May 19, 2015

leidos

Director, Division of Nuclear Materials Safety
Attn: Ms. Casandra Frasier
U.S. Nuclear Regulatory Commission (NRC) Region III
2443 Warrenville Road, Suite 210
Lisle, Illinois 60532

Subject: Radioactive Material License 24-32591

Dear Ms. Frasier:

The St. Louis office of Leidos, Inc. possesses Radioactive Material License 24-32591, which authorizes us to provide limited commercial radiation services. On January 7, 2015 Leidos submitted a request for revisions to this license. (See the enclosed transmittal letter with reissued letter and associated "Attachment 1"). Although Attachment 1, Section 9 "Authorized Use" included "calibration and analytical standards for use with gamma spectroscopy systems", it did not address the use of such sources as tracers for alpha spectrometry. On May 1, 2015, Leidos requested expeditious license amendment to add 10 microcuries of uranium-232 for use as a radio analytical tracer. Request that the amendment of Leidos' NRC License 24-32591 authorize "calibration, analytical standards and tracers for use with gamma spectroscopy systems and alpha spectrometry systems".

Please address questions or concerns to the undersigned by email at Dennis.R.Chambers@Leidos.com or telephonically at 314.770.3068.

Sincerely,

Dennis R. Chambers

Dennis R. Chambers, CHP
Radiation Safety Officer

RECEIVED MAY 19 2015

leidos

U.S. Nuclear Regulatory Commission
Region III
ATTN: Material Licensing Section
801 Warrenville Road
Lisle, Illinois 60532

May 19, 2015

Subject: Amendment of Leidos NRC License 24-32591-01

Dear Sir or Madam,

The subject service provider license authorizes Leidos to possess and use relatively small quantities of radioactive materials for the purposes of:

- instrument calibration as a commercial service,
- collection of leak testing samples and sample analysis as a commercial service,
- storage of client contaminated analytical instrumentation, tools and equipment,
- use as calibration and analytical standards for use with gamma spectroscopy systems, and
- conducting radiological site characterization surveys, including collection and analysis of soil and other environmental samples.

Leidos respectfully requests an amendment to our existing radioactive material service provider license to authorize the use and/or possession of licensable quantities of byproduct material, source material, and special nuclear material in accordance with the provisions of 10 *CFR* 30.6 (b) (1), 10 *CFR* 40.5(b)(1), and 10 *CFR* 70.5 (b)(1), respectively.

The purpose of the specific byproduct material listed in the enclosed application is for use in performing radiological instrument calibrations as a commercial service. The purpose of the general categories of byproduct, source, and special nuclear materials noted on the table below (Attachment 1) is for the use and/or possession of these materials as a commercial service incident to decontamination and decommissioning activities on land areas, buildings and other structures, including performance of radiological site characterization surveys and sampling of soil, sediment, surface water, storm water, groundwater and other environmental media, and remedial action.

Attachment 1 below provides clarifying information to clearly show the requested changes to the license for the amendment.

If you have any questions or request additional information, please phone me at (314) 770-3068.

Sincerely,

Dennis R. Chambers

Dennis R. Chambers, CHP
Leidos St. Louis Radiation Safety Officer

Enclosures

U.S. Nuclear Regulatory Commission
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ATTN: Material Licensing Section
801 Warrenville Road
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January 7, 2015

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Dennis R. Chambers, CHP
Leidos St. Louis Radiation Safety Officer

Enclosures

Attachment 1 – Requested Revisions to License

Sections 6, 7, and 8					
6. Byproduct, source and/or special nuclear material		**7. Chemical and/or physical form**		**8. Maximum amount that license may possess at any one time under this license**	
Existing License	**Revised License**	**Existing License**	**Revised License**	**Existing License**	**Revised License**
A. Th-230	A. delete	Sealed or plated sources	delete	4.76E-02 kg	delete
B. Natural Uranium	B. delete	Sealed or plated sources	delete	1.41E+03 kg	delete
C. Depleted Uranium	C. delete	Sealed or plated sources	delete	2.00E+03 kg	delete
D. Th-230	D. delete	Any	delete	4.76E-07 kg	delete
E. Natural and Depleted Uranium	E. Any source material (including progeny)	Any	same	1.41E+01 kg	Not to exceed 10 mCi per radionuclide in a readily dispersible form and a 100 mCi total except as specified in Condition 18.
-----	F. Any byproduct material with Atomic No 1-96	-----	Any	-----	500 mCi
-----	G. Any special nuclear material (Pu-238, Pu-239, U-233, U-235)	-----	Any	-----	Not to exceed 10 μCi per radionucluide and 100 μCi total except as specified in Condition 18.
-----	H. Th-229	-----	Any	-----	10 μCi
-----	I. U-232	-----	Any	-----	10 μCi
	J. Naturally occurring radionuclides (Rn-222, Ra-226)	-----	Any	-----	100 mCi

	K. Accelerator produced radioisotopes (Co-57, Na-22, Cd-109, Tl-201, Ga-67)	-----	Any	-----	Not to exceed 10 mCi per radionucluide except as specified in Condition 18.
Section 9. Authorized Use					
Items 6A-6K	For use in: 1. Performing radiological instrument calibrations as a commercial service. 2. Collection of leak testing samples and sample analysis as a commercial service, 3. Storage of client contaminated analytical instrumentation, tools and equipment, 4. Calibration and analytical standards for use with gamma spectroscopy systems, and 5. As a commercial service incident to decontamination and decommissioning activities on land areas, buildings and other structures, including performance of radiological site characterization surveys and sampling of soil, sediment, surface water, storm water, groundwater and other environmental media, and remedial action.				
Conditions					
10A. Licensed materials listed in Subitems 6A-6K shall be used at temporary job sites of the licensee anywhere in the United States where the Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material, including areas of exclusive federal jurisdiction within Agreement States. Except for calibration sources, reference standards, and radioactively contaminated equipment owned by the licensee, possession of licensed material at each temporary job site shall be limited to material originating from each site. This material must either be transferred to an authorized recipient or remain at the site after licensed activities are completed.					
10B. Licensed materials listed in Subitems 6A-6K may be used at the licensee's facility located at 13397 Lakefront Drive, Suite 100, Earth City, Missouri.					
11A. Licensed material shall be used by, or under the supervision of, Dennis R. Chambers, CHP.					
11B. The Radiation Safety Officer for this license is Dennis R. Chambers, CHP.					
12-14 can remain the same.					
15. The licensee shall maintain records of information important to decommissioning each temporary job site at the applicable job site pursuant to 10 CFR 30.35(g), 10 CFR 40.36(f), and 10 CFR 70.25(g). The records shall be made available to the client. At the completion of activities at a temporary job site, the licensee shall transfer these records to the customer for retention.					
16 and 17 can remain the same.					
18. In addition to the possession limits in Item 8, the licensee shall further restrict the possession of licensed material to quantities below the minimum limits specified in 10 CFR 30.35, 10 CFR 40.36, or 10 CFR 70.25 for establishing decommissioning financial assurance.					
19-21 can remain the same.					

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FAX TO: MS. CASANDRA FRASLER
NRC REGION III LICENSING
PHONE: 630-515-1259 (FAX)

1) Resubmitted cover letter, resigned and redated.
2) FROM: LEIDOS, STLOUIS,
DENNIS R. CHAMBERS, RSO

Ms. Frasier,
Please contact me with any questions.

Regards,
Dennis R. Chambers

U.S. Nuclear Regulatory Commission
License Amendment Request

RECEIVED JAN 09 2015

U.S. Nuclear Regulatory Commission
Region III
ATTN: Material Licensing Section
801 Warrenville Road
Lisle, Illinois 60532

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Dennis R. Chambers, CHP
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RECEIVED JAN 09 2015

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ATTACHMENT 2

Health Physics Procedures

LEIDOS
HEALTH PHYSICS PROCEDURES

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Procedure Number	Title	Revision	Date
HP-01	Health Physics Manual	0	01/07/2015
HP-02	ALARA Program	0	01/07/2015
HP-03	Radiological Limits	0	01/07/2015
HP-04	Qualifications and Training	0	01/07/2015
HP-05	Personal Protective Equipment	0	01/07/2015
HP-06	Radiological Respiratory Protection	0	01/07/2015
HP-10	Personnel and Equipment Decontamination	0	01/07/2015
HP-11	Radiological Monitoring	0	01/07/2015
HP-12	Health Physics Oversight	0	01/07/2015
HP-20	Radiological Posting and Labeling	0	01/07/2015
HP-21	Health and Safety Work Permits	0	01/07/2015
HP-22	Radiological Reporting	0	01/07/2015
HP-23	Radioactive Source Control	0	01/07/2015
HP-24	Contamination Control	0	01/07/2015
HP-25	Storage and Control of Radioactive Waste	0	01/07/2015
HP-30	Radiological Instrumentation	0	01/07/2015
HP-40	Personnel Radiation Exposure Monitoring	0	01/07/2015
HP-50	Radioactive Material Shipping	0	01/07/2015
HP-51	Limited Quantity Radioactive Material Shipping	0	01/07/2015
HP-52	Shipping and Receipt Surveys	0	01/07/2015

LEIDOS ST. LOUIS

HEALTH PHYSICS MANUAL

HP-01

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1.0 Purpose

The Leidos Health Physics Program, as defined within this manual (Health Physics Procedure [HP]-01) and supporting procedures, is developed to ensure work activities involving potential exposure to ionizing radiation, where the activities are conducted under this program, are performed in accordance with applicable regulatory requirements. This program contains the basic concepts and criteria of a radiation safety program and is implemented through procedures addressing specific categories of radiation safety and regulatory compliance. The program provides for the following commitments:

1.1 radiological safety of occupationally exposed personnel, the public and the environment,

1.2 monitoring of radiation and radioactive materials,

1.3 controlling distribution and releases of radioactive materials, and

1.4 maintaining occupational radiation exposure to individuals within regulatory limits, and at levels as low as reasonably achievable (ALARA).

2.0 Scope

2.1 This manual and supporting procedures apply to all Leidos or subcontractor personnel at sites or locations working under this Leidos Radiation Safety Program. This program is designed to ensure regulatory compliance through the implementation of procedures, personnel training, and development of technical work records that document a specific method of compliance. The Radiation Safety Program provides the following commitments:

2.1.1 Each individual is responsible for integrating the information contained in Health and Safety Work Permits (HSWPs), Radiation Worker Training (RWT), and additional site-specific radiation safety training into all applicable work activities.

2.1.2 Each individual working under this Radiation Safety Program must understand and accept the responsibility to follow all procedures and maintain radiation exposures at levels ALARA.

2.1.3 Leidos shall comply strictly with all regulatory requirements, radiation exposure limits, and limits regarding release of radioactive materials.

2.1.4 Leidos shall maintain a comprehensive radiation safety program to keep individual and collective radiation exposures to workers and the public below regulatory limits and ALARA.

2.2 This manual and supporting procedures are based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20 (10 *CFR* 20), *Standards for Protection against Radiation.* Sites where this program is implemented other than those regulated by the Nuclear Regulatory Commission (NRC) (i.e., U.S. Department of Energy [DOE], U.S. Army Corps of Engineers [USACE], etc.) may require establishment of guidelines and requirements differing from those set forth in this procedure. The Leidos Radiation Protection Manager (RPM) will document these differences and establish guidelines and requirements in the Site

Safety and Health Plan (SSHP) for that site (or in other appropriate documents), as applicable.

3.0 References

3.1 10 *CFR* 19, Notices, "Instructions and Reports to Workers: Inspection and Investigations."

3.2 10 *CFR* 20, "Standards for Protection against Radiation."

3.3 10 *CFR* 20, Appendix G – "Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests."

3.4 10 *CFR* 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," including 10 *CFR* 30.72, Schedule C – "Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release."

3.5 10 *CFR* 33, "Specific Domestic Licenses of Broad Scope for Byproduct Material."

3.6 10 *CFR* 40, "Domestic Licensing of Source Material."

3.7 10 *CFR* 61, "Licensing Requirements for Land Disposal of Radioactive Waste," including 10 *CFR* 61.55, "Waste Classification."

3.8 10 *CFR* 70, "Domestic Licensing of Special Nuclear Material."

3.9 10 *CFR* 71, "Packaging and Transportation of Radioactive Material."

3.10 10 *CFR*, Chapter III, Department of Energy, Part 835, "Occupational Radiation Protection."

3.11 29 *CFR* 1910.132, "Occupational Safety and Health Administration Requirements," including 29 *CFR* 1910.132, "Personal Protective Equipment, and 29 *CFR* 1910.134, Respiratory Protection."

3.12 40 *CFR*, "Protection of the Environment," with emphasis on provisions of hazardous waste regulations; Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); the Resource Conservation and Recovery Act (RCRA); and associated hazardous waste regulations in Parts 240 through 281.

3.13 49 *CFR*, "Transportation."

3.14 49 *CFR*, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177, "Hazardous Materials Regulations," and Part 178, "Specifications for Packagings."

3.15 ANSI 1997a. American National Standards Institute. *Inspection, Test, Construction, and Performance Requirements for Direct Reading Electrostatic/electroscope Type Dosimeters.* ANSI N322-1997. February 1997.

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3.19 ANSI 2003b. American National Standards Institute. *American National Standard Performance Specifications for Health Physics Instrumentation - Portable Instrumentation for Use in Normal Environmental Conditions.* ANSI N42.17A-2003. April 2003.

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3.25 DOE 2004. U.S. Department of Energy. *DOE Standard, Radiological Control.* DOE-STD-1098-99. July 1999 (Reaffirmed December 2004).

3.26 DOT 2012. U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA). *2012 Emergency Response Guidebook: A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident.* 2012.

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3.36 NRC 1974a. U.S. Nuclear Regulatory Commission. *Termination of Operating Licenses from Nuclear Reactors.* Regulatory Guide 1.86. 1974.

3.37 NRC 1974b. U.S. Nuclear Regulatory Commission. *Applications of Bioassay for Uranium.* Regulatory Guide 8.11. June 1974.

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4.0 Definitions

This procedure uses the standard definitions contained in 10 *CFR* 20. These and additional definitions are provided below.

4.1 **Access Control Point (ACP)** – an area established to maintain contamination control and access control of restricted areas. ACPs are a good health physics practice and are established at the discretion of the RPM. The ACP is typically where radiological workers will conduct frisk surveys upon exit from the restricted area, conduct equipment surveys, log into and out of the restricted area, doff potentially contaminated personal protective equipment (PPE), and log entry/exit self-reading dosimeter (SRD) readings, as applicable.

4.2 **As Low As Reasonably Achievable (ALARA)** – making every reasonable effort to maintain exposures to radiation as far below the regulatory dose limits prescribed in 10 *CFR* 20 as is practical consistent with the purpose for which the activity is undertaken, taking into account the state of technology, the economics of improvements in relation to the state of technology, the economics of improvements in relation to the benefits to public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

4.2.1 **Airborne Radioactivity Area** – a room, enclosure, or area in which airborne radioactive materials exist in concentrations in excess of the derived air concentrations (DACs) specified in Appendix B to 10 *CFR* 20, or

4.2.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

4.3 **Assigned Protection Factor (APF)** – The expected workplace level of respiratory protection that would be provided by a properly functioning respirator or a class of respirators to properly fitted and trained users. Operationally, the inhaled concentration can be estimated by dividing the ambient airborne concentration by the APF.

4.4 **Authorized User (AU)** – Individuals who, by their training and experience, are allowed to work unsupervised with radioactive material or radiation-generating devices and have knowledge of radiation safety techniques and procedures to ensure the safety of personnel working with radioactive material. Health Physics Technicians (HPTs) are generally among the subset of AUs in this Health Physics Program.

4.5 **Authorized User Assistant (AUA)** – Individuals trained and qualified to work with radioactive materials under the direction of (through the use of an HSWP) AU (i.e., HPT). An AUA is referred to in this document as a radiological worker who has successfully completed radiation worker training (RWT).

4.6 **Conditional Release** – The release of an item from the restricted area that externally meets the requirements of "Unconditional Release," but may have areas inaccessible for surveying. Conditionally released items shall not leave the site controlled area without the approval of the RPM and concurrence of the appropriate client representative.

4.7 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site-specific contamination limits as documented on Attachment 2 of HP-03, "Radiological Limits," or other, more stringent site-specific documentation (i.e., SSHP, Radiation Protection Plan [RPP], etc.).

4.8 **Contamination (Radioactive)** – Deposition of radioactive material in any place not desirable. The presence of unwanted radioactive material on tools, equipment, surfaces, clothing, personnel, and etc.

4.9 **Controlled Area** – An area, outside of a restricted area but inside the site boundary, access to which can be limited for any reason.

4.10 **Decontamination** – The removal of radioactive contamination from surfaces, people, or equipment.

4.11 **Dosimeter** – A device used to measure cumulative radiation dose, such as an SRD, thermoluminescent dosimeter (TLD), or electronic dosimeter (ED).

4.12 **Exposure Extension** – An authorization to increase a worker's allowable exposure to radiation within Leidos exposure guidelines.

4.13 **Extremity** – Hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

4.14 **Frisk** – The term used to describe the method and requirements for monitoring of contamination on personnel, personal clothing and/or body, or other materials and equipment. Frisking is generally performed using either a portable radiation detection instrument or a portal monitor.

4.15 **Health and Safety Work Permit (HSWP)** – A permit issued by the RPM required for work or surveillance that has the potential to result in an individual receiving a Total Effective Dose Equivalent (TEDE) of 100 millirem (mrem) in a year from exposure to radiation or radioactive contamination. The HSWP is a primary part of the ALARA program. HSWPs communicate work area radiological hazards to personnel and specify controls and protective equipment necessary for worker protection.

4.16 **High Radiation Area** – Any area, accessible to individuals, in which levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 100 mrem in 1 hour at 30 centimeters (cm) from the radiation source or from any surface that the radiation penetrates.

4.17 **Primary Radiological Coverage** – A level of radiation safety provided for a work activity determined by the RPM to involve significant radiological hazards, which implies continuous health physics coverage while the work is in progress.

4.18 **Protective Clothing** – Special clothing worn by a radiological worker to prevent bodily or personal clothing contamination.

4.19 **Qualified Personnel** – A person who has demonstrated and documented proficiency in performing a task as specified in health physics procedures and training documents.

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

4.21 **Radiation (Ionizing Radiation)** – alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in 10 *CFR* 20, does not include non-ionizing radiation such as radio- or microwaves, or visible, infrared, or ultraviolet light.

4.22 **Radiation Monitoring** – Continuous or periodic determination of the amount of radiation present in a given area.

4.23 **Radiological Worker Level I (RWI)** – an individual that has successfully completed RWT. An RWI is referred to in this document as a radiological worker who has successfully completed RWT.

4.24 **Radiological Worker Level II (RWII)** – an individual meeting RWI requirements and qualified to perform health physics tasks by satisfactorily completing specific training requirements, as approved by the RPM. An RWII is referred to in this document as an HPT.

4.25 **Radioactive Material Area (RMA)** – an area or room in which an amount of radioactive material is used or stored exceeding 10 times the quantity of such material specified in Appendix C to 10 *CFR* 20.

Note: If a combination of materials is present (e.g., a combination of uranium [U]-238 and cobalt [Co]-60), the following relationship must be used to determine if the area must be posted as an RMA:

$$\frac{\mu Ci_{Co}}{10Q_{Co}} + \frac{\mu Ci_{U}}{10Q_{U}} \leq 10$$

where Q = the quantity shown in Appendix C of 10 *CFR* 20.

4.26 **Radioactive Material Storage Area (RMSA)** – An administratively designated area where radioactive material is stored and controlled.

4.27 **Radioactivity** – Spontaneous disintegration of radioactive nuclei with the resulting emission of nuclear radiation; may be either in the form of particles or electromagnetic energy.

4.28 **Respiratory Protection Factor** – A measure of the degree of protection afforded by a respirator mathematically defined as the ratio of the concentration of contaminant in the ambient atmosphere to that inside the facepiece under conditions of use.

4.29 **Restricted Area** – An area, access to which is limited by the licensee, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.30 **Secondary or Intermittent Radiological Coverage** – Refers to a level of health physics protection provided for work involving radiological conditions determined by the RPM to require a degree of physical control of the work by the health physics organization short of continuous coverage.

4.31 **Self-Contained Breathing Apparatus (SCBA)** – An atmosphere-supplying respirator for which the source of breathing air is designed to be carried by the user.

4.32 **Self-Reading Dosimeter (SRD)** – Pocket ionization chamber used to monitor X-ray or gamma radiation.

4.33 **Stay Time** – The amount of time a worker may remain in an area and not exceed the allowable exposure guidelines. Typically, stay times are calculated to maintain worker exposures to external radiation ALARA.

4.34 **Thermoluminescent Dosimeter (TLD)** – A dosimeter that measures radiation exposure by radiation interaction with a crystalline structure. TLDs are typically the primary method to measure and quantify personnel exposure from external radiation fields.

4.35 **Unrestricted Area** – An area to which access is neither limited nor controlled by the responsible party.

4.36 **Unrestricted Use (Unconditional Release)** – Classification for materials and equipment (e.g., tools) that, given the levels of residual radioactivity, may be released from or used on site without the imposition of radiological controls, restrictions, or requirements.

4.37 **Very High Radiation Area** – An area, accessible to individuals, in which the levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter (m) from the source or any surface that the radiation penetrates.

4.38 **Waiting Area** – A low exposure area designated for workers to minimize their exposure (utilizing the ALARA techniques of time and distance) while they are not actively performing work in a radiological area. Waiting areas are typically only used in radiation areas, high radiation areas, and very high radiation areas.

4.39 **Week** – 7 consecutive days starting on Sunday.

4.40 **Whole Body Count** – An analysis performed external to the body to determine the amount of gamma-emitting radioactivity deposited in a person's body.

5.0 Responsibilities

5.1 The Radiation Safety Officer (RSO) is responsible for:

5.1.1 Developing radiation safety standards and controls.

5.1.2 Ensuring compliance with the requirements delineated in 10 *CFR* 20, and other applicable federal and state regulations.

5.1.3 Making the appropriate notifications in accordance with Leidos Environmental Health and Safety (EHS) Procedure 19, "Radiation Protection".

5.1.4 Ensuring site activities conducted under this Radiation Safety Program are performed in accordance with this manual and supporting procedures.

5.1.5 Posting a current copy of NRC Form 3, "Notice to Employees," for personnel examination at NRC-regulated sites.

5.1.6 Performing an annual audit of the Radiation Safety Program to identify and address program quality and compliance.

5.1.7 Reviewing personnel exposures upon availability of monitoring results.

5.1.8 Supporting and enforcing radiation safety standards and controls outlined in this procedure.

5.1.9 Assigning a site RPM for each client site working under this Radiation Safety Program.

5.2 The Site Radiation Protection Manager (RPM) is responsible for:

5.2.1 Assuming the roles and responsibilities of the RSO at a specific client site. As noted in Section 6.4.3 of HP-04, "Qualifications and Training," RPM responsibilities specifically exclude:

5.2.1.1 Establishment of or approval to exceed alternate administrative exposure limits;

5.2.1.2 Notifications to regulatory agencies;

5.2.1.3 Approval to dispose of radioactive material, including radioactive waste;

5.2.1.4 Approval authority for SSHPs; and

5.2.1.5 Approval of health physics procedures.

5.3 HPTs are responsible for:

5.3.1 Implementation of this manual and supporting procedures under the direction of the RPM.

5.3.2 Reporting non-conformance with health physics procedures and policies.

5.3.3 Stopping work or ordering an area evacuated when, in their judgment, the radiological conditions warrant such an action and such actions are consistent with site and personnel safety.

5.4 Each radiological worker is responsible for:

5.4.1 Integrating the information contained in HSWPs, RWT, and additional site-specific radiation safety training and instructions into all applicable work activities for maintaining their exposure ALARA.

6.0 Procedure

6.1 General

6.1.1 Health physics activities should be governed by written procedures that are available for review and audit.

6.1.2 The health physics organization is illustrated graphically on Attachment 1.

6.1.3 Responsibilities of personnel performing health physics tasks are communicated through the training qualifications associated with specified tasks and as directed by the RPM.

6.1.4 The Site RPM may delegate responsibilities described in health physics procedures to qualified HPTs when specified by this Health Physics Manual and its implementing procedures (i.e., RPM or designee).

6.1.5 Contractor personnel performing radiation safety-related activities on-site shall be verified to have the training and experience to perform their assigned duties.

6.1.6 HPTs are responsible for providing support for job coverage (i.e., health physics oversight).

6.1.7 The RPM shall be notified of any radiological incidents or emergencies that may involve the contamination of personnel or the loss of control of radioactive material, or that may otherwise be reportable in accordance with 10 *CFR* 20 or more restrictive limits as appropriate. (See HP-22, "Radiological Reporting.")

6.1.8 In health physics procedures, the word "shall" is to be understood as a requirement, and the word "should" is to be understood as a recommendation.

6.1.9 Exemptions to health physics procedures shall be permitted pursuant to the written authorization of the RSO, as site-specific conditions warrant. Procedural exemption authorization shall not be delegated.

6.1.10 In addition to health physics procedures, health physics instructions are implemented to standardize guidance for program areas that are not related to safety. Health physics instructions need only be approved by the RPM.

6.1.11 Procedure attachment (forms) equivalents may be implemented as specific conditions warrant, as approved by the RPM. The information recorded in procedural attachments may also be recorded by electronic means, as approved by the RPM.

6.2 Health Physics Training and Qualification

6.2.1 The training and qualification program for site personnel is designed to provide an adequate level of radiation safety training commensurate with the duties of each worker.

6.2.2 The RSO will have a minimum of four years of applied radiation safety experience, a Bachelor of Science in Health Physics or other related educational field, and 2 years of management experience.

6.2.3 A site RPM will have a minimum of four years of applied radiation safety experience and one year of management experience. The site RPM supports the RSO as the designated client site radiation safety representative.

6.2.4 Senior HPTs will have a minimum of a high school diploma, three years of applied radiation safety experience, and be qualified on the performance of specific tasks. Additional education and training may be substituted for up to one (1) year of experience.

6.2.5 The RPM is responsible for ensuring training for the health physics organization meets the requirements to provide adequate protection of occupationally exposed personnel, public, and environment.

6.2.6 The RPM shall review and approve the content of lesson plans, handout material, and examination question banks for health physics training programs, as applicable.

6.2.7 Prior to allowing unescorted access into the restricted area, personnel are required to successfully complete Site Orientation Training (SOT) and RWT. The RPM may permit access into the restricted area without completing SOT and RWT provided the personnel are accompanied by an individual who has satisfactorily completed SOT and RWT.

6.2.8 HP-04, "Qualifications and Training," outlines the minimum training and qualifications for site personnel. The extent of the training shall be commensurate with the potential hazard. Minimum essential training shall include instructions to workers mandated by 10 *CFR* 19 and Section 2-13 of Engineer Manual (EM) 385-1-80. All individuals likely to receive a dose equal to or exceeding 100 mrem above background in one year shall receive initial training and retraining at least annually thereafter.

6.2.9 RWT

Site employees who frequently enter the restricted area and work in radiological areas shall complete initial RWT.

6.2.9.1 The RPM shall approve all material presented in RWT and the qualifications of instructors who present the material.

6.2.9.2 RWT shall meet the requirements of 10 *CFR* 19.

6.2.9.3 Successful completion of the training provides the necessary knowledge to safely work in radiological areas and meets the requirements to become a Radiological Worker.

6.2.9.4 Specialized training for radiological workers is conducted on an "as needed" basis. This type of training includes use of containment devices, operation of special decontamination equipment, special controls for unusual radiological conditions, and other topics, as required.

6.2.9.5 HP-04, "Qualifications and Training," outlines the content and requirements for successful completion of initial RWT.

6.2.10 Respiratory Protection Training

6.2.10.1 The Respiratory Protection Training Program has been developed in accordance with 10 *CFR* 20 and 29 *CFR* 1910.134.

6.2.10.2 Personnel expected to enter an airborne radioactive material area using respiratory protection equipment must have respiratory protection training. This includes contractors and vendors as well as permanent site personnel.

6.2.10.3 Personnel must successfully complete a refresher training class, and must undergo a fit test and physical examination annually to maintain respiratory protection qualification.

6.2.10.4 Detailed requirements for training, qualification, and use of respiratory protection equipment are contained in HP-06, "Radiological Respiratory Protection."

6.2.11 Health Physics Training

6.2.11.1 Health physics Training is designed to train and qualify health physics personnel (HPTs, Health Physicists, etc.) in the tasks necessary to maintain site radiation safety. Current industry standards and practices are also incorporated into the training material, which serves as the basis for developing competent professionals in the radiation safety field.

6.2.11.2 Contractors or temporary personnel working in the health physics organization are required to complete appropriate health physics training prior to assuming responsibility for radiation safety activities. Training consists of reviewing site-specific procedures and equipment and demonstrating a working knowledge of their implementation. Examination material, an evaluation of past experience, or formal on-the-job training may be utilized to verify qualifications for performing given tasks.

6.2.11.3 Details on health physics training requirements are contained in HP-04, "Qualifications and Training."

6.3 Exposure Control

Occupational dose limits for adults will not exceed those specified in 10 *CFR* 20, Subpart C. In addition, surveys and monitoring will be accomplished in accordance with the criteria specified in 10 *CFR* 20, Subpart F.

Control of radiation exposure received is achieved through a program using HSWPs, administrative exposure limits, and exposure reports. Exposures are monitored using TLDs, EDs, SRDs, portable survey instruments, air sampling, and bioassay samples. The Radiation Safety Program contains guidelines to ensure exposures are maintained ALARA.

6.3.1 Administrative Exposure Limits

6.3.1.1 Personnel receive an initial administrative limit on the annual TEDE as an ALARA awareness limit. The purpose of this limit is to stress each individual's personal awareness of ALARA, radiation exposure accumulation, and their responsibility for maintaining exposures at levels compliant with the ALARA principle.

6.3.1.2 Personnel may be allowed to receive an addition to the initial administrative limit with a formal request for extension, at the discretion of the RSO. It is the responsibility of all personnel, including project management, to make every effort to assure that both individual and collective doses are compliant with the ALARA principle.

6.3.1.3 The dose equivalent to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, shall not exceed 0.5 rem (5 millisieverts [mSv]) TEDE. In addition to assuring compliance with dose constraints on the embryo/fetus, Leidos will take actions to assure that the uniform monthly exposure rate to a declared pregnant woman complies fully with 10 *CFR* 20.1208. If the dose equivalent to an embryo/fetus is found to have exceeded 0.5 rem TEDE, or is within 0.05 rem of this limit when the female worker declares her pregnancy, then Leidos shall be deemed to be in compliance with the limit if the dose to the embryo/fetus does not exceed 0.05 rem TEDE during the remainder of the pregnancy.

6.3.1.4 In the event of jobs involving comparatively high radiation exposures, where individual radiation exposures are anticipated to exceed the initial administrative exposure limit, exposure extensions may be processed prior to start of work. No such exposures will result in exceedance of regulatory dose limits.

6.3.1.5 Provisions for planned special exposures are not expected to be used; however, if planned special exposures become necessary, the activity will be conducted in accordance with the guidance

contained in NRC Regulatory Guide 8.35, "Planned Special Exposures."

6.3.2 HSWPs

The HSWP is the primary tool for ensuring ALARA objectives are incorporated into daily activities. The major emphasis of the program is toward proper planning of activities. This is accomplished by specifying radiological conditions and health physics requirements such as engineering controls, respiratory protection, protective clothing, and dosimetry based upon current conditions, job scope, and historical information. The ALARA objectives incorporated in the HSWP are listed below.

6.3.2.1 **Job Planning** – Issuance of an HSWP requires adequate time to review the radiological hazards at the site and recommend the appropriate protective measures.

6.3.2.2 **Pre-job Estimates** – The collective TEDE estimate involved with each HSWP is conducted when required by HP-02, "ALARA Program." Estimates are based on actual or expected radiation levels, stay times, and/or past experience. Subsequent pre-job actions are based on the estimated exposure.

6.3.2.3 **Post-job Recommendations** – ALARA recommendations for future and similar jobs may be documented on the HSWP. Recommendations are reviewed by the RPM for implementation feasibility. Feedback is provided to originators of ALARA recommendations.

6.3.3 Health Physics Job Reviews

6.3.3.1 Jobs that involve a collective radiation exposure in excess of 1 person-rem will be reviewed by the RPM to ensure that proper radiological controls are utilized and that exposures received are ALARA. Job reviews are scheduled to maintain an ongoing review of major activities with the following objectives:

- Develop or review training guidelines for performing health physics job coverage for specific tasks and/or job categories.
- Review associated site activities to identify and incorporate radiation safety requirements and controls.
- Identify improvements such as equipment changes, procedure changes, shielding applications, or design modifications that may economically reduce exposure or the spread of contamination.

6.3.3.2 Modifications to work activities involving radiation exposure are incorporated into the HSWP, as applicable.

6.3.4 Monitoring for Whole Body External Exposure to Gamma Radiation

Leidos will monitor occupational exposure to radiation from licensed and unlicensed radiation sources under their control and shall supply and require the use of individual monitoring devices in accordance with 10 *CFR* 20.1502, "Conditions Requiring Individual Monitoring of External and Internal Occupational Dose." In addition, Leidos will assure compliance with more dose limits applicable to minors and to declared pregnant women.

Monitoring of radiological workers and calculation of occupational exposure from external sources of radiation will be conducted in accordance with the guidance in NRC Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses," and other appropriate guidance documents.

6.3.4.1 Although monitoring for whole body external exposure to gamma radiation may be accomplished using TLDs, EDs, or SRDs, monitoring for the purpose of establishing the official dosimetry record will be accomplished using TLDs provided by a National Voluntary Laboratory Accreditation Program (NVLAP)-accredited commercial dosimetry service.

6.3.4.2 Personnel will wear whole body dosimetry on the chest to assure a representative measurement of whole body radiation exposure unless otherwise directed by the RPM.

6.3.4.3 Health physics personnel should direct placement of the dosimetry on that portion of the whole body expected to receive the largest exposure during work.

6.3.4.4 Multiple dosimeters are utilized, when necessary, to determine which portion of the whole body receives the highest radiation exposure and to document dose to specific portions of the body (e.g., extremity dose, lens of the eye).

6.3.4.5 Personnel shall immediately stop work and notify an HPT if dosimetry is lost, if an off-scale SRD reading is noted, or if an ED alarm occurs.

6.3.4.6 The HPT or RPM, as applicable, will investigate and initiate a Personnel Monitoring Incident Report for a lost dosimeter or an elevated monitoring result, in accordance with HP-22, "Radiological Reporting."

6.3.4.7 Short-term visitor exposure is normally limited to 50 mrem TEDE. Visitors must have a qualified escort (i.e., qualified radiological worker who has successfully completed RWT and SOT).

6.3.4.8 Although personnel dosimetry may not be required if the RPM determines that personnel entering the restricted area are not likely to exceed 500 millirem per year (mrem/yr) deep dose equivalent (DDE), dosimetry will generally be used for projects

such that effective doses exceed the general public exposure limits of 0.1 rem per year (rem/yr).

6.3.5 Monitoring for Extremity Exposure

6.3.5.1 Monitoring to determine shallow dose equivalent to extremities is required for tasks where an individual's extremity dose is likely to exceed 5 rem/yr.

6.3.5.2 Extremity monitoring will generally be conducted using TLDs.

6.3.5.3 Extremity dose should be recorded and reported as shallow dose equivalent.

6.3.5.4 Actions to preclude or minimize beta and/or gamma radiation exposure to extremities include the use of protective clothing and shielding, and minimization of exposure time.

6.3.6 Monitoring For External Beta Exposure

6.3.6.1 Monitoring to determine shallow dose equivalent to the skin is required for tasks where an individual's skin dose is likely to exceed 5 rem/yr.

6.3.6.2 Monitoring to determine dose equivalent to the lens of the eye is required for tasks where an individual's dose to the lens of the eye is likely to exceed 1.5 rem/yr. Radiation exposure to the skin of the whole body from beta radiation is primarily monitored with TLDs.

6.3.6.3 Radiation exposure due to skin contamination should be calculated, recorded, and reported if any portion of the skin receives greater than 1,000 mrem due to a skin or personal clothing contamination incident.

6.3.6.4 Actions to preclude or minimize beta radiation exposure to the skin of the whole body and the lens of the eye include use of protective clothing, safety glasses, shielding, and/or minimizing exposure time and distance from the source(s).

6.3.7 Quality Control of Dosimetry

6.3.7.1 The TLD processing program shall be accredited by the NVLAP for the energies and types of radiation expected to be encountered at a site.

6.3.8 Monitoring and Control of Surface Contamination

6.3.8.1 Contaminated surfaces of structures or land areas within the restricted area are controlled and posted if alpha or beta/gamma removable surface contamination levels exceed site "removable" contamination limits and/or derived concentration guideline levels (DCGLs). Engineering, preventative, and administrative

controls are utilized to the extent practical to minimize the spread of contamination.

6.3.8.2 Acceptable surface contamination levels prescribed by NRC Regulatory Guide 1.86 will be implemented with respect to average, maximum, and removable activity on materials and equipment (e.g., tools, excavation equipment) being released for unrestricted use.

6.3.8.3 Monitoring of personnel and equipment for surface contamination shall be conducted in accordance with HP-11, "Radiological Monitoring." Routine surveillance surveys for surface contamination shall be conducted in accordance with HP-12, "Health Physics Oversight."

6.3.9 Monitoring and Control of Airborne Radioactive Material

6.3.9.1 Monitoring radiological workers to determine dose from internally deposited radionuclides is required for individuals likely to receive an intake of 10 percent of the applicable ALI(s) in Table 1, Columns 1 & 2 of Appendix B to 10 *CFR* 20.

6.3.9.2 The primary methods of monitoring for internal radiation exposure include air sampling, whole body counting, and use of bioassays (e.g., urinalysis or fecal analysis). The RPM is responsible for determining the most appropriate monitoring method. Monitoring for airborne radioactivity shall be conducted in accordance with HP-11, "Radiological Monitoring."

6.3.9.3 Site areas shall be posted as airborne radioactivity areas in accordance with the requirements of 10 *CFR* 20 and HP-20, "Radiological Posting and Labeling."

6.3.9.4 If monitoring is required, DAC-hours are calculated and documented in dose record files for any individual who, considering respiratory protection, is estimated to have received 0.4 DAC-hours (i.e., 1 mrem).

6.3.9.5 Process and engineering controls such as temporary ventilation and containment are utilized when practical to minimize the need for respiratory protection equipment. Routine use of respiratory protection equipment to control internal exposures is strongly discouraged. The use of respiratory protection equipment is normally limited to non-routine evolutions where process and engineering controls are not practical or in emergency situations.

6.3.9.6 When process or engineering controls are not practical to eliminate exposure to airborne radioactive materials and/or radiation, ALARA assessments should consider exposure and total risks with and without respiratory protection equipment. The goal is to minimize the workers total risk (i.e., radiological, industrial, and environmental factors). Respirators should not be

used if the assessment indicates that the total radiation dose or total risk would be increased. ALARA assessments are also performed when respiratory protection devices have a protection factor less than the peak number of DACs (i.e., the concentration inside the respirator is assumed to be greater than 1 DAC even after considering the respirator protection factor).

6.3.9.7 The HSWP identifies when the potential exists for airborne radioactive material and specifies the controls used to limit exposure. Health physics personnel are trained in the proper use of air sampling equipment and DAC-hour calculation methods. The RPM is responsible for specifying when the use of respiratory protection equipment is required.

6.3.9.8 When the use of respiratory protection equipment is necessary, only those devices which are National Institute of Occupational Safety and Health (NIOSH)-approved are used. Selection of such devices for a particular application is based upon protection factors specified in site procedures and 10 *CFR* 20, Appendix A. The protection factor for the type of respiratory protection device selected should reduce the inhaled concentration to less than 1 DAC, whenever practical.

6.3.9.9 The following requirements shall apply to the use of respiratory protective equipment:

- Personnel are fully respirator qualified when all three of the following criteria are satisfactorily completed.
  - Personnel are medically qualified to wear respiratory protection equipment.
  - Personnel have successfully completed either an initial respiratory training class or an annual re-qualification class.
  - Personnel have been successfully fitted for the respirator to be used within one year of use.
- Personnel designated to maintain respirator qualification are required to undergo medical evaluation on an annual basis.
- Respirator qualification requires annual respirator fit tests, for which facial hair around the sealing periphery of the respirator mask must be shaved so that facial hair does not interfere with the form, fit, or function of the respirator mask.
- Most personnel who receive occupational radiation exposure on a routine basis may also be expected to work in airborne radioactive material areas when such conditions

exist. Project managers are responsible for ensuring that the number and skills of respirator-qualified personnel are adequate for supporting normal site operations, periods of increased workload, and emergency conditions.

- Personnel who have medical limitations or cannot obtain a satisfactory seal due to facial dimensions are not qualified to wear respiratory protection equipment.

6.3.10 Radiological Posting and Labeling

6.3.10.1 Posting requirements are defined in 10 *CFR* 20, Subpart J, for radiation areas, high radiation areas, very high radiation areas, airborne radioactivity areas and areas or rooms where licensed material is used or stored. Areas within the restricted area are posted as a radiation area if general area levels are equal to or greater than 5 mrem/hour and as a high radiation area if general area levels are equal to or greater than 100 mrem/hour at 30 cm. General area measurements for posting purposes are made at twelve (12) inches (30 cm) from the radiation source or from any surface that the radiation penetrates.

6.3.10.2 High radiation areas are conspicuously posted and barricaded in accordance with 10 *CFR* 20.

6.3.10.3 Control of access to high radiation areas shall be in accordance with 10 *CFR* 20.1601. Entryways to high radiation areas should be locked, except during periods when access to the areas is required. Positive controls shall be maintained during each entry into a high radiation area.

6.3.10.4 When conditions are impractical for barricading or locking, such as limited evolution jobs or temporary storage, flashing lights (normally red) are utilized with the high radiation area posting to alert the individual to potential entry into a high radiation area. Direct surveillance to prevent unauthorized entry may be substituted for locked areas or flashing lights for temporary high radiation areas.

6.3.10.5 Surveys and Monitoring will comply with 10 *CFR* 20, Subpart F.

6.3.10.6 Any individual or group of individuals entering a high radiation area shall be provided with, or accompanied by, one or more of the following:

- A radiation monitoring device which continuously indicates the radiation levels in the area.
- A radiation monitoring device which continuously integrates the radiation dose rate in the area and alarms when a preset integrated dose is received. Entry into such

areas with such a device may be made after the radiation levels in the area are known.

- A Senior HPT with a radiation exposure rate monitoring device, who is responsible for providing positive control over the activities within the area.

6.3.10.7 Areas are posted as very high radiation areas if dose rates could exceed 500 rads in 1 hour at 1 m from any source.

6.3.10.8 In addition to the requirements for high radiation areas stated in 10 *CFR* 20.1601, Leidos will institute additional measures to ensure that an individual is not able to gain access to very high radiation areas.

6.3.10.9 Very high radiation areas shall require special posting in accordance with 10 *CFR* 20, must be locked when not open for access, and require primary health physics coverage for each small group entering when open for access. When unlocked, a guard will be posted to prevent unauthorized access.

6.3.10.10 The RPM shall institute the controls necessary (in addition to the controls above) to ensure that an individual is not able to gain unauthorized access to very high radiation areas in which radiation levels could be encountered at 500 rads or more in 1 hour at 1 meter from a radiation source or any surface through which the radiation penetrates.

6.3.10.11 Restricted areas are posted and controlled to ensure that personnel in unrestricted areas will not receive greater than 2 mrem in any 1 hour or 100 mrem TEDE in 1 year.

6.3.10.12 Client sites working under the Leidos Radiation Safety Program shall be posted in accordance with HP-20, "Radiological Posting Labeling."

6.4 Radioactive Material Control

The health physics organization is responsible for identification, surveillance, and accountability of radioactive material as conditions warrant.

6.4.1 Control of Radioactive Material within the Restricted Area

6.4.1.1 Radioactive material is maintained within the restricted area of the site or in an RMSA, unless otherwise approved by the RPM or a designated Senior HPT.

6.4.1.2 Labeling is not required if any one of the exceptions delineated in 10 *CFR* 20 apply.

6.4.1.3 The RPM, with the assistance of HPTs, shall control radioactive sources in accordance with HP-23, "Radioactive Source Control."

6.4.1.4 Good housekeeping is necessary to ensure material used by workers is decontaminated and/or stored in a controlled manner once work is completed. This includes proper packaging and prompt survey upon removal of items from a contaminated area.

6.4.1.5 Movement and storage of radioactive material is monitored by the health physics organization when the potential exists for unnecessary or inadvertent radiation exposure. Surveys are routinely performed in RMSAs and non-posted areas to ensure compliance with health physics procedures and policies.

6.4.1.6 Designated RMSAs are posted and controlled in accordance with 10 *CFR* 20.

6.4.2 Control of Radioactive Material Outside the Restricted Area

6.4.2.1 The RPM, or Senior HPTs, may designate RMSAs outside of the restricted area(s), but within the controlled area of the site.

6.4.2.2 Materials with the potential to be volumetrically contaminated shall be evaluated on a case-by-case basis, and unconditional release shall be approved by the RPM.

6.4.3 Control of Radioactive Material Receipt and Shipment

6.4.3.1 Receipt and shipment of radioactive material is performed in accordance with U.S. Department of Transportation (DOT) regulations contained in 49 *CFR,* 10 *CFR* 71, and health physics procedures, including:

6.4.3.2 HP-50, "Radioactive Material Shipping";

6.4.3.3 HP-51, "Limited Quantity Radioactive Material Shipping"; and

6.4.3.4 HP-52, "Shipping and Receipt Surveys."

6.4.3.5 Leidos personnel will comply with the initial and retraining requirements of 49 *CFR* 172.704.

6.4.3.6 For NRC-licensed material, controls for shipments include package determination and a quality assurance (QA) program in accordance with 10 *CFR* 71.

6.4.3.7 HPTs are responsible for performing radiation and contamination surveys on vehicles and radioactive material payloads upon arrival at, and departure from, the site. They will also prepare and review shipment documents and verify recorded radiation and contamination levels.

6.4.3.8 Radioactive materials are promptly surveyed and normally stored within the restricted area or approved RMSAs after receipt.

6.4.3.9 HP-52, "Shipping and Receipt Surveys," establishes criteria for radiation and contamination surveys on radioactive shipments;

and specifies when surveys are required, the types of surveys required, and the extent of surveys and documentation required.

6.5 Radiological Surveillance

Radiological surveillance is established to ensure compliance with applicable regulations while ensuring that radiation exposures are maintained ALARA. Specific requirements are contained in HP-11, "Radiological Monitoring," and HP-12, "Health Physics Oversight."

6.5.1 Routine Surveillance

6.5.1.1 HPTs are responsible for performing routine surveys (radiation, contamination, and/or airborne radioactive material) in specified areas of the site. Survey requirements, including frequencies, are established on a site-specific basis to adequately assess trends within the restricted area and ensure that adequate controls are being maintained to preclude the contamination of additional areas.

6.5.1.2 Routine surveys within the restricted area shall be sufficient to assess significant changes in radiological conditions, to provide a method for establishing controls, and to ensure proper controls already established are adequate.

6.5.1.3 In areas outside the restricted area(s) of the site (controlled and/or uncontrolled areas), surveys are routinely performed in areas used frequently by personnel who work extensively in the restricted area, as appropriate.

6.5.1.4 Surveys, both routine and non-routine, will be appropriately documented to serve as a useful tool in job planning and establishing a radiological history for future reference. HP-11, "Radiological Monitoring," and HP-12, "Health Physics Oversight," specify the types of surveys to be documented.

6.5.1.5 Any survey that reveals abnormal results shall be investigated to determine the cause of the abnormal results and the method for returning the area to normal. The RPM is informed of abnormal survey results.

6.5.2 Radiation Surveys

Surveys performed to determine radiation levels throughout the site are conducted with survey instruments calibrated for the types and ranges expected or actually present. Area radiation surveys are performed to determine general area radiation levels and to identify components that are significant contributors to the general area levels.

6.5.3 Contamination Surveys

6.5.3.1 Surveys for surface contamination are usually performed using a smear technique or by direct measurement. Instrumentation used

to analyze smears taken outside the restricted area or smears taken to unconditionally release equipment or clear contaminated areas should be capable of detecting contamination levels at 50 percent of the applicable release limit.

6.5.3.2 Contamination surveys are performed in controlled and uncontrolled areas of the site to evaluate the effectiveness of contamination control methods and to adequately assess personnel protection requirements. Prior to issuing a HSWP, contamination levels in a work area are determined, or an evaluation is performed and used to establish protective clothing requirements.

6.5.3.3 Personnel monitoring for contamination is accomplished using friskers or stationary monitors. The GM frisker and dual phosphor alpha/beta scintillation detectors are the primary types of instrumentation used by personnel exiting contaminated areas.

6.5.4 Airborne Radioactive Material Surveys

6.5.4.1 Concentrations of airborne radioactive material are assessed on a routine basis at a frequency dictated by site conditions in accordance with HP-11, "Radiological Monitoring." These assessments are performed using equipment and techniques appropriate for the types of radioactive material present at the sampling locations.

6.5.4.2 Air sampling data, or an evaluation of potential conditions, are used as the basis for establishing respiratory protection requirements for HSWPs. Periodic air samples are also collected when work is being performed where a reasonable potential for airborne radioactive material exists to ensure that respiratory protection specified is adequate and that radiological conditions have not deteriorated.

6.5.4.3 Air sampling will be accomplished in accordance with NRC Regulatory Guide 8.25 and HP-11, "Radiological Monitoring."

