Radiation Protection Plan
Final

Balance of Plant Operable Unit Field Investigation
Niagara Falls Storage Site
Lewiston, New York

Contract No. W912QR-12-D-0023

Delivery Order No. DN01

Prepared by:
URS Group, Inc.

[redacted]

For:
U.S. Army Corps of Engineers (USACE)
Buffalo District
Buffalo, New York

US Army Corps of Engineers®
Buffalo District

November 2012

Radiation Protection Plan

Balance of Plant Operable Unit Field Investigation
Lewiston, New York

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Authored By: [redacted] 13 December 2012
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Date

Approved By: [redacted] 13 December 2012
[redacted], Project Manager
Date

Concurrence By: [redacted] 13 December 2012
[redacted] CIH, Regional Safety and Health Officer
Date

[X] New Plan

[ ] Title Change

[ ] Plan Revision

[ ] Plan Rewrite

Effective Date 2 November 2012

CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW

COMPLETION OF INDEPENDENT TECHNICAL REVIEW

URS Group, Inc. (URS) has completed the *Niagara Falls Storage Site Accident Prevention Plan* for the Niagara Falls Storage Site Balance of Plant Operable Unit Field Investigation, Lewiston, New York. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with existing USACE policy.

[redacted] 13 December 2012

Signature/URS Report Preparer – [redacted] Date

[redacted] 1 November 2012

Signature/URS Independent Technical Reviewer – [redacted] Date

Independent Technical Review Team Members: [redacted]

CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows:

Item	Technical Concerns	Possible Impact	Resolutions
	None		

As noted above, all concerns resulting from independent technical review of the plan have been resolved.

[redacted]

Signature/URS Principal – [redacted] Date

Radiation Protection Plan (RPP)

Niagara Falls Storage Site FUSRAP Site

Plan Approvals

[redacted] _____ 1 Nov-2012
Date

[redacted]
Certified Health Physicist

[redacted] _____ 1-Nov-2012
Date

[redacted]
Site Radiation Safety Officer

Table of Contents

List of Tables

List of Appendices

1.0 PURPOSE AND SCOPE

This Radiation Protection Plan (RPP) was prepared to implement the URS -Safety Management Standard 052, (SMS-052) "Radiation Protection Program," at the Niagara Falls Storage Site (NFSS) Formerly Utilized Sites Remedial Action Program (FUSRAP) Site. This plan provides detail on the work practices necessary to fully implement SMS-052:

- Activities at the project site where the potential for exposure to ionizing radiation exists are conducted in a manner consistent with sound radiological practices,
- Radiological exposure to site personnel and the environment are maintained As Low as Reasonably Achievable (ALARA), and
- Activities at this site are performed in a manner consistent with applicable NFSS FUSRAP site requirements, local, state, and federal regulations.

2.0 APPLICABILITY

The work practices specified in this RPP apply to work conducted by site personnel that may result in the exposure of employees to ionizing radiation. All site visitors and employees, working in a radiation area or a restricted area are responsible for following this RPP. The Project Manager (PM) and the Site Radiation Safety Officer (SRSO) are responsible for ensuring that the RPP is implemented at the NFSS FUSRAP Site.

Implementation of this RPP will be performed through implementation of the Accident Prevention Plan (APP), Environmental Health and Safety Plans (HASP), and associated standard operating procedures.

3.0 GENERAL

3.1 References

- URS Safety Management Standard -052 Radiation Protection Program
- DOT 49 CFR 171-177, Transportation – Hazardous Materials Regulations
- NRC 10 CFR 20, Standards for Protection Against Radiation
- OSHA 29 CFR 1910.1096, Ionizing Radiation
- OSHA 29 CFR 1926.53, Ionizing Radiation
- NRC Regulatory Guide 8.25
- URS Safety Management Standard -042 Respirator Protection
- US Army Corps of Engineers EM 385-1-80, Radiation Protection Manual
- US Army Corps of Engineers EM 385-1-1, Safety and Health Requirements
- US Army Corps of Engineers ER 385-1-80, Ionizing Radiation Protection ER 385-1-80, Ionizing Radiation Protection

3.2 Definitions

Airborne Radioactivity Area – Area where the measured concentration of airborne radioactivity above natural background exceeds a peak concentration of 1 derived air concentration (DAC) or 12 DAC-hours during a workweek.

As Low As Reasonably Achievable (ALARA) – An approach to radiological control or a process to manage and control exposures to the work force and to the general public at levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations.

Bioassay – Measurement of radioactive material deposited within or excreted from the body. This process may include whole body and organ counting as well as collection of urine and fecal samples.

Contaminated Area – An area in which radioactive contamination is present that exceeds removable levels presented in Table 3.

Controlled Area – An area in which access is controlled in order to protect personnel from exposure to radiation and radioactive materials. An area in which the existing or potential radiation and radioactivity levels are above normal background but are less than that designating a radiological area or a restricted area.

Derived Air Concentration (DAC) – The concentration of a radionuclide in air that, if breathed over the period of a work year, would result in the annual limit on intake being reached.

Disintegration per Minute (dpm) – The rate of emission by radioactive material as determined by correcting the counts per minute observed by a detector for background, efficiency, and window size associated with the instrument.

Dose – A generic term for the amount of energy deposited in body tissue due to radiation exposure. Technical definitions for dose terms necessary for various exposure calculations and recordkeeping purposes include the following:

> **Absorbed Dose (D)** – Energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. The units of absorbed dose are the rad and the gray (Gy).
>
> **Dose Equivalent (HT)** – The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).
>
> **Effective Dose Equivalent (HE)** – The sum of the products of the dose equivalent to the organ or tissue (HT) and the weighting factors (WT) applicable to each of the body organs or tissues that are irradiated (HE= SWTxHT).
>
> **Committed Dose Equivalent (HT,50)** – The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by a person during the 50-year period following the intake.
>
> **Committed Effective Dose Equivalent (HE,50)** – The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues (HE,50=SWTxHT,50).

Total Effective Dose Equivalent (TEDE) – The sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Total Organ Dose Equivalent (TODE) – The sum of the deep dose equivalent (for external exposures) and the committed dose equivalent to an individual organ or tissue (for internal exposures).

Fixed Contamination – Radioactive material that cannot readily be removed from surfaces by nondestructive means such as causal contact, wiping, brushing, or washing.

Frisking – Process of monitoring personnel for contamination.

Hazardous Work Permit (HWP) – Permit that identifies hazardous conditions and health and safety hazards, establishes worker protection and monitoring requirements, and also contains specific approvals for radiological work activities. The HWP serves as an administrative process for planning and controlling both hazardous and radiological work.

High Radiation Area – An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent to or in excess of 100 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Internal Dose – The portion of the dose equivalent received from radioactive material taken into the body.

Occupational Dose – The dose received by a person during employment in which the person's assigned duties involve exposure to radiation and to radioactive material. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research plans, or as a member of the public.

Optically Stimulated Luminescence Dosimeter (OSL) – Radiation detection and measuring device used to record the radiological exposure of personnel or area to certain types of radiation.

Personnel Dosimetry – Devices designed to be worn by a single person for the assessment of dose equivalent such as film badges, optically stimulated luminescence dosimeter, and pocket ionization chambers.

Personnel Monitoring – Systematic and periodic estimates of radiation dose received by personnel during work hours.

Radiation Work Permit (RWP) – Permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The RWP serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological, health and safety issues.

Radioactive Material Area – A controlled area or structure where radioactive material is used, handled, or stored.

Radiation – Ionizing radiation that includes alpha particles, beta particles, X-rays, gamma rays, neutrons, and other particles capable of producing ions.

Radiation Area – An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent or in excess of 5 mrem in 1 hour at 30 cm from the source of radiation or from any surface that the radiation penetrates.

Radiological Controlled Areas (RCA) – Include Radiation Areas, Contamination Areas, or Airborne Radioactivity Areas.

Radiological Worker – Worker whose job assignment requires work on, with, or in the proximity of radiation production machines or radioactive materials. A radiological worker has the potential of being exposed to more than 100 mrem per year, which is the sum of the dose equivalent to external irradiation and the committed effective dose equivalent to internal irradiation.

Removable Contamination – Radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.

Survey – An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other source of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Unrestricted Area – An area designated by the Nuclear Regulatory Commission (NRC) as being an area to which access is neither limited nor controlled by an NRC licensee.

3.3 Responsibilities

3.3.1 Project Manager-[redacted]

The PM is responsible for:

- Reviewing each scope of work to identify potential radiation risks and hazards.
- Designating an SRSO and arranging for employees on the project to receive appropriate radiation safety training.
- Ensuring that employees working on the project are monitored for radiation exposures.
- Assessing and controlling risks to employee and public health and safety from site activities.

The PM will ensure that all employees are knowledgeable of applicable radiological safety requirements for their work area and compliance with these requirements. PMs emphasize the need for high standards for radiological control through direct communication, support of radiation control goals and a presence in the workplace.

3.3.2 Project Certified Health Physicist [redacted]

The Project Certified Health Physicist (CHP) is responsible for:

- Reviewing and approving the RPP.
- Reviewing and approving implementing radiation procedures.
- Conducting appropriate radiation safety training for employees.
- Reviewing dose calculations.

3.3.3 Site Radiation Safety Officer – [redacted]

The SRSO is responsible for:

- Coordinating implementation of the Radiation Protection Program.
- Developing and administering the RPP incorporated in the HASP and associated standard operating procedures.
- Evaluating potential site/employee radiation exposure.
- Recommending necessary workplace and administrative controls.
- Issuing RWPs/HWPs.
- Administering personnel monitoring program.
- Arranging for each individual's monitoring results to be sent to the individuals and employers as appropriate.

3.3.4 Radiation Technicians

Radiation Technicians are responsible for assisting the SRSO in implementing the radiological controls on each site. Specific responsibilities include:

- Performing radiological surveys.
- Collecting samples and smears.
- In conjunction with the SRSO, assessing radiological hazards during work changes and making adjustments to ensure that worker radiological exposures and releases to the environment are maintained ALARA.

The SRSO will review the qualifications of Radiation Technicians to ensure that the level of expertise is commensurate with the assigned duties.

3.3.5 Employees

Employees are responsible for knowing radiological protection requirements for their work areas and for complying with these requirements.

4.0 ALARA

4.1 Policy Statement

All work with ionizing radiation will be conducted in accordance with established good practices in radiation protection, and in all cases, incorporate radiological criteria to ensure safety and maintain radiation exposures ALARA. The primary method to maintain exposure ALARA will focus on the use of established work practices and facility and equipment design features. These features will be augmented with the use of administrative and procedural requirements. In most cases, decontamination operations represent an uncommon activity.

4.2 Administrative Implementation Procedures

The following minimum steps will be implemented on all sites aimed at maintaining radiation exposures ALARA.

- Estimate radiation exposure and use the estimate to set project ALARA dose goals.
- Review actual radiation exposures and compare with projected dose values. If necessary, make adjustments to the administrative and engineering control in place.

Commensurate with the nature of the work being performed and radiation levels present, the following additional measures will be considered:

- Inclusion of radiation control hold points in work documents;
- Work processes and special tools to reduce exposures;
- Engineering controls to minimize the spread of activity;
- Special radiological training or monitoring requirements;
- Engineering, design, and use of temporary shielding;
- Walkdown or dry-run of the activity using applicable procedures; and
- Staging and preparation of necessary materials/special tools.

4.3 ALARA Committee

An ALARA Committee will be formed and will be minimally comprised of the SRSO, the PM, and one representative of the site labor force. The ALARA Committee will meet periodically (at least once each quarter) and will review past site radiation data, or personnel exposures, air monitoring, effluent monitoring, and contamination level data to assess the presence of unacceptable trends. Due to the schedule for this project, the Committee will meet at once. Additionally, this Committee will periodically assess the success of the radiological controls and serve as a forum for recommendations for improvements. A written record of the Committees activities will be maintained.

5.0 EXPOSURE LIMITS

5.1 Administrative Goals

Administrative goals for radiological protection performance will be established. These limits are more conservative than regulatory limits, commensurate with the work plan and level of hazard, and in accordance with the ALARA principle. The annual radiological goals include (not to exceed):

- Maximum individual total effective dose equivalent – 500 mrem;
- Maximum embryo/fetus total organ dose equivalent for a declared pregnancy – 100 mrem; and
- Maximum total effective dose equivalent to a member of the public, or visitor (excluding radon and thoron) – 100 mrem.

5.2 Occupational Exposure Limits

The occupational exposure to employees performing the duties of radiation workers will be controlled so that the limits in Table 1 (below) are not exceeded in one year. Furthermore, measures will be taken to maintain doses as far below these limits as reasonable achievable through use of administrative goals, engineering controls, and application of the ALARA process. All of the occupational exposure received during the year, including exposure while employed elsewhere, will be included in the determination of occupational exposure. Radiation exposure from normal background, therapeutic and diagnostic medical radiation, and voluntary participation in medical research plans will not be included in determining occupational exposure. Planned special exposures will not be required.

Table 1. Occupational Dose Limits

	ALARA Limit		10 CFR 20 Limit	
Category	**mrem/yr**	**mSv/yr**	**mrem/yr**	**mSv/yr**
Total Effective Dose[1]	500	5	5,000	50
Total Organ Dose Equivalent	5,000	50	50,000	500
Lens of Eye	1,500	15	15,000	150
Shallow Dose	5,000	50	50,000	500
Embryo/Fetus	100/gestation	1/gestation	500/gestation	5/gestation
Minor	N/A	N/A	500	5
General Public	100	1	100	1

[1] In addition to the annual dose limits, soluble uranium intake will be limited to 10 milligrams in a week in consideration of chemical toxicity.

5.3 Embryo/Fetus Exposure Limits

The occupational dose equivalent limits applicable to the embryo/fetus are detailed in Table 1, and apply to a "declared pregnancy." In such a case, a woman may elect to declare the pregnancy and limit the dose received by the embryo/fetus as provided in regulatory requirements. In this case, the dose equivalent goal for the embryo/fetus, from the period of conception to birth from occupational exposure, will be no more than 100 mrem.

Efforts shall be made to maintain exposures ALARA and to avoid significant variations above a uniform monthly exposure during the pregnancy. If the dose equivalent has exceeded 500 mrem at the time the pregnancy is declared, steps shall be taken to ensure that additional occupational exposure is unlikely. SMS Attachment 52-4, Declaration of Pregnancy Form, will be used to document this decision. SMS Attachment 52-5, Embryo/Fetus Initial Dose Calculation, will be used to assess the radiation exposure to the embryo/fetus at the time of declaration. SMS Attachment 52-6, Withdrawal of Pregnancy Declaration, will be used to withdraw a pregnancy declaration.

5.4 Minor Exposure Limits

URS policy is that no worker under 18 years of age will be allowed to work on site where there is the potential for exposure to radiation.

5.5 Members of the Public Exposure Limits

The annual exposure limit for any member of the public shall be limited to 100 mrem total effective dose equivalent, regardless of whether the individual is inside or outside of a controlled area. The dose equivalent in any unrestricted area from external sources will not exceed 2 mrem in any one hour or 50 mrem per year, regardless of occupancy by a member of the public.

5.6 Air and Liquid Effluents

The release of radioactivity in air or liquid effluents to unrestricted areas will be monitored and controlled in accordance with the requirements of 10 CFR 20.1302. Projects that are subject to state or local regulatory requirements will comply with the effluent limitations in those requirements. For projects at low-hazard sites, workplace monitoring and/or conservative modeling can be used to determine compliance with effluent limitations. Records of air monitoring, radioactive effluent monitoring, and/or modeling will be generated and maintained to demonstrate compliance with effluent limitation requirements.

6.0 CONDUCT OF RADIOLOGICAL WORK

6.1 Planning

Incorporating radiological protection requirements such as engineering controls and dose and contamination reduction considerations are key to the successful execution of work activities in areas where there is a potential for exposure to radiation or radioactive materials. Reviewing and incorporating such controls and considerations will be made on a site-by-site basis and will be commensurate with the quantity and type of radioactive materials present. Appropriate requirements will be documented in applicable work plans and procedures.

Projected radiation dose (internal and external) estimates will be made for all jobs involving potential exposure to radiation or radioactive materials. The complexity of these exposure estimates will be commensurate with the levels of radiation and radioactive materials present and the types of activities involved. Documentation of these exposure estimates will be placed in the project file.

Trigger levels for the development and execution of ALARA reviews will be adopted on a site-specific basis and documented. At a minimum, ALARA reviews will be conducted any time projected individual dose exceeds 200 mrem, or collective dose estimates exceed 2,000 person-mrem.

6.2 Work Permits

URS uses a Radiation work permit (RWP) process to detail specific requirements for work activities, as defined in SMS 052. RWPs (see SMS Attachment 52-2) will be used to inform workers of area radiological conditions and entry requirements, and to provide a mechanism to relate worker exposure to specific work activities. They will be used at all sites that have a potential for exposure to radiation or radioactive materials. If appropriate, radiological

requirements will be combined with other, non-radiological requirements, onto a single HWP (see SMS Attachment 52-3). Implementation of a work permit plan will have the following minimum requirements:

- RWPs/HWPs will be written based on radiological survey data that are appropriate to characterize the expected work conditions.
- RWPs/HWPs will detail the work area and activity that are within their scope and will specify requirements for protective measures, including dosimetry, air sampling, PPE, respiratory protection, work area preparation, and health physics oversight.
- RWPs/HWPs will be reviewed and approved by the SRSO. Modifications to existing RWPs/HWPs will require the concurrence of the SRSO or designee.
- RWPs/HWPs will be posted in a conspicuous area (if possible, they will be posted at the access point to the applicable radiological work area).
- Workers will acknowledge by signature that they have read, understand, and will comply with the RWPs/HWPs prior to initial entry to the area and after any revisions to the RWPs/HWPs.
- RWPs/HWPs will be updated if radiological conditions change to the extent that protective requirements need modification.

6.3 Control Zones

6.3.1 Access/Egress Procedures

Only appropriately trained, authorized, and qualified personnel will be permitted access to radiological controlled areas. The degree of control will be commensurate with the existing and potential radiological hazards within the area and may include, for example, signs and barricades, entrance ways locked against ingress, control devices or alarms, or administrative controls. The establishment of High or Very High Radiation Areas is not anticipated for this project; however, additional access control measures for High and Very High Radiation Areas will be established in accordance with 10 CFR 20, as appropriate. The controls will be established so that rapid egress from the controlled area in an emergency is not prevented.

Control measures and established procedures will incorporate a RWP/HWP system to ensure appropriate planning, control, hazard communication, and documentation of work activities in Radiological Controlled Areas (RCA) that include Radiation Areas, Contamination Areas, or Airborne Radioactivity Areas. Task-specific RWP/HWP s will be used for short-term work in these RCAs with the potential for changing radiological conditions. General RWP/HWP's may be used for longer term activities in RCAs with known, stable radiological conditions.

Personnel frisking and/or monitoring will be conducted before exiting radiologically contaminated areas and other areas where contamination is suspected. If the instruments indicate greater than 100 cpm above background, a Radiation Technician will be contacted for decontamination of personnel.

6.3.2 Posting and Labeling

The standard radiation symbol (ANSI N2.1/12.1) in magenta or black on a yellow background (or alternate as provided by regulations) will be used to warn individuals of the presence of radiation and/or radioactive material. Each access point to a controlled or restricted area will be

posted with the appropriate identification and instructions. For controlled or restricted areas, each area will be posted as detailed in Table 2 below.

Table 2. Posting Requirements

Posting Sign	Definition
Caution Radiation Area	5 mrem in 1 hour at 30 cm
Caution-High Radiation Area or Danger High Radiation Area	100 mrem in 1 hr at 30 cm
Grave Danger-Very High Radiation Area	500 rads in 1 hr at 1 m
Caution Contaminated Area	Removable radioactive contamination in excess of Table 3 values
Caution Airborne Radioactivity Area or Danger Airborne Radioactivity Area	>1 DAC or 12 DAC hours/week
Caution, Radioactive Material or Danger Radioactive Material	Radioactive material handled, used or stored

Additionally, NRC Form 3, "Notices to Employees," will be posted in a location visible to all employees who work with or around radioactive materials.

7.0 MONITORING

7.1 Personnel Monitoring

7.1.1 Internal Dosimetry

All personnel who have the potential to receive intakes of radioactive materials that may result in a committed effective dose equivalent (HE, 50) of 500 mrem will participate in an appropriate bioassay plan. This plan will be reviewed and approved by a qualified Health Physicist and will be capable of detecting internal radioactive materials at a level below 10% of the Annual Limit of Intake listed in Appendix B of 10 CFR 20 for each radionuclide for which exposure at this level is likely.

Prior to commencement of work in restricted or controlled areas with the potential for internal exposure in excess of the levels stated above, each radiation worker will have an appropriate baseline bioassay performed. These individuals will also have an appropriate exit bioassay performed when they leave the project.

All personnel who perform routine field activities where the potential for removable surface or airborne radioactive contamination exists will participate in an appropriate routine bioassay plan. Special follow-up bioassay procedures will be implemented whenever a suspected intake has occurred or routine bioassay results are above a derived investigation level.

7.1.2 External Dosimetry

Monitoring applies to any individual likely to receive an annual external whole body exposure in excess of 10% of the occupational limit. All personnel dosimetry used will be processed and evaluated by a processor holding a current accreditation under the National Voluntary

Laboratory Accreditation Plan (NVLAP) of the National Institute of Standards and Technology (NIST).

7.1.3 Summation of Internal and External Exposures

Internal committed effective dose equivalents and external effective dose equivalents during the year will be combined to determine the annual total effective dose equivalent in accordance with the requirements of federal and state regulations. Generally, summation will be required when intakes exceed 10% of the annual limit on intake, may result in a total effective dose equivalent of 50 mrem for minors or visitors, or a dose equivalent of 50 mrem to the embryo/fetus for declared pregnant women. The deep dose equivalent to the whole body may be used as the effective dose equivalent for external exposures.

7.1.4 Medical Surveillance

No specific medical surveillance requirements exist for exposure to radiation levels at occupational levels. General medical surveillance requirements for all hazardous waste sites are contained in each HASP.

All cases of overexposure and suspected ingestion or inhalation of radioactive materials must be reported to the SRSO immediately. The URS Medical Consultant will advise the SRSO on the type(s) of test(s) required to accurately assess exposure effects.

7.2 Workplace Monitoring

7.2.1 Surveys

Radiological monitoring and surveys of radiation exposure levels, contamination, and airborne radioactivity will be conducted to:

- Characterize workplace conditions and detect changes in those conditions;
- Verify the effectiveness of physical design features, engineering and process controls, and administrative control procedures;
- Demonstrate regulatory compliance;
- Detect the gradual buildup of radioactive material;
- Identify and control potential sources of personnel exposure; and
- Identify areas requiring postings.

Monitoring will be performed only by trained and qualified personnel, following RP 4.0 Radiation Surveys and RP 5.0 Smear Counter Setup and Operation. Monitoring will be conducted as specified in the HASP and associated RWPs.

Minimally, radiological surveys will be conducted:

- During the establishment of controlled areas;
- Weekly in active controlled areas, radiation and/or contamination areas;
- Monthly, or upon access in inactive controlled areas;

- As specified on RWPs/HWPs; and
- During the release of controlled areas.

7.2.2 Air Sampling

General area and personal air sampling will be conducted in accordance with the guidance in NRC Regulatory Guide 8.25. Air sampling will be employed when necessary to determine whether confinement of radioactive material is effective, to determine workplace administrative controls required, estimate worker intakes, and determine what personal protective equipment (PPE) is appropriate.

General area air sampling for airborne radioactivity will be conducted with high-volume air samplers where the potential for airborne radioactivity is above background levels. High-volume air samplers are those with sufficient flow rate to achieve a minimum detectable activity (MDA) of 10% of the applicable DAC in an 8-hour shift. For small jobs with documented minimal airborne radioactivity potential, general area air sampling for airborne radioactivity will not be required. Air samples will be analyzed in accordance with written procedures. In areas with a potential for short-term airborne excursions, representative grab samples will be collected in the immediate vicinity of work being performed to determine whether the area is an airborne radioactivity area requiring additional work controls and if personal breathing-zone air sampling is necessary to assess the worker's intake of airborne radioactive materials. As with the protocol for personal sampling, high-volume sample results will be compared with the appropriate DAC.

When required to estimate worker intakes, representative personal air sampling from each field team working in radiologically contaminated areas will be conducted for airborne radioactivity in the breathing zone. The data will be compared with the DACs that are appropriate for the contaminant(s) expected to be present to gauge employee exposure potential. DACs for radioactive contaminants in Appendix B to 10 CFR 20 will be used to assess exposure potentials, as appropriate.

7.3 Release of Materials from Contamination Areas

Radiological contamination survey, documentation, and labeling requirements will be established for all property/material released from an RCA. All equipment, materials, and property used in an RCA established for contamination control will be considered as potentially contaminated and will not be released to an uncontrolled or unrestricted area until they have been surveyed and meet the unconditional release limits listed in Table 3 below, or approved alternative site-specific requirements.

Table 3. Surface Radioactivity Release Limits

Acceptable Surface Contamination Levels			
Nuclide[a]	**Average[b,c]**	**Maximum[b,d]**	**Removable[b,e]**
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Tranuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2

Table 3. Surface Radioactivity Release Limits

Acceptable Surface Contamination Levels			
Nuclide[a]	**Average[b,c]**	**Maximum[b,d]**	**Removable[b,e]**
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm β-γ/100 cm^2	15,000 dpm β-γ/100 cm^2	1,000 dpm β-γ/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this tape, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

If the property/material to be released either cannot be monitored using standard survey techniques or is a volume or bulk material, such as liquids, soils, and so forth, it will be considered potentially contaminated. A special property/waste release evaluation will be conducted prior to release. The release limits for these materials will be established in accordance with specific guidance from the cognizant regulatory authority. All surveys and evaluations for release of potentially contaminated property/material to uncontrolled or unrestricted areas will be documented.

7.4 Instrument Calibration

Radiation detection instrumentation will be provided as appropriate for performing necessary surveys and monitoring. The instrumentation will be selected based upon the type of radiation detected, MDA measurement capability, and range in accordance with the radiological hazards present or anticipated for the project.

The vendor or a calibration service will perform calibration of radiological instruments and equipment in accordance with ANSI N323 (1997) using standards traceable to the NIST primary standards. The calibration certificate will be maintained by the SRSO.

Field calibration of counting instrumentation in accordance with approved written procedures is authorized if it meets the above requirements and the source calibration certificate and documented detection efficiency determination are maintained in the site-specific project file.

Each instrument or piece of equipment will have a calibration sticker with an expiration date affixed.

At a minimum, performance tests of radiological instruments will be conducted before use. Satisfactory performance test results will be within ±20% of the expected response. Instruments that do not meet performance test criteria, are found to be out of calibration, or are defective, will be removed from service until repaired and/or calibrated. The results of these checks will be recorded in a daily source check log by the performer and will be maintained in the project file. All performance tests will be conducted in accordance with approved written procedures.

8.0 PERSONNEL PROTECTIVE EQUIPMENT

8.1 Use and Selection of Protective Clothing

PPE will be selected based on the contamination levels in the work area and the anticipated work activity, ALARA and safety considerations, and consideration of nonradiological hazardous materials that may be present. Surfaces are considered radiologically contaminated if above Table 3 levels. PPE provided will be in good condition and free of chemical or radioactive contamination.

Full Set

- Coveralls (Tyvek ® or cotton)
- Cotton glove liners
- Rubber or chemical resistant gloves
- Shoe covers
- Protective overshoes
- Hood (Tyvek ® or cotton)

Protective clothing and equipment selected for project tasks will be described in the HASP, together with procedures for donning and removing PPE without spreading contamination or contaminating the worker. The necessary PPE for a task will be specified by the RWP.

8.2 Use and Selection of Respiratory Protection Devices

URS Respiratory Protection SMS -042 details specific procedures for respiratory usage, fit, cleaning, and so forth.

Engineering control measures will be provided to limit the concentrations of radioactivity in air to levels below those that constitute an airborne radioactivity area to the extent feasible. When this level is not feasible, other methods such as administrative controls and respiratory protection will be employed to limit the potential for intake of radioactive material.

Only respiratory protection equipment that is tested and certified by the National Institute for Occupational Safety and Health (NIOSH) will be used. Protection factors listed in Appendix A of 10 CFR 20 will be used in the assessment of potential radioactive material intake.

Selection of appropriate respiratory protection devices will be designated within either the HASP or the RWP. At a minimum, respiratory protection devices will be selected so that a protection

factor greater than the multiple by which peak concentrations or airborne radioactivity exceed the values specified in Appendix B of 10 CFR 20 is not exceeded. Only respiratory protection equipment that has been specifically certified for emergency use by NIOSH/Mine Safety and Health Administration (MSHA) will be used as emergency devices.

Whenever respiratory protection will be used at a site, the following additional minimum requirements will be met:

- Air sampling will be performed to identify the potential hazard, permit proper equipment selection, and estimate exposures.
- Surveys and bioassays as appropriate will be performed to evaluate actual intakes.
- Respirators will be tested for operability immediately prior to each use.
- Written procedures will be available regarding selection, fitting, issuance, maintenance, and testing of respirators (including testing for operability prior to each use), supervision and training of personnel, monitoring (including air sampling and bioassays), and recordkeeping.

9.0 RADIOACTIVE MATERIAL ACCOUNTABILITY AND CONTROL

All procurement, receipt, and storage of radioactive material will be coordinated with the individual or organization responsible for radiation protection at the project site. A source custodian and documented inventory record will be established and maintained for radioactive sources. All sources brought on site by external organizations will not be allowed into areas under company control without prior notification and approval by the company individual or organization responsible for radiation protection. Radioactive materials licenses will be required for sources that exceed exempt quantities.

Transportation of radioactive material (specific activity >2000 pCi/g) in commerce, generally off site, will be in accordance with Department of Transportation (DOT) requirements in 49 CFR 170 through 180, and other federal, state, and local regulations, as applicable.

10.0 DECONTAMINATION

10.1 Personnel

The guideline for determining the presence of skin contamination on personnel is detectable radiological contamination above background.

If necessary, decontamination of personnel will be performed only under the direct supervision of the SRSO. Generally, dry, nonabrasive methods will be attempted first and, if necessary, may be followed by washing with soap and water. Material generated during decontamination, including wipes, tape, and water, will be collected and disposed of as radioactive waste. Specific decontamination procedures and documentation requirements are contained in site-specific standard operating procedures (SOPs). Non-radiological decontamination procedures are contained within the HASP.

10.2 Equipment

Surface contamination criteria presented in Table 3 will be used to determine if a piece of equipment is contaminated with radioactive materials. When decontamination is necessary, decontamination will be performed using techniques that are appropriate based on site-specific conditions. Generally, dry decontamination methods such as high-efficiency particulate air (HEPA) vacuuming or wipedowns are preferred when facilities for the collection of radiological contaminated wastewater are not in place. If adequate facilities exist for the collection of such fluids, it may be appropriate to use a wet decontamination technique. Additional decontamination methods include sand or other abrasive blasting.

Specific decontamination procedures and decontamination requirements are contained in the site-specific SOPs. Non-radiological equipment decontamination procedures are contained in the HASP.

11.0 WASTE MANAGEMENT

Radioactively contaminated waste material generated during this project will be managed in accordance with the EM-1110-35-1, "Management Guidelines for Working with Radioactive and Mixed Waste, and the project-specific work plan. Materials suspected of being mixed waste (RCRA/TSCA/etc. hazardous substances combined with radioactive materials) will be identified and segregated as soon as practical to avoid combining mixed waste with other waste forms.

While the scope of this waste minimization plan will be commensurate with the level of radioactive materials present and activities conducted at each site, at a minimum, the following guidelines will be used:

- Removal of excess/unnecessary packaging material prior to bringing materials into radiological controlled areas;
- Restriction of materials entering radiological areas to those materials necessary for performance of work;
- Restriction of the quantities of hazardous materials, such as paints, solvents, chemicals, cleaners, and fuels, entering radiological areas;
- Substitution of reusable items in place of disposable ones, when practical;
- Selection of consumable materials such as PPE that is compatible with waste processing systems, volume reduction, and waste acceptance criteria;
- Survey of potentially contaminated material leaving controlled areas to separate uncontaminated materials from contaminated materials; and
- Emphasis on waste reduction methodologies in training.

Additional waste minimization procedures and/or requirements will be identified in each site-specific work plan and will be commensurate with the levels of radioactive materials present and activities being performed.

12.0 EMERGENCY PROCEDURES

Details on the site-specific emergency procedures are provided in the HASP. At a minimum, emergency procedures will take into account client emergency response procedures and the responsibilities of off-site state and local emergency response agencies. All site personnel will be instructed in their emergency responsibilities and the emergency procedures.

13.0 TRAINING

Training will be provided to general employees, radiation workers, and radiological control staff at a project site under this RPP. Periodic retraining will be conducted whenever a significant change to the RPP or implementing procedures occurs or at a frequency consistent with applicable regulatory or client requirements and commensurate with radiological hazards present on the site. Minimum retraining frequency of two years will be implemented.

All formal training under the RPP will verify individual knowledge by an appropriate examination. Documentation of training will be generated containing the individual's name, date of training, topic(s) covered, pass or fail, and the name of the certifying official. No employee will be permitted to independently perform tasks inside of a radiological controlled area until the appropriate training and qualification requirements are met.

Additional training requirements will be determined on a site-specific basis and will be commensurate with the radiological hazards present on each site. These additional requirements will be documented in the HASP.

13.1 Radiological Worker Training

At a minimum, all personnel entering an area where radioactive material or radiation generating devices are used, and where there is a potential for an individual to receive a Total Effective Dose Equivalent (TEDE) of 100 mrem or more in one year, will receive the following training:

- **Radiological Fundamentals** – Atomic Structure, Definitions and Units of Measure, the Four Basic Types of Ionizing Radiation, Units of Measure for Radiation.
- **Biological Effects** – Sources of Radiation, Effects of Radiation on Cells Acute and Chronic Radiation Dose, Prenatal Radiation Exposure, Risks in Perspective.
- **Radiation Dose Limits** – Basis for and Purpose of Radiation Dose Limits and, Administrative Control Levels, and Worker Responsibilities Regarding Dose Limits.
- **ALARA Program** – ALARA Program, Responsibilities for the ALARA Program, External and Internal Dose Reduction, Radioactive Waste Minimization.
- **Personnel Monitoring Programs** – External Dosimetry, Internal Monitoring, Methods for Obtaining Radiation Dose Records.
- **Radiological Access Controls and Postings** –Radiological Work Permits, Radiological postings, Requirements for entering, working and exiting Radiological Control Areas.
- **Radioactive Contamination** – Types and sources of contamination, Contamination control methods, Contamination monitoring equipment, Decontamination

- **Radiological Emergencies** – Emergency Alarms and Responses, Radiological Emergency Situations, Considerations in Rescue and Recovery Operations.
- **Practical Factors** – Review an Appropriate Radiological Work Permit (RWP), Record the Appropriate Information on the RWP, Select and Wear Required Dosimeter(s), Enter Simulated Area and Demonstrate ALARA Techniques, Monitor for Contamination, Respond to Emergency Situations or Abnormal Radiological Situations.

13.1.1 Authorized Users

Authorized Users (AU) are individuals who, by their training and experience, are allowed to work, unsupervised, with radioactive material or radiation generating devices, and also directly supervise Authorized Users Assistants working with radioactive material. Training for Authorized Users will include eight hours of classroom training on the topics detailed above in addition to the practical factors.

13.1.2 Authorized User Assistants

Authorized User Assistants (AUA) are individuals allowed to work with radioactive material only under the direct supervision of an AU (that is, in the physical presence of the AU).Training for AUA will include four hours of classroom training on the topics detailed above in addition to the practical factors.

13.2 General Awareness Training

General employees who are not radiation workers but may be involved in an occasional or indirect manner with radioactive material or activities supporting decontamination and decommission (D&D) efforts will receive training specific to the site activities. This training will be similar in content to the radiation worker training but will not require a practical exercise.

13.3 Visitors

Visitors to the site will be provided with a handout that summarizes the necessary radiation training. Visitors will not be allowed unescorted access to radiation areas.

14.0 AUDITS

An internal audit of the field implementation of this RPP will be conducted at least once per year by the SRSO. Audit findings will be reported in writing to appropriate personnel and agencies.

15.0 RECORDS MANAGEMENT

RPP records will be maintained to document compliance with regulatory requirements and the exercise of due diligence in the control of radiological hazards for the protection of employees, members of the public, and the environment. These records will be transferred to the project file at the conclusion of the project.

At the completion of site activities, copies of exposure monitoring records will be sent to the individuals monitored and their employers where appropriate. URS employees will have copies also sent to the URS' Health Services Administrator for inclusion into each respective employee’s medical file. Exposure monitoring records for subcontract personnel will be

transferred to each respective subcontract organization. Monitored individuals will be provided with a copy of their radiation monitoring results, consistent with the requirements of 10 CFR 19.13. Upon completion of work at a site, exposure data pursuant to the 10 CFR 19.13 requirement will be provided for URS employees only. Subcontract personnel will be required to make requests for exposure records directly to their respective employer.

Exposure records that are maintained by URS will be maintained in a manner consistent with applicable Privacy Act requirements. The records will be available for retrieval over a period not less than 75 years after the date of creation of the record. All quantities used in the records will be in special units of curie, rad, or rem, including multiples and subdivisions of these units. Records identified with an individual's name or identifying number will be available upon request from that individual.

Records to be maintained include the following (as available):

- Doses received by individuals, for whom monitoring was required, during previous employment;
- Doses received by individuals for whom monitoring was required;
- Dose assessments and organ burdens for individuals for whom bioassay was performed;
- Doses to the embryo/fetus of a declared pregnant employee;
- Written declarations of pregnancy;
- Written withdrawal of declaration of pregnancy;
- Results of surveys for radiation and radioactive material in the workplace and outside of controlled or unrestricted areas as required by regulatory requirements or the radiation protection program;
- Results of surveys for the release of material or equipment to uncontrolled or unrestricted areas;
- Records of effluents and radioactive waste disposal under control;
- Results of calibrations performed on radiological instruments and quality control checks for radiological instrumentation and personal monitoring devices;
- Records of ALARA evaluations and control actions;
- Records of radiological training completed, including general employee radiological training;
- Records of internal reviews and audits with corrective actions closeout; and
- Records of regulatory agency inspections and audits with corrective actions closeout.

Interim storage of the above radiological records will be the responsibility of the SRSO and will be maintained in a readily retrievable, controlled manner. Upon completion of each site project, and upon request, copies of all radiation exposure records will be made available to appropriate parties.

Records associated with radiation surveys and measurements performed to support activities associated with D&D of a site and equipment are:

- Name of the person making the evaluation and recording the results;
- Date of the survey;
- Instrument serial number used for surveys and measurements; and
- Results obtained.

URS will record contamination levels observed and procedures followed for incidents involving contamination of individuals. The record should include name of individuals involved, description of work activities, calculated dose, probable causes (including root causes), steps taken to reduce future incidents of contamination, times and dates, and the surveyor's signature.

Appendix A: Implementing Procedures

Table of Contents

PROCEDURE APPROVALS:		
[redacted]	[redacted]	1-Nov-2012
(printed name)	Site Radiation Safety Officer *(signature)*	Date
[redacted]	[redacted]	1-Nov-2012
(printed name)	Certified Health Physicist *(signature)*	Date

1.0 Purpose

This procedure describes how dosimetry will be issued, bioassay samples will be handled, and results will be provided to monitored individuals.

2.0 Equipment

2.1 Optically stimulated luminescence (OSL) dosimeters.

2.2 OSL dosimeter clips.

2.3 Bioassay sampling kit from contracted laboratory.

3.0 Procedure

3.1 TLD/OSL Dosimeter Control.

3.1.1 Store all dosimeters that have not been placed in use or have been removed from use in an appropriate dosimeter storage location.

3.1.2 At the time of monthly dosimeter exchange, replace the control dosimeters and submit the removed dosimeters for processing with the monthly set of dosimeters.

3.2 OSL Dosimeter Issue.

3.2.1 Ensure the individual has completed a Dosimetry Form, and has completed all required training.

3.2.2 Provide a copy of the Dosimeter User Instructions, and ensure the individual reads and signs the form. Answer any questions regarding the information and instructions on the form. Be sure to explain where the dosimeter is to be placed when not being worn, required notifications and

actions if the dosimeter is lost, damaged, or missing, and that dosimetry is to be worn only by the person to whom dosimetry was issued.

3.3 OSL Dosimeter Exchange.

3.3.1 Exchange all dosimeters monthly. Exchange each dosimeter set including the control badges, one for one, for the expiring dosimeter.

3.3.2 Identify any missing dosimeters and contact the assigned individuals.

3.3.3 Promptly submit the dosimeters for processing.

3.4 Bioassays.

3.4.1 Identify the specific individuals to participate in the bioassay program. Generally, these will be individuals who will be in direct contact with loose radioactive material.

3.4.2 Order the sample collection kits from the bioassay laboratory.

3.4.3 Collect initial bioassay samples prior to invasive site work.

3.4.3.1 Collect samples and submit them for analysis as directed by the analytical laboratory.

3.4.3.2 Ensure that all individuals who provide an initial bioassay also provide samples at the completion of the job.

3.4.4 Collect final bioassay samples at the completion of the job from all individuals who provided an initial sample.

3.5 Dosimetry Letters.

At the end of the project or annual, provide documentation of their dose to each monitored individual. Arrange for each individual's monitoring results to be sent to the individuals and employers as appropriate.

4.0 Documents Generated By This Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

4.1 Dosimetry Issue Form.

4.2 Dosimetry User Instructions.

4.3 Dosimetry Log.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

5.2 ANSI HPS N13.30-1996, “Performance Criteria for Radiobioassay.”

AFFILIATION NAME: _____

NAME: _____ DOB _____ SEX: M F

(Last) (First) (MI) Mo/Day/Yr (Circle one)

EMPLOYEE NUMBER: _____

PERMANENT ADDRESS: _____

CITY: _____ STATE: _____ ZIP: _____

EMPLOYER (FULL NAME): _____

EMPLOYER'S ADDRESS: _____

CITY: _____ STATE: _____ ZIP: _____

I know of no medical disqualification which should prevent my receiving a radiation dose within applicable State and Federal Standards. I received and understood the briefing prior to receiving a dosimeter to be worn at all times when present in areas where dosimetry is required.

Signature_____

Date_____

Will this individual receive Radiation Worker Training? __ YES __ NO

If the response to either of the following two questions is "YES", please ask the individual to bring, at the time of dosimetry issue, all information he/she has available regarding the name, location and address, dates (time periods) at the facility, dates (time periods) monitored, and exposures (internal and external) received. Documentation provided to the individual by the facility is preferred, if available.

Has this individual worked at any facility where he/she was required to wear a dosimeter or be otherwise monitored for personal exposure to ionizing radiation in the last year? ____ YES ____ NO

Will this individual participate in the bioassay program (Urinalysis, fecal analysis) for monitoring of internal radiation exposure? ____ YES ____ NO

Has this individual completed the initial bioassay samples? ____ YES ____ NO

DOSIMETER BADGE ISSUE INFORMATION

Badge Number: _____ Issue Date: _____

Issued By: _____

Your assigned dosimeter is provided to monitor your exposure to ionizing radiation during your work at this site. The exposure measured by your dosimeter is corrected to exclude natural radiation from the earth, atmosphere, space (cosmic radiation), and radioactive material naturally present in your own body; thus this dosimeter measures only your occupational radiation exposure and not your total exposure.

IMPORTANT NOTICE:

If, during your tenure at this Site you know you will be receiving a "Nuclear Medicine" diagnosis or treatment please notify the Site Radiation Safety Officer (SRSO) so that proper steps can be taken to ensure your facility dosimetry is properly modified. If you are sent to Nuclear Medicine without prior knowledge, please request that the medical staff provide you with information regarding any injection or oral dosage of radioactive material, and contact the SRSO before entering the site.

You are responsible for wearing and using your dosimeter in a manner that will properly reflect the dose you receive and will protect your dosimeter from damage, loss, or exposure to radiation in any manner that is not in strict accordance with approved practices. You are responsible for notifying the SRSO if there is any question of whether a practice regarding proper use of a dosimeter has been violated.

The following practices are to be followed by all individuals who are assigned a dosimeter for use at the Site.

1. Assigned dosimeters must be worn at all times and in all locations on the Site where their use is required.
2. Removal of a personal dosimeter from the Site by an assigned user is prohibited unless case-by-case written authorization is granted by the SRSO.
3. Personal dosimeters shall be placed on the DOSIMETER field storage rack at all times when not being worn. Do NOT leave your dosimeter on furniture, in a drawer etc., for any reason.
4. Dosimeters are to be worn on the front of the body between the shoulders and the waist unless directed otherwise by a Radiation Work Permit or at the direction of the SRSO.
5. Instructions to prevent contamination or improper exposure of your dosimeter must be followed.
7. Dosimeter badge holders are NOT to be opened.
8. Notify the SRSO immediately if a dosimeter is:
   a. Lost or found.
   b. Damaged (includes exposure to excessive heat or submersion in water or other liquid).
   c. Worn by an individual other than the one assigned.

I have read these Dosimeter User Instructions and my questions about my responsibilities as a Dosimeter User have been addressed. I understand my Dosimeter User responsibilities and will comply with this instruction.

User Signature: _____ Employee #: _____ Date: _____

Dosimeter User Log

Name	Frequency	Type of Dosimeter	Serial Number	Date Issued	Date Returned

PROCEDURE APPROVALS:		
[redacted]	[redacted]	1-Nov-2012
(printed name)	Site Radiation Safety Officer *(signature)*	Date
[redacted]	[redacted]	1-Nov-2012
(printed name)	Certified Health Physicist *(signature)*	Date

1.0 Purpose

This procedure details the issuance of Radiation Work Permits (RWP) or Hazardous Work Permits (HWP). It also provides detail on how access to Radiological Control Areas (RCA) will be controlled and posted.

2.0 Equipment

2.1 Radiological signs.

2.2 Rope, barrier tape, and other and posting materials as appropriate.

3.0 Procedure

3.1 Review historical radiation survey information, and complete a radiological survey of the work area.

3.2 Establish Radiological Controlled Areas (RCA).

Permit only trained, authorized, and qualified personnel to access radiological control areas. Establish control measures and procedures using an RWP system where necessary to ensure appropriate planning and activities in controlled areas.

3.3 Ensure RCA is Properly Posted.

Post a standard radiation symbol in magenta or black on yellow background at each access point to a controlled or restricted area along with appropriate identification and instructions.

Table 1. Posting Requirements

Posting Sign	Definition
Caution Radiation Area	5 mrem in 1 hour at 30 cm
Caution-High Radiation Area or Danger High Radiation Area	100 mrem in 1 hr at 30 cm
Grave Danger-Very High Radiation Area	500 rads in 1 hr at 1 m
Caution Contaminated Area	Removable radioactive contamination in excess of Reg Guide 1.86 Table 1 values
Caution Airborne Radioactivity Area or Danger Airborne Radioactivity Area	>1 DAC or 12 DAC hours/week
Caution, Radioactive Material or Danger Radioactive Material	Radioactive material handled, used or stored

3.4 Issue RWP or HWP.

3.4.1 Complete a RWP (Attachment 52-2 to Safety Management Standard (SMS) 52) to inform workers of area radiological conditions and entry requirements. Where appropriate, combine radiological requirements with other non-radiological requirements into a single HWP (Attachment 52-3 to SMS 52)

3.4.2 Review radiological survey data, and other information prior to issuing RWP or HWP.

3.4.3 The Site Radiation Safety Officer (SRSO) or designee assigns a RWP number and completed the RWP log.

3.4.4 Complete the appropriate sections of the RWP or HWP.

3.4.5 Contact the Site Health and Safety Officer and the Project Manager for approval.

3.5 Post RWP/HWP.

3.5.1 Maintain a signed copy of the RWP / HWP at the RCA entrance.

3.5.2 Each individual entering the RCA is required to review, comply with all requirements, and sign the RWP/HWP.

3.5.3 The RWP will be used to document each entry into a RCA. Additional pages may be used to document entries.

3.5.4 RWP/HWP will be terminated if there is a change in radiological conditions, completion of the job, or as deemed necessary by the SRSO.

3.6 Review RWP /HWP.

3.6.1 Upon termination of the RWP/HWP, maintain copies in the project file.

4.0 Documents Generated By This Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

4.1 Issued RWP or HWPs, and all entry log pages.

4.2 RWP or HWP Log.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

5.2 NRC Regulatory Guide 1.86 “Termination of Operating Licenses for Nuclear Reactors” June 1974.

PROCEDURE APPROVALS:		
[redacted]	[redacted]	1-Nov-2012
(printed name)	Site Radiation Safety Officer *(signature)*	Date
[redacted]	[redacted]	1-Nov-2012
(printed name)	Certified Health Physicist *(signature)*	Date

1.0 Purpose

The purpose of this document is to define the procedure for the use of portable survey instruments. This document is not intended to cover every instrument configuration and field situation, but rather provides general procedures for commonly used instrument configurations and field situations.

2.0 Equipment

Radiation detection instrumentation comes in many configurations provided by several vendors. Some equipment is provided as a single entity containing the radiation detector and meter combined. Other equipment is provided as component parts consisting of a radiation detector or a meter, which can be mixed and matched as the situation requires. For the purposes of this procedure, the term “instrument” means a detector and meter provided as a single entity. The most commonly used equipment is listed below.

2.1 Instruments.

2.1.1 Ludlum Model 19

2.2 Detectors.

2.2.1 Ludlum Model 44-9 “pancake” GM-probe

2.2.2 Ludlum Model 44-1 1” NaI probe

2.2.3 Ludlum Model 44-10 2” NaI probe

2.2.4 Ludlum Model 44-20 3” NaI probe

2.2.5 Ludlum Model 43-93 Alpha/Beta Phoswhich probe

2.2.6 Meters

2.2.7 Ludlum Model 3

2.2.8 Ludlum Model 12

2.2.9 Ludlum Model 2221

2.2.10 Ludlum Model 2360

2.3 Miscellaneous Equipment

2.3.1 Exempt Operational Check Sources

2.3.2 Batteries

2.3.3 Cables

3.0 Procedure

3.1 Calibrations.

Perform all work with instruments calibrated and checked in accordance with the manufacturer's recommendations. Prior to each use, confirm the instrument is in calibration. Instruments must be calibrated annually. Instruments with a separate detector and meter must be calibrated and used together. Instruments which are not in calibration must be calibrated prior to use.

3.1.1 Ensure copies of the calibration documents are maintained in the field with the instruments.

3.2 Establish the Operational Tolerance Limits.

These tolerances are established when an instrument is returned from the instrument vendor following calibration, and are used as the basis for the daily operational checks. These tolerances may also be reestablished during field setup to account for field conditions.

3.2.1 Complete this procedure for each instrument (meter/detector combination) upon initial receipt following instrument vendor calibration.

3.2.2 Record the data in the Radiation Instrument Daily Check spreadsheet. Make a separate tab for each instrument in the spreadsheet. A screen view of the spreadsheet is shown in Attachment A.

3.2.3 Review the instrument calibration documentation and confirm all settings are consistent and documented in the spreadsheet.

3.2.4 Retrieve the specific check source that will be used to conduct the daily operation check.

3.2.5 Complete the entries in the tan-colored cells.

3.2.5.1 Record the meter and probe specific information (i.e., serial number, etc.).

3.2.5.2 Record the calibration information.

3.2.5.3 Record the daily check source serial number and details.

3.2.5.4 Describe the detailed position of the check source relative to the probe. Be specific as other users will have to duplicate this position every time the instrument is used.

3.2.5.5 Record all instrument-specific parameters in the notes section (e.g., window settings, threshold, calibrated efficiencies).

3.2.5.6 Complete Columns Labeled Initial QC Setup.

3.2.5.6.1 Collect 10 background measurements and record them in column BKGD.

NOTE: For instruments that do not allow for timed reading, record the measurement once the needle has generally stabilized.

3.2.5.6.2 Collect 10 source measurements and record them in column Source.

3.2.5.6.3 Once all entries are completed in the worksheet, the spreadsheet calculates the net values and tolerances (within 20% of the mean).

3.2.5.7 Repeat this procedure for all instruments.

3.3 Instrument Daily Checks.

When in use, check each instrument daily for proper operation prior to use. A background location should be selected and the same area used for these check during the project.

3.3.1 Complete for each instrument using the specific check source used to establish the instrument tolerances.

3.3.1.1 The instrument allows for fast (F) and slow (S) response. Set the instrument on Fast (F) for checks and monitoring.

3.3.1.2 Record all the data on the Radiation Instrument Daily Check spreadsheet,

3.3.1.2.1 If daily checks are done at both the start and end of the day use S to indicate starts of day check, and E for end of day check.

3.3.1.3 Check the batteries. If the battery indicator is toward the low end of the "acceptable battery range," replace the batteries. Record the result on the form. If you replace the batteries, make a note in the Notes column.

3.3.1.4 Check the high voltage (HV) on the instrument, if provided. Record the high voltage.

3.3.1.5 Do a one-minute background reading.

NOTE: For instruments that do not allow for timed reading, record the measurement once the needle has generally stabilized.

3.3.1.6 Do a one-minute count of the source. Position the check source directly over the instrument and in a position consistent with the operations check location.

3.3.1.7 Enter the data into the Daily Instrument Check spreadsheet. The spreadsheet will indicate if the values are in or out of tolerances. Confirm that daily fluctuations do not exceed 20%.

3.3.1.8 Repeat for other instruments.

3.3.2 If the instrument does not pass the daily check:

3.3.2.1 Check over the instrument. Make sure the settings are correct. Common causes of instrument problems are:

- the batteries are bad
- the battery terminals are blocked
- the cable is defective

3.3.2.2 Repeat the test.

3.3.2.3 Remove any instrument that does not pass this second test from service. Record out of service (OOS) in the notes section.

3.3.3 Maintain a copy of the Daily Instrument Check spreadsheet for each radiation monitoring instrument to record the results of the daily instrument checks.

3.3.4 Keep the completed Daily Instrument Check spreadsheet on file as permanent documentation that the instrument was known to be operating

properly for measurements made on any given date according to required retention times for the radioactive materials license and the project.

4.0 Data Analysis

4.1 Instrument Efficiency.

4.1.1 Instrument efficiency is the percentage of radiation detected of a known value. For field instruments, efficiency values are estimated from manufacturer information, or calculated from calibration data or the operational check source.

4.1.2 The basic formula to calculate efficiency (ε), assuming the background count time is consistent, is:

$$\varepsilon = \frac{R_{std}}{A_{std}}$$

R_{std} = gross count rate of the standard in cpm

A_{std} = known activity level of the standard in dpm

4.2 Detection Limits.

4.2.1 Each instrument has a lower boundary for detection of radiation. This value is known as the minimum detectable concentration (MDC). For field instruments, the MDC is used to determine adequate sensitivity of the instrumentation for the intended use.

4.2.2 The basic formula to calculate the MDC at a 95% confidence interval is:

$$MDC = \frac{3 + \left(4.65\sqrt{B}\right)}{T \cdot \varepsilon \cdot \frac{A}{100}}$$

B = background cpm for time interval

T = time interval in minutes

ε = efficiency

A = physical area seen by the detector in cm^2

5.0 Documents Generated By This Procedure

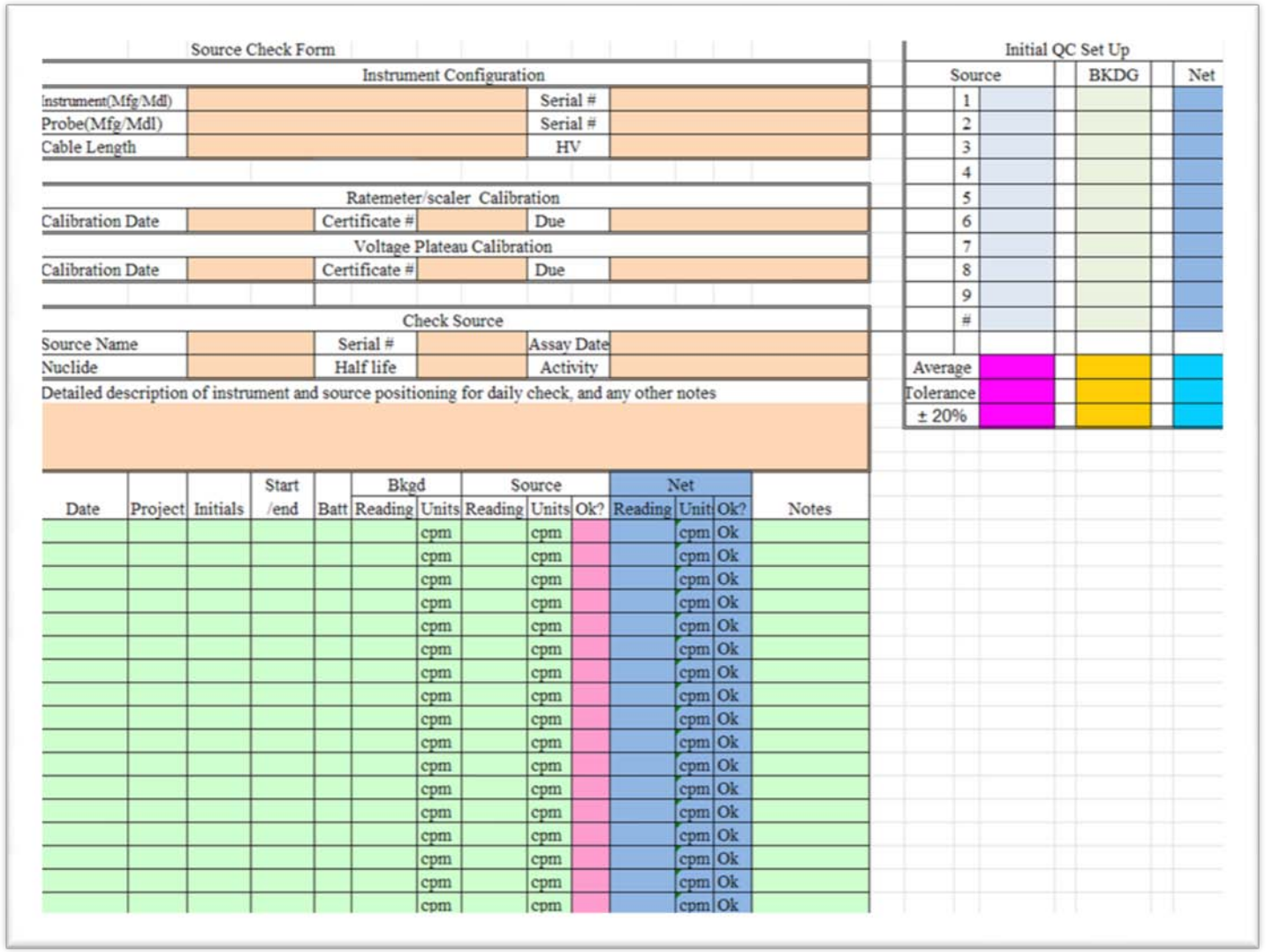
Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

5.1 Daily Instrument Check Spreadsheet.

6.0 References

6.1 URS Safety Management Standard 52 Radiation Protection Program.

Attachment A: Screen View of the Instrument Daily Check Spreadsheet



Source Check Form

Instrument Configuration			
Instrument(Mfg/Mdl)		Serial #	
Probe(Mfg/Mdl)		Serial #	
Cable Length		HV	

Ratemeter/scaler Calibration					
Calibration Date		Certificate #		Due	
Voltage Plateau Calibration					
Calibration Date		Certificate #		Due	

Check Source					
Source Name		Serial #		Assay Date	
Nuclide		Half life		Activity	

Detailed description of instrument and source positioning for daily check, and any other notes

Initial QC Set Up

	Source	BKDG	Net
1			
2			
3			
4			
5			
6			
7			
8			
9			
#			
Average			
Tolerance			
± 20%			

					Bkgd		Source			Net			
Date	Project	Initials	Start /end	Batt	Reading	Units	Reading	Units	Ok?	Reading	Unit	Ok?	Notes
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	
						cpm		cpm			cpm	Ok	

PROCEDURE APPROVALS:		
[redacted]	[redacted]	1-Nov-2012
(printed name)	Site Radiation Safety Officer *(signature)*	Date
[redacted]	[redacted]	1-Nov-2012
(printed name)	Certified Health Physicist *(signature)*	Date

1.0 Purpose

To provide a method for conducting radiation surveys and identifying area with elevated radiation levels using radiation detection equipment.

2.0 Equipment

2.1 Project-specific radiation detection instruments, generally includes meters for identifying contamination, and dose rates.

2.2 Marking Materials: Chalk, Flags, Paint, etc.

2.3 Survey forms.

3.0 Procedure

3.1 General Survey Types.

3.1.1 Incoming equipment surveys – Document the prior radiological condition of equipment and items to be used on site. Generally focus on items (i.e., drill rig, excavator, sample coolers) with a potential to be in direct contact with potentially contaminated material.

3.1.2 Routine surveys – Document the radiological conditions of controlled areas.

3.1.2.1 Indoors – Includes walls, ceilings, floors, with particular attention to drains, air vents, etc. Surfaces to be surveyed should be relatively clean of loose material, and drains should not contain standing water.

3.1.2.2 Outdoor – Includes ground surfaces, soil, concrete, asphalt, and exterior building surfaces. Surveys shall not be conducted over

standing water, snow-covered ground, or areas with saturated soils. In limited situations, where the soil/surface is always saturated (i.e., drainages) measurement may be collected when the ground is as dry as practical and the condition documented.

3.1.3 Contamination Surveys/Release Surveys – Ensure items and equipment leaving the site are not contaminated.

3.1.3.1 Decontamination Confirmation – If water was used for decontamination, ensure items are dry before surveying.

3.1.4 Department of Transportation (DOT) surveys document the package or transport vehicle is in compliance with DOT limits for surface contamination and dose rates.

3.2 Radiation Scanning.

3.2.1 Pass the detector over the surface at the appropriate distance and speed.

3.2.1.1 The speed of detector movement will vary depending upon the radionuclide of concern, the experience of the surveyor, and the required observation interval.

3.2.1.2 Typical survey conditions for each radiation type are listed below.

3.2.1.2.1 Alpha radiation (i.e., Ludlum 43-98): detector distance of 1 cm or less; detector survey speed of no greater than 5 centimeters per second.

3.2.1.2.2 Beta radiation (i.e., Ludlum 44-9): detector distance of 1 cm or less; detector survey speed of no greater than one detector width per second.

3.2.1.2.3 Gamma radiation (i.e., Ludlum 44-10): detector distance of 4 cm or less; detector survey speed of no greater than 1.0 m per second.

3.2.2 Prior to conducting surface surveys for reference, HP will review client-provided historical data. Note increases in count rate as indicated by the audible output or meter reading. Compare count rates to ambient instrument daily background readings level. For field screening investigate any count rate of greater than twice ambient background as a general rule of thumb.

3.2.2.1 Mark areas that meet or exceed the field screening levels.

3.2.2.2 Continue traversing the area at close intervals. Typically, the intervals will be close enough to thoroughly cover the area. However, some situations may have larger intervals.

3.2.3 Record the survey results on the appropriate form or log book. A general purpose survey map is shown in Attachment A.

3.3 Fixed Point Surveys.

3.3.1 Hold the detector over the surface at the appropriate distance.

3.3.2 Collect data for the counting period. The counting period should be less than or equal to the background count time. The count time depends on the radionuclide of concern and the detection requirements of the project. For basic screening, a typical count time is one minute.

3.3.3 Record the survey results on the appropriate form or logbook.

3.3.4 Compare results to the established levels for the project. Mark areas that meet or exceed action levels.

3.3.5 Repeat these steps for all fixed-point survey intervals.

3.3.6 Surveys for loose contamination include collection of both fixed point measurements and smear samples at the same location. Perform the surveys in various representative locations, as determined by the project RSO and the specific circumstances. Examples of locations are listed below:

3.3.6.1 Normal personnel traffic routes and at entrance and egress locations.

3.3.6.2 Building surfaces such as floor, ledges, corners, ventilation ducting, piping runs, lighting fixtures, sinks, drain covers, etc.

3.3.6.3 Equipment surfaces such as wheels, steps, ledges, probes, etc.

3.3.6.4 Collect a minimum of five fixed-point measurements and smear samples from equipment for incoming, and release surveys. Larger items with a high potential for contamination may require up to 20 smear samples.

3.4 Documentation.

3.4.1 Project staff members are responsible for documenting radiation survey activities.

3.4.2 Document all radiation survey results in field log books or on field forms. Documentation shall include the following:

3.4.2.1 Names of personnel, and survey date.

3.4.2.2 Survey type, DOT survey, excavation control, exposure rate, contamination.

3.4.2.3 Location designations.

3.4.2.4 Serial numbers and calibration information for all survey equipment used,

3.4.2.5 Survey results, including background measurements.

3.4.2.6 Other applicable information or project specific requirements.

4.0 Documents Generated By This Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

4.1 Survey Maps.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

Attachment A: Survey Form

Name:_____

Date:_____

Comments:_____

_____

URS Survey

Site Name: _____

Location: _____

⬭ Denotes Smear Location

* Denotes Contact Readings

All Readings in cpm unless other w ise noted

Meter:_____ Meter:_____

Serial #:_____ Serial #:_____

Cal Due:_____ Cal Due:_____

Bkg:_____ Bkg:_____

Counter:_____ Counter:_____

Cal Due:_____ Cal Due:_____

Smear Results

Smear	Location	α cpm	βγ cpm	α dpm	βγ dpm

Counter: _____

Serial # _____ Cal Due:_____

Bkg		Efficiency	
α =	_____	α =	_____
βγ =	_____	βγ =	_____

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[redacted]	[redacted]	1-Nov-2012
(printed name)	Site Radiation Safety Officer *(signature)*	Date
[redacted]	[redacted]	1-Nov-2012
(printed name)	Certified Health Physicist *(signature)*	Date

1.0 Purpose

Smear surveys are used to detect the amount of loose surface radioactive contamination present. Radioactive contamination is loose radioactive material where it is not wanted. The terms swipe, smear, or wipe survey are used interchangeably. Smear surveys provide information on the potential for radioactive material to enter the body and contribute to internal exposure or the potential for the radioactive material to be spread beyond the boundaries of the licensed facility or radiation control area.

2.0 Equipment

2.1 Ludlum 2929 attached to a Ludlum 43-10-1 or equivalent

2.2 Check sources

2.3 Smears and baggies

2.4 Gloves

2.5 Tweezers

3.0 Procedure

3.1 Instrument Setup.

In order to perform smear counting, the instrumentation needs to be verified during setup. Typically, the instrumentation will come from the rental company already calibrated, which includes the voltage plateau determination. The instrument must be calibrated annually. To set up the instrument, perform the chi-squared determination.

The following procedure is for use with the Ludlum 2929 attached to a Ludlum 43-10-1. This instrument measures both alpha and beta. Typically it is set up to measure both.

3.2 Unpack and Assemble the Instrument.

3.3 Chi-Square Determination.

Chi-square is used to calculate the probability that the differences in count values obtained in a series of count intervals follow the assumed statistical distribution. It also serves as an indication that the counting instrument is operating satisfactorily. During the annual calibration the determination of the operating voltage must be performed prior to performing the chi-square test. A chi-square test is performed by calculating the chi-square value from a series of individual counts and comparing this value to a table or graph of acceptable values. Mathematically, the chi-square value can be calculated with the following equation:

$$X^2 = \frac{1}{x_{avg}} \sum_{1}^{N} \left(x_N - x_{avg}\right)^2$$

Where: X^2 is the chi-square value

x_{avg} is the average of all x values

N is the number of measurements (i.e., 10 counts)

x_N is the x value at N measurement

3.3.1 Obtain a total of 10 one-minute counts using an NIST traceable source.

3.3.2 Calculate the average count rate (cpm) [x_{avg}].

3.3.3 Subtract the average count rate from each individual count. Note that some values will be negative.

3.3.4 Square the difference (answer) obtained in step 3.3.3.

3.3.5 Add the squares of all the differences obtained in step 3.3.4.

3.3.6 Divide the total of the squares by the average count rate. This result is the chi-square value [X^2].

3.3.7 Determine the N-1 value by subtracting 1 from the number of measurements.

3.3.8 Using Table 1, look up the upper and lower boundary values for the N-1 value.

3.3.9 Compare the calculated chi-square value to the boundary values. The result should be between the two numbers.

3.3.10 If the number is higher than the satisfactory value there is a problem with the instrument and the instrument should be removed from service until the problem is resolved.

Table 1: Chi-Squared Values for N-1 Measurements

N-1	X^2 0.975	X^2 0.025
2	5.02	0.0010
3	7.38	0.0506
4	9.35	0.216
5	11.1	0.484
6	12.8	0.831
7	14.4	1.24
8	16.0	1.69
9	17.5	2.18
10	19.0	2.70
11	20.5	3.25
12	21.9	3.82
13	23.3	4.40
14	24.7	5.01
15	26.1	5.63
16	27.5	6.26
17	28.8	6.91
18	30.2	7.56
19	31.5	8.23
20	32.9	8.91
21	34.2	9.59
22	35.5	10.3
23	36.8	11.00
24	38.1	11.7
25	39.4	12.4
26	40.6	13.1
27	41.9	13.8
28	43.2	14.6
29	44.5	15.3
30	45.7	16.0
31	47.0	16.8
41	59.3	24.4
51	71.4	32.4

Table 1: Chi-Squared Values for N-1 Measurements

N-1	X^2 0.975	X^2 0.025
61	83.3	40.5
71	95.0	48.8
81	106.6	57.2
91	118.1	65.6
101	129.6	74.2

3.4 Data Analysis.

3.4.1 Instrument Efficiency.

3.4.2 Instrument efficiency is the percentage of radiation detected of a known value.

3.4.3 The basic formula to calculate efficiency (ε), assuming the background is the consistent, is:

$$Ef = \frac{R_{std}}{A_{std}}$$

R_{std} = gross count rate of the standard in cpm

A_{std} = known activity level of the standard in dpm

3.5 Smear Activity.

3.5.1 The basic formula to calculate the activity on a smear in dpm is:

$$dpm = \frac{Sample_{cpm} - Bkgd_{cpm}}{Ef}$$

$Sample_{cpm}$ = gross count rate of the smear in cpm

$Bkgd_{cpm}$= background count rate in cpm

Ef= Detector Efficiency in decimal format

3.6 Minimum Detectable Concentration (MDC).

Each instrument has a lower boundary for detection of radiation. This value is known as the MDC. If a lower MDC is required, the count time is increased.

3.6.1 The basic formula to calculate the MDC at a 95% confidence interval is:

$$MDC = \frac{3 + \left(4.65\sqrt{B}\right)}{T \cdot \varepsilon \cdot \frac{A}{100}}$$

B = background cpm for time interval

T = time interval in minutes

ε = efficiency

A = physical area seen by the detector in cm^2

3.7 Smear Collection.

3.7.1 Label the smear sample with the smear number, location, and date before collection.

3.7.2 Wear gloves when taking smears. Gloves shall be considered potentially contaminated until the smear is determined to be within permissible limits.

3.7.3 Take all smear surveys over an area of 100 cm^2, the size of a $1 bill.

3.7.3.1 If the item or area to be surveyed is less than 100 cm2, then survey the largest area possible and record that area on the survey sheet.

3.7.3.2 Use moderate pressure; be sure not to tear the smear.

3.7.3.3 Place smears in a baggie, envelope, or other individual container for transport to the counting area. Once a swipe is taken it must be considered to be radioactive. Do not place smears in your pocket.

3.8 Smear Counting.

3.8.1 Wearing gloves, remove the smear from the collection paper, using tweezers.

3.8.2 Place the smear in the counting drawer ensuring the active side is facing up towards the detector.

NOTE: The active side is the side that was rubbed against a surface.

3.8.3 When closing the drawer be certain that the actuator switch has engaged. To do this push the drawer all the way in and listen for a click. When you hear the click, hold the drawer in and lock it in place using the black lever on the side of the detector.

3.8.4 Count the sample and record the number of counts received on the survey form.

3.8.4.1 Typical count time is one (1) minute. A different count time may be required depending upon project requirements, such as detection limits.

3.8.5 Unlock the drawer and remove the smear.

3.8.6 Store or dispose of the smear according to project requirements.

4.0 Documents Generated By This Procedure

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4.1 Smear count calculation spreadsheet.

4.2 Smear Results Form.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

Attachment A: Smear Results Form

Project

Direct Scan		Smear Collection		Smear Counting	
Instrument		Area (cm2)		Instrument	
Serial#		Tech		Serial#	
Cal Due		Signed		Cal Due	
Bkg		Date		Bkg (cpm)	
Units				alpha	beta
Tech				Efficiency (%)	
Signed				alpha	beta
Date				Tech	
				Signed	
				Date	

Item #	Description	Direct Scan			Smear#	cpm		dpm		notes
		low	high	avg		alpha	beta	alpha	beta	

PROCEDURE APPROVALS:		
[redacted]	[redacted]	1-Nov-2012
(printed name)	Site Radiation Safety Officer *(signature)*	Date
[redacted]	[redacted]	1-Nov-2012
(printed name)	Certified Health Physicist *(signature)*	Date

1.0 Purpose

This procedure details the procedures for handling samples for handling, tracking, and preparing samples for shipment under Chain of Custody (COC).

2.0 Equipment

2.1 Shipping containers.

2.2 Samples. These may include media samples (soil, sludge, water), smears or air sample filters.

2.3 Radiation survey instruments as needed.

2.4 COC forms and seal if necessary.

3.0 Procedure

3.1 Sample Identification and Labeling.

3.1.1 Ensure samples collected during site activities have unique sample identification (ID) numbers, as directed by the analytical lab, and the project work plan.

3.2 COC Procedures.

3.2.1 Document the custody of all samples on the COC forms. The COC forms document possession of the sample from collection through laboratory receipt. Record the following minimum information on the COC form:

3.2.1.1 Sample ID.

3.2.1.2 Sampling date and time.

3.2.1.3 Required analysis.

3.2.1.4 Number of containers.

3.2.1.5 Sampler signature.

3.2.2 A sample is defined as being in an individual's custody if the following conditions occur:

3.2.2.1 The sample is in that individual's actual physical possession.

3.2.2.2 The sample is in that individual's view after being in their physical possession.

3.2.2.3 The sample is in that individual's physical possession and then locked or otherwise sealed so that tampering would be evident.

3.2.2.4 The sample is maintained in a secure area that is restricted to authorized personnel only.

3.3 Package Samples.

3.3.1 Review project and laboratory requirements for hold times and shipping requirements.

3.3.2 If not previously surveyed during collection, survey the exterior of each sample container using a thin window Geiger-Muller detector or equivalent on the surface of the sample container.

3.3.3 Package the samples for transport taking care not to contaminate the outside of any sample container. Typically soil samples are shipped in coolers or other strong tight containers. Smears and air sample filters may be packaged in Tyvex envelopes.

3.3.4 Place COC and any other required documentation inside the package.

3.4 Radiological Screening of Package.

3.4.1 Complete a radiological survey of the package to confirm compliance with Department of Transportation (DOT) shipping requirements for surface contamination and dose rate.

3.4.2 DOT shipping contamination control requirements are located in 40 CFR 173.443.

NOTE: This procedure does not take precedence over the requirements of 40 CFR 173, or any other regulatory requirements for shipping of radioactive materials.

3.4.3 Dose Rate Survey.

3.4.3.1 Survey all sides of the package including top and bottom

3.4.3.2 The maximum dose rate must not exceed 0.5 mrem/hr. (nominally 500 µR/hr with a 1R=1rem conversion).

3.4.4 Contamination Survey.

3.4.4.1 Scan the package focus on areas with a higher potential for contamination (i.e., handles).

3.4.4.2 Identify any locations with elevated readings.

3.4.4.3 Collect a timed count at the location of the highest measurement. Convert the results to cpm by dividing the resulting counts by the time in minutes.

3.4.4.4 Collect a smear sample representative of area of 300 cm^2. Count the resulting sample.

3.4.4.5 Convert the survey results to dpm/cm^2 using the following formula

$$\frac{dpm}{cm^2} = \frac{cpm}{eff * A}$$

A = Area of smear sample in cm^2; OR surface area of the detector in cm^2; Note: the Ludlum 44-9 has a surface area of 15 cm^2;

eff = instrument efficiency; assume 10% if exact value is unknown

3.4.4.6 Radiological contamination limits are provided in Table 1.

Table 1

Contaminant	Maximum Permissible Limits	
	Non-fixed (dpm/cm2)	Fixed (dpm/cm2)
Beta and gamma emitters and low toxicity alpha emitters	220	40,000
All other alpha emitting radionuclides	22	4,000

3.4.1 If all measurements are within acceptable limits, release the package.

4.0 Documents Generated By This Procedure

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4.1 Sample Collection Logs.

4.2 Chain-of-Custody Forms.

4.3 Package Radiation Survey Results.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

PROCEDURE APPROVALS:		
[redacted]	[redacted]	1-Nov-2012
(printed name)	Site Radiation Safety Officer *(signature)*	Date
[redacted]	[redacted]	1-Nov-2012
(printed name)	Certified Health Physicist *(signature)*	Date

1.0 Purpose

To describe the method for performing subsurface gamma logging measurements in boreholes, and radiation scans of core samples.

2.0 Equipment

2.1 NaI detector, examples: Ludlum 44-10 (2”x2”) or Ludlum (0.5”x1”). Detector choice depends upon borehole diameter and detection requirements.

2.2 Meter: Ludlum Model 2221 Portable ratemeter-scaler or equivalent, calibrated with the detectors and a cable of sufficient length for borehole depth.

2.3 Ludlum Model 2221, with Ludlum 44-9.

2.4 Capped plastic (PVC) pipe of sufficient length to case the borehole to desired logging depth. Pipe diameter will be determined by the dimensions of the drill bit and detector size (optional).

2.5 Plastic bags (optional).

2.6 Rope of sufficient length for borehole depth.

2.7 Strapping tape.

3.0 Procedure

3.1 Assemble Equipment.

3.1.1 Create a handle on the gamma detector, using strapping tape and rope. The detector cable **should not** be used to lower the detector into the borehole.

3.1.2 Mark the cable and/or rope at six-inch intervals, with the bottom of the detector as 0. This will be used to measure the depth of the borehole.

3.2 Core Scanning.

3.2.1 If possible, complete the core scans before gamma logging the borehole.

3.2.2 Have the driller open the core, and record the core sampler length and the amount of material that was recovered.

3.2.3 Using the 44-9 slowly scan the core and record as a minimum the low, high, and average count rate for the core. Note any unusual measurements or materials.

3.2.4 Collect timed counts at project-specified intervals or at the location of any unusual measurement.

3.2.5 Repeat scan with NaI detector or other detectors as appropriate.

3.2.6 Collect samples from the core material as necessary.

3.2.7 If elevated material is seen in the core, ensure that information is provided to the person completing the gamma scan.

3.3 Borehole Setup.

3.3.1 Insert PVC or plastic pipe into the borehole prior to logging. The pipe should not extend more than 1 ft above the ground surface.

3.3.1.1 Record the height of the pipe above the ground surface.

3.3.2 If the hole does not contain water and will stay open, the borehole can be logged without inserting the pipe.

3.3.3 Enclose the detector in a double layer of plastic bags to protect the detector from contamination and contact with ground water.

3.4 Gamma Logging.

3.4.1 Lower the detector assembly to the bottom of the borehole, watching the count rate response for indications of locations of elevated gamma activity, and note these locations.

3.4.2 When the detector reaches the bottom of the borehole or borehole liner pipe, record the depth of the hole.

3.4.3 Collect and record the first timed count.

3.4.3.1 Move the detector up to the next interval and record the next timed count, then repeat.

3.4.4 If elevated measurements were identified during the core scan or when lowering the detector, ensure timed counts are taken in those locations.

3.4.5 Take a measurement with the detector bottom at the ground surface. If the pipe extends above the ground surface take the final measurement above the ground surface inside the pipe.

3.5 Collect Samples.

3.5.1 Review the borehole and core data to identify intervals for collection of samples.

3.5.2 Collect samples from the core material as necessary.

4.0 Documents Generated By This Procedure

Any forms included in this procedure are examples that show the minimum amount of information necessary to ensure the procedure is appropriately followed. The exact form included in this procedure does not need to be used as long as all of the information shown in the example is included. As needed, forms may be modified to include additional applicable information for different projects.

4.1 Core Logs.

4.2 Borehole Logs.

5.0 References

5.1 URS Safety Management Standard 52 Radiation Protection Program.

Borehole Log

PROJECT ____________________ Page ___ of ____

Borehole ID# __________ **Date** __________

Drilled Depth __________ **Liner Height** __________

Technician __________

Meter Type __________ **PROBE** __________ **Meter Type** __________

METER S/N __________ **PROBE S/N** __________ **METER S/N** __________

Measured depth to bottom (ft) __________

Depth (ft)	Count (cpm)	Sam X	Notes	Depth (ft)	Count (cpm)	Sam X	Notes