health Physics Technicians performing this procedure.

5.2.2 Reviewing and approving documentation generated by the use of this procedure.

5.3 Health Physics Technicians

5.3.1 Performance of the requirements of this procedure.

5.3.2 Adherence to other procedures referenced.

5.3.3 Documentation of all work performed under this procedure.

6.0 SAMPLING PROCEDURE

6.1 Methods for collecting miscellaneous samples should be determined based on the characteristics of the sample media. Care should be taken to limit potential for spreading contamination during sample collection.

Sample quantity should be determined based on the following:

- Type of analyses required
- Number of analysis requested
- Detection sensitivity required of analytical result
- Estimated activity level of material

6.2 Label and secure all samples in accordance with References 3.1, 3.2 and 3.5. Record pertinent information on form USRS-049 and in the sample logbook if used.

7.0 ANALYSIS PROCEDURE

- 7.1 Samples that require gamma, beta, or alpha spectroscopy or isotopic discrimination of any type shall be sent to an approved laboratory for analysis
- 7.2 Samples that can fit into a 1/8" x 2" planchet that require gross alpha and/or beta/gamma results may be counted in a Ludlum 2929 or equivalent.
- 7.2.1 Ensure that minimum counting system sensitivity requirements are met by calculating MDA values for alpha and beta, as applicable. Increase sample count time and background count time, or use shielding to lower background count rate as necessary to reduce MDA. If minimum MDA requirements cannot be met by these methods, forward sample to off-site laboratory for analysis.
- 7.2.2 Place sample into planchet with the surface of measurement up.
- 7.2.3 Count sample for an appropriate length of time, per References 3.1 and 3.2.
- 7.2.4 Record count and counting time data on Form USRS-011 in accordance with Reference 3.9.
- 7.2.5 Determine net activities as follows:

$$\text{DPM} = \frac{\text{Gross CPM} - \text{Background CPM}}{\text{Efficiency}}$$

$$\text{mCi} = \frac{\text{Gross CPM} - \text{Background CPM}}{\text{Efficiency} \times 2.22 \text{ E}^6}$$

- 7.2.6 Document all samples obtained on Form USRS-049.
- 7.2.7 Sample Chain of Custody records shall be documented in accordance with Reference 3.5 applicable.

8.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

- 8.1 Form USRS-006, Smear Counting Analysis Report
- 8.2 Form USRS-049, Sample Status Log

9.0 FORMS

- 9.1 Form USRS-006, Smear Counting Analysis Report
- 9.2 Form USRS-049, Sample Status Log



Field Operating Procedure
SURFACE SOIL SAMPLING

300-SP-304

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

REVISION HISTORY

Revision (Date)	Rev. No	Prepared By	Description of Changes	Affected Pages
October 2018	0	D DeLong	New Issue	All
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1.0 SCOPE

This procedure sets forth the methods for collecting samples of surface soil on Up-Side Radiological Survey, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to provide methods for collecting surface soil samples.

3.0 REFERENCES

- 3.1 Project/Site Health and Safety Plan
- 3.2 Project/Site Detailed Work Procedure
- 3.3 NUREG/1575-MARSSIM, Multi Agency Radiation Survey and Site Investigation Manual
- 3.4 NUREG/CR-5512, Residual Radioactive Contamination From Decommissioning
- 3.5 USRS Procedure; 400-CP-402, Sample Chain of Custody
- 3.6 USRS Procedure; 300-SP-305, Sediment Sampling
- 3.7 USRS Procedure; 300-SP-306, Water Sampling
- 3.8 USRS Procedure; 300-SP-303, General Sampling

4.0 EQUIPMENT

- 4.1 Digging implement: garden trowel, shovel, spoons, post-hole digger, etc.
- 4.2 Special sampling apparatus (cup cutter, Shelby tube, etc.) as required.
- 4.3 Plastic bags, approximately 10 cm diameter by 30 cm long.
- 4.4 Cardboard “ice cream” containers (1 quart size) or geology sample bags.
- 4.5 Twist ties
- 4.6 Masking or duct tape.
- 4.7 Record forms.
- 4.8 Labels and security seals.
- 4.9 Indelible pen.
- 4.10 Equipment cleaning supplies, as appropriate.

4.11 ¼" Mesh Screen

5.0 RESPONSIBILITIES

5.1 USRS Radiological Field Operations Manager (Project Manager)

5.1.1 Implementation of this procedure.

5.1.2 Periodic reviews of adherence to the requirements of this procedure.

5.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

5.2 Health Physics Supervisors

5.2.1 Assignment of Health Physics Technicians performing this procedure.

5.2.2 Reviewing and approving documentation generated by the use of this procedure.

5.3 Health Physics Technicians

5.3.1 Performance of the requirements of this procedure.

5.3.2 Adherence to other procedures referenced.

5.3.3 Documentation of all work performed under this procedure.

6.0 PROCEDURE

NOTE:

Because standard service soil contamination criteria for radionuclides are applicable to average concentration in the upper 15 cm of soil, the usual sampling protocol described here is based on obtaining a sample of this upper 15 cm. Special situations, such as evaluating trends or airborne deposition, determining near surface contamination profiles, and measuring non-radiological contaminants, necessitate special sampling procedures. These special situations are evaluated and incorporated into site-specific survey plans as the need arises.

Direct surface radiation measurements are to be performed at each location before initiating sampling. This will identify the presence of gross contamination, which will require that samples and equipment be treated as radioactive and handled in accordance with appropriate procedures.

6.1 Loosen the soil at the selected sampling location to a depth of approximately 15 cm, using a trowel or other digging implement.

- 6.2** Remove large rocks, vegetation, and foreign objects (these items may be also collected as separate samples, if directed).
- 6.3** Place approximately 2 kg (or an amount in accordance with Reference 3.1 and 3.2) of the soil into a plastic bag-lined cardboard container or geology sample bag.
- 6.4** Seal the bag using a twist tie, cap, and tape the cap in place (or tie the sample bag strings).
- 6.5** Label and secure the sample container in accordance with References 3.1 and 3.2.

NOTE: A box shall be lined with plastic and approved absorbent material prior to placing samples inside the box if the samples are to be shipped for analysis.

NOTE: A load rating stamped on the bottom of the box shall be noted. This rating shall not be exceeded to prevent degradation of the box during shipping.

- 6.6** The container should be placed in a cardboard box (also properly labeled) for storage or for shipping.

CAUTION

Samples must be contained within an outer protective cover to prevent (minimize) cross-contamination of samples from one site to another.

- 6.7** Document all samples obtained on Form USRS– 049, Sample Status Log and in the sample logbook if applicable.
- 6.8** Sample Chain of Custody records shall be documented in accordance with Reference 3.5.

CAUTION

DO NOT proceed to the next sample site or leave the area with any equipment until you have completed Steps 6.9 and 6.10.

- 6.9** Clean sampling tools before proceeding to the next sampling location.
- 6.10** Survey sampling equipment to ensure no removable contamination exists which could result in cross-contamination of samples.

7.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

7.1 Form USRS-049, Sample Status Log

8.0 FORMS

8.1 Form USRS–049, Sample Status Log



Field Operating Procedure

SEDIMENT SAMPLING

300-SP-305

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019

Date

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1.0 SCOPE

This procedure describes the methods for collecting sediment samples on Up-Side Radiological Survey, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to provide methods for collecting samples of sediment.

3.0 REFERENCES

- 3.1 Project/Site Health and Safety Plan
- 3.2 Project/Site Detailed Work Procedure
- 3.3 NUREG/1575-MARSSIM, Multi Agency Radiation Survey and Site Investigation Manual
- 3.4 NUREG/CR-5512, Residual Radioactive Contamination From Decommissioning
- 3.5 USRS Procedure; 400-CP-402, Sample Chain of Custody
- 3.6 USRS Procedure; 300-SP-306, Water Sampling
- 3.7 USRS Procedure; 300-SP-303, General Sampling

4.0 EQUIPMENT

- 4.1 Digging implement: garden trowel, post-hole digger, split spoon auger, etc.
- 4.2 Thin walled metal or plastic tube (Shelby tube).
- 4.3 Ponar, “clam shell” dredge (with rope).
- 4.4 Wide-mouth plastic or glass bottle.
- 4.5 Labels and security seals.
- 4.6 Record forms.
- 4.7 Indelible pen.

5.0 RESPONSIBILITIES

- 5.1 USRS Radiological Field Operations Manager (Project Manager)
 - 5.1.1 Implementation of this procedure.

- 5.1.2 Periodic reviews of adherence to the requirements of this procedure.
- 5.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.
- 5.2 Health Physics Supervisors
 - 5.2.1 Assignment of Health Physics Technicians performing this procedure.
 - 5.2.2 Reviewing and approving documentation generated by the use of this procedure.
- 5.3 Health Physics Technicians
 - 5.3.1 Performance of the requirements of this procedure.
 - 5.3.2 Adherence to other procedures referenced.
 - 5.3.3 Documentation of all work performed under this procedure.

6.0 PROCEDURE

CAUTION

Collection of sediments can be very messy. Take care to minimize transfer of the sample from equipment services. Protective clothing is recommended (gloves) to minimize skin contamination if the sample is likely to contain radioactive or hazardous materials.

- 6.1 Using a collection tool, obtain approximately 2 kg (or an amount in accordance with References 3.1 and 3.2) of sediment. Include all material collected. Rocks and foreign objects can be discarded during the sample preparation, as appropriate.
- 6.2 Place the sediment into a plastic or glass bottle and tighten the screw cap.
- 6.3 Label and secure the sample container in accordance with References 3.1 and 3.2.
 - NOTE: A box shall be lined with plastic and approved absorbent material prior to placing samples inside the box if the samples are to be shipped for analysis.
 - NOTE: A load rating stamped on the bottom of the box shall be noted. This rating shall not be exceeded to prevent degradation of the box during shipping.
- 6.4 The container should be placed in a cardboard box (also properly labeled) for storage or for shipping.

CAUTION

Samples must be contained within an outer protective cover to prevent (minimize) cross-contamination of samples from one site to another.

- 6.5** Document all samples obtained on Form USRS–049, Sample Status Log and in the sample logbook if applicable.
- 6.6** Sample Chain of Custody records shall be documented in accordance with Reference 3.5.

CAUTION

DO NOT proceed to the next sample site or leave the area with any equipment until you have completed Steps 6.7 and 6.8.

- 6.7** Clean sampling tools before proceeding to the next sampling location.
- 6.8** Survey sampling equipment to ensure no removable contamination exists which could result in cross-contamination of samples.
- 6.9** Transfer the sample(s) to the laboratory for analysis.

7.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

- 7.1** Form USRS-049, Sample Status Log

8.0 FORMS



Field Operating Procedure

WATER SAMPLING

300-SP-306

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

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1.0 SCOPE

This procedure describes the methods for collecting water samples on Up-Side Radiological Survey, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to provide methods for collecting samples of water.

3.0 REFERENCES

- 3.1** Project/Site Health and Safety Plan
- 3.2** Project/Site Detailed Work Procedure
- 3.3** NUREG/1575-MARSSIM, Multi Agency Radiation Survey and Site Investigation Manual
- 3.4** NUREG/CR-5512, Residual Radioactive Contamination From Decommissioning
- 3.5** USRS Procedure; 400-CP-402, Sample Chain of Custody
- 3.6** USRS Procedure; 300-SP-304, Surface Soil Sampling
- 3.7** USRS Procedure; 300-SP-305, Sediment Sampling
- 3.8** USRS Procedure; 300-SP-303, General Sampling

4.0 EQUIPMENT

- 4.1** Bailing implement: cup, can, pail, etc.
- 4.2** Coliwassa sampling tubes
- 4.3** Bore-hole bailer
- 4.4** Submersible pump, vacuum or peristaltic pump with power source
- 4.5** Plastic sampling container
- 4.6** Funnel
- 4.7** Large Erlenmeyer Flask with two-hole stopper
- 4.8** Tygon tubing
- 4.9** Labels and security seals
- 4.10** Indelible pen.

4.11 Record forms

5.0 RESPONSIBILITIES

5.1 USRS Radiological Field Operations Manager (Project Manager)

5.1.1 Implementation of this procedure.

5.1.2 Periodic reviews of adherence to the requirements of this procedure.

5.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

5.2 Health Physics Supervisors

5.2.1 Assignment of Health Physics Technicians performing this procedure.

5.2.2 Reviewing and approving documentation generated by the use of this procedure.

5.3 Health Physics Technicians

5.3.1 Performance of the requirements of this procedure.

5.3.2 Adherence to other procedures referenced.

5.3.3 Documentation of all work performed under this procedure.

6.0 PROCEDURE

6.1 Surface Sample

6.1.1 Dip water carefully from the selected location, being careful to avoid collection of bottom sediment or vegetation.

6.1.2 Using a funnel, transfer the water into an appropriate container.

6.1.3 Collect total volume of water in accordance with References 3.1 and 3.2.

6.1.4 Cap the container tightly.

6.1.5 Label and secure the sample in accordance with References 3.1 and 3.2.

NOTE: A box shall be lined with plastic and approved absorbent material prior to placing samples inside the box if the samples are to be shipped for analysis.

NOTE: A load rating stamped on the bottom of the box shall be noted. This rating shall not be exceeded to prevent degradation of the box during shipping.

- 6.1.6** The container should be placed in a cardboard box (also properly labeled) for storage or for shipping.
- 6.1.7** Document all samples obtained on Form USRS–049, Sample Status Log.
- 6.1.8** Sample Chain of Custody records shall be documented in accordance with Reference 3.5.
- 6.1.9** Transfer the sample(s) to the laboratory for analysis.
- 6.2** Subsurface (well or borehole) Sample (Option 1)
 - 6.2.1** Lower the bailer apparatus into the borehole or other below surface source of water.
 - 6.2.2** Allow water to flow into the bailer (use care to avoid build up of sediments on the bailer diaphragm, which could prevent the diaphragm from sealing).
 - 6.2.3** Retrieve the bailer and empty contents through a funnel into a plastic sampling container.
 - 6.2.4** Repeat procedure until a total volume of water has been collected in accordance with References 3.1 and 3.2.
 - 6.2.5** Repeat steps 6.1.4 through 6.1.9.
- 6.3** Subsurface Sample (Option 2)
 - 6.3.1** Lower the pump (if submersible) until the inlet end of the tubing contacts the water surface.
 - 6.3.2** Start pump and collect water in large flask.
 - 6.3.3** Empty flask into a plastic sampling container as necessary.
 - 6.3.4** Repeat procedure until a total volume of water has been collected in accordance with References 3.1 and 3.2.
 - 6.3.5** Repeat steps 6.1.4 through 6.1.9.
- 6.4** Drum/Container Sampling
 - 6.4.1** A Coliwassa type tube sampler should be used for collecting water/liquid samples from the drum/container.
 - 6.4.2** Insert the tube into the container until the bottom of the tube is at the bottom of the liquid level in the container to be sampled.

- 6.4.3** Place a thumb over-the-top of the tube opening, trapping the liquid inside the tube.
- 6.4.4** Pull the tube out of the container, taking care not to spill liquid that is on the outside of the tube.
- 6.4.5** Place the bottom opening of the tube inside the opening of the sampling container and remove the thumb on top of that tube, releasing the liquid into the sample container.
- 6.4.6** Repeat steps 6.4.2 through 6.4.5 until desired volume of liquid has been placed into the sample container.
- 6.4.7** Seal the container.

NOTE: **The Coliwassa sampling tube should be disposed of after each sample is taken, using a new sampling tube for each sample.**

7.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

- 7.1** Form USRS-049, Sample Status Log

8.0 FORMS

- 8.1** Form USRS–049, Sample Status



Field Operating Procedure

ISSUE AND USE OF RADIATION WORK PERMITS 400-CP-401

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019

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1.0 PURPOSE

This procedure describes the circumstances when a Radiation Work Permit (RWP) is required and addresses the requirements for planning, developing, issuing, using, modifying and terminating RWPs. The RWP provides a complete document addressing existing radiological conditions, work scope, radiological limitations, specific protective requirements, as low as reasonably achievable (ALARA) considerations and instructions to radiological support personnel.

2.0 SCOPE

This procedure shall be implemented to initiate a RWP prior to jobs: when personnel will enter areas where contamination is, or could be present; in quantities that classify the area as a contamination area (CA); when radiation exposure rates classify the work area as a radiation area (RA); when air concentrations could exceed 10 percent of the derived air concentration (DAC); and at the discretion of the Project Manager (PM). This procedure describes the radiological surveys required to generate a RWP and provides guidelines to specific protective measures required based upon the radiological conditions in the work area. A RWP will be required when entering radiologically posted areas [i.e., airborne radioactivity area, contaminated area (CA) or RA].

3.0 RESPONSIBILITIES

Radiation Safety Officer - The RSO is responsible for implementation and compliance with this Standard Operating Procedure (SOP) during project operations, and providing safety briefings to personnel working with radioactive materials. The RSO or designee will conduct periodic reviews to ensure adherence to the requirements of these documents.

Project Manager - The Project Manager is responsible for implementation and compliance with this SOP during field operations. The Project Manager or designee shall be on site during radiological work and will conduct periodic reviews, via personal observation of activities carried out under RWPs and other job-specific guidance, to ensure adherence to the requirements of these documents. In instances where the RWP or job-specific guidance documents are not being followed, the Project Manager shall stop the work.

The Project Manager shall review and approve RWPs generated by this procedure and ensure that RWPs generated per this procedure is maintained in project files.

Health Physics Supervisor - The Health Physics Supervisor or designee shall be on site during radiological operations. The Health Physics Supervisor is responsible for the assignment of personnel that will perform the tasks required by this SOP, for the implementation and monitoring of radiological training, control of radioactive material, dosimetry coverage, and to ensure that personnel under their cognizance observe proper precautions. The Health Physics Supervisor is responsible for ensuring that RWPs are properly prepared and completed as required.

Health Physics Technician - The Health Physics Technician(s) (HPT) shall be responsible for the performance of the requirements of this SOP and documentation of work performed, including interpretation and verification of data. The HPT shall ensure compliance with this and any other referenced procedure. The HPTs shall be aware of changing radiological conditions, which may require different levels of personal protective equipment (PPE) or respiratory protection and be responsible for enforcing the provisions of the RWP and ALARA philosophy. The HPTs shall also perform safety evaluations and response checks of instruments and equipment.

Site Health and Safety Specialist – For purposes of this procedure, the Site Health and Safety Specialist (SHSS) shall be responsible for reviewing draft RWPs to ensure that relevant non-radiological concerns are addressed.

4.0 DEFINITIONS AND ABBREVIATIONS

Airborne Radioactivity Area (ARA) - A room, enclosure or area in which radioactive material is dispersed in the air in the form of dusts, fumes, particulates, mists, vapors or gases and where the concentration of the dispersed radioactive materials is in excess of:

- The derived air concentrations (DACs) specified in Table 1, Column 3 of Appendix B, Title 10 Part 20 of CFR.
- Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

Contaminated Area (CA) - Any area where removable surface contamination levels exceed 20 percent of the contamination limits established in Nuclear Regulatory Commission Reg. Guide 1.86.

Radiation Area (RA) - Any area accessible to personnel in which there exists ionizing radiation at exposure rates such that an individual could receive a deep dose equivalent (DDE) in excess of 5 millirem (mrem) in 1 hour at 30 centimeters (cm) from the radiation source or from any surface that the radiation penetrates.

Restricted Area - Also referred to as a Radiologically Controlled Area (RCA), is an area containing radioactive materials (in excess of the levels established in Reg. Guide 1.86) to which access is controlled to protect individuals from exposure to ionizing radiation.

Total Effective Dose Equivalent (TEDE) - TEDE is the sum of the DDE (external dose) and the committed effective dose equivalent (internal dose).

5.0 PROCEDURE DETAILS

5.1 GENERAL

5.1.1 Criteria for Initiating Radiation Work Permit

An RWP is required when entering radiological areas (i.e., RCAs, RMAs, radiation areas, contaminated areas, airborne radioactivity areas, underground RMAs, etc.).

5.1.2 Planning and Prerequisites

5.1.2.1 Planning the RWP

The Project Manager, or designee, initiates the RWP process by filling in the General Information section of the RWP. The accepted form to use for an RWP is included as Attachment 3 of this document. The Project Manager, or designee, enters the effective date (date the RWP was initiated) and the expiration date that will correspond to the estimated completion date for the project.

The Project Manager completes the Task section of the RWP. This includes an estimate of the number of personnel required for each task and the number of personnel-hours that will be spent inside a RCA. A detailed description is encouraged but not required and can be attached to the RWP. Work performed in areas with different radiological conditions should be listed as different tasks. This may not become apparent until after the surveys performed to support preparing the RWP are completed.

The Project Manager or designee:

- Obtain and review any previous surveys performed in the work area.
- Obtain all information available on the identity, form and quantities of radionuclides present in the work area.
- Review facility drawings, if available, to determine ventilation flows, component and equipment layouts and building structures, which can be used for contamination barriers.

The Project Manager, or designee, selects the necessary instrumentation, equipment and protective clothing to perform surveys in the work area. If contamination is expected in the work area, equipment to be taken into the work area may be wrapped to prevent contamination of equipment.

5.1.2.2 The RWP Pre-job Survey

Safety hazards that may be encountered during the work are evaluated (confined space entry, electric equipment or mechanical equipment requiring lock-out tags, falling objects, bumping hazards, slippery surfaces, fire hazards, etc.). An analysis of each

hazard and precautions to be taken shall be documented and provided to personnel prior to entry into the area.

The HPT obtains radiation exposure rates in the area where the personnel will be positioned during work activities. The adjacent area is surveyed to identify any locations where elevated readings are observed and a route to the work area is established.

Swipe samples are obtained from the work area, adjacent areas and along the route to the work area in sufficient quantity to adequately design work controls to maintain exposures ALARA. HPTs will rely on their professional experience or consultation with the Health Physics Supervisor, or designee, to determine what constitutes "sufficient quantity."

The issuance of an RWP for work in an ARA will require air sampling to be done as part of the RWP. Air sampling is conducted in accordance with 300-SP-302, *Air Sampling and Analysis*.

An individual assigned by the Project manager (i.e., the HPT who surveyed the work area and obtained information from prior surveys, when available) records the exposure rates measured during the survey of work area on survey forms as specified in procedure 300-SP-301, *Radiation and Contamination Surveys*.

5.2 PROCEDURE PROCESS

5.2.1 Specifying Worker and Worksite Requirements

Based on and the data obtained from the pre-job survey and factoring in anticipated contamination conditions in the area, the HPT determines the quantities to specify in Radiological Limits section of the RWP. Limits should be specified as an order of magnitude bound (i.e., whole-body exposure < 10 mrem/hour) that would not be expected to be exceeded under normal working conditions. Space is provided for clarifying remarks or other specific points of note. The radiological limits will govern the work to be done under the RWP. If, at any point during the work, the limits are known to be exceeded, then work must cease and the RWP must be modified or a new RWP must be issued to reflect the current radiological conditions. A well-selected limit will be one general enough to avoid unnecessary stoppages of work while still protecting worker safety per the ALARA philosophy.

Next, the HPT determines the types of protective clothing required to be used by personnel performing prescribed tasks, the respiratory protection requirements, dosimetry requirements, and monitoring requirements and indicates them under the protection requirements section of the RWP. Finally, any additional training requirements for personnel and the need for ALARA briefings or reviews are noted on the RWP.

Determinations of protection requirements are to be performed by the RCT using their professional judgment and in accordance with industry standard practices and appropriate regulatory guidelines. Air monitoring is required if it is likely that airborne

contamination may be present or created (i.e., during excavation and demolition) during work activities. Work activities will be stopped if the concentrations of airborne contaminants exceed 10 percent of the DAC.

5.2.2 Special Instructions

Special instructions associated with personal protective clothing, dosimetry, monitoring and inspection, respiratory protection, training or ALARA are indicated in this section of the RWP.

5.2.3 Review and Approvals

The Project Manager and SHSS, or designees, as a minimum, shall approve the RWP prior to work. The Project Manager shall review the sections of the draft RWP completed by the HPT for completeness and accuracy. In cases where the Health Physics Supervisor has prepared the draft sections of the RWP prescribed for the HPT, instead of the HPT, then the Project Manager shall review and approve the RWP. The SHSS shall verify that relevant non-radiological safety considerations are addressed. When the non-radiological concerns of the SHSS have been adequately addressed, the Project Manager will approve the RWP and forward to the RSO.

The check boxes in the approval section will be marked to indicate which of the approvers is required for each particular RWP. Any mandatory approver may prescribe changes to the draft RWP prior to final approval.

5.2.4 Using the Radiation Work Permit

A pre-job briefing is held with the individuals performing the work described in the RWP. The following topics are discussed in the pre-job briefing:

- Complete descriptions of the work tasks to be performed and method to minimize exposures to radiation and contamination while performing these work tasks.
- Discussions of the radiation, contamination, and airborne radioactive materials in the work area and situations, which could result in increased levels of these components.
- Health and safety concerns, which could be encountered during work activities.
- Emergency procedures and responsibilities.
- Discussions of the protective equipment requirements and the monitoring requirements.

The HPT compiles the current year dose for the individuals performing RWP work to verify that the radiation exposure received during the work activities will not result in the individuals' dose exceeding the administrative limits specified in the Radiological Control Plan.

Each individual entering the RWP work area is required to understand the RWP and sign the Radiation Work Permit Authorization Log, indicating that the individual understands the provisions of the RWP, is aware of his/her current year dose, and will comply with the RWP requirements.

In cases where an Access Log is used, the HPT (or individual) logs the time the individual entered the work area, along with the reading on the individual's Pocket Ion Chamber (PIC) or Direct Reading Dosimeter (DRD), if worn. The HPT (or individual) also indicates if the individual wore a respirator during the work activities.

When an individual who signed in on a Radiation Work Permit Access Log exits the work area, the HPT (or individual) logs the time the individual leaves the area and the individual's DRD reading, if worn. If the individual returns to the work area, another signature entry (and corresponding line entries) must be made on the Radiation Work Permit Access Log.

As previously noted, if the radiological limits listed on the RWP are exceeded at any point during a prescribed work task, then all work shall be stopped until the RWP can be modified to address the over-limit condition, or a new RWP is issued.

5.2.5 Modifying the Radiation Work Permit

In the event of changes to the conditions or scope of the work that do not justify the generation of a new RWP, modifications to the RWP may be made by the Health Physics Supervisor, or designee with concurrence of the Project Manager. No more than two modifications can be made to an RWP before a new RWP must be issued. Modifications to the RWPs will be reviewed and approved in accordance with the initial requirements, as specified in Section 5.2.3.

To modify the RWP, each change is made with a single line cross out of the text or item. The Health Physics Supervisor or designee must initial and date adjacent to each change.

The Health Physics Supervisor or designee must communicate all changes to the individuals working under the RWP.

5.2.6 Terminating the Radiation Work Permit

The RWP is terminated when the end date of the RWP is reached or can be terminated by one of the following reasons:

- The job has been completed.
- There is a significant change in the scope of work.
- There is a significant change in the radiological conditions.
- The RWP is revised.

When the RWP is terminated before the end date, a single line is drawn through the end date and a new end date recorded in its place. The person terminating the RWP initials adjacent to the change. Extension of the end date of the RWP must be done per the change procedure noted in the previous section. The RWP can be terminated by the Project Manager, RSO, or designee. As part of the termination of an RWP, the Post-job Radiological Conditions and Closeout Review sections of the RWP shall be completed.

To complete the Post-job Radiological Conditions section, the HPT shall conduct a survey of the worksite governed by the RWP. This survey should be conducted in a manner similar to the pre-job survey and should include determination of the current measurements for all quantities obtained in the pre-job survey. In addition, if personnel monitoring was in effect during work under the RWP and/or an individual was found to have contamination above the monitoring limits, then the appropriate checkbox should be marked.

At a minimum, the closeout review will be conducted by the Project Manager. As part of the closeout review, the reviewer(s) shall verify that associated records for the RWP are noted on the RWP form and that they are present in the project files. Reviewers shall also determine if there were any lessons learned that might be of value to future work to be performed on site. If so, then a lessons learned synopsis shall be written and communicated/incorporated to project personnel.

6.0 RECORDS

Radiation Work Permit Access Log

Radiation Work Permit Authorization Log

Radiation Work Permit

7.0 REFERENCES

<i>Number</i>	<i>Title</i>
300-SP-301	<i>Radiation and Contamination Surveys</i>
300-SP-302	<i>Air Sampling and Analysis</i>
Regulatory Guide 1.86	<i>U.S. Atomic Energy Commission</i>

8.0 ATTACHMENTS

Attachment 1 – Radiation Work Permit Access Log

Attachment 2 – Radiation Work Permit Authorization Log

Attachment 3 – Radiation Work Permit

[illegible]

ATTACHMENT 2 – RADIATION WORK PERMIT AUTHORIZATION LOG

RWP NUMBER: _____ REVISION: _____ DATE: _____

WORK LOCATION: _____ START DATE: _____ END DATE: _____

Worker Name	Employee ID Number	Current year TEDE (mrem)	*Signature	RCT Authorization	Date

* By my signature, I indicate that I have read, understand, and will comply with all requirements of this RWP.

RSO USE ONLY

Effective Date	Expiration Date
----------------	-----------------

GENERAL INFORMATION (to be completed by the Requestor)																															
Requested by (Name & Project)			Date		Phone No. (Site Mailing Address																								
Work Location			Work Area		Building/Site		Extent		Room No.																						
Work Plan		Health & Safety Plan		Contract Number		Expected Start Date		Expected End Date																							
Tasks to be performed inside an RCA <i>(add attachment if necessary)</i>							Estimated No. Personnel		Estimated No. Personnel-hours																						
RADIOLOGICAL LIMITS																															
<input type="checkbox"/> Anticipated radiological conditions <input type="checkbox"/> See Attached Map																															
<div><div>Surface Contamination (dpm/100 cm sq)<table><tr><td></td><td>Direct</td><td>Swipe</td><td>LAS (Large Area Swipe)</td></tr><tr><td>Alpha</td><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr><tr><td>Beta/gamma</td><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr><tr><td>Gamma cpm</td><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr></table></div><div>External Dose Rate (mrem/hr in work area)<table><tr><td>Beta + gamma</td><td><input type="text"/></td></tr><tr><td>Neutron</td><td><input type="text"/></td></tr><tr><td>Total (b + g + n)</td><td><input type="text"/></td></tr></table></div></div>											Direct	Swipe	LAS (Large Area Swipe)	Alpha	<input type="text"/>	<input type="text"/>	<input type="text"/>	Beta/gamma	<input type="text"/>	<input type="text"/>	<input type="text"/>	Gamma cpm	<input type="text"/>	<input type="text"/>	<input type="text"/>	Beta + gamma	<input type="text"/>	Neutron	<input type="text"/>	Total (b + g + n)	<input type="text"/>
	Direct	Swipe	LAS (Large Area Swipe)																												
Alpha	<input type="text"/>	<input type="text"/>	<input type="text"/>																												
Beta/gamma	<input type="text"/>	<input type="text"/>	<input type="text"/>																												
Gamma cpm	<input type="text"/>	<input type="text"/>	<input type="text"/>																												
Beta + gamma	<input type="text"/>																														
Neutron	<input type="text"/>																														
Total (b + g + n)	<input type="text"/>																														
Radionuclide(s) Airborne Radioactivity <input type="checkbox"/> Anticipated or <input type="checkbox"/> Measured																															
Completed by		Name		Signature		ID Number		Date																							

Issue and Use of Radiation Work Permits

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ALARA/RADIOLOGICAL PROTECTION REQUIREMENTS (to be completed by RCT)				
Protective Clothing Requirements <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"><input type="checkbox"/> None</div> <div style="width: 50%;"><input type="checkbox"/> Rubber Overshoes</div> <div style="width: 50%;"><input type="checkbox"/> Double Coveralls</div> <div style="width: 50%;"><input type="checkbox"/> Lab Coat</div> <div style="width: 50%;"><input type="checkbox"/> Skull Cap</div> <div style="width: 50%;"><input type="checkbox"/> Hood</div> <div style="width: 50%;"><input type="checkbox"/> Double Gloves</div> <div style="width: 50%;"><input type="checkbox"/> Plastic Coverall</div> <div style="width: 50%;"><input type="checkbox"/> Gloves¹</div> <div style="width: 50%;"><input type="checkbox"/> Booties</div> <div style="width: 50%;"><input type="checkbox"/> Single Coverall</div> <div style="width: 50%;"><input type="checkbox"/> Double Booties</div> <div style="width: 50%;"><input type="checkbox"/> Tape Openings</div> <div style="width: 50%;"><input type="checkbox"/> Other: _____</div> </div>				
Respiratory Requirements <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"><input type="checkbox"/> None</div> <div style="width: 50%;"><input type="checkbox"/> Combination cartridge*¹</div> <div style="width: 50%;"><input type="checkbox"/> Chemical cartridge*</div> <div style="width: 50%;"><input type="checkbox"/> Powered Air Purifying Respirator</div> <div style="width: 50%;"><input type="checkbox"/> Ventilation</div> <div style="width: 50%;"><input type="checkbox"/> Air Line Respirator*</div> <div style="width: 50%;"><input type="checkbox"/> SCBA*</div> <div style="width: 50%;"><input type="checkbox"/> Negative Pressure Respirator</div> <div style="width: 50%;"><input type="checkbox"/> Supplied air suit*</div> <div style="width: 50%;"><input type="checkbox"/> Bubble Hood*</div> <div style="width: 50%;">* Requires Health & Safety approval</div> <div style="width: 50%;"><input type="checkbox"/> Other: _____</div> </div>				
Dosimetry Requirements <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"><input type="checkbox"/> None</div> <div style="width: 50%;"><input type="checkbox"/> WB dosimeter</div> <div style="width: 50%;"><input type="checkbox"/> Supplemental dosimeter</div> <div style="width: 50%;"><input type="checkbox"/> TLD finger rings</div> <div style="width: 50%;"><input type="checkbox"/> Special neutron dosimetry</div> <div style="width: 50%;"><input type="checkbox"/> Pu access list</div> <div style="width: 50%;"><input type="checkbox"/> Alarming dosimeter</div> <div style="width: 50%;"><input type="checkbox"/> Bioassay sample</div> <div style="width: 50%;"><input type="checkbox"/> Whole-body count</div> <div style="width: 50%;"><input type="checkbox"/> Accident dosimeter</div> <div style="width: 50%;"><input type="checkbox"/> Nasal swipes</div> <div style="width: 50%;"><input type="checkbox"/> Other: _____</div> </div>				
Monitoring Requirements <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"><input type="checkbox"/> None</div> <div style="width: 50%;"><input type="checkbox"/> Notify RCT before job starts</div> <div style="width: 50%;"><input type="checkbox"/> Intermittent coverage</div> <div style="width: 50%;"><input type="checkbox"/> Personnel before leaving job</div> <div style="width: 50%;"><input type="checkbox"/> Equipment and tools before removal</div> <div style="width: 50%;"><input type="checkbox"/> Continuous coverage</div> <div style="width: 50%;"><input type="checkbox"/> RCT monitor doffing of PCs</div> <div style="width: 50%;"><input type="checkbox"/> Air monitoring</div> <div style="width: 50%;"><input type="checkbox"/> Self-frisking</div> <div style="width: 50%;"><input type="checkbox"/> Other: _____</div> </div>				
Additional Training Requirements <div style="border-bottom: 1px solid black; height: 20px; width: 100%;"></div>				
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> ALARA Pre-job briefing <input type="checkbox"/> ALARA review (see attachments) </div>				
Completed by RCT	Name	Signature	Employee ID Number	Date
<input type="checkbox"/> Completed				
SPECIAL INSTRUCTIONS				
Special Instructions: <div style="border: 1px solid black; height: 150px; width: 100%; margin-top: 5px;"></div>				
Completed by	Name	Signature	ID Number	Date
<input type="checkbox"/> Completed				

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APPROVALS				
1.	Project Manager	Name _____	Signature _____	ID Number _____ Date _____
<input type="checkbox"/>				
2.	HPT	Name _____	Signature _____	ID Number _____ Date _____
<input type="checkbox"/>				
3.	SHSS	Names _____	Signatures _____	ID Numbers _____ Date _____
<input type="checkbox"/>				
<input type="checkbox"/>				
POST-JOB RADIOLOGICAL CONDITIONS (to be completed by the RCT/HPT)				
Measured Radiological Conditions (Record all readings as highest / general area)				<input type="checkbox"/> See attached map
		Surface Contamination (dpm 100 sq cm)		External Dose Rate
	Direct	Swipe	LAS (large area swipe)	(mrem/hr in work area)
Alpha	_____	_____	_____	Beta + gamma _____
Beta/gamma	_____	_____	_____	Neutron _____
Tritium	_____	_____		Total (b + g + n) _____
Airborne Radioactivity		Survey of Personnel Leaving Job Site		
DAC	_____ <input type="checkbox"/> Estimated or	<input type="checkbox"/> Personnel contaminated above applicable limits		
Isotope	_____ <input type="checkbox"/> Measured	(If yes, attach the Radiological Incident Report)		
Completed by RCT	Name _____	Signature _____	ID Number _____	Date _____
<input type="checkbox"/> Completed				
REVIEW				
Associated reports for this job (indicate the ones that apply):				
<input type="checkbox"/> CAM Results	<input type="checkbox"/> Nasal swipe data	<input type="checkbox"/> RWP acknowledgement log		
<input type="checkbox"/> Job-specific air monitoring	<input type="checkbox"/> Bioassay sample(s)	<input type="checkbox"/> Dose tracking report		
<input type="checkbox"/> Pre-job survey data	<input type="checkbox"/> Whole Body Count(s)	<input type="checkbox"/> Radiological occurrence/incident report		
<input type="checkbox"/> Post-job survey data	<input type="checkbox"/> Wound count	<input type="checkbox"/> ALARA Pre-job briefing		
<input type="checkbox"/> Finger ring data	<input type="checkbox"/> Skin contamination	<input type="checkbox"/> Formal ALARA review		
<input type="checkbox"/> Special dosimetry results	<input type="checkbox"/> Personal clothing survey	<input type="checkbox"/>		
<input type="checkbox"/> Other: _____				
<input type="checkbox"/> Lessons Learned	(If Yes, then briefly explain. Add attachment(s) if necessary)			
Reviewed by HPT	Name _____	Signature _____	ID Number _____	Date _____
<input type="checkbox"/> Reviewed				
Reviewed by Project Manager	Name _____	Signature _____	ID Number _____	Date _____



Field Operating Procedure
SAMPLE CHAIN OF CUSTODY

400-CP-402

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

REVISION HISTORY

Revision (Date)	Rev. No	Prepared By	Description of Changes	Affected Pages
October 2018	0	D DeLong	New Issue	All
June 2019	1	D DeLong	Remove Disclaimer / Periodic Review	All

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1.0 SCOPE

This procedure is to establish administrative controls for transfer of samples collected on Up-Side Radiological Survey, LLC (USRS) projects to the laboratory for analysis.

2.0 PURPOSE

The purpose of this procedure is to provide guidelines for administrative controls of samples collected and transferred to the subcontractor laboratory for analysis.

3.0 REFERENCES

3.1 Project/Site Health and Safety Plan

3.2 Project/Site Detailed Work Procedure

3.3 NUREG/1575-MARSSIM, Multi Agency Radiation Survey and Site Investigation Manual

4.0 RESPONSIBILITIES

4.1 USRS Radiological Field Operations Manager (Project Manager)

4.1.1 Implementation of this procedure.

4.1.2 Periodic reviews of adherence to the requirements of this procedure.

4.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

4.2 Health Physics Supervisors

4.2.1 Assignment of Health Physics Technicians performing this procedure.

4.2.2 Reviewing and approving documentation generated by the use of this procedure.

4.3 Health Physics Technicians

4.3.1 Performance of the requirements of this procedure.

4.3.2 Adherence to other procedures referenced.

4.3.3 Documentation of all work performed under this procedure.

5.0 PROCEDURE

NOTE

In many instances the laboratory will supply chain of custody forms, in that case, instructions provided by the laboratory will be followed in filling out the chain of custody forms.

- 5.1 The sample collector must initiate a chain of custody form by filling in the requested information. Identifying data for the sample(s) must also be entered into the sample log in accordance with References 3.1 and 3.2.
- 5.2 Proper chain of custody is maintained when the sample(s) are maintained under the direct surveillance of an individual, in a controlled access facility, or the sample is in a tamper-proof container.
- 5.3 If the sample(s) are to be transported by any means other than hand delivery by the custodial individual, security seals must be used. Include a copy of the chain of custody form with the sample container.
- 5.4 Upon transfer of the samples to another individual, that individual shall sign as recipient. A copy of the chain of custody form will be maintained for record-keeping purposes while the original will remain with the sample.
- 5.5 Upon arrival of the sample at the laboratory, the laboratory recipient shall inspect the sample for signs of tampering. If indication of tampering is noted, the laboratory shall notify site personnel who will collect another sample.
- 5.6 Once the sample(s) are in the custody of the laboratory, it shall be maintained in accordance with the laboratory's chain of custody and quality assurance procedures.
- 5.7 Samples sent to an off-site laboratory for analysis shall be returned to the site after processing for disposal if this is the condition of the laboratory contract. There may be occasions where the laboratory will hold and/ or dispose of the samples.

6.0 GENERAL INFORMATION

- 6.1 The Chain of Custody/ Analysis Record form must be completed in its entirety as follows:
 - **Client Name** – USRS, LLC
 - **P.O.#** - Purchase order number obtained from technical support personnel.

- **Project Name** – Name of the facility and the type of project or project tracking number.
- **Project Number** – Unique number that associates the project to specific records analysis. This is as assigned by the Project Manager.
- **Sampler** – Individual performing sampling.
- **Sample ID #** - The unique number recorded in the sample logbook, on the sample and on the chain of custody form for a sample.
- **Date Collected / Time Collected** – The date and time the sample was taken.
- **Sample Type** – Grab, Composite, Water, Soil, Oil, etc. as appropriate.
- **Total of Containers** – Number of containers with this Sample Identification Number.
- **Analysis Req'd** – Indicates the desired type of analysis for the laboratory to conduct.
- **Name of Shipper** – Person preparing the samples for shipment from project to the laboratory.
- **Air Bill No.** - Shipper's specific air bill number assigned to shipment for tracking purposes.
- **Date / Time of Shipment** – Date and time samples were dropped off for shipment to laboratory.
- **Sample Relinquished by** – Project personnel taking samples for shipment.
- **Date / Time** – Date and time sample shipment container sealed.
- **Sample Received by** – Laboratory personnel receiving and opening sample shipment.
- **Date / Time** – Date and time sample received a laboratory.
- **Received by (Lab)** – Name of laboratory that received sample shipment.
- **Seals Intact?** - To be completed by laboratory.
- **Report Results By (Date)** – the date that you expect to get sample results by. ASAP is not appropriate.

- **Turnaround Time Requested** – The needed turnaround time for sample analysis. Circle Normal or Rush. Be aware of the increased costs for Rush turnaround time.
- **Report Results To** – Project Manager's Name, Address and Telephone number.
- **Disposal** – Project Manager will designate disposal method preferred and sign the '**Authorized for Disposal By**' block.
- **Date/Time of Disposal** – Laboratory will provide date and time samples were disposed of and sign the '**Disposed of By**' block.

NOTE: **If multipurpose paper is not available, copies of the chain of custody will have to be made for tracking purposes.**

6.2 The sampler is to retain the Pink copy of the Chain of Custody and forward the White (original) and Yellow copy with the sample shipment to the laboratory.

6.3 The laboratory shall return the Yellow copy to USRS, LLC upon completion to be included in documentation for the project Final Report.

7.0 EXHIBITS

Sample Chain of Custody



Project Name: _____

Project Number: _____

[illegible]



Field Operating Procedure

RELEASE OF MATERIALS FROM CONTROLLED AREAS

400-CP-403

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

REVISION HISTORY

Revision (Date)	Rev. No	Prepared By	Description of Changes	Affected Pages
October 2018	0	D DeLong	New Issue	All
May 2019	1	D DeLong	Remove Disclaimer / Periodic Review	All

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1.0 SCOPE

This procedure sets forth the specific requirements for release of materials from controlled areas applicable to Up-Side Radiological Survey, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to specify requirements for releasing material from controlled areas and to minimize the potential for unintentionally releasing contaminated items to uncontrolled areas in accordance with the provisions of Reference 3.1.5.

3.0 REFERENCES AND DEFINITIONS

3.1 References

- 3.1.1** DOE Order 5400.5 (2-8-90), Radiation Protection of the Public and the Environment
- 3.1.2** DOE Order 5480.11 (12-21-88), Radiation Protection for Occupational Workers
- 3.1.3** 10 CFR 20 (2018), Standards for Protection Against Radiation
- 3.1.4** USRS Field Procedure, 300-SP-301 Radiation and Contamination Surveys
- 3.1.5** NRC's "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials (NRC 1993), Office of Nuclear Material Safety and Safeguards (NMSS)".
- 3.1.6** ANSI/ANS-3.1 – 2014, Selection, Qualifications and Training of Personnel for Nuclear Power Plants
- 3.1.7** USRS Technical Procedure, 200-IP-202 Operation and Calibration of the Ludlum Model 2929 Scaler
- 3.1.8** USRS Field Procedure, 400-CP-409 Radiological Area Posting and Access Control
- 3.1.9** USRS Field Procedure, 400-CP-404 Control of Radioactive Material
- 3.1.10** USRS Field Procedure, 400-CP-401 Issue and Use of Radiation Work Permits

3.2 Definitions

- 3.2.1** **Activity** – The rate of disintegration (transformation) or decay of radioactive material. The units of activity for the purpose of this procedure are disintegrations per minute (dpm), Becquerel (Bq), or micro-Curies for loose contamination and disintegration per minute or milliard/hour for fixed contamination.

- 3.2.2 Contamination** – Deposition of radioactive material in any place it is not desired, particularly where its presence may be harmful. The harm may be actual exposure to individuals or release of the material to the environment or general public. Contamination may be due to the presence of alpha particle, beta particle or gamma ray emitting radionuclides.
- 3.2.3 Controlled Area** – Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials and or to prevent the release of radioactive materials to the uncontrolled areas.
- 3.2.4 Fixed Contamination** – Radioactive contamination that is not readily removed from a surface by applying light to moderate pressure when wiping with a paper or cloth disk smear, or massilinn.
- 3.2.5 Minimum Detectable Activity (MDA)** – for purposes of this procedure, MDA for removable radioactive contamination is defined as the smallest amount of sample activity that will yield a net count with a 95% confidence level based upon the background count rate of the counting instrument used.
- 3.2.6 Evaluator** – an individual designated by the Radiological Field Operations Manager to evaluate materials or items in accordance with section 6.2, 6.3 and step 6.5.6.
- 3.2.7 Release for Unconditional Use** – A level of radioactive material that is acceptable for use of property without restrictions due to residual radioactive material without license conditions or controls. Under normal circumstances, authorized limits for residual radioactive material are set equal to, or below, the values specified in Reference 3.1.5, Table 1.
- 3.2.8 Survey Exempt Materials** – The contents of sealed containers, which remain unopened while in a controlled area, are exempt, the outside surfaces are not exempt.

4.0 PRECAUTIONS, LIMITATION

4.1 Precautions

- 4.1.1** Instruments used to perform release surveys shall be operated in accordance with the respective operating procedure:

4.1.1.1 Ludlum Model-2929 – Reference 3.1.7

4.1.1.2 Ludlum Model-3 – Reference 3.1.8

- 4.1.2** MDA for the Ludlum Model-2929 shall be in accordance with Reference 3.1.7.

- 4.1.3** Large area smears maybe used to augment (but not replace) the 100-cm² smear survey. Large area wipes may be counted with the Ludlum Model-3 or equivalent.

Large area smears are used to obtain immediate information concerning loose contamination for the purpose of radiological protection and to minimize time spent performing disk smears on a item easily identified as contaminated.

4.1.4 A release document package shall include the following forms:

- 4.1.4.1 USRS-005 – Material Release Log.
- 4.1.4.2 USRS-001 – Radiological Survey Report or USRS-010, Unconditional Release of Equipment or Items Report and/or USRS-006, Smear Counting Analysis Report.
- 4.1.4.3 USRS-003 – Daily Instrument Performance Test Log or equivalent.

4.1.5 The release document shall include the following information:

- 4.1.5.1 The date of the release survey.
- 4.1.5.2 The number of the release survey.
- 4.1.5.3 A description or identification of the item.
- 4.1.5.4 The identity of the Health Physics Technician performing the release survey.
- 4.1.5.5 The evaluator of the material for release.
- 4.1.5.6 The release approval of the Health Physics Supervisor or designee.

4.1.6 All surveys performed for the release of material shall be documented on a Radiological Survey Report (USRS-001) and/or on a Unconditional Release of Equipment or Items Report (USRS-010).

4.1.7 Radiation and contamination surveys shall be performed in accordance with the Reference 3.1.4.

4.1.8 Items identified as radioactive during the release survey shall be controlled in accordance with Reference 3.1.10.

4.1.9 Personnel performing release surveys shall be logged in on a Radiation Work Permit in accordance with the Reference 3.1.11 (if applicable).

4.1.10 Audible response instruments must be used during direct scan surveys.

- 4.1.11 Instruments used for release surveys check shall be within current calibration and shall have had a performance test check performed daily or prior to use in accordance with the instrument's operating procedure.
- 4.1.12 Release of materials from controlled areas shall be performed in accordance with the provisions and directives of References 3.1.1, 3.1.2, 3.1.3, and 3.1.5.
- 4.1.13 Items presented for release shall be direct scanned in an area of low background.

4.2 Limitations

- 4.2.1 The maximum probe speed during direct scan surveys of services shall be 2 cm/sec.
- 4.2.2 A response check shall be performed at the completion of the workday for instruments used for direct scan surveys in accordance with the instruments operating procedure.
- 4.2.3 The probe face shall be held within 1/4 inch of the surface being surveyed for alpha, and within 3/8 inch of the surface being surveyed for beta gamma.
- 4.2.4 If an instrument used to perform release surveys fails any operational check, it shall be removed from service. Data collected during the period of instrument failure must be evaluated by the Health Physics Supervisor.
- 4.2.5 Posting and access control of controlled areas shall be performed in accordance with the provisions of Reference 3.1.9.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

5.1.1 USRS Radiological Field Operations Manager

- 5.1.1.1 Implements the requirements of this procedure.
- 5.1.1.2 Designates qualified evaluators.
- 5.1.1.3 Reviews the adherence of personnel to the requirements of this procedure, periodically.
- 5.1.1.4 Ensure Health Physics Technicians are qualified by training and experience to perform requirements of this procedure.

5.1.2 Health Physics Supervisor

- 5.1.2.1 Review the release documentation.

- 5.1.2.2 Approve unconditional releases by signing the RSRS-005 form.

5.1.3 Health Physics Technicians

- 5.1.3.1 Perform the requirements of this procedure.
- 5.1.3.2 Adhere to other procedures (referenced in this procedure).
- 5.1.3.3 Document all releases.

5.2 Qualifications

5.2.1 Health Physics Technicians shall be qualified in accordance with the requirements of Reference 3.1.6 to perform release surveys of materials.

- 5.2.1.1 Documentation supporting qualifications shall be obtained and kept in the permanent project files.

5.2.2 Junior Health Physics/Decontamination Technicians may perform release surveys under the direct supervision of a Health Physics Technician meeting the requirements of section 5.2.1.

5.2.3 Evaluators shall be designated by the RSRS Radiological Field Operation Manager (Project Manager).

6.0 PROCEDURE

6.1 Release Limits for Gross Activity (Unknown Isotopes) - Regulatory

EMMISSION	REMOVABLE* (dpm/100 cm ²)	TOTAL (Fixed and Removable)* (dpm/100 cm ²)
Alpha	20	100
Beta-Gamma	200	1,000

Notes:

* Limits taken from NRC's "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials (NRC 1993), Office of Nuclear Material Safety and Safeguards (NMSS)".

NOTE:

If all of the actual isotopic constituents of the contamination are known and documented on the release documents, additional release limits of Table 1 of Reference 3.1.5 may be applied.

6.2 Inaccessible surfaces

6.2.1 Items with inaccessible surfaces should be disassembled as completely as possible to facilitate release surveys. Items with inaccessible surfaces will not be unconditionally released unless evaluated by a designated evaluator who authorizes and documents the release.

6.2.2 The following guidance will be used when performing evaluations:

- The history of the item should be reviewed.
- The actual release survey shall be reviewed.
- Determination of the radiological conditions in the area the item has been used or stored shall be reviewed.
- Use of sensitive detectors such as NaI or equivalent should be considered. (These detectors may indicate internal contamination that the Model-3 or equivalent may not detect due to its lower sensitivity to photon emissions).

6.3 Materials considered hazardous due to their physical or chemical nature and fragile items shall not be unconditionally released unless evaluated. For example, gases, pyrophoric materials, easily damaged electronic devices, or other easily damaged materials cannot be directly or indirectly surveyed. These materials will be evaluated on a case-by-case basis for release in a manner consistent with section 6.2.2. Evaluation for release shall be performed by a designated evaluator only.

6.4 Survey Exempt Materials

6.4.1 Items such as briefcases, pens, papers, personal clothing, etc., are exempt from the Health Physics release survey requirements of this procedure.

6.4.2 Individuals shall survey the exempt items in the same manner as a whole body frisk when leaving a controlled area or have a Health Physics Technician perform the survey.

6.5 Survey Procedure

6.5.1 Upon receipt of an item presented for release, attempt to determine history:

- Purpose of item.
- The current and past use of the item.
- The location(s) in which the item was used or stored.
- If the item was ever used for work with radioactive material or used in an area where radioactive material was used or stored.

This knowledge of the item history should provide the surveyor with information helpful in performing the release survey.

6.5.2 Using protective clothing such as gloves, perform large area smears of 100% of the accessible surfaces of the item using large area wipes (e.g. massilin).

6.5.2.1 Determine if transferable (loose) radioactive material is present by measuring the amount of activity on the surface of the cloth.

6.5.2.2 If the presence of radioactive material is indicated by a count rate above background, the item shall be treated as contaminated until the results of the disk smear survey are obtained and a determination is made concerning the actual 100 cm² loose contamination levels. The material shall be controlled in accordance with Reference 3.1.10.

6.5.3 Perform a direct scan of 100% of all accessible areas of the item, in accordance with the instruments operating procedure, and reference 3.1.4.

NOTE:

Items presented for release shall be direct scanned in an area of low background, preferably ≤ 100 CPM. The Health Physics Technician performing the release survey shall determine if the background is acceptable for the direct scan of the item. Release surveys shall not be done in areas where background is ≥ 300 CPM.

6.5.3.1 If the scan indicates radioactive material on the surface of the item is less than the limits for release for total activity, proceed to 6.5.3.3.

- 6.5.3.2 If the scan indicates radioactive material on the surface of the item is greater than regulatory limits for total activity, the item cannot be released.
- 6.5.3.3 During the direct scan of the accessible surfaces of the item, a static measurement shall be taken:
- If an increase in the audible count rate is detected.
 - After each minute of scanning.
 - When the Health Physics Technician determines that an indication of fixed activity less than 10 cm² may be present.
- 6.5.3.4 During the static measurement, the meter probe shall be held at the proper distance from the surface being surveyed for the proper response period to allow the meter reading to stabilize, in accordance with the instruments operating procedure.

6.5.4 Perform disk smears of 100% of the effective surface area.

- 6.5.4.1 100% of the effective accessible surface means performing a 100 cm² disk smear on all accessible areas of the item suspected of being contaminated.

6.5.5 Count the smears in accordance with Reference 3.1.4.

- 6.5.5.1 Record smear data on the Smear Counting Analysis Report (USRS-006). If a Model-3 or equivalent was used, document results on a Radiological Survey Report (USRS-001).
- 6.5.5.2 If the smear results indicate transferable activity below the release limits, proceed to step 6.5.6.
- 6.5.5.3 If the smear results indicated transferable activity above the release limits, the item cannot be released.

6.5.6 If the item has internal or inaccessible surfaces, have USRS personnel disassemble the item and repeat steps 6.5.2 through 6.5.5 or have the item evaluated for release by designated evaluator.

6.5.7 If the item meets the release limits or is evaluated as meeting the unconditional release criteria, complete forms USRS-010, USRS-005, and/or USRS-001. Health Physics Supervision must review the released documents and approve the release prior to allowing the item to leave the controlled area.

- 6.5.8** Items identified as radioactive during the release survey shall be controlled in accordance with Reference 3.1.10.

7.0 RECORDS

The following records are generated by use of this procedure. These records will be maintained in the permanent project file.

- 7.1** USRS-001 – Radiological Survey Report
- 7.2** USRS-005 – Material Release Log
- 7.3** USRS-006 – Smear Counting Analysis Report
- 7.4** HP Daily Log
- 7.5** USRS-003 – Daily Instrument Performance Test Log
- 7.6** USRS-010 – Unconditional Release of Equipment or Items Report

8.0 FORMS

- 8.1** USRS-003 – Daily Instrument Performance Test Log
- 8.2** USRS-006 – Smear Counting Analysis Report
- 8.3** USRS-001 – Radiological Survey Report
- 8.4** USRS-005 – Material Release Log
- 8.5** USRS-010 – Unconditional Release of Equipment or Items Report



Field Operating Procedure

CONTROL OF RADIOACTIVE MATERIAL

400-CP-404

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

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1.0 SCOPE

The scope of this procedure encompasses the Up-Side Radiological Survey, LLC (USRS) requirements for use, handling, receipt, storage, and disposition of radioactive material on USRS projects. This procedure does not address or present any requirements for the control of radioactive material prepared and labeled for shipment under the requirements of 49 CFR, "Transportation".

2.0 PURPOSE

The purpose of this procedure is to describe and standardize the requirements and actions necessary to control radioactive material. In addition, the following specific goals will be achieved:

- 2.1 Prevention of unauthorized and unplanned exposure to personnel.
- 2.2 Accountability of radioactive material will be maintained.
- 2.3 Meet the requirements of cited references.

3.0 REFERENCES AND DEFINITIONS

3.1 References

- 3.1.1 DOE Order 5400.5, Radiation Protection of the Public and the Environment
- 3.1.2 DOE Order 5480.11, Radiation Protection for Occupational Workers
- 3.1.3 10 CFR 20, Standards for Protection Against Radiation
- 3.1.4 10 CFR 30, Domestic Licensing of Byproduct Material
- 3.1.5 USRS Field Procedure, 400-SP-403 Release of Materials From Controlled Areas
- 3.1.6 USRS Field Procedure, 400-CP-409 Radiological Posting and Access Control
- 3.1.7 10 CFR 71, Packaging and Transportation of Radioactive Material

3.2 Definitions

- 3.2.1 **Accountable Radioactive Material** – For the purpose of this procedure, any material that contains activity in quantities that exceed the values listed in Reference 3.1.4, Schedule B. This definition does not apply to material to be unconditionally released in accordance with Reference 3.1.5.
- 3.2.2 **Special Nuclear Material** – Includes Plutonium, Uranium-233, or Uranium enriched in the isotopes Uranium-233 or Uranium-235, and any other radionuclide which the NRC determines to be special nuclear material.

- 3.2.3 By-Product Material** – Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material. Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity. Any discrete source of naturally occurring radioactive material, other than source material.
- 3.2.4 Samples** – Aliquots (portions) of material deposited on or placed within a container for the purposes of transferring and performing a quantitative or qualitative analysis of that material.
- 3.2.5 Receipt** – For the purpose of this procedure, receipt is defined as the act of receiving radioactive materials and/or sources at the RSRS field project site.
- 3.2.6 Radioactive Material** – Any material that emits ionizing radiation during the process of nuclear transformation or any item or other material contaminated with material which emits ionizing radiation.
- 3.2.7 Closed Transport Vehicle** – Transport Vehicle equipped with a securely attached exterior enclosure that, during normal transportation, restricts access to unauthorized persons to the cargo space containing Radioactive Material. The enclosure may be temporary or permanent, and must limit access from the top, bottom, sides, and ends.

4.0 PRECAUTIONS

- 4.1** Radioactive Material Storage Areas must be posted in accordance with Reference 3.1.6.
- 4.2** If a smoke detector, electron tube, radioactively doped radiation detection crystal (generally not considered as licensed material) or other exempt quantity radioactive source(s) are damaged, Health Physics controls may be required during disposal.
- 4.3** The control of radioactive material shall be performed in accordance with the provisions of References 3.1.1, 3.1.2, 3.1.3, 3.1.5 and 3.1.7.

5.0 RESPONSIBILITIES

5.1 Responsibilities

5.1.1 USRS Radiological Field Operations Manager (Project Manager) is responsible to:

- 5.1.1.1 Implements the requirements of this procedure.
- 5.1.1.2 Periodically review the adherence of personnel to the requirements of this procedure.
- 5.1.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform requirements of this procedure.

5.1.2 Health Physics Supervisors (HPS) are responsible to:

- 5.1.2.1 Ensure personnel using this procedure comply with all procedural requirements.

5.1.3 Health Physics Technicians (HPT) are responsible to:

- 5.1.3.1 Perform the requirements of this procedure.

5.1.4 Junior Health Physics/Decontamination Technicians are responsible to:

- 5.1.4.1 Comply with all directions of the Health Physics Technicians regarding this procedure.

6.0 CONTROL OF RADIOACTIVE MATERIAL

6.1 RADIOACTIVE MATERIAL CONTROL

For the purpose of this SOP, Table 6-1 identifies the limits of contamination and/or activity for defining RAM.

TABLE 6-1
CONTAMINATION LIMITS TABLE

ISOTOPE	REMOVEABLE DPM/100CM ²	TOTAL DPM/100CM ²
Transuranics (Pu-239, Pu-240, Pu-241, Am-241, etc.)	20	100
Ra-226, Ra-228, Th-228, Th-230	20	100
Thorium-nat, Th-232, Strontium-90 Beta-gamma emitters (e.g. I-131)	200	1,000
Uranium-nat, U-234, U-235, U-238 Beta-gamma emitters (e.g. Cs-137, Co-60, H-3)	1,000	5,000

- 6.1.1** Materials or equipment that are outside of contamination, high contamination, or airborne radioactivity areas, confirmed or suspected of having removable radioactive contamination above the values specified in Table 6-1 shall be securely wrapped in plastic or placed in containers and labeled appropriately.
- 6.1.2** Materials or equipment with removable or suspected surface contamination levels in excess of 100 times the values set in Table 6-1 shall require additional packing controls such as double-wrapping or the use of plastic bags inside of containers.
- 6.1.3** Materials or equipment that generate an exposure rate equal to or greater than 0.5 mR/hr or exceed the values of Section 3.2.1 shall be stored in a designated radioactive material area. The exception to this is during movement or staging, when the radioactive material shall be in the possession of either a radiation worker or a Health Physics Technician, working under a valid RWP. Possession is defined as physical control or line-of-sight control. In addition, radioactive material with a contact (1 inch) exposure rate of 100 mR/hr shall be continuously escorted by a Health Physics Technician.
- 6.1.4** Protective clothing and equipment that exceed the criteria of Table 6-1, Column 3 shall be stored within a Radioactive Materials Area except during transfer when in possession of a radiation worker, or a Health Physics Technician or in use within the Controlled Area by a radiation worker.

- 6.1.4.1 Protective gear that exceeds 0.5 mR/hr on contact shall not be issued for use.
- 6.1.4.2 Protective gear that exceeds the limits of Table 6-1, Column 2 shall not be issued for use.
- 6.1.5 Materials or equipment that generate an exposure rate equal to or greater than 5mR/hr @ 30cm, but less than 100 mR/hr @ 30cm shall be stored in a Radioactive Materials Area and a Radiation Area, unless in possession of a Health Physics Technician or a radiation worker working under a valid RWP.
- 6.1.6 Material or equipment that generates an exposure rate equal to or greater than 100 mR/hr @ 30cm shall be stored in a Radioactive Materials Area and a High Radiation Area.
- 6.1.7 The exception to this is during movement or staging, when the radioactive material shall be in possession of a Health Physics Technician who is working under a valid RWP.
- 6.1.8 Radioactive Materials contained in Contaminated, Highly Contaminated or Airborne Radioactivity Areas shall be surveyed, decontaminated when needed and handled in accordance with the requirements of this procedure prior to release to Controlled Areas.
- 6.1.9 Materials shall only be released to uncontrolled areas in accordance with Reference 3.1.5.




6.2 RECEIPT

6.2.1 Upon notification for Health Physics to receive Radioactive Material at a job site, complete Form USRS-014.

6.2.2 The following surveys must be performed within 3 hours after receipt, or within 3 hours after the beginning of the next working day, if received after working hours, for all radioactive material being received at the site.

6.2.2.1 Common Carrier (Non-Exclusive Use)

- a) Common carrier vehicles have no regulatory requirements for incoming surveys or release surveys; however,
- b) Determine the shipping requirements from the label affixed to the package. If the following exposure rates are exceeded, notification of the Health Physics Supervisor is required. Additional notifications are required in accordance with Section 6.7.

Label	Surface Exposure Rate Limit	1 Meter Exposure Rate Limit
White I 	0.5 mR/hr	Background
Yellow II 	50 mR/hr	1.0 mR/hr
Yellow III 	200 mR/hr	10 mR/hr

- c) Perform an external smear survey of the package for $\beta\gamma$ and α . If greater than 20 dpm/100cm² α and/or greater than 1,000 dpm/100cm² $\beta\gamma$, post and control the package as deemed appropriate by the Health Physics Supervisor. If greater than 2,200 dpm/100cm² $\beta\gamma$ and/or greater than 220 dpm/100cm² α , detain the vehicle and initiate notifications as required by Section 6.7.
- d) If the material is vendor equipment that may have been used at other facilities, then perform a detailed survey of material and document results on form USRS-001.

Place at least two labels (RADIOACTIVE MATERIAL STICKER) on each package (e.g., top and front of package) if the values of Table 6-1 are met or exceeded.

6.2.2.2 Exclusive Use Vehicles

- a) Exclusive use vehicles shall have incoming surveys performed within areas designated by Health Physics Supervision.
- b) Perform a radiation survey of the vehicle and notify the Health Physics Supervisor if the dose rates in the table below are exceeded. On the supervisor's recommendation, initiate notifications required by Section 6.7.

**TABLE 6-2
TRANSPORT EXPOSURE RATE LIMITS**

Vehicle Area or Surface	Open Transport mR/hr	Closed Transport mR/hr
Exterior Surface of Package	200	1,000
Outer Surface of Vehicle including top and underside	200	200
Flat Bed Vehicle: At any point on the vertical planes projected from the outer edge of the vehicle, on the load's upper surface (or enclosure used and on lower external surface of vehicle)	200	N/A
Two (2) meters from outer lateral surfaces of vehicle (excluding top and underside)	10	10
Occupied Position of Car or Transport Vehicle. NOTE: Does not apply to private motor carrier when persons occupying these positions are provided with Special Health Supervision, Personnel Radiation Exposure Monitoring Devices and Training	2	2

- c) Perform a survey of the vehicle and/or package(s) for contamination. If any levels exceed 1,000 dpm/100cm² βγ or 20 dpm/100cm² α, post and control in accordance with the provisions of Reference 3.1.7. If levels exceed 22,000 dpm/100cm² βγ or 2,200 dpm/100cm² α, notify the Health Physics Supervisor and initiate notifications required by Section 6.7 of this procedure.

6.3 DISPOSAL

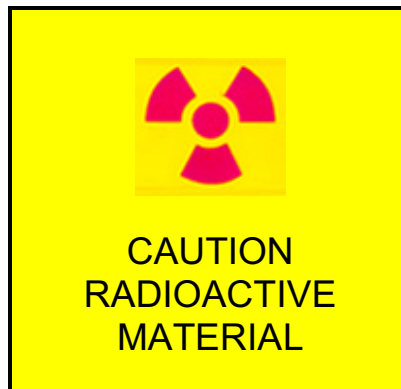
The requirements of Reference 3.1.6 and this procedure are in effect until such time as the material meets 49 CFR shipping requirements.

6.4 LABELING

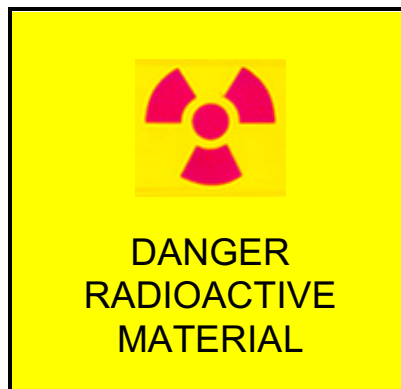
6.4.1 Radioactive materials shall be labeled as follows:

6.4.1.1 Each container (drum, plastic bag, box, etc.) of radioactive material shall bear a durable, clearly visible label identifying the radioactive contents.

6.4.1.2 The label required shall bear the radiation caution symbol (trefoil) and the words:



or



6.4.1.3 The label can consist of bags, wrappings, etc. pre-marked with the above words, or a tag, sticker, etc. affixed to the container, bag, etc. with the above words and symbol (trefoil) included on the tag or sticker.

- 6.4.1.4 The label shall also provide sufficient information to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposures.
- 6.4.1.5 As appropriate, the information will include radiation levels, if available, a list of materials, estimates of activity, contamination levels, date, and signature or initials of Health Physics Technician who performed the survey of the radioactive material in the container.
- 6.4.1.6 The information required in Step 6.5.1.5 can either be entered on the tag, sticker, or written in black permanent ink on the container provided the container meets the requirements of Steps 6.5.1.2 and 6.5.1.3 of this procedure.
- 6.4.2** The following are not subject to the labeling and posting requirements:
- 6.4.2.1 Materials surveyed and determined to have contamination levels less than the values of Table 6 - 1.
- 6.4.2.2 Radioactive materials or containers packaged and labeled for off site shipment in accordance with Title 49 Code of Federal Regulations, Part 173.
- 6.4.2.3 Radiological control samples such as air, water and soil samples or smears that are in the possession of a Health Physics Technician.
- 6.4.2.4 Equipment or components undergoing maintenance covered by a RWP.
- 6.4.2.5 Contaminated portable tools and equipment permanently marked with yellow and/or magenta paint and maintained in the Controlled Areas.
- 6.4.2.6 Installed system components located within an area, the entrance to which is posted in accordance with Reference 3.1.6.
- 6.4.3** Tags and labels shall have a yellow background with a magenta (or black) standard radiation symbol and the lettering shall be magenta (or black).
- 6.4.4** Labels, tags, or writing on the surface of the container with permanent black ink shall include contact radiation readings, 30 cm radiation readings, transferable surface contamination levels (both alpha and beta-gamma), date of survey, surveyor's name and/or initials and description of items.

6.5 STORAGE AREA INSPECTION

- 6.5.1** Radioactive material storage areas shall be inspected by health Physics Technicians during routine surveillance.
- 6.5.2** Health Physics Technicians shall note the physical status of storage areas on surveys noting:

- 1) Locked/secure status.
- 2) Labeling/posting.
- 3) Condition of containers.

6.6 REGULATORY REPORTING

6.6.1 The USRS Radiological Field Operations Manager (Project Manager) will make all notifications through the office of the Site Manager.

6.6.1.1 The final delivering carrier must be immediately notified of excessive contamination and, in the case of excessive radiation levels, must be immediately notified by telephone, telegraph, mail-gram, or facsimile. These values are listed for each type of shipment class and vehicle type in Section 6.3 of this procedure.

6.6.1.2 The appropriate NRC Region must be immediately notified by telephone, telegram, telegraph, mail-gram, or facsimile of excessive contamination or radiation levels.

6.7 MISCELLANEOUS

6.7.1 Clean Trash

6.7.1.1 For purposes of segregation, clean trash shall have clear or black plastic bags reserved for this use, to distinguish it from radiological trash which will be in yellow bags or clear plastic with yellow and magenta bordering or markings with the standard radiation symbol.

6.7.1.2 No radiological control material shall be discarded into clean trash (e.g., massilin cloth, yellow herculite, radioactive stickers/signs, radiation rope/ribbon, rad bags) unless the material is surveyed and meets the criteria for unconditional release and the material is shredded, cut, or defaced in such a way that the standard radiation symbol and associated wording is illegible.

6.7.1.3 All material to be surveyed as clean trash shall be surveyed in accordance with the provisions of Reference 3.1.6 and documented on forms USRS 005, and USRS-010.

7.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

7.1 Form USRS-014 Receipt of Radioactive Material Investigation

7.2 Form USRS-005 Material Release Log

7.3 Form USRS-010 Unconditional Release Form

8.0 FORMS

8.1 USRS-005, Material Release Log

8.2 USRS-010, Unconditional Release Form

8.3 USRS-014, Receipt of Radioactive Material Investigation



Field Operating Procedure

**DOSIMETRY
400-CP-405**

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

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1.0 POLICY

Up-Side Radiological Survey, LLC (USRS) position regarding personnel monitoring is more conservative than those of the Nuclear Regulatory Commission (10 CFR 20), the International Commission on Radiological Protection (ICRP), (Publication 26), and the National Council on Radiation Protection and Measurements (NCRP), (Report 39). USRS's position is that all radiation exposures, no matter how small, should be monitored and evaluated in the spirit of as low as reasonably achievable (ALARA), and that all radiation exposures should be as low as reasonably achievable.

All personnel who work with radioactive materials will be assigned appropriate radiation personnel dosimetry and must wear that dosimetry when working. When not in use, that dosimetry will be stored and maintained in an appropriate manner.

2.0 PURPOSE

This procedure describes the requirements for personnel dosimetry (radiation monitoring devices) and the guidelines for use and maintenance of that dosimetry. Its purpose is to provide specific guidelines for the control of project dosimetry, occupational external radiation exposure records, and maintenance of personal exposure history for all USRS full time and temporary Project personnel, visitors and groups for whom monitoring is required.

Records of personal exposure to radiation is of vitally important part of working with radioactivity and as such will require strict attention to the details of this procedure.

3.0 RESPONSIBILITY

The Field Operations Group is responsible for administrating the initial order of project dosimetry and the maintenance of all occupational external radiation exposure records and personnel exposure history.

The Project Manager is responsible for enforcement of the project personnel dosimetry program. The Project Manager, Health Physics Supervisor or designee is responsible for the maintenance of all personnel exposure information for the project. Prior to the start of work, the Project Manager or designee shall obtain the following for each individual assigned to the project:

3.1 Site Registration Form

All new personnel and visitors required to enter a radiologically controlled area must complete a Site Registration Form (USRS Form 109) or equivalent prior to starting work at a facility.

Completed Site Registration Forms will be retained with the individual's personnel exposure file. Site Registration Forms for USRS personnel will be updated annually or earlier if existing information is known to be incorrect.

3.2 Occupational Radiation Exposure History

An NRC Form 4 or equivalent must be completed by each individual and reviewed by the Project Manager or designee prior to the individual being permitted to work in a radiologically controlled area where a dose of more than 25 mrem could be received. Exposure results shall be listed on the form 4 on a quarterly basis.

3.3 Dosimetry Assignment

The TLD badge number, name, social security number, whether or not a worker has a completed NRC Form 4, the monitoring period (date from, to) and the individuals date of birth shall be recorded on USRS Form 111a, for each individual monitored on a project. The original form will be maintained as a permanent record of the project monitoring. A copy will be maintained in the corporate office.

4.0 EXPOSURE LIMITS/ADMINISTRATIVE CONTROL LEVELS

4.1 Occupational Exposure Limits

4.1.1 Nuclear Regulatory Commission (NRC) limits per calendar year:

Whole Body (TEDE)	5 Rem
Eye Dose Equivalent	15 Rem
Skin Dose Equivalent	50 Rem
Organ Dose (CEDE)	50 Rem

4.2 Administrative Control Levels

RSRS Radiation Administrative Control Levels per calendar year:

Whole Body	1.00 Rem
Eye Dose Equivalent	3.00 Rem
Skin Dose Equivalent	5.0 Rem
Organ Dose (CEDE)	5.0 Rem

The USRS Radiation Safety Officer (RSO) shall approve exposure above the Annual Administrative Control Levels.

5.0 RADIOLOGICALLY CONTROLLED AREAS

5.1 A Radiologically Controlled Area (RCA) is considered to be any portion of a facility, plant, vehicle or project for which restrictions apply for purposes of occupational radiation exposure control. Radiation exposures received within the boundary of a restricted area are occupational exposures. As described in the applicable Project Detail Work Procedure, radiologically controlled areas will be established to provide the specific radiological controls necessary for the completion of the work scope and the protection of all project personnel. The following guidelines apply:

5.1.1 RCA Location

A RCA is always located within a restricted area as defined by 10 CFR 20.3.

5.1.2 RCA Areas

Each radiation area, high radiation area, airborne radioactivity area, and contaminated area shall be contained within radiologically controlled area.

5.1.3 RCA Personnel Monitoring

All personnel and casual visitors within a RCA will be provided with appropriate dosimetry and monitored for radiation exposure.

6.0 GENERAL REQUIREMENTS

All personnel who could potentially receive 25% or more of the permissible legal limit for external radiation exposure are required by 10 CFR 20 to be furnished with personnel monitors. In interest of ALARA, all USRS personnel who work with radioactive material are required to wear appropriate radiation exposure monitors. Personnel working within a RCA will receive, at a minimum, a thermo-luminescent dosimeter (TLD) or equivalent and for work in areas with dose rates above 5 mrem/hr, a TLD and a low range Pocket Ion Chamber (PIC).

6.1 Pocket Ion Chamber

All personnel working in a radiologically controlled area may be issued/monitored by a Pocket Ion Chamber (PIC). PIC's may either be issued for an individual or group depending on the type and duration of work to be performed. The Project Manager or designee will determine if it will be necessary to issue individual or group PIC's. The PIC's used for general radiation work will have a range of response of 0 to 200 millirem. PIC's will be set to zero (0) at the start of each work shift.

6.2 TLD

TLD's are the permanent record of an individual's occupational radiation exposure. Upon receipt of Project of dosimetry, TLD's and TLD finger rings shall be stored in a low background area inside the project main office or in other designated storage locations when not in use. A TLD Control badge shall be kept where the assigned badges are stored when they are not in use. All USRS personnel entering a Radiologically Controlled Area (RCA) where anticipated dose of 25 mrem could be received will be issued a TLD.

The individual's name, social Security number, issue date, and date of return will be recorded on the Monthly Badge Issue Log, (USRS Form 111a).

6.3 Visitors/Group Monitoring

A casual visitor is any person touring or visiting the RCA on an infrequent basis, escorted while in the restricted area and not performing or supervising hands-on work.

Visitors will be issued a TLD on a case-by-case basis depending on the type and duration of the job. The project manager or designee shall determine if a TLD is to be issued to a visitor. TLD's will always be issued to occupational workers expected to exceed 25 mrem. A visitor expected to receive in excess of 25 mrem shall be trained as, and considered an occupational worker.

6.3.1 Visitor RCA Conditions

A visitor may be escorted into a RCA provided that:

- There are not entries into high radiation areas or airborne contamination areas
- The external radiation exposure is limited to 50 mrem per year, or 10 mrem per entry.
- The visitor is furnished with a personal radiation dosimeter, i.e. PIC.

6.3.2 Visitor Dosimetry

Visitors within a RCA shall receive, as a minimum, a low range, 0-200 mR Pocket Ionization Chamber (PIC).

Visitor TLD results are recorded on the Site Registration Form, which is maintained at the facility. When a visitor is issued a TLD, individual's name, social security number, issue date, and date of return will also be recorded on the Monthly Badge Issue Log.

6.4 Lost Badges

In the event of a lost TLD or PIC, the Project Manager or designee shall be notified immediately. A Lost Badge Report, (USRS Form 111) will be completed and filed in the individual's exposure file. The dose estimated from all exposure received while the individual was in an exposure situation must be determined and recorded in the individual's dose record.

In the event of multiple loss occurrences, the RSO shall be notified immediately.

7.0 PROJECT DOSIMETRY ISSUANCE/CONTROL

7.1 Prior to project commencement, the Project Manager and RSO will determine the appropriate radiation monitoring dosimetry required in accordance with the USRS Health and Safety manual. The Project Manager or designee will contact the USRS corporate office and provide them with the following information:

- USRS Project Name and Account Number
- Project start date and project duration
- Appropriate dosimetry required for project
- Number of dosimetry requested
- Name, Address, social Security, birth date project personnel to be monitored.
- Address dosimetry is to be shipped to.

7.1.1 Personnel assigned to projects will wear the appropriate badge dosimetry for no more than one month or the duration of the project, which ever is shortest. It will be arranged at the time of initial project TLD order by the USRS Corporate office as to how many months supply of dosimetry will be required for the project. It will be the responsibility of the project manager or designee to return dosimetry to the vendor for processing at the end of each monthly monitoring.

If the original projected project duration is extended, the Project Manager or designee shall inform the corporate office so that the proper arrangements can be made to supply additional dosimetry from the vendor.

7.1.2 Dosimetry Processor (Vendor)

The dosimetry vendor must meet the criteria and be in accordance with USRS's Health and Safety Manual.

7.2 Upon receiving project dosimetry, the Project Manager or designee shall verify that the dosimetry received meets the requirements of the project. Any problems should be reported to the corporate office for immediate attention and resolution. All documentation received with dosimetry will be filled out completely. When all required preliminary training and documentation has been completed as described in the project Detail Work Procedure, the dosimetry will be issued to project personnel.

It is the responsibility of the Project Manager or designee to ensure that USRS-111a, Badge Issue Log is completed at the time of dosimetry issuance and a copy is sent to the corporate office.

8.0 DOCUMENTATION

8.1 Radiation Work Permits

All personnel working in a radiologically controlled area must be assigned to a specific Radiation Work Permit (RWP), USRS-002 applicable to the job being

performed. If applicable, a Radiation Work Permit Access Log, USRS-023 will be attached to each RWP.

All personnel assigned to a job requiring an RWP shall sign the Access Log prior to starting work, indicating time in and starting PIC dose. Upon completion of the work or at the end of the shift, personnel shall sign out on the Access Log, indicating time out and the current PIC dose.

8.2 Weekly Available Exposure Report

A weekly-accumulated estimated exposure report will be maintained and posted for employee review at the start of each workweek. This report will reflect a running total of exposure available for the current calendar quarter. The beginning annual available exposure will be 1,000 mrem for those individuals with the completed and signed Occupational Exposure History Form.

8.3 Occupational Radiation Exposure History Letter

An Occupational Radiation Exposure History Letter, (USRS Form 115), or equivalent will be completed for all personnel for whom permanent exposure results have been obtained. Copies of this letter will be sent to the individual, and maintain an individuals personnel exposure file by the USRS corporate office. For current employees, this letter will be completed annually. For former employees, this letter will be completed and mailed within thirty working days after results have been obtained.

Any time USRS Is required to report and individual's exposure to the Department of Health or other Regulatory Agency a copy of the report will be sent individual.

8.4 Project Records/ Documentation

Upon completion of the project, it will be the responsibility of the Project Manager or designee to forward all project records, logs and communications regarding personnel exposure, exposure records, the dosimetry records, and all other pertinent information about personnel dosimetry and individual radiation protection for RSO review, and filing in anticipation of an NRC review.

9.0 RECORDS

The following records are completed by this procedure and shall be maintained as specified in procedure USRS 100-AP-103, Radiological Records.

9.1.1 USRS-109, Site Registration Form

9.1.2 NRC Form 4

9.1.3 USRS-111, Lost Badge Report

9.1.4 USRS-111a, Badge Issue Log

9.1.5 USRS-002, Radiation Work Permit

9.1.6 USRS-023, Radiation Work Permit Access Log



Field Operating Procedure

RADIOLOGICAL POSTING AND ACCESS CONTROL

400-CP-409

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



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Radiation Safety Officer

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Date

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October 2018	0	D DeLong	New Issue	All
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1.0 SCOPE

This procedure sets forth the specific requirements for posting and access control of radiological areas on Up-Side Radiological Survey, LLC (USRS) projects.

2.0 PURPOSE

The purpose of this procedure is to identify the requirements and types of postings necessary to clearly identify radiological conditions in a specific area or location within an area.

This procedure specifies the requirements for access to and egress from controlled radiological areas identified in this document.

3.0 REFERENCES AND DEFINITIONS

3.1 References

- 3.1.1 DOE Order 5480.11, Radiation Protection for Occupational Workers
- 3.1.2 10 CFR 20, Standards for Protection Against Radiation
- 3.1.3 ANSI/ANS 3.1 - 2014, Selection, Qualification and Training of Personnel for Nuclear Power Plants
- 3.1.4 USRS Field Procedure, 300-SP-301 Radiation and Contamination Surveys
- 3.1.5 USRS Field Procedure, 400-CP-401 Issue and Use of Radiation Work Permits
- 3.1.6 USRS Field Procedure, 400-CP-404 Control of Radioactive Material

3.2 Definitions

NOTE: These definitions are for informational purposes only and are to be used as posting guidelines. See Section 6.0 of this procedure for actual posting requirements.

- 3.2.1 **Alarming Dosimeter** – A device which continually integrates the dose received and alarms at a pre-set dose and exposure rate setting.
- 3.2.2 **Annual Limit on Intake (ALI)** – The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a 1-year period. ALI is the smaller value of intake of a given radionuclide by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 sievert [Sv]) or a committed dose equivalent of 50 rems (0.5 Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Table 1, Columns 1 and 2 of Appendix B of 10 CFR 20.) One ALI is equivalent to 2,000 DAC-hrs.

- 3.2.3 As Low As Reasonably Achievable (ALARA)** – An approach to radiation protection for the control and management of exposure (both individual and collective) to the workforce and the general public; thus ensuring a level of exposure as low as social, technical, economic, practical, and public policy considerations permit. The ALARA program is structured to increase worker awareness of exposure reduction techniques and the associated benefits of that reduction.
- 3.2.4 Barricade** – Any rope, ribbon or other barrier, yellow and magenta in color, erected to warn personnel of radiological hazards within a Controlled Area.
- 3.2.5 Contaminated Area** – Any area where removable surface contamination levels exceed 20 percent of the contamination limits provided in Table 1 (Attachment 1).
- 3.2.6 Controlled Area** - Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials and/or prevent the inadvertent release of radioactive material to the uncontrolled areas.
- Any area, building or room in which radiological area exists shall be bounded by a Controlled Area to act as a buffer zone to protect individuals from exposure to radiation and prevent the inadvertent release of radioactive material to the uncontrolled areas.
 - Any area, building or room where residual fixed alpha contamination exceeds 100 dpm/100cm² and/or fixed beta-gamma contamination exceeds 1,000 dpm/100cm².
 - Any area, building or room in which an individual may receive a dose equivalent of 0.5 mR, but less than 2 mR in any one hour at 30cm from the radiation source or from any surface through which the radiation may penetrate.
 - Any area, building or room where, in the opinion of the Radiological Field Operations Manager (Project Manager), posting of the area, building or room is necessary for adequate control of existing radiological conditions.
- 3.2.7 Derived Air Concentration (DAC)** – The concentration of a given radionuclide in air, which, if breathed for a working year of 2,000 hours under conditions of light work (inhalation rate of 1.2 cubic meters of air per hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of Appendix B of 10 CFR 20, Standards for Protection Against Radiation.
- 3.2.8 Fixed Contamination** – Surface contamination exceeding the contamination limits provided in Table 1 (Attachment 1), that cannot be readily removed from a surface by applying light to moderate pressure when wiping with a paper or cloth disk swipe, or masslin.

3.2.9 Health Physics Technician – An individual who performs radiological protection functions and meets the requirements of reference 3.1.3.

3.2.10 Hot Particle - A hot particle is a small, discrete, highly radioactive form of contamination. Because of their small size, hot particles spread easily. Because of their high dose rates and activity, hot particles on the skin can cause high dose rates to a very small area of the skin. High-energy beta hot particles such as irradiated fuel fragments exhibit penetrating beta radiation. Approximately 50% of their high-energy betas will penetrate through a 90 mg/cm² shield. Low energy beta hot particles such as cobalt that originate from the activation of stellite (high cobalt alloy), exhibits low penetrating beta radiation. Approximately 10% of their low energy betas will penetrate through a 90 mg/cm² shield.

3.2.11 Hot Spot - Any small (< 1ft²) location which contains or is a source of penetrating radiation with a reading of 100 mR/hr and at least 5 times the 30cm exposure rate.

3.2.12 Radiological Area – A generic term used to describe any posted area within a Controlled Area where specific radiological hazards exist. Radiological Areas shall be posted with signs conforming to reference 3.1.2. The background color is to be yellow and the symbol color may be black or magenta. The wording on the sign shall be appropriate for identification and control of the radiological hazards specified.

3.2.12.1 Radioactive Materials Area (RMA) – Any designated area where radioactive materials meeting or exceeding any of the following criteria are stored or used:

- Posting of a RMA is not required if the radioactive material is stored inside a posted RCA, contaminated area or airborne radioactivity area.
- The amount of licensed material in the area exceeds 10 times the quantity of such material specified in Appendix C of reference 3.1.2.

3.2.12.2 Airborne Radioactivity Area – A room, enclosure or area in which radioactive material is dispersed in air in the form of dusts, fumes, particulates, mists, vapors, or gases, and the concentration of the dispersed radioactive materials is in excess of:

- The derived air concentrations (DACs) specified in Table 1, Column 3 of Appendix B, Title 10 Part 20 of CFR.
- Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

3.2.12.3 Contaminated Area – Any area where loose surface contamination levels exceed 1,000 dpm/100cm² for beta-gamma emitters and/or 20 dpm/100cm² for alpha emitters.

3.2.12.4 Highly Contaminated Area – Any area where loose surface contamination levels are:

- $\geq 2,000$ dpm/100cm² loose α
- $\geq 100,000$ dpm/100cm² loose $\beta\gamma$

unless transuranics are present then:

- ≥ 200 dpm/100cm² loose α
- $\geq 50,000$ dpm/100cm² loose $\beta\gamma$

3.2.12.5 Radiation Area – An area, accessible to individuals, in which there exists ionizing radiation at exposure rates such that an individual could receive a deep dose equivalent (DDE) in excess of 5 mrem (0.05 mSv) but less than 100 mrem (1 mSv) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

3.2.12.6 High Radiation Area – An area, accessible to individuals, in which there exists ionizing radiation at exposure rates such that an individual could receive a deep dose equivalent (DDE) in excess 100 mrem (1 mSv) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

3.2.12.7 Very High Radiation Area – An area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess 500 rads (5 grays) in 1 hour at 1 meter from a radioactive source or from any surface that the radiation penetrates.

3.2.12.8 Radiography Area – Any area where X-ray producing equipment or radioactive sources are in use to perform radiography.

3.2.12.9 Underground Radioactive Materials (URM) –An underground area that is known to contain radioactive materials such as pipelines, tanks, cribs, covered ponds, covered ditches, catch basins, inactive burial grounds and sites of known, covered spills.

3.2.13 Radiation Work Permit (RWP) – A document generated, in accordance with 400-CP-401, *Issue and Use of Radiation Work Permits*, to provide specific requirements for radiological activities.

3.2.14 Re-suspension –The probability that loose radioactive contamination on surfaces will become airborne.

4.0 PRECAUTIONS, LIMITATION

4.1 Precautions

- 4.1.1** Signs identifying radiological hazards shall be posted on all sides of the barrier surrounding the identified radiological hazard area.
- 4.1.2** Signs identifying radiological hazards shall be firmly attached to the barrier surrounding the identified radiological hazard with materials that will withstand the effects of adverse weather and use conditions.
- 4.1.3** Radiation detection instruments used to identify and quantify radiological hazards shall be:
 - 4.1.3.1** Calibrated with sources approximating the type emissions and energies expected during surveys.
 - 4.1.3.2** Have a detection capability applicable to the type emission expected.
 - 4.1.3.3** Used by only qualified operators.
 - 4.1.3.4** Have a range capable of measuring the highest expected exposure rate or contamination level expected during the survey.
- 4.1.4** Radiation and contamination surveys used for the purpose of radiological protection shall be performed by personnel meeting the requirements of reference 3.1.3.
- 4.1.5** Entry into areas identified as Very High Radiation Areas requires prior approval from the USRS Radiological Field Operations Manager (Project Manager) for each specific entry.
- 4.1.6** Personnel exiting Contaminated Areas shall perform a whole-body contamination survey immediately upon exit from area.
- 4.1.7** A TLD or film badge is required to be worn by individuals as specified by the work plan and/or RWP.
- 4.1.8** Highly Contaminated Areas require an assessment to determine the probability of re- suspension prior to entry. Respiratory protection, decontamination or other engineering methods will be considered in Highly Contaminated Areas prior to entry.
- 4.1.9** All tools and equipment leaving a Contaminated Area shall be surveyed and decontaminated or packaged and labeled prior to leaving the immediate vicinity of the Contaminated Area.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

5.1.1 USRS Radiological Field Operations Manager

- 5.1.1.1 Implements the requirements of this procedure.
- 5.1.1.2 Reviews the adherence of personnel to the requirements of this procedure, periodically.
- 5.1.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform requirements of this procedure.

5.1.2 Health Physics Technicians

- 5.1.2.1 Performing radiation, contamination, and airborne radiological surveys as necessary to verify the adequacy of area postings and the radiological controls within an area.
- 5.1.2.2 Installation of all radiological postings and a demonstrated understanding of control requirements.
- 5.1.2.3 Notifying the area occupant(s) when an area is initially posted or when area posting is changed.

5.1.3 Individuals

- 5.1.3.1 Complying with all radiation protection instructions and postings.
- 5.1.3.2 Not smoking, eating, drinking or chewing while in a Controlled Area.
- 5.1.3.3 Performing a job or task in such a manner that the creation and spread of contamination are minimized.
- 5.1.3.4 Performing a job or task in such a manner that complies with good ALARA practices and principles.
- 5.1.3.5 Presenting all tools and equipment to Health Physics personnel for surveying prior to removing the items from a Controlled Area.
- 5.1.3.6 Obeying "Evacuate" or "Stop Work" orders from Health Physics personnel.
- 5.1.3.7 Not loitering in radiation areas.

- 5.1.3.8 Keeping track of your current radiation exposure and exposure limits.
- 5.1.3.9 Wearing dosimetry in a manner required by the RWP.
- 5.1.3.10 Performing a personal contamination survey upon exit from a Controlled Area.
- 5.1.3.11 Reporting the loss, damage or unexpected exposure of dosimetry to Health Physics immediately.
- 5.1.3.12 Wearing protective clothing and equipment specified by the RWP or area postings.
- 5.1.3.13 Avoiding skin or clothing contact with contaminated surfaces.
- 5.1.3.14 Minimizing the amount of radioactive waste generated.
- 5.1.3.15 Maintaining training qualifications current.
- 5.1.3.16 Notifying Health Physics of wounds, sores or rashes before entering any area where contamination exists and exit immediately if a wound occurs in such an area.

5.2 Qualifications

- 5.2.1** Health Physics Technicians shall be qualified in accordance with the requirements of Reference 3.1.3 to perform posting and access control.
- 5.2.2** Junior Health Physics/Decontamination Technicians may perform posting and access control under the direct supervision of a Health Physics Technician meeting the requirements of section 5.2.1.

6.0 PROCEDURE

6.1 AREA POSTING

- 6.1.1** When any of the criteria for a Controlled Area as defined in Section 3.2.5 of this procedure or Radiological Area are met, an area shall be properly posted using the sign specified for the identified radiological hazard.

6.2 Controlled Area

- 6.2.1** Controlled Areas shall be designated by clearly and conspicuously posting all accessible sides of the area with a sign bearing the following:



- 6.2.2** To enter a Controlled Area, a person must meet all posted requirements. A Controlled Area shall surround all Radiological Areas. A TLD or film badge is required in all Controlled Areas, unless the area is specifically posted "No TLD Required for Entry".

6.3 Radiological Area

NOTE

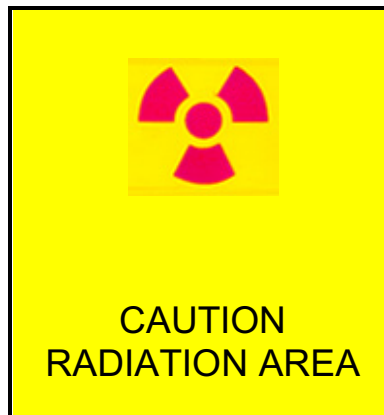
Dose rate measurements used to determine criteria for Radiation Areas or High Radiation Areas should be made at a distance of 30cm from the radioactive source or from any surface through which the radiation penetrates.

- 6.3.1** An area shall be clearly and conspicuously posted as a Radiological Area by display signs on all accessible sides of the area of a yellow background with a super-imposed magenta or black trefoil.
- 6.3.2** Signs as defined in this procedure shall be posted as required to define specific radiological hazards/areas within a Radiological Area.
- 6.3.3** Access requirements for Radiological Areas shall be posted on a sign at all routine access points.
- 6.3.4 Radiation Area**
- 6.3.4.1** A Radiological Area shall be posted "Radiation Area" when the following condition exists:

- Any area, accessible to individuals, in which the individual could receive a dose equivalent greater than 5 mrem but less than 100 mrem in 1 (one) hour at 30cm from the radiation source or from any surface through which the radiation penetrates.

6.3.4.2 Access requirements for Radiation Areas shall be restricted to Radiation Workers wearing TLDs or film badges and signed-in on an approved RWP.

6.3.4.3 Radiation Areas shall be clearly and conspicuously posted by displaying on all accessible sides of the area, signs of a yellow background with a superimposed magenta or black trefoil and the words:



6.3.4.4 These Radiation Areas shall also be posted "Radiation Work Permit (RWP) Required for Entry", and "TLD or Film Badge Required for Entry".

6.3.5 High Radiation Area

6.3.5.1 A Radiological Area shall be posted "High Radiation Area" when the following condition exists:

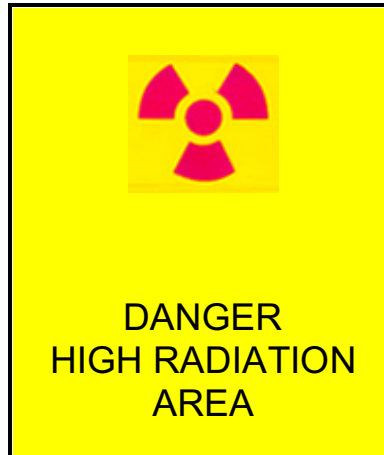
- Any area, accessible to individuals, in which the individual could receive a dose equivalent of 100 mrem (1 millisievert) but less than 500 rem in 1 (one) hour at 30cm from the radiation source or from any surface through which the radiation penetrates.

6.3.5.2 Access to High Radiation Areas shall be restricted to Radiation Workers wearing a TLD or film badge and a self-reading dosimeter, having a dose-rate instrument, and signed-in on an approved RWP.

NOTE

In lieu of a dose rate instrument, an alarming dosimeter set to alarm at the maximum dose and exposure rate allowed by the RWP is acceptable.

- 6.3.5.3 High Radiation Areas shall be clearly and conspicuously posted by displaying on all accessible sides of the area, signs of a yellow background with a superimposed magenta or black trefoil and the words:



- 6.3.5.4 The anticipated exposure rate or range of exposure rates should be written or posted with each sign identifying a High Radiation Area.
- 6.3.5.5 These High Radiation Areas shall also be posted "TLD or Film Badge Required", "Dose Rate Instrument or Alarming Dosimeter Required", "Radiation Work Permit (RWP) Required for Entry" and "HP Required for Entry".
- 6.3.5.6 Each point of entrance or access shall be equipped with one or more of the following:
- a. A control device that limits the level of radiation to which an individual might be exposed to less than 100 mrem in 1 (one) hour.
 - b. A control device that energizes a conspicuous audible or visible alarm in such a manner that the entering individual is alerted the fact that entry into a High Radiation Area has occurred.
 - c. Some form of positive control (such as key control) over each entry, posted with a means for secure lockout during periods when access is not required.

6.3.6 Very High Radiation Area

- 6.3.6.1 A Radiological Area shall be posted "Very High Radiation Area" when the following condition exists:

- Any area, accessible to individuals, in which the individual could receive a dose equivalent of 500 rem in 1 (one) hour at 1 meter from the radiation source or from any surface through which the radiation penetrates.

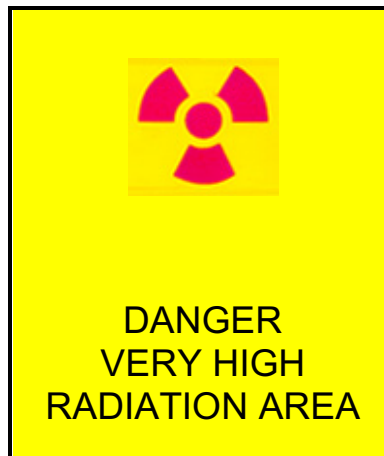
NOTE

Dose rate measurements used to determine criteria for Very High Radiation Areas should be made at 100cm from the radioactive source or from any surface through which the radiation penetrates.

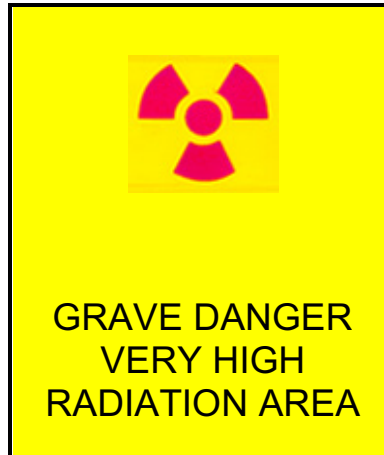
6.3.6.2 Access to Very High Radiation Areas shall be restricted to qualified Radiation Workers on an approved RWP, wearing a TLD or film badge and a self-reading dosimeter, and possessing a dose- rate instrument or device described in Steps 4.3 or 6.3.5.2. Additionally, individuals shall be escorted by a Health Physics Technician that is aware of dose margins and associated stay times. All personnel shall be aware of the maximum and average exposure rates prior to entry.

6.3.6.3 Very High Radiation Areas shall be clearly and conspicuously posted by displaying on all accessible sides of the area, signs of a yellow background with a superimposed magenta or black trefoil and the words:

For exposure rates of 500 R/hr to 1,000 R/hr:



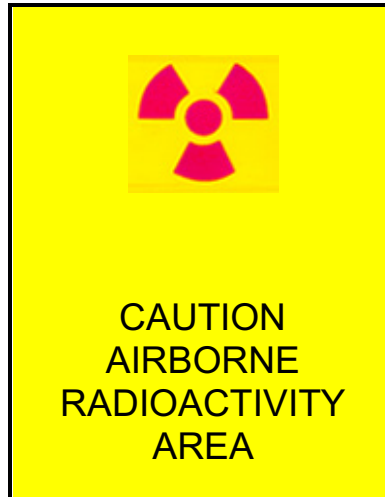
For exposure rates > 1,000 R/hr:



- 6.3.6.4 The anticipated exposure rate or range of exposure shall be written on, or posted with each sign identifying a Very High Radiation Area.
- 6.3.6.5 These Very High Radiation Areas shall also be posted "TLD or Film Badge Required", "Dose Rate Instrument or Alarming Dosimeter Required", "Radiation Work Permit (RWP) Required for Entry" and "HP Required for Entry".
- 6.3.6.6 Each point of entrance or access shall be equipped with a positive locking device keyed with a unique lock. Control of the keys to this area shall be maintained by the USRS Radiological Field Operations Manager (Project Manager) or his/her designee.

6.3.7 Airborne Radioactivity Area

- 6.3.7.1 A Radiological Area shall be posted "Airborne Radioactivity Area" when the following condition exists:
- Any room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exists in concentrations of 10 percent of the DAC value for the specific radionuclide as listed in Table 1, Column 3, in Appendix B of reference 3.1.2.
- 6.3.7.2 Airborne Radioactivity Areas shall be clearly and conspicuously posted by displaying on all accessible sides of the area, signs of a yellow background with a superimposed magenta or black trefoil and the words:



6.3.7.3 Airborne Radioactivity Areas shall also be posted "Radiation Work Permit (RWP) Required for Entry", and "Health Physics Required for Entry".

6.3.8 Radioactive Materials Area

6.3.8.1 A Radiological Area shall be posted "Radioactive Materials Area" when the following condition exists:

- Any area or room in which licensed radioactive materials is used or stored in an amount exceeding 10 times the quantity of such material specified in Appendix C of reference 3.1.2.

6.3.8.2 Radioactive Materials Areas shall be clearly and conspicuously posted by displaying on all accessible sides of the area, signs of a yellow background with a superimposed magenta or black trefoil and the words:



6.3.8.3 Radioactive Materials Areas shall also be posted "Radiation Work Permit (RWP) Required for Entry", and "TLD or Film Badge Required for Entry".

6.3.8.4 The exterior package surface of any radioactive material shall be labeled in accordance with Reference 3.1.6.

6.3.9 Contaminated Area

6.3.9.1 A Radiological Area shall be posted " Contaminated Area" when the conditions outlined in Step 3.2.12.3 of this procedure exist.

6.3.9.2 Contaminated Areas shall be clearly and conspicuously posted by displaying on all accessible sides of the area, signs of a yellow background with a superimposed magenta or black trefoil and the words:



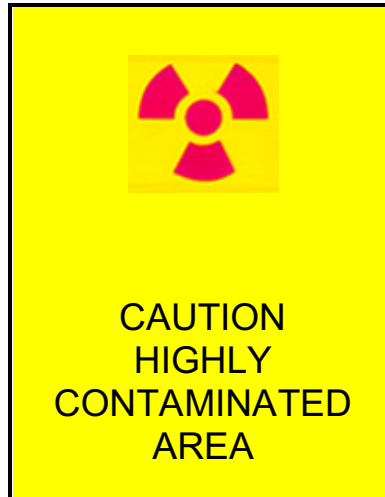
6.3.9.3 Contaminated Areas shall also be posted "RWP Required for Entry", and "Personnel Contamination Survey Required Upon Exiting". Each Contaminated Area that is to be entered shall have a step-off pad maintained in an uncontaminated condition located at the access/egress point.

6.3.9.4 Contaminated Areas that require personnel access on a daily basis should have a frisking station within 10 feet of the access/egress point, if background radiation levels permit. All personnel exiting the Contaminated Area shall perform a whole body frisk upon exiting the area.

6.3.10 Highly Contaminated Area

6.3.10.1 A Radiological Area shall be posted " Highly Contaminated Area" when the conditions outlined in Step 3.2.12.4 of this procedure exist.

6.3.10.2 Highly Contaminated Areas shall be clearly and conspicuously posted by displaying on all accessible sides of the area, signs of a yellow background with a superimposed magenta or black trefoil and the words:



6.3.10.3 Highly Contaminated Areas shall also be posted "RWP Required for Entry", "Health Physics Required for Entry", and "Personnel Contamination Survey Required Upon Exiting". Each Highly Contaminated Area that is to be entered shall have a step-off pad maintained in an uncontaminated condition located at the access/egress point.

6.3.11 Radiography Area

6.3.11.1 The area shall be clearly and conspicuously posted to indicate where the equipment is used, as appropriate, by a licensed radiographer.

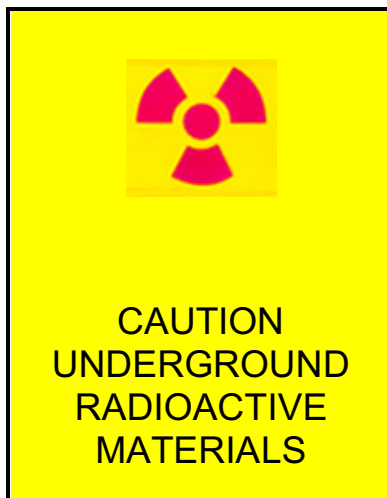
6.3.11.2 Health Physics will determine and post the integrated Radiation Area and High Radiation Area.

6.3.11.3 Area boundaries in accordance with Steps 6.3.4, 6.3.5, and 6.3.6 of this procedure.

6.3.12 Underground Radioactive Materials Area

6.3.12.1 The entrance to any area (normally outside areas) shall be posted to indicate the presence of underground items that contain radioactive materials such as pipelines, tanks, cribs, covered ponds, covered ditches, catch basins, inactive burial grounds and sites of known, covered, unplanned spills.

6.3.12.2 The entrances to the areas shall be clearly and conspicuously posted:



6.3.12.3 Underground Radioactive Material Areas shall also be posted "Pipes and Tanks", "Excavating, digging, drilling prohibited without Site Manager's approval".

7.0 RECORDS

The records generated by the use of this procedure are documented in accordance with the provisions of Reference 3.1.4, 3.1.5, and Reference 3.1.6. No new records are created.

8.0 FORMS

8.1 USRS-001 – Radiological Survey Report



Field Operating Procedure
RADIOLOGICAL INCIDENT RESPONSE

500-EP-501

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

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1.0 PURPOSE

The purpose of this procedure is to define Up-Side Radiological Survey, LLC [(USRS) hereinafter referred to as "the Company"] protocols for handling and reporting radiological emergencies when using Company radioactive material license.

This procedure has been written to comply with Title 10 Part 20 of the Code of Federal Regulations (10 CFR 20), "Standards for Protection against Radiation." This procedure was developed using the guidance provided in the following documents:

- NUREG-1556, Volume 18, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Service Provider Licenses," and

Due to the diverse nature of projects performed by the Company, the specific requirements for emergency response for each project will vary. Therefore, the site-specific health and safety plan (SSHASP) for each project will provide details with regard to evacuation routes, routes to medical facilities, notification phone numbers, and emergency response actions and equipment.

This procedure is tied to the Company's radioactive materials license. The NRC must approve any proposed changes or revisions to this procedure before the changes may be implemented.

The License Radiation Safety Officer (RSO) is responsible for updating this procedure. Approval authority rests with the Radiation Safety Committee.

2.0 SCOPE

This procedure applies to all Company operations where Company radioactive material license is used to possess radioactive material.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 Licensed Radiation Safety Officer

The RSO is responsible for ensuring that methods or procedures are available to field projects to accomplish the following radiation safety objectives:

- Emergency response procedures are in place
- Emergency response kits are available if necessary
- Emergency response notification lists are available with names and telephone numbers

- Required regulatory notifications are made in a timely manner.

3.1.2 Project Manager

The Project Manager (PM) is responsible to:

- Implement this procedure
- Ensure that SSHASPs are consistent with this procedure
- Weigh actual and potential risks against the benefit to be gained before authorizing emergency exposure in excess of the occupational dose limits
- Ensure that the risk of injury to individuals involved in rescue and recovery operations is minimized
- If necessary, procure, maintain, and train employees in use of emergency kits, including spill kits.

3.1.3 Project Health Physicist

The Project Health Physicist (PHP) is responsible for:

- Assist the PM in implementing this procedure.
- Coordinate the actions of the emergency response team. The PHP ensures all members of the emergency response team are qualified by training and experience to perform the requirements of this procedure.
- Provide guidance and recommendations to the PM regarding potential doses associated with authorized emergency exposure situations, and how to minimize them; and
- Record any authorized emergency exposures in the occupational dose records.

3.1.4 Project Personnel

All Company project personnel shall be familiar with this procedure and the SSHASP so that participation in an emergency response would ensure minimal chance of expansion of the emergency conditions at the site.

3.2 General Safety Procedures to Handle Spills

The name and telephone number of the PM, PHP, and RSO or an alternate person(s), shall be posted conspicuously in areas of use and communicated to the workers, so that it is readily available to workers in case of emergencies. Emergency equipment shall be readily available for handling spills. Spill kits should include the following items at a minimum:

- Disposable gloves
- Housekeeping gloves
- Disposable lab coats
- Disposable head coverings
- Disposable shoe covers
- Roll of absorbent paper with plastic backing
- Masking Tape
- Plastic trash bags with twist ties
- "Radioactive Material" labeling tape
- Marking Pen
- Pre-Strung "Radioactive Material" labeling tags
- Box of Wipes
- Instructions for "Emergency Procedures"
- Clipboard with a copy of the Radioactive Spill Report Form for the facility
- Pens
- Appropriate survey instruments, including batteries (for survey meters)

Copies of emergency procedures shall be available to project personnel handling radioactive material. Current copies of emergency procedures shall be posted in designated locations throughout the project site in close proximity to areas where radioactive material is handled.

3.3 Minor Spills of Liquids and Solids

Due to the diverse nature of projects performed by the Company, the specific requirements for emergency response for each project will vary. When appropriate, the SSHASP for each project will provide additional details, supplementary to those provided below, regarding response to minor spills.

3.3.1 Project Personnel Response

Project personnel shall perform the following actions after a minor spill of radioactive liquids and/or solids:

- Notify persons in the area that a spill has occurred.
- Prevent the spread of contamination.
- Clean up the spill.
- Place materials used to clean up the spill in an appropriate receptacle.
- Perform radiation and contamination surveys of the spill area and the surrounding area to ensure that the spill cleanup measures have been successful.
- Ensure that personnel and equipment are monitored for contamination prior to leaving the area.
- Report the incident to the PHP and PM.
- Allow no one to return to work in the area unless approved by the PHP.
- Follow the instructions of the PHP, PM, and the project management staff.

3.3.2 Project Management Staff Response

Project management staff shall perform the following actions after a minor spill of radioactive liquids and/or solids:

- Monitor the decontamination activities. If necessary, provide technical guidance to the workers combating the spill.
- Document the spill, the spill response, and the final radiological condition of the area where the spill occurred.
- Report the incident to the RSO.
- As appropriate, determine the cause and corrective actions needed. Consider bioassays, if there is a potential for internal contamination.
- Make regulatory notifications in accordance with approved non-conformance reports.

3.4 Major Spills of Liquids and Solids

Due to the diverse nature of projects performed by the Company, the specific requirements for emergency response for each project will vary. When appropriate, the SSHASP for each project will provide additional details, supplementary to those provided below, regarding response to major spills.

3.4.1 Project Personnel Response

Project personnel shall perform the following actions after a major spill of radioactive liquids and/or solids:

- Evacuate the area.
- Prevent the spread of contamination.
- Shield the source only if it can be done without further contamination or significant increase in radiation exposure.
- Isolate, secure, and post the area.
- Notify the PM and PHP.
- Survey all personnel who could have been contaminated. Decontaminate any contaminated personnel.
- Allow no one to return to work in the area unless approved by the PHP.
- Follow the instructions of the PHP, PM, and the project management staff.

3.4.2 Project Management Staff Response

Project management staff shall perform the following actions after a major spill of radioactive liquids and/or solids:

- Report the incident to the RSO.
- Monitor the evacuation and isolation activities. If necessary, provide technical guidance to the workers performing these activities.
- Confirm decontamination of personnel.
- Supervise decontamination activities and document the results. Documentation shall include location of surveys and decontamination results.
- Document the spill, the evacuation and isolation of the spill area, and to the extent practical the radiological condition of the spill area.
- As appropriate, determine cause and corrective actions needed. Consider bioassays, if there is a potential for internal contamination.
- Make regularly notifications in accordance with approved procedures for non-conformance reports.

3.5 Incidents Involving Radioactive Dusts, Vapors, and Gases

Due to the diverse nature of projects performed by the Company, the specific requirements for emergency response for each project will vary. When appropriate, the SSHASP for each project will provide additional details, supplementary to those provided below, regarding response to incidents involving radioactive dusts, vapors, and gases.

3.5.1 Project Personnel Response

Project personnel shall perform the following actions after an incident occurs that involves radioactive dusts, vapors, and gases.

- Notify all personnel to vacate the room or area immediately.
- If so equipped, shut down the ventilation system unless it is determined that the ventilation system needs to be used to clear the air for access purposes.
- Notify the PM and PHP.
- Isolate, secure, and post the area. If so equipped, ensure that all access doors to the area are closed and posted with radiation warning signs, or post guards (trained) at all access doors to prevent accidental opening of the doors or entry to the area.
- Survey all personnel who could have been contaminated. Decontaminate any contaminated personnel.
- Report suspected inhalations and ingestions of licensed material to the PHP. Decontaminate the area only when advised and/or supervised by the PHP.
- Allow no one to return to work in the area unless approval by the PHP.
- Follow the instructions of the PHP, PM, and the project management staff (e.g., decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).

3.5.2 Project Management Staff Response

Project management staff shall perform the following actions after an incident occurs that involves radioactive dusts, vapors, and gases:

- Report the incident to the RSO.
- Supervise decontamination activities. If necessary, provide technical guidance to the workers performing these activities.

- Perform air sample surveys in the area before permitting resumption of work with licensed materials.
- Provide written directions to potentially contaminated individuals about providing and collecting urine, breath, blood, or fecal samples, etc.
- Consider need for medical exam and/or whole body count before permitting involved individuals to return to work with licensed material.
- As appropriate, determine cause and corrective actions needed. Consider bioassays, if there is a potential for internal contamination.
- Document the incident, the incident response, and the final radiological condition of the area where the incident occurred.
- Make regulatory notifications in accordance with Approved procedure for non-conformance reports.

3.6 Incipient Stage Fires Involving Radioactive Material

Due to the diverse nature of projects performed by the Company, the specific requirements for emergency response for each project will vary. When appropriate, the SSHASP for each project will provide additional details, supplementary to those provided below, regarding response to incipient stage fires involving radioactive material.

3.6.1 Project Personnel Response

Project personnel shall perform the following actions to combat an incipient stage fire:

- Attempt to put out the fire by approved methods (e.g., fire extinguisher) if other fire hazards or radiation hazards are not present.
- Notify all persons present to vacate the area and have one individual call the PHP and PM.
- Once the fire is out, isolate the area to prevent the spread of possible contamination.
- Survey all persons involved in combating the fire for possible contamination.
- Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water, then washing with a mild soap.

- In consultation with the PHP, determine a plan of decontamination and the types of protective devices and survey equipment necessary to decontaminate the area.
- Allow no one to return to work in the area unless approved by the PHP.
- Follow the instructions of the PHP, PM, and the project management staff (e.g., decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).

3.6.2 Project Management Staff Response

Project management staff shall perform the following actions to support the combat of an incipient stage fire:

- Supervise decontamination activities. If necessary, provide technical guidance to the workers performing these activities.
- Coordinate activities with facility's industrial hygienist or environmental health & safety office, and with local fire department.
- If decontamination of personnel was not fully successful, consider alternative decontamination methods such as inducing perspiration by covering the area with plastic.
- Consult with fire safety officials to ensure that there is no possibility of another fire starting.
- Report the incident to the RSO.
- As appropriate, determine cause and corrective actions needed. Consider bioassays, if there is a potential for internal contamination.
- Document the incident, the incident response, and the final radiological condition of the area where the incident occurred.
- Make regulatory notifications in accordance with Approved procedure for non-conformance reports.

3.7 Fires, Explosions, or Major Emergencies

Due to the diverse nature of projects performed by the Company, the specific requirements for emergency response for each project will vary. When appropriate, the SSHASP for each project will provide additional details, supplementary to those provided below, regarding response to fires, explosions, or other major emergencies involving radioactive material.

3.7.1 Instruction to Workers

Project personnel shall perform the following actions to combat a fire, explosion, or other major emergency involving radioactive material:

- Notify all persons in the area to leave immediately.
- Notify the fire department.
- Call the PHP, PM, and other safety personnel.
- Upon arrival of firefighters, inform them where radioactive materials are stored or where radioisotopes were being used. Inform them of the present location of the licensed material and the best possible entrance route to the radiological area, as well as any precautions to avoid exposure or risk of creating radioactive contamination by use of high pressure water, etc.
- Allow no one to return to work in the area unless approved by the PHP.
- Follow the instructions of the PHP, PM, and the project management staff (e.g., decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).

3.7.2 Project Management Staff Response

Project management staff shall perform the following actions to support the combat of a fire, explosion, or other major emergency involving radioactive material:

- Ensure that thorough contamination surveys of the firefighters and their equipment are performed before they leave the controlled area and decontaminate them, if necessary.
- Supervise decontamination activities. If necessary, provide technical guidance to the workers performing these activities.
- Report the incident to the RSO.
- As appropriate, determine cause and corrective actions needed. Consider bioassays, if there is a potential for internal contamination.
- Document the incident, the incident response, and the final radiological condition of the area where the incident occurred.
- Make regulatory notifications in accordance with Approved procedure for non-conformance reports.

3.8 Emergency Exposures

Individuals involved in rescue and recovery operations can receive higher doses than normally authorized, i.e., occupational dose limits. Emergency exposures are only to be authorized on the agreement of the PM, PHP, and (time permitting) the RSO, with the following provisions:

- The risk of injuries to those involved in the rescue or recovery shall be minimized.
- Company management shall weigh actual and potential risks against the benefits to be gained.
- Only workers with current radiation worker training may be involved; and
- No individual shall be required to perform rescue action that might involve substantial personal risk.

Each individual authorized to perform emergency actions likely to result in occupational doses exceeding the values of the occupational dose limits is to be briefed beforehand on the known or anticipated hazards.

All doses exceeding the occupational dose limits are to be recorded in the affected individual's occupational dose record.

3.8.1 Notifications

Regulatory notifications are made in accordance with Approved procedure for non-conformance reports.

3.8.2 Return to Work

Company employees whose occupational dose has exceeded the numerical value of any of the occupational dose limits as a result of an authorized emergency exposure may be permitted to return to work in radiological areas during the current year providing that all of the following conditions are met:

- Approval is first obtained from the President.
- The individual receives counseling from radiological protection and medical personnel regarding the consequences of receiving additional occupational exposure during the year; and
- The affected employee agrees to return to radiological work.

3.9 Records

Documents generated while using this procedure are to be retained as radiological protection records in accordance with 100-AP-103, Radiological Records.

4.0 GUIDANCE

Annual Occupational Limit – 5 rem total effective dose equivalent; the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rem; 50 rem (shallow dose) to skin or any extremity; and 15 rem to lens of the eye.

Incipient stage fire – A fire which is in the initial or beginning stage and which can be controlled or extinguished by portable fire extinguishers, Class II standpipe or small hose systems without the need for protective clothing or breathing apparatus.

Major Spill is a spill of radioactive material that requires a response by personnel or equipment from outside the original organization performing the task or maintaining the facility. A spill is considered major if it may have an adverse effect on the environment or the public.

Minor Spill is a spill of radioactive material that is controlled and handled by the workers from the project responsible for the task or maintenance of the facility. A minor spill does not impact the environment or the public.

Total effective dose equivalent (TEDE) – The sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

5.0 REFERENCES

- 10 CFR 20 – Standards for Protection Against Radiation
- NUREG-1556, Vol. 18 – Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Services Provider Licenses
- USRS Procedure, 100-AP-103 – Radiological Records
- Approved Procedure for Nonconformance Reports.



Field Operating Procedure

DECONTAMINATION OF EQUIPMENT AND TOOLS

600-CP-601

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019

Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019

Date

REVISION HISTORY

Revision (Date)	Rev. No	Prepared By	Description of Changes	Affected Pages
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1.0 SCOPE

This procedure establishes the procedural requirements for the decontamination of equipment, material, and tools, used on Up-Side Radiological Survey, LLC (USRS) projects, contaminated with radioactive material.

The purpose of this procedure is to provide a instruction for the decontamination of equipment, material, and tools. Each decontamination operation is unique; thus, this procedure provides general, effective decontamination techniques and guidelines to be utilized by USRS field personnel. This document applies to all USRS personnel involved in the decontamination process.

2.0 DEFINITIONS

- 2.1 **Decontamination** - The processes whereby contamination can be safely and effectively removed from equipment, tools and materials, to levels required by Reference 3.1.2.
- 2.2 **Herculite** - A plastic or polyethylene floor covering used for decontamination operations. HERCULITE is a brand name.
- 2.3 **S.D.S.** - Safety Data Sheet; Manufacturer directions, safety information and limitations for use of decontamination related solvents or cleaning solutions.
- 2.4 **Radiation Work Permit (RWP)** - A document generated by Health Physics to provide:
 - 2.4.1 A description and scope of the work to be performed.
 - 2.4.2 The existing radiological conditions in the work area.
 - 2.4.3 The limitations placed upon the scope of work.
 - 2.4.4 The maximum radiological limits allowed.
 - 2.4.5 The protective measures to be employed during the work to protect the worker(s).
 - 2.4.6 The period of time the RWP is valid.
 - 2.4.7 Special instructions to workers and Health Physics Technicians during the course of work.
- 2.5 **Shall** - The word "shall" as used in this procedure is to be understood as denoting a mandatory requirement.
- 2.6 **Should** - The word "should" as used in this procedure is to be understood as denoting a recommendation that is a sound safety practice; it does not denote a

mandatory requirement, however, is normally done unless job conditions require other actions.

3.0 PRECAUTIONS, LIMITATION

3.1 Precautions

- 3.1.1** All decontamination of contaminated tools or equipment shall be performed in accordance with the direction of the Health Physics Technician providing the job coverage in accordance with this Procedure, and the RWP requirements.
- 3.1.2** Areas used for decontamination shall be posted and controlled in accordance with the provisions of procedure 400-CP-409, *Radiological Posting and Access Control*.
- 3.1.3** Controls to contain the spread of loose contamination during the decontamination activity shall be determined prior to the decontamination of equipment, material, and tools.

3.2 Limitations

- 3.2.1** Protective clothing worn by the personnel involved in decontamination activities shall be determined according to the RWP.
- 3.2.2** Decontamination cleaning solvents/solutions shall only be used in accordance with the directions and limitations listed on the manufacturer supplied MSDS. Decontamination solutions/solvents shall be approved by the Project Manager prior to use. Solvents/solutions requiring a ph adjustment shall be modified prior to use.
- 3.2.3** Respiratory protection devices required by the RWP for decontamination operations shall be selected and used 400-CP-408, *Selection and Use of Respiratory Protection*.
- 3.2.4** A pre-job briefing shall be held to instruct Decontamination Technicians of the conditions of the RWP. All personnel performing work in the decontamination area shall sign the RWP prior to work.
- 3.2.5** Every effort will be made by USRS personnel to avoid re-contamination of decontaminated materials. Contamination controls shall always be observed throughout a decontamination operation.
- 3.2.6** Radiation and contamination surveys shall be performed in accordance with the provisions of 300-SP-301, *Radiation and Contamination Surveys*.
- 3.2.7** Release of equipment, materials, and tools from the decontamination area shall be performed in accordance with the provisions of 400-CP-403, *Release of Material from Controlled Areas*.

4.0 RESPONSIBILITIES

4.1 Responsibilities

4.1.1 USRS Radiological Field Operations Manager

- 4.1.1.1 Implements the requirements of this procedure.
- 4.1.1.2 Designates qualified evaluators.
- 4.1.1.3 Reviews the adherence of personnel to the requirements of this procedure, periodically.
- 4.1.1.4 Ensure Health Physics Technicians are qualified by knowledge, training and experience to perform requirements of this procedure.

4.1.2 Health Physics Supervisor/Evaluator

- 4.1.2.1 The Health Physics Supervisor shall perform periodic surveillance of the decontamination operation and ensure adherence to applicable procedures.
- 4.1.2.2 The Health physics Supervisor shall write the RWP in accordance with the provisions of 400-CP-401, *Issue and Use of RWP*.
- 4.1.2.3 The Health Physics Supervisor shall assign job coverage assignments to Health Physics Technicians.
- 4.1.2.4 The Health Physics Supervisor shall assure that the RWP is up-to-date prior to decontamination activities.
- 4.1.2.5 The Health Physics Supervisor or designee shall conduct the decontamination operation pre-job briefings.
- 4.1.2.6 The Health Physics Evaluator shall provide release evaluations of decontaminated materials in accordance with the provisions of 400-CP-403, *Release of Material from Controlled Areas*.

4.1.3 Health Physics Technicians

- 4.1.3.1 The Health Physics Technician shall provide constant or intermittent job coverage as required by the RWP.
- 4.1.3.2 Prior to the start of decontamination operations, the Health Physics Technician shall assure that the area where decontamination is to be performed is properly established in accordance with 400-CP-

409, *Radiological Posting and Access Control* and all engineering controls are in place and operable.

4.1.3.3 The Health Physics Technician performing the job coverage shall remain cognizant of changing radiological conditions which may require different levels of personal protection equipment and/or respiratory protection equipment than the levels originally assigned for a particular decontamination operation.

4.1.3.4 The Health Physics Technician performing job coverage shall be responsible for enforcing the provisions of the RWP and ALARA considerations.

4.1.4 Junior Health Physics/Decontamination Technicians

4.1.4.1 The Junior Health Physics/Decontamination Technician shall decontaminate USRS equipment and tools in accordance with the provisions of this procedure.

4.1.4.2 The Junior Health Physics/Decontamination Technician shall adhere to the requirements of the RWP, and ALARA considerations. The Junior Health Physics/Decontamination Technician shall comply with all directions of the Health Physics Technicians.

4.1.4.3 The Junior Health Physics/Decontamination Technician shall advise Health Physics supervision if the work scope or job conditions change.

5.0 PROCEDURE

5.1 Release Limits for Gross Activity (Unknown Isotopes) - Regulatory

EMMISSION	REMOVABLE* (dpm/100 cm ²)	TOTAL (Fixed and Removable)* (dpm/100 cm ²)
Alpha	20	100
Beta-Gamma	200	1,000

Notes:

* **Limits taken from** NRC's "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials (NRC 1993), Office of Nuclear Material Safety and Safeguards (NMSS)".

NOTE:

If all of the actual isotopic constituents of the contamination are known and documented on the release documents, the release limits of Table 1 of Reference 3.1.5 may be applied.

5.2 Pre-Decontamination Preparation

- 5.2.1 The Project Manager shall initiate decontamination instructions.
- 5.2.2 A radiological survey shall be performed by a Health Physics Technician on any object which is to be removed from a controlled area.
- 5.2.3 If radiological survey results indicate that a RWP is required for decontamination, the Health Physics Supervisor shall write the RWP in accordance with the provisions of 400-CP-401, *Issue and Use of RWP*.
- 5.2.4 If a survey indicates that decontamination is required, the item should be bagged, wrapped, or contained under the direction of Health Physics Supervision. The Health Physics Technician shall label the item in accordance with the provisions of 400-CP-404, *Control of Radioactive Material*.
- 5.2.5 The Project Manager shall approve or disapprove the decontamination operation based on conditions of the RWP and the cost effectiveness of the operation versus disposal costs.

5.3 Establishment of the Decontamination Area

- 5.3.1 The Project Manager and/or Health Physics Supervisor shall determine a location for set-up of the decontamination area.
- 5.3.2 Once a location has been established, the decontamination area shall be constructed by the Junior Health Physics/Decontamination Technicians under the direction of the Project Manager and/or Health Physics Supervisor.
- 5.3.3 The decontamination area should consist of:

5.3.3.1 Herculite (or equivalent) floor surfaces. A double layer of Herculite (or equivalent) may be laid on the floor at the Health Physics Supervisor's direction.

5.3.3.2 Herculite (or equivalent) wall surfaces, if applicable.

5.3.3.3 Engineering controls (HEPA ventilation, vacuum cleaners, containment tent walls, glove bags, etc.), if applicable. Engineering controls shall be determined on the basis of the ALARA considerations section of the RWP. All possible engineering controls shall be utilized when feasible to minimize the usage of respiratory protection equipment.

5.3.3.4 Safe, sturdy work stations with contamination resistant surfaces such as tables that will support decontamination attempts on heavy pieces of equipment.

5.3.3.5 Adequate supply of overhead light, adequate electrical/compressed air supply for the operation of electrical/pneumatic driven decontamination equipment.

NOTE:

Use caution when decontaminating with compressed air tools to minimize spread of activity in the work area. A containment with filtered inlet and exhaust is recommended.

5.3.3.6 Overhead lifting equipment, if applicable.

5.3.3.7 Adequate supply of USRS approved cleaning solutions and solvents; adequate supply of decontamination equipment such as:

- Light duty decontamination equipment such as paper wipes, paper towels, massilin towels, etc.

- Medium to heavy-duty decontamination equipment such as scrub pads, wire brushes, steel wool, files, sandpaper, etc.
- Fully stocked hand tool kit for disassembly of contaminated equipment.
- Power tools, such as drills, saws, needle guns, electric screwdrivers, etc.
- Radioactive material storage bags, stickers, etc.
- Buckets, barrels or drums for the storage of contaminated liquids, sludges or slurries, if applicable.
- Blotter paper or sorbent, if applicable.
- Approved absorbent material such as Oil-Dri™, etc., if applicable.

5.3.3.8 Storage drums/bags for the storage of contaminated protective clothing under direction of Health Physics supervision.

5.3.3.9 Proper surveillance instruments (air monitor/sampler, contamination monitor, friskers, dose rate meter, etc.) in accordance with the RWP.

5.3.3.10 An adequate supply of personal protective clothing, gloves, respiratory equipment, etc.

5.3.3.11 Step-Off Pad or Double Step-Off Pad in accordance with the provisions of the RWP.

5.3.3.12 A designated area within the decontamination area for the segregation of radiological waste.

5.3.3.13 Fire extinguisher(s), if required.

5.3.4 Once the decontamination area has been established and stocked for operation, the bagged or wrapped contaminated or controlled equipment should be placed in the decontamination work area by a Junior Health Physics/Decontamination Technician under the direction of the Project Manager and the Health Physics Technician. Contaminated or controlled items should always be escorted by a Health Physics Technician to the decontamination area.

5.4 Decontamination

5.4.1 After radiological posting of the decontamination area, all requirements of the RWP shall be observed.

5.4.2 The preparation for decontamination of a particular tool, material, or piece of equipment shall be performed as follows:

5.4.2.1 Position the wrapped item so that the written information on the wrapping is visible.

NOTE:
Junior Health Physics/Decontamination Technicians may operate survey instrumentation for decontamination monitoring purposes. Senior Health Physics Technicians shall oversee Junior Health Physics/Decontamination Technicians when survey instruments are in use. Survey instruments used in a known or suspected contaminated area should be protected (wrapped in plastic, poly, etc.) against possible contamination before use.

5.4.2.2 The Health Physics Technician shall direct the removal of the item from the wrapping in such a manner (rolling plastic wrapping inside out, etc.) to control the spread of contamination.

5.4.2.3 An item that is highly contaminated with loose surface contamination should be misted with an approved liquid. The water vapor will wet down the particulate contamination and help prevent the possibility of airborne contamination.

5.4.2.4 Once the item has been removed from the wrapping and has been properly positioned, discard the wrapping as radiological waste.

5.4.3 The following decontamination techniques should be considered for the decontamination of equipment, materials, and tools:

5.4.3.1 Any equipment with inaccessible areas shall be dismantled so that all surfaces are accessible for decontamination and for survey.

5.4.3.2 Decontamination shall be performed in a safe, effective manner.

5.4.3.3 The Health Physics Technician shall be notified IMMEDIATELY if the job conditions change (e.g. suspected asbestos found, presence of mercury in a switch or a light bulb, a fluid leak, or any other special circumstances).

5.4.3.4 A Junior Health Physics/Decontamination Technician shall be assigned as a fire watch if any spark creating decontamination techniques (grinding, etc.) are used. There shall be a dedicated fire extinguisher located within the decontamination area when these operations are performed.

5.4.3.5 In order to secure a safe cleaning surface, the item should be positioned on the work table (if size and weight allow) and locked into a vise.

5.4.3.6 The decontamination area shall remain organized and free of debris. The Junior Health Physics/Decontamination Technicians shall "clean as they go."

5.4.3.7 A HEPA vacuum cleaner may be used during the decontamination operation for cleanup or for small volume ventilation (containments). Permanent facility ventilation shall not be used to vacuum debris.

5.4.3.8 Loose Surface Contamination Removal

- When item is properly positioned for decontamination and the pre-survey has been completed, perform the following:
- Moisten the surface of the item with an approved liquid (e.g. pH adjusted SPRAY 9 or equivalent).
- Fold a paper or cloth wipe into sections, using one surface of the wipe, gently wipe contamination off in ONE direction AWAY from the body. This should reduce the possibility of personnel contamination.
- Re-fold the paper or cloth wipe so that a CLEAN surface is available (this should prevent cross- contamination) and continue until item is ready for survey.
- For some materials, duct tape will effectively remove loose surface contamination. Wrap the duct tape loosely around the gloved hand, ADHESIVE side OUT. Roll the tape over the contaminated area.
- Re-survey.

5.4.3.9 Fixed Surface Contamination Removal

NOTE:

High power removal techniques will make fixed activity loose and airborne. Controls to minimize contamination spread must be developed prior to the operation.

5.4.3.9.1 There are many techniques that can be used to remove fixed contamination. The techniques selected for a particular decontamination operation is at the discretion of the Project Manager and the Health Physics Technician. The techniques can be divided into the following categories:

- Light hand decontamination
- Abrasive hand decontamination
- Power tool decontamination
- Machine decontamination (use of abrasive bead blaster, grit blaster, high pressure water wash systems, etc.).

The specific implementation of these techniques is not included within the scope of this procedure.

- Cleaning solutions/solvents (use of ultrasonic cleaners, acid baths, electro-polishing, etc.).

The specific implementation of these techniques is not included within the scope of this procedure.

5.4.3.9.2 Light hand decontamination consists of using many of the same techniques as described in Section 5.4.3.8 of this procedure.

5.4.3.9.3 Abrasive hand decontamination shall be performed in the following manner:

- Remove as much loose surface contamination as possible as indicated in Section 5.4.3.8 of this procedure.
- Moisten the surface of the item(s) to contain contamination.

- Use an abrasive cleaning tool (e.g. sandpaper, steel wool, steel brush, hand grinder, etc.) to loosen fixed contamination. Clean in one direction ONLY and clean AWAY from the body to prevent personnel contamination.
- Continue to moisten the surface of the item(s) to contain contamination.
- Remove as much loose surface contamination as possible per Section 5.4.3.8 of this procedure.
- Re-survey.

5.4.3.10 Power tool decontamination shall be performed in the following manner only under the direction of the Health Physics Technician.

NOTE:

WHEN USING POWER TOOLS, ALWAYS CONSIDER THE POTENTIAL OF INJURY DUE TO THE HAZARDS INVOLVED. POWER TOOLS SHALL BE USED CAUTIOUSLY AND IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

5.4.3.10.1 Some of the electric power tools that can be used in decontamination operations are:

- Drills - Used to drill out contaminated areas, to disassemble contaminated components and when used with grinding wheels or disks, may be used as an abrasive tool.
- Saws - used to separate contaminated pieces from clean pieces.
- Grinders - used to grind fixed contamination from surfaces.
- Electric Screwdrivers - used in the disassembly of component parts.

5.4.3.10.2 Some of the air-powered tools that can be used in decontamination operations are:

- Needle Gun - a pneumatic tool which can remove contamination from concrete and/or steel surfaces.

- Socket tools or impact hammer - used in disassembly of component parts.
- Jackhammer / Roto-hammer - a pneumatic tool for removing contamination from concrete and/or steel surfaces.

5.4.3.10.3 Power tool decontamination shall be performed in the following manner:

- Remove as much loose surface contamination as possible as indicated in Section 5.4.3.8 of this procedure.
- Moisten the surface of the item lightly to contain contamination. Use a spray bottle for moistening. **DO NOT USE ELECTRIC POWER TOOLS ON A WET WORKING SURFACE. KEEP LIQUIDS AWAY FROM ELECTRIC POWER TOOLS.**
- Whenever feasible the use of containment devices (e.g. glove box, etc.) should be used to contain the spread of contamination when using power tools for decontamination operations.
- Use the power tool to remove fixed contamination. Clean in one direction **ONLY** and clean **AWAY** from the body to prevent personnel contamination.
- Re-survey.

5.5 Post Decontamination

5.5.1 If the decontamination was successful, the Junior Health Physics/Decontamination Technician shall notify the Health Physics Technician who shall perform a free release survey in accordance with 400-CP-403, *Release of Material from Controlled Areas*.

5.5.1.1 If the item satisfies the criteria for release, remove the item to a holding area for disposal and document results as 400-CP-404, *Control of Radioactive Material*.

5.5.1.2 If the item remains contaminated, attempt a second decontamination, then perform 5.5.1.1.

5.5.1.3 If the item remains contaminated, attempt a third decontamination **ONLY** by direction of the Project Manager.

- 5.5.2** If an item cannot be effectively or economically decontaminated, the Project Manager shall direct the USRS work crew to volume-reduce (reduce to component parts) the equipment, material, or tools as much as possible. The individual parts can be surveyed and released in accordance with Section 5.5.1.
- 5.5.3** If an item is volume-reduced to its component parts and decontamination is not feasible, the item parts shall be considered radiological waste. Radiological waste is to be segregated into similar materials for shipment purposes by the direction of the Project Manager. The Health Physics Supervisor shall direct the segregation of radiological waste into the following categories:
- Steel, hard metals
 - Wood
 - Transite, fiber products
 - Paper
 - Rubber
 - Cloth (duct tape is considered a cloth)
 - Aluminum, soft metals (brass)
 - Glass
 - Concrete
 - Questionable items (e.g. light bulbs, pipe with lead solder, electronic component parts) which could be considered mixed or hazardous waste
 - Other categories, if applicable
- 5.5.4** After all decontamination operations have been completed a Health Physics Technician shall perform a release survey of the decontamination area and de-post the area in accordance with 400-CP-409, *Radiological Posting and Access Control* and 400-CP- 403, *Release of Material from Controlled Areas*.

6.0 RECORDS

The following records are generated by use of this procedure. These records will be maintained in the permanent project file.

- 6.1** USRS-001 – Radiological Survey Report
- 6.2** USRS-005 – Material Release Log
- 6.3** USRS-006 – Smear Counting Analysis Report
- 6.4** HP Daily Log
- 6.5** USRS-003 – Daily Instrument Performance Test Log
- 6.6** USRS-010 – Unconditional Release of Equipment or Items Report

7.0 FORMS

- 7.1** USRS-003 – Daily Instrument Performance Test Log
- 7.2** USRS-006 – Smear Counting Analysis Report
- 7.3** USRS-001 – Radiological Survey Report
- 7.4** USRS-005 – Material Release Log
- 7.5** USRS-010 – Unconditional Release of Equipment or Items Report



Field Operating Procedure

ALARA PROGRAM

700-AP-701

Revision 1

Approved By:



Victor Letourneaut
President

July 17, 2019
Date

Approved By:



Daryl DeLong
Radiation Safety Officer

June 10, 2019
Date

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1.0 PURPOSE

The purpose of this procedure is to implement As Low As Reasonably Achievable (ALARA) commitments. This procedure and subordinate operating procedures satisfy the requirements of DOE Order 5480.11 and are consistent with the ALARA principles and requirements in applicable NRC and California Regulations, including 10 CFR 20.

2.0 SCOPE

Maintaining radiation exposures ALARA based upon cost vs. benefit analysis in relation to strict compliance with the requirements of DOE Order 5480.11 the U.S. NRC Regulatory Guide 8.8 and California Radiation Control Regulations. This ALARA program applies to all Up-Side Radiological Survey, LLC (RSRS) personnel conducting field operations.

3.0 REFERENCES AND DEFINITIONS

3.1 References

3.1.1 DOE Order 5480.11, Radiation Protection for Occupational Workers

3.1.2 10 CFR 20, Standards for Protection Against Radiation

3.1.3 Respiratory Protection Program for USRS

3.1.4 USNRC Regulatory Guide 8.8, Information Relevant to Ensuring that Occupational Radiation Exposures Will Be As low As Reasonably Achievable

3.1.5 300-SP-301, Radiation and Contamination Surveys

3.1.6 400-CP-401, Issue and Use of Radiation Work Permits

3.1.7 400-CP-404, Control of Radioactive Material

3.2 Definitions

3.2.1 **As Low As Reasonably Achievable (ALARA)** – An approach to radiation protection to control or manage exposure (both individual and collective to the workforce and general public) as low as social, technical, economic, practical, and policy considerations permit. ALARA is not a dose limit, but a process which has the objective to ensure dose to all exposed people is as far below applicable limits as reasonably achievable.

3.2.2 **ALARA Goal** - Any radiation dose poses some risk, therefore goals are set to maintain individual and thereby, collective dose As Low As Reasonably Achievable to minimize that risk.

- 3.2.3 Benefit** - the total exposure savings of implementing an ALARA engineering objective. A comparative monetary value of \$5,000 per man-rem will be utilized for RSRS projects.
- 3.2.4 Chronic Exposure**- Small repeated doses received over a long period of time.
- 3.2.5 Acute Exposure** - A large dose received in a short period of time, i.e., less than one day.
- 3.2.6 Collective Dose** - The total cumulative dose for all personnel involved in a specific project recorded in man-Rem.
- 3.2.7 Cost** - The total monetary value of resources such as "labor and materials" to accomplish an ALARA engineering objective.
- 3.2.8 Dose Equivalent (H)** - The product of absorbed dose (D) in rads in tissue, a quality factor (Q), and other modifying factors (lv). Dose equivalent (H) is expressed in units of Rem (or Sievert). $DQN = H$
- 3.2.9 Collective Dose Equivalent (H₀)** – The sum over specified tissues of the products of the dose equivalent in a tissue (H_i) and the weighting factor (W_i) for that tissue, i.e., $H_0 = \sum H_i W_i$. The effective dose equivalent is expressed in units of Rem (or Sievert).
- 3.2.10 Radiation Work Permit (RWP)** – A document that provides guidelines for specifying protective radiological measures within the scope of work. The RWP also document existing radiological conditions, work scope and radiological limitations.

4.0 PREREQUISITES, PRECAUTIONS, AND LIMITATIONS

The ALARA program is measured with the benefit of reductions in individual and/or collective exposures to workers and/or the general public.

While ALARA has no limitation other than the derived benefit vs. actual cost, the application of ALARA techniques need individual consideration for the safety and comfort of the worker.

4.1 Shielding

- 4.1.1** Shielding composed of high density materials should be handled carefully. Injury may result from improper handling of heavy shielding material.
- 4.1.2** Shielding should be inspected frequently to ensure its original configuration is maintained and should be surveyed periodically.
- 4.1.3** Shielding should not impede work evolutions. The exposure saved by shielding may be spent by longer work periods.

- 4.1.4** Shielding should be installed based upon seismic considerations.
- 4.1.5** Lead is classified as a hazardous material due to its toxicity. Precautions for handling lead should be exercised during use.
- 4.1.6** Shielding should be evaluated for weight considerations. Shielding may damage or destroy equipment if load limits of supports are exceeded.
- 4.1.7** Shielding should be protected by plastic wrapping when used in loose contamination areas.
- 4.1.8** Radioactive sources should be stored in shielded containers and kept shielded at all other times practical during use.
- 4.1.9** Shielding should be evaluated for compatibility with the area in which it is to be used. For example, lead shot should not be used in areas where loose materials may cause damage to equipment.
- 4.1.10** Temporary shielding is particularly effective against small, localized hot spots and should be used when possible.
- 4.1.11** Consider the installation of permanent shielding. The estimated exposure for installing the shielding must be weighed against the expected exposure reduction.
- 4.1.12** Many different types of shielding are available for use. Consider the following:
- Lead blankets, bricks, sheets, matting, lead glass.
 - Water
 - Plastic and wood materials
 - Aluminum
 - Cement concrete blocks

4.2 Remote Handling Devices

- 4.2.1** Remote handling devices should only be used by personnel that are familiar with their operation. Loss of control of highly radioactive material may occur if handling devices are used improperly.
- 4.2.2** Remote handling devices should be inspected prior to use and periodically to ensure they are in good condition.
- 4.2.3** Care should be exercised to prevent cross contaminating handling devices.

- 4.2.4** Cranes used to remotely handle radioactive material shall be operated ONLY by qualified operators.

4.3 Temporary Confinements/Containments

- 4.3.1** Temporary confinements/containments used to limit the spread of contamination should be constructed of fireproof or fire retardant materials.
- 4.3.2** If the possibility of system leakage exists from inside of temporary confinements/containments, an appropriate drainage path to radioactive drain collecting systems should be installed. Use berms in areas where no drains are available.
- 4.3.3** Air quality in temporary confinements/containments should be evaluated frequently for habitability and levels of contaminants.
- 4.3.4** When ventilation systems are used with temporary confinements/containments, it is important to balance the supply and exhaust airflows to prevent damage to the confinement/containment.
- 4.3.5** Temporary confinements/containments used outside should be constructed to withstand adverse environmental conditions. It is particularly important to provide roof drainage in the event of rain.
- 4.3.6** Temporary confinements/containments should be constructed with clear plastic windows to allow outside personnel to view activities inside the confinement/containment. This is important in the event of an incapacitating injury to personnel inside the confinement/containment.

4.4 Worker Comfort

- 4.4.1** The comfort of the worker is extremely important to the ALARA philosophy. Job performance is directly proportional to the degree of comfort a worker feels.
- 4.4.2** Bubble hoods should be used instead of airline full-face respirators when possible.
- 4.4.3** The minimum amount of protective clothing required should be determined and only this amount should be used.
- 4.4.4** The time a worker wears a full-face respirator shall be limited according to the provisions of Reference 3.1.3. Frequent breaks and maximum total work periods should be observed.
- 4.4.5** Heat stress should be considered and monitored during work. Counter measures should be used to reduce this possibility (fluid intake, stay times, or ice vest, etc.).

- 4.4.6** Awkward working positions should be avoided when possible.
- 4.4.7** Unsafe conditions are a distraction to workers. Unsafe conditions should be removed/corrected from a work area.
- 4.4.8** Good lighting is essential to worker comfort. A brightly-lit work area is important to the psychological well being of a worker. A brightly lighted work area should be considered whenever possible.
- 4.4.9** Low dose areas should be designated in work areas where personnel may take rest breaks without removing protective clothing/equipment.
- 4.4.10** Methods to adjust humidity and temperature in the work area should be considered.
- 4.4.11** It is comforting to workers to know they are being watched and help is immediately available in the event of an emergency. An outside person(s) shall ALWAYS be available to assist workers inside radiologically significant (high radiation, high contamination, airborne, confined spaces, etc.) areas.

4.5 Communications

- 4.5.1** Headphones and microphone systems should be considered.
- 4.5.2** Hand signals should be understood by all personnel before starting work.
- 4.5.3** A pre-planned reliable communication system shall be employed. Poor communication results in more exposure.
- 4.5.4** A reliable two-way communication system shall be required when personnel are working in areas where:
- Time keeping is in effect.
 - General area exposure rates require constant communication.
 - Line of sight cannot be maintained in confined spaces.
 - Frequent monitoring is required.
 - Communication is required to meet an ALARA commitment.

4.6 Decontamination

- 4.6.1** Consider decontaminating the work area, or equipment prior to the commencement of work. In addition to exposure reduction due to the removal of the contamination, decontamination may allow work crews to forego protective

clothing and/or respirators thereby increasing their productivity and reducing their exposure.

- 4.6.2** The estimated exposure for decontamination tasks shall be weighed against the expected exposure savings.

4.7 Removal of Sources or Relocation of Work

- 4.7.1** Consider flushing systems, piping, tanks, valves, etc. prior to commencement of work. Consider removing unused equipment in the work area, if equipment is a radiation source. Consider storage of radiological sources in another area.

- 4.7.2** Consider moving the equipment that is to be worked on to an area with lower radiation levels.

4.8 Improve Access

- 4.8.1** Consider the improvement of access to work areas by the installation of scaffolding, removal of Interferences, establishing different access control points.

- 4.8.2** Care should be exercised in the location of control points. Personnel should not be required to remain in a radiation area while awaiting their turn at the step-off-pad.

4.9 Special Tools and Fixtures

- 4.9.1** Consider obtaining or fabricating and using special tools or fixtures:

- Tools, such as a long handled retriever can significantly reduce dose.
- Fixtures, such as a temporary confinement/containment with forced ventilation through HEPA filters should be considered for contamination control when applicable.

4.10 Mock-Up Exercises

- 4.10.1** Consider mock-ups or dry runs to make certain each individual is familiar with their roll in the operation. Mock-up exercises can also help identify problems and solutions with little or no exposure.

5.0 RESPONSIBILITIES

5.1 The USRS Radiological Field Operations Manager (Project Manager) shall be responsible for:

5.1.1 Implementation of this procedure.

5.1.2 Periodic reviews of adherence to the requirements of this procedure.

5.1.3 Promoting the ALARA philosophy.

5.1.4 While maintaining ALARA principles, shall ensure the use of respiratory protection will be reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactivity at the source.

5.1.5 Implementing ALARA through RWPs in full compliance with the USRS ALARA Program including all goals and procedures.

5.2 The Health Physics Supervisor shall be responsible for:

5.2.1 Reviewing work environments, procedures, and equipment to maintain work crew exposure consistent with the USRS ALARA Program goals, procedures, and with applicable RWPs.

5.2.2 Actively promoting the ALARA philosophy by establishing high standards for the performance of radiological controls. These standards and management expectations should be frequently communicated to the work force.

5.2.3 While maintaining ALARA principles, ensure the use of respiratory protection is reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactivity at the source.

5.2.4 Monitoring subordinate's year-to-date radiation exposures.

5.2.5 Establishing working conditions that encourage improved radiological controls. This includes temperature, humidity, and lighting as well as the more difficult consideration of accessibility. Work conditions should be considered in planning work.

5.3 RSRS Personnel shall be responsible to:

5.3.1 Review work environments, procedures, and equipment to maintain work crew exposure consistent with the USRS ALARA Program goals, procedures, and with applicable RWPs.

5.3.2 Maintain their own exposures ALARA consistent with the USRS ALARA program, goals, procedures, and with the applicable RWPs.

- 5.3.3** Make suggestions to improve the ALARA program.
- 5.3.4** Follow all procedures and work instructions.
- 5.3.5** Attend and participate in ALARA briefings.
- 5.3.6** Obey promptly "stop work" and "evacuate" instructions of Health Physics.
- 5.3.7** Keep track of his/her individual radiation dose and avoid exceeding dose control levels and limits.
- 5.3.8** Wear dosimetry as required by procedures, RWPs, or Health Physics instructions.
- 5.3.9** Remain in as low a dose rate area as practical to accomplish work.
- 5.3.10** Leave radiation areas or airborne radioactivity areas when not working, and use "low dose waiting areas" when designated.
- 5.3.11** NO SMOKING, EATING, DRINKING OR CHEWING in controlled areas, or bring open containers of smoking, eating, drinking, or chewing materials into controlled areas.
- 5.3.12** Wear protective clothing and respirators whenever required by signs, RWPs, Health Physics personnel, procedures and instructions.
- 5.3.13** Remove protective clothing and respirators properly to minimize the spread of contamination.
- 5.3.14** Minimize the spread of a known or possible radioactive/hazardous materials spill and notify Health Physics promptly.
- 5.3.15** Avoid unnecessary contact with contaminated surfaces.
- 5.3.16** Limit the amount of material requiring decontamination or disposal as radioactive waste.
- 5.3.17** Place contaminated tools, equipment, and solid waste on disposable surfaces (for example, sheet plastic) when not in use and inside plastic bags when work is finished.
- 5.3.18** Control the amount of materials brought into radiologically controlled areas to minimize radioactive waste.
- 5.3.19** Report unsafe or non-compliance situations promptly.

- 5.3.20** Report the presence of treated or open wounds to Health Physics before work in areas where radioactive/hazardous contamination exists, and exit immediately if a wound occurs while in such an area.
- 5.3.21** Report prior or concurrent occupational radiation exposure.
- 5.3.22** Report known or suspected pregnancy to Health Physics promptly.

6.0 ALARA PROCEDURE

Considerations provided in Section 6.1 insure that when dealing with possible radiation exposure to personnel the review of these considerations play a major roll in preparing all individuals in the practices of ALARA. ALARA considerations, once approved, become requirements of the RWP.

6.1 ALARA Considerations

6.1.1 An ALARA Considerations Form (USRS-024) shall be completed by the Health Physics Planner/Supervisor or ALARA designee for every job specific RWP where the following conditions are anticipated:

- High Radiation/Very High Radiation Area entry.
- A potential radiation exposure > 50 mrem individual whole body or > 500 mrem collective whole body exposure.
- High Contamination or Hot Particle controls.
- Use of temporary shielding.
- When required by another procedure.
- Respiratory protection usage or when measures are taken in lieu of respiratory protection, e.g. DAC hour tracking, glove bag, etc.

6.1.2 Extended RWPs shall have USRS-024 forms completed for specific tasks which qualify under Section 6.1.1.

6.1.3 The USRS-024 form shall be reviewed and approved in accordance with the following:

ESTIMATED WHOLE BODY DOSE		REQUIRED APPROVAL
INDIVIDUAL	COLLECTIVE	
> 50 mrem but < 500 mrem	> 500 mrem but < 5,000 mrem	Health Physics Supervisor
> 500 mrem but < 1,000 mrem	> 5,000 mrem but < 10,000 mrem	Health Physics Supervisor RSO/Project Manager
> 1,000 mrem	> 10,000 mrem	Health Physics Supervisor RSO/Project Manager USRS Health Physicist

6.1.4 The USRS-024 Form shall be attached to the RWP and become part of the RWP package.

6.1.5 The USRS-024 form shall be closed out by the Health Physics Supervisor/Planner or ALARA designee in conjunction with its' corresponding RWP or at the completion of a specific task for extended RWPs.

6.1.5.1 Enter the total post job dose estimate in Section HB of the RSRS-24 form. Designate where dose information is from; ie, RWP Access Log, TLD, etc

6.1.5.2 If the post job estimate exceeds the pre job estimate the ALARA designee or Health Physics Supervisor shall be notified.

6.1.5.3 The USRS-024 form shall be submitted with the RWP package and retained in the permanent project file.

6.2 ALARA Training

6.2.1 All USRS personnel involved in radiological related activities shall receive training in the ALARA principle and USRS's ALARA policies. This training shall be implemented on a job by job basis and documented on Form USRS-027 Training Record.

6.3 ALARA Pre-Job Planning

6.3.1 ALARA pre job planning should be included in the initiation of the work plan and RWPs where the possibility of meeting Section 6. 1.1 specifications is anticipated. The intent of ALARA Pre-Job planning is to provide an objective view of the proposed activity that may not be readily apparent to the author. ALARA Pre-Job planning should consider the following:

- A specific description of the job (including location).
- The original dose equivalent estimate for completing the job.
- Resources required (equipment, supplies and personnel).
- Radiological conditions.
- Identify persons performing work.
- Job assignments.
- Training requirements, mock-up, dry run.
- Time required to complete the job.
- Consideration of exposure reduction techniques.

- Consideration of the RWP requirements.
- Any special or unusual hazards.
- Current radiation effective dose equivalent (available status).
- Other qualifications (Example-current respirator use, medical, etc.).

6.4 Pre-Job Briefing

6.4.1 The Pre job briefing shall attempt to insure that all individuals involved in a specific task are working toward a common goal and are aware of radiological conditions and methods of minimizing exposure.

6.5 Post Job Review

6.5.1 The ALARA Coordinator/Health Physics Supervisor or designee should conduct a debriefing meeting upon conclusion of jobs involving collective dose equivalent of greater than 100-person mrem. Debriefings should include the following:

6.5.1.1 Identification of any problems encountered and the resolution of the problem.

6.5.1.2 Suggestions for improving the future performance of similar tasks, including techniques for further reducing exposures.

6.5.1.3 Comparison of the actual dose equivalent to the estimated dose equivalent.

6.6 ALARA Reports

6.6.1 The ALARA reports and associated forms should be completed in accordance with the provisions of this procedure.

7.0 RECORDS

The following records are completed by this procedure and shall be maintained as specified in procedure RSRS 100-AP-103, Radiological Records.

7.1.1 USRS-024, ALARA Considerations Form

7.1.2 USRS-025, Pre-Job Briefing Checklist (IH/Safety)

7.1.3 USRS-026, Pre-Job Briefing Checklist (Health Physics)

7.1.4 USRS-027, Training Record