6.6 Instrumentation

6.6.1 Instrumentation is available to properly detect and measure encountered types of radiation over a wide range of exposure rates and energies.

6.6.2 Calibration guidance contained in NRC Regulatory Guide 8.25 and American National Standards Institute (ANSI) N323A-1997 is referenced in order to maintain an industry standard calibration program.

6.6.3 HP-30, "Radiological Instrumentation," defines instrument calibration requirements, the determination of quality control (QC) acceptance criteria, and instrument efficiency determinations.

6.6.4 QC of radiation survey instruments is established and maintained in accordance with HP-30, "Radiological Instrumentation."

6.7 Quality Control

6.7.1 Administration of the internal program for maintaining a high level of quality is accomplished through the organization described in Section 6.1. The RPM ensures proper evaluation of procedures and reported results.

6.7.2 Procedures delineate the requirement that data analysis and review are conducted in a timely manner by qualified personnel to ensure consistency and accuracy of results.

6.7.3 Periodic audits performed on the radiological monitoring QA program are described in Section 6.8.

6.8 Oversight

6.8.1 Oversight is performed to ensure the effectiveness of the health physics program through the following measures.

6.8.1.1 Identify non-compliance with federal, state, and procedural requirements.

6.8.1.2 Identify work practices that could be improved, particularly those which could result in unnecessary exposure.

6.8.1.3 Evaluate the effectiveness of health physics training.

6.8.1.4 Identify radiological control problems and other potential problems.

6.8.1.5 The RPM, or another qualified health physicist, shall annually review the performance of the Radiation Safety Program.

6.8.2 The RPM and/or HPTs are responsible for reviewing activities in the restricted area. These reviews consist of reviewing HSWP requirements and survey records, and periodic observation of selected activities. Reviews are performed to assure procedural compliance, proper work practices, proper postings, and adequate health physics surveillance.

6.8.3 Health physics training programs are reviewed annually by the RPM, or designee, to identify areas for improvement. Experience gained through past problems and occurrences are considered during such reviews.

6.9 Radiological and Personnel Monitoring Incident Reporting

6.9.1 HP-22, "Radiological Reporting," defines the criteria and methods for reporting and tracking radiological and personnel monitoring incidents. Proper emphasis is placed on the correction of reported items to prevent their recurrence.

6.9.2 The report objectives are to identify generic problems and adverse trends and recommend actions that may reduce the frequency of repeated problems.

6.9.3 Instrument deficiency reports are used to report problems or deficiencies with portable radiation detection and measurement equipment, in accordance with HP-30, "Radiological Instrumentation."

7.0 Records

7.1 Records will be maintained in accordance with 10 *CFR* 20, Subpart L. These records include:

7.2 Records of Surveys;

7.3 Determination of prior occupational dose;

7.4 Records of planned special exposures;

7.5 Records of individual monitoring reports;

7.6 Records of dose to individual members of the public; and

7.7 Records of waste disposal.

7.8 Records of the Radiation Protection Program shall include: the provision of the program, and

7.8.1 Audits and other reviews of program content and implementation.

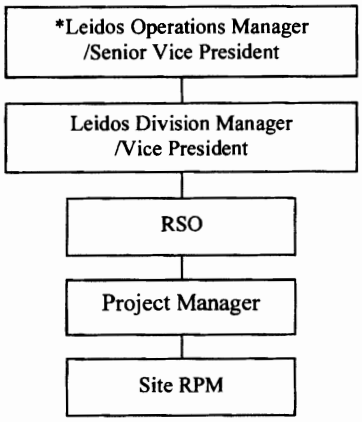
7.9 Records of audits and reviews of the Radiation Protection Program shall be maintained on file for 3 years. Records of the provisions of the Radiation Protection Program shall be kept on file until the NRC terminates the NRC license (if applicable).

7.10 The units of curie, rad, and rem, including multiples and subdivisions, shall be used to clearly indicate the units of all quantities on records required by 10 *CFR* 20. SI units may be used in conjunction with the units specified above (in parenthesis following the specified unit).

7.11 Information recorded on shipping manifests must be recorded in SI units or in SI units and those units specified in Section 7.3.

7.12 All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system. Reports will be developed and submitted in accordance with 10 *CFR* 20, Subpart M. These reports will address theft or loss of licensed material; incidents; reports of exposures, radiation levels, and concentrations of radioactive material exceeding the restraints or limits; planned special exposures; reports to individuals of exceeding dose limits; reports of individual monitoring; and reports of transactions involving nationally tracked sources.

LEIDOS HEALTH PHYSICS ORGANIZATION



LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-02

REV. 0

ALARA PROGRAM

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LIST OF ATTACHMENTS

1. ALARA POLICY STATEMENT
2. PRE-JOB ALARA REVIEW
3. POST-JOB ALARA REVIEW
4. ALARA SUGGESTION FORM

1.0 Purpose

This program establishes the policies for maintaining exposures to ionizing radiation as low as reasonably achievable (ALARA). The ALARA Program helps ensure exposure of the general public and facility personnel to radiation and radioactive material is kept as far below site limits as is reasonably achievable.

2.0 Scope

This procedure applies to all Leidos and subcontractor activities that take place involving radioactive material at sites working under this Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection against Radiation."

3.2 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01.Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Health and Safety Work Permits." Leidos St. Louis Health Physics Procedure. HP-21.

3.3 NRC 1977. U.S. Nuclear Regulatory Commission. *Operating Philosophy for Maintaining Occupational Exposures As Low As Is Reasonably Achievable.* Regulatory Guide 8.10. Revision 1. May 1977.

3.4 NRC 1978. U.S. Nuclear Regulatory Commission. *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will be As Low As Is Reasonably Achievable.* Regulatory Guide 8.8. Revision 3. June 1978.

3.5 USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Safety.* Engineer Regulation. ER 385-1-80. June 30, 2010.

3.6 USACE 2012. U.S. Army Corps of Engineers. *Safety: Safety and Health Requirements Manual.* Engineer Manual. Consolidated EM 385-1-1. September 15, 2008, with Change #7 effective July 20, 2012.

4.0 Definitions

4.1 **As Low As Reasonably Achievable (ALARA)** – Making every reasonable effort to maintain exposures to radiation as far below the regulatory dose limits prescribed in 10 *CFR* 20 as is practical consistent with the purpose for which the activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

4.2 **Reasonably (or Reasonable)** – Within the bounds of good sense and practicality.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Incorporate the ALARA concept into training programs developed for site personnel.

5.1.2 Ensure that the ALARA Program is implemented in accordance with procedural requirements.

5.1.3 Establish an ALARA Suggestion Program.

5.1.4 Review ALARA suggestions for program incorporation.

5.1.5 Perform pre- and post-job ALARA reviews, as required by this procedure.

5.2 All site personnel have the responsibility to:

5.2.1 Follow ALARA practices and procedures.

5.2.2 Incorporate the ALARA concept into everyday work habits and activities.

5.2.3 Make ALARA suggestions to the RPM when better methods or equipment could be utilized to reduce exposure to ionizing radiation.

6.0 Procedure

6.1 ALARA Program Elements

6.1.1 Develop an ALARA Policy Statement.

6.1.2 Post the ALARA Policy Statement to be accessible to all employees who work with radioactive materials or ionizing radiation.

6.1.3 Develop procedural requirements to ensure the completion of pre- and post-job ALARA reviews and application of the ALARA concept in site design changes, work activity changes, and/or work practices, as applicable.

6.1.4 Establish lines of communication between the site management (Leidos and client) and site personnel such that information concerning the radiological hazards of site activities can be readily accessed by site personnel and clients.

6.1.5 Assess ALARA performance indicators, such as: radiological incident reports, personnel contamination events, and cumulative dose reports.

6.1.6 Review ALARA suggestions for potential dose reduction, assign responsibility for implementation, and follow up each accepted suggestion to ensure incorporation into the program.

6.2 ALARA Policy Statement

6.2.1 The ALARA Policy Statement is contained in Attachment 1 (or equivalent) to this procedure.

6.2.2 The policy statement is used to clearly delineate the responsibilities for the successful implementation of the ALARA Program. This policy statement contains the description of the ALARA Program and its elements.

6.2.3 The policy statement should be provided to all employees during radiation worker training (RWT).

6.3 Work Review

6.3.1 Pre- and Post-Job ALARA Reviews

6.3.1.1 Pre- and post-job ALARA reviews should be documented using Attachments 2 and 3 (or equivalent), respectively.

6.3.1.2 Any work activity that is likely to cause radiation exposures in excess of monitoring thresholds (i.e., 10 percent of 10 *CFR* 20 exposure limits for radiological workers) should have a pre-job ALARA review and an ALARA pre-job briefing conducted by the RPM (or designee) in accordance with HP-21, "Health and Safety Work Permits."

6.3.1.3 A post-job ALARA review will be conducted for all work activities that require a pre-job review. All post-job reviews will be completed within 3 months of job completion or closure of the health and safety work permit (HSWP).

6.3.1.4 Pre- and post-job ALARA reviews, upon completion, will be retained in the project files.

6.3.2 ALARA Goals

Due to changing radiological hazards and concentrations of radionuclides in the material handled at each site, the approach to ALARA goals is necessarily unique. The primary focus of ALARA goal setting will be through pre- and post-job reviews. All goals determined through pre-job reviews should be achievable and realistic.

6.4 ALARA Suggestion Program

6.4.1 Any site employee may make suggestions for the improvement of activities, facilities, and procedures to help reduce exposure to radiation or radioactive materials. Documentation of the suggestion should be performed by completing Attachment 4 (or equivalent) and submitting it to the RPM.

6.4.2 The RPM should indicate approval or disapproval on the ALARA Suggestion Form, and then transmit the form to the Project Manager for further evaluation.

6.4.3 All suggestions should undergo a complete review cycle as listed on Attachment 4 (or equivalent), regardless of any previous reviewer's rejection. Suggestions approved by the site RPM should be implemented into the appropriate facility programs as soon as practicable.

6.5 References (see Section 3.0) used to establish this ALARA Program may be used, at the discretion of the RPM, as additional guidance for ALARA implementation.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

LEIDOS
ALARA POLICY STATEMENT
(AS LOW AS REASONABLY ACHIEVABLE)

The goal of the Leidos ALARA Program is to provide for the radiological safety of the general public and occupationally exposed personnel by limiting all exposures to ionizing radiation, whether occupational or non-occupational, individual or collective, to the lowest reasonably achievable level.

Leidos management demonstrates a strong commitment to the reduction of radiation exposure, including review of the initial design of site work practices with the goal of incorporating the ALARA concept to the maximum extent practicable.

Leidos management provides an opportunity for all site personnel to participate in the ALARA Program by making ALARA suggestions. The individuals in the decision-making process for tasks involving occupational exposure are encouraged to make ALARA suggestions. Routine responsibilities for all site personnel include compliance with requirements of work permits, procedures and training, and participation in pre- and post-job reviews.

Leidos management acknowledges its responsibility to incorporate the ALARA concept in all phases of site and employee activities.

The ALARA Program contains the following elements:

Pre- and Post-Job Reviews

Tracking and Trending of Occupational Exposures

Review of Radiological Incident Reports

Development of ALARA Procedures

ALARA Suggestions

PRE-JOB ALARA REVIEW

HSWP No.: _____ - ___ . _____ **Date:** _____

Client/Location/Site: _____

Material Type: _____

Job Description: _____

_____

_____

_____

_____

_____

Personnel Performing Review: _____

_____

_____

_____

Estimated Person-Hours: _____

Estimated Average General Area Dose Rate: _____

Estimated Average Derived Air Concentration: _____

Calculated External Exposure: _____

(Person hours * dose rate)

Calculated Internal Exposure: _____
(Person hours * DAC * 2.5 mrem/DAC-hour)

Note: DAC – derived air concentration; mrem - millirem

Initial Person-Rem Estimate: _____ **Goal:** _____

Job Classification: **O Routine**

O Non-Routine

PRE-JOB ALARA REVIEW

NOTE:

Prior to performing the ALARA pre-job review, the RPM (or designee) should review previous job histories and/or interview personnel experienced in the task, as appropriate.

PRE-JOB REVIEW GUIDELINES

• HSWP prepared	YES ☐	NO ☐	N/A ☐
• all equipment operable and in good repair	YES ☐	NO ☐	N/A ☐
• dry runs or walkthroughs performed	YES ☐	NO ☐	N/A ☐
• special ventilation required	YES ☐	NO ☐	N/A ☐
• special dosimetry required	YES ☐	NO ☐	N/A ☐
• overall safety aspects of the job discussed	YES ☐	NO ☐	N/A ☐
• housekeeping responsibilities established	YES ☐	NO ☐	N/A ☐

SPECIAL CONTROLS AND/OR COMMENTS: _____

_____

_____

_____

_____

_____

(Attach additional pages as necessary.)

REVIEW PERFORMED BY: _____

Job estimate: > 500 mrem/year internal or external exposure.

RPM (or designee) _____ Date _____

Project Manager _____ Date _____

_____

POST-JOB ALARA REVIEW

Job/Task: _____ **Date:** _____

HSWP No.: _____

Total Person-Rem: _____ **Estimated Person-Rem:** _____

1. Was the Person-Rem estimate for the work accurate? (±25 percent) Yes ☐ No ☐
   If "No," explain. _____
   _____

2. Were exposure reduction suggestions implemented? Yes ☐ No ☐
   If "No," explain. _____
   _____

3. Were exposure reduction methods successful? Yes ☐ No ☐
   If "No," explain. _____
   _____

4. Were any radiation incident reports written on this job? Yes ☐ No ☐
   If "Yes," review and note cause(s).
   _____
   _____

5. Was new equipment identified during the course of work
   that could enhance the work, save time, or reduce dose? Yes ☐ No ☐
   If "Yes," identify and perform cost/benefit analysis. _____
   _____
   _____

6. Did existing equipment perform well? Yes ☐ No ☐
   If "No," explain. _____
   _____

POST-JOB ALARA REVIEW

7. Is facility refurbishment necessary? Yes ☐ No ☐
If "Yes," explain. _____

8. Was housekeeping satisfactory for the duration of the job? Yes ☐ No ☐
If "No," explain. _____

9. Were procedures adequate to the task? Yes ☐ No ☐
If "No," explain. _____

RECOMMENDATIONS (derived from post-job review or debrief with workers):

RPM (or designee): _____ Date: _____

Project Manager: _____ Date: _____

ALARA SUGGESTION FORM

Name: _____ **Date:** _____

Facility: _____

Suggestion: _____

Approve ☐ Disapprove ☐

Project Manager: _____ / _____
Signature Date

Approve ☐ Disapprove ☐

RPM: _____ / _____
Signature Date

Comments: _____

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-03

REV. 0

RADIOLOGICAL LIMITS

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LIST OF ATTACHMENTS

1. NRC REGULATORY GUIDE 1.86 SURFACE CONTAMINATION LIMITS

2. SITE LIMITS

1.0 Purpose

This procedure establishes the guidelines to determine site limits on surficial radiological contamination, individual dose, and the concentrations of radioactive material in air.

2.0 Scope

This procedure applies to all Leidos and subcontractor personnel at sites working under this Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection against Radiation."

3.2 ANSI 1999. American National Standards Institute. *Surface and Volume Radioactivity Standards for Clearance.* ANSI 13.12-1999. August 1999.

3.3 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01.

3.4 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Monitoring." Leidos St. Louis Health Physics Procedure. HP-11.

3.5 NRC 1974. U.S. Nuclear Regulatory Commission. *Termination of Operating Licenses for Nuclear Reactors.* Regulatory Guide 1.86. June 1974.

3.6 NRC 2003. U.S. Nuclear Regulatory Commission. *Radiological Assessments for Clearance of Materials from Nuclear Facilities.* NUREG-1640. June 2003.

3.7 USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Safety.* Engineer Regulation. ER 385-1-80. June 30, 2010.

3.8 USACE 2012. U.S. Army Corps of Engineers. *Safety: Safety and Health Requirements Manual.* Engineer Manual. Consolidated EM 385-1-1. September 15, 2008, with Change #7 effective July 20, 2012.

4.0 Definitions

4.1 **Administrative Exposure Limit** – A limit established in order to stress individual responsibility for maintaining exposures as low as reasonably achievable (ALARA) and to assist in the prevention of any individual exceeding regulatory exposure limits.

4.2 **Air Effluent (AE)** – The concentration of a given radionuclide in air which, if inhaled continuously over the course of a year, would produce a total effective dose equivalent (TEDE) of 0.05 rem.

4.3 **Annual Limit on Intake (ALI)** – the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the Reference Man that would result in a committed effective dose equivalent (CEDE) of 5 rems or a committed dose equivalent (CDE) of 50 rems to any individual organ or tissue.

4.7 **Committed Dose Equivalent (CDE)** – the dose equivalent to organs or other tissues that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

4.8 **Committed Effective Dose Equivalent (CEDE)** – 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 (CDE) to these organs or tissues.

4.9 **Contamination** – The deposition of radioactive material on accessible surfaces of structures, objects, equipment, or personnel that exceeds site surficial release limits.

Contamination may be either "fixed" (e.g., not removable by rubbing with a dry smear) or "removable". Total contamination refers to fixed plus removable contamination.

4.10 **Declared Pregnant Woman** – a woman who has voluntarily informed the Radiation Protection Manager (RPM), in writing, of her pregnancy and the estimated date of conception.

4.11 **Deep Dose Equivalent (DDE)** – external whole body dose equivalent at a tissue depth of 1 centimeter (cm) (1,000 milligrams per square centimeter [mg/cm^2]).

4.12 **Derived Air Concentration (DAC)** – The concentration of a given radionuclide in air which, if breathed by Reference Man for a working year of 2,000 hours under conditions of light work (inhalation rate of 1.2 cubic meters [m^3] per hour) results in an intake of one ALI.

4.13 **Dose** – a generic term meaning absorbed dose, dose equivalent, effective dose equivalent, CDE, CEDE, or TEDE, as used in this procedure.

4.14 **Exposure** – being exposed to ionizing radiation or to radioactive materials.

4.15 **Extremity** – Hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

4.16 **Lens (Eye) Dose Equivalent (LDE)** – external exposure to the lens of the eye taken as the dose equivalent at a tissue depth of 0.3 cm (300 mg/cm^2).

4.17 **Minimum Detectable Activity (MDA)** – The smallest amount of radioactivity that can be detected given the conditions of a specific sample.

4.18 **Shallow Dose Equivalent** – the dose equivalent at a tissue depth of .007 cm averaged over an area of 1 square centimeter (cm^2) when applied to the external exposure of the skin of the whole body or the skin of an extremity.

4.19 **Total Effective Dose Equivalent (TEDE)** – the sum of the DDE and the CEDE.

4.20 **Total Organ Dose Equivalent (TODE)** – the sum of the DDE and CDE.

5.0 Responsibilities

5.1 The RPM shall:

5.1.1 Calculate or approve existing administrative and/or project limits, and document the limits on Attachment 2, or equivalent.

5.1.2 Post Attachment 2 (or equivalent) in an appropriate project work area.

5.2 Health Physics Technicians (HPTs) shall:

5.2.1 Evaluate survey results against the project/site limits of Attachment 2, or equivalent.

6.0 Procedure

6.1 General Requirements

6.1.1 The following limits are project and site-specific: administrative dose, surficial contamination, airborne DAC values, and personnel release. The RPM should use this procedure as a guideline to establish these limits.

6.1.2 Prior to the start of work, the RPM, or designee, shall establish and/or calculate all applicable limits for a project or site, and document those limits on Attachment 2, "Site Limits," or equivalent. The RPM shall approve all site limits.

6.1.3 Supporting information, such as source term and calculations, shall be attached, and filed in health physics files.

6.1.4 Attachment 2 (or equivalent) shall be revised during the project when determined necessary by the RPM. A copy of the most current Attachment 2 (or equivalent) should be posted at the site in an appropriate project work area as determined by the RPM.

6.1.5 Alternatively, previously established limits may be adopted for use at client sites when the limits are contained in an approved document and are approved by the RPM.

6.2 Dose Limits

6.2.1 Regulatory Dose Limits

6.2.1.1 Individual doses for occupational workers shall not exceed 5 rem TEDE or 50 rem TODE per calendar year, excluding medical and background radiation exposures.

6.2.1.2 Individual doses for visitors and members of the general public shall not exceed 0.1 rem TEDE per calendar year.

6.2.1.3 The total radiation dose to the embryo/fetus of a declared pregnant woman shall not exceed 0.5 rem TEDE for the duration of pregnancy.

6.2.1.4 Doses to the lens of the eye shall not exceed 15 rem.

6.2.1.5 Doses to the skin of the whole body or to the skin of any extremity shall not exceed 50 rem.

6.2.2 Administrative Dose Limits

6.2.2.1 Unless otherwise documented for the site, individual doses for visitors or the general public shall not exceed 0.05 rem TEDE per calendar year from site activities.

6.2.2.2 Unless otherwise documented for the site on Attachment 2 (or equivalent), the more limiting of the following administrative dose limits shall apply to individual doses for radiological workers:

- TEDE limited to 0.5 rem per year (rem/yr).
- TODE limited to 5.0 rem/yr.
- Eye Dose Equivalent limited to 1.5 rem/yr.
- Shallow Dose Equivalent limited to 5 rem/yr.
- Extremity Dose limited to 5 rem/yr.

- Declared pregnant women – 500 mrem for the entire gestation period. Declared pregnant women should be limited to exposure rates less than 50 mrem per month unless otherwise approved by the RPM.
- Cumulative Lifetime Exposure Limit limited to 1 rem per year of age.

6.2.2.3 Approval by the Radiation Safety Officer (RSO) is required for any employee to exceed an administrative dose limit, and shall be documented in the employee's exposure record.

6.2.2.4 Alternate site-specific administrative dose limits may be established by the RPM with written approval from the RSO, as documented on Attachment 2, or equivalent.

6.3 Surficial Contamination Limits

6.3.1 The RPM shall provide HPTs with project or site-specific surficial contamination limits on Attachment 2, or equivalent.

6.3.2 Using site characterization data, surficial contamination limits may be derived using NRC Regulatory Guide 1.86 guidance, as presented in Attachment 1, "NRC Regulatory Guide 1.86 Surface Contamination Limits" (or equivalent). Column 1 "Average" values should be used for total activity. Column 3 "Removable" values should be used for removable activity.

6.3.3 Surficial contamination limits may be derived by using the most conservative radionuclide present, or by weighting the radionuclides using the following equation:

$$\text{Weighted Limit (dpm/100 cm}^2\text{)} = \frac{1}{F_1/\text{Limit}_1 + F_2/\text{Limit}_2 + F_3/\text{Limit}_3}$$

Where:

F = The fractional abundance of the radionuclide ($\geq$1 percent abundance)

Limit = The radionuclide surficial contamination limit.

Note: dpm/100 cm^2 = disintegrations per minute per 100 square centimeters

6.3.4 Alternate means of deriving project or site surficial contamination limit may be established by the RPM.

6.4 Derived Air Concentration and Air Effluent Values

6.4.1 The RPM shall provide HPTs with project or site -specific DAC values on Attachment 2, or equivalent.

6.4.2 Using site characterization data, effective DAC values may be derived using the DAC values specified in 10 *CFR* 20, Appendix B, Table 1, Column 3.

6.4.3 Using site characterization data, effective AE concentration values may be derived using the AE values specified in 10 *CFR* 20, Appendix B, Table 2, Column 1.

6.4.4 DAC or AE values may be derived by using the most conservative radionuclide present, or by weighting the radionuclides using the following equation:

$$\text{Weighted DAC or AE } (\mu\text{Ci/ml}) = \frac{1}{F_1/DAC_1 + F_2/DAC_2 + F_3/DAC_3}$$

Where:

F = The fractional abundance of the radionuclide ($\geq$1 percent abundance)

DAC = The radionuclide 10 *CFR* 20, Appendix B, DAC or AE value

Note: µCi/ml = microcuries per milliliter

6.4.5 Alternate means of deriving site DAC or AE values may be established by the RPM, as documented in the Site Safety and Health Plan (SSHP), technical work record (TWR), or equivalent document.

6.4.6 In conjunction with establishing site-specific DAC & AE values, the RPM, or designee, shall provide site-specific minimum air sample volumes on Attachment 2 that are based on the established DAC & AE values.

6.5 Personnel Release Limits

6.5.1 The RPM shall provide HPTs with site-specific total (direct frisk) personnel contamination limits on Attachment 2, or equivalent.

6.5.2 Personnel contamination release criteria should be calculated from the MDA of personnel release detection equipment, in accordance with HP-11, "Radiological Monitoring," Attachment 2, "Radiological Survey Calculation" (or equivalent).

6.5.3 Personnel contamination scanning techniques and detection equipment shall be of sufficient sensitivity to detect less than 5,000 dpm/100 cm^2 beta or 100 dpm/100 cm^2 alpha.

6.6 Additional Guidance

6.6.1 The RPM may use the references listed in Section 3.0 of this procedure (as appropriate) as additional guidance for determination or derivation of site radiological limits. The use or derivation of site radiological limits other than those specified in this procedure should be coordinated with the project client.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

NRC Regulatory Guide 1.86 Surface Contamination Limits

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
Transuranics, 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
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 exist, the limits established for alpha and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, 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 m^2. 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 of objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

Site Limits

Project/Site: _____

Type	Value	Units
Occupational administrative dose		Rem TEDE
Total alpha surficial contamination		dpm/100 cm^2
Total beta surficial contamination		dpm/100 cm^2
Removable alpha surficial contamination		dpm/100 cm^2
Removable beta surficial contamination		dpm/100 cm^2
Occupational alpha DAC value		µCi/ml
Occupational beta DAC value		µCi/ml
Minimum Occupational Air Sample Volume		Liters
Non-occupational alpha AE value		µCi/ml
Non-occupational beta AE value		µCi/ml
Minimum Non-occupational Air Sample Volume		Liters
Personnel release (alpha)		cpm/probe area
Personnel release (beta)		cpm/probe area

Notes:
1) Attach supporting information, such as source term and calculations.
2) Dose limits not listed are equivalent to the dose limits contained within the procedure, unless specified.
3) If a limit does not apply to the project/site, place an "N/A" in the "Value" column.
4) Any volumetric release limits applicable to release of material/equipment at the site should be specified.

Approved By (RPM): _____ Date: _____

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-04

REV. 0

QUALIFICATIONS AND TRAINING

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LIST OF ATTACHMENTS

1. HEALTH PHYSICS TRAINING AND QUALIFICATIONS
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3. HEALTH PHYSICS REQUIRED READING LOG

1.0 Purpose

This procedure describes the qualifications and training necessary to ensure that radiological workers and the health physics staff can perform their duties in accordance with the Leidos Health Physics Program.

2.0 Scope

This procedure applies to all Leidos and subcontractor personnel working under the Leidos Health Physics Program. This procedure does not apply to respiratory protection training.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations."

3.2 10 *CFR* 20, "Standards for Protection against Radiation."

3.3 49 *CFR* 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans," Subpart H, "Training."

3.4 ANSI 1993. American National Standards Institute. *Selection, Qualification, and Training of Personnel for Nuclear Power Plants.* American National Standards Institute and American Nuclear Society. ANSI/ANS-3.1-1993. April 23, 1993.

3.5 IATA 2014. International Air Transport Association. *Dangerous Goods Regulations.* 55th edition. January 1, 2014.

3.6 Leidos 2014. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.

3.7 NRC 1994. U.S. Nuclear Regulatory Commission. *Health Physics Positions (HPPOS) Database.* NUREG/CR-5569. Revision 1. 1994.

3.8 NRC 2000. U.S. Nuclear Regulatory Commission. *Qualification and Training of Personnel for Nuclear Power Plants.* NRC Regulatory Guide 1.8. Revision 3. May 2000.

3.9 USACE 2010. U.S. Army Corps of Engineers *Safety: Ionizing Radiation Safety.* Engineer Regulation. ER 385-1-80. June 2010.

3.10 USACE 2012. U.S. Army Corps of Engineers. *Safety: Safety and Health Requirements Manual.* Engineer Manual. Consolidated EM 385-1-1. September 15, 2008, with Change #7 effective July 20, 2012.

4.0 Definitions

4.1 **Hazardous Materials (HAZMAT) Employee** – A person employed by a HAZMAT employer and one who, in the course of employment, directly affects hazardous materials transportation safety. This term includes an owner-operator of a motor vehicle used to transport hazardous materials in commerce. This term includes an individual, including a self-employed individual, employed by a HAZMAT employer who, during the course of employment:

- Loads, unloads, or handles hazardous materials;
- Manufactures, tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packaging as qualified for use in the transportation of hazardous materials;
- Prepares hazardous materials for transportation;
- Is responsible for safe transport of hazardous materials; or
- Operates a vehicle used to transport hazardous materials.

4.2 **HAZMAT Employer** – A person who uses one or more employee(s) in connection with: transporting hazardous materials in commerce; causing hazardous materials to be transported or shipped in commerce; or representing, marking, certifying, selling, offering, manufacturing, reconditioning, testing, repairing, or modifying containers, drums, or packaging as qualified for use in the transportation of hazardous materials. This includes an owner-operator of a motor vehicle used to transport hazardous materials in commerce.

4.3 **Health Physics Technician (HPT)** – Individual knowledgeable in the field of health physics, responsible for implementation of Health Physics Program and procedure requirements.

4.4 **Radiation Protection Manager (RPM)** – An individual who, by virtue of qualifications and experience, assumes the role and responsibilities of the Radiation Safety Officer (RSO) at a specific client site. The site RPM is delegated the authority to implement the Leidos Health Physics Program, except for the responsibilities listed in Section 6.4.3 of this procedure.

4.5 **Radiation Safety Officer (RSO)** – An individual who, by virtue of qualifications and experience, has been given the authority to implement the radiation safety program. The RSO is qualified to direct the use of radioactive material in a manner that protects health and minimizes danger to life or property. The RSO is responsible for recognizing potential radiological hazards, developing a radiation safety program to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation safety operations.

4.6 **Radiation Worker** – An individual, who, by virtue of his/her job assignment, is likely to receive in excess of 100 millirem per year (mrem/yr) total effective dose equivalent (TEDE). Radiation workers are required to successfully complete Radiation Worker Training (RWT) prior to unescorted access to the Restricted Area, and to renew training annually thereafter.

4.7 **Restricted Area** – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.8 **Task Evaluation Standards (TES)** – HPT training standards that describe the knowledge and requirements necessary to perform an individual health physics task. The HPT trainee is required to discuss knowledge items and perform the task according to the standard, without coaching, in order to successfully qualify on the

task. Some tasks may only require discussion or simulation, based on the nature of the task.

4.9 **Transportation Representative (TR)** – An individual maintaining requisite training and qualifications in accordance with 49 *CFR* 172, Subpart H, and IATA, if applicable. The TR is responsible for characterization, classification (if waste), packaging, marking, labeling, and preparation of radioactive material/waste shipments in accordance with applicable regulatory requirements, including generation of required shipping papers. Additionally, the individual is responsible for the assessment of incoming radioactive material shipments and manifests to ensure compliance with regulatory requirements.

4.10 **Year** – For the purpose of determining HPT experience, a year may be defined as a period of 2,000 hours obtained in no less than a 40 week period.

5.0 Responsibilities

5.1 The Radiation Safety Officer (RSO) shall:

5.1.1 Assign a project RPM, as necessary, to meet project performance requirements. The RSO shall verify the candidate RPM has the requisite education, training, and experience.

5.1.2 Review the past experience of prospective HPTs to ensure that HPT qualifications meet the requirements of this procedure.

5.1.3 Provide training to meet the requirements of this procedure.

5.1.4 Approve all material presented in health physics procedures, TES, and RWT.

5.1.5 Approve the qualifications of individuals who present training material.

5.2 The Transportation Representative (TR) shall:

5.2.1 Maintain shipper training and qualifications as specified in 49 *CFR* 172, Subpart H, and IATA, "Dangerous Goods Regulations."

5.2.2 Maintain and implement the Leidos Transportation Security Plan required by 49 *CFR* 172, Subpart I, and ensure applicable components of the Plan are included in the training provided to "HAZMAT employees."

5.2.3 Develop, maintain, and provide, as directed by the RSO, training to project employees commensurate with the requirements in 49 *CFR* 172, Subpart H, and IATA "Dangerous Goods Regulations."

5.3 Health Physics Technicians (HPTs) shall:

5.3.1 Successfully qualify on the requirements of this procedure prior to performing health physics tasks.

5.4 Project/employee supervisors (radiation worker and/or HAZMAT employee supervisors) shall:

5.4.1 Identify employees requiring access to a Restricted Area, ensuring Site Orientation Training (SOT) and RWT are scheduled and completed prior

to unescorted Restricted Area access, and ensuring RWT is completed annually.

5.4.2 Ensure HAZMAT employees receive training required by this procedure at the specified frequency.

5.4.3 Restrict employees from access to a Restricted Area or work with hazardous materials, as applicable, if an employee's RWT or HAZMAT training expires.

5.5 Radiation workers (including health physics staff) shall:

5.5.1 Successfully complete SOT and RWT prior to unescorted Restricted Area access.

5.5.2 Maintain current radiation worker qualifications (complete retraining annually) for the duration of time unescorted Restricted Area access is required. Health physics staff maintain radiation worker qualifications through the maintenance of their individual training programs. Annual radiation worker retraining is not required.

5.6 HAZMAT employees (including health physics personnel) shall:

5.6.1 If handling or preparing hazardous materials for shipment by air, successfully complete training designed to address the requirements of 49 *CFR* 172, Subpart H, and IATA, "Dangerous Goods Regulations," within 90 days following initial employment or change in job responsibilities subject to initial training.

5.6.2 Prior to completion of initial training, perform tasks subject to the training requirements only under the direct supervision of a properly trained and knowledgeable HAZMAT employee.

5.6.3 Perform only those functions/tasks trained to complete.

5.6.4 Successfully complete retraining every 3 years to meet the requirements of 49 *CFR* 172, Subpart H.

5.6.5 If handling or preparing hazardous materials for transport by air, successfully complete retraining every 2 years to meet the requirements of IATA, "Dangerous Goods Regulations."

6.0 Procedure

6.1 General Requirements

6.1.1 Prior to allowing unescorted access into a Restricted Area, personnel shall successfully complete SOT and RWT.

6.1.1.1 Other RWT programs may be accepted in lieu of Leidos RWT if certification of successful completion of the training is provided and the training is determined by the RSO to be equivalent to Leidos RWT.

6.1.1.2 The RSO may permit access to the Restricted Area without completing SOT and RWT, provided an individual who has

satisfactorily completed SOT and RWT accompanies the person at all times while in the Restricted Area. Within the Restricted Area, this access shall be limited to posted Radiation Areas or Radioactive Material (Storage) Areas.

6.2 Site Orientation Training (SOT)

6.2.1 Employees shall successfully complete SOT prior to being allowed unescorted access to Restricted Areas of the site.

6.2.2 SOT shall, at a minimum, contain the following information:

6.2.2.1 Names of site health physics staff and designees;

6.2.2.2 Hazards and symptoms of exposure to radiation and/or radioactive materials, including the contaminants present, exposure limits, required monitoring, and pregnancy concerns;

6.2.2.3 Site and task personal protective equipment (PPE), including training on correct use of PPE;

6.2.2.4 Safe work practices to minimize risk;

6.2.2.5 Safe use of engineering controls and equipment;

6.2.2.6 Medical surveillance requirements and employee medical/exposure records access;

6.2.2.7 Response to abnormal conditions, alarms and/or other forms of emergency communications;

6.2.2.8 Content of the site emergency response plan, including actions to be taken by employees;

6.2.2.9 Site control measures; and

6.2.2.10 Reporting requirements.

6.3 Radiation Worker Training (RWT)

6.3.1 Shall be completed prior to initial unescorted access to the Restricted Area and annually thereafter (every 12 months),

6.3.2 Shall include a written examination in which the trainee is required to answer at least 70 percent of the questions correctly,

6.3.3 Shall not be required for approved RWT instructors by virtue of their knowledge of the subject matter, and

6.3.4 Shall contain the following topics at a minimum:

6.3.4.1 The provisions of applicable regulations (and the Leidos St. Louis Health Physics Program and procedures) concerning occupational radiation protection, including employee rights and responsibilities, risks from occupational exposure to ionizing radiation, and prenatal exposure controls;

6.3.4.2 Radiological fundamentals;

6.3.4.3 Biological effects resulting from exposure to sources of ionizing radiation;

6.3.4.4 Exposure limits (administrative and regulatory), including employee responsibilities;

6.3.4.5 As Low As Reasonably Achievable (ALARA) Program;

6.3.4.6 Personnel monitoring;

6.3.4.7 Radiological access controls and postings;

6.3.4.8 Radioactive contamination control;

6.3.4.9 Radiological emergencies, including employee actions in the event of an emergency; and

6.3.4.10 Packaging, marking, labeling, and preparation of radioactive materials or radioactive waste for shipment, commensurate with assigned duties and responsibilities. This shall include applicable regulations governing this activity (49 *CFR*, 10 *CFR*, and IATA), as well as components of the Transportation Security Plan, if applicable.

6.3.5 RWT for employees at U.S. Department of Energy (DOE) sites, as well as other project sites involving work in contaminated areas, potential contaminated areas, work requiring access to high and/or very high radiation areas or other areas as determined by the RSO, shall include a practical factors evaluation. This shall include demonstration of the following:

6.3.5.1 Ability to read, understand, and comply with the requirement of a radiation work permit (RWP) or health and safety work permit (HSWP), including:

- Identification of the unique number assigned to the RWP/HSWP, effective date and termination date;
- Scope of work allowed by the RWP/HSWP, including radiological areas where the work will be performed;
- Pre-job briefing requirements;
- Engineering controls, if specified;
- Protective clothing, other PPE, and dosimetry requirements;
- Health physics survey requirements;
- Radiological hazards present in the work area, including contamination levels, airborne radioactivity, and radiation dose rates;
- Radiological hold points, including identification of abnormal conditions and "back out" criteria;
- Other ALARA requirements, including tools/work practices to minimize personnel exposure, contamination control

measures, low dose waiting areas and radioactive waste minimization/ reduction; and

- Personnel, equipment, and material survey requirements.

6.3.5.2 Using the information presented in an RWP or HSWP, demonstrate the following:

- Properly select, inspect, and don protective clothing and other PPE, if required;
- Complete all prerequisites necessary to access the work area, including: briefings, verifying correct dosimetry (including dose and dose rate alarm set-points, if using electronic dosimeters) and dosimetry placement, material preparation, identification of radiological areas, and low exposure waiting areas;
- Access a simulated work area, demonstrating knowledge and understanding of radiological postings;
- Perform a simulated task in the area, utilizing appropriate tools and work control measures specified in the RWP/HSWP;
- Proper identification of abnormal conditions and demonstration of acceptable response actions, including response to radiological alarms;
- Demonstrate knowledge of radiological hold points and health physics survey requirements;
- Demonstrate knowledge of proper methods for removal of tools and equipment from radiological areas while minimizing the potential spread of contamination;
- Properly doff protective clothing and exit the work area;
- Properly perform required survey instrument inspections and pre-use checks, and complete personnel monitoring;
- Demonstrate the proper response to an alarm or indication of elevated radioactivity while performing a personnel survey or faulty radiation survey equipment; and
- Demonstrate the ability to determine and record exposure.

6.4 Qualifications of the Radiation Safety Officer (RSO)

6.4.1 The RSO shall have a minimum of 4 years of applied professional level radiation safety experience, a minimum of 1 year of supervisory experience, and a Bachelor of Science (BS) in Health Physics or other related educational field. Experience as an HPT shall not be used as credit toward the 4 years of professional level experience.

NOTE: Certification by the American Board of Health Physics demonstrates acceptable equivalency to the education and experience requirements for the RSO.

6.4.2 The RSO should participate in refresher training. Refresher training may consist of: attendance at seminars or training courses on radiation protection issues, self development through review of books and literature on radiation protection issues, or attendance at scientific meetings where radiation protection issues are discussed.

6.4.3 The RSO may delegate responsibilities described in health physics procedures to a Site RPM, except for: establishing alternate administrative exposure limits, approval to exceed site administrative exposure limits in excess of the authorization provided in HP-01, regulatory agency notification, approval to dispose of radioactive material or radioactive waste, safety and health plan approval, and Health Physics procedure approval.

6.5 Qualifications of the Radiation Protection Manager (RPM)

6.5.1 An individual designated as Site RPM, with RSO responsibilities delegated as allowed by this procedure, shall meet the following minimum requirements:

6.5.1.1 Certification as a registered Radiation Protection Technologist by the National Registry of Radiation Protection Technologists (NRRPT);

6.5.1.2 A 4-year degree in health physics, radiation physics, industrial safety, or related field and 1 year of experience as a senior-level HPT;

6.5.1.3 Qualification or previous experience as a radiological engineer or an ALARA engineer; or

6.5.1.4 Qualification or designation as a health physicist.

6.5.2 The Site RPM should participate in refresher training.

6.6 Qualifications of the Transportation Representative (TR)

6.6.1 A TR shall possess a high school diploma or equivalent and 3 years of experience in characterization of hazardous materials; classification of radioactive waste; and packaging, labeling, marking, shipment, and receipt of radioactive material packages.

6.6.2 A TR that directs the work of others shall also have a minimum of 1 year supervisory experience or, for an entry level supervisory TR, demonstrated supervisory and leadership capabilities, as determined acceptable by the RSO.

6.6.3 A TR that also performs package and/or shipment or receipt radiological surveys shall also meet the qualification requirements of a senior level HPT.

6.6.4 A TR shall possess a current (within 3 years of hire or assignment date) training certificate or complete a training program, with successful completion of a written and/or oral examination, sufficient to demonstrate proficiency in executing responsibilities associated with the hazardous materials transportation regulations of 49 *CFR* and IATA, if shipping hazardous material by air.

6.6.5 A TR shall successfully complete retraining every 3 years to address the requirements of 49 *CFR* 172, Subpart H, and, if packaging or preparing shipments by air, retraining every 2 years to address the requirements of IATA, "Dangerous Goods Regulations."

6.7 Qualifications of Health Physics (Technician) Supervisor (HPS)

6.7.1 An HPS shall have the same education and applicable HPT experience as a senior level HPT. The HPS shall have, in addition to the senior level HPT experience, at least 1 year of supervisory experience or, for an entry level HPS, demonstrated supervisory and leadership capabilities, as determined acceptable by the RSO.

6.7.2 An HPS also performing senior level HPT tasks shall complete all Task Evaluation Standard requirements.

6.8 Qualifications of Health Physics Technicians (HPTs)

6.8.1 The RSO, RPM, or HPS (for HPTs only) shall review prospective or newly hired health physics personnel (Leidos and contractor personnel) education and work experience, including employment verification sufficient to validate the minimum experience requirement, and shall classify each as junior level HPT (Jr. HPT) or senior level HPT (Sr. HPT).

6.8.1.1 Sr. HPT shall possess a high school diploma or equivalent and 3 years of applicable HPT experience. Knowledge of health physics fundamentals should be demonstrated and verified by the RSO. This may include verification of one of the following:

- Completion of an Associates or Bachelors degree in health physics or nuclear engineering.
- Completion of HPT training provided through an Institute for Nuclear Power Operations (INPO) accredited training program.
- Registration by the National Registry of Radiation Protection Technologists (NRRPT).
- Completion of DOE radiological control technician (RCT) core training (or successful completion of a comprehensive challenge examination).
- Successful completion of a written or oral examination administered by the RSO or individual(s) designated by the RSO.
- Other means determined appropriate by the RSO.

NOTE: A Sr. HPT assigned to a project at a DOE site is required to complete 6.8.1.A.5 and the oral examination requirement specified in 6.8.1.A.6.

6.8.1.2 Jr. HPT shall possess a high school diploma or equivalent.

NOTE: A Jr. HPT shall not perform job coverage, equipment or material release surveys, radioactive material receipt or shipping surveys, or personnel decontamination, and shall not approve RWPs/HSWPs or radioactive effluent release permits unless under the direct supervision of a fully qualified Sr. HPT, HPS, RPM, or the RSO.

6.8.2 Education and/or training may be substituted for up to 1 year of HPT experience using the following guidance:

Training/Education	Experience Allowance
Associates, Bachelors, or Advanced Degree In Health Physics or Nuclear Engineering	1 Year
Navy Engineering Laboratory Technician (ELT) Training	1 Year
Commercial Nuclear Utility Sponsored HPT Training Program	Duration of training at 1:1 up to a maximum of 1 year
Health Physics Short Courses	Duration of courses at 1:1 up to a maximum of 1 year

6.8.3 Work experience credited toward the minimum requirement for an HPT will be determined using the following guidance:

Type of HPT Related Experience	Experience Allowance
Navy ELT (non-overhaul)	1:1 up to 1 year
Navy ELT (overhaul)	1:1 with no limit
Shipyard/Tender HPT	1:1 with no limit
National Laboratory HPT	1:1 with no limit
Fuel Processing/Plutonium Production HPT	1:1 with no limit
Nuclear Power Plant Sr. or Jr. HPT (operational HPT performing job coverage)	1:1 with no limit
Dosimetry, Respiratory Protection, Count Room (radiochemistry), or Instrument Calibration Technician	1:1 up to 6 months
Control Point Monitor, Laundry Monitor, or Decontamination Technician (with performance of radiological surveys)	1:1 up to 3 months
Radiation Worker Training (RWT) Instructor	1:1 up to 6 months
HPT Training Instructor	1:1 up to 1 year
Nuclear Facility Decommissioning HPT	Typically 1:1 with no limit
Miscellaneous HPT Work Experience at Other Facilities	Case-by-case, as determined by the RSO

6.9 HPT, HPS, and TR Training and Qualification

6.9.1 The RSO, RPM, or HPS (for HPTs only) shall initiate Attachment 1, "Health Physics Training and Qualifications" (or equivalent), for each newly hired HPT, HPS, or TR.

6.9.2 The RSO, RPM, or HPS (for HPTs only) shall determine required reading/ self study and identify each using Attachment 2, "Health Physics Required Reading" (or equivalent).

6.9.3 The RSO, RPM, or HPS (for HPTs only) shall determine TES completion requirements and identify each on Attachment 1, or equivalent.

6.9.4 NOTE: Completion of each TES may be accomplished through discussion (D), simulated performance (S) or actual performance (P), as determined by the RSO, RPM, or HPS.

6.9.5 Initial training completion shall be documented on Attachment 1, or equivalent, and include:

6.9.5.1 Completion of required reading/self-study assignment, including review of HP-01, Health Physics Manual, Leidos health physics procedures, and applicable federal and state regulations.

6.9.5.2 Successful completion of TES. The TES requirements for each HPT shall be determined commensurate with HPT duties. These may include, but are not limited to, the tasks identified on Attachment 1, or equivalent.

6.9.6 Following completion of all training requirements, the employee shall sign and date Attachment 1, or equivalent, indicating successful completion.

6.9.7 The RSO or RPM shall verify completion of Attachment 1, or equivalent.

6.9.8 The RSO or RPM may promote a Jr. HPT to Sr. HPT when the Sr. HPT qualification and experience requirements are met. This action shall be documented on Attachment 1, or equivalent, as will any additional training and/or qualification requirements.

6.10 Retraining

6.10.1 Permanently employed Leidos personnel and temporary personnel (Leidos and Leidos contractor personnel) assigned to a project for 6 months or longer shall participate in continuing training.

6.10.2 Continuing HPT training shall include:

6.10.2.1 A review of HP-01, "Leidos Health Physics Manual," and all health physics procedures every 3 years;

6.10.2.2 Review of health physics procedure revisions, as documented on Attachment 3, "Health Physics Required Reading Log," or equivalent;

6.10.2.3 Annual review of applicable changes to regulations, industry events, lessons learned, deficiencies identified during the performance of periodic program reviews, and general topics, as determined by the RSO, RPM, or HPS and documented on Attachment 3, or equivalent; and

6.10.2.4 Formal specialized training commensurate with the duties of the HPT, HPS, or TR, as required by the RSO or RPM. This

specialized training may be conducted concurrently with other re-qualification efforts, such as Hazardous Waste Operations and Emergency Response (HAZWOPER).

6.10.3 All HAZMAT employees, including health physics personnel and the TR, involved in preparing hazardous material/waste for transport by any mode other than air transport shall complete retraining:

6.10.3.1 Every 3 years at a minimum (49 *CFR* 172, Subpart H).

6.10.3.2 When conditions, processes, or new transportation hazards are identified, or the individual's job assignment changes, necessitating training.

6.10.3.3 As determined necessary by the RSO or RPM.

6.10.4 All HAZMAT employees, including health physics personnel and the TR, involved in preparing hazardous material/waste for transport by air shall complete retraining:

6.10.4.1 Every 2 years at a minimum to satisfy the requirements of IATA, "Dangerous Goods Regulations."

6.10.4.2 When conditions, processes, or new transportation hazards are identified, or the individual's job assignment changes, necessitating training.

6.10.4.3 As determined necessary by the RSO or RPM.

NOTE: Training specified in 6.10.3 and 6.10.4 shall be commensurate with the employee's assigned duties and responsibilities.

6.10.5 All employees required to maintain radiation worker qualifications shall complete retraining annually (no later than 12 months from the initial or last retraining date). Health physics staff (Jr. and Sr. HPTs, HPSs, RPMs, Health Physicists, and the RSO) maintain their radiation worker qualification through the maintenance of their individual training programs. Annual retraining is not required for health physics staff.

6.10.6 The RSO or RPM may allow a grace period of 30 days from the required HPT or radiation worker retraining completion date. However, the initial training date shall be maintained as the basis for determining training/retraining expiration.

Example: A Sr. HPT completes required training and qualifications on January 15, 2015. The Sr. HPT is then required to complete retraining no later than December 31, 2015. The RSO allows a 30 day grace period, extending the retraining requirement to January 31, 2016. Annual retraining must be completed again no later than December 31, 2016 (December is maintained as the individual's retraining expiration month). For the purpose of retraining, qualifications and expiration dates may be tracked on a monthly basis. Therefore, in this example, the Sr. HPT could complete retraining at any time prior to December 31st.

7.0 Records

7.1 All records generated as a result of this procedure shall be maintained by the RSO or RPM until transmitted to the appropriate electronic record system.

HEALTH PHYSICS TRAINING AND QUALIFICATIONS

Technician Name (Print): **Employment Date:**

Education/work history evaluation: Jr. HPT _____ Sr. HPT _____ HPS _____ TR _____
Attach a copy of resume, work history evaluation and supporting documents, e.g., TR training certificate, etc.

Fundamental knowledge of health physics documented (Sr. HPT and HPS)? Yes/ No/ NA (RSO or RPM) _____ Date: _____

Required reading/self study complete (HP-01, HP procedures, regulations). (HPS/HPT/TR) _____ Date: _____

HAZMAT training complete (49 *CFR* 172, Subpart H) commensurate with duties. (RSO, RPM or HPS) _____ Date: _____

TASK EVALUATION STANDARDS

Task Evaluation Standard Title or Category	Method[1]				Completion	Evaluator
	D	S	P	NA	HPT Initial/Date	Initial/Date
Maintain HP records and issue dosimetry.						
Control point monitoring						
Setup and operation of radiation survey instruments.						
QC checks of radiation survey instruments.						
Obtain, count, evaluate and document an air sample.						
Perform and document a radiation and contamination survey.						
Setup and post a radiation area, contamination area, radioactive material (RAM) area, airborne radioactivity area.						
Perform job coverage in a radiation area and contamination area.						
Perform job coverage in a high radiation area, airborne radioactivity area and high contamination area.						
Perform a RAM receipt survey.						
Label and control RAM.						
Perform and document a RAM/waste package survey.						
Perform and document a RAM/waste shipment survey.						
Generate, revise and terminate an RWP or HSWP.						
Source leak test, inventory & control.						
Perform and document an equipment/material release survey.						
Response to personnel contamination monitor alarm.						
Personnel and equipment decontamination.						
Response to area radiation or airborne radioactivity monitor alarms.						
Response to abnormal radiological conditions.						
Other TES – *attach separate completion records.*						

Completed: (Employee) _____ Date: _____ Verified: (RSO or RPM) _____ Date: _____

[1] D = discuss; S = Simulate; P = Perform; NA = Not Applicable (Determined by RSO, RPM or HPS). Use D or S when radiological conditions prohibit actual performance or conditions do not currently exist (event driven, such as response to alarms, etc.).

HEALTH PHYSICS REQUIRED READING

Entire Staff ☐ HPS ☐ TR ☐ Sr. HPT ☐ Jr. HPT ☐

Year:_____

Number	Title	Issue Date	Completion Date

Required reading should be numbered using the following format: YY-XX (YY = year, XX = sequential number)

HEALTH PHYSICS REQUIRED READING LOG

Entire Staff ☐ HPS ☐ TR ☐ Sr. HPT ☐ Jr. HPT ☐

Title:					
Issued By:		**Issue Date:**		**RR Number:**	
Printed Name	**Signature**	**Date**	**Printed Name**	**Signature**	**Date**

Signature indicates the subject document has been read.

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-05

REV. 0

PERSONAL PROTECTIVE EQUIPMENT

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1.0 Purpose

This procedure establishes guidelines and requirements for the proper use of personal protective equipment (PPE).

2.0 Scope

2.1 The use of Level A and Level B PPE is beyond the scope of this procedure.

2.2 This procedure applies to Leidos and subcontractor personnel working under this Leidos Radiation Safety Program who wear protective clothing in the performance of their work.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection Against Radiation."

3.2 29 *CFR* 1910, Subpart I, "Personal Protective Equipment."

3.3 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." St. Louis – Location 508. Standard Operating Procedure. STL-HP-01. Revision 1.

3.4 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03. Revision 1.

3.5 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Health Physics Oversight." Leidos St. Louis Health Physics Procedure. HP-12.

3.6 Leidos 2014d. *Leidos St. Louis Health Physics Manual.* "Health and Safety Work Permits." Leidos St. Louis Health Physics Procedure. HP-21.

3.7 USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Protection.* Engineer Regulation. ER 385-1-80. June 30, 2010.

3.8 USACE 2012. U.S. Army Corps of Engineers. *Safety: Safety and Health Requirements Manual.* Engineer Manual. Consolidated EM 385-1-1. September 15, 2008, with Change #7 July 20, 2012.

4.0 Definitions

4.1 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site-specific contamination limits as documented on Attachment 2 (or equivalent) of HP-03, "Radiological Limits" or other site-specific documentation (i.e., Site Safety and Health Plan [SSHP], Radiation Protection Plan, etc.).

4.2 **Doff** – To remove protective clothing.

4.3 **Don** – To dress into protective clothing.

4.4 **Personal Protective Equipment (PPE)** – For the purposes of this procedure, the protective equipment worn to: (1) prevent radioactive contamination from transferring to an individual's skin or personal clothing, (2) prevent internal exposures from inhalation of airborne radioactive materials, and (3) prevent external exposures from beta radiation to extremities, skin, or to the lens of the eyes.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Prescribe protective clothing requirements.

5.2 PPE wearers shall:

5.2.1 Don and doff PPE in accordance with the requirements of this procedure.

6.0 Procedure

6.1 General Requirements

6.1.1 The RPM (or designee) shall determine PPE requirements based on the level of (expected) radioactive contamination, levels of beta radiation dose rates, and the scope of work. Consideration should be given for known or suspected hazardous materials in work areas, as applicable. The RPM shall approve PPE requirements through the health and safety work permit (HSWP) system.

6.1.2 PPE requirements should be communicated by: an HSWP, SSHP, area postings, or verbally.

6.1.3 PPE requirements beyond the scope of this procedure (i.e., Level A or B) shall be addressed on a case-by-case basis by the RPM and Site Safety and Health Officer (SSHO), as applicable.

6.1.4 The PPE wearer should check each PPE item for defects (i.e., tears, holes, defective zippers, etc.) prior to donning. Any defective items should be discarded.

6.2 Donning PPE

6.2.1 The following guidelines should be used when donning PPE, as applicable.

6.2.1.1 Secure dosimetry to the appropriate body location. Dosimetry should be worn under coveralls unless directed otherwise by the RPM.

6.2.1.2 Place booties over personal shoes.

6.2.1.3 Put on inner gloves.

6.2.1.4 Put on coveralls. Tape the coverall cuffs over the booties, as directed by HSWP requirements.

6.2.1.5 Place rubber shoes over the booties.

6.2.1.6 Don respirator.

6.2.1.7 Put on the hood, and secure it to the coveralls.

6.2.1.8 Put on required gloves over the cotton glove liners, and tape them over sleeves of the coveralls.

6.3 Doffing PPE

6.3.1 Remove all protective clothing prior to exiting the contamination area.

6.3.2 Reusable and disposable PPE should be placed in separate containers.

6.3.3 Following is the order in which protective clothing should be removed, as applicable. The RPM (or designee) may alter the following sequence as

necessary based on site conditions and/or the work activity being performed.

6.3.3.1 Remove tape securing protective clothing.

6.3.3.2 Remove rubber shoe covers.

6.3.3.3 Remove outer rubber gloves.

6.3.3.4 Remove cloth hood.

6.3.3.5 Remove respirator.

6.3.3.6 Remove dosimetry and place it outside the contamination area.

6.3.3.7 Remove coveralls.

6.3.3.8 Remove disposable shoe covers, one at a time, placing one foot at a time onto an uncontaminated area.

6.3.3.9 Remove inner gloves.

6.3.3.10 Perform required surveys in accordance with HP-12, "Health Physics Oversight."

7.0 Records

No records are generated by this procedure.

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-06

REV. 0

RADIOLOGICAL RESPIRATORY PROTECTION

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LIST OF ATTACHMENTS

1. RESPIRATORY PROTECTION ISSUE LOG

1.0 Purpose

This procedure contains the basic concepts and criteria for a radiological respiratory protection program.

2.0 Scope

2.1 This procedure is to be used as a supplement to *Leidos Corporate Environmental, Health and Safety Program Manual,* Environmental Health and Safety (EHS)-9, "Respiratory Protection," when implemented for the protection of personnel from airborne radioactive material.

2.2 Dust masks may be used in areas not requiring radiological respiratory protection. Use of dust masks in such circumstances will be for worker comfort and will not be covered by this program.

2.3 The use of atmosphere-supplying respirators, self-contained breathing apparatus, and emergency use respiratory protection equipment (RPE) is beyond the scope of this procedure.

2.4 This procedure applies to Leidos and subcontractor personnel working under the Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20 "Standards for Protection against Radiation."

3.2 10 *CFR*, Chapter III, Department of Energy, Part 835, "Occupational Radiation Protection."

3.3 29 *CFR* 1910.134, "Respiratory Protection."

3.4 Leidos 2014a. *Leidos Corporate Environmental, Health and Safety Program Manual.* "Respiratory Protection Program." Environmental Health and Safety Procedure. EHS-9. Revision 0. February 2014.

3.5 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Rev. 1.

3.6 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Radiological Monitoring." Leidos St. Louis Health Physics Procedure. HP-11. Rev. 1.

3.7 Leidos 2014d. *Leidos St. Louis Health Physics Manual.* "Personnel Exposure Monitoring." Leidos St. Louis Health Physics Procedure. HP-40.

3.8 NRC 1999. U.S. Nuclear Regulatory Commission. *Acceptable Programs for Respiratory Protection.* Regulatory Guide 8.15. Revision 1. October 1999.

3.9 NRC 2001. U.S. Nuclear Regulatory Commission. *Manual of Respiratory Protection against Airborne Radioactive Materials.* NUREG/CR-0041, Revision 1. January 2001.

3.10 USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Safety.* Engineer Regulation. ER 385-1-80. June 30, 2010.

3.11 USACE 2012. U.S Army Corps of Engineers Manual. *Safety: Safety and Health Requirements Manual.* Engineer Manual. Consolidated EM 385-1-1. September 15, 2008, with Change #7 effective July 20, 2012.

4.0 Definitions

4.1 **Annual Limit on Intake (ALI)** – The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by Reference Man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

4.2 **Assigned Protection Factor (APF)** – The expected workplace level of respiratory protection that would be provided by a properly functioning respirator or a class of respirators to properly fitted and trained users. Operationally, the inhaled concentration can be estimated by dividing the ambient airborne concentration by the APF.

4.3 **Derived Air Concentration (DAC)** – The concentration of a given radionuclide in air that, if breathed by Reference Man for a working year of 2,000 hours under conditions of light work (inhalation rate of 1.2 cubic meters [m^3] of air per hour), results in an intake of one ALI.

4.4 **Restricted Area** – An area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall ensure that:

5.1.1 The content of the Respiratory Protection Program, when utilized to protect workers from exposure to sources of ionizing radiation, is in compliance with applicable radiological regulations, including 10 *CFR* 20, Subpart H.

5.1.2 To the extent practical, process or other engineering controls (e.g., containment or ventilation) are used to control the concentrations of radioactive material in the air.

5.1.3 Respiratory protection is indicated on the health and safety work permit (HSWP) when required for radiological purposes.

5.1.4 Radiological air sampling is performed and DAC-hours are tracked as required by HP-11, "Radiological Monitoring."

5.1.5 The site bioassay program is implemented in accordance with HP-40, "Personnel Exposure Monitoring," to ensure that the Respiratory Protection Program is effective.

5.1.6 For sites regulated by the Nuclear Regulatory Commission (NRC), the regional administrator of the appropriate NRC regional office is notified in writing at least 30 days before the date that RPE is used for the purpose of limiting intakes of radioactive material.

5.1.7 The Respiratory Protection Program is implemented, in accordance with *Leidos Corporate Environmental, Health and Safety Program Manual,* EHS-9, "Respiratory Protection," including;

5.1.7.1 RPE procurement,

5.1.7.2 Respirator issuance,

5.1.7.3 Respirator maintenance,

5.1.7.4 Respirator selection (when not used for radiological protection),

5.1.7.5 Respirator use,

5.1.7.6 Respirator cleaning and disinfection,

5.1.7.7 Respirator equipment return,

5.1.7.8 Respiratory training program implementation,

5.1.7.9 Respirator fit testing,

5.1.7.10 Respiratory Protection Program surveillances, and

5.1.7.11 Medical surveillance.

6.0 Procedure

6.1 General Requirements

6.1.1 Unwarranted use of respiratory protective equipment shall not be permitted and is considered contrary to the ALARA principle due to the increased time to perform individual tasks and the increase in physiological stress.

6.1.2 Process and engineering controls, such as temporary ventilation and containment, are utilized when practical to minimize the need for RPE. The use of RPE is normally limited to non-routine evolutions for which process and engineering controls are not practical or in emergency situations.

6.1.3 When process or engineering controls are not practical to eliminate exposure to airborne radioactive materials and radiation dose rates, ALARA assessments should consider exposure and total risks with and without RPE.

6.1.4 During respiratory protection training, each respirator user shall be advised that he or she may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other conditions that might require such relief.

6.2 Hazard Assessment

6.2.1 The RPM shall conduct a hazard assessment of operations that involve the use of radioactive materials to determine the need for radiological

respiratory protection. When assessing area(s) and condition(s), the following (as a minimum) shall be taken into consideration for selection of radiological RPE:

6.2.1.1 Survey and bioassay results as necessary to evaluate intakes,

6.2.1.2 Radioactive material sampling results,

6.2.1.3 Removal efficiency of ventilation controls,

6.2.1.4 Removable contamination levels,

6.2.1.5 Radionuclides,

6.2.1.6 Re-suspension factors,

6.2.1.7 Area dose rates,

6.2.1.8 General conditions, including equipment and materials used and worker activity,

6.2.1.9 10 *CFR* 20-DACs,

6.2.1.10 The APF for the respirator, and

6.2.1.11 Feasibility of engineering controls to reduce employee exposure to below the exposure limit.

6.2.2 Respiratory protection or other appropriate exposure reduction methods shall be considered for any planned work involving removable surface contamination levels exceeding the radionuclide-specific levels in Table 1 following. If the radionuclide of concern is not included in Table 1, the RPM shall calculate the action level for that radionuclide. In the event that the action levels are exceeded for work that was not expected to reach the action level, a stop work order shall be initiated so that respiratory protection and other PPE for the activity can be re-evaluated. The RPM may re-initiate site work when PPE for the activity has been re-evaluated and necessary revisions have been made to the HSWP.

6.2.3 HSWPs for scoping surveys and characterization surveys (i.e., when the magnitude and extent of contaminant levels is not well known) shall use the action levels as a "hold point" for requiring evacuation and re-evaluation of current protection requirements.

6.2.4 The RPM shall consider the use of engineering controls prior to the assignment of respirators for the purposes of protecting personnel from airborne loose surface contamination. This does not preclude the use of RPE at contamination levels less than those specified previously.

6.2.5 Active processing areas should be decontaminated following any work activity that results in loose surface contamination levels of 10,000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) beta-gamma and/or 2,000 dpm/100 cm^2 alpha. If the alpha activity is known to be natural or depleted uranium (DU), the beta-gamma action level of

10,000 dpm/100 cm^2 may be used at the discretion of the Health Physics Technician (HPT) for the area.

Table 1. Removable Contamination Action Levels

Radionuclide[a]	Action Level[b] (dpm/100 cm^2)
Americium (Am)-241	3.0E+04
Cobalt (Co)-60	7.4E+07
Cesium (Cs)-137	4.3E+08
Iodine (I)-129	7.6E+07
I-131	1.5E+11
Neptunium (Np)-237	2.4E+04
Plutonium (Pu)-238	3.4E+04
Pu-239	3.1E+04
Pu-240	3.1E+04
Radium (Ra)-226	1.5E+06
Ra-228	3.2E+05
Strontium (Sr)-90	1.0E+07
Thorium (Th)-228	6.3E+04
Th-230	4.0E+04
Th-232	8.0E+03
Uranium (U)-234	1.0E+05
U-235	1.1E+05
U-238	1.1E+05

[a] The radionuclides listed also include daughter products from buildup within 1 year.
[b] Action levels were developed using the RESRAD-Build Version 3.5.

6.3 Fit Testing

6.3.1 A quantitative fit test (QNFT) or qualitative fit test (QLFT) shall be performed if the respirator will be used for the purpose of protecting individuals from airborne radioactive material.

6.3.2 QNFTs shall achieve an APF of at least 1,000.

6.3.3 Documentation of QNFT results shall be provided by the QNFT testing vendor.

6.3.4 QLFTs are authorized for use with negative-pressure respirators only.

6.3.5 A successful QLFT for a full-face negative-pressure respirator is assumed to achieve a PF of 100.

6.4 Assigned Protection Factors (APFs)

6.4.1 APFs for respirators are prescribed in 10 *CFR* 20, Appendix A.

6.4.2 No adjustment is to be made for the use of sorbents against radioactive material in the form of gases or vapors.

6.4.3 For particulates, the APF for a full-face, negative-pressure respirator that successfully achieves the QLFT is 100.

6.4.4 The RPM shall select RPE that provides an APF greater than the multiple by which peak concentrations of airborne radioactive materials in the

working area are expected to exceed the values specified in 10 *CFR* 20, Appendix B.

6.4.5 If the selection of a respiratory protection device with an APF greater than the multiple defined in the preceding sentence is inconsistent with the goal of keeping the total effective dose equivalent (TEDE) ALARA, the RPM may select RPE with a lower APF.

6.4.6 The concentration of radioactive material in the air that is inhaled when respirators are worn may be initially estimated by dividing the average concentration in air, during each period of uninterrupted use, by the APF. If the intake is later found to be greater than estimated (through bioassay or other means), the corrected value shall be used; if the exposure is later found to be less than estimated, the corrected value may be used.

6.5 Respirator Issuance

6.5.1 Respirators may be issued to qualified individuals either long term or on a daily basis, as determined by the RPM and SSHO.

6.5.2 Utilize Attachment 1, "Radiological Respiratory Protection Issue Log," (or equivalent) to document the issuance of RPE.

6.5.3 After use, respirators shall be cleaned, surveyed, and placed in the appropriate container or designated area. Only qualified individuals may survey respirators. Long-term issued RPE shall be stored in accordance with the instructions received in training. Such instructions will be consistent with the manufacturers' recommendations/guidance.

6.6 Additional Guidance

6.6.1 The RPM may use references listed in Section 3.0 of this procedure (as appropriate) as additional guidance for implementation of the Respiratory Protection Program.

7.0 Records

All records generated as a result of this procedure shall be maintained by RPM until transmitted to the appropriate electronic record facility.

RESPIRATORY PROTECTION ISSUE LOG

ISSUE INFORMATION						
Date	***HSWP***	**Person Issued to (Last Name, First Initial)**	**Equipment Type**	***Filter Type***	***Issued By***	***Comments***

FF = FULL-FACE, NEGATIVE PRESSURE, PAPR = FULL-FACE, POWERED-AIR POSITIVE PRESSURE, HF = HALF-FACE, NEGATIVE PRESSURE

COMMENTS:_____

REVIEWED BY:_____ DATE_____

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-10

REV. 0

PERSONNEL AND EQUIPMENT DECONTAMINATION

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LIST OF ATTACHMENTS

1. PERSONNEL CONTAMINATION REPORT
2. PERSONNEL CONTAMINATION REPORT LOG

1.0 Purpose

This procedure establishes guidelines for performing and documenting decontamination of personnel and equipment.

2.0 Scope

This procedure applies to decontamination at sites working under this Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection against Radiation."

3.2 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.

3.3 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03. Revision 1.

3.4 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Radiological Monitoring." Leidos St. Louis Health Physics Procedure. HP-11. Revision 1.

3.5 Leidos 2014d. *Leidos St. Louis Health Physics Manual.* "Radiological Reporting." Leidos St. Louis Health Physics Procedure. HP-22. Revision 1.

3.6 USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Protection.* Engineer Regulation. ER 385-1-80. June 30, 2010.

3.7 USACE 2012. U.S. Army Corps of Engineers. *Safety: Safety and Health Requirements.* Engineer Manual. Consolidated EM 385-1-1. September 15, 2008, with Change #7 effective July 20, 2012.

4.0 Definitions

4.1 **Contamination** – The deposition of radioactive material on accessible surfaces of structures, objects, equipment, or personnel that exceeds site surficial release limits pursuant to HP-03, "Radiological Limits." Contamination may be either "fixed" (e.g., not removable by rubbing with a dry smear) or "removable." Total contamination refers to fixed plus removable contamination.

4.2 **Decontamination** – The removal of radioactive contamination from surfaces, people or equipment.

4.3 **Restricted Area** – An area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Verify compliance with this procedure during planned and periodic audits of the radiation safety program.

5.1.2 Review incidents involving contamination pursuant to HP-22, "Radiological Reporting."

5.1 Health Physics Technicians (HPTs) shall:

5.1.3 Perform personnel decontamination in accordance with the requirements of this procedure.

5.1.4 Direct equipment decontamination in accordance with the requirements of this procedure.

6.0 Procedure

6.1 General Decontamination

6.1.1 Personnel or equipment shall be considered contaminated if any surface exceeds the contamination limits specified in HP-03, "Radiological Limits."

6.1.2 Surveys shall be performed and documented pursuant to HP-11, "Radiological Monitoring."

6.1.3 Following decontamination, surfaces shall be resurveyed to determine if the surfaces meet release criteria.

6.1.4 Personnel performing decontamination shall wear protective clothing appropriate for the levels of contamination encountered.

6.1.5 Decontamination shall be performed starting at areas of low contamination levels and moving to higher levels of contamination.

6.1.6 The RPM shall be notified of all personnel contamination incidents.

6.2 Personnel Decontamination

6.2.1 Decontamination shall be performed with the least possible insult to the individual. If skin irritation occurs, decontamination efforts shall be discontinued, and the RPM shall be notified immediately.

6.2.2 If extraordinary means (in excess of this procedure) are required to decontaminate an individual, or when decontaminating a wound, then medical personnel shall direct the decontamination.

6.2.3 The temperature of personnel decontamination water should be lukewarm.

6.2.4 Decontaminate skin in the following manner:

6.2.4.1 Survey the affected area to determine the magnitude and extent of the contamination. Document initial survey results on Attachment 1, "Personnel Contamination Report," from HP-11, "Radiological Monitoring" (and/or equivalent forms).

6.2.4.2 Wash the affected area thoroughly using soap and water (or, if water is not available, wipe the area with pre-moistened towelettes).

6.2.4.3 If multiple washings are not effective, consider wrapping the affected area in plastic to induce sweating.

6.2.4.4 Continue the decontamination effort until the contamination has been removed. If the contamination cannot be removed, contact the RPM.

6.2.5 During the decontamination process, care should be taken to avoid cross contamination of the hair, mouth, eyes, or nose.

NOTE:

Lifesaving measures and medical attention to seriously injured personnel shall take precedence over personnel decontamination procedures.

6.2.6 To decontaminate nasal passages, have the individual use moderate nose blowing to remove the contamination. Nasal passages may be surveyed using cotton swabs. The RPM shall determine if a bioassay sample is required.

6.2.7 All contamination incidents shall be documented on Attachment 1, "Personnel Contamination Report," of this procedure (and/or Attachment 1 from HP-11, "Radiological Monitoring"). All contamination incidents shall be tracked on Attachment 2, "Personnel Contamination Reporting Log," of this procedure and reported in accordance with the requirements in HP-22, "Radiological Reporting." Equivalent forms may be used at the discretion of the RPM.

6.2.8 If radon is suspected as the cause of the contamination incident, attempt to verify by determining the half-life of the contaminant (i.e. on the decontamination materials), or performing an immediate lab analysis. Note the investigation results on the Personnel Contamination Report form.

6.2.9 If personnel contamination activity in excess of 15,000 disintegrations per 100 square centimeters (dpm/100 cm^2) is encountered, save the decontamination materials for lab analysis to support a skin dose evaluation, at the direction of the RPM.

6.3 Personal Clothing Decontamination

6.3.1 Personal clothing may be decontaminated by the following methods:

6.3.1.1 Attempt to remove the contamination by tape press.

6.3.1.2 Send the contaminated item to a licensed laundering vendor.

6.3.1.3 With the owner's permission, cut out the contaminated areas of the clothing or shoes, and dispose of as radioactive waste.

6.3.1.4 Other appropriate methods as determined by the RPM.

6.4 Equipment Decontamination

6.4.1 Equipment shall be decontaminated in a restricted area.

6.4.2 Loose contamination may be removed from equipment surfaces by one of the following methods:

6.4.2.1 Wipe the surface with a moist rag.

6.4.2.2 Vacuum the surface with a high-efficiency particulate air (HEPA) filter equipped vacuum.

6.4.2.3 Spray the equipment with pressurized hot water/steam.

6.4.3 Liquid waste generated during decontamination shall be collected so that the liquids may be contained, unless waived by the RPM.

6.4.4 Fixed contamination may be eliminated by removing the top surface layer using abrasive means (i.e., angel grinder, disc sander, sand blaster, etc.).

7.0 Records

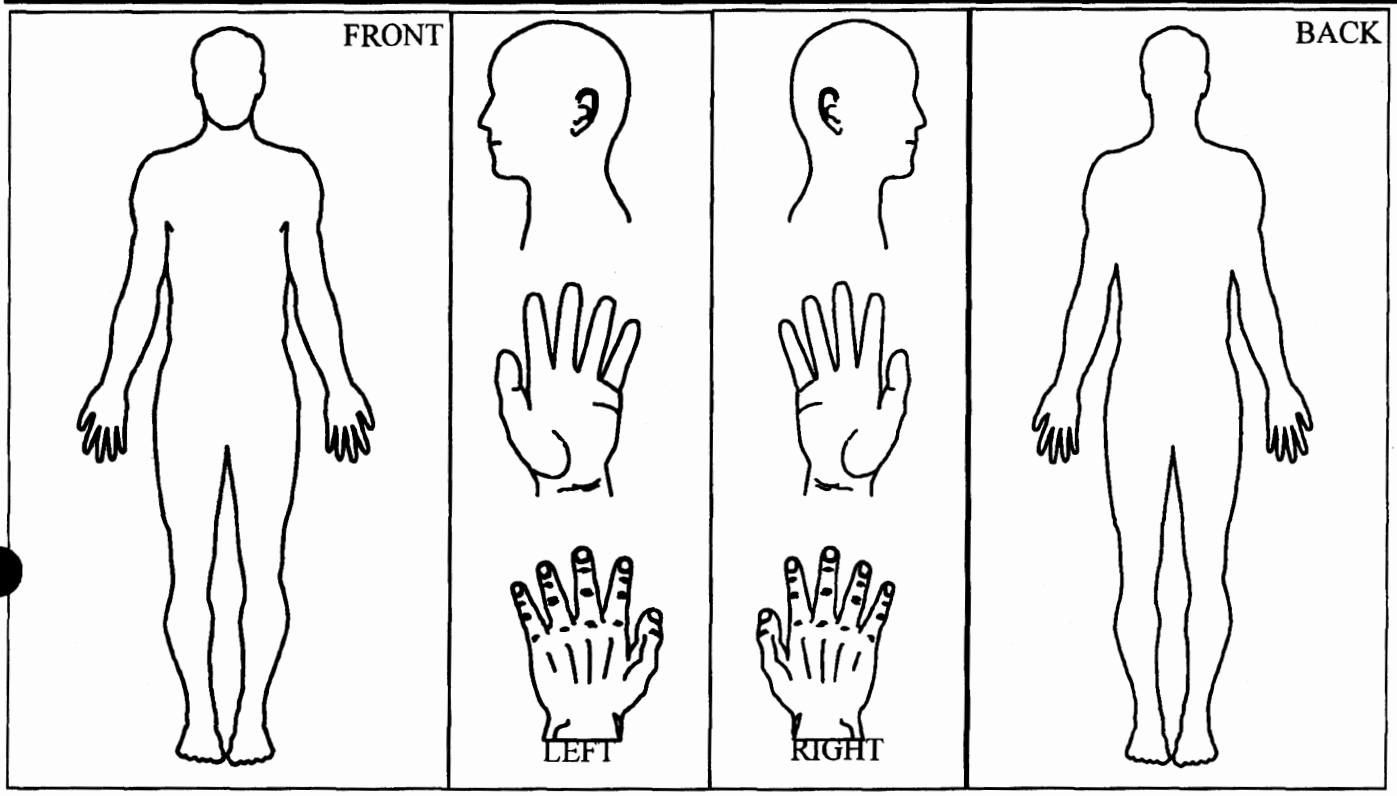
All records generated as a result of this procedure shall be maintained by RPM until transmitted to the appropriate electronic record system.

PERSONNEL CONTAMINATION REPORT

Site:_____

Employee Name	SSN	Company	Date/Time of Occurrence

Health and Safety Work Permit (HSWP) NO.	Inst. Type: _____	Serial Number: _____	Calibration Due Date: _____
	Inst. Type: _____	Serial Number: _____	Calibration Due Date: _____



INDICATE THE CONTAMINATED AREAS IN THE DIAGRAM ABOVE

SPECIFY CALCULATED ACTIVITY IN UNITS OF dpm/100 cm^2

DESCRIBE THE CONTAMINATION INCIDENT, THE SITE LOCATION AT WHICH THE INDIVIDUAL BECAME CONTAMINATED, THE DECONTAMINATION METHODS USED, AND THE POST-DECONTAMINATION SURVEY RESULTS:

PERSONNEL MONITORING INCIDENT REPORT INITIATED IN ACCORDANCE WITH HP-22? ☐ YES ☐ NO

Initiated By:_____ Date:_____

Contaminated Individual: _____ Date:_____

Reviewed By:_____ Date:_____

PERSONNEL CONTAMINATION REPORT LOG

Site: _____ **Year:** _____

Date	Individual's Name	Employee ID #	Entered By	Remarks

REVIEWED BY_____DATE_____

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-11

REV. 0

RADIOLOGICAL MONITORING

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LIST OF ATTACHMENTS

1. LEIDOS RADIOLOGICAL SURVEY REPORT
2. LEIDOS RADIOLOGICAL SURVEY REPORT WALKOVER SURVEYS
3. RADIOLOGICAL SURVEY CALCULATIONS
4. AIR SAMPLE REPORT
5. DAC-HOUR TRACKING

1.0 Purpose

The purpose of this procedure is to provide guidelines for performance and documentation of radiological surveys and sampling.

2.0 Scope

This procedure applies to all areas of a site working under this Leidos Radiation Safety Program, including those areas where radioactive materials are not normally stored or handled.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection against Radiation."

3.2 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.

3.3 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03. Revision 1.

3.4 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Personnel and Equipment Decontamination." Leidos St. Louis Health Physics Procedure. HP-10. Revision 1.

3.5 Leidos 2014d. *Leidos St. Louis Health Physics Manual.* "Radiological Posting and Labeling." Leidos St. Louis Health Physics Procedure. HP-20. Revision 1.

3.6 Leidos 2014e. *Leidos St. Louis Health Physics Manual.* "Radiological Instrumentation." Leidos St. Louis Health Physics Procedure. HP-30. Revision 1.

3.7 Leidos 2014f. *Leidos St. Louis Health Physics Manual.* "Personnel Radiation Exposure Monitoring." Leidos St. Louis Health Physics Procedure. HP-40. Revision 1.

3.8 NRC 1979. U.S. Nuclear Regulatory Commission. *Health Physics Surveys for Byproduct Material at NRC-Licensed Processing and Manufacturing Plants.* Regulatory Guide 8.21. Revision 1. October 1979.

3.9 NRC 1981. U.S. Nuclear Regulatory Commission. *Radiation Safety Surveys at Medical Institutions.* Regulatory Guide 8.23. Revision 1. January 1981.

3.10 NRC 1992. U.S. Nuclear Regulatory Commission. *Air Sampling in the Workplace.* Regulatory Guide 8.25. Revision 1. June 1992.

3.11 NRC 1995. U.S. Nuclear Regulatory Commission. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions.* NUREG-1507. Draft Report for Comment. August 1995.

3.12 NRC 2002. U.S. Nuclear Regulatory Commission. *Health Physics Surveys in Uranium Recovery Facilities.* Regulatory Guide 8.30. Revision 1. May 2002.

4.0 Definitions

4.1 **Airborne Radioactivity Area** – a room, enclosure, or area in which airborne radioactive materials exist in concentrations:

4.1.1 In excess of the derived air concentrations (DACs) specified in Appendix B to 10 *CFR* 20, or

4.1.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

4.2 **Annual Limit on Intake (ALI)** – The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by Reference Man that would result in a committed effective dose equivalent (CEDE) of 5 rem or a committed dose equivalent (CDE) of 50 rem to any individual organ or tissue. ALI values are given in Table 1, Columns 1 and 2, of Appendix B, 10 *CFR* 20.1001-2401.

4.3 **Breathing Zone (BZ)** – The region in the vicinity of a worker's mouth and nostrils from which air is drawn into the lungs while performing his/her assigned work. Air sampled from this region represents the air the worker breathes while at work, whether standing, sitting, or moving.

4.4 **Chain of Custody** – An unbroken trail of accountability that ensures the physical security of radioactive materials.

4.5 **Contact Exposure Rate** – The exposure rate from a surface or piece of equipment measured with the radiation detector housing positioned a distance of no greater than 0.5 centimeter (cm) (1/4 inch) from the surface or equipment.

4.6 **Contamination** – The deposition of radioactive material on accessible surfaces of structures, objects, equipment, or personnel that exceeds the site-specific surficial release limits pursuant to HP-03, "Radiological Limits." Contamination may be either "fixed" (e.g., not removable by rubbing with a dry smear) or "removable." Total contamination refers to fixed plus removable contamination.

4.7 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site-specific contamination limits as documented on Attachment 2 of HP-03, "Radiological Limits" or other site-specific documentation (i.e., Site Safety and Health Plan [SSHP], Radiation Protection Plan [RPP], etc.).

4.8 **Controlled Area** – An area outside of a restricted area but inside the site boundary, access to which can be limited for any reason.

4.9 **Derived Air Concentration (DAC)** – The concentration of a given radionuclide in air which, if breathed by Reference Man for a working year of 2,000 hours under conditions of light work (inhalation rate of 1.2 cubic meters [m^3] per hour) results in an intake of one ALI. DAC values are given in Table 1, Column 3, of Appendix B of 10 *CFR* 20.

4.10 **General Area Exposure Rate** – An indication of the potential for a human to incur a radiation dose. Ambient (i.e., general area) exposure rates are measured in units of *millirem per hour* or *microroentgen per hour.*

4.11 **Geometry** – The size and type of container used to hold a sample during counting.

4.12 **Intake** – Amount of radioactive material entering the body through the nose, mouth, or skin.

4.13 **Removable Contamination** – Radioactive contamination easily transferred by normal handling and contact.

4.14 **Minimum Detectable Activity (MDA)** – The smallest amount of radioactivity that can be detected given the conditions of a specific sample.

4.15 **Monitoring** – The measurement of radiation levels, concentrations, surface area concentrations, or quantities of radioactive material; and the use of the results of these measurements to evaluate potential exposures and doses.

4.16 **Radiation Detection Instrument** – A device, consisting of a detector and a ratemeter, which detects ionizing radiation.

4.17 **Radiation Survey Instrument** – A hand-held radiation survey instrument capable of detecting ionizing radiation.

4.18 **Radioactive Material Storage Area (RMSA)** – An administratively designated area where radioactive material is stored and controlled.

4.19 **Representative** – Faithfully showing the quality and characteristics of the area from which a sample is drawn or a measurement is made.

4.20 **Restricted Area** – An area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.21 **Sample** – a representative portion of a medium (i.e., air, water, soil, etc.) of interest, or one or more separated constituents from a representative portion of the medium.

4.22 **Scan** – An evaluation technique performed by moving a survey instrument over the surface of an object at a specified speed and distance above the surface of the object to detect radiation.

4.23 **Stop Work Authority** – The authority of all management and radiological workers to immediately stop work for the following reasons:

4.23.1 Unanticipated conditions arise that would result in a significant increase in radiological or industrial safety hazards.

4.23.2 Working conditions have degraded to the point that the work is not being performed consistent with the as low as reasonably achievable (ALARA) concept.

4.23.3 The potential for deterioration of occupational safety exists if the job is continued.

4.23.4 The work practices may result in violation of regulatory or NRC license requirements or radiation safety procedures.

4.24 **Unrestricted Area** – Any area to which access is neither limited nor controlled.

4.25 **Unrestricted Release** – Equipment, components, materials, land areas (property), and other items that may be used, transferred, sold, or disposed of without regard for their radiological constituents.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Assure that all radiological monitoring surveys (i.e., contamination, radiation, airborne concentration, etc.) are performed pursuant to this procedure.

5.1.2 Verify compliance with this procedure during planned and periodic surveillances of the Radiation Protection Program.

5.1.3 Specify the types and frequency of air sample collection.

5.1.4 If internal monitoring is required pursuant to HP-40, "Personnel Radiation Exposure Monitoring," ensure individual DAC-hour dose records are maintained in accordance with the requirements of this procedure.

5.1.5 Ensure that radiological monitoring survey documentation is reviewed in accordance with the requirements of this procedure.

5.2 Health Physics Technicians (HPTs) shall:

5.1.1 Perform all radiological monitoring surveys (i.e., contamination, radiation, airborne concentration, etc.) in accordance with the provisions of this procedure.

5.1.2 Perform air sampling as required by this procedure.

5.1.3 Perform air sample evaluation as required by this procedure.

5.1.4 Conduct routine surveillance surveys in accordance with the provisions of HP-12, "Health Physics Oversight."

6.0 Procedure

6.1 General Requirements

6.1.1 Maintain exposures ALARA when conducting radiological monitoring surveys.

6.1.2 Instrumentation referenced in this procedure is to be prepared for use, and used, in accordance with HP-30, "Radiological Instrumentation."

6.1.3 Performance requirements for coverage, release, and routine surveillance surveys are defined in HP-12, "Health Physics Oversight."

6.1.4 Radiological monitoring surveys shall be performed, as appropriate, to:

6.1.1.1 Establish and maintain health and safety work permits (HSWPs).

6.1.1.2 Determine whether the confinement of radioactive materials is effective.

6.1.1.3 Measure airborne radioactivity concentrations, radioactive contamination, and radiation levels in the workplace.

6.1.1.4 Estimate worker intakes and/or exposures to radiation.

6.1.1.5 Determine posting requirements.

6.1.1.6 Determine appropriate protective equipment and measures.

6.1.1.7 Warn of elevated radiation, contamination, and/or airborne radioactivity levels.

6.1.1.8 Investigate emergency situations.

6.1.1.9 Investigate abnormal conditions.

6.1.1.10 Release material or equipment for unrestricted use or disposal.

6.1.1.11 Investigate anticipated or changing radiological conditions.

6.1.1.12 Comply with other radiation safety procedures.

6.1.1.13 Comply with regulations or NRC license requirements.

6.1.1.14 Investigate radiological conditions in accordance with HP-12, "Health Physics Oversight," Attachment 5, "Routine Surveillance Frequency."

6.1.5 In addition to surveys required by Section 6.1.3, the following air sample surveys shall be required:

6.1.5.1 To monitor airborne concentrations of radioactive material to uncontrolled areas (for non-occupational exposure to members of the public), as directed by the RPM.

6.1.5.2 To monitor airborne concentrations of radioactive material in work areas where personnel exposure is likely to exceed 500 millirem per year (mrem/yr) CEDE, as determined by the RPM.

6.1.5.3 To monitor airborne concentrations of radioactive material in work areas where personnel exposure is <u>not likely</u> to exceed 500 mrem/yr CEDE, as determined by the RPM, for the purpose of routine surveillance in accordance with Section 6.13 of this procedure.

6.1.5.4 During entries into "Airborne Radioactivity Areas."

6.1.5.5 Whenever respirators are worn for the purpose of protecting individuals from airborne radioactive material exposure.

6.1.5.6 As determined by the RPM.

6.1.6 Each survey shall be planned with regard to:

6.1.6.1 Specific radiation types.

6.1.6.2 Predetermined radiation levels, contamination levels, or airborne concentrations.

6.1.6.3 Locations where the radiation, contamination, and/or airborne radioactive material is expected.

6.1.6.4 The minimum detection sensitivity for each survey (i.e., survey instrument MDA or minimum detectable concentration (MDC) based on survey parameters such as instrument background, scan speed, count time, etc.).

6.1.7 Radiation and contamination surveys shall be documented on Attachment 1, or equivalent.

6.1.8 The RPM, or designee, should establish, and make available, minimum air sample volumes and count times for occupational and non-occupational samples based on site-specific data, as applicable and available. Minimum site-specific air sample volumes shall be documented on HP-03, "Site Limits," Attachment 2.

6.1.9 Air sample volumes and count times should be of sufficient volume and duration to detect an MDC of 10 percent of the DAC or 100 percent of the Air Effluent (AE) concentration, if practical.

6.1.10 Airborne radioactive material surveys shall be documented on Attachment 4, or equivalent.

6.1.11 The RPM shall evaluate the need for personnel radiation exposure monitoring in accordance with HP-40, "Personnel Radiation Exposure Monitoring."

6.1.12 Surveys shall be signed by the individual(s) that performed the survey, and reviewed by the RPM, or designee.

6.2 General Area Radiation Surveys

6.2.1 General area surveys shall be performed with a portable radiation survey instrument that is sensitive to gamma, beta, and/or neutron radiations (i.e., microR meter, microrem meter, ionization chamber, remball, etc.), as appropriate.

6.2.2 Hold the instrument detector at waist level, slowly walking over the area of interest. General area surveys are conducted to ascertain the general area dose rate in accessible areas where personnel may be working or standing near surfaces that contribute to whole body exposure.

6.2.3 An increase in the instrument response or in the needle/indicator movement may indicate the presence of radioactivity in excess of background. The instrument shall be held stationary in the locations where the increased response is noted in order to confirm the response.

6.2.4 General area surveys should include normally accessible areas.

6.2.5 Obtain a representative number of general area radiation readings at knee level when the source of radiation is below waist level (i.e., radioactive material storage areas [RMSAs]). Note the position of the reading on the radiation survey form (i.e., knee level).

6.2.6 Document radiation levels on Attachment 1, or equivalent. Any comments and notations that may be necessary for interpretation of results should be recorded on the survey form.

6.3 Contact Radiation Surveys

6.3.1 Surveys shall be performed with a portable radiation survey instrument that is sensitive to gamma, beta, and/or neutron radiations (e.g., microrem meter, microR meter, ionization chamber, remball, etc.), as appropriate.

6.3.2 Contact surveys should be taken so the detector housing is within 1/4 inch of the item being evaluated. The detector housing should be positioned so that the active area of the detector is as close to the radiation source as practical.

6.3.3 A general area survey should be performed each time contact dose rates are measured, as appropriate.

6.3.4 Dose rate contributors shall be clearly identified on the survey form (i.e., bags, drums, piping, equipment, etc.).

6.4 Beta Radiation Surveys

6.4.1 Beta dose rate contribution is determined by calculating the open window reading and closed window reading difference, multiplied by the appropriate beta correction factor.

6.4.2 Beta radiation surveys shall be conducted where bulk beta-emitting radioactive materials are being used, handled, or stored, as determined necessary by the RPM.

6.4.3 Beta radiation surveys may not be necessary when beta-emitting radioactive materials are present in the matrix of soil contamination, at the discretion of the RPM.

6.5 Removable Contamination (Smear) Surveys

6.5.1 Smear surveys shall be performed to assess removable contamination on vehicles, equipment, structures, bench tops, fume hoods, and other items.

6.5.2 Using moderate pressure, wipe the smear over an area of 100 square centimeters (cm^2). A 100 cm^2 area is approximated by a four-inch square or an eighteen-inch "S" shaped wipe.

6.5.3 Ensure sufficient quantities of smears are taken to adequately assess the magnitude and extent of contamination.

6.5.4 The smear should be placed in a sample holder (e.g., smear booklet or glassine envelope) such that individual smears are separated from each other to prevent cross contamination.

6.5.5 Smears shall be evaluated with a radiation detection instrument (i.e., bench scaler, gas flow proportional counter, liquid scintillation counter, etc.) that is sensitive to the type of radiation expected to be encountered.

6.5.6 Smear results (i.e., gross counts per minute [cpm]) shall be converted to disintegrations per minute per 100 square centimeters (dpm/100 cm^2), as applicable, in accordance with Attachment 3, equations 1 and 2. Items with total surface area < 100 cm^2 shall be smeared over the entire surface and documented as disintegrations per minute (dpm)/item. Smear results shall be recorded on Attachment 1, or equivalent.

6.5.7 Smear results shall be compared with applicable site removable contamination criteria pursuant to HP-03, "Radiological Limits." The RPM shall be notified when unexpected removable contamination is encountered.

6.5.8 The RPM shall review survey data and implement appropriate controls (i.e., respiratory protection, protective clothing, area entry restrictions, etc.) as necessary.

6.6 Total Contamination (Direct Frisk) Surveys

6.6.1 Direct frisk surveys shall be performed to measure total (fixed plus removable) surficial contamination on personnel, vehicles, equipment, structures, and other items.

6.6.2 Direct frisk surveys shall be performed with a portable survey instrument (e.g., GM detector, dual-phosphor scintillation detector, gas flow proportional detector, etc.) that is sensitive to the type of radiation expected to be encountered.

6.6.3 Direct frisk scan surveys shall be conducted by moving the detector at 1-2 inches/second and with the active area of the detector at 1/4 inch (alpha) and 1/2 inch (beta) from the surface of interest, as applicable.

6.6.4 When an increased instrument count rate is detected, the surveyor shall pause to allow the instrument response to stabilize.

6.6.5 Direct frisk activity (dpm/100 cm^2) shall be calculated in accordance with Attachment 3, equations 1, 2, and 3.

6.6.6 Alternate scan speed and/or distance may be implemented at the discretion of the RPM.

6.6.7 Scan area coverage for release surveys of equipment and materials shall be 100 percent of accessible areas unless otherwise specified by the RPM.

6.6.8 A fixed-point (stationary) measurement should be performed where elevated activity was noted (and confirmed) during a scan survey.

6.6.9 Survey results shall be recorded on Attachment 1, or equivalent.

6.6.10 The surveyor shall compare survey results with applicable site-specific total contamination criteria in accordance with HP-03, "Radiological

Limits," and notify the RPM when unexpected surficial contamination is encountered.

6.7 Personnel Release Surveys

6.7.1 A radiological survey is required upon exit from any potentially contaminated area, as determined by the RPM or designee.

6.7.2 When scan area coverage (i.e., whole body, hand and foot, etc.) is not specified on a guiding document (SSHP, HSWP, etc.), the RPM, or designee, should determine scan area coverage by evaluating the level of removable contamination in the work area, and the likelihood of contact with the contamination.

6.7.3 If the survey indicates contamination above background, the initial survey, personnel decontamination, and re-survey shall be performed and documented in accordance with HP-10, "Personnel and Equipment Decontamination." Surveys that do not indicate personnel contamination are not required to be documented.

6.8 Release Surveys of Equipment/Materials for Unrestricted Use

6.8.1 Equipment and materials being surveyed for unrestricted release shall be surveyed in accordance with Sections 6.5 and 6.6 of this procedure (total and removable contamination surveys).

6.8.2 Equipment/material release surveys shall be documented on Attachment 1, or equivalent.

6.8.3 Release surveys shall be conducted by a Senior HPT or under the direction of a Senior HPT.

6.9 Airborne Particulate Sampling

6.9.1 Airborne particulate radioactivity shall be determined using an air pump connected to a filter cartridge.

6.9.2 In order to meet MDA requirements, verify the required minimum air sample volume from Attachment 2 of HP-03, "Site Limits," prior to collecting an air sample, and document the minimum air sample volume on Attachment 4 (or equivalent) of this procedure.

6.9.3 The flow rate to be used for calculations should be the average of the pre- and post-sampling flow rates.

6.9.4 The filter cartridge should contain a membrane filter, rather than a glass fiber filter, unless specified by the RPM.

6.9.5 Air shall be drawn through the filter for the duration of monitoring, or until visible dust loading or decreased flow is noted.

6.9.6 The following information should be recorded on Attachment 4 (or equivalent); the sample location, sample ID number, sampler ID, sampler calibration due date, sample date, the time at start/stop, the flow rate at start/stop, minimum air sample volume, HSWP number (as applicable),

monitored workers, and whether the sample is occupational/non-occupational.

6.9.7 The filter shall be removed from the cartridge and placed in a sample envelope such that individual filters are separated from each other to prevent cross contamination.

6.10 Air Sample Types

6.10.1 When occupational air sampling is required in the workplace, the RPM shall specify the type of occupational air sample that is required, including:

6.10.1.1 A breathing zone (BZ) sample is obtained within the *breathing zone* of the worker (i.e., in the vicinity of the nose and mouth). Sampling shall be performed at low flow rates with the intent of collecting a sample representative of what an individual worker is breathing.

6.10.1.2 A general area (GA) sample (or continuous air monitor sample) is collected in a fixed position without regard to the specific work evolution that represents the environment in the room.

6.10.1.3 A work area (WA) sample is temporary in nature and is obtained when a sample would be (conservatively) representative of a work crew. The sample should be obtained between the source of airborne exposure and the breathing zone of the individual with the highest likelihood for exposure. For example, an air sample placed near a drilling mast (or in the breathing zone of the individual handling the augers) would provide a conservative estimate of exposure for the entire drilling crew.

6.10.1.4 In situations in which there is a potential for accidents to cause intakes exceeding 40 DAC-hours in one day, continuous air monitoring should be conducted. Monitoring may be performed through the use of BZ, GA, or WA samples, as determined appropriate by the RPM.

6.10.2 Perimeter (non-occupational) air samples shall be used to monitor non-occupational exposure, as required by the RPM. Perimeter air samples shall be placed at the boundary of the unrestricted area at sufficient locations to determine potential exposure to receptors.

6.11 Air Sample Evaluation

6.11.1 Air sample data shall be documented on Attachment 4, "Air Sample Report," or equivalent. As an alternative, air sample information may be entered into an air sample database, as directed by the RPM.

6.11.2 When the need for gross alpha/beta analysis is not immediate (i.e., internal monitoring is not required pursuant to HP-40, "Personnel Radiation Exposure Monitoring"), air sample counting and evaluation may be delayed to reduce the interference of radon and thoron components. Air

samples should be counted 10-14 days after collection for accurate indication of actual air concentrations without radon and/or thoron interference.

6.11.3 In situations in which there is a potential for intakes to exceed 40 DAC-hours in one week, air samples should be screened on a daily basis (credit may be taken for assigned protection factors if respirator protection is worn).

6.11.4 Screening air sample results > 1.0 DAC or 1.0 AE requires immediate notification of the RPM. In addition, results documented on Attachment 4, or equivalent, shall be reviewed by the RPM, or designee, within 24 hours of counting the elevated screening sample.

6.11.5 Formal air sample results (i.e., reported from the laboratory or final count results) shall be reviewed by the RPM or designee within 7 days of receipt of the results.

6.11.6 Air samples may be screened (counted) for gross alpha and/or beta with a bench counter (e.g., dual phosphor scintillator, gas flow proportional counter) using the following method, as appropriate:

6.11.6.1 Place the air sample filter on the count tray, taking care not to disturb the active surface of the filter.

6.11.6.2 Close and lock the count tray,

6.11.6.3 Ensure the sample count time is set correctly to satisfy MDA requirements.

6.11.6.4 Count the sample.

6.11.6.5 Record the results of the count on Attachment 4, or equivalent.

6.11.6.6 Calculate the air sample activity and DAC-hours in accordance with Attachment 3, Equations 10 and 12, respectively.

6.11.6.7 Document air sample activity and DAC-hours on Attachments 4 and 5, respectively. Equivalent forms may be used at the discretion of the RPM.

6.11.7 Air samples may also be evaluated (counted) by other methods or sent to a qualified vendor as determined appropriate by the RPM.

6.12 DAC-Hour Tracking

6.12.1 The HPTs shall complete Attachment 5, "DAC-hour Tracking," or equivalent, when:

6.12.1.1 Air monitoring (i.e., required internal monitoring) is conducted.

6.12.1.2 DAC-hour tracking is not required for air sampling conducted solely for routine surveillance purposes.

6.12.2 DAC-hours should be calculated using formal air sample results.

6.12.3 All individuals that were in the sampled area during the time frame of the air sample shall be entered on Attachment 5, or equivalent.

6.12.4 If internal monitoring is required, copies of Attachment 5, or equivalent, shall be forwarded to individual dose files when calculated individual DAC-hours are equal to, or greater than, 0.4 DAC-hours (1 mrem). As an alternate method, DAC-hr tracking results may be maintained by transferring dose information to an electronic dose-tracking database, as determined by the RPM.

6.13 Routine Surveillance Surveys

6.13.1 Routine surveillance surveys shall be conducted to verify that the radiological controls implemented by this Radiation Safety Program are sufficient to prevent the spread of contamination, generation of airborne radioactivity, or radiation levels >2 mrem/hour outside Controlled Areas.

6.13.2 Routine surveillance surveys shall be conducted by HPTs in accordance with the requirements set forth in HP-12, "Health Physics Oversight."

6.14 Walkover Surveys

6.14.1 Walkover surveys shall be performed with a portable survey instrument that is sensitive to gamma radiation (i.e., scintillation detector) in order to find contamination in soil or other media.

6.14.2 Walkover surveys should be conducted by moving the detector at a rate that does not exceed 1.5 feet per second (0.5 meter per second) at 4 inches (10 cm) from the surface.

6.14.3 An increase in the instrument response or in the needle/indicator movement may indicate the presence of radioactivity above background. The instrument should be held stationary for a time period determined appropriate by the RPM, or designee, at locations where the increased response is noted in order to determine if the response is above or below the site investigation level.

6.14.4 Alternate scanning speed, scanning distance, or modes of transport (e.g., all-terrain vehicle [ATV]) may be implemented, as long as survey data quality objectives are met, at the discretion of the RPM.

6.14.5 Instrument count-rate and other notations that may be necessary for interpretation of results shall be documented on Attachment 1, or equivalent, unless otherwise recorded electronically.

6.15 Radiological Sampling

6.15.1 Samples (i.e., water, soil, etc.) shall be collected in accordance with the provisions of a site-specific sampling plan, or equivalent document.

6.15.2 A chain-of-custody record shall be initiated by the individual collecting or overseeing the collection of samples.

6.15.3 A copy of the chain-of-custody form shall accompany the samples throughout transportation and analyses.

6.15.4 Any break in custody or evidence of tampering shall be documented and may compromise the validity of the sample results.

6.15.5 Sample custody shall be assigned to one individual at a time in order to prevent confusion of responsibility.

6.15.6 Custody is maintained when:

6.15.6.1 The sample is under direct surveillance by the assigned individual.

6.15.6.2 The sample is maintained in a tamper-free or tamper-evident container.

6.15.6.3 The sample is within a controlled-access facility.

6.15.7 Samples submitted to a radioanalytical laboratory should be accompanied by a "Request for Analysis" form used by the laboratory, if required.

6.15.8 The radioanalytical laboratory shall have written procedures that document the laboratory's analytical capabilities for the requested analysis and a quality assurance/quality control (QA/QC) program that assures the validity of the analytical results.

6.16 Additional Guidance

6.16.1 The RPM may use the references contained in Section 3.0 of this procedure as additional guidance to determine appropriate elements of the Radiological Monitoring Program for specific client facilities or sites.

7.0 Records

7.1 The RPM shall maintain records of surveys and calibrations required by this procedure for 3 years after the record is made.

7.2 Records of the results of surveys, measurements, and calculations shall be maintained until the NRC terminates the license (if applicable) requiring the record, if used to determine:

7.2.1 External dose (i.e., deep dose equivalent [DDE], shallow dose equivalent, lens (eye) dose equivalent, dose to extremities, etc.) from radiation sources external to the body;

7.2.2 Internal dose (i.e., CEDE, CDE) from the intake of radioactive materials;

7.2.3 The release of radioactive effluents to the environment; and

7.2.4 Compliance with the dose limit for members of the public.

7.3 All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

LEIDOS RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION:	HSWP:	Page of
PURPOSE OF SURVEY:	DATE:	TIME:

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency (%) Alpha (α)	Efficiency (%) Beta (βγ)
☐ Ludlum 2929/43-10-1 ___	N/A								
☐ Ludlum 2360/43-89 ___	125								
☐ Ludlum 2221/44-9 ___	15.5								
☐ Micro-R ___	N/A								

Contamination Limits: ($dpm/100\ cm^2$)	Removable α _____	Removable βγ _____	Total α _____	Total βγ _____	BKG
Instrument MDA: ($dpm/100\ cm^2$)	α MDA _____	βγ MDA _____	α MDA _____	βγ MDA _____	

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr

REMARKS:

TECHNICIAN(S) SIGNATURE/DATE: _____ / _____ / _____

REVIEWER SIGNATURE/DATE: _____ / _____

LEIDOS RADIOLOGICAL SURVEY REPORT (Supplement)

SURVEY LOCATION:														Page of
Contamination Limits: (dpm/100 cm²)		Removable α _____			Removable βγ _____			Total α _____			Total βγ _____			
Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr
REMARKS:														
TECHNICIAN(S) SIGNATURE/DATE: _____ / _____ _____ / _____														
REVIEWER SIGNATURE/DATE: _____ / _____														

LEIDOS RADIOLOGICAL SURVEY REPORT (Map)

SURVEY LOCATION:	HSWP:	Page of
LEGEND: (Fill in blank) _____ = Smear Location _____ = G/A Dose Rate ☐ mR/hr ☐ µR/hr	DATE:	TIME:
REMARKS:		
TECHNICIAN(S) SIGNATURE/DATE: _____ / _____		/
REVIEWER SIGNATURE/DATE: _____ / _____		

LEIDOS RADIOLOGICAL SURVEY REPORT WALKOVER SURVEYS

SURVEY LOCATION:				
DATE:	TIME:	HSWP:		
PURPOSE OF SURVEY:				
Instrument Type(s): (√ if used)	**Serial Number: (meter/detector)**	**Cal Due Date: (meter-detector)**	**Background: (CPM α/βγ)**	**Efficiency (%) (α/βγ)**
___Ludlum 2221/44-10				N/A

REMARKS:

TECHNICIAN(S) SIGNATURE/DATE: _____ / _____ _____ / _____

REVIEWER SIGNATURE/DATE: _____ / _____

RADIOLOGICAL SURVEY CALCULATIONS

Count-rate
(Equation 1)

$$\text{Net Counts Per Minute (NCPM)} = \text{GCPM} - \text{BCPM}$$

GCPM = gross counts per minute
BCPM = background counts per minute

Activity
(Equation 2)

$$\text{DPM} = \frac{\text{NCPM}}{\varepsilon_i}$$

NCPM = net counts per minute
ε_i = instrument efficiency (cd^{-1})

Activity - Direct Frisk
(Equation 3)

$$\text{dpm}/100\ \text{cm}^2 = \frac{\text{NCPM}}{\varepsilon_i \times \text{DA}} \times \frac{100\ \text{cm}^2}{100\ \text{cm}^2}$$

where: Ludlum 43-93 probe area = 126 cm^2
Ludlum 44-9 probe area = 15.5 cm^2
Ludlum 43-89 probe area = 125 cm^2
Ludlum 43-5 probe area = 76 cm^2

dpm = disintegrations per minute
ε_i = instrument efficiency (cd^{-1})
DA = detector area (cm^2)
NCPM = net counts per minute

Counter Detection Limit (L_D) – 95% confidence level, **differing** count/background count times
(Equation 4)

$$L_D = 3 + 3.29\sqrt{(R_B)(T_S)(1+\frac{T_S}{T_B})}$$

L_D = *a priori* detection limit [minimum significant activity level]
R_B = background count rate (cpm)
T_B = background count time (minutes)
T_S = sample count time (minutes)

The detection limit, L_D, is the *a priori* (before the fact) activity level that an instrument can be expected to detect 95% of the time. It is the smallest amount of activity that can be detected at a 95% confidence level. It should be used to calculate the minimum detection capability of an instrument.

Counter Detection Limit (L_D) – 95% confidence level, **same** count/background count times
(Equation 5)

$$L_D = 3 + 4.65\sqrt{R_B}$$

L_D = *a priori* detection limit [minimum significant activity level]
R_B = background counts

The detection limit, L_D, is the *a priori* (before the fact) activity level that an instrument can be expected to detect 95% of the time. It is the smallest amount of activity that can be detected at a 95% confidence level. It should be used to calculate the minimum detection capability of an instrument.

Portable Counter (time count) Minimum Detectable Activity (MDA)
(Equation 6)

$$\text{MDA (dpm/100 cm}^2) = \frac{L_D}{[DA][\varepsilon_i][\varepsilon_s][T]} x \frac{100\,cm^2}{100\,cm^2}$$

L_D = *a priori* detection limit [minimum significant activity level]
DA = detector area (cm^2)
ε_i = instrument efficiency (cd^{-1})
ε_s = surface efficiency (unitless)
T = count time (minutes)

Notes: Surface efficiency is normally only used during a final status survey and is otherwise set to one (1).

Bench Counter Smear Minimum Detectable Activity (MDA)
(Equation 7)

$$\text{Smear MDA (dpm/100 cm}^2) = \frac{L_D}{(T)(\varepsilon_i)}$$

L_D = *a priori* detection limit [minimum significant activity level]
T = smear count time (minutes)
ε_i = instrument efficiency (cd^{-1})

Notes: Smear is assumed to have been wiped over a 100 cm^2 area on the item surveyed.

Frisker Scan Minimum Detectable Activity (MDA)
(Equation 8)

The observable background counts (b) is defined as the number of background counts observed within the observation interval (i). The equation used for calculating b' is as follows:

$$b = (\text{BCPM}) \times (i) \times (1 \text{ min}/60 \text{ sec}) = \text{counts/interval}$$

BCPM = instrument background (or reference area background count rate for final status surveys)
i = observation interval (seconds)

The minimum detectable number of net source counts in the interval is given by s_i. Therefore, for an ideal observer, the number of source counts required for a specified level of performance can be arrived at by multiplying the square root of the number of background counts by the detectability value associated with the desired performance (d) as shown below:

$$s_i = d\sqrt{b} \quad \text{(counts per observation interval)}$$

The MDCR is defined as the increase above background recognizable during a survey in a given period of time. The variable, d, is defined as the index of sensitivity and is dependent on the selected decision errors for Type I (alpha) and Type II (beta) errors. A true positive error (1-β) of 95% and a false positive error (alpha) of 60% may be selected to be consistent with NUREG-1507. The value of 1.38 was obtained from Table 6.1 in NUREG-1507 (Table 6.5 in MARSSIM).

$$\text{MDCR (cpm)} = s_i \times (60/i)$$

Finally, the scan MDAs for surfaces may be calculated:

$$\text{Scan MDA} = \frac{\text{MDCR}}{\sqrt{p}\ \varepsilon_i\ \varepsilon_s\ DA} \times \frac{100 \text{ cm}^2}{100 \text{ cm}^2}$$

where:

MCDR = minimum detectable count rate (cpm)
ε_i = instrument efficiency (cd^{-1})
ε_s = surface efficiency (unitless - normally only used for final status surveys)
p = surveyor efficiency (unitless - normally assumed to be 50% (0.50))
DA = detector area (cm^2)

Air Sample Minimum Detectable Concentration (MDC)
(Equation 9)

$$\text{Air Sample MDC } (\mu\text{Ci/ml}) = \frac{L_D}{(T)\,(\varepsilon_i)\,(\varepsilon_c)\,(V)\,(2.22\ E^9)}$$

where:
L_D = *a priori* detection limit [minimum significant activity level]
T = air sample count time (minutes)
ε_i = instrument efficiency (cd^{-1})
ε_c = collection efficiency (default to 0.99
V = sample volume (ml)
2.22E9 = conversion from dpm to μCi and L to ml.

Air Sample Activity
(Equation 10)

$$\text{Air Sample Activity } (\mu\text{Ci/ml}) = \frac{(NCPM)}{(\varepsilon_i)\,(\varepsilon_c)\,(V)\,(2.22\ E^9)}$$

where:
NCPM = Net counts per minute = Gross counts per minute – background counts per minute
ε_i = Instrument efficiency (cd^{-1})
ε_c = Collection efficiency (default value is 0.99)
V = Sample volume (liters) [if converting from ft^3, multiply ft^3 by 28.3 to calculate liters]
2.22E9 = Conversion from dpm to μCi and L to ml.

DAC Fraction
(Equation 11)

$$\text{DAC Faction} = \frac{\text{Air Sample Activity } (\mu\text{/mL})}{\text{Site (alpha or beta) DAC Value } (\mu\text{Ci/mL})}$$

DAC = derived air concentration

DAC-hrs
(Equation 12)

DAC-hrs = (DAC Fraction) * (# hrs in monitored work area)

Dose Equivalent
(Equation 13)

$$CEDE = DAC - hrs \times 2.5 \frac{mrem}{DAC - hr}$$

CEDE = committed effective dose equivalent (mrem)
DAC-hrs = derived air concentration hours

AIR SAMPLE REPORT

Section I

Date: _____ Sample ID: _____ HSWP#: _____

Occupational: ☐ DAC value: _____ µCi/ml **(H)** Breathing Zone: ☐ General Area: ☐ Work Area: ☐

Non-Occupational: ☐ AE value: _____ µCi/ml **(H)** Radionuclides: _____

Site: _____ Location: _____ Sampled By: _____

Wearer (if applicable): _____ Activity Performed: _____

Monitored Workers: _____

Pump Model: _____ Serial Number: _____ Calibration Due Date: _____

Flow Meter: _____ Serial Number: _____ Calibration Due Date: _____

Sample Information	Time			Flow Rate (lpm)	
Date	Start	Stop	Total (minutes)	Start	Stop
	Total Time:			Average Flow Rate:	(lpm)

Minimum Occupational Air Sample Volume: _____ Liters Minimum Non-Occupational Air Sample Volume: _____ Liters

Sample Volume = _____ (lpm) x _____ (minutes) = _____ Liters **(A)**

Remarks: _____

Sent to lab **after** a screen for final count ☐ (Section II required) Sent to lab **without** a screen for final count ☐ (Section II NOT required)

Section II

Instrument Information	Serial Number:		Cal. Due Date:				
Instrument Type	meter	detector	meter	detector	1st Count	2nd Count	3rd Count
					☐	☐	☐
					☐	☐	☐
					☐	☐	☐

Count Information			**ALPHA**			**BETA**		
Variables		**Units**	**1st Count**	**2nd Count**	**3rd Count**	**1st Count**	**2nd Count**	**3rd Count**
Count Date								
Count Time (e.g., noon, 1300, etc.)								
Sample Count Time		Minutes						
Total Counts		Counts						
Sample Count Rate		CPM						
Background Count Rate		CPM						
Volume of Air (Liters)	**(A)**	Liters						
Net Count Rate (CPM)	**(B)**	CPM						
Counter Efficiency	**(C)**							
Collection Efficiency	**(D)**	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Efficiency = (C) x (D)	**(E)**							
Activity (DPM) = (B) / (E)	**(F)**	DPM						
Conc. = (F) / (2.22E9 x (A))	**(G)**	µCi/ml						
DAC/AE Fraction = (G) / (H)								
Final Count?		Yes / No						

Immediate RPM notification. **Note: DAC/AE fractions > 1.0 requires RPM Notified** ☐

Calculated By: _____ Date: _____

Reviewed By: _____ Date: _____

DAC-HOUR TRACKING

Site: _____ Air Sample Date/Time: _____ HSWP: _____ Sample ID: _____

NAME	HPID#	WORK AREA	TIME IN	TIME OUT	TOTAL TIME (HR)[1]	Sample Results (µCi/mL)	Sample DAC (µCi/mL)	Corrected DAC Fraction[2]	DAC-hrs[3]	CEDE[4] (mrem)	CALCULATED BY (INITIALS)

[1] Total time is to be recorded in hours and fractions of hours (e.g., 1.5).

[2] PF = 1 for no respirator; PF = 50 for Full Face Negative Pressure; PF = 2,000 for a Supplied Air; PF = 10,000 for SCBA (see 10 *CFR* 20, Appendix A)
Corrected DAC-Fraction = Sample Results/Sample DAC/PF

[3] Calculate DAC-Hrs by multiplying the total time by the Corrected DAC Fraction.

[4] Calculate CEDE by multiplying DAC-hrs by (2.5 mrem per DAC-hr).

Reviewed by RPM: _____ DATE: _____

If monitoring is required and ≥ 0.4 DAC-hrs calculated (i.e., 1 mrem), dose records updated by: _____ Date: _____

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-12

REV. 0

HEALTH PHYSICS OVERSIGHT

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LIST OF ATTACHMENTS

1. RADWORKER RESTRICTED AREA REQUIREMENTS

2. ROUTINE SURVEILLANCE FREQUENCY

1.0 Purpose

This procedure establishes guidelines and requirements for health physics (HP) oversight, including restricted area requirements, job coverage, stop-work, release surveys, and routine surveillance.

2.0 Scope

This procedure applies to HP oversight at sites working under this radiation safety program. At sites controlled by others, the provisions of their HP program may apply.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection against Radiation."

3.2 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.

3.3 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03. Revision 1.

3.4 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Personal Protective Equipment." Leidos St. Louis Health Physics Procedure. HP-05. Revision 1.

3.5 Leidos 2014d. *Leidos St. Louis Health Physics Manual.* "Radiological Respiratory Protection." Leidos St. Louis Health Physics Procedure. HP-06. Revision 1.

3.6 Leidos 2014e. *Leidos St. Louis Health Physics Manual.* "Personnel and Equipment Decontamination." Leidos St. Louis Health Physics Procedure. HP-10. Revision 1.

3.7 Leidos 2014f. *Leidos St. Louis Health Physics Manual.* "Radiological Monitoring." Leidos St. Louis Health Physics Procedure. HP-11. Revision 1.

3.8 Leidos 2014g. *Leidos St. Louis Health Physics Manual.* "Radiological Posting and Labeling." Leidos St. Louis Health Physics Procedure. HP-20. Revision 1.

3.9 Leidos 2014h. *Leidos St. Louis Health Physics Manual.* "Radiological Reporting." Leidos St. Louis Health Physics Procedure. HP-22. Revision 1.

4.0 Definitions

4.1 **Airborne Radioactivity Area** – A room, enclosure, or area in which airborne radioactive materials exist in concentrations:

4.1.1 In excess of the derived air concentrations (DACs) specified in 10 *CFR* 20, Appendix B, or

4.1.2 To such a degree that an individual present in the area without respiratory protective equipment (RPE) could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

4.2 **Contamination** – The deposition of radioactive material on accessible surfaces of structures, objects, equipment, or personnel that exceeds site surficial release limits. Contamination may be either "fixed" (e.g., not removable by rubbing with

a dry smear) or "removable." Total contamination refers to fixed plus removable contamination.

4.3 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site-specific contamination limits, as documented on Attachment 2 of HP-03, "Radiological Limits," or other site specific documentation (i.e., Site Safety and Health Plan [SSHP], Radiation Protection Plan, etc.).

4.4 **Controlled Area** – An area, outside of a restricted area but inside the site boundary, to which access can be limited for any reason.

4.5 **Health Physics Technician (HPT) Coverage** – The assistance provided by HPTs for the purpose of keeping radiation exposure as low as reasonably achievable (ALARA), preventing the spread of contamination and airborne radioactive material hazards, and monitoring the general work area.

4.5.1 **Continuous Coverage** – HPTs providing continuous coverage are in the area to monitor radiological conditions during performance of the task and are available to direct or stop work activities as conditions warrant. Line-of-sight coverage is not required (e.g., HPTs may leave the immediate work area to count smears or air samples).

4.5.2 **Intermittent Coverage** – The assignment of an HPT to one or more jobs, such that HP coverage, is periodic. HPTs providing intermittent coverage are aware of the worker's presence in the work area, but radiological conditions do not require continuous communication with the workers.

4.6 **High Radiation Area (HRA)** – An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 100 millirem (mrem) in 1 hour at 30 centimeters (cm) from the radiation source or (30 cm from any surface that the radiation penetrates).

4.7 **Hot Spot** – The region in a radiation/contamination area in which the level of radiation/contamination is significantly greater than in neighboring regions in the area.

4.8 **Removable Contamination** – Radioactive material easily transferred by normal handling and contact.

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

4.10 **Radioactive Material Area (RMA)** – An area or room in which an amount of radioactive material exceeding 10 times the quantity of such material specified in 10 *CFR* 20, Appendix C, is used or stored.

Note: If a combination of materials is present (i.e., a combination of uranium and cobalt [Co]-60), the following relationship must be used to determine if the area must be posted as an RMA:

$$\frac{\mu Ci_{Co}}{10Q_{Co}} + \frac{\mu Ci_{U}}{10Q_{U}} \leq 10$$

where:

Q = the quantity shown in Appendix C of 10 *CFR* 20.

4.11 **Radioactive Material Storage Area (RMSA)** – An administratively designated area in which radioactive material is stored and controlled.

4.12 **Restricted Area** – An area, access to which is limited for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.13 **Stop Work Authority** – The authority provided to HPTs and radiological workers to immediately stop work for the following reasons:

4.13.1 Unanticipated conditions develop that which would result in a significant increase in radiological or industrial safety hazards.

4.13.2 The conditions on the job have degraded to the point that the work is not being performed consistent with the ALARA concept.

4.13.3 The potential for deterioration of occupational safety exists if the job is continued.

4.13.4 The work practices may result in violation of regulatory requirements or HP procedures.

4.14 **Unconditional (Unrestricted) Release** – Equipment; components; materials; land areas (property); and other items that may be used, transferred, sold, or disposed of without regard for their radiological constituents.

4.15 **Unrestricted Area** – An area to which access is neither limited nor controlled.

4.16 **Very High Radiation Area (VHRA)** – An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 meter from the source or any surface that the radiation penetrates.

4.17 **Volumetric Material** – Material that takes the shape of its container, such as water, sand, or soil.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Verify compliance with this procedure during planned and periodic audits of the radiation safety program.

5.1.2 Shut-down or prevent a task or project from starting if the task/project may violate requirements for radiological protection, and specify the actions necessary to continue work and lift the stop-work order.

5.1.3 Specify job coverage requirements on a SSHP, Work Plan (WP), health and safety work permit (HSWP), or equivalent.

5.1.4 Ensure that radiological workers are trained on restricted area requirements.

5.2 Health Physics Technicians (HPTs) shall:

5.2.1 Shut down or prevent a task from starting if the task may violate regulatory requirements for radiological protection.

5.2.2 Perform job coverage, release surveys, and routine surveillance in accordance with the requirements of this procedure.

5.2.3 Initiate stop-work orders in accordance with the provisions of this procedure.

5.3 Radiation workers shall:

5.3.1 Comply with the requirements in Attachment 1, "Radworker Restricted Area Requirements," of this procedure (or equivalent).

5.3.2 Shut down or prevent a task from starting if the task may violate regulatory requirements for radiological protection.

6.0 Procedure

6.1 General Requirements

6.1.1 Radiation and contamination surveys shall be performed in accordance with HP-11, "Radiological Monitoring."

6.1.2 Airborne radioactivity surveys shall be performed in accordance with HP-11, "Radiological Monitoring."

6.1.3 Survey results shall be compared against the criteria specified in HP-03, "Radiological Limits."

6.1.4 Respiratory protection shall be considered and used in accordance with the provisions of HP-06, "Radiological Respiratory Protection."

6.2 Restricted Area Requirements

6.2.1 Prior to allowing unescorted access into the restricted area, personnel are required to successfully complete Site Orientation Training and Radiation Worker Training (RWT) in accordance with HP-04, "Qualifications and Training." The RPM may permit an individual access to the RESTRICTED AREA without this training, provided the individual is accompanied by a qualified escort and a waiver form has been completed and signed by the RPM (or designee).

6.2.2 No entry is permitted into the restricted area without sufficient cause for the entry (i.e., no "sightseeing" in contamination, airborne radioactivity, radiation, or high radiation areas).

6.2.3 Individuals with accumulated exposure greater than 70 percent of allowable administrative exposure limits will be restricted from entry into high-radiation areas (HRAs).

6.2.4 Approval by the Radiation Safety Officer (RSO) and/or an extension of the administrative dose limit is required for individuals with accumulated exposure greater than 70 percent of allowable administrative exposure limits.

6.2.5 Individuals shall follow restricted area requirements in accordance with Attachment 1 of this procedure (or equivalent) while working in restricted areas.

6.3 Job Coverage

6.3.1 Job-specific surveys shall be performed as frequently as necessary to document the level of radiological hazards in the work area.

6.3.2 Continuous coverage shall be provided for all entries into HRAs or airborne radioactivity areas, and for work that may cause a significant change to radiological conditions.

6.3.3 Intermittent coverage shall be provided for entries into restricted areas with little or no potential to change radiological conditions.

6.4 HRAs and Very High Radiation Areas (VHRAs)

6.4.1 HRAs and VHRAs shall be conspicuously posted and barricaded in accordance with 10 *CFR* 20.

6.4.2 Entryways to HRAs and VHRAs should be locked, except during periods when access to the areas is required. Positive controls shall be maintained during each entry into an HRA.

6.4.3 When conditions are impractical for barricading or locking, such as limited evolution jobs or temporary storage, flashing lights (normally red) are utilized with the HRA and VHRA postings to alert the individual to potential entry into an HRA or VHRA.

6.4.4 To prevent unauthorized entry into temporary HRAs or VHRAs, direct surveillance may be substituted for locked areas or flashing lights.

6.4.5 Personnel entering an HRA or VHRA shall have one or more of the following:

6.4.5.1 A radiation monitoring device that continuously indicates the radiation exposure rate in the area.

6.4.5.2 A radiation monitoring device that continuously integrates the radiation exposure rate in the area and alarms when a preset integrated dose is received. Entry into such areas with this monitoring device may be made after the exposure rate level in the area has been established and personnel have been made knowledgeable of them.

6.4.5.3 Accompaniment by an HPT who is using a radiation exposure rate monitoring device and is responsible for providing positive control over the activities within the area.

6.4.6 In addition to the requirements for entry into HRAs, the following requirements shall apply for entry into VHRAs:

6.4.6.1 Areas are posted as VHRAs if dose rates could exceed 500 rads in 1 hour at 1 meter from any source.

6.4.6.2 The RPM shall institute the controls necessary (in addition to the controls described previously) to ensure that an individual is not able to gain unauthorized or inadvertent access to VHRAs in which radiation levels could be encountered at 500 rads or more in 1 hour at 1 meter from a radiation source or any surface through which the radiation penetrates.

6.5 Stop Work

6.5.1 All HPTs and other radiological workers shall have the responsibility and authority to initiate a stop-work order.

6.5.2 If radiological conditions exceed expected levels to an extent at which additional protection measures may be required, HPTs shall initiate a stop-work order and notify the RPM.

6.5.3 Once aware of known or suspected unsafe work conditions, the individual shall assess the situation and, as necessary, issue a stop-work order. The RPM shall be notified immediately.

6.5.4 Specific work activities shall be permitted to proceed to a safe condition after issuance of the stop-work order. The RPM (or designee) should supervise specific work activities as they proceed to a safe shut down.

6.5.5 Stop-Work orders shall be documented in accordance with HP-22, "Radiological Reporting."

6.6 Personnel Release Surveys

6.6.1 A personnel release survey (frisk with a handheld radiological survey instrument) is required upon exit from any potentially contaminated area as determined by the RPM (or designee).

6.6.2 Radiological workers may perform personnel frisks unless otherwise specified on the task-specific HSWP.

6.6.3 A whole-body frisk should take approximately 2 to 3 minutes and should include the head, neck, chest, abdomen, shoulders, arms, back, hips, seat of pants, legs, shoe tops, shoe bottoms, personnel dosimetry, and hard-hat, as applicable.

6.6.4 When an increased instrument count rate is detected above the background count rate, the surveyor shall pause over the suspect area for a time sufficient to allow the instrument response to stabilize.

6.6.5 If personnel skin or clothing contamination above background is confirmed, personnel decontamination shall be performed and documented in accordance with HP-10, "Personnel and Equipment Decontamination."

6.7 Surficial Material and Equipment Release Surveys

6.7.1 Material and equipment that may be unconditionally released include sampling equipment, personal protective equipment (PPE), monitoring equipment, or any other solid item.

6.7.2 When surveying materials, consideration must be made for the chemical hazards associated with the material. If the material is radiologically clean but has a chemical hazard, the site Project Manager must be contacted for correct disposition of the material.

6.7.3 Clients may restrict the release of selected materials, such as PPE. Verify release restrictions in site work plans or SSHPs prior to releasing an item for unrestricted use.

6.7.4 A surficial total and removable contamination survey must be performed prior to unconditional release.

6.7.5 Only HP personnel may perform material or equipment release surveys.

6.7.6 Surveys should be concentrated on locations most likely to be contaminated; however, the entire item shall be surveyed for total contamination by direct frisk of accessible surfaces, unless documented otherwise by the RPM.

6.7.7 Materials with inaccessible surfaces should be evaluated for release on a case-by-case basis. Factors to be considered are the removable contamination activity of the work area, the likelihood of internal contamination based on the function of the item, or whether disassembly of the item is practical.

6.7.8 Release survey results shall be compared to the surficial contamination limits provided by the RPM on Attachment 2 of HP-03, "Site Limits" (or equivalent).

6.8 Material Conditional Release Surveys

6.8.1 At no time shall materials/items conditionally released from the restricted area be removed from the site without approval of the RPM.

6.8.2 Radioactive materials (i.e., calibration sources, samples, etc.) that do not meet the requirements for unrestricted release may need to be removed

from the restricted area for use in instrument performance tests, sample analysis, or other program needs. These items may be removed from the restricted area in accordance with the following requirements:

6.8.2.1 Radioactive source standards must be under continuous control of HPTs.

6.8.2.2 Radioactive material, other than source standards, shall be placed in closed containers with the exterior of the container meeting the unconditional release limits for removable contamination. The container will also have the appropriate labels or stickers in accordance with 10 *CFR* 20.

6.8.2.3 Packages of radioactive material offered for transport in accordance with 49 *CFR* shall meet the removable contamination limits.

6.9 Vehicle Release Surveys

6.9.1 Vehicles shall be surveyed for removable and total contamination prior to release from a restricted area.

6.9.2 Only HP personnel may perform vehicle release surveys.

6.9.3 During the release survey, consideration should be given for surfaces most likely to be contaminated, such as the wheels/tires, floorboard, steering wheel, or areas in which radioactive material may have been transported.

6.9.4 Surfaces shall be reasonably free of material that will prohibit the detection of radioactivity, such as mud.

6.9.5 Vehicle identifying information, such as license plate number, rental agency, or company name, should be noted on the survey form.

6.10 Volumetric Material Release Surveys

6.10.1 A surficial survey may not be representative of volumetric material radioactivity; HPTs shall contact the Radiation Protection Manager (RPM) for release requirements. At no time shall volumetric material (or an item known or suspected to be volumetrically contaminated) be released from the site without approval of the RPM.

6.10.2 Sampling shall be performed to determine volumetric material activity, as directed by the RPM (or designee). The RPM (or designee) shall compare the concentration of radionuclides in the material with appropriate volumetric release limits with concurrence of the project client.

6.10.3 An unopened container of volumetric material, such as a bag of sand, may be released using standard survey techniques.

6.10.4 Materials and equipment requiring volumetric release surveys may also require surficial release surveys, as determined by the RPM (or designee).

6.11 Routine Surveillance

6.11.1 At projects/sites controlled by this radiation safety program with an expected duration longer than three months, the RPM shall specify the frequency of routine surveys by completion of Attachment 2, "Routine Surveillance Frequency," of this procedure (or equivalent).

6.11.2 Routinely accessed restricted areas shall be routinely surveyed at the frequencies specified by the RPM. Survey frequencies should be based on the likelihood of changing radiological conditions. Types of routine surveys may include removable contamination surveys, total contamination surveys, radiation surveys, and/or airborne radioactive material surveys.

6.11.3 HRAs and VHRAs do not require routine surveillance. Surveys in posted HRAs and VHRAs should be conducted as appropriate when access is required into the area to verify the magnitude and extent of potential radiological hazards in the area. Pre-entry surveys should cover areas that are planned to be accessed by personnel, at a minimum.

6.11.4 When performing a routine surveillance survey, the area and type of work in the area should be considered, specifically:

6.11.4.1 Office areas should routinely have desktops and door handles smeared, because those and similar areas are the most likely areas on which contamination would be spread.

6.11.4.2 Work areas should routinely have hand tools, control panels, or other frequently handled items smeared, because these areas are most likely to become contaminated.

6.11.4.3 Consideration should be given to all likely areas in which contamination may have been spread rather than exclusively those areas through which personnel walk.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

RADWORKER RESTRICTED AREA REQUIREMENTS

Prior to Entry into a Restricted Area

1. Pick up your thermoluminescent dosimeter (TLD) and self-reading dosimeter (SRD) (if required) from the issue point.

2. Log in (if required by the HSWP) by filling out the sign-in sheet, and proceed to the restricted area. If respiratory protection is required, use the code at the bottom of the sheet to indicate the type of respirator you are using. Accurately account for time and radiation exposure in the restricted area.

3. Properly don PPE in accordance with HP-05, "Personnel Protective Equipment," HPT instructions, or posted instructions, as applicable.

4. Remove all external packaging if bringing materials and equipment into the restricted area to minimize generation of radioactive waste.

5. Take only the tools and materials actually needed for the work; limit the amount of materials in the area.

6. Report the presence of treated or open wounds to the HPT covering the activity.

While in the Restricted Area

7. Utilize the appropriate container for all potentially non-radioactive trash generated outside of a contamination area. Ensure protective clothing, respirators, and radioactive waste are placed in the proper containers.

8. While working in contamination areas, keep your hands away from your face and use caution not to splash or cause a spill while handling liquids.

9. Do not sweep with standard brooms in a restricted area. Masslinn mops are the only approved "sweeping" means. All vacuum cleaners used in the restricted area should be HEPA-filtered vacuums.

10. Ensure that the HPT covering the activity is contacted before entry is made to any normally inaccessible area.

11. Notify the HPT covering the activity prior to entry into any airborne radioactivity area or HRA.

12. Notify the HPT covering the activity for any changes to the job scope, prior to air tool usage in contamination areas and any radiological deficiency (e.g., missing or defaced postings, down or damaged barriers).

13. DO NOT move or remove postings, barriers, shielding, or equipment unless directed to do so by a Senior HPT, Health Physicist, or the RPM.

14. Follow all HPT instructions and HP procedures. Promptly obey "stop work" and "evacuate" instructions issued by the HPT covering the activity.

15. DO NOT smoke, chew, eat, or drink or bring smoking, eating, chewing, or drinking materials into the restricted area.

16. Properly doff PPE, and perform an appropriate body frisk (as required by the HSWP or HPT instruction) when leaving a contamination area.

17. Minimize the spread of a known or a potential radioactivity spill, and notify the HPT covering the activity.

18. Avoid unnecessary contact with contaminated surfaces, including your clothing (if contaminated), tools, and other equipment.

19. Keep your radiation and hazardous material exposure ALARA, including leaving radiation areas or airborne radioactivity areas when not working.

20. Exit the area promptly if a wound occurs or any injury is received, and notify the HPT covering the activity.

21. Maintain good housekeeping practices to minimize the spread of contamination.

22. When utilizing an SRD:

    - Have a HPT re-zero the dosimeter prior to entering the restricted area if the dosimeter reads greater than 1/2 full scale.
    - Exit the area and have an HPT document exposure and re-zero the dosimeter, if a dosimeter reads 3/4 full scale or greater while working in the restricted area.
    - Notify the HPT covering the activity immediately any time a self-reading dosimeter reads off-scale, is dropped, or is lost.
    - Keep track of your own radiation dose.
    - Notify the HPT covering the activity of any unexpected exposures received (e.g., receiving high exposures in low exposure areas).
    - Do not exceed your remaining allowable exposure.

Upon Exit from the Restricted Area

23. Perform an appropriate body frisk as required by the HSWP, posted instructions, or HPT instructions.

24. Sign out of the HSWP (as required), and return your dosimetry to the issue point.

ROUTINE SURVEILLANCE FREQUENCY

Site:_____ Date: _____ Signature (RPM):_____

Frequency	Location/Description	Radiation Survey[a]	Contamination Survey[b]	Air Sample[c]

[a] List the requirement such as general area and/or on-contact radiation survey.
[b] List the requirement such as total and/or removable contamination survey.
[c] List the requirement such as breathing zone (occupational), work area (occupational), general area (occupational), and/or perimeter (non-occupational) air samples.

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-20

REV. 0

RADIOLOGICAL POSTING AND LABELING

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1.0 Purpose

This procedure establishes guidelines and requirements for radiological postings and labels.

2.0 Scope

This procedure applies to all radiological areas at sites working under this Leidos radiation safety program.

This procedure is based primarily upon the requirements set forth in 10 *Code of Federal Regulations (CFR)* 20. Sites other than those regulated by the U.S. Nuclear Regulatory Commission (NRC) may require establishment of guidelines and requirements for radiological postings differing from those set forth in this procedure (i.e., 10 *CFR* 835). Leidos will document these differences and establish guidelines and requirements for radiological postings in the Site Safety and Health Plan (SSHP) or other appropriate document for that site, as applicable.

3.0 References

3.1 10 *CFR* 19, "Notices, Instructions and Reports for Workers: Inspection and Investigations."

3.2 10 *CFR* 20, "Standards for Protection against Radiation."

3.3 DOE 2009. U.S. Department of Energy. *Radiological Control.* DOE Standard. DOE-STD-1098-2008. October 2008, with Change Notice 1 effective May 2009.

3.4 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.

3.5 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03. Revision 1.

4.0 Definitions

4.1 **Airborne Radioactivity Area** – A room, enclosure, or area in which airborne radioactive materials exist in concentrations:

4.1.1 In excess of the derived air concentrations (DACs) specified in 10 *CFR* 20, Appendix B, or

4.1.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in 1 week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

Posting requirement: "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."

4.2 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site-specific contamination limits, as documented on Attachment 2 of HP-03, "Radiological Limits," or other site-specific documentation (i.e., Site Safety and Health Plan [SSHP], Radiation Protection Plan, etc.). *Post as:* "CONTAMINATION AREA."

4.3 **Controlled Area** – An area, outside of a restricted area but inside the site boundary, to which access can be limited for any reason.

4.4 **High-Radiation Area (HRA)** – An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 100 mrem in 1 hour at 30 cm from the radiation source or 30 cm from any surface that the radiation penetrates. *Posting requirement:* "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."

4.5 **Hot Spot** – The region in a radiation/contamination area in which the level of radiation/contamination is significantly greater than in neighboring regions in the area. *Post as:* "HOT SPOT" with additional information concerning the area and applicable dose rates.

4.6 **Radiation Area** – An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates. *Posting requirement:* "CAUTION, RADIATION AREA."

4.7 **Radioactive Material Area** – Any area, room or enclosure within a restricted area in which radioactive material is present, handled, or stored in quantities exceeding 10 times the quantity in 10 *CFR* 20, Appendix C. *Posting requirement:* "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

Note: If a combination of materials is present (i.e., a combination of uranium and cobalt [Co]-60), the following relationship must be used to determine if the area must be posted as an RMA:

$$\frac{\mu Ci_{Co}}{10Q_{Co}} + \frac{\mu Ci_{U}}{10Q_{U}} \leq 10$$

Where:

Q = the quantity shown in 10 *CFR* 20, Appendix C.

Note: μCi = microcurie(s)

4.8 **Radioactive Material Storage Area (RMSA)** – An administratively designated area in which radioactive material is stored and controlled. *Post as:* "RADIOACTIVE MATERIAL STORAGE AREA."

4.9 **Restricted Area** – An area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. *Post as:* "RESTRICTED AREA."

4.10 **Very High-Radiation Area (VHRA)** – An area, accessible to individuals, in which the radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 meter from the source or from any surface that the radiation penetrates. *Posting requirement:* "GRAVE DANGER, VERY HIGH RADIATION AREA."

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Ensure radiological areas are established based upon current radiological conditions.

5.1.2 Ensure posting requirements are met prior to approval of all health and safety work permits (HSWPs).

5.1.3 Remove postings and labels used to identify radiation hazards when the conditions that required their use no longer exist.

5.2 Health Physics Technicians (HPTs) shall:

5.2.1 Post areas in accordance with the requirements of this procedure.

6.0 Procedure

6.1 Posting and Labeling Requirements

6.1.1 Radiological area posting/labeling requirements shall be as described in 10 *CFR* 20, Subpart J.

6.1.2 Any area, room, or enclosure under the control of this program that meets the definitions described in Section 4.0 shall meet the posting requirements, as described in the definition.

6.1.3 Areas or containers meeting the exceptions of 10 *CFR* 20.1903 or 20.1905 are not required to be posted/labeled but may be posted/labeled as an added measure of information and safety.

6.1.4 Each posted area shall be defined and clearly marked with appropriate signs and may include a portion or all of a room, building, area, or vehicle. Areas without clearly defined existing boundaries (e.g., walls, doors, or fences) may be defined by the use of magenta/yellow tape, ribbon, or rope.

6.1.5 Any container of radioactive material shall be labeled as "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL," unless specifically exempted from labeling pursuant to 10 *CFR* 20.1905. The label shall provide sufficient information (such as the radionuclide[s] present, date, radiation levels, and container activity information) to permit individuals to take precautions to avoid or minimize exposures.

6.1.6 Warning signs, tags, labels, notices, and other radiation hazard identification markings shall be removed only by authorization of the RPM (or designee) when conditions requiring their use no longer exist.

6.1.7 NRC Form 3, "Notice to Employees", should be posted in prominent locations within the area if the work being performed is under the jurisdiction of the NRC.

6.2 Exceptions to Posting Requirements

6.2.1 Areas or rooms containing radioactive materials for periods less than 8 hours are not required to be posted if the following conditions are met:

6.2.1.1 The materials are constantly attended and controlled by an individual who takes necessary precautions to prevent exposures in excess of the limits stated in HP-03, "Radiological Limits."

6.2.1.2 The area or room is subject to HP staff control.

6.2.2 A room or area is not required to be posted with a caution sign due to the presence of a sealed source, unless the source creates a "Radiation Area" due to its presence in the area.

6.3 Exemptions to Labeling Requirements

6.3.1 The following are not required to be labeled:

6.3.1.1 Containers holding radioactive materials in concentrations less than the quantities listed in 10 *CFR* 20, Appendix C.

6.3.1.2 Containers holding radioactive materials in concentrations less than those specified in Table 3 of 10 *CFR* 20, Appendix B.

6.3.1.3 Containers attended by an individual, who takes precautions necessary to prevent exposure of individuals in excess of the limits established in HP-03, "Radiological Limits."

6.3.1.4 Containers that are in transport and packaged and labeled in accordance with DOT regulations.

6.3.1.5 Containers that are accessible only to individuals authorized to handle or use them.

6.3.1.6 Installed manufacturing or process equipment, such as piping and tanks.

6.4 Caution or Danger Signs

6.4.1 Each Caution (or Danger) posting shall depict a magenta (or black) trefoil symbol on a yellow background, as described in 10 *CFR* 20.1901. Each area, building, or room shall be posted at each entrance point.

6.4.2 Each sign, tag, or label shall be displayed prominently and shall be recognizable from a safe distance, and kept current, reflecting any changes in radiological conditions.

6.4.3 Supplementary notices, specifying the requirements for entry to and exit from areas and other special precautions that are to be exercised, should be posted in conjunction with radiation warning signs and tags to provide personnel with any required additional instructions or information not given by the signs and tags.

6.4.4 Caution signs may not be necessary in areas/rooms containing radioactive materials for a period of less than 8 hours, provided that the materials are attended throughout the temporary storage period by an individual who has been trained in the precautions for radiation exposure of personnel.

7.0 Records

There are no records generated by this procedure.

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-21

REV. 0

HEALTH AND SAFETY WORK PERMITS

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LIST OF ATTACHMENTS

1. HSWP LOG
2. HEALTH AND SAFETY WORK PERMIT
3. PRE-JOB BRIEFING
4. HSWP ENTRY CONTROL LOG

1.0 Purpose

The purpose of this procedure is to provide the guidelines and requirements for the generation, implementation, revision, and termination of health and safety work permits (HSWPs) at sites were Leidos is responsible for maintaining radiological safety.

2.0 Scope

This procedure applies to all personnel requiring access to a location covered by an HSWP under this Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR 20),* "Standards for Protection against Radiation."

3.2 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.

3.3 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "ALARA Program." Leidos St. Louis Health Physics Procedure. HP-02. Revision 1.

4.0 Definitions

4.1 **Health and Safety Work Permit (HSWP)** – A document used for control of specific work that provides the minimum protective requirements for the performance of that work.

4.2 **Health and Safety Work Permit (HSWP) Package** – A compilation of documentation providing the complete record of an HSWP from its generation to its closure. The completed HSWP package should contain:

4.2.1 The Pre-Job [As Low As Reasonably Achievable] ALARA Review form, (HP-02, Attachment 2), as applicable;

4.2.2 Pre-Job Briefing forms (Attachment 3 of this procedure);

4.2.3 HSWP (Attachment 2 of this procedure) and revisions;

4.2.4 Post-Job ALARA Review form (HP-02, Attachment 3), as applicable; and

4.2.5 Other documentation as determined by the Radiation Protection Manager (RPM).

4.2 **Radiological or Industrial Safety Hold** – A planned point at which work stops due to the potential health and safety consequences of performing the next step.

4.3 **Restricted Area** – An area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

5.0 Responsibilities

5.1 The RPM shall:

5.1.1 Ensure that HSWPs are initiated as required by this procedure.

5.1.2 Determine if a pre-job ALARA review is required, and ensure reviews are completed prior to approval of the HSWP.

5.1.3 Review and approve all HSWPs prior to job commencement.

5.1.4 Conduct a quarterly assessment of active HSWPs to confirm that the exposure conditions and training/use requirements reflected on the HSWP are current and appropriate.

5.1.5 Maintain copies of terminated HSWP's as part of the radiation protection records.

5.1.6 Maintain a log of HSWPs that have been established and their statuses.

5.2 All personnel performing work under an HSWP shall:

5.2.1 Read the current version of the HSWP and clearly understand the work to be performed;

5.2.2 Comply with the requirements of the HSWP;

5.2.3 Complete the HSWP Entry Control Log (Attachment 4 of this procedure) , or equivalent, prior to entering and upon exiting the work area, if required by the HSWP;

5.2.4 Notify the Health Physics Technician (HPT) covering the activity of any unexpected change in conditions in the work area;

5.2.5 Make every effort to minimize the spread of contamination and ensure proper disposal of materials;

5.2.6 Notify the HPT covering the activity when a hold, as specified in the work procedure, work instructions, or on the HSWP, is encountered, and

5.2.7 Attend a pre-job briefing on the current revision of the HSWP.

5.3 HPTs shall:

5.3.1 Perform required surveys and monitoring for HSWPs;

5.3.2 Perform pre-job briefings for HSWPs;

5.3.3 Provide coverage for the job, as applicable;

5.3.4 Periodically review HSWP Entry Control Logs at their work area for accuracy and completeness;

5.3.5 Notify the RPM if an HSWP revision becomes necessary.

6.0 Procedure

6.1 General

6.1.1 An HSWP shall be initiated for any of the following conditions:

6.1.1.1 Work in or entry into a contamination area, radiation area, high-radiation area (HRA), very high-radiation area (VHRA), or airborne radioactivity area.

6.1.1.2 Transfer of or work with radioactive material as determined by the RPM,

6.1.1.3 Any work as determined by the site RPM.

6.1.2 The RPM shall review scheduled work and assign a Senior HPT to perform the HSWP assessment if warranted by the hazard. Otherwise, the RPM shall perform the assessment.

6.1.3 The RPM, or designee, shall issue the HSWP number. This number shall be entered on the Attachment 1, HSWP Log (or equivalent). The HSWP number uses the following format: the year, next sequential number, and the revision (e.g., 01-004.02).

6.1.4 The RPM (or designee) and work supervisor shall document the pre-job ALARA review, if required, in accordance with HP-02, "ALARA Program."

6.1.5 Using HSWP assessment data and the pre-job ALARA review, if completed, the RPM (or designee) will complete the Attachment 2, Health and Safety Work Permit (or equivalent).

6.1.6 Prior to issue of the HSWP:

6.1.6.1 The HSWP shall be reviewed by the RPM (or designee) and Local Environmental, Health, and Safety (EHS) Official and approved by the RPM.

6.1.6.2 The RPM or HPT covering the activity shall conduct a pre-job briefing for all HSWPs. The pre-job briefing shall:

- Include a discussion of the completed pre-job ALARA review, as applicable;
- Consist of a step-by-step overview of the job, as applicable;
- Consist of a review of the requirements of the HSWP; and
- Be documented on the Attachment 3, Pre-Job Briefing (or equivalent) form.

6.1.7 After an HSWP number is issued, the RPM (or designee) shall establish and maintain an HSWP package, which includes: the HSWP, pre-job ALARA review (as applicable), HSWP assessment (as applicable), and Pre-Job Briefing forms.

6.1.8 Only personnel who have attended a pre-job briefing and signed the briefing form shall be authorized to perform work under that HSWP. Personnel preparing, reviewing, or approving HSWPs or giving pre-job briefings are considered authorized on the briefing form by merit of their familiarity with the requirements of the HSWP.

6.1.9 All personnel shall complete Attachment 4, HSWP Entry Control Log, (or equivalent) for the HSWP under which they are performing work, if required by the HSWP.

6.1.10 Dose In, Dose Out, and Total Dose sections of the HSWP Entry Control Log (or equivalent) shall be completed if a direct reading dosimeter is required by the HSWP.

6.1.11 Prior to end of shift, the HPT covering the activity should ensure all personnel have logged out of the HSWP Entry Control Logs (or equivalent) and all log entries are complete.

6.1.12 The RPM or designee shall ensure that supporting documentation outlined in Section 4.2 are placed in the HSWP package.

6.1.13 HSWPs shall remain active for the duration of the work, up to a maximum of 1 year.

6.1.14 The RPM or HPTs shall perform quarterly assessments of all HSWPs to verify the HSWP requirements are appropriate for the work being performed (i.e., conditions or work to be performed have not changed significantly).

6.1.14.1 The quarterly assessments shall be performed and documented.

6.1.14.2 Verification of the quarterly assessment shall be made by signing and dating the appropriate space on Attachment 2, Health and Safety Work Permit, (or equivalent) and indicating whether a revision is necessary.

6.1.14.3 If necessary, revisions to HSWPs shall be made according to this procedure.

6.1.15 Site-specific work plans (WP), radiation protection plans, or health and safety plans may be used in lieu of HSWPs to control on-site Leidos activities if approved by the RSO.

6.2 Radiological Holds

6.2.1 Radiological holds shall be identified in the additional requirements section of the HSWP or in the appropriate procedure/instruction for work covered by the HSWP.

6.2.2 Work shall be stopped and the HPT covering the activity shall be notified when a radiological hold is encountered.

6.2.3 Work shall not resume until the RPM (or designee) has evaluated conditions and authorization is given.

6.3 HSWP Revision

6.3.1 An HSWP shall be revised if any of the following conditions apply:

6.3.1.1 Changes in conditions sufficient to warrant a change in personnel protection or monitoring requirements, (e.g., a change in protective clothing, respiratory protection equipment [RPE], or dosimetry).

6.3.1.2 A significant change in the scope of the job as it is described on the HSWP.

6.3.1.3 The RPM (or designee) determines a revision is necessary.

6.3.2 When an HSWP is determined to need revision, the RPM (or designee) shall employ a complete revision or a pen-and-ink change, as necessary. Complete revisions shall be performed as follows:

6.3.2.1 During transition from one revision to another, all work under the HSWP shall stop to ensure all personnel actively working on the HSWP are notified of the revision and are briefed on the changes and requirements for performing work on the revised HSWP. Complete Attachment 3, Pre-Job Briefing, (or equivalent) form.

6.3.2.2 Work under the revised HSWP may begin after personnel are briefed and appropriate documentation is completed.

6.3.2.3 Remove all copies of the terminated HSWP and HSWP Entry Control Logs.

6.3.2.4 Sign and date the "Terminated by" blank on the original HSWP, and provide the reason for the termination.

6.3.2.5 Prepare and issue the revised HSWP according to the requirements of this procedure.

NOTE:

All personnel shall be briefed on the changes made under the revised HSWP before being authorized to enter the work area governed by that HSWP.

6.3.2.6 The revised HSWP shall retain the same number as the original HSWP except the "Rev." designator, which will be .00 for initial HSWPs, shall be changed to .01 for the first revision and to .02 for the second, etc.

6.3.3 Pen-and-ink changes shall be authorized by the RPM (or designee) for minor changes to personal protection or monitoring requirements. Pen-and-ink changes shall be made as follows:

6.3.3.1 Pen-and-ink changes shall be made on the original and all copies of the latest revision to the HSWP.

6.3.3.2 Deletions to requirements shall be made using a single-line strikeover, then initialing and dating the revision.

6.3.3.3 Additions to requirements shall be initialed and dated after the addition.

6.3.3.4 The "Additional Requirements" section of the HSWP shall be used to clarify any pen-and-ink changes, if necessary.

6.3.3.5 If numerous pen-and-ink changes have made the HSWP illegible, a complete revision shall be performed. Personnel performing work covered by the revised HSWP shall be briefed on the revision and shall document the briefing by re-signing the Attachment 3, Pre-Job Briefing, (or equivalent) form prior to working under the revised HSWP.

6.3.3.6 The RPM (or designee) shall ensure that all personnel briefed on the previous version of the HSWP are contacted and informed of the revision to the HSWP, as applicable.

6.4 HSWP Termination

6.4.1 HSWPs shall be terminated for any of the following reasons:

6.4.1.1 Any condition requiring a complete revision to the HSWP.

6.4.1.2 Completion of the job.

6.4.1.3 If the time limits are reached.

6.4.2 The RPM or designee shall complete the "Terminated By," "Reason for Termination," and revision or HSWP termination blanks on the original maintained in the HSWP Package.

6.4.3 After HSWP termination, the RPM (or designee) shall perform the post-job ALARA review, if required, in accordance with HP-02, "ALARA Program."

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

HSWP LOG

PERMIT NUMBER	JOB DESCRIPTION	DATE AUTHORIZED	DATE TERMINATED

HEALTH AND SAFETY WORK PERMIT

HSWP No: ___ ___-___ ___ . ___ ___ Date Issued: _____ Expiration Date: _____

Client: _____ Location: _____ Site: _____

Job Description: _____

_____

H/S COVERAGE

- ☐ Continuous
- ☐ Intermittent
- ☐ Buddy System
- ☐ Confined Space Entry Permit.
- ☐ Notify H/S upon entry to area.
- ☐ HSWP Entry / Exit Log Required
- ☐ HPT perform all personnel frisk surveys
- ☐ Radiological Workers may perform personnel frisk surveys

DRESS REQUIREMENTS

- ☐ Cotton Coverall
- ☐ Canvas Hood
- ☐ Paper Coveralls
- ☐ Plastic Coveralls
- ☐ Tyvek Coveralls
- ☐ Skull Cap
- ☐ Cloth Gloves
- ☐ Rubber Gloves
- ☐ Plastic Booties
- ☐ Lab Coat
- ☐ Surgeon's gloves
- ☐ Rubber Apron
- ☐ Rubber Shoe covers
- ☐ No personal outer-clothing.
- ☐ Tape gloves and booties to coveralls
- ☐ Other_____
- ☐ Other_____
- ☐ Other_____
- ☐ Other_____
- ☐ Other_____
- ☐ Other_____
- ☐ Other_____
- ☐ Other_____

DOSIMETRY REQUIREMENTS

- ☐ Self Reading Dosimeter
- ☐ Whole Body TLD
- ☐ Ring TLD
- ☐ Electronic Dosimeter
- ☐ Multi-Badging

RESPIRATORY PROTECTION

- ☐ Air Purifying Respirator
- ☐ Powered Air Purifying Respirator
- ☐ Air Line Respirator
- ☐ SCBA
- ☐ Other_____
- ☐ Other_____

SAFETY EQUIPMENT

- ☐ Safety Glasses
- ☐ Steel-toed Shoes
- ☐ Goggles
- ☐ Hard Hat
- ☐ Face-Shield
- ☐ Leather Apparel
- ☐ Hearing Protection
- ☐ Welding Shield w/ _____ number lens
- ☐ Other _____
- ☐ Other _____
- ☐ Other _____
- ☐ Other _____

ADDITIONAL REQUIREMENTS (ALARA considerations, pen-and-ink changes, safety, job specific):

_____

_____

_____

_____

_____

_____

A PRE-JOB BRIEFING IS REQUIRED PRIOR TO ENTRY ON THE HSWP.

Reviewed By: _____ **Date:** _____
Local EHS Representative

Approved By: _____ **Date:** _____
RPM

Collective Dose Goal: _____ **Approved By:** _____ **Date:** _____

Terminated By: _____ **Date:** _____

Revision Termination ____ **HSWP Termination:** _____ **(check one)**

Reason for Termination: _____

HEALTH AND SAFETY WORK PERMIT CONTINUATION SHEET

Page 2 of 2

QUARTERLY ASSESSMENT VERIFICATION HSWP Number			
Date (month/day/year)	**Signature of RPM/HPT**	**Revision Required Yes***	**No**

*If "Yes," state the reason a revision is required and whether a pen-and-ink change or complete revision is necessary:

Revision Approved: _____ Date: _____
RPM

PRE-JOB BRIEFING

HSWP No. _____ **Date:** _____

PRE-JOB BRIEFING CHECKLIST	**INITIALS**
• Discuss pre-job ALARA review, if applicable.	N/A
• Review requirements of HSWP.	
• Review the step-by-step aspects of the job, ensuring all personnel are aware of their required actions.	

Job Description: _____

PERSONNEL ATTENDING PRE-JOB BRIEFING

HSWP No. _____

Printed Name	Signature*	Employee ID No.

*** By signature, personnel certify they have read, understand, and will comply with the requirements of the HSWP.**

Signature _____ _____
RPM Date

HSWP ENTRY CONTROL LOG

HSWP No. ___ ___-___ ___. ___ ___ CLIENT: _____ LOCATION: _____

AREA _____ DATE _____

A PRE-JOB BRIEFING IS REQUIRED PRIOR TO ENTRY ON THIS HSWP.

PRINTED NAME	TIME IN	DOSE IN	RESP. TYPE	TIME OUT	DOSE OUT	TIME IN	DOSE IN	RESP. TYPE	TIME OUT	DOSE OUT	TOTAL DOSE

RESP. TYPE: FF = FULL FACE; SCBA = SELF-CONTAINED BREATHING APPARATUS; AL = AIRLINE

Reviewed By: _____ Date: _____

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-22

REV. 0

RADIOLOGICAL REPORTING

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LIST OF ATTACHMENTS

1. RADIOLOGICAL OCCURRENCE REPORT (ROR)
2. RADIOLOGICAL OCCURRENCE REPORT LOG
3. LEIDOS NOTIFICATION INFORMATION
4. REGULATORY REPORTING REQUIREMENTS SUMMARY
5. INFORMATION TO BE PROVIDED IN TELEPHONE REPORTS

1.0 Purpose

The purpose of this procedure is to provide requirements and guidelines for identifying, documenting, reporting, and correcting unsatisfactory radiological conditions such that continuous improvements are made to the Leidos Radiation Safety Program.

2.0 Scope

This procedure applies to unsatisfactory radiological conditions at all sites where work is performed under the Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection against Radiation."

3.2 10 *CFR* 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material."

3.3 10 *CFR* 40, "Domestic Licensing of Source Material."

3.4 10 *CFR* 70, "Domestic Licensing of Special Nuclear Material."

3.5 49 *CFR*, Subtitle B, Chapter I, Subchapter C, Hazardous Material Regulations. Part 171, "General Information, Regulations, and Definitions."

3.6 Leidos 2014a. Leidos St. Louis Health Physics Manual. "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03. Revision 1.

3.7 Leidos 2014c. Leidos St. Louis Health Physics Manual. "Radiological Instrumentation." Leidos St. Louis Health Physics Procedure. HP-30. Revision 1.

3.8 Leidos 2014d. *Leidos Corporate Environmental, Health and Safety Program Manual.* "Radiation Protection." Leidos Environmental Health and Safety Procedure. EHS-19. Revision 0. February 2014.

3.9 Leidos 2015. *Environmental Science and Engineering Quality Assurance Procedure.* "Nonconformance and Corrective Action." ESE A16.1.

3.10 USACE 1997. U.S. Army Corps of Engineers. *Safety: Radiation Protection Manual.* Engineer Manual. EM 385-1-80. Sections 6-12. May 30, 1997.

3.11 USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Safety.* Section 19, "Reports." Engineer Regulation. ER 385-1-80. June 30, 2010.

3.12 USACE 2012. U.S. Army Corps of Engineers. *Safety: Safety and Health Requirements Manual.* Engineer Manual. Consolidated EM 385-1-1. Section 06.E.11a. September 15, 2008, with Change #7 effective July 20, 2012.

4.0 Definitions

4.1 **Immediate Actions** – Those actions taken to halt the progress of a radiological incident and recover normal or stable radiological conditions.

4.2 **Radiological Event** – A condition or occurrence that reduces the radiological safety provided to site personnel or the public, or indicates an adverse trend in radiation protection program performance. These include:

4.2.1 Occupational radiation exposures exceeding administrative exposure limits;

4.2.2 Unplanned intakes of radioactive material in excess of 10 percent of an Annual Limit on Intake (ALI);

4.2.3 Unmonitored radiation exposure (i.e., exposure received without appropriate monitoring equipment) estimated to exceed 100 millirem (mrem) Total Effective Dose Equivalent (TEDE), 1,500 mrem eye dose equivalent, 5,000 mrem Total Organ Dose Equivalent (TODE) or Shallow Dose Equivalent (SDE);

4.2.4 Radiological areas not properly controlled or posted;

4.2.5 High radiation areas or very high radiation areas not properly controlled, guarded, or locked, as required;

4.2.6 Uncontrolled radioactive material resulting in loose surface contamination exceeding the criteria established in HP-03, "Radiological Limits";

4.2.7 Radioactive spills (uncontrolled release of radioactivity into the site environment). The material may be in liquid, solid, or gaseous form and may vary considerably in volume or activity. The key element in identifying a spill is the "uncontrolled" nature of the release;

4.2.8 An issued "Stop Work Order," due to unexpected or degrading radiological work conditions or unsafe radiological work practices;

4.2.9 Defective radiological instrumentation used to perform any of the following:

- Assess personnel exposure or comply with exposure limits;
- Release equipment, material, or personnel;
- Determine radioactive effluent quantities or concentrations; or
- Label, ship, or receive radioactive material, including radioactive waste.

4.2.10 Personnel contamination events resulting in calculated skin exposure exceeding 5,000 mrem SDE; or

4.2.11 Any significant event as determined by the Radiation Safety Officer (RSO) or Radiation Protection Manager (RPM).

4.3 **Radiological Incident** – A condition or occurrence that indicates a potentially unsafe condition and requires the notification of a regulatory agency. Radiological incidents are described in Attachment 4 to this procedure.

CAUTION:

The descriptions of radiological incidents presented in Attachment 4 are paraphrased. The most current version of the applicable federal regulation should be checked as the situation allows.

5.0 Responsibilities

5.1 The Corporate Environmental, Health, and Safety (EHS) Manager shall:

5.1.1 Make all regulatory-required radiological incident notifications required by Leidos EHS procedures, where applicable.

5.1.2 Determine the need for and generate or direct the generation of (as necessary) non-conformance reports (NCRs) in accordance with Leidos *Environmental Science and Engineering Quality Assurance Procedure* ESE A16.1, "Nonconformance and Corrective Action."

5.2 The RSO or RPM shall:

5.2.1 Notify project management and the Corporate EHS Manager of all radiological incidents in accordance with the requirements in Leidos EHS Procedures 19, "Radiation Protection," and 21, "Regulatory Agency Inspections and Related Reporting."

5.2.2 Coordinate with the Corporate EHS Manager to assure timely notifications of radiological incidents in accordance with federal, state, local, and client requirements.

5.2.3 Initiate a corrective action report (CAR), as necessary, in accordance with Leidos ESE A16.1, "Nonconformance and Corrective Action," for radiological occurrence reports (RORs) generated in accordance with this procedure.

5.2.4 Assign corrective actions and verify completion/closure for RORs.

5.2.5 Review, at least quarterly, all generated RORs for adverse trends and common or recurrent problems.

5.3 Health Physics Technicians (HPTs) shall:

5.3.1 Immediately notify the RSO or RPM of any unsatisfactory radiological condition.

5.3.2 Take immediate actions to establish safe radiological conditions during a radiological incident or event.

5.3.3 Implement or verify implementation of corrective actions as assigned by the RSO or RPM.

6.0 Procedure

NOTE:
When working on a client site, all regulatory communications and notifications required by this procedure are to be made by the client, unless Leidos is working under a license issued to Leidos by the U.S. Nuclear Regulatory Commission (NRC) (or agreement state).

6.1 When any unsatisfactory radiological condition is identified, it should be brought to the immediate attention of the RSO or RPM.

6.2 The RSO or RPM shall evaluate the condition and, if warranted, take the immediate corrective actions necessary to resolve the unsatisfactory condition and/or to render the condition safe.

6.2.1 If no action is warranted, then exit this procedure.

6.2.2 If action is warranted, then the RSO or RPM shall determine if the condition is a radiological incident or a radiological event, as outlined in subsequent steps.

6.3 The RSO or RPM will utilize Section 4.1 (Attachment 4, or equivalent) to determine if the unsatisfactory radiological condition is a radiological incident (the issues listed in Attachment 4 require notification to a regulatory agency).

6.4 If the condition is a radiological incident, then:

6.4.1 The RSO or RPM shall immediately notify the appropriate client representative, the Project Manager, and the Corporate EHS Manager (contact information is provided in Attachment 3) that the condition is a radiological incident.

6.4.2 If a telephone report is required, then:

6.4.2.1 The RSO or RPM will gather the minimum information needed for a telephone report, as provided in Attachment 5 or equivalent.

6.4.2.2 The RSO or RPM will immediately contact the Corporate EHS Manager, relay the need for a telephone report, relay the time limit and time remaining, relay the reporting information, and request that a telephone report be made.

6.4.2.3 If the Corporate EHS Manager cannot be contacted in a reasonable amount of time, then the RSO or RPM will make the telephone report and then continue in attempts to contact the Corporate EHS Manager.

6.4.3 If only a 30-day written report is required (i.e., shipping incident) then the report will be handled via the ROR form and associated report process.

6.5 The RSO or RPM will utilize Section 4.2 to determine if the unsatisfactory radiological condition is a radiological event. Radiological events indicate a degraded or degrading safety margin and must be brought to the attention of Leidos and client management.

6.6 If the condition is a radiological event, then the RSO or RPM shall notify the appropriate client representative, the Project Manager, and the Corporate EHS Manager of the event in a timely manner.

6.7 If the condition is a radiological incident or radiological event, then the RSO, RPM, or designee will investigate by:

6.7.1 Gathering written statements from witnesses, as necessary;

6.7.2 Collecting or preserving evidence, as necessary;

6.7.3 Interviewing involved parties, as necessary; and/or

6.7.4 Conducting a fact-finding investigation and/or fact-finding meeting, as necessary.

6.8 If the condition is a radiological incident or radiological event, then the RSO, RPM, or designee will document the condition by:

6.8.1 Completing the applicable portions of Attachment 1, *Radiological Occurrence Report* (ROR), or equivalent;

6.8.2 Attaching appropriate supplementary documentation to the ROR;

6.8.3 Entering the appropriate information on Attachment 2, *Radiological Occurrence Report Log*, or equivalent; and

6.8.4 If the ROR documents a radiological incident, then forwarding a draft copy of the RIR to the Corporate EHS Manager.

6.9 The RSO, RPM, or designee & Corporate EHS Manager shall review the requirements in Leidos ESE A16.1, *Nonconformance and Corrective Action*, and generate any additional reports or records, as required.

NOTE:
At sites where Leidos is providing subcontracted health physics support only, or Leidos is working under a client's NRC license, alternative quality assurance (QA) procedures may be in place. The RSO or RPM and Corporate EHS Manager shall determine the appropriate project procedures for execution, if any, in lieu of the procedures specified in Section 6.9.

6.10 If the condition was a radiological incident, then the RSO, RPM, or designee should complete the investigation by determining the root cause(s) of the incident (root cause investigations are formal, rigorous, and required for significant conditions that are adverse to quality). The root cause(s) shall be documented in the ROR.

6.11 If the condition was a radiological event, then the RSO, RPM, or designee should complete the investigation by determining the apparent cause(s) of the incident. The apparent cause(s) shall be documented in the ROR.

6.12 The RSO, RPM, or designee shall specify corrective actions that address the root or apparent cause(s) and which are:

6.12.1 Specific, measurable, contain action statements, are relevant to the condition and cause(s), and are timely;

6.12.2 Documented in the ROR; and

6.12.3 Approved by the Project Manager, the client (if applicable), and the Corporate EHS Manager (if a radiological incident).

6.13 If the condition was a radiological incident, then a follow-up report to a regulatory agency will be required within 30 days as provided in Attachment 4, or equivalent.

6.13.1 The RSO, RPM, or designee should reference the applicable regulations to determine the required content for the report, the method of delivery, and the correct mailing address as appropriate. Attachment 4, or equivalent, may be used as a guide in determining the applicable regulations.

6.13.2 The report should be completed and provided for review to the Project Manager and the Corporate EHS Manager within 20 calendar days of the discovery or occurrence of the condition.

6.13.3 The report should be approved by the Project Manager, the Corporate EHS Manager, and the client (if applicable) prior to being issued to the regulatory agency.

6.13.4 The Corporate EHS Manager will determine who will send the 30-day written report to the regulatory agency.

6.14 The RSO, RPM, or designee will maintain the ROR up-to-date and will:

6.14.1 Ensure all corrective actions generated as a result of an ROR are completed in accordance with the established schedule; and

6.14.2 Verify corrective action implementation adequately resolves the deficiencies.

6.15 When all corrective actions are complete, the RSO, RPM, or designee will complete the ROR form and:

6.15.1 Update the ROR log; and

6.15.2 Ensure that lessons learned as a result of an ROR are incorporated into employee continuing training, as appropriate.

6.16 If an ROR describes a radiological incident and involves occupational exposure or exposure of an identified member of the public to radiation or radioactive material, then the RSO or RPM shall ensure that:

6.16.1 The affected individual(s) is/are provided access to a copy of any written report that was provided to the NRC;

6.16.2 The individual's exposure history is updated, as appropriate, and a copy of the ROR is maintained with the individual's personnel exposure history file (if applicable); and

6.16.3 If an individual exposure estimate is adjusted or modified as a result of the ROR, then the individual is informed of the exposure total, any work restrictions, and any adjustments to the individual's allowed administrative exposure limit.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RSO or RPM until transmitted to the appropriate electronic record system.

RADIOLOGICAL OCCURRENCE REPORT (ROR)

ROR No.:_____ Page 1 of ___

PART 1: IDENTIFICATION

(Attach additional sheets, as necessary, for all sections)

Date of Condition: _____ Time of Condition: _____ Time of Discovery: _____

HSWP No.: _____

Client:_____ Site: _____

Personnel Involved *(Full Names)*: _____

_____

Description of Condition: _____

_____

Initiated by: _____ Date: _____ Time: _____

PART 2: IMMEDIATE ACTIONS TAKEN

(Include date & time completed): _____

_____

_____

_____

PART 3: SCREENING AND INTERNAL NOTIFICATIONS

Type of Condition: ☐ Radiological Incident *(complete Part 4)* ☐ Radiological Event

Trigger Criteria *(alpha-numeric from Attachment 4 or item number from procedure Section 4.2)*: _____

Project MGR Notified: _____ Date: _____ Time: _____

Corporate EHS MGR Notified: _____ Date: _____ Time: _____

Client Notified: _____ Date: _____ Time: _____

PART 4: REGULATORY TELEPHONE NOTIFICATION

(For radiological incidents except Attachment 4 items C1 and E1)

Regulatory Agency Contacted: _____ No. Called: ( ) -

Name of Person Taking Telephone Report: _____ Date: _____ Time: _____

Report Made By: _____ Title: _____

PART 5: RESULTS OF INVESTIGATION

Event Narrative *(what happened, sequence of events)*: _____

_____

_____

Root or Apparent Cause(s) *(circle which)*: _____

_____

_____

RADIOLOGICAL OCCURENCE REPORT (ROR)

ROR No.:_____ Page 2 of ___

PART 6: CORRECTIVE ACTIONS

(Number each item, use additional sheets or attachments as necessary)

No.____ Action to be Taken:_____

_____

Responsible Person: _____ Accept *(signature)*:_____ Due:_____

Corrective Action Complete: _____ Date: _____
Individual

Corrective Action Closure: _____ Date: _____
RSO or RPM

PART 7: FOLLOWUP WRITTEN REGULATORY REPORT

(For radiological incidents, use registered mail with receipt notification)

Regulatory Agency: _____

Date Sent: _____ Method Sent: _____ Receipt or Tracking Number: _____

Sent By: _____ Title: _____

PART 8: ROR CLOSURE

Required reports complete and submitted? Yes ☐ No ☐

Verified by: _____ Date: _____
RSO or RPM

Corrective Actions Complete? Yes ☐ No ☐

Verified by: _____ Date: _____

Corrective Action Effectiveness Verified by:_____ Date: _____
Responsible Supervisor

Individual exposures and exposure history files updated, if required? Yes ☐ No ☐ N/A ☐

Verified by: _____ Date: _____
RSO or RPM

ROR Complete? Yes ☐ No ☐

Approved by: _____ Date: _____
RSO or RPM

RADIOLOGICAL OCCURRENCE REPORT LOG

Site: _____ Year: _____

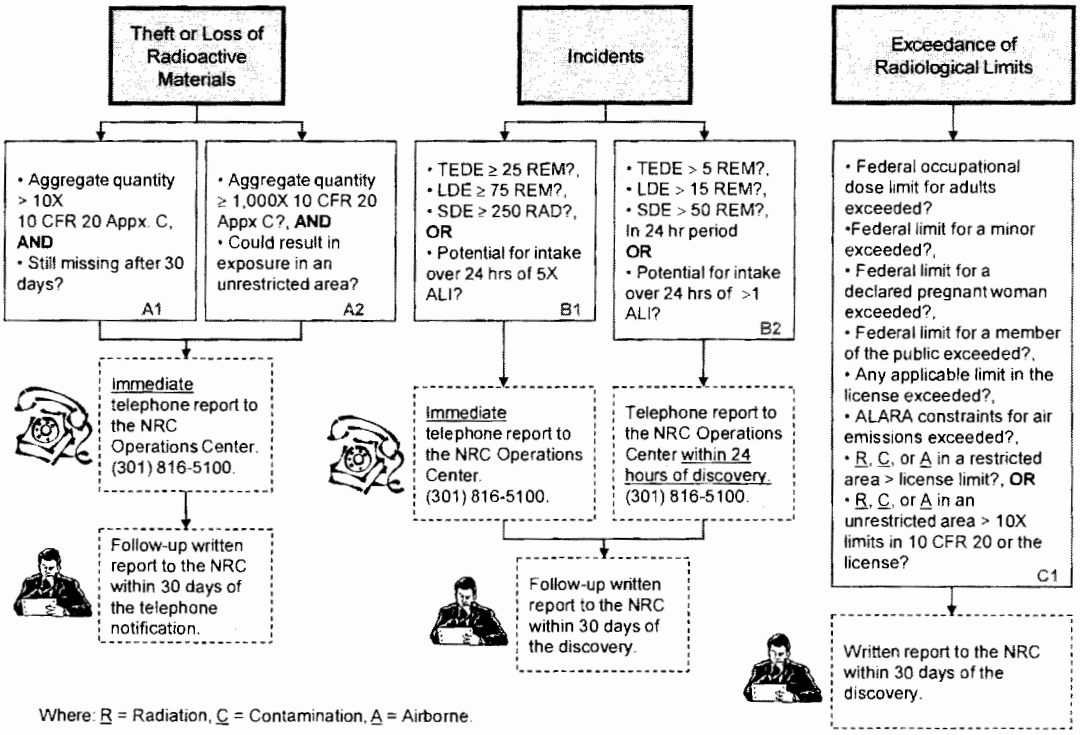
ROR Number	Description	Initiated By (Initial and Date)	Closed By (Initial and Date)

LEIDOS NOTIFICATION INFORMATION

Title	Name	Telephone Number/Pager	e-mail
Corporate EHS Manager	Gary Waggoner	(571) 526-6753 Office (858) 354-4468 Mobile	gary.a.waggoner@leidos.com
Group EHS Manager	Stephen Lowery	(405) 242-6213 Office (405) 919-4176 Mobile (405) 242-6373 Fax	stephen.h.lowery@leidos.com

REGULATORY REPORTING REQUIREMENTS SUMMARY

10 CFR 20.2201, 2202, and 2203



Where: R = Radiation, C = Contamination, A = Airborne.

10 CFR 30.50, 40.60, and 70.50

Other Radiological Incidents

Any event that prevents immediate protective actions necessary to avoid exposures to radiation or radioactive materials that could exceed regulatory limits or releases of licensed material that could exceed regulatory limits (may include fires, explosions, gas releases, etc...) D1

An unplanned contamination event that:
• Restricts access to the contaminated area by workers or the public for more than 24 hours by imposing additional controls or prohibiting entry into the area,
• Involves a quantity of material > 5X the lowest ALI per 10 CFR 20 Appx. B, **AND**
• Does not involve the decay of isotopes with a half-life of < 24 hours. D2

An event in which equipment is disabled or fails to function as designed when:
• The equipment is required by regulation or license to prevent releases that exceed regulatory limits, prevent exposures exceeding regulatory limits, or mitigate consequences of an accident,
• The equipment is required to be available and operable when it is disabled or fails, **AND**
• No redundant equipment is available. D3

An event that requires unplanned medical treatment at a medical facility for an individual with loose radioactive contamination on the clothing or body. D4

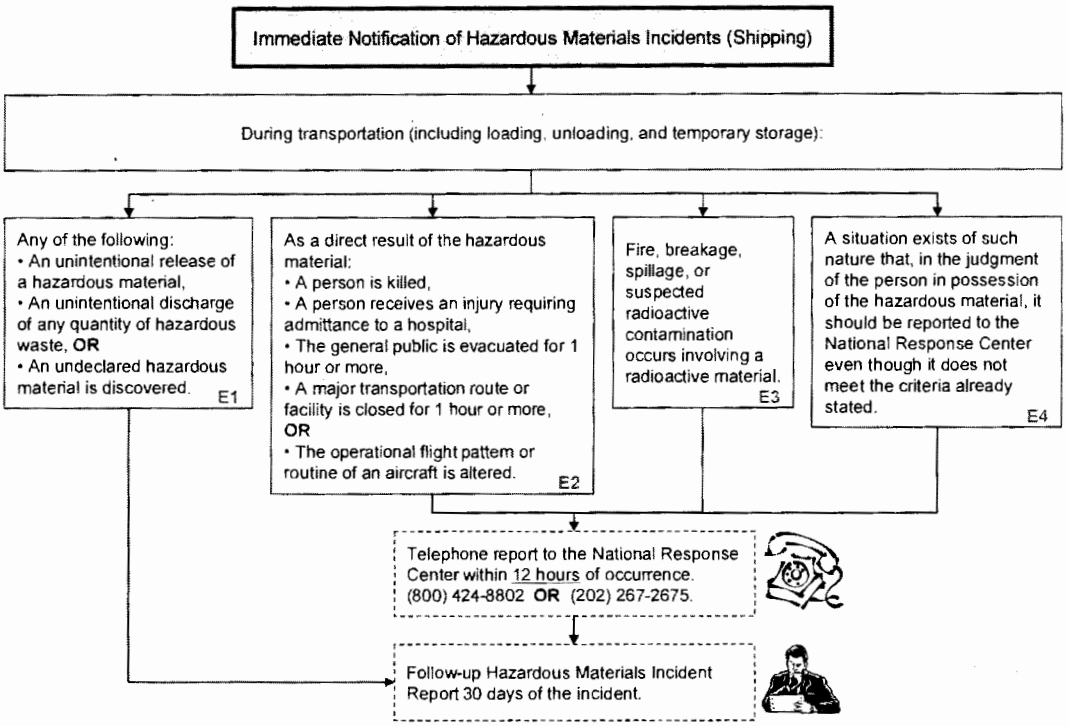
A fire or explosion that damages any licensed material or any device, container, or equipment containing license material, when:
• Involves a quantity of material > 5X the lowest ALI per 10 CFR 20 Appx. B, **AND**
• The damage affects the integrity of the licensed material or its container. D5

Telephone report to the NRC Operations Center within 4 hours of discovery. (301) 816-5100.

Telephone report to the NRC Operations Center within 24 hours of discovery. (301) 816-5100.

Follow-up written report to the NRC within 30 days of the discovery.

49 CFR 171.15 and 171.16



INFORMATION TO BE PROVIDED IN TELEPHONE REPORTS

Information to be provided in a U.S. Nuclear Regulatory Commission telephone report.

- ❑ The caller's name, and position title;
- ❑ The caller's call-back telephone number;
- ❑ Date and time of the event;
- ❑ The exact location of the event;
- ❑ A description of the event, including;
  - ❑ The isotopes, quantities, and chemical and physical form of the licensed material involved;
  - ❑ Any personnel radiation exposure data that is available;
  - ❑ The sequence of occurrences leading to the event; **AND**
  - ❑ Whether remaining structures, equipment, and personnel are available to and can continue to perform their safety functions;
- ❑ External conditions affecting the event;
- ❑ Actions taken in response to the event;
- ❑ Event status (on-going or terminated);
- ❑ Current site status, including any declared emergency class;
- ❑ *Notifications that have been made; **AND***
- ❑ Status of any press releases made or planned.

Information to be provided to the National Response Center in a telephone report (shipping).

- ❑ The caller's name and call-back telephone number;
- ❑ Name an address of person or organization making the shipment;
- ❑ Date, time, and location of the event;
- ❑ The extent of injury, if any;
- ❑ Class or division, proper shipping name, and quantity of hazardous materials involved;
- ❑ Type of incident and nature of hazardous material involvement; **AND**
- ❑ Whether a continuing danger to life exists at the scene.

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-23

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RADIOACTIVE SOURCE CONTROL

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LIST OF ATTACHMENTS

1. RADIOACTIVE SEALED SOURCE LEAK TEST FREQUENCY
2. RADIOACTIVE SEALED SOURCE LEAK TEST SURVEY
3. RADIOACTIVE SOURCE LOG AND INVENTORY
4. RADIOACTIVE SOURCE ISSUE LOG

1.0 Purpose

This procedure establishes the requirements for the control, accountability, and leak testing of radioactive sources.

2.0 Scope

This procedure applies to the inventory and leak testing of radioactive sources controlled under this Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection against Radiation."

3.2 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.

3.3 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Monitoring." Leidos St. Louis Health Physics Procedure. HP-11.

3.4 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Radiological Reporting." Leidos St. Louis Health Physics Procedure. HP-22.

4.0 Definitions

4.1 **Controlled Area** – An area, outside of a restricted area but inside the site boundary, to which access can be limited for any reason.

4.2 **Minimum Detectable Activity (MDA)** – The smallest amount of radioactivity that can be detected given the conditions of a specific sample.

4.3 **Restricted Area** – An area to which access is limited for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.4 **Sealed Source** – Any device containing radioactive material that may be used as a source of radiation, and which has been constructed in such a manner as to prevent the escape of radioactive materials.

4.5 **Semi-Annual** – A time period that consists of 6 months.

4.6 **Source Housing** – Device designed to support, shield, and/or contain a sealed radiation source.

4.7 **Unrestricted Area** – An area to which access is neither limited nor controlled by the responsible party.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Secure radioactive sources stored in controlled areas or restricted areas from unauthorized access.

5.1.2 Authorize source purchases.

5.1.3 Verify that leak tests are performed at the frequency specified by this procedure.

5.1.4 Evaluate the disposition of leaking or degraded sources.

5.1.5 Direct a search, make notifications, and evaluate potential consequences in the event of a lost source.

5.1.6 Verify that the source inventory is current.

5.1.7 Verify that sources under their control be stored, issued, and used in accordance with this procedure.

5.2 Health Physics Technicians (HPTs) shall:

5.2.1 Perform source leak test surveys.

5.2.2 Perform source inventories.

5.2.3 Maintain a current inventory of sources, as directed by the RPM.

5.2.4 Forward a copy of all survey and related documentation to the RPM (or designee) for review.

6.0 Procedure

6.1 Radioactive Source Accountability

6.1.1 The radioactive source shall be assigned a specific number, and the number shall be entered on Attachment 3, "Radioactive Source Log and Inventory," (or equivalent) upon receipt. The manufacturer's original serial number may be used as the specific number.

6.1.2 Each source shall be accounted for on Attachment 3 (or equivalent). Attachment 3 may be maintained electronically if either electronic or paper backup copies exist.

6.1.3 The source tracking number shall be indicated on the source Certificate of Calibration and source container.

6.1.4 Source storage locations shall be posted; lockable; and controlled to prevent loss, theft, or unauthorized use.

6.1.5 The source or source holder will be physically labeled with the assigned number and placed in the source storage location.

6.1.6 A physical inventory will be conducted at least semi-annually and documented on Attachment 3 (or equivalent) in accordance with Section 6.4 of this procedure to account for all radioactive sources.

6.1.7 The results of the inventory shall be entered into the current source inventory file.

6.1.8 Records of the inventories shall be maintained for inspection by regulatory agencies and shall include the quantities and kinds of radioactive material, location of the source, and the date of the inventory.

6.2 Leak Tests

6.2.1 Upon receipt, and at the frequency specified in Attachment 1, Radioactive Sealed Source Leak Test Frequency, all sources that meet or exceed the activity threshold specified in Attachment 1 shall be surveyed for removable contamination (leak tested) in accordance with HP-11, "Radiological Monitoring."

6.2.2 Do not touch or smear the surface upon which radioactive material is deposited. Smear(s) should be taken on the back of the source, the interior of the source storage container, or any other location on which one might expect to find contamination.

6.2.3 Leak test surveys should be documented on Attachment 2 (or equivalent). Activity results shall be converted from disintegrations per minute (dpm) to microcuries (μCi), as shown on Attachment 2. Leak test results that indicate no detectable activity above background are to be documented as less than the MDA.

6.2.4 If the survey results indicate removable activity above the MDA: contain (i.e., in a radioactive material bag or other appropriate method) the source, conspicuously label the source as "Out of Service," and notify the RPM. The equipment or area associated with the leaking source shall be surveyed and decontaminated, if required.

6.2.5 The RPM (or designee) should evaluate sources with leakage above the MDA, but below 0.005 μCi for repair or disposal. Any source with leakage equal to or greater than 0.005 μCi shall be disposed of in accordance with this procedure.

6.3 Issuance of Sources

6.3.1 Sources will only be issued to response test and calibrate radiation measuring instruments, unless otherwise authorized by the RPM.

6.3.2 Each source will be signed out on Attachment 4, Radioactive Sealed Source Issue Log, (or equivalent) prior to removing the source from the immediate storage area (i.e., room).

6.3.3 Sources in use shall be under the constant surveillance and control of the authorized user.

6.3.4 The source must be signed in when returned to its designated storage location.

6.4 Inventory of Sources

6.4.1 Obtain a list of sources from the Source Inventory Database or a photocopy of the current Attachment 3, Radioactive Sealed Source Log and Inventory (or equivalent).

6.4.2 Perform a physical inventory of each source, and document the inventory on Attachment 3 (or equivalent).

6.4.3 Visually inspect the source for cracks, chips, corrosion, or other conditions that could result in the leakage of radioactive material. If any

source degradation is evident, perform a source leak test. Ensure the source/source container bears appropriate warning labels.

6.4.4 Notify the RPM if any sources are unaccounted for, physically degraded, or not at the location specified on Attachment 3 (or equivalent).

6.5 Disposal of Radioactive Sources

6.5.1 The Radiation Safety Officer (RSO) shall approve the disposal of all sources.

6.5.2 Sources shall be disposed of in accordance with applicable shipping procedures.

6.5.3 Indicate source disposal on Attachment 3 (or equivalent).

6.5.4 The disposal of sources shall be performed in accordance with state and federal regulations, after approval from the RSO and the Corporate Environmental, Health, and Safety (EHS) Manager.

6.6 Reports of Theft or Loss of Radioactive Material

6.6.1 If a radioactive source is lost or stolen, the RPM shall direct a search for the source and make the appropriate notifications in accordance with the guidance provided in HP-22, "Radiological Reporting."

6.6.2 The RSO shall provide reports of lost or stolen radioactive material to the appropriate regulatory authorities in accordance with HP-22.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

RADIOACTIVE SEALED SOURCE LEAK TEST FREQUENCY

Source Type	Use	Activity	Minimum Leak Test Frequency
Beta/gamma-emitting	Active	≥ 100 microcuries	6 months
Alpha-emitting	Active	≥ 10 microcuries	3 months
Beta/gamma-emitting	Not in use	Any	Not required
Alpha-emitting	Not in use	Any	Not required
Beta/gamma-emitting	Active	< 100 microcuries	Not required
Alpha-emitting	Active	< 10 microcuries	Not required

RADIOACTIVE SEALED SOURCE LEAK TEST SURVEY

Technician Name: _____ Date: _____

Instrument/Detector _____ Serial #_____/_____ Calibration Due Date_____/

Instrument/Detector _____ Serial #_____/_____ Calibration Due Date_____/

Source ID	Isotope(s)	Removable Beta[a] (dpm/smear)	Removable Beta[a] (μCi /smear)	Removable Alpha[a] (dpm/smear)	Removable Alpha[a] (μCi/smear)

[a] Conversion from dpm to μCi should be calculated as follows: Activity (μCi) = Activity (dpm) * (1μCi/2.22E6 dpm)

REVIEWED BY: _____ **DATE:** _____

RADIOACTIVE SOURCE LOG AND INVENTORY[a,b]

SOURCE LOG ____ INVENTORY ____

SOURCE TRACKING NO.	RADIONUCLIDE(S)	ACTIVITY (μCi)[c]	STORAGE LOCATION	CUSTODIAN	COMMENTS	VERIFIED PRESENT (INITIALS/ DATE)

[a] The Source Log may be copied to perform an inventory. Indicate "INVENTORY" at the top of the form.
[b] When a source has been disposed of, note the source disposal date in the "COMMENTS" column.
[c] List activity from last assay date.

REVIEWED BY: _____ **DATE:** _____
RPM

RADIOACTIVE SOURCE ISSUE LOG

LOCATION:_____ **YEAR:**_____

SERIAL NUMBER	DATE/TIME SOURCE OUT	SIGNATURE	DATE/TIME SOURCE IN	SIGNATURE

REVIEWED BY: _____ **DATE:**_____
RPM

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HEALTH PHYSICS PROCEDURE

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CONTAMINATION CONTROL

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1.0 Purpose

This procedure outlines the methods for preventing the spread of radioactive contamination and controlling contaminated or potentially contaminated areas, equipment, and materials.

2.0 Scope

This procedure applies to all personnel, areas, equipment, and materials at a site working under this Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR 20),* "Standards for Protection against Radiation."

3.1 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01.

3.2 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03.

3.3 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Personnel Protective Equipment." Leidos St. Louis Health Physics Procedure. HP-05.

3.4 Leidos 2014d. *Leidos St. Louis Health Physics Manual.* HP-10, "Personnel and Equipment Decontamination." Leidos St. Louis Health Physics Procedure. HP-10.

3.5 Leidos 2014e. *Leidos St. Louis Health Physics Manual.* "Radiological Monitoring." Leidos St. Louis Health Physics Procedure. HP-11.

3.6 Leidos 2014f. *Leidos St. Louis Health Physics Manual.* HP-12, "Health Physics Oversight." Leidos St. Louis Health Physics Procedure. HP-12.

3.7 Leidos 2014g. *Leidos St. Louis Health Physics Manual.* "Radiological Posting and Labeling." Leidos St. Louis Health Physics Procedure. HP-20.

3.8 Leidos 2014h. *Leidos St. Louis Health Physics Manual.* "Storage and Control of Radioactive Waste." Leidos St. Louis Health Physics Procedure. HP-25.

4.0 Definitions

4.1 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site-specific contamination limits, as documented on Attachment 2 of HP-03, "Radiological Limits," or other site-specific documentation (i.e., Site Safety and Health Plan [SSHP], Radiation Protection Plan, etc.).

4.2 **Contamination (Radioactive)** – Deposition of radioactive material in any place not desirable. The presence of unwanted radioactive material on tools, equipment, surfaces, clothing, personnel, and etc.

4.3 **Removable Contamination** – Radioactive material easily transferred by normal handling and contact.

4.4 **Restricted Area** – An area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.5 **Step-off Pad** – A buffer zone between clean areas and contaminated areas to prevent the spread of contamination. Typically, a step-off pad is used as the primary ingress/egress point to an indoor contamination area.

4.6 **Unrestricted Area** – An area to which access is neither limited nor controlled by the responsible party.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Approve PPE, internal and external radiation exposure monitoring, health and safety work permit (HSWP), and SSHP contamination control requirements.

5.2 Health Physics Technicians (HPTs) shall:

5.2.1 Perform surveys in accordance with HP-11, "Radiological Monitoring," to identify the presence of contamination.

5.2.2 Provide direction to radiological workers to control the spread of contamination.

5.3 Radiological workers shall:

5.3.1 Wear protective clothing and respirators properly and when required by signs, HSWPs, HPTs, procedures, or instructions.

5.3.2 Minimize the spread of a known or a possible radioactivity spill and promptly notify the HPT covering the activity.

5.3.3 Avoid unnecessary contact with contaminated surfaces, including clothing (if contaminated), tools, and other equipment.

5.3.4 Minimize the amount of uncontaminated materials brought into contamination areas.

5.3.5 Maintain good housekeeping practices to minimize the spread of contamination.

6.0 Procedure

6.1 Removable contamination shall be controlled to the extent practical to prevent:

6.1.1 Personnel contamination events.

6.1.2 The spread of contamination within restricted areas.

6.1.3 The spread of contamination to the environment.

6.1.4 Unnecessary airborne exposure.

6.2 The RPM (or designee) shall specify contamination control requirements on HSWPs, Work Plans (WPs), SSHPs, or verbally.

6.3 Every contamination control situation cannot be procedurally anticipated; however, the following shall be considered in the control of radioactive contamination:

6.3.1 Temporary enclosures to separate highly contaminated work from adjacent areas.

6.3.2 Establishing a step-off pad or separate area between contaminated and uncontaminated areas to prevent the spread of contamination.

6.3.3 Ventilating areas and enclosures.

6.3.4 Keeping potentially contaminated soil wet.

6.3.5 Minimizing dust.

6.3.6 Wrapping items before taking them into a contamination area.

6.3.7 Containerizing contaminated material.

6.3.8 Covering contaminated material.

6.3.9 Monitoring the site regularly.

6.3.10 Decontaminating areas and items.

6.3.11 Practicing good housekeeping.

6.3.12 Implementing administrative and engineering controls.

6.4 Contamination surveys shall be performed in accordance with HP-11, "Radiological Monitoring."

6.5 Contamination areas shall be surveyed routinely in accordance with the requirements of HP-12, "Health Physics Oversight."

6.6 Contamination areas shall be controlled and posted in accordance with HP-20, "Radiological Posting and Labeling."

6.7 When entering a contamination area, personal protective equipment (PPE) should be worn in accordance with HP-05, "Personnel Protective Equipment," and HSWP requirements.

6.8 Items taken into a contamination area should be treated as potentially contaminated until surveys are performed to demonstrate compliance with site-specific release criteria for unrestricted use.

6.9 An HPT shall survey equipment and/or materials prior to release from a contamination area in accordance with HP-12, "Health Physics Oversight." Equipment and/or material release surveys shall be documented in accordance with HP-11, "Radiological Monitoring."

6.10 Personnel shall conduct a frisk survey, or be surveyed by an HPT, in accordance with HP-12, "Health Physics Oversight," and HSWP requirements.

6.11 Contaminated personnel shall be decontaminated in accordance with HP-10, "Personnel and Equipment Decontamination."

6.12 Contaminated equipment/material shall be either containerized or decontaminated in accordance with HP-10, "Personnel and Equipment Decontamination."

6.13 Radioactive wastes shall be controlled in accordance with HP-25, "Storage and Control of Radioactive Waste."

7.0 Records

No records are generated as a result of this procedure.

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STORAGE AND CONTROL OF RADIOACTIVE WASTE

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LIST OF ATTACHMENTS

1. RADIOACTIVE WASTE CONTAINER INVENTORY FORM
2. LEIDOS WASTE CHARACTERIZATION FORM
3. MONTHLY RADIOISOTOPE SEWER DISCHARGE LOG

1.0 Purpose

This procedure describes the methods for the storage, control, segregation, characterization, and disposal of radioactive waste.

2.0 Scope

This procedure applies to waste materials at sites working under this Leidos Radiation Safety Program.

3.0 References

3.1 10 *CFR* 20, "Standards for Protection Against Radiation."

3.2 10 *CFR* 71, "Packaging and Transportation of Radioactive Material."

3.3 10 *CFR* 835 "Occupational Radiation Protection."

3.4 40 *CFR*, Part 240 through 281, "Resource Conservation and Recovery Act."

3.5 49 *CFR*, Subpart C, Parts 171 through 177, "Hazardous Materials Regulations."

3.6 APHA Method 7110 - American Public Health Association, Method 7110, "Gross Alpha and Gross Beta Radioactivity (Total, Suspended, and Dissolved)", Standard Methods for the Examination of Water and Wastewater.

3.7 HP-01, "Health Physics Manual."

3.8 HP-11, "Radiological Monitoring."

3.9 HP-50, "Radioactive Material Shipping."

3.10 HP-51, "Limited Quantity Radioactive Material Shipping."

3.11 HP-52, "Shipping and Receipt Surveys."

3.12 Site-specific, disposal-site waste acceptance criteria.

3.13 IN 94-07 - U. S. Nuclear Regulatory Commission, NRC Information Notice 94-07, "Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 *CFR* Part 20." January 28, 1994.

4.0 Definitions

4.1 **Acceptance Criteria** – Specified limits placed on characteristics of an item, process, or service defined in codes, standards, or other required documents.

4.2 **Activity** – The rate of disintegration (transformation) or decay of radioactive material stated in disintegrations per second (dps), becquerels (Bq), curies (Ci), millicuries (mCi), nanocuries (nCi), picocuries (pCi), or other acceptable units.

4.3 **Investigation-Derived Waste (IDW)** – waste derived from filed investigation activities (i.e., remedial investigation/feasibility studies, remedial design, characterization, final status survey, etc.) that may pose a risk to human health and the environment.

4.4 **Radioactive Material Storage Area (RMSA)** – An administratively designated area where radioactive material is stored and controlled.

4.5 **Restricted Area** – An area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.6 **Sewer Release Criteria** – Minimum requirements for release or discharge of liquid effluent into the waters of the state or the sanitary sewer system.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Verify compliance with this procedure during planned and periodic audits of the Radiation Protection Program.

5.1.2 Identify waste collection points and supervise the storage of radioactive wastes at these locations.

5.1.3 Make final waste disposal arrangements with vendors, as necessary.

5.1.4 Maintain records of packaged waste.

5.2 Health Physics Technicians (HPTs) shall:

5.1.5 Ensure that only suitable containers are used for collection of contaminated waste.

5.1.6 Direct handling of radioactive waste in a manner that prevents the spread of contamination and minimizes direct radiation exposure.

5.1.7 Direct segregation of wastes into appropriately marked containers.

5.3 The Transportation Representative (TR) shall:

5.3.1 Coordinate with the client transportation representative, as applicable, to prepare radiological waste for shipment to a licensed disposal facility.

5.3.2 Prepare radiological waste for shipment in accordance with the requirements of HP-50, "Radioactive Material Shipping."

Note: The TR (and any other Leidos personnel) is not authorized to sign waste manifests or shipping papers for client radiological waste disposal.

5.4 The Environmental Compliance Manager (ECM) shall:

5.4.1 Ensure that containerization, labeling, tracking, and management of radioactive waste placed in storage is conducted in compliance with applicable federal and state laws and regulations, the site waste management plan or other appropriate document/plan, and this procedure.

6.0 Procedure

6.1 Control of Waste

6.1.1 Control of radioactive waste materials (i.e., waste minimization) should be accomplished by preventing materials from becoming unnecessarily and/or excessively contaminated.

6.1.2 Additional control methods shall include, but are not limited to:

6.1.2.1 Decontaminating and reusing radioactive materials such as tools and equipment;

6.1.2.2 Re-cycling;

6.1.2.3 Using waste volume reduction techniques when practical; and

6.1.2.4 Monitoring materials for radioactivity and removing non-radioactive materials prior to disposal.

6.2 Collection of Waste

6.2.1 Each restricted area that generates radioactive waste shall have designated waste collection locations.

6.2.1.1 Suitable containers should be staged at each collection location or a location convenient to the generation point.

6.2.1.2 At the discretion of the RPM, a Container Inventory Form (Attachment 1 or equivalent form) may be initiated and affixed to the container.

6.2.2 Precautions should be instituted to prevent mixing of various hazardous substances when organizing the waste disposal area.

6.2.3 If a bag tears during collection, the waste shall be repackaged and the area surveyed for contamination as determined appropriate by the responsible HPT.

6.2.4 Liquid radioactive wastes shall be stored in a secondary containment to prevent the spread or leakage of material.

6.2.5 If required by the RPM, each item added to a container should be recorded on a Container Inventory Form (Attachment 1 or equivalent form). Examples of item listings are; bag of PPE, rags, mop heads, High-Efficiency Particulate Air (HEPA) filter, tygon tubing, bag of poly trash, bag of cardboard trash, etc.

6.2.6 When required by the RPM, an estimate of the activity contained in each item shall be included on the Container Inventory Form.

6.2.7 Items should be added to the container in a manner that minimizes void spaces and volume.

6.3 Waste Tracking

6.3.1 The waste tracking and documentation requirements contained in Sections 6.3.2 through 6.3.10 are applicable for management of Leidos-generated waste or when Leidos is responsible for management of client-generated waste.

6.3.2 The RPM or designee shall contact the ECM or designee to obtain a waste inventory tracking number for containerized radioactive waste staged for storage in a posted RMSA.

6.3.3 Containers staged at temporary waste collection locations (personal protective equipment [PPE] waste containers at egress point from restricted area) do not require a tracking number.

6.3.4 The radiological contents of contaminated waste staged for storage shall be documented on Attachment 4, "WITS Data/Waste Transfer Form," and Attachment 2, "Waste Characterization Form" (or equivalent forms). Copies of the completed forms shall be forwarded to the ECM.

6.3.5 Radioactive waste collected at temporary waste collection locations (i.e., PPE, soil cuttings, etc.) that is transferred directly to another person (i.e., client, another contractor, a waste broker, a licensed disposal facility, etc.) shall be coordinated with the ECM and documented on Attachment 4, "WITS Data/Waste Transfer Form" (or equivalent).

6.3.6 Shipping papers/manifests supercede the requirement to complete Attachment 4 (i.e., for a waste broker or licensed disposal facility).

6.3.7 Radioactive waste that is transferred directly to another person in accordance with Section 6.3.5 does not require a tracking number.

6.3.8 Management of IDW shall be conducted in accordance with Environmental, Health, and Safety (EHS) Procedure 280, "Investigation-Derived Waste."

6.3.9 Tracking of radiological waste shall be conducted in accordance with EHS Procedure 7, "Hazardous Waste Management."

6.3.10 The RPM or designee shall contact the ECM or designee to obtain a transfer log number for contaminated radioactive waste.

6.4 Preparation to Characterize Waste

6.4.1 The physical and radiological contents of all containerized waste staged for storage or disposal shall be documented.

6.4.2 Waste being prepared for shipment shall be characterized in accordance with HP-50, "Radioactive Material Shipping," if not previously characterized.

6.4.3 The following steps shall be taken in preparation for characterization:

6.4.3.1 Record a unique identification number of the container to be characterized on the Waste Characterization Form (Attachment 2 or equivalent form).

6.4.3.2 Survey the exterior of the waste container in accordance with HP-11, "Radiological Monitoring," to determine if direct exposure controls are needed, and support the activity determination, as applicable.

6.4.4 Record a description of the container contents on the Waste Characterization Form.

6.4.4.1 The container may be a candidate to be opened and inspected if it does not have a Container Inventory Form affixed to it. Attempts to determine the history of the container shall be made prior to opening.

6.4.4.2 If the container is leaking, off-gassing, or bulging, it should not be opened, and the RPM shall be notified.

6.4.4.3 If the RPM has confidence that the Container Inventory Form is accurate, the activity estimate shall be made based on the inventory in the container.

6.4.4.4 If the RPM does not have confidence that the Container Inventory Form is accurate, a plan shall be developed for opening and sampling the container.

6.4.5 When required, an estimate of the volume of each type of material comprising the waste shall be included on the Container Inventory Form.

6.4.6 The Container Inventory Form, if available, shall be maintained with the Waste Characterization Form.

6.4.7 The container shall be placed in its designated storage location, which should be recorded on the Waste Characterization Form. If the container is subsequently moved to another storage location, the Waste Characterization Form for that container shall be updated to reflect the new storage location.

6.4.8 Copies of the Container Inventory Form and Waste Characterization Form shall be forwarded to and maintained by the RPM.

6.5 General Disposal Requirements

6.5.1 Containerized radioactive waste should be stored on site in a posted RMSA.

6.5.2 At the discretion of the RPM, alternative means of disposal may be implemented, including the following:

6.5.2.1 Transfer to a waste disposal service that is licensed to receive such waste in accordance with 10 *CFR* 20.2001 or applicable state, federal, and local regulations;

6.5.2.2 Transfer to the original supplier if properly licensed to receive radioactive materials;

6.5.2.3 Transfer to an authorized recipient per 10 *CFR* 20.2001 or applicable state, federal, and local regulations;

6.5.2.4 Release into the sanitary sewer in accordance with 10 *CFR* 20.2003 or applicable state, federal, and local regulations;

6.5.2.5 Segregating and storing short-lived radionuclides until the level of residual radioactivity permits conventional disposal;

6.5.2.6 Recycling; or

6.5.2.7 Other means specifically approved in advance by the NRC, pursuant to 10 *CFR* 20, Subpart K, or by other applicable state or federal agencies.

6.6 Off-site Radioactive Waste Disposal

6.6.1 For off-site disposal, the RPM should coordinate with the TR to perform the following:

6.6.1.1 Contract an independent, licensed vendor to seal, survey, pick up and transport filled waste containers to a final disposal facility.

6.6.1.2 Perform and document all analyses on the waste required by the licensed vendor.

6.6.1.3 If the disposal is being coordinated by Leidos for a client, the Leidos TR shall coordinate with the client TR to obtain necessary signatures on waste shipping papers and manifest forms.

NOTE: LEIDOS PERSONNEL ARE NOT AUTHORIZED TO SIGN WASTE MANIFESTS OR SHIPPING PAPERS FOR THE DISPOSAL OF CLIENT-GENERATED RADIOLOGICAL, HAZARDOUS, OR MIXED WASTE.

6.6.1.4 Arrange transfer and disposal of sealed, surveyed, and manifested waste containers to a disposal facility.

6.6.1.5 Ensure that all waste transporters meet the applicable requirements of HP-50, "Radioactive Material Shipping."

6.6.1.6 If the disposal is being coordinated by Leidos for a client, the Leidos TR should notify the client TR prior to shipment of radioactive waste for disposal.

6.6.2 The RPM, in conjunction with the disposal vendor, shall confirm that each container is sealed and surveyed in accordance with HP-52, "Shipping and Receipt Surveys," before the containers are shipped for disposal.

6.6.3 The RPM shall provide the disposal vendor with the inventory of radioactive materials contained in the waste containers.

6.6.4 The RPM and/or the client representative shall determine when the capacity of a radioactive waste collection area dictates a radioactive waste shipment to a commercial disposal facility or waste broker.

6.7 Disposal into Sanitary Sewerage

6.7.1 The liquid waste to be discharged shall be confirmed:

6.7.2 To be soluble (or readily dispersible biological material) in water.

6.7.3 To meet the monthly and annual discharge limits specified in 10 *CFR* 20.2003(a)(4) and 10 *CFR* 20, Appendix B.

6.7.4 To have a "Sum of Ratios" (SOR) not exceeding unity (1.0) when multiple radionuclides are discharged pursuant to 10 *CFR* 20.2003(a)(3).

6.7.5 To meet all applicable state and local discharge permitting requirements prior to discharge.

6.7.6 Discharges shall only be released into the discharge points authorized by the RPM.

6.7.7 During discharge:

6.7.7.1 Turn on water from the faucet for 10 seconds prior to discharge.

6.7.7.2 Pour liquid waste slowly into drain.

6.7.7.3 Leave water running from faucet for 30 seconds after discharge.

6.7.8 After discharge:

6.7.8.1 Survey the discharge point and surrounding work surfaces to confirm no residual radioactivity remains.

6.7.8.2 Decontaminate surfaces as necessary.

6.7.8.3 Record the activity concentration volume and total activity of the material discharged in the Monthly Radioisotope Sewer Discharge Log (Attachment 3), or equivalent document.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

RADIOACTIVE WASTE CONTAINER INVENTORY FORM

Waste Container #:		**Waste Form: (Circle)** Solid Liquid		**Container Type:**
Date	**Description of Item Deposited (including radionuclide and concentration)**	**Approximate Activity[5] (μCi)**	**Approximate Volume or Surface Area of Items[5] (Circle)** mL cm^2	**Signature**
Container Closure Date:	Container Weight:	Closed by (signature):		

[5] Long lived radioactive waste only. Radioactive waste with short half lives being stored for decay and disposal in conventional trash does not require tracking of total activity or volume.

LEIDOS WASTE CHARACTERIZATION FORM

Container Number:	Container Type:	Container Weight:

Description of Contents: ☐ Container Inventory Form Attached	Container Location:

Activity Determination

Method (attach all documentation): Analytical Results ☐ Microshield Calculation ☐ Other ☐

Describe:

Curie Content:

Activity determination performed by:	Date:
Activity determination reviewed by:	Date:

MONTHLY RADIOISOTOPE SEWER DISCHARGE LOG

Date Poured	Inventory #	Nuclide	Activity Concentration (μCi/mL)	Total Volume Poured (mL)	Activity (μCi)
		Radionuclide 1			
		Radionuclide 2			
		Radionuclide 3			
		Radionuclide 4			
		Radionuclide 5			

Year:_____Month:_____

Monthly Facility Water Usage:_____

Instructions to calculate total monthly activity discharge per nuclide:

1. Calculate activity/discharge/nuclide: Activity concentration (μCi/mL) * Volume discharged (mL)
2. Calculate total monthly activity discharged/nuclide (μCi): Σ (Total activity per discharge)
3. Monthly activity concentration/nuclide (μCi/mL): (Activity Concentration (μCi/mL) * Volume (mL)/Monthly Facility Water Usage

Limits for Total Activity Discharged

5 Ci/yr-H^3
1 Ci/yr-C^{14}
1 Ci/yr-All other radionuclides combined

Monthly Activity Concentration Limits

WASTE/ TRANSFER FORM

SECTION I

PART 1 GENERAL INFORMATION

TRANSFER LOG #	**TRACKING #'s**		
Present location:		**Area/Code:**	**CONTROL #:**
Container Description:	Quantity:	Units: ☐ KG ☐ YD^3 ☐ FT^3 ☐ GA	Accumulation Date:
Category:		Sub-Category:	
Class:		Sub-Class:	

PART 2 REQUESTED ACTION: [check all that apply]

☐ Add New Record ☐ Transfer to:_____ Area/Code:_____ ☐ Storage Area manager initials

☐ Change Existing Records

☐ Create Labels ☐ Consolidated with TRACKING No:_____

PART 3 REGULATORY INFORMATION

Regulation Class: ☐ Not Regulated ☐ DOT [Fill in Blocks 1, 3, 4, & 5] ☐ MDNR/State regulated [Fill in Block 6 MDNR WASTE ID] ☐ NESHAPS

(If regulated, justify in Comments field) ☐ RCRA/DOT [Fill in Blocks 1, 3, 4, 5, & 6] ☐ TSCA ☐ SPECIAL

[1] DOT PSN or Description:

[2] DOT Technical Name: ☐ RQ:_____

[3] DOT ID:	[4] DOT Primary Hazard Class:	[5] DOT Subsidiary Hazard Class:

[6] EPA or MDNR ID's:

Waste Treatment Group	Target Date:	Treatment or Disposal Date:	Method

PART 4 CHARACTERISTICS [For Transfers Only. Check All That Apply]

☐ PCBs [concentration _____ PPM]

☐ Friable Asbestos >1%

☐ Characteristic or listed Hazardous waste [RCRA]

☐ Petroleum Products or Residues

☐ Radioactive Material Contamination

☐ Non-Friable Asbestos

☐ Contains an RQ of a Hazardous Substance

PART 5 REQUESTER'S COMMENTS AND DATA

Requester's NAME [printed]:	Signature:	Date:

SECTION II TRANSFER APPROVAL AND CERTIFICATION [complete only for transfers]

☐ Approved ☐ Disapproved. Explanation _____

Additional requirements for transfer: _____

Approver's NAME [printed]:	Signature:	Date:

TRANSFER COMPLETE CERTIFICATION

NAME [printed]:	Signature:	Date transfer completed:

SECTION III Data Review and entry

Date Reviewed:	Reviewer initials:	Date entered:	Data entered by [initials]:

Shaded areas require exact nomenclature

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-30

REV. 0

RADIOLOGICAL INSTRUMENTATION

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LIST OF ATTACHMENTS

1. EXPOSURE REATEMETER SETUP RECORD
2. INITIAL INSTRUMENT CHECK IN (EXAMPLE)
3. BENCH COUNTER MDC RECORD
4. INSTRUMENT SETUP CALCULATIONS
5. RADIATION SURVEY INSTRUMENT CALIBRATION FREQUENCY
6. INSTRUMENT OUT-OF-SERVICE TAG (EXAMPLE)
7. DEFECTIVE INSTRUMENT REPORT
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10. LUDLUM MODELS – OPERATING INSTRUCTIONS
11. FRISKER SETUP RECORD

1.0 Purpose

This procedure establishes the guidelines and requirements for the calibration, setup, operation, and quality control (QC) of radiological survey instruments.

2.0 Scope

This procedure applies to all radiation survey instruments utilized at locations where this Leidos Radiation Safety Program is implemented.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection Against Radiation."

3.2 ANSI 1997. American National Standards Institute. *American National Standards Radiation Protection Instrumentation Test and Calibration.* ANSI N323A-1997. April 3, 1997.

3.3 ANSI 2004. American National Standards Institute. *American National Standard Performance Specifications for Health Physics Instrumentation - Portable Instrumentation for Use in Normal Environmental Conditions.* ANSI N42.17A-2003. April 29, 2004.

3.4 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01.

3.5 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03.

3.6 NRC 1995. U.S. Nuclear Regulatory Commission. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions.* NUREG-1507. Draft Report for Comment. August 1995.

3.7 NRC 2007. U.S. Nuclear Regulatory Commission. *Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment.* Regulatory Guide 4.15. Revision 2. July 2007.

4.0 Definitions

4.1 **Background Test** – Daily verification of satisfactory count rate instrument operation by measuring background counts at a fixed location.

4.2 **Bench Counter** – Alpha and/or beta scintillation (non-portable) counting system.

4.3 **Calibration** – Adjustment of instrumentation so the accuracy and performance meet requirements specified by procedures.

4.4 **Calibration Equipment** – Equipment that is certified as calibrated to standards traceable to the National Institute of Standards and Technology (NIST) and that is used to perform calibration tests on radiation survey instruments.

4.5 **Due Date** – The next date an instrument is due to be calibrated.

4.6 **Frisker** – Geiger-Mueller (GM), alpha and/or beta scintillation, or other appropriate portable contamination survey instruments.

4.7 **Minimum Detectable Concentration (MDC)** – The *a priori* activity level that a specific instrument and technique can be expected to detect 95 percent of the time.

4.8 **Out-of-Calibration (OOC)** – Instrument removed from service due to a lapsed calibration due date.

4.9 **Out-of-Service (OOS)** – Status of any instrument not available for issue and use due to damage, equipment failure, or removal from service for long-term storage.

4.10 **Out-of-Specification Condition** – Status of instrument that does not meet calibration criteria or QC checks.

4.11 **Portable Scaler** – Frisker instrument with a timed integrated count function.

4.12 **Pre-operational Checks (POCs)** – Checks performed on any portable instrument daily or prior to use.

4.13 **Quality Control (QC) Checks** – Daily response checks on radiation survey instrumentation to verify acceptable instrument performance.

4.14 **Radiation Survey Instruments** – Instrumentation used to measure radiation or sample mediums where radioactive material may be present.

4.15 **Source Test** – Verification of satisfactory instrument operation using a radioactive source.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Approve of instrument calibration laboratories, after verifying that they meet the requirements of this procedure.

5.1.2 Review and approve instrument background acceptance criteria, source test acceptance criteria, instrument efficiency, and MDCs.

5.2 Radiological Workers and Health Physics Technicians (HPTs) shall:

5.2.1 Perform pre-operational and QC checks on radiation survey instruments in accordance with this procedure.

5.2.2 Maintain instrument accountability in accordance with this procedure.

5.2.3 Operate radiation survey instruments in accordance with this procedure or Technical Manual guidance.

6.0 Procedure

6.1 Instrument Calibration

6.1.1 Radiation survey instruments shall be calibrated under any of the following conditions:

6.1.1.1 Prior to calibration due date,

6.1.1.2 After maintenance and repair that may affect calibration,

6.1.1.3 If a pre-op check, background test, or source test out-of-specification condition cannot be corrected by minor repair, such as battery change, cord replacement, or detector window replacement.

6.1.2 Instrumentation shall be calibrated at the frequencies specified in Attachment 5. More frequent calibrations may be necessary due to instrument repair or performance concerns, as determined by the RPM.

6.1.3 Instruments shall be calibrated in accordance with the guidance of ANSI N323A-1997.

6.1.4 Upon completion of calibration, each instrument shall labeled with the following information:

6.1.4.1 Instrument serial number,

6.1.4.2 Initials or other specific identifying mark of the calibrator, and

6.1.4.3 Calibration due date.

6.1.5 Radiation survey instruments shall be uniquely identified on the instrument housing.

6.2 Source Decay Corrections

6.2.1 Radioactive source decay corrections shall be performed at a frequency to ensure the reported source activity used to determine instrument response does not exceed ± 5 percent of the actual source activity. Source decay corrections should be calculated by the formula provided in Attachment 4, Equation 3.

6.3 Determination of Acceptance Criteria

6.3.1 Instrument Setup General Requirements

6.3.1.1 Following on-site instrument calibration, or upon receipt from a calibration facility, survey instrument background acceptance criteria, source acceptance criteria, and instrument efficiency (for alpha and/or beta) shall be established and documented on Attachments 1, 2 or 11, or equivalent forms.

NOTE: It may be necessary to establish site-specific background acceptance criteria, source acceptance criteria, and instrument efficiency when using instruments at different sites having significantly different background count rates, as determined by the RPM.

6.3.1.2 QC parameters may be updated due to change in instrument location, area background, or other parameters that affect instrument response.

6.3.1.3 Source tests shall be performed in a consistent and reproducible manner.

6.3.2 Bench Counter Setup

6.3.2.1 Bench counter background, source, and efficiency data shall be recorded on Attachment 2, or equivalent.

6.3.2.2 Count times for bench counters shall be established in order to meet MDC requirements, as practical. Count times may be initially set as:

- Air sample (occupational) – 10 minutes
- Air sample (non-occupational) – 60 minutes
- Smear – 1 minute

6.3.2.3 In order to establish bench counter background acceptance criteria:

- Obtain 10 background counts.
- Determine the standard deviation of the 10 background counts.
- Determine the mean of the background counts.
- Establish background acceptance criteria as ± 3 standard deviations of the mean background.

6.3.2.4 In order to establish bench counter source test acceptance criteria:

- Obtain 10 source counts.

  NOTE: NIST traceable sources are recommended, but not required.

- Determine the mean source counts.
- Establish source acceptance criteria as ± 20 percent of the mean source counts.

6.3.2.5 In order to establish bench counter instrument efficiency:

- Determine the net count rate by subtracting the mean background count rate from the mean source count rate.
- Determine the instrument efficiency by dividing the net count rate by the source activity. Source activity should be calculated as shown on Attachment 4, Equation 6, or by other methods as determined appropriate by the RPM.

6.3.2.6 Calculate the MDC for counting smears in accordance with Attachment 4, Equation 2. Compare the smear MDC with the contamination release limit pursuant to HP-03, "Radiological Limits." If the smear MDC is greater than the release limit, increase the count time until the analysis of the smear with the bench counter can detect less than the release limit.

6.3.2.7 Calculate MDC for counting air samples, given a minimum air sample volume, in accordance with Attachment 4, Equation 5. Compare the air sample MDC with 0.10 derived air concentration (DAC). If necessary, increase the minimum sample volume and/or count time to achieve an MDC less than 0.10 DAC, as practical.

6.3.2.8 Bench counter MDC data shall be recorded on Attachment 3, "Bench Counter MDC Record," or equivalent.

6.3.3 Portable Scaler Setup

6.3.3.1 Portable scaler setup data shall be recorded on Attachment 2, or equivalent.

6.3.3.2 Portable scaler background acceptance criteria, source test acceptance criteria, and efficiency should be setup in the same manner as a bench counter, except:

- When the detector surface area is at least 3 times larger than the source active surface area, obtain 3 source counts at the top of the active area of the detector, 4 source counts at the center of the active area of the detector, and 3 source counts at the bottom of the active area of the detector (total of 10 source counts altogether).
- Establish background acceptance criteria as ± 20 percent of the mean background count for sodium iodide (NaI) gamma walkover survey instruments.

6.3.4 Frisker Setup

6.3.4.1 Friskers with a timed scaler function shall be setup as a portable scaler.

6.3.4.2 Friskers without a timed scaler function should be setup in accordance with the following guidance.

- Frisker setup data shall be recorded on Attachment 11, or equivalent.
- Observe background and source count rates.
- Frisker source acceptance criteria shall be determined on one scale as ± 20 percent of ratemeter source response.
- Frisker background shall be determined as ± 20 percent of ratemeter local background response.
- In order to establish frisker instrument efficiency, divide the net count rate by the source activity.

6.3.5 Exposure Ratemeter Setup

6.3.5.1 Exposure ratemeter setup data shall be recorded on Attachment 1, or equivalent.

6.3.5.2 Observe ratemeter source response on the most appropriate scale (i.e., the scale where the response is nearest the mid-scale reading).

6.3.5.3 Exposure ratemeter source acceptance criteria shall be determined as ± 20 percent of ratemeter source response using an appropriate gamma emitting check source.

6.4 Pre-Operational Checks

6.4.1 Pre-operational checks shall be performed prior to instrument use. The following pre-operational checks shall be satisfactorily completed:

6.4.1.1 Verify instrument calibration is current.

6.4.1.2 Check the instrument for physical damage that may affect correct operation.

6.4.1.3 Battery check the instrument.

6.4.1.4 Verify all external cable connections are hand tight, as applicable.

6.4.1.5 Check zero adjustment of instrument, as applicable.

6.4.1.6 Ensure source and background tests have been completed for the current day by checking the Instrument QC Check Log (Attachment 8, or equivalent form) or the instrument's daily source check sticker, if applicable.

6.4.2 If any pre-operational check fails to meet requirements, make an immediate repair (e.g., replace batteries), or tag the instrument as OOS in accordance with Section 6.7.1 of this procedure.

6.5 QC Checks

6.5.1 General Requirements

6.5.1.1 QC checks shall be performed daily and prior to initial use for in-use radiation survey instruments. QC checks consist of the following:

- Pre-operational checks identified in Section 6.4 of this procedure, as appropriate;
- Background Test (except exposure ratemeters); and
- Source Test.

6.5.1.2 Upon completion of a satisfactory daily QC check, document that the QC check has been completed on Attachment 8, "Instrument QC Check Log," or equivalent form.

6.5.1.3 Instruments failing a QC check shall be tagged OOS, and an investigation performed, as required by Section 6.8 of this procedure.

6.5.1.4 Relocation of a bench counter instrument may require re-verification of acceptable QC checks.

6.5.2 Background Test

6.5.2.1 Background tests shall be performed in a consistent manner and location.

6.5.2.2 The instrument background shall be verified to respond within background acceptance criteria.

6.5.2.3 Background tests are not required for exposure rate instruments.

6.5.3 Source Test

6.5.3.1 Source tests shall be performed in a consistent and reproducible manner.

6.5.3.2 The following source tests are required:

- For exposure rate and count rate instruments, one point shall be verified to respond within source acceptance criteria.

6.6 Instrument Operation

6.6.1 Refer to Attachment 10 for (commonly used) instrument operation instructions. If instrument instructions are not provided, operate the instrument in accordance with the instrument Technical Manual.

6.7 Instrument Operational Status

6.7.1 Attachment 6, "Out of Service" tag, or equivalent, shall be attached to an instrument if any of the following occur:

6.7.1.1 The calibration interval has expired.

6.7.1.2 Maintenance or major repair is required.

6.7.1.3 The instrument has failed a QC check or pre-operational check, as determined by the RPM or HPT.

6.7.2 The OOS tag shall remain attached to the instrument, and the instrument shall not be released for use until appropriate action and documentation are complete.

NOTE: OOS tags are not required for instruments located in the calibration laboratory, provided that the instruments are stored in a location that clearly indicates their status.

6.7.3 Personnel using radiation survey instruments shall perform QC Checks any time instrument response is questionable. Any instrument that provides "As Found" data within acceptance criteria will be considered as having provided satisfactory survey results and will not require an instrument investigation.

6.7.4 Equipment considered to be out-of-specification shall be tagged OOS until proper disposition is determined by the RPM or Senior HPT. Disposition may include any of the following:

6.7.4.1 Recalibration,

6.7.4.2 Repair,

6.7.4.3 Replacement of the equipment, or

6.7.4.4 Re-evaluation or revision of the acceptance criteria for the equipment as determined by the RPM.

6.8 Instrument Investigations

6.8.1 Only those out-of-specification conditions that affect proper instrument performance need to be considered for investigative purposes. The following conditions do not require investigation:

6.8.1.1 Loose cable connectors.

6.8.1.2 Meter light not operational.

6.8.1.3 Plastic or rubber covers not pertaining to radiation detector, torn or missing.

6.8.1.4 The instrument was damaged while in use and was removed from service as soon as damage was suspected (e.g., hole in mylar window of scintillator causing upscale readings).

6.8.1.5 Other conditions, as determined by the RPM.

6.8.2 Investigations shall determine if the instrument was used for any of the following:

6.8.2.1 Assigning permanent record exposure.

6.8.2.2 Unconditional releases of equipment, material, or personnel.

6.8.2.3 Determining radioactive effluent concentrations.

6.8.2.4 Shipping, receiving, or labeling radioactive material.

6.8.3 If any condition of Section 6.8.2 is applicable, Attachment 7, "Defective Instrument Report" form (or equivalent) shall be completed, and the need for a Radiological Incident Report (HP-22) shall be evaluated by the RPM.

6.8.4 For instruments that fail a QC check, the investigation need only trace the instrument use back to the time of the last satisfactory QC check.

6.9 Instrument Accountability

6.9.1 Instrument accountability should be maintained by documenting instrument sign-out and return on Attachment 9 (Instrument Sign-Out Log) or equivalent form.

6.9.2 The RPM may waive the use of Attachment 9, as appropriate.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

EXPOSURE REATEMETER SETUP RECORD

Date:_____ **Location:**_____

Instrument Type:_____ **Instrument Serial Number:** _____

Instrument Range	Source	Source Position	Observed Exposure Rate[a]		Acceptance Criteria[a,b]	
			mR/hour	µR/hour	mR/hour	µR/hour

[a] Circle correct units.
[b] ± 20 percent of observed exposure rate

Comments/Restrictions: _____

_____

_____

_____

_____

_____

_____

_____

_____ _____
Calculated By: Date

_____ _____
Approved: RPM/Designee Date

INITIAL INSTRUMENT CHECK IN (EXAMPLE)

Meter Number: 164328
Meter Model: 2360
Cal. Due: 10/12/2015

Detector Number: 168667
Detector Model: 43-89 "A"
Cal. Due: 10/12/2015

ALPHA	Source Type:	Th-230	Threshold:	120 mV
ALPHA	Source #:	STL-0001	High Voltage:	535 V
ALPHA	Source activity:	21,296		
ALPHA	Source count time:	1 minute	Bkg. count time:	10 minutes

	Source GCPM	BKG CPM		
ALPHA	2,107	0.3	Average Bkg. (CPM):	0.2
ALPHA	2,212	0.6	Average Source (GCPM):	2114
ALPHA	2,115	0.1	Average Net Source (NCPM)	2114
ALPHA	2,048	0.4	Source Range (GCPM):	1,691 to 2,536
ALPHA	2,114	0.4	Background Range (CPM):	0 to 0.5
ALPHA	2,142	0.4	Determined Efficiency:	9.9%
ALPHA	2,129	0.1	20% of Bkg.	NA
ALPHA	2,058	0.3	1 Standard Deviation of Bkg.	0.1
ALPHA	2,082	0.2	3 Standard Deviations of Bkg.	0.3
ALPHA	2,131	0.3		

Beta/Gamma (Circle One)

BETA	Source Type:	SrY-90	Threshold:	3.5 mV
BETA	Source #:	STL-0003	High Voltage:	535 V
BETA	Source activity:	8,487		
BETA	Source count time:	1 minute	Bkg. count time:	1 minute

	Source GCPM	BKG CPM		
BETA	2,317	256	Average Bkg. (CPM):	233
BETA	2,387	249	Average Source (GCPM):	2,352
BETA	2,361	236	Average Net Source (NCPM)	2,119
BETA	2,355	208	Source Range (GCPM):	1,882 to 2,823
BETA	2,356	250	Background Range (CPM):	178 to 288
BETA	2,369	245	Determined Efficiency:	25.0%
BETA	2,326	223	20% of Bkg.	47
BETA	2,295	220	1 Standard Deviation of Bkg.	18
BETA	2,340	240	3 Standard Deviations of Bkg.	55
BETA	2,416	203		

Calculated By: _____ Date: _____

Approved: _____ Date: _____
RPM/Designee

BENCH COUNTER MDC RECORD

Date:_____ Location:_____

Instrument Type:_____ Instrument Serial Numbers:_____

ALPHA			BETA		
Smear MDC			**Smear MDC**		
Background count time (T_b)		min	Background count time (T_b)		min
Background count rate (R_b)		counts	Background count rate (R_b)		counts
Smear count time (T_g)		min	Sample count time (T_g)		min
Instrument efficiency (ε_i)		cpm/dpm	Instrument efficiency (ε_i)		cpm/dpm
Smear MDC[a]		dpm/100cm^2	Smear MDC[a]		dpm/100cm^2
Release limit		dpm/100cm^2	Release limit		dpm/100cm^2
Fraction of release limit			Fraction of release limit		
Occupational Air Sample MDC			**Occupational Air Sample MDC**		
Background count time (T_b)		min	Background count time (T_b)		min
Background count rate (R_b)		counts	Background count rate (R_b)		counts
Air sample count time (T_g)		min	Air sample count time (T_g)		min
Instrument efficiency (ε_i)		cpm/dpm	Instrument efficiency (ε_i)		cpm/dpm
Collection Efficiency (ε_c)		fraction (.99)	Collection Efficiency (ε_c)		fraction (.99)
Minimum sample volume		liters	Minimum sample volume		liters
Air Sample MDC		µCi/ml	Air Sample MDC		µCi/ml
Air sample DAC		µCi/ml	Air sample DAC		µCi/ml
DAC fraction MDC			DAC fraction MDC		

[a] This calculation assumes the smear was taken over a 100 cm^2 area. Smears taken over different sized areas should be normalized to 100 cm^2 to compare to the release limit.

Calculated By:_____ Date:_____

Approved:_____ Date:_____
RPM/Designee

BENCH COUNTER MDC RECORD

Date:_____ Location:_____

Instrument Type:_____ Instrument Serial Numbers:_____

ALPHA			BETA		
Non-Occupational Air Sample MDC			**Non-Occupational Air Sample MDC**		
Background count time (T_b)		min	Background count time (T_b)		min
Background count rate (R_b)		counts	Background count rate (R_b)		counts
Air sample count time (T_g)		min	Air sample count time (T_g)		min
Instrument efficiency (ε_i)		cpm/dpm	Instrument efficiency (ε_i)		cpm/dpm
Collection Efficiency (ε_c)		fraction (.99)	Collection Efficiency (ε_c)		fraction (.99)
Minimum sample volume		liters	Minimum sample volume		liters
Air Sample MDC		µCi/ml	Air Sample MDC		µCi/ml
Air sample AE		µCi/ml	Air sample AE		µCi/ml
AE fraction MDC			AE fraction MDC		

Calculated By:_____ Date:_____

Approved:_____ Date:_____
RPM/Designee

INSTRUMENT SETUP CALCULATIONS

Portable Counter (timed count) Minimum Detectable Concentration (MDC)
(Equation 1)

$$\text{MDC}\,(\text{dpm}/100\text{cm}^2) = \frac{3 + 3.29\sqrt{(R_b)(T_g)(1+\frac{T_g}{T_b})}}{\frac{[DA]}{100}[\varepsilon_i][\varepsilon_s][T_g]}$$

DA = detector area (cm^2)
ε_i = instrument efficiency (cpm/dpm)
ε_s = surface efficiency (unitless)
R_b = background count rate (cpm)
T_b = background count time (minutes)
T_g = gross count time (minutes)

Note: Surface efficiency is typically only used for final status surveys and is otherwise set to 1.0.

Bench Counter Smear Minimum Detectable Concentration (MDC)
(Equation 2)

$$\text{Smear MDC}\,(\text{dpm}/100\text{cm}^2) = \frac{3 + 3.29\sqrt{(R_b)(T_g)(1+\frac{T_g}{T_b})}}{(T_g)(\varepsilon_i)}$$

ε_i = instrument efficiency (cd^{-1})
R_b = background count rate (cpm)
T_b = background count time (minutes)
T_g = smear count time (minutes)

Note: This calculation assumes the smear was taken over a 100 cm^2 area. Smears taken over different sized areas should be normalized to 100 cm^2 to compare to the release limit.

INSTRUMENT SETUP CALCULATIONS

Radioactive Source Decay
(Equation 3)

$$A(t) = A_0 e^{-0.693t/T}$$

A_0= original source activity
A(t) = source activity at time t
t = difference between t_0 and time t (same units as T)
T= radionuclide half life (same units as t)

INSTRUMENT SETUP CALCULATIONS

Frisker/Floor Monitor Scan Minimum Detectable Concentration (MDC)
(Equation 4)

The observable background counts (b') is defined as the number of background counts observed within the observation interval (i). The equation used for calculating b' is as follows:

$$b' = (\text{BCPM}) * (i) * (1 \text{ min}/60 \text{ sec}) = \text{counts/interval}$$

BCPM = instrument or reference area background count rate (cpm)
i = observation interval (seconds)

The minimum detectable number of net source counts in the interval is given by s_i. Therefore, for an ideal observer, the number of source counts required for a specified level of performance can be arrived at by multiplying the square root of the number of background counts by the detectability value associated with the desired performance (d') as shown below:

$$s_i = d\sqrt{b'}$$

The MDCR is defined as the increase above background recognizable during a survey in a given period of time. The variable, d, is defined as the index of sensitivity and is dependent on the selected decision errors for Type I (alpha) and Type II (beta) errors. A true positive error ($1-\beta$) of 95 percent and a false positive error (alpha) of 60 percent may be selected to be consistent with NUREG-1507. The value of 1.38 was obtained from Table 6.1 in NUREG-1507 (Table 6.5 in MARSSIM).

$$\text{MDCR (cpm)} = s_i \times (60/i)$$

Finally, the scan MDCs for surfaces may be calculated:

$$\text{Scan MDC} = \frac{MDCR}{\sqrt{p}\,\varepsilon_i\,\varepsilon_s \dfrac{DA}{100\ cm^2}}$$

MCDR = minimum detectable count rate (cpm)
ε_I = instrument efficiency (cpm/dpm)
ε_s = surface efficiency (unitless – typically only used for final status surveys, otherwise set to 1.0)
p = surveyor efficiency (unitless – typically assumed to be 0.5)
DA = detector area

INSTRUMENT SETUP CALCULATIONS

Air Sample Minimum Detectable Concentration (MDC)
(Equation 5)

$$\text{Air Sample MDC } (\mu Ci/mL) = \frac{3 + 3.29\sqrt{(R_b)(T_g)(1+\frac{T_g}{T_b})}}{(T_g)(\varepsilon_i)(\varepsilon_c)(V)(2.22E^9)}$$

R_b = background count rate (cpm)
T_b = background count time (minutes)
T_g = air sample count time (minutes)
ε_i = Instrument efficiency, to be expressed as counts per disintegration (e.g. 0.12)
ε_c = Collection efficiency, default with 0.99
V = Sample volume (liters) [if converting from ft^3, multiply ft^3 by 28.3 to calculate liters]
2.22E9 = conversion factor from dpm to µCi and L to ml.

Note: When setting up a bench counter, it is necessary to make assumptions about sample volume. In the absence of work-specific information, the minimum occupational sample run time may be set as 4 hours. (i.e., 4 hours X 60 minutes X 3 LPM = 720 liters) Adjust the minimum run time as necessary to achieve 0.10 DAC, as practical.

Radioactive Sealed Source Activity Determination
(Equation 6)

Sr/Y-90 Beta Sources (Other beta sources can be done the same way but may not need correction for daughter product in-growth)

1. If source activity is given on the source calibration certificate as Sr-90 activity, the activity should be doubled and then decay corrected using Equation 3. Note that backscatter corrections are not made.
2. If source activity is not given on the source calibration certificate, then the surface beta emission rate will be given. In this case the surface beta emission rate typically includes contributions from Sr-90 activity, Y-90 activity, and backscatter. The backscatter factor may or may not be given. If the backscatter factor is given, then use it; if not, then assume the value of 0.43 (NUREG-1507). The source activity is calculated as:

$$\text{Activity (dpm)} = (R / (1 + B)) * 2$$

R = Source surface emission rate (dpm) – This includes the 2π activity plus backscatter.
B = Backscatter factor (unitless) – This corrects R to the source Sr/Y-90 2π activity.

Note: Instrument efficiencies determined from these calculations will be high because of the actual backscatter from the source (unless you are surveying a material made of the same material as the source holder). Efficiency corrections for the material to be surveyed can be made using the methodology outlined in NCRP-112.

Alpha Sources

Backscatter is negligible for alpha sources; therefore, if source activity is given on the source calibration certificate, then you are done (that is the 4π activity as long as there is no concern for daughter product in-growth). If surface alpha emission rate is given, then you have to double it to calculate the source 4π activity.

RADIATION SURVEY INSTRUMENT CALIBRATION FREQUENCY

Instrument Type	Application	Calibration Frequency
Count rate meters (alpha, beta, or both)	Personnel monitoring and surface contamination measurement	Annually
Exposure or dose equivalent rate meters	Determining exposure or dose equivalent rates	Annually
Alpha/beta scaler	Quantify radioactive material on smears and air sample media	Annually
Air samplers	Collect airborne radioactive material samples	Annually
Liquid Scintillation Counter	Quantify radioactive material on smears, air sample media, and liquid sample media.	Annually

INSTRUMENT OUT-OF-SERVICE TAG (EXAMPLE)

OUT-OF-SERVICE

Model type meter _____ detector _____
S/N meter _____ detector _____
Calibration due date _____

(check all that apply)

REASON FOR TAGGING
- ☐ Out of calibration
- ☐ Broken
- ☐ Failed QC check
- ☐ Other _____

PROBLEMS FOUND
- ☐ Bad cable
- ☐ Light leak
- ☐ Probe/detector
- ☐ Broken switch _____
- ☐ No response
- ☐ Erratic response
- ☐ Pegs high
- ☐ Physical damage _____
- ☐ Speaker
- ☐ Other _____

Defective Instrument Report completed? ☐ yes
Tagged by:

_____ _____
Print/Signature Date

DEFECTIVE INSTRUMENT REPORT

Model:_____ Serial Number:_____ Date:_____

Problem with Instrument:_____

_____

_____

_____

_____

Date Found Out-of-Spec: _____ By: _____/_____/_____

(Print) Signature

Last Calibration Date: _____

Last Pre-Op Test:_____

Last QC Check:_____

Was this instrument used for any of the following surveys since the last satisfactory QC check?:

No	Yes		
☐	☐	A.	Assign permanent record exposure.
☐	☐	B.	Unconditional release of equipment, material or personnel.
☐	☐	C.	Determine radioactive effluent quantities.
☐	☐	D.	Ship, receive or label radioactive waste.

If any of the above questions are marked "Yes" a Radiological Incident Report shall be considered by the RPM.

Corrective actions taken:_____

_____

_____

_____

Evaluation Performed By: _____/_____/_____

(Print) (Signature) Date

Reviewed By: _____/_____

RPM/Designee (Date)

INSTRUMENTATION QC CHECK LOG **METER:** _____ **DATE (MO/YR):** _____

Meter		Acceptance Criteria				Alpha			
Number	Cal. Due	Bkgrd. QC (cpm) range		Source QC (ncpm) range			Source Number	Inst. Efficiency	Inst. Avg. Bkgrd.
		Alpha	Beta	Alpha	Beta				
						Beta			
Number	Cal. Due	to	to	to	to	Source Type	Source Number	Inst. Efficiency	Inst. Avg. Bkgrd.

Date	Time	Bkgrd. QC (cpm)		Source QC (ncpm)		Bat. Check Sat/Unsat	QC[a] Sat/Unsat	HPT Initial	Comment
		Alpha	Beta	Alpha	Beta				

[a] An unsatisfactory QC check requires recording the result in the comment column and repeating the evaluation. Tag the instrument out of service and notify the HP Supervisor upon failing the QC check two times in succession.

Reviewed By: _____ (RPM/Designee) Date: _____

INSTRUMENTATION QC CHECK LOG **METER:** _____ **DATE (MO/YR):** _____

Source		Acceptance Criteria					Model	Number	Cal. Due
Type		Bkgrd. QC (cpm) range		Source QC (cpm) range		Meter			
Number		to		to		Detector			
Date	Time	Pre-use Bkg cpm	Post Bkg cpm[a]	Pre-use Source cpm	Post-Source cpm[a]	Bat Check	HV Check	Pre-use HPT Initials	Post HPT Initials[a]

[a] Gamma scan instruments used for confirmation or verification surveys require a post check-in.

Reviewed By:_____ (RPM/Designee) Date: _____

Daily Check-in of Exposure Ratemeters **METER:** _____ **DATE (MO/YR):** _____

Source		Acceptance Criteria					Model	Number	Cal. Due
Type		Source QC	Units: _____		Scale	Meter			
Number			to			Detector			
Date	Time	Reading	Pre-op Check	Bat Check	Initial	Comments			

Reviewed By: _____ Date: _____
RPM/Designee

INSTRUMENT SIGN-OUT LOG

Location:______________________ Month/Year:______________

LAST NAME (PRINT)	DETECTOR/INSTRUMENT TYPE/SERIAL#	JOB LOCATION	DATE/TIME OUT	DATE/TIME IN	RETURNED BY

LUDLUM MODELS – OPERATING INSTRUCTIONS

LUDLUM MODEL 3 WITH 43-5 PROBE – OPERATING INSTRUCTIONS

Instrument Operation:

1) Turn the selector knob to the "ON" position.
2) Adjust meter dial to appropriate scale.
3) When scanning, adjust response to "FAST."
4) Plug in headset, if used.

Instrument Control Features:

AUDIO: Built in speaker with volume control
AUDIO JACK: For optional headset
METER DIAL: 0 – 5K cpm
MULTIPLIERS: X0.1, X1, X10, X100
DIGITAL RATEMETER: Provides a digital display of count rate when selector switch is in Dig. Rate position. (added option only)
RESPONSE: Toggle switch for FAST (4 seconds) or SLOW (22 seconds) from 10 percent to 90 percent of final reading
RESET: Push-button to zero meter
POWER: 2 each "D" cell batteries (*housed in sealed compartment that is externally accessible*)
BATTERY LIFE: Typically 2,000 hours with alkaline batteries (*battery condition can be checked on digital display*)
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)

LUDLUM MODEL 18 WITH 44-9 PROBE – OPERATING INSTRUCTIONS

Instrument Operation:

1) Turn the selector knob to the "ON" position.
2) Adjust meter dial to appropriate scale.
3) When scanning, adjust response to "FAST."
4) Plug in headset, if used.

Instrument Control Features:

AUDIO: Built in unimorph speaker with volume control
METER DIAL: 0 - 500 cpm, 0 – 2.5 kV, BAT OK
MULTIPLIERS: X1, X10, X100, X1000
SCALER: LCD display, and colons to indicate when a count is in process. (option only)
COUNT: Push-button to initiate scaler count
HIGH VOLTAGE ADJUST: Accessible from front of instrument (*protective cover provided*)
RESPONSE: Will vary according to number of counts present. Typically 2 - 11 seconds from 10 percent to 90 percent of final reading
POWER: 2 each "D" cell batteries (*housed in sealed compartment that is externally accessible*)
BATTERY LIFE: Greater than 350 hours with alkaline batteries (*battery condition can be checked on meter*)
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)

LUDLUM 2360 ALPHA/BETA DATALOGGER WITH 43-93 PROBE – OPERATING INSTRUCTIONS

Instrument Operation:

1) Turn the selector knob to the "ON" position.
2) Select alpha only, beta only, or both to display.
3) Use switch to select count time, as desired.
4) To obtain a fixed-point count, depress button in handle to activate scaler.
5) Adjust meter dial to appropriate scale.

Instrument Control Features:

INDICATED USE: Alpha, beta discrimination, and data logging.
DATA LOGGER: Capable of logging up to 550 individual data points with the following identifiers for each point (*All data is stored allowing batteries to be removed without loss of data*).
LOGGING PUSHBUTTON: Located in the handle; used to activate scaler and/or log a count.
LOGGING FUNCTION CONTROL: Internal selection that enables the pushbutton to log the ratemeter reading, initiate a scaler count, and log the resulting reading, log both the scaler and ratemeter reading, or disables the logging function.
LOCATION CODE: A 10 character alphanumeric identifier (*by bar code reader or PC*).
CALIBRATION DUE DATE: An internal date that disables the instrument if the required calibration interval has been missed.
HEADER INFORMATION: Six lines of user defined memory at the beginning of the stack for storing user name, survey name, serial numbers, etc. (*Information is dumped with logged data*).
RS-232 PORT: Allows the instrument to be connected to a PC for data dump, and setup parameters.
AUDIO: Built in unimorph speaker with volume control.
AUDIO DIVIDE: Selectable dual or individual click-per-event for alpha and beta counts and divisions of 1, 10, 100, or 1000 events-per-click (*beta channel only*).
METER DIAL: 0 - 500 cpm, 0 - 2 kV, BAT OK, OL (overload).
MULTIPLIERS: X1, X10, X100, X1000.
SCALER: 6 digit LCD, overflow arrow, and colons to indicate when a count is in process.
COUNT TIME: Switch selectable times of 0.1, 0.5, 1, 2, 5, 10, and 60 minutes, or PC to allow for a specific count time to be set from a PC.
SELECTOR SWITCH: Toggle switch to select alpha+beta, alpha only, or beta only.
RESET/READ HV: A two position momentary action switch to allow for the meter to be reset or a reading of the HV setting.
OVERLOAD: Senses detector saturation. Indicated by red lamp on meter and meter deflecting to full scale (*Adjustable depending on detector selected*).
RESPONSE: Will vary according to the number of counts present. Typically 2 - 11 seconds from 10 percent to 90 percent of final reading.
POWER: 2 each "D" cell batteries (*housed in compartment that in front of instrument*).
BATTERY LIFE: Greater than 150 hours (*battery condition can be checked on meter*).
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C).

LUDLUM 2929 WITH 43-10-1 PROBE – ALPHA/BETA BENCH COUNTER OPERATING INSTRUCTIONS

Instrument Operation:

1) Turn the selector knob to the "ON" position.
2) Instrument simultaneously displays alpha and beta.
3) Use numeral thumbwheel and multiplier to select count time.
4) Disengage sample tray locking device, and slide tray out.
5) Place smear or air sample in sample tray.
6) Slide in sample tray, and engage locking device.
7) Press "COUNT."

Instrument Control Features:

INDICATED USE: Alpha beta sample counting with ZnS(Ag) adhered to plastic scintillation material
SAMPLE HOLDER: Anodized aluminum tray with 1" diameter sample ring to allow for 1" or 2" diameter samples
SAMPLE SIZE (maximum): 2"(5.1cm) diameter X 0.4"(0.9 cm) thick
AUDIO: Built in unimorph-type speakers with volume controls to provide a dual tone (*1 per channel*) click-per-event audio
SCALERS: 2 ea. 6 digit LED displays providing a range of 0 - 999999 counts (*controlled by COUNT and HOLD buttons*)
TIMER: Thumbwheel adjustment from 0 - 99 minutes with selectable divisions of X0.1, X1, X10, or EXT for manual timing
METER DIAL: 0 - 2.5 kV; BAT TEST
TEMPERATURE RANGE: -4°F (-20°C) to 122°F (50°C)

LUDLUM MODEL 19 MicroR/RATEMETER – OPERATING INSTRUCTIONS

Instrument Operation:

1) Turn the selector knob to the appropriate range.

Instrument Control Features:

INDICATED USE: Low-level (μR) gamma survey
METER DIAL:0 - 25 μR/hour, 0 - 50 μR/hour, BAT TEST, High Voltage Test
RANGE SELECTIONS: 0 - 25, 0 - 50, 0 – 250, 0 - 500, 0 - 5000 μR/hour
LIGHT: Push button to activate
RESET: Push button to zero meter
POWER: Two each "D" cell batteries (*housed in sealed compartment that is externally accessible*)
BATTERY LIFE: Typically 2,000 hours with alkaline batteries (*battery condition can be checked on meter*)
TEMPERATURE RANGE: -4°F (-20°C) to 122°F (50°C)

FRISKER SETUP RECORD

Meter Number: _____
Meter Model: _____
Cal Due: _____
Source Type: _____
Source Number: _____
Source DPM: _____

Detector Number: _____
Detector Model: _____
Cal Due: _____
Threshold: _____
High Voltage: _____

Instrument Range	Observed Count Rate (cpm)	Acceptance Criteria[a] (cpm)
Background Response (A)		
		to
Source Response (B)		
		to
Efficiency[b]: (%)		

[a] ± 20 percent of observed background or source count rate.
[b] Efficiency = Net count rate (B-A)/Source DPM

Comments/Restrictions: _____

_____ _____
Performed By Date

_____ _____
(RPM/Designee) Date

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-40

REV. 0

PERSONNEL RADIATION EXPOSURE MONITORING

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LIST OF ATTACHMENTS

1. VISITOR LOG
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1.0 Purpose

The purpose of this procedure is to provide the requirements and guidelines for monitoring employee occupational exposure to ionizing radiation.

2.0 Scope

This procedure applies to all personnel working in radiological areas under this Leidos Radiation Safety Program. Planned special exposures are not within the scope of this procedure.

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 19, "Notices, Instructions and Reports to Workers: Inspections and Investigations."

3.2 10 *CFR* 20, "Standards for Protection against Radiation."

3.3 ANSI 1997. American National Standards Institute. *Inspection, Test, Construction, and Performance Requirements for Direct Reading Electrostatic/Electroscope Type Dosimeters.* ANSI N322-1997. February 6, 1997.

3.4 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01.

3.5 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radiological Limits." Leidos St. Louis Health Physics Procedure. HP-03.

3.6 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Radiological Monitoring." Leidos St. Louis Health Physics Procedure. HP-11.

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3.10 ICRP 1975. International Commission on Radiological Protection. *Report of the Task Group on Reference Man.* Annals of the ICRP, Publication 23. 1975.

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3.18 NRC 1988. U.S. Nuclear Regulatory Commission. *Criteria for Establishing a Tritium Bioassay Program.* Regulatory Guide 8.32. July 1988.

3.19 NRC 1992a. U.S. Nuclear Regulatory Commission. *Air Sampling in the Work Place.* Regulatory Guide 8.25. Revision 1. June 1992.

3.20 NRC 1992b. U.S. Nuclear Regulatory Commission. *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses.* Regulatory Guide 8.34. July 1992.

3.21 NRC 1992c. U.S. Nuclear Regulatory Commission. *Radiation Dose to the Embryo/Fetus.* Regulatory Guide 8.36. July 1992.

3.22 NRC 1993. U.S. Nuclear Regulatory Commission. *Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program.* Regulatory Guide 8.9. Revision 1. July 1993.

3.23 NRC 1996. U.S. Nuclear Regulatory Commission. *Instruction Concerning Risks From Occupational Radiation Exposure.* Regulatory Guide 8.29. Revision 1. February 1996.

3.24 NRC 1999. U.S. Nuclear Regulatory Commission. *Instruction Concerning Prenatal Radiation Exposure.* Regulatory Guide 8.13. June 1999.

3.25 NRC 2005. U.S. Nuclear Regulatory Commission. *Instructions for Recording and Reporting Occupational Radiation Exposure Data.* Regulatory Guide 8.7. November 2005.

3.26 NRC 2010. U.S. Nuclear Regulatory Commission. *Planned Special Exposures.* Regulatory Guide 8.35. Revision 1. August 2010.

3.27 NRC 2011. U.S. Nuclear Regulatory Commission. *Personnel Monitoring Device-Direct-Reading Pocket Dosimeters.* Regulatory Guide 8.4. June 2011.

3.28 NRC 2014. U.S. Nuclear Regulatory Commission. *Bioassay at Uranium Mills.* Regulatory Guide 8.22. Revision 2. May 2014.

3.29 USEPA 1988. U.S. Environmental Protection Agency, Office of Radiation Programs. *Limiting Values or Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion.* Federal Guidance Report No. 11, EPA-520/1-88-020. September 1988.

4.0 Definitions

4.1 **Administrative Exposure Limit** – A limit established to stress responsibility for maintaining exposures As Low As Reasonably Achievable (ALARA) and to assist in the prevention of exceeding the limits specified in 10 *CFR* 20.

4.2 **Airborne Radioactivity Area** – A room, enclosure, or area in which airborne radioactive materials exist in concentrations:

4.2.1 In excess of the derived air concentrations (DACs) specified in Appendix B to 10 *CFR* 20, or

4.2.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

4.3 **Background Radiation** – The ambient radiation field to which we are exposed daily, originating from cosmic sources, naturally occurring radionuclides (potassium [K]-40, etc.), and human endeavors (fallout, fuel cycle, etc.).

4.4 **Baseline Monitoring** – Monitoring performed prior to the start of work in a radiological area.

4.5 **Committed Dose Equivalent (CDE)** – the dose equivalent to organs or other tissues that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

4.6 **Committed Effective Dose Equivalent (CEDE)** – the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the CDE to these organs or tissues.

4.7 **Confirmatory Monitoring** – Monitoring carried out in situations where workers are unlikely to be exposed to significant intakes, in order to demonstrate satisfactory work conditions.

4.8 **Declared Pregnant Woman** – A woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

4.9 **Deep Dose Equivalent (DDE)** – external whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams per square centimeter [mg/cm^2]).

4.10 **Direct Bioassay** – In vivo measurements to estimate the quantity of radioactive material in the human body using instrumentation that detects radiation emitted from within the body. For purposes of this procedure, "direct bioassay" will be referred to as "body count."

4.11 **Indirect Bioassay** – Determination of kinds, quantities, or concentrations of radioactive material in the human body by analysis and evaluation of materials excreted from the body. For purposes of this procedure, "indirect bioassay" will be referred to as "bioassay," and consists of performing laboratory analysis of a urine sample.

4.11.1 A full 24-hour bioassay sample is defined as all voids collected within a 24-hour period.

4.11.2 A simulated 24-hour bioassay sample is defined as the voids collected just before retiring at night and all the voids until and including the first void after rising in the morning, on two successive days.

4.11.3 A spot bioassay sample is defined as any single void collected.

4.12 **Lens (Eye) Dose Equivalent (LDE)** – external exposure to the lens of the eye taken as the dose equivalent at a tissue depth of 0.3 cm (300 mg/cm^2).

4.13 **Monitoring** – The measurement of radioactivity in the whole body, in a region of the body, in material eliminated from the body, or in the air for purposes of estimating the intake of radioactive material. The term monitoring also includes interpretation of the measurements. It may consist of the use of personnel dosimetry devices for measurement of DDE from external sources, air sampling, and/or bioassay services for measurement of CEDE.

4.14 **Restricted Area** – An area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.15 **Routine Monitoring** – Monitoring carried out at regular intervals during normal operations.

4.16 **Shallow Dose Equivalent** – the dose equivalent at a tissue depth of .007 cm averaged over an area of 1 square centimeter (cm^2) when applied to the external exposure of the skin or extremity.

4.17 **Special Monitoring** – Monitoring carried out in actual or suspected abnormal conditions.

4.18 **Termination Monitoring** – Monitoring carried out shortly after all work in a radiological area ceases.

4.19 **Thermo-Luminescent Dosimeter (TLD)** – A dosimeter that measures radiation exposure by radiation interaction with a crystalline structure. The TLD is the primary means of measuring external personnel exposure to beta and gamma radiation.

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

4.21 **Total Organ Dose Equivalent (TODE)** – the sum of the DDE and CDE.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Administer industry-standard internal and external radiation exposure monitoring programs.

5.1.2 Determine if internal and/or external monitoring is required pursuant to 10 *CFR* 20, or perform monitoring, as appropriate.

5.1.3 Review monitoring results from the internal and external radiation exposure monitoring programs.

5.1.4 Review the results of all unusual exposure incidents and make notifications as required by HP-22, "Radiological Reporting."

5.1.5 Note any special dosimetry requirements (i.e., extremity dosimeters) on health and safety work permits (HSWPs).

5.1.6 Identify individuals whose dose records indicate they are near administrative dose levels and re-assign them to non-RAM work while a re-evaluation of their work practices is completed.

5.2 Monitored Personnel shall:

5.2.1 Comply with the requirements of this procedure while participating in the internal and external radiation exposure monitoring programs, as applicable.

5.2.2 Provide baseline, confirmatory routine, special, and termination bioassays, as directed by the RPM.

5.2.3 Provide past exposure history for employee exposure history files.

5.2.4 Notify the RPM, or designee, immediately upon arrival at the workplace following administration of a radiopharmaceutical.

5.2.5 Plan and perform work involving radioactive materials in a fashion that minimizes the radiation exposures received.

5.2.6 Control their own exposure to radiation hazards such that their annual dose remains below the administrative limits and are ALARA.

5.2.7 Notify the RPM, or designee, of any unusual conditions that may cause an unexpected intake of radioactive material or external exposure, such as spills, facial contamination, or higher than expected removable contamination levels or air particulate concentrations.

5.2.8 Use dosimetry in accordance with this procedure and HSWP requirements.

5.2.9 Report missing dosimetry to the RPM, or designee.

6.0 Procedure

6.1 General Requirements

6.1.1 Refer to HP-03, "Radiological Limits," for federal and administrative exposure limits.

6.1.2 No one under the age of 18 will be allowed access to a restricted area if the work being performed is at a U.S. Army Corps of Engineers (USACE) site.

6.1.3 Declared pregnant women may not be allowed access to certain areas of the restricted area in order to maintain the administrative limit of less than 50 millirem (mrem) TEDE/month.

6.1.4 Upon notification of medical administration of a radioisotope, the RPM shall remove the affected individual's dosimetry from use until such time as the activity retained in the individual's body is not detectable utilizing a personnel contamination monitor.

6.1.5 If monitoring is required, air sampling and/or urine bioassay sampling shall be the primary means of monitoring for internal radiation exposure (e.g., CEDE and CDE), as determined appropriate by the RPM.

6.1.6 Other methods for monitoring internal radiation exposure (i.e., whole body monitoring, fecal bioassay sampling, etc.) may be implemented at the discretion of the RPM.

6.1.7 If monitoring is required, monitoring with TLDs shall be the primary means of monitoring for external radiation exposure (e.g., DDE), as determined appropriate by the RPM.

6.1.8 If required to monitor for both internal and external radiation exposure in accordance with 10 *CFR* 20.1502(a) and (b), compliance with dose limits (e.g., TEDE, TODE) shall be demonstrated by summing external and internal doses in accordance with the requirements of 10 *CFR* 20.1202.

6.2 Internal Radiation Monitoring

6.2.1 General

6.2.1.1 If internal exposure monitoring is required, individuals shall participate in the bioassay and/or air monitoring programs as directed by the RPM.

6.2.1.2 If internal exposure monitoring is not required, breathing zone air sampling may be performed solely to confirm that monitoring is not required in accordance with the routine surveillance schedule documented on Attachment 2 of HP-12, "Health Physics Oversight" (or equivalent).

6.2.1.3 Air monitoring shall be conducted in accordance with HP-11, "Radiological Monitoring."

6.2.2 Bioassay Monitoring

6.2.2.1 Bioassay may be used for routine, confirmatory, or special monitoring of personnel to determine if an intake of radionuclides has occurred, as determined by the RPM.

6.2.2.2 An analytical laboratory that has been pre-approved by the RPM shall perform analysis of the radionuclide content of bioassay samples. The RPM shall ensure that the bioassay analytical laboratory:

6.2.1.1.1 Meets the performance specifications for indirect bioassay recommended in ANSI N13.30.

6.2.1.1.2 Has written procedures that document the laboratory's analytical capabilities and a quality assurance (QA)/quality control (QC) program that assures the validity of the analytical results.

6.2.3 Bioassay Sampling (Urine bioassay)

6.2.3.1 Bioassay samples shall be either 24 hour samples or simulated 24-hour samples, as defined in Section 4.0 of this procedure.

6.2.3.2 The RPM, or designee, shall issue sample containers and Attachment 1, "Bioassay Instructions/COC," (or equivalent) to the monitored employee.

6.2.3.3 The monitored employee shall collect the specified urine sample(s) and return the container(s) and completed bioassay instructions/chain-of-custody to the RPM, or designee.

6.2.3.4 Upon receipt, the RPM, or designee, shall complete and secure the container labels, affix a tamper-evident seal to the container, complete a chain of custody form (see below), and forward the sample to the analytical laboratory.

6.2.3.5 Each bioassay sample chain-of-custody form should provide the following sample information:

- Monitored individual's name,
- Date and time of voids,
- Required analysis, and
- Reason for sample (baseline, routine, special, exit).

6.2.4 Monitoring Frequency

6.2.4.1 Baseline bioassays for monitored employees shall be performed at the start of employment, unless waived by the RPM on Attachment 3 (or equivalent).

6.2.4.2 Routine bioassay monitoring should be performed at a frequency specified by the RPM, as appropriate.

6.2.4.3 If monitoring is required, routine air sampling shall be conducted daily when radionuclides are being used or handled, as determined appropriate by the RPM.

6.2.4.4 If monitoring is not required, routine air sampling shall follow the routine surveillance schedule set by the RPM in accordance with HP-12, "Health Physics Oversight."

6.2.4.5 Special or non-routine bioassays should be performed, at the discretion of the RPM:

- After detection of facial contamination or positive nasal smear results.

- Following acute exposure to airborne radioactivity without respiratory protection in place.
- When it is suspected that an individual may have incurred an intake in excess of 10 percent of the ALI for any radionuclide.

6.2.5 Assessment of Internal Dose

6.2.5.1 Radioactive material intakes shall be determined by correcting reported bioassay measurement results using the methodology described in NUREG/CR-4884, or by other appropriate methods as determined by the RPM.

6.2.5.2 CEDE and/or CDE for radionuclide intakes detected through bioassay and/or air monitoring should be calculated using methodologies contained in NRC Regulatory Guide 8.34, *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses,* or other appropriate methods as determined by the RPM.

6.2.5.3 If sufficient data to determine a worker's intake is available from both air sampling and bioassay measurements, and the results are significantly different, then the workers intake estimate should be based on the data considered to be most accurate as determined by the RPM.

6.3 External Radiation Monitoring

6.3.1 General

6.3.1.1 TLDs are used to measure external occupational radiation exposure. TLD results are considered the official record of DDE for occupational radiation exposure received from external radiation sources.

6.3.1.2 TLDs should normally be processed in quarterly monitoring periods, unless determined otherwise by the RPM.

6.3.1.3 TLD storage area exposure rates shall not be distinguishable from background.

6.3.1.4 TLDs in storage or transit shall be accompanied with a control TLD to monitor accumulated dose while in storage or transit.

6.3.1.5 TLDs should be sent to a processing facility within 2 weeks from the end of a monitoring period. TLDs of terminating personnel may be stored until the end of a monitoring period and sent with the other TLDs from that monitoring period.

6.3.2 Monitoring for Extremity Exposure

6.3.2.1 Radiological workers likely to exceed 5 rem per year (rem/yr) to the extremities shall wear extremity dosimeters (ring badges) to evaluate the dose to extremities, as determined by the RPM.

6.3.2.2 When ring badges are required, each hand shall be provided with a dosimetry device unless an alternate approach is justified and documented.

6.3.2.3 Monitored personnel shall place ring badges such that they are as close as possible to the radiation source during work operations without restricting the use of the extremity (i.e., facing the palm of the hand).

6.3.3 Monitoring for Skin Exposure

6.3.3.1 Radiological workers likely to exceed 5 rem/yr to the skin shall be monitored for shallow dose equivalent.

6.3.3.2 The RPM, or designee, should control skin dose rates primarily by using appropriate protective equipment (shielding and protective clothing such as gloves) and decontamination.

6.3.3.3 Dose to the skin of the extremities shall be considered to be an extremity dose rather than a dose to the skin of the whole body.

6.3.3.4 The RPM, or designee, shall calculate the skin dose (e.g., shallow dose equivalent) if it is suspected that a worker may have received greater than 5,000 mrem shallow dose equivalent from skin contamination, or if detectable skin contamination cannot be removed by decontamination pursuant to HP-10, "Personnel and Equipment Decontamination."

6.3.4 Monitoring for Exposure to the Lens of the Eye

6.3.4.1 Radiological workers likely to exceed 1,500 mrem/yr LDE shall be monitored.

6.3.4.2 The RPM, or designee, should control dose to the lens of the eye primarily by using protective equipment (shielding and protective clothing such as safety glasses), as appropriate.

6.3.4.3 The RPM, or designee, shall calculate LDE if it is suspected that a worker may have received greater than 1,500 mrem to the lens of the eye.

6.3.5 Equipment Specifications

6.3.5.1 Dosimetry services shall be accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

6.3.5.2 The RPM shall ensure that dosimeter issuance, retrieval, handling, storage, and processing practices; personnel training and qualifications; QA; documentation; calibration; and record keeping practices meet the minimum conditions for accreditation by NVLAP and the requirements of ANSI N13.11.

6.3.6 Estimating External Dose

6.3.6.1 When a dosimeter is reported lost or missing, the RPM, or designee, shall estimate the dose of the individual through the use of:

- Secondary dosimeter totals (if worn).
- Workplace conditions and stay times.
- Dose assessments from co-workers.
- Dose assessments from similar jobs/tasks.
- A combination of the above methods.

6.3.6.2 Dose estimates for DDE and/or shallow dose equivalent shall be documented on Attachment 8, "External Dose Estimation" (or equivalent).

6.3.7 External Dose Assessment

6.3.7.1 The dose of record for DDE, shallow dose equivalent, and extremity dose is that which is recorded from processing of the TLD, unless determined otherwise by the RPM.

6.3.7.2 The results of a dose estimate or assessment shall be included in the individual's radiation dose totals, in accordance with the requirements of this procedure.

6.4 Short-Term Visitor Access Requirements

6.4.1 Short-term visitors are administratively limited to 50 mrem TEDE, and are normally limited to escorted touring inside of a restricted area.

6.4.2 Short-term visitors are not considered monitored employees.

6.4.3 Short-term visitors shall not enter contamination areas, radiation areas, high-radiation areas (HRAs), very high-radiation areas (VHRAs), or airborne radioactivity areas unless escorted by a Senior Health Physics Technician (HPT). Entry requirements in other restricted areas shall be determined by the site RPM, as appropriate.

6.4.4 Short-term visitors and escorts shall read, understand, and sign Attachment 1, "Visitor Log" (or equivalent).

6.5 Employee Radiation Exposure Monitoring Participation

6.5.1 In order to determine monitoring requirements, the RPM, or designee, should anticipate individual exposure using dose modeling, historical monitoring data, and/or professional judgment. Anticipated exposure should be evaluated using one of, or a combination of, the following factors:

6.5.1.1 Expected duration within the restricted area for a given activity.

6.5.1.2 Expected dose rates in work areas for the radionuclide of concern.

6.5.1.3 Expected or historical air particulate concentrations in the work areas.

6.5.1.4 Historical exposure performing similar work.

6.5.2 A radiological worker shall participate in the radiation monitoring program if they are likely to incur greater than 10 percent of a regulatory dose limit from internal or external sources of radiation (i.e., DDE or CEDE).

6.5.3 A declared pregnant woman shall participate in a radiation monitoring program if they are likely to incur more than 100 mrem DDE or CEDE during the period of gestation. The RPM may require monitoring of declared pregnant women regardless of the exposure potential.

6.5.4 A minor shall participate in the radiation monitoring program if they are performing work on a non-USACE site and are likely to receive 100 mrem/yr DDE, an LDE of 150 mrem/yr, an SDE of 500 mrem/yr, or 500 mrem/yr CEDE.

6.5.5 The RPM may elect to conduct monitoring in lieu of performing an assessment to determine monitoring requirements.

6.6 Monitored Employee Processing Requirements

6.6.1 Each Monitored Employee shall:

6.6.1.1 Provide documentation indicating successful completion of Radiation Worker Training (RWT).

6.6.1.2 Complete applicable sections of Attachment 3 (or equivalent), "Monitored Employee Information."

6.6.1.3 Provide an initial bioassay sample. The RPM shall specify the type of bioassay (i.e., 24-hour, simulated 24-hour, or spot sample) and instruct personnel how to complete the bioassay. The bioassay, along with a chain-of-custody, shall be sent to the laboratory for analysis. This requirement may be waived or postponed by the RPM by completing the waiver section of Attachment 3 (or equivalent).

6.6.1.4 Be issued a TLD and extremity dosimeter (if required), unless waived by the RPM.

6.6.2 Each monitored employee previously monitored for radiation exposure shall:

6.6.2.1 Provide a completed NRC Form 4, or equivalent.

6.6.2.2 Provide a signed Attachment 2, "Request for Radiation Exposure Records" form (or equivalent).

6.6.3 The RPM, or designee, shall review all of the initial paperwork provided by the employee and complete the remainder of Attachment 3, "Monitored Employee Information" (or equivalent).

6.6.4 If the individual is expected to exceed 10 percent of any applicable federal limit, and the current year exposure is estimated, then the RPM, or designee, shall attempt to verify the estimated current year dose information provided using Attachment 2, "Request for Radiation Exposure Records" (or equivalent). Copies of all dose verification requests shall be kept in the individual's dosimetry file.

6.6.5 If the individual's available dose balance is insufficient for the exposure anticipated, then the individual shall be denied access to the restricted area.

6.6.6 The RPM, or designee, shall enter the individual into the monitoring program by completing Attachment 4, "Monitored Employee Log" (or equivalent).

6.7 Termination of Monitoring

6.7.1 Personnel terminating work on site shall return their dosimetry and submit an exit bioassay sample to the RPM, or designee (unless waived by the RPM). The exit bioassay shall be accompanied by a chain-of-custody.

6.7.2 The RPM, or designee, shall complete appropriate sections of Attachment 3, "Monitored Employee Information" (or equivalent), and Attachment 4, "Monitored Employee Log," (or equivalent) to terminate an individual from the monitoring program.

6.8 Radiation Exposure Reports

6.8.1 Within 30 days of receipt of dosimetry and bioassay results, employee radiation exposure should be assessed.

6.8.2 The results of annual radiation exposure monitoring shall be documented on Attachment 5, "NRC Form 5," (or equivalent) and forwarded to the monitored individual.

6.8.3 The RPM should utilize the guidance contained in HP-22 "Radiological Reporting," if applicable, for recording and reporting occupational radiation exposure data.

6.9 Additional Guidance

6.9.1 The RPM may use the references listed in Section 3.0 of this procedure (as appropriate) as additional guidance for implementation of the personnel monitoring program and for calculation of occupational radiation exposure.

7.0 Records

7.1 Records of radiation dose assigned to individuals shall make a clear distinction among the dosimetric quantities entered on the records (e.g., TEDE, CEDE, CDE, DDE, shallow dose equivalent, LDE).

7.2 Records of the results of surveys, air sampling, measurements, and calculations shall be maintained until the NRC terminates the license (if applicable) requiring the record, if used, to determine:

7.2.1 External dose (i.e., DDE, shallow dose equivalent, LDE, dose to extremities, etc.) from radiation sources external to the body; and

7.2.2 Internal dose (i.e., CEDE or CDE) from the intake of radioactive materials.

7.3 Records of individual monitoring results shall be reported to individuals and maintained for each individual for whom monitoring was required in accordance with this Radiation Safety Program.

7.4 All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

VISITOR LOG

Date	Visitor Signature*	SSN	Company	Escort Signature*	Time In	Time Out	Estimated External Dose (mrem)	Comments

***Signature indicates that you have read, understand, and will comply with the information presented below.**

VISITOR RESPONSIBILITIES
If not currently radworker trained, read and understand NRC Regulatory Guide 8.29, "Instruction Concerning Risk from Occupational Radiation Exposure."
If entering an HSWP area, read, understand, and comply with the requirements of the HSWP, and place a "V" next to your name on the entry log (if required to sign in).
Stay with, and obey all instructions given by, your escort at all times.

ESCORT RESPONSIBILITIES	
The escort is responsible for the radiological and industrial safety of the visitor(s) being escorted by them. The escort may accompany up to 5 visitors simultaneously. Ensure the visitor does NOT enter an airborne radioactivity area. Should an emergency develop during escort of a visitor, accompany the visitor(s) to the site assembly area.	Note the anticipated external dose in the table above. The visitor (admin) exposure limit for the whole body is 50 mrem unless otherwise approved by the RPM.

Leidos
Attn: Radiation Safety Officer
13397 Lakefront Drive, Suite 100
Earth City, MO 63045

SUBJECT: REQUEST FOR RADIATION EXPOSURE RECORDS

Exposure Records Department:

Please send copies of your records of occupational radiation exposure for the person listed below to the above address:

Name: _____

SSN: _____

Monitored Dates: _____

Authorization: I authorize by a copy of an original signed request, release of my occupational radiation exposure records to Leidos under the provisions of the Privacy Act of 1974.

_____ _____
SIGNATURE DATE

MONITORED EMPLOYEE INFORMATION
EMPLOYEE ID: _____ (Page 1 of 3)

EMPLOYEE

Name (print): _____ SSN: _____ Date: _____

Date of Birth: _____ Job Title: _____

Email: _____ Work Phone: _____

Permanent Home Address: _____
Street Address

_____
City State Zip

Have you ever been monitored for occupational radiation exposure? ☐ YES ☐ NO

- If yes, your estimated lifetime dose is: _____ rem

Have you been monitored for occupational radiation exposure this calendar year? ☐ YES ☐ NO

- If yes, complete this table:

Period of Time Monitored During the Current Year		Name/Address of Facility or Site where monitored	Exposure Estimate / Record (mrem) Include: DDE/LDE/SDE,WB/SDE,ME/ CEDE/CDE/TEDE/TODE, as available	
From	To			
				Record ☐ Written Estimate ☐ Best Personal Est. ☐
				Record ☐ Written Estimate ☐ Best Personal Est. ☐
				Record ☐ Written Estimate ☐ Best Personal Est. ☐
				Record ☐ Written Estimate ☐ Best Personal Est. ☐

MONITORED EMPLOYEE INFORMATION
EMPLOYEE ID: _____ (Page 2 of 3)

EMPLOYEE COMPLETE

It is my responsibility to:

- Provide the RPM, or designee, with correct occupational exposure information (when estimated, information that is to the best of your knowledge).
- Read, understand, and comply with the protective requirements of the HSWP prior to entry into the restricted area (if applicable).
- Comply with RPM verbal instructions.
- Inform the RPM before it becomes necessary to change either the scope of work, or the method in which work will be accomplished (previously agreed on by the RPM).
- Notify the RPM, or designee, immediately upon arrival at work following the use of a radiopharmaceutical.
- Notify the RPM, or designee, of any open cut or wound.
- Notify the RPM, or designee, immediately if my dosimeter is missing.
- Return my dosimetry and provide an exit bioassay sample with chain-of-custody information (as applicable) at the completion of work at this project.

_____ _____

Individuals Signature Date

Sex: ☐ Male ☐ Female (If female, please read and sign the following statement)

NRC Regulatory Guide 8.13 requires that female workers authorized to receive occupational radiation exposure, and their supervisors, be given special instructions about prenatal radiation exposure risks to the developing embryo/fetus. The instruction also explains that during the entire gestation period a declared pregnant female worker will be limited to less than 500 mrem for the entire gestation period to minimize risks from radiation exposure to the embryo/fetus.

I have both read and received instruction in NRC Regulatory Guide 8.13. I am aware of the radiation exposure risks for an embryo/fetus and further understand that any decision to provide special protection from such risk, through a written declaration of pregnancy, is voluntary.

_____ _____

Individuals Signature Date

MONITORED EMPLOYEE INFORMATION
EMPLOYEE ID: _____ (Page 3 of 3)

RPM, or designee COMPLETE

Monitoring Prerequisites:

☐ Current radworker training on file ☐ Initial bioassay submitted

☐ Dosimeter issued

If any of the above is not checked, indicate the reason for the waiver:

_____

_____

Current year available federal exposure: _____ mrem TEDE
(Reduce 5 rem by 1.25 rems for each monitored quarter in which written records/estimates are not available)

Site administrative exposure limit: _____ mrem TEDE

Current year whole body exposure: _____ mrem TEDE
(Add all current year whole body exposure, including estimates)

Current year available administrative exposure: _____mrem TEDE
(Admin. limit - current year whole body exposure, use 100 mrem if admin. limit is 100 mrem)

Individual entered on Attachment 4 (or equivalent), "Monitored Employee Log"? ☐ Yes ☐ No

Monitoring start date: _____

_____ _____
RPM Signature Date

Monitoring Termination:

☐ Exit bioassay submitted with chain-of-custody information ☐ Dosimeter retrieved

If either of the above is not checked, indicate the reason for the waiver:

_____

Monitoring stop date: _____

_____ _____
RPM (or designee) Signature Date

_____

MONITORED EMPLOYEE LOG

Year: ___________ Page #:_____

NAME LAST, FIRST, M.I.	SSN (Last 4 digits are HPID)	BIOASSAY DATE		DOSIMETER DATE		DOSIMETER NUMBER	ISSUED BY (Initial)	REMARKS
		INITIAL	EXIT	ISSUE	RETURN			

OCCUPATIONAL DOSE RECORD FOR A MONITORING PERIOD

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

6. MONITORING PERIOD	7. LICENSEE NAME	8. LICENSE NUMBER(S)	9A	9B
TO			☐ RECORD ☐ ESTIMATE	☐ ROUTINE ☐ PSE

INTAKES

10A. RADIONUCLIDE	10B. CLASS	10C. MODE	10D. INTAKE in µCi

DOSES (in rem)

DEEP DOSE EQUIVALENT	(DDE)	11.
LENS (EYE) DOSE EQUIVALENT	(LDE)	12.
SHALLOW DOSE EQUIVALENT, WHOLE BODY	(SDE,WB)	13.
SHALLOW DOSE EQUIVALENT, MAX EXTREMITY	(SDE,ME)	14.
COMMITTED EFFECTIVE DOSE EQUIVALENT	(CEDE)	15.
COMMITTED DOSE EQUIVALENT, MAXIMALLY EXPOSED ORGAN	(CDE)	16.
TOTAL EFFECTIVE DOSE EQUIVALENT ***(BLOCKS 11 +15)***	((TEDE)	17.
TOTAL ORGAN DOSE EQUIVALENT, MAX ORGAN ***(BLOCKS 11 + 16)***	(TODE)	18.

19. COMMENTS
This report is furnished to you under the provisions of the Nuclear Regulatory Commission regulation 10 *CFR* 19. You should preserve this report for future reference.

20. SIGNATURE - LICENSEE Leidos Radiation Safety Officer or designee	21. DATE PREPARED

INSTRUCTIONS AND ADDITIONAL INFORMATION PERTINENT TO THE COMPLETION OF OCCUPATIONAL DOSE RECORD FOR A MONITORING PERIOD
(All doses should be stated in rems)

1. Type or print the full name of the monitored individual in the order of last name. Include "Jr," "Sr," "III," etc., first name, middle initial (if applicable).

2. Enter the individual's identification number, including punctuation. This number should be the 9-digit social security number if at all possible. If the individual has no social security number, enter the number from another official identification as a passport or work permit.

3. Enter the individual's identification used as shown below:

CODE	ID TYPE
SSN	U.S. Social Security Number
PPN	Passport Number
CSI	Canadian Social Insurance Number
WPN	Work Permit Number
PADS	PADS Identification Number
OTH	Other

4. Check the box that denotes the sex of the individual being monitored.

5. Enter the date of birth of the individual being monitored in the format MM/DD/YYYY.

6. Enter the monitoring period for this report is filed. The format should be MM/DD/YYYY-MM/DD/YYYY.

7. Enter the name of the licensee.

8. Enter the license or registration number or numbers.

9A. Place an "X" in Record or Estimate. Choose "Record" if the dose data listed represent a final determination of the dose received to the best of the licensee's knowledge. Choose "Estimate" only if the listed dose data are preliminary and will be superseded by a final determination resulting in a subsequent report. An example of such an instance would be dose data based on self-reading dosimeter results and the licensee intends to assign the record dose on the basis of TLD results that are not yet available.

9B. Place an "X" in either Routine or PSE. Choose "Routine" if the data represent the results of monitoring for routine exposures. Choose "PSE" if the listed dose data represents the results of monitoring of planned special exposures received during the monitoring period. If more than one PSE was received in a single year, the licensee should sum them and report the total of all PSEs.

10A *Enter the symbol for each radionuclide that resulted in an* internal exposure recorded for the individual. Using the format "Xx-###x," for instance, Cs-137 or Tc-99m.

10B Enter the lung clearance class as listed in Appendix B to 10 *CFR* Part 20.1001-2401 (D, W, Y, V, or O for other) for all intakes by inhalation.

10C Enter the mode of intake. For inhalation, enter "H." For absorption through the skin, enter "B." For oral ingestion, enter "G." For injection, enter "J."

10D. Enter the intake of each radionuclide in μCi.

11. Enter the deep dose equivalent (DDE) to the whole body.

12. Enter the eye dose equivalent (LDE) recorded for the lens of the eye.

13. Enter the shallow dose equivalent recorded for the skin of the whole body (SDE, WB).

14. Enter the shallow dose equivalent recorded for the skin of the extremity receiving the maximum dose (SDE, ME).

15. Enter the committed effective dose equivalent (CEDE).

16. Enter the committed dose equivalent (CDE) recorded for the maximally exposed organ.

17. Enter the total effective dose equivalent (TEDE). The TEDE is the sum of items 11 and 15.

18. Enter the total organ dose equivalent (TODE) for the maximally exposed organ. The TODE is the sum of items 11 and 16.

19. COMMENTS.

In the space provided, enter additional information that might be needed to determine compliance with limits. An example might be to enter the note that the SDE, ME was the result of exposure from a discrete hot particle. Another possibility would be to indicate that an overexposed report has been sent to NRC in reference to the exposure report.

20. Signature of the person designated to represent the licensee.

21. Enter the date this form was prepared.

NRC FORM 4
(08-2014)
10 *CFR* PART 20

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0005 **EXPIRES: 08/31/2017**

Estimated burden per response to comply with this mandatory collection request: 37 minutes. This information is required to record an individual's lifetime occupational exposure to radiation to ensure that the cumulative exposure to radiation does not exceed regulatory limits. Send comments regarding burden estimate to the FOIA, Privacy, and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0005), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to the information collection.

CUMULATIVE OCCUPATIONAL DOSE HISTORY

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

6. MONITORING PERIOD (MM/DD/YYYY – MM/DD/YYYY)			7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUNTINE ☐ PSE ☐
11a. EDEX	11b. DDE	12. LDE	13. SDE,WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

6. MONITORING PERIOD (MM/DD/YYYY – MM/DD/YYYY)			7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUNTINE ☐ PSE ☐
11a. EDEX	11b. DDE	12. LDE	13. SDE,WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

6. MONITORING PERIOD (MM/DD/YYYY – MM/DD/YYYY)			7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUNTINE ☐ PSE ☐
11a. EDEX	11b. DDE	12. LDE	13. SDE,WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

6. MONITORING PERIOD (MM/DD/YYYY – MM/DD/YYYY)			7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUNTINE ☐ PSE ☐
11a. EDEX	11b. DDE	12. LDE	13. SDE,WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

6. MONITORING PERIOD (MM/DD/YYYY – MM/DD/YYYY)			7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUNTINE ☐ PSE ☐
11a. EDEX	11b. DDE	12. LDE	13. SDE,WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

6. MONITORING PERIOD (MM/DD/YYYY – MM/DD/YYYY)			7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ☐ ESTIMATE ☐ NO RECORD ☐	10. ROUNTINE ☐ PSE ☐
11a. EDEX	11b. DDE	12. LDE	13. SDE,WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE	18. TODE

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

INSTRUCTIONS AND ADDITIONAL INFORMATION PERTINENT TO THE COMPLETION OF NRC FORM 4

(All doses should be stated in rems)

1. Type or print the full name of the monitored individual in the order of last name (include "Jr," "Sr," "III," etc.), first name, middle initial (if applicable).
2. Enter the individual's identification number, including punctuation. This number should be the 9-digit social security number if at all possible. If the individual has no social security number, enter the number from another official identification such as a passport or work permit.
3. Enter the code for the type of identification used as shown below:

CODE	ID TYPE
SSN	U.S. Social Security Number
PPN	Passport Number
CSI	Canadian Social Insurance Number
WPN	Work Permit Number
PADS	PADS Identification Number
OTH	Other

4. Check the box that denotes the sex of the individual being monitored.
5. Enter the date of birth of the individual being monitored in the format MM/DD/YY.
6. Enter the monitoring period for which this report is filed. The format should be MM/DD/YY – MM/DD/YY.
7. Enter the name of the licensee or facility not licensed by NRC that provided monitoring.
8. Enter the NRC licensee number or numbers.
9. Place an "X" in Record, Estimate, or No Record. Choose "Record" if the dose data listed represents a final determination of the dose received to the best of the licensee's knowledge. Choose "Estimate" only if the listed dose data are preliminary and will be superseded by a final determination resulting in a subsequent report. An example of such an instance would be dose data based on self-reading dosimeter results and the licensee intends to assign the record dose on the basis of TLD results that are not yet available. If the individual or an organization has indicated that the individual was monitored, but the monitoring records could not be obtained, enter "No Record" for this monitoring period. The individual would not be available for a PSE. For monitoring periods during the current year where records are not available, reduce the individual's allowable dose by 1.25 rems for each quarter for which records were unavailable as required by 10 *CFR* 20.2104(e)(1).
10. Place an "X" in either Routine or PSE. Choose "Routine" if the data represents the results of monitoring for routine exposures. Choose "PSE" if the listed dose date represents the results of monitoring of planned special exposures received during the monitoring period.

11A. EDEX – Enter the EDEX for the entire monitoring period (e.g., year). EDEX is the sum of the EDEX component determined using NRC-approved special dosimetry methods (see RG 8.40) and the EDEX component estimated by the DDE for those time periods when not using NRC-approved special dosimetry methods.

Note: If EDEX has been determined by measuring the DDE (at the highest exposed part of the whole body – see 10 *CFR* 20.1201(c)) for the entire monitoring period, then box 11a and 11b will have the same value.

11B. DDE - Enter the DDE measured at the highest point on the whole body for the entire monitoring period (e.g., year – including those time periods when EDEX was being determined using NRC-approved special dosimetry methods).

12. Enter the eye dose equivalent (LDE) recorded for the lens of the eye.
13. Enter the shallow dose equivalent recorded for the skin of the whole body (SDE,WB).
14. Enter the shallow dose equivalent recorded for the skin of the extremity receiving the maximum dose (SDE,ME).
15. Enter the committed effective dose equivalent (CEDE).
16. Enter the committed dose equivalent (CDE) recorded for the maximally exposed organ.
17. Enter the total effective dose equivalent (TEDE). The TEDE is the sum of items 11a and 15.
18. Enter the total organ dose equivalent (TODE) for the maximally exposed organ. The TODE is the sum of items 11b and 16.
19. Signature of the monitored individual. The signature of the monitored individual on this form indicates that the information contained on the form is complete and correct to the best of his or her knowledge.
20. Enter the date this form was signed by the monitored individual.
21. [OPTIONAL] Enter the name of the licensee or facility not licensed by NRC, providing monitoring for exposure to radiation (such as a DOE facility) or the employer if the individual is not employed by the licensee and the employer chooses to maintain exposure records for its employees.
22. [OPTIONAL] Signature of the person designated to represent the licensee or employer entered in item 21. The licensee or employer who chooses to countersign the form should have on file documentation of all information on the NRC Form 4 being signed.
23. [OPTIONAL] Enter the date this form was signed by the designated representative.

PRIVACY ACT STATEMENT
NRC FORM 4
CUMULATIVE OCCUPATIONAL DOSE HISTORY

Pursuant to 5 U.S.C. 552a(e)(3), enacted into law by Section 3 of the Privacy Act of 1974 (Public Law 93-579), the following statement is furnished to individuals who supply information to the U.S. Nuclear Regulatory Commission on NRC Form 4. This information is maintained in a system of records designated as NRC-27 and described at 77 Federal Register 67223 (November 8, 2012), or the most recent Federal Register publication of the NRC's Systems of Records Notices that is located in NRC's Agencywide Documents Access and Management System (ADAMS).

1. **AUTHORITY:** 5 U.S.C. 7902; 29 U.S.C. 668; 42 U.S.C. 2051, 2073, 2093, 2095, 2111, 2133, 2134, and 2201(o); 10 *CFR* Part 20; 10 *CFR* Part 34; Executive Order (E.O.) 9397, as amended by E.O. 13478; E.O. 12196, as amended; E.O. 12610.
2. **PRINCIPAL PURPOSE(S):** The information is used by the NRC in its evaluation of the risk of exposures to radiation associated with the licensed activities and in exercising its statutory responsibility to monitor and regulate the safety and health practices of its licensees. The data permits a meaningful comparison of both current and long-term exposure experience among types of licenses and among licensees within each type. Data on your exposure to radiation is available to you upon your request.
3. **ROUTINE USE(S):** In addition to the disclosures permitted under subsection (b) of the Privacy Act, information may be used to provide data to other Federal and State agencies involved in monitoring and/or evaluating radiation exposure received by individuals monitored for radiation exposure while employed by or visiting or temporarily assigned to certain NRC licensed facilities; and to return data provided by licensee upon request. Information may be disclosed in accordance with any of the Routine Uses listed in the Prefatory Statement of General Routine Uses, including to an appropriate Federal, State, local or Foreign agency in the event the information indicates a violation or potential violation of law; in the course of an administrative or judicial proceeding; to an appropriate Federal, State, local and foreign agency to the extent relevant and necessary for an NRC decision about you or to the extent relevant and necessary for that agency's decision about you; in the course of discovery under a protective order issued by a court of competent jurisdiction, and in presenting evidence; to a Congressional office to respond to their inquiry made at your request; to NRC-paid experts, consultants, and others under contract with the NRC, on a need-to-know basis; or to appropriate persons and entities for purposes of response and remedial efforts in the event of a suspected or confirmed breach of data from this system of records.
4. **WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION:** It is voluntary that you furnish the requested information, including the Social Security number (SSN) in block #2. The SSN is used to assure that NRC has an accurate and unique identifier not subject to the coincidence of similar names or birth dates among the large number of persons on who data is maintained and to assure that there are no missed doses or monitoring periods and an individual gets a complete dose history when requested. The licensee must complete NRC Form 5 on each individual for whom personnel monitoring is required under 10 *CFR* 20.1502. In addition, licensees must submit this information to NRC in accordance with the requirement under 10 *CFR* 20.2206. Failure to do so may subject the licensee to enforcement action in accordance with 10 *CFR* 20.2401.
5. **SYSTEM MANAGER(S) AND ADDRESS:** REIRS Project Manager, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

BIOASSAY INSTRUCTIONS/COC (EXAMPLE)

This kit is being provided by Leidos for the collection of a 24-hour urine sample that will be used to assess the levels of internal radiological contaminants in your system. It is important to follow the directions below to obtain a valid sample. If you have any questions regarding how to provide the sample, please contact the Radiation Safety Officer.

Instructions:

1. Keep the sample box and containers clean and free of any foreign material.
2. Prior to collecting urine in the bottles, record the DATE and TIME of your LAST UNCOLLECTED VOID below. The sampling period is 24-hours, which begins with the last uncollected void and ends after 24-hours. (It is not necessary to fill both containers to have a valid sample. If both containers are not full after 24-hours note the END TIME below. If both containers are filled before 24-hours, the sampling is complete. Note the END TIME below and complete the following steps.)
3. Between voidings, secure bottle with caps provided. When the bottles are full, tighten the caps securely.
4. Complete the enclosed security labels and place securely on bottles when sampling is complete. SIGN AND DATE THE CHAIN OF CUSTODY BLOCK BELOW IN THE FIRST "RELINQUISHED BY" LINE!
5. Place the sample bottles in the sample kit box.
6. Return the completed sample kit and this sheet to the RPM, or designee.
7. Use a cooler and secure samples if shipping.

Complete the following information:

Name:	SSN:
Date of last uncollected void:	Time of last uncollected void:
Sample collection end date:	Sample collection end time:

Chain of Custody:

Relinquished by:	Date:	Received by:	Date:
Relinquished by:	Date:	Received by:	Date:
Relinquished by:	Date:	Received by:	Date:

EXTERNAL DOSE ESTIMATION

Employee Name:	**Social Security No.**
Assessment Period (dates):	
Computed Dose (mrem DDE):	
Reason (check): ☐ Lost Dosimeter ☐ Damaged Dosimeter ☐ Other (describe): _____	**Basis (check):** ☐ Prior exposure history ☐ Comparison with coworkers ☐ Ambient exposure rate and stay time analysis ☐ Other (describe): _____ _____ _____ _____
Notes and Calculations:	
Assessment performed by (name and signature):	
Assessment Date:	
RPM Approval (name and signature):	

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-50

REV. 0

RADIOACTIVE MATERIAL SHIPPING

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LIST OF ATTACHMENTS

1. CHECKLIST FOR SHIPPING EMPTY PACKAGES
2. CHEKCLIST FOR LSA OR SCO
3. CHECKLIST FOR NORMAL CLASS 7 RADIOACTIVE MATERIAL
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5. CHECKLIST FOR GENERAL DESIGN REQUIREMENTS FOR RADIOACTIVE SHIPMENT PACKAGES
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7. CHECKLIST FOR RADIOACTIVE LSA OR SCO SHIPMENTS
8. EXCLUSIVE USE VEHICLE - DRIVER'S INSTRUCTIONS

9. EMERGENCY RESPONSE INFORMATION FOR LSA, UN-2912, AND SCO, UN-2913 GUIDE 162, RADIOACTIVE MATERIALS (LOW TO MODERATE LEVEL RADIATION

10. RADIOACTIVE SHIPMENT MANIFEST EXAMPLE

11. GENERAL PACKAGING REQUIREMENTS

1.0 Purpose

This procedure provides the guidelines and requirements necessary to maintain compliance with regulations when shipping radioactive materials. It is applicable only to materials shipped "in commerce." Movements within or between buildings or facilities are subject to on-site requirements.

2.0 Scope

The policies and requirements in this procedure apply to all personnel who generate, handle, package, and ship radioactive materials from a site working under this Leidos Radioactive Material Transportation Program. This procedure does not cover rules for shipping limited quantities, fissile materials, Type-B packages, or Highway Route Controlled shipments. Shipments of Limited Quantity Radioactive Material should follow the requirements contained in HP-51, "Limited Quantity Radioactive Material Shipping."

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20.1906, "Procedures for Receiving and Opening Packages."

3.2 10 *CFR* 20.2006, "Transfer for Disposal and Manifests."

3.3 10 *CFR* 20, Appendix E – "Nationally Tracked Source Thresholds."

10 *CFR* 20, Appendix G – "Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests.

3.4 10 *CFR* 61.55, "Waste Classification."

3.5 10 *CFR* 61, "Licensing Requirements for Land Disposal of Radioactive Waste."

3.6 10 *CFR* 71, "Packaging and Transportation of Radioactive Material."

3.7 10 *CFR* 835, "Occupational Radiation Protection."

3.8 49 *CFR,* Subtitle B, Chapter I, Subchapter C, Parts 171 through 177, "Hazardous Materials Regulations."

3.8.1 49 *CFR* 171, "General Information, Regulations, and Definitions."

3.8.2 49 *CFR* 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements, and Security Plans.

3.8.2.1 Subpart A – "General."

3.8.2.2 Subpart B – "Table of Hazardous Materials and Special Provisions."

3.8.2.3 Subpart C – "Shipping Papers."

3.8.2.4 Subpart D – "Marking."

3.8.2.5 Subpart E – "Labeling."

3.8.2.6 Subpart F – "Placarding."

3.8.2.7 Subpart G – "Emergency Response Information."

3.8.2.8 Subpart H – "Training."

3.8.2.9 Subpart I – "Safety and Security Plans."

3.8.3 49 *CFR* 173, "Shippers – General Requirements for Shipments and Packagings."

3.8.3.1 Subpart A – "General."

3.8.3.2 Subpart B – "Preparation of Hazardous Materials for Transportation."

3.8.3.3 Subpart I – "Class 7 (Radioactive) Materials."

3.8.4 49 *CFR* 174, "Carriage by Rail."

3.8.4.1 Subpart A – "General Requirements."

3.8.4.2 Subpart B – "General Operating Requirements."

3.8.4.3 Subpart C – "General Handling and Loading Requirements."

3.8.4.4 Subpart D – "Handling of Placarded Rail Cars, Transport Vehicles and Freight Containers."

3.8.4.5 Subpart K – "Detailed Requirements for Class 7 (Radioactive) Materials."

3.8.5 49 *CFR* 177, "Carriage by Public Highway."

3.8.5.1 Subpart A – "General Information and Regulations."

3.8.5.2 Subpart B – "Loading and Unloading."

3.8.5.3 Subpart C – "Segregation and Separation Chart of Hazardous Materials."

3.8.5.4 Subpart D – "Vehicles and Shipments in Transit; Accidents."

3.9 DOT 2012. U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA). *2012 Emergency Response Guidebook: A Guidebook for First Responders during the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident.* 2012.

3.10 IAEA 2004. International Atomic Energy Agency. *Regulations for the Safe Transport of Radioactive Material: 1996 Edition (As Amended 2003).* Safety Standards Series No. TS-R-1.

3.11 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01.

3.12 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Limited Quantity Radioactive Material Shipping." Leidos St. Louis Health Physics Procedure. HP-51.

3.13 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* HP-52, "Shipping and Receipt Surveys." Leidos St. Louis Health Physics Procedure. HP-52.

3.14 NRC 1979. U.S. Nuclear Regulatory Commission. *Packaging of Low-Level Radioactive Waste for Transport and Burial.* IE Bulletin No 79-19. August 10, 1979.

3.15 NRC 1998a. U.S. Nuclear Regulatory Commission. *Instructions for Completing NRC'S Uniform Low-Level Radioactive Waste Manifest.* NUREG/BR-0204. Revision 2. July 1998.

3.16 NRC 1998b. U.S. Nuclear Regulatory Commission. *Categorizing and Transporting Low Specific Activity Materials and Surface Contaminated Objects.* NUREG-1608. July 1998.

3.17 NRC and DOT 1990. U.S. Nuclear Regulatory Commission and U.S. Department of Transportation. *U.S. Schedules of Requirements for Transport of Specified Types of Radioactive Material Consignments.* NUREG-1660. January 1999.

4.0 Definitions

4.1 **Carrier** (Common Carrier) – person who transports passengers or property in commerce by rail car, aircraft, motor vehicle, or vessel (e.g., Federal Express) (49 *CFR* 171.8).

4.2 **Closed Transport Vehicle** – a transport vehicle or conveyance equipped with a securely attached exterior enclosure that, during normal transportation, restricts the access of unauthorized persons to the cargo space containing the Class 7 (radioactive) materials. The enclosure may be either temporary or permanent, and in the case of packaged materials, may be of the "see-through" type, and must limit access from top, sides, and bottom (49 *CFR* 173.403).

4.3 **Consignment** – a package, group of packages, or load of radioactive material offered for transport in the same shipment (49 *CFR* 173.403).

4.4 **Exclusive Use (sole use)** – means sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must provide to the initial carrier specific written instructions for maintenance of exclusive use shipment controls, including the vehicle survey requirement of 173.443(c), and must include these instructions with the shipping paper information provided to the carrier by the consignor (49 *CFR* 173.403).

4.5 **Fissile Material** – means any plutonium-239, plutonium-241, uranium-233, uranium-235 or any combination of these radionuclides. See 49 *CFR* 173.453 for "Fissile Materials-exceptions."

4.6 **Hazardous Material** – a substance or material determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and

property when transported in commerce, and so designated as hazardous under Section 5103 of the Federal Hazardous Materials Transportation Law (49 U.S. Code [USC] 5103). The term includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table (49 *CFR* 172.101), and materials that meet the defining criteria for hazardous classes and divisions in Part 173 of Subchapter C (49 *CFR* 171.8).

4.7 **Hazardous Waste** – A solid waste as defined in 40 *CFR* 261.2, if it is not excluded from regulation as a hazardous waste under 40 *CFR* 261.4(b) and if it meets the detailed criteria specified in 40 *CFR* 261.3.

4.8 **Highway Route Controlled Quantity** – a quantity of radioactive material within a single package that exceeds 3,000 times the applicable A_1 value specified in 49 *CFR* 173.435 for special form Class 7 (radioactive) material; 3,000 times the applicable A_2 value of the radionuclides specified in 49 *CFR* 173.435 for normal form Class 7 (radioactive) material; or 1,000 terabecquerels (TBq) (27,000 curies [Ci]), whichever is least (49 *CFR* 173.403).

4.9 **In-Commerce** – the movement of materials or goods in trade using commercial for-hire carriers operating over public roadways, air, or water and over railroad properties.

4.10 **Limited Quantity (LQ)** – A quantity of Class 7 (radioactive) material not exceeding the material's package limits specified in 49 *CFR* 173.425 and conforming with the requirements specified in 49 *CFR* 173.421. (Also see HP-51, "Limited Quantity Radioactive Material Shipping".)

4.11 **Low Specific Activity (LSA)** – a Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limits set forth in 49 *CFR* 173.403.

4.12 **Package** – the packaging, together with its radioactive contents, as presented for transport (49 *CFR* 173.403).

4.13 **Packaging** – the assembly of components necessary to ensure compliance with the packaging requirements of 10 *CFR* 71, "Packaging and Transportation of Radioactive Material." It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shock. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging (10 *CFR* 71.4).

4.14 **Radioactive Material** – any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table in 49 *CFR* 173.436 or the values derived according to the instructions specified in 49 *CFR* 173.433. Materials in which either the activity concentration or the total activity is below these levels are not defined as radioactive material for the purposes of transport.

4.15 **Reportable Quantity (RQ)** – a value associated with a hazardous substance which may require immediate notification in case of a spill or discharge. RQ is specified in column 3 of the appendix to 49 *CFR* 172.101 for any material

identified in column 1 of the appendix. (Note: Table 2, column 3 of the appendix provides the RQ, in Ci and in TBq, for radionuclides listed in column 1.)

4.16 **Surface Contaminated Object (SCO)** – a solid object which is not itself radioactive, but which has radioactive material distributed on its surface.

4.17 **Transport Index** (TI)– a dimensionless number (rounded up to the first decimal place) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is determined by multiplying the maximum radiation level in millisieverts per hour (mSv/hour) at 1 meter (m) (3.3 feet [ft]) from the external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour (mrem/hour) at 1 m (3.3 ft) (49 *CFR* 173.403).

4.18 **Transportation Representative (TR)** – the individual responsible for maintaining training qualifications in accordance with 49 *CFR* 172, Subpart H, and for ensuring that packaging and transportation of radioactive materials complies with the provisions of federal and state regulations.

4.19 **"Type-A Package"** – a packaging, together with its radioactive contents limited to A_1 or A_2 as appropriate, that meets the requirements of 173.410 and 173.412 and is designed to retain the integrity of containment and shielding as required by 49 *CFR* Part 173 under normal conditions of transport. A Type-A quantity refers to a quantity of Class 7 (radioactive) material, of which the aggregate radioactivity does not exceed A_1 for special form Class 7 (radioactive) material or A_2 for normal form Class 7 (radioactive) material where A_1 and A_2 values are given in 49 *CFR* 173.435 or are determined in accordance with 49 *CFR* 173.433.

In 10 *CFR* 71.4, the U.S. Nuclear Regulatory Commission (NRC) defines **A_1** as the maximum activity of special form radioactive material permitted in a Type-A package, and **A_2** as the maximum activity of radioactive materials, *other than special form material, LSA, and SCO material,* permitted in a Type-A package.

4.20 **"Type-B Package"** – a packaging designed to transport greater than an A_1 or A_2 quantity of radioactive material that, together with its contents, is designed to retain the integrity of containment and shielding required by 49 *CFR* 173 when subjected to the normal conditions of transport and hypothetical accident test conditions.

4.21 **Type-A Quantity** – a quantity of radioactive material in a single package, of which the aggregate radioactivity does not exceed the A_1 value for special form radioactive material or the A_2 value for normal form radioactive material.

4.22 **Type-B Quantity** – any quantity of radioactive material greater than a Type-A quantity (49 *CFR* 173.403).

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) will verify compliance with this procedure during periodic audits.

5.2 The Radiation Safety Officer (RSO) will generally be qualified both as RSO and as TR, and may serve concurrently in both roles.

5.3 The TR is responsible for maintaining training qualifications in accordance with 49 *CFR* 172, Subpart H, and for ensuring that packaging and transportation of radioactive materials complies with the provisions of federal and state requirements. The RSO and/or RPM will generally support the TR and may serve in dual capacities if fully qualified by virtue of training and experience.

5.4 The RSO, in coordination with the TR, will revise this procedure in response to regulatory changes or to accommodate feedback from field operations.

5.5 Health Physics Technicians (HPTs) are responsible for conducting the radiological surveys necessary to maintain compliance with this procedure.

6.0 Requirements

6.1 General

6.1.1 Requirements contained in 49 *CFR* Subpart I, Class 7 (Radioactive) Materials, "are in addition to, not in place of, other requirements set forth in this subchapter for Class 7 (radioactive) materials and those of the Nuclear Regulatory Commission in 10 *CFR* Part 71" (49 *CFR* 173.401).

6.1.2 All personnel who handle radioactive materials during shipment preparation, packaging, transfer, or receipt shall receive initial and periodic training commensurate with their responsibilities in accordance with 49 *CFR* 172, Subpart H, "Training". Individual(s) serving as TR shall demonstrate specialized training in radioactive materials requirements.

6.1.3 Transportation records, including those involving radioactive materials, will be documented using SI units consistent with the provisions of 49 *CFR* 171.10. Conventional US units will generally be documented in parentheses in addition to the SI units.

6.1.4 Additional limitations and requirements for airfreight or international shipments shall be addressed during shipment planning.

6.1.5 All attachments and/or checklists associated with this procedure may be revised and/or substituted with equivalent or updated forms as determined appropriate by the RPM or TR.

6.1.6 The requirements for classification, marking, labeling, receiving, and shipping limited quantities of radioactive materials are covered in HP-51, "Limited Quantity Radioactive Material Shipping."

6.2 Receiving Radioactive Materials

6.2.1 Guidance on surveys of vehicles is contained in 49 *CFR* 173.443 (c). Radiological surveys shall be performed in accordance with HP-52, "Shipping and Receipt Surveys."

6.2.2 Guidance on receiving and opening packages is contained in 10 *CFR* 20.1906, "Procedures for Receiving and Opening Packages," and includes the following:

6.2.2.1 Requirements for receiving radioactive material expeditiously;

6.2.2.2 Surveying packages, when received, for radiation and contamination;

6.2.2.3 Notifying authorities if excessive contamination or radiation is found;

6.2.2.4 Using written procedures for receiving radioactive materials; and

6.2.2.5 Following any special instructions provided for opening packages.

6.3 Material Characterization

6.3.1 Isotopic content, concentration, and total activity of each package or bulk shipment must be determined prior to classification and packaging of the shipment.

6.3.2 A radioactive material is defined in 49 *CFR* 173.403 as "any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table in 173.346 or values derived according to the instructions in 173.333." If the material being shipped does not meet the threshold for classification as Class 7 (radioactive) material, it is not radioactive for the purposes of transport. In such cases, shippers should consult 49 *CFR* 173.140 to confirm that the material to be shipped is not regulated as Class 9 (Miscellaneous Hazardous Materials). If the material to be shipped does not exceed the thresholds for Class 7 or Class 9, it may be shipped without regard to radioactive content.

6.3.3 Classification thresholds for shipments to be made via airfreight or which have international destinations will vary and shall be made according to the requirements of HP-51, "Limited Quantity Radioactive Material Shipping."

6.3.4 If the material is radioactive as determined above, consult the "Hazardous Materials Table" in 49 *CFR* 172.101. This table is used to identify 10 distinct pieces of data including but not limited to Hazardous Material Description and proper shipping name, Hazard Class or Division, Identification Numbers, Label Codes, Special Provisions, Packaging Requirements, and Quantity Limitations. For radioactive materials, there are 20 entries.

6.3.5 If other hazardous materials are in the material being shipped or are being shipped with the radioactive materials, these are identified in the same manner using the table in 49 *CFR* 172.101. The order of preference for identification is specified in 49 *CFR* 173.2a, "Classification of Material Having More than One Hazard." Material that is both radioactive and which must be assigned a U.S. Environmental Protection Agency (EPA) hazardous waste code (e.g., "mixed waste") shall also be prepared according to 40 *CFR* 261 and be documented on an approved hazardous waste manifest according to 40 *CFR* 262.

6.4 Material Classification

6.4.1 Establishing a material classification and associated proper shipping name is an iterative process conducted to best balance the shipping needs with the available resources. Although qualifying a material for a packaging exception is usually cost-effective, using specification packaging and one of the listed radioactive material proper shipping names can sometimes be justified when time is a consideration.

6.4.2 If the radioactive material will not be classified as LSA, SCO, LQ, or Instruments and Articles, the classification is based on the total radionuclide content and the nature of the material to be shipped (i.e., whether the material is special form or normal form) and the A_1 and A_2 values contained in 49 *CFR* 173.435, "Table of A_1 and A_2 for Radionuclides." Unless the radioactive material meets the requirements of 49 *CFR* 173.403 for special form, it is defined as normal form material.

6.4.3 Classification of mixtures of nuclides in LSA, SCO, LQ or instruments and articles, special form, or normal form radioactivity is based on the sum of fractions method, as described in 49 *CFR* 173.433, together with "Requirements for Determining A_1 and A_2 Values for Radionuclides and for Listing of Radionuclides on Shipping Papers and Labels." The sum of fractions must include 95 percent of the most significant nuclides. If all the nuclides are not quantified, special rules apply.

6.4.4 Hazardous materials may be present in waste or other shipments. These materials must be identified on the shipping papers and shipped according to the requirements for the material.

6.4.5 10 *CFR* 61, "Licensing Requirements for Land Disposal of Radioactive Waste" provides information for classification of wastes.

6.4.6 Waste materials being shipped for disposal are classified as waste. The word "Waste" must appear before the proper shipping name for the material.

6.5 Packaging, Marking, and Labeling Radioactive Materials

6.5.1 Empty Packages (See 49 *CFR* 173.428 and Attachment 1)

6.5.1.1 Empty Class 7 (radioactive) materials packaging is packaging which previously contained Class 7 (radioactive) materials and has been emptied of contents as far as practical. Such material is

exempt from shipping paper and marking (except for the UN identification number marking requirement described in 49 *CFR* 173.422(a)) requirements provided that the packaging meets the requirements of 49 *CFR* 173.421(a) (2), (3) and (5).

6.5.1.2 The shipping name for empty packages that once contained Class 7 (radioactive) materials is Radioactive Material, excepted package, empty packaging, UN 2908. Note: The proper shipping name is not required to be used because the package is exempt from the requirements for shipping papers.

6.5.1.3 Although the package must be empty, it may contain residual contamination. Empty Class 7 (radioactive) packaging must comply with 49 *CFR* 173.428, which incorporates the requirements of 49 *CFR* 173.421 (a)(2), (3), and (5) by reference. These provisions limit the radiation level at any point on the external surface of the packaging to 0.5 mrem/hour, limits residual removable radioactivity on the outside of the package to the standards prescribed in 49 *CFR* 173.443(a), and prohibits the presence of fissile material unless excepted by 49 *CFR* 173.453. In addition, the package must be securely closed and must be unimpaired so that it will not leak residual activity under conditions normally incident to transportation.

6.5.1.4 Non-fixed (removable) contamination on the exterior surface of the closed package may not exceed the standards specified in 49 *CFR* 173.443(a) (i.e., 22,000 dpm/100 cm^2 for beta-gamma emitters and low toxicity alpha emitters, and 2,200 dpm/100 cm^2 for all other alpha emitting radionuclides). In addition, contamination on the interiors of empty containers may not exceed 100 times the limits specified above and cited in 49 *CFR* 173.443(a). No special marking and labeling of empty packages is necessary. Any previous labels must be removed, obliterated, or covered. The package must be labeled with an Empty label. The Empty label is sized so it may be used to cover previous Type I, Type II, or Type III labels. No placard is required for empty shipments.

6.5.1.5 Empty packages are exempt from special paperwork, except that in accordance with 49 *CFR* 173.422(a) "the outside of each package must be marked with the four digit UN identification number for the material preceded by the letters UN" as shown in Column 4 of the Hazardous Materials Table in 49 *CFR* 172.10.

6.5.1.6 If the empty package is not hazardous waste itself, no manifest is required.

6.5.2 Low Specific Activity (LSA) and Surface Contaminated Object (SCO)

6.5.2.1 LSA material refers to Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limit set forth in 49 *CFR* 173.403. LSA must be in one of three groups: LSA-I, LSA-II, or LSA-III.

- **LSA-I:** (i) Uranium and thorium ores, concentrates of uranium and thorium ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides; or (ii) Solid unirradiated natural uranium, depleted uranium, natural thorium, or their solid or liquid compounds or mixtures; or (iii) Radioactive material other than fissile material, for which the A2 value is unlimited; or (iv) Other radioactive material, excluding fissile material in quantities not excepted under 49 *CFR* 173.453, in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the values for activity concentration specified in 49 *CFR* 173.436, or 30 times the default values listed in Table 8 of 49 *CFR* 173.433.
- **LSA-II:** (i) Water with tritium concentration up to 0.8 terabecquerels per liter (TBq/L) (20.0 curies per liter [Ci/L]); or (ii) Other radioactive material in which the activity is distributed throughout and the average specific activity does not exceed 10-4 A2/g for solids and gases, and 10-5 A2/g for liquids.
- **LSA-III:** Solids (e.g., consolidated wastes and activated materials), excluding powders, that meet the requirements of 49 *CFR* 173.468 and in which: (i) The radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.); (ii) The radioactive material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of Class 7 (radioactive) material per package by leaching when placed in water for seven days would not exceed 0.1 A2; and (iii) The estimated average specific activity of the solid, excluding any shielding material, does not exceed 2 × 10-3 A2/g.

6.5.2.2 SCO refers to a solid object which is not itself radioactive but which has radioactive material distributed on its surface. SCO exists in two phases:

- **SCO-I:** A solid object on which: (i) The non-fixed contamination on the accessible surface averaged over 300 square centimeters (cm^2) (or the area of the surface if less than 300 cm^2) does not exceed 4 becquerels per square centimeter (Bq/cm^2) (10-4 microcurie per square centimeter ($\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or 0.4 Bq/cm^2 (10-5 $\mu Ci/cm^2$) for all other alpha emitters; (ii) The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 × 104 Bq/cm^2 (1.0 $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or 4 × 103 Bq/cm^2 (0.1 $\mu Ci/cm^2$) for all other alpha emitters; and (iii) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 × 104 Bq/cm^2 (1 $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or 4 × 103 Bq/cm^2 (0.1 $\mu Ci/cm^2$) for all other alpha emitters.
- **SCO-II:** A solid object on which the limits for SCO-I are exceeded and on which: (i) The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 400 Bq/cm^2 (10-2 $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or 40 Bq/cm^2 (10-3 $\mu Ci/cm^2$) for all other alpha emitters; (ii) The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8 × 105 Bq/cm^2 (20 $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or 8 × 104 Bq/cm^2 (2 $\mu Ci/ cm^2$) for all other alpha emitters; and (iii) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8 × 105 Bq/cm^2 (20 $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or 8 × 104 Bq/cm^2 (2 $\mu Ci/cm^2$) for all other alpha emitters (49 *CFR* 173.403) (see Attachment 2).

6.5.2.3 Examples of shipping names for LSA and SCO, together with the Class and Identification Numbers as specified in 49 *CFR* 172.101, are as follows:

- Radioactive material, low specific activity, (LSA-I) non-fissile or fissile excepted, 7, UN2912
- Radioactive material, low specific activity, (LSA-II) non-fissile or fissile excepted, 7, UN3321

- Radioactive material, low specific activity, (LSA-III) non-fissile or fissile excepted, 7, UN3322
- Radioactive material, surface-contaminated objects (SCO-I or II) non-fissile or fissile excepted, 7, UN2913

6.5.2.4 Packaging for LSA and SCO (see 49 *CFR* 173.427), unless excepted by paragraph (c) or (d) of 49 *CFR* 173.427, must be packaged in accordance with paragraph (b) and must be transported in accordance with the following conditions:

- The external dose rate may not exceed a level of 10 mSv/hour (1 rem/hour) at 3 m from the unshielded material;
- The quantity of LSA and SCO material in a single conveyance may not exceed the limits specified in Table 5;
- LSA material and SCO that are or contain fissile material must conform to the applicable requirements of 49 *CFR* 173.453;
- Packaged and unpackaged Class 7 (radioactive) materials must conform to the contamination limits specified in 49 *CFR* 173.443;
- External radiation levels may not exceed those specified in 49 *CFR* 173.441;
- For LSA material and SCO consigned as exclusive use:
  - Shipments must be loaded by the consignor and unloaded by the consignee from the conveyance or freight container in which originally loaded:
  - There may be no loose radioactive material in the conveyance; however, when the conveyance is the packaging, there may not be any leakage or radioactive material from the conveyance;
  - Packaged and unpackaged Class 7 (radioactive) materials must be braced so as to prevent shifting of lading under conditions normally incident to transportation;
  - Specific instructions for maintenance of exclusive use shipment controls shall be provided by the offeror to the carrier. Such instructions must be included with the shipping paper information;
  - Except for shipments of unconcentrated uranium or thorium ores, the transport vehicle must be placarded in accordance with 49 *CFR* 172, Subpart F;
  - For domestic transportation only, packaged and unpackaged Class 7 (radioactive) materials containing less than an A2 quantity are excepted from the marking and

labeling requirements of 49 *CFR* 173.427. However, the exterior of each packaged or unpackaged Class 7 (radioactive) material must be stenciled or otherwise marked "RADIOACTIVE—LSA" or "RADIOACTIVE—SCO," as appropriate, and packaged or unpackaged Class 7 (radioactive) materials that contain a hazardous substance must be stenciled or otherwise marked with the letters "RQ" in association with the description in this paragraph (a)(6)(vi); and

- Transportation by aircraft is prohibited except when transported in an industrial package (IP) in accordance with Table 6 of 49 *CFR* 173.427, or in an authorized Type-A or Type-B package. Except as provided in paragraph (c) of 49 *CFR* 173.427, LSA material and SCO must be packaged as follows:
- In an IP (IP–1, IP–2 or IP–3); 49 *CFR* (173.411), subject to the limitations of Table 6 of 49 *CFR* 173;
- In a Department of Transportation (DOT) Specification 7A (49 *CFR* 178.350) of this subchapter) Type-A package;
- In any Type-B(U) or -B(M) packaging authorized pursuant to 49 *CFR* 173.416;
- In a packaging which meets the requirements of 49 *CFR* 173.24, 173.24a, and 173.410, but only for domestic transportation of an exclusive use shipment that is less than an A2 quantity.
- For exclusive use transport of liquid LSA-I only, in either: (i) Specification 103CW, 111A60W7 (49 *CFR* 173.31, and 49 *CFR* 179.201–1 to 179.201–11 of this subchapter) tank cars. Bottom openings in tanks are prohibited; or (ii) Specification MC 310, MC 311, MC 312, MC 331 or DOT 412 (49 *CFR* 178.348 or 49 *CFR* 178.337) cargo tank motor vehicles. Bottom outlets are not authorized. Trailer-on-flat-car service is not authorized.
- LSA material and SCO in groups LSA-I and SCO-I may be transported unpackaged under the following conditions:
- All unpackaged material, other than ores containing only naturally occurring radionuclides, shall be transported in such a manner that under normal conditions of transport there will be no escape of the radioactive contents from the conveyance nor will there be any loss of shielding;

- Each conveyance must be under exclusive use, except when only transporting SCO-I on which the contamination on the accessible and the inaccessible surfaces is not greater than 4.0 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters and 0.4 Bq/cm^2 for all other alpha emitters; and
- For SCO-I where it is suspected that non-fixed contamination exists on inaccessible surfaces in excess of the values specified in paragraph (c)(2) of 49 *CFR* 173.427, measures shall be taken to ensure that the radioactive material is not released into the conveyance or the environment.
- LSA and SCO that exceed the packaging limits specified in 49 *CFR* 173.427 must be packaged in accordance with 10 *CFR* 71.

6.5.2.5 Subject to regulatory limitations, packaging for LSA and SCO shipments may utilize strong tight containers, IPs, or bulk loading such as rail cars. In addition, LSA material and SCO in groups LSA-I and SCO-I may be transported unpackaged under the conditions cited in 49 *CFR* 173.427(c). Unless excepted from labeling by 49 *CFR* 173.421 through 49 *CFR* 173.427, each package must be labeled as specified in 49 *CFR* 172.403. Class 7 (radioactive) materials must generally be marked in accordance with 49 *CFR* 172.310, labeled in accordance with 49 *CFR* 172.403, and placarded pursuant to 49 *CFR* 172.504. Labels consist of Radioactive White-I, Radioactive Yellow-II, and Radioactive Yellow-III labels as specified in 49 *CFR* 172.436, 173.438, and 173.440, respectively. In addition, Fissile labels, as specified in 49 *CFR* 172.441, are to be used in accordance with requirements. Placards, as described in 49 *CFR* 172.556, will also be used as appropriate. In addition to the "Radioactive" placard, which may be required by 49 *CFR* 172.504(e), each transport vehicle, portable tank, or freight container that contains more than 1,001 pounds (lbs) or more gross weight of fissile or LSA uranium hexafluoride must also be placarded with a "CORROSIVE" placard. Placarding of other subsidiary hazards is addressed in 49 *CFR* 172.505.

6.5.2.6 Domestic shipments containing less than an A_2 quantity that are conducted as exclusive use are excepted from the marking and labeling requirements of 49 *CFR* 172. However, packaged and unpackaged materials must be marked with "RADIOACTIVE – LSA" or "RADIOACTIVE - SCO," as appropriate, and with "RQ" if the materials contain a hazardous material. In addition, unless the material is unconcentrated uranium or thorium ore, placards

are required for exclusive use shipments of LSA and SCO shipped in excepted packaging pursuant to 49 *CFR* 173.427(b)(4); liquid LSA-I material; or unpackaged LSA material or SCO.

6.5.2.7 Placards are required for exclusive use shipments of LSA and SCO materials, except shipments of unconcentrated uranium and thorium ores.

6.5.2.8 Packages for Type-A shipments must meet the "General Design Requirements" contained in 49 *CFR* 173.410; Industrial Packaging cited in 49 *CFR* 173.411; and "Additional design requirements for Type A packages" stated in 49 *CFR* 173.412. In addition, authorized Type-A and Type-B packages are addressed in 49 *CFR* 173.415 and 49 *CFR* 173.416, respectively.

6.5.2.9 Type-B packaging requirements are addressed in 49 *CFR* 173.13. These requirements include testing according to 49 *CFR* 178, "Specifications for Packagings for Class 7 (Radioactive) Materials," as well as the tests specified in 49 *CFR* 173.465, "Type A packaging tests," and 49 *CFR* 173.466, "Additional tests for Type A packagings designed for liquids and gasses." The shipper must demonstrate compliance with the criteria. Methods for this are provided in 49 *CFR* 173.461, "Demonstration of compliance with tests." Compliance can be demonstrated by actual testing, testing with models, reference to other similar tests, calculations, or reasoned evaluation using conservative procedures. Documentation of compliance must be retained on file for at least one year after the last shipment. Note that the documentation must show compliance for the package and the contents, not just the package.

6.5.2.10 LSA-III Class 7 (radioactive) material must meet the test requirement of Paragraph (b), 49 *CFR* 173.468, "Test for LSA-III material."

6.5.2.11 In addition to other markings, radioactive materials are subject to the following package marking requirements (see 49 *CFR* 172.310, 173.471(b), 173.472(c), 173.473(b) and 178.3):

- Gross weight if above 50 kilograms (kg) (110 lb);
- "TYPE IP-1," "TYPE IP-2," "TYPE IP-3," "TYPE-A," "TYPE-B(U)," or "TYPE-B(M)" as appropriate to the package;
- For each IP-1, IP-2, IP-3, or Type-A package, the code for the country of origin of design (e.g., "USA");
- For each DOT 7A Type-A packaging: "USA DOT 7A TYPE-A" and the name of packaging manufacturer (the

person certifying that the package meets all requirements for a Type-A package);

- For Type-B packages, the trefoil radiation symbol - resistant to the effects of fire and water, plainly marked by embossing, stamping or other means resistant to the effects of fire and water (not on a sticky label);
- For Type-B and fissile material packages, the applicable DOT, NRC or DOE package certificate ID number, as specified in the relevant certificate, e.g., USA/9166/B(U)-85; and
- Exclusive use domestic transportation of LSA materials and SCO is excepted from other marking requirements but must be stenciled or marked as "RADIOACTIVE – LSA" or "RADIOACTIVE – SCO," as appropriate.
- Excepted packages are exempt from other marking requirements but must be marked with the UN identification number for the material.

6.5.3 Labeling

Labeling requirements are stated in 49 *CFR* 172, Subpart E – "Labeling." Labeling requirements for radioactive material are stated in 172.403, "Class 7 (radioactive) material." Three kinds of labels are used for packages containing radioactive materials: White-I, Yellow-II, and Yellow-III. Two labels must be placed on each package, on opposite sides of the package. The TR will enter the radionuclides and the transport index (TI) on the labels based on information from health physics staff and will place the labels on the package. Labels are selected based on the TI and the radiation level at the surface of the package. The TI is determined (for non-fissile packages) as the "number determined by multiplying the maximum radiation level in milliSievert(s) per hour at one meter (3.3 feet) from the package by 100...." This is the exposure rate in mrem/hour at 1 m. To select the label, select the most restrictive condition from the following table:

Transport Index	Maximum Radiation Level at Any Point on the External Surface	Label Category[a]
Zero (Less than 0.05)[b]	Less than or equal to 0.005 mSv/hour (0.5 mrem/hour)	White-I
More than zero, but not more than 1	Greater than 0.005 mSv/hour (0.5 mrem/hour, but less than or equal to 0.5 mSv/hour (50 mrem/hour)	Yellow-II
More than 1, but not more than 10	Greater than 0.5 mSv/hour (50 mrem/hour) but less than or equal to 2 mSv/hour (200 mrem/hour)	Yellow-III
More than 10	Greater than 2 mSv/hour (200 mrem/hour) but less than or equal to 10 mSv/hour (1,000 mrem/hour)	Yellow-III (Must be shipped under exclusive use provisions; see 173.441(b))

[a] Any package containing a "highway route controlled" quantity (49 *CFR* 173.403) must be labeled as "RADIOACTIVE YELLOW-III."

[b] If the measured TI is not greater than 0.5, the value may be considered to be zero.

6.6 Shipping

6.6.1 Materials containing radionuclides for which either the activity concentration or the total activity in the consignment are below the values specified in the table in 49 *CFR* 173.436 are not defined as a radioactive material for the purposes of transport but may still be radioactive for the purposes of possession or disposal. The determination for materials shipped via airfreight or for foreign destination shall be made according to the limitations of HP-51, "Limited Quantity Radioactive Material Shipping."

6.6.2 Shipping Documentation

6.6.2.1 Every shipment of radioactive material must be documented. The following records are required. The shipper shall maintain a shipping log to record each shipment and will assign a unique log number. The shipper should maintain checklists for each shipment. See the attachments for shipping checklists. Documentation of package certification shall be maintained for at least one year following the shipment.

6.6.2.2 Copies of the package surveys and truck surveys shall be maintained with the shipment documentation.

6.6.2.3 A loading diagram showing the package number(s) and placement on the vehicle shall be maintained with the shipment documentation.

6.6.2.4 Certification that the shipment meets the requirements for transportation shall be maintained. These requirements are described as follows.

6.6.3 Shipping Papers

6.6.3.1 Requirements in the regulations for shipping papers are contained in 49 *CFR* 172, Subpart C, 172.200–172.205. The principal shipping paper will be either a bill of lading or a waste shipping manifest.

6.6.3.2 Shipping papers must have the 24-hour emergency response phone number for use in an emergency involving the shipment of hazardous material. See 49 *CFR* 172.604, "Emergency Response Telephone Number," for details regarding use of this number on the shipping papers and the requirements for the person(s) who may be contacted.

6.6.3.3 Hazardous materials, including radioactive materials, must be identified using the proper shipping names listed in the hazardous materials table, 49 *CFR* 172.101.

6.6.3.4 Hazardous materials must be entered first on the shipping papers if other kinds of materials are included on the documents.

6.6.3.5 The hazardous material must be identified with an "X" in the hazardous materials column on the bill of lading or manifest. If the quantity of material is a reportable quantity, use "RQ" instead of "X" in the hazardous materials column. The list of RQs for all radionuclides is contained in 49 *CFR* 171.101, "List of Hazardous Substances and Reportable Quantities," Table 2 – "Radionuclides."

6.6.3.6 Show the label (i.e., Radioactive White-I, Yellow-II or Yellow-III) used on the package on the shipping papers.

6.6.3.7 If the shipment is exclusive use, place "Exclusive Use Shipment" on the shipping papers and have the carrier representative initial the receipt of the written instructions.

6.6.3.8 If the shipment is of LSA or SCO materials, place the appropriate group notation of LSA-I, LSA-II, LSA-III, SCO-I, or SCO-II on the shipping papers.

6.6.3.9 Shippers must certify that the shipment is prepared according to the regulations of 49 *CFR*. The certification must say:

6.6.3.10 "This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

6.6.3.11 Shipping paper pages must be numbered with the page number and number of pages, (e.g., Page 1 of 4).

6.6.3.12 The shipping papers required for a shipment are listed on the attached checklists for different kinds of radioactive material shipments.

6.6.3.13 Regarding shipment paperwork for exclusive use shipments, provide written instructions for maintenance of the exclusive use shipment controls (see Attachment 8) to the carrier. Include the instructions with the shipping papers (49 *CFR* 173.427 (a)(6)(iv)). Have the carrier representative (driver or railroad conductor) acknowledge the exclusive use instruction by initialing a notation on the shipping papers. Uniform Low-Level Radioactive Waste Manifest NRC Form 540, "Shipping Paper and Continuation Page," must be completed and provided to the carrier with the shipping papers. A copy is sent to the consignee. NRC Form 541, "Container and Waste Description," lists the contents of each container in detail. It must be forwarded to the consignee. It may be transmitted in electronic form (i.e., LowTrack). Radioactive Material, Type-A Shipments (see Attachment 3) limiting quantities of normal form and special form radioactive materials are found in 49 *CFR* 173.435, Table of A_1 and A_2 values for radionuclides. If shipping a mixture of nuclides, the fraction of the limit for each of the nuclides must be summed. The sum must be less than 1.0. The methods for performing the sum of fractions are provided in 49 *CFR* 173.433.

6.6.3.14 The shipping paper requirements for airfreight shipment are contained in the International Air Transport Association's (IATA's), "Dangerous Goods Regulations." The shipping paper requirements for shipment by vessel (water) are contained in the International Maritime Associated Dangerous Goods Code.

6.6.3.15 All Leidos hazardous material shipping papers require review and approval by Corporate Environmental, Health, and Safety (EHS) prior to release of the shipment.

6.6.3.16 Hazardous Waste Manifest (49 *CFR* 172.205)

- A Uniform Low-Level Radioactive Waste Manifest must be prepared for each waste shipment (49 *CFR* 172.205, "Hazardous waste manifest"). (See also 10 *CFR* 20.2006, "Transfer for Disposal and Manifests.") Complete instructions for preparing the Uniform Low-Level Radioactive Waste Manifest are contained in NUREG/BR-0204, "Instructions for Completing the NRC's Uniform Low-Level Radioactive Waste Manifest," Revision 2, which is published and distributed by the NRC. This document discusses in detail the

requirements for completing NRC Form 540 (Uniform Low-Level Radioactive Waste Manifest – Shipping); NRC Form 541 (Uniform Low-Level Radioactive Waste – Container); and NRC Form 542 (Uniform Low-Level Radioactive Waste Manifest – Manifest Index and Regional Compact Tabulation). Copies of forms can be downloaded from the internet or obtained from the NRC.

No person may offer, transport, transfer, or deliver a hazardous waste (waste) unless an EPA Form 8700–22 and 8700–22A (when necessary) hazardous waste manifest (manifest) is prepared in accordance with 40 *CFR* 262.20 and is signed, carried, and given as required of that person. The shipper (generator) shall prepare the manifest in accordance with 40 *CFR* 262.

The original copy of the manifest must be dated by, and bear the handwritten signature of, the person representing:

- The shipper (generator) of the waste at the time it is offered for transportation, and
- The initial carrier accepting the waste for transportation;

- A copy of the manifest must be dated by, and bear the handwritten signature of, the person representing:
  - Each subsequent carrier accepting the waste for transportation, at the time of acceptance, and
  - The designated facility receiving the waste, upon receipt.
- A copy of the manifest bearing all required dates and signatures must be:
  - Given to a person representing each carrier accepting the waste for transportation,
  - Carried during transportation in the same manner as required by this subchapter for shipping papers,
  - Given to a person representing the designated facility receiving the waste,
  - Returned to the shipper (generator) by the carrier that transported the waste from the United States to a foreign destination with a notation of the date of departure from the United States, and
  - Retained by the shipper (generator) and by the initial and each subsequent carrier for three years from the date the waste was accepted by the initial carrier. Each retained copy must bear all required signatures and dates up to and

including those entered by the next person who received the waste.

- All Leidos hazardous waste manifests require prior review and approval of the shipping paperwork by Corporate EHS prior to release of the shipment.
- Provide the driver and the consignee with the instructions for maintaining exclusive use while in transit.
- Placarding requirements apply for Yellow-III labeled shipments, for LSA, and for SCO.
- Placarding requirements are contained in 49 *CFR* 172, Subpart F, "Placarding" (172.500-172.560).
- "RADIOACTIVE" placards are required on each end and on each side of conveyances of exclusive use LSA or SCO shipments and for shipments with Yellow-III labels. Placards must be supplied by the shipper. Placards may be on the front of the trailer, the front of the tractor, or both. The shipper must install the placards on railroad shipments. The railroad may have to provide buffer cars between cars placarded "RADIOACTIVE' and any other occupied railcar(s).

6.6.4 Shipping Radioactive Materials to Other Licensees

6.6.4.1 Shipping radioactive materials is covered under 49 *CFR* 171–174. Part 173, "Shippers – General Requirements for Shipments and Packagings," Subpart I, "Radioactive Materials," covers most of the requirements for packaging and shipping radioactive materials. General requirements that cover shipping all hazardous materials are covered in the other sections and subparts.

6.6.4.2 Before shipping radioactive materials, the shipper must obtain written evidence in the form of a certification letter or a copy of the recipient's NRC or Agreement State license documenting that the recipient is authorized to possess the radionuclides and quantities proposed for delivery.

6.6.4.3 All radioactive wastes being shipped to a waste disposal site must be documented using a uniform Low-Level Radioactive Waste Manifest. Detailed instructions for completing the waste manifest are contained in NUREG/BR-0204, "Instructions for Completing NRC'S Uniform Low-Level Radioactive Waste Manifest."

6.6.4.4 When shipping hazardous materials listed in 49 *CFR* 172.101, "Hazardous Materials Table," the requirements applicable to both radioactivity and other hazards apply.

6.6.4.5 Waste must be appropriately characterized, and a waste profile developed. The waste profile will be provided to the disposal site to demonstrate that, based on information contained in the waste profile, the wastes comply with the site Waste Acceptance Criteria (WAC). Upon documentation that the wastes comply with the WAC, disposal authorization will be provided by the disposal site.

6.6.4.6 Radiological surveys shall be performed in accordance with HP-52, "Shipping and Receipt Surveys."

6.6.4.7 For non-exclusive use shipments, the number of packages in the conveyance must be limited so that the total transport index (TI) (sum of the individual package TIs) does not exceed 50. Where a consignment is transported under exclusive use, there is no limit on the sum of the TIs aboard a single conveyance.

6.6.4.8 The TR shall ensure that the material being shipped is appropriately packaged, marked and labeled in accordance with 49 *CFR* and 10 *CFR* 71, as applicable, prior to the package(s) being loaded into the conveyance. General packaging requirements are presented in Attachment 11, "General Packing Requirements." In addition, the TR will verify that the vehicle is properly placarded.

6.6.4.9 When loading exclusive use closed transport vehicles, care must be exercised to maintain the vehicle exterior dose rate readings to within the vehicle radiation level limits. Packages being shipped with lesser radiation readings may be used to shield higher radiation readings such that dose rates on the exterior of the vehicle are compliant with both regulatory requirements and guidance applicable to maintaining doses at levels that are "as low as reasonably achievable" (ALARA).

6.6.4.10 Packages must be secured in the vehicle so as to prevent the shifting of loads under conditions normally incident to transport. Packages must also be positioned to minimize the potential dose to the driver and to transportation workers, and to balance the load to the most practical extent.

6.6.5 Post-Shipment Actions

When written confirmation of receipt of the shipment is received from the consignee, log the date of receipt in the Radioactive Shipment Log and place the written notification in the shipment file.

6.6.5.1 If written notification of receipt of a waste shipment has not been received within 20 days of the shipment date, contact the consignee's facility and determine the status of the shipment.

6.6.5.2 If the shipment has been received at the consignee's facility, arrange to obtain written notification of shipment receipt and so note in the Radioactive LSA Shipment Log. No further actions are required.

6.6.5.3 If the shipment has not been received at the consignee's facility, do the following:

6.6.5.4 Notify the Project Manager of a reportable event, in accordance with 10 *CFR* 20, Appendix G – "Requirements for Transfers of Low-Level Waste Intended for Disposal at Land Disposal Facilities and Manifests."

6.6.5.5 Investigate in accordance with 10 *CFR* 20, Appendix G, and document the investigation. The investigation must include:

- Tracing and locating the shipment.
- Determining the cause of the failure of the shipment to reach the consignees facility in a timely manner.
- Any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section must:
  - Be investigated by the shipper if the shipper has not received notification or receipt within 20 days after transfer; and
  - Be traced and reported. The investigation shall include tracing the shipment and filing a report with the nearest NRC Regional Office. Each licensee who conducts a trace investigation shall file a written report with the appropriate NRC Regional Office within 2 weeks of completion of the investigation (10 *CFR* 20, Appendix G).

6.7 Radioactive Material Transportation

6.7.1 Carriage by Rail

The requirements for carriage by rail are included in 49 *CFR* 174, "Carriage by Rail." Relevant subparts are as follows: "General Requirements" (40 *CFR* 174, Subpart A); "General Operating Requirements" (49 *CFR* 174, Subpart B); "General Handling and Loading Requirements" (49 *CFR* 174, Subpart C); and "Detailed Requirements for Class 7 (Radioactive) Materials" (49 *CFR* 174, Subpart K).

This covers the requirement to comply with the other parts of 49 *CFR*, inspection of the load on acceptance, expedited movement, and disposition at the destination.

49 *CFR* 174, Subpart B – General Operating Requirements

As with highway transportation, shipping papers are required. Train crews must be notified of the position of the car containing the hazardous material in the train. The crew must have a copy of the manifest and bill of lading. Leaking packages must be repaired before they may be forwarded.

49 *CFR* 174, Subpart C – General Handling and Loading Requirements

Hazardous materials in packages loaded into freight containers must be braced and blocked so they cannot fall or slide. Contamination leaking onto cars or railroad property must be removed. Packages, freight cars, and freight containers must be properly marked and placarded.

49 *CFR* 174, Subpart K - Detailed Requirements for Class 7 (Radioactive) Materials

LSA and SCO shipments must be loaded into rail cars without spilling. (See 49 *CFR* 174.700, "Special handling requirements for Class 7 (radioactive) materials." Activity limits based on TI and labeling are provided as for highway shipments. Radiation levels are prescribed for adjacent cars or occupied areas of 0.02 mSv/hour (2 mrem/hour) in any normally occupied position or adjacent rail car, as for truck cabs. Occupationally exposed hazardous materials (HAZMAT) railroad workers must be under a radiation protection program. Exclusive use rail cars must be surveyed prior to release by the consignee in the same manner as described for trucks.

6.7.2 Carriage by Aircraft

Requirements are contained in 49 *CFR* 175, with "Specific Regulations Applicable According to Classification of Material," contained in 49 *CFR* 175, Subpart C. Specific portions of interest include 49 *CFR* 175.700, "Special limitations and requirements for Class 7 materials;" 49 *CFR* 175.701, "Separation distance requirements for packages containing Class 7 (radioactive) materials in passenger-carrying aircraft;" 49 *CFR* 175.702, "Separation distance requirements for packages containing Class 7 (radioactive] materials in cargo aircraft;" 49 *CFR* 175.703, "Other special requirements for the acceptance and carriage of packages containing Class 7 materials;" 49 *CFR* 175.704, "Plutonium shipments;" 49 *CFR* 175.705, "Radioactive contamination;" and 49 *CFR* 175.706, "Separation Distances for undeveloped film from packages containing Class 7 (radioactive) materials".

No package shipped by airfreight (49 *CFR* 175.700) may have a TI that exceeds 3.0 (49 *CFR* 173.448(e)). Radioactive material in passenger air transportation is limited to material that is intended for use in, or incident to, research, medical diagnosis, or treatment (49 *CFR* 173.448). Otherwise, it shall be shipped via air-cargo only and be labeled appropriately. For

radioactive material shipped via the U.S. Mail, the package contents must not exceed 10 percent of the LQ amount. The shipment must be described on the "Shippers Declaration for Dangerous Goods."

6.7.3 Carriage by Vessel

Requirements for Class 7 (radioactive) materials are contained in 49 *CFR* 176, with "Detailed Requirements for Radioactive Material," contained in 49 *CFR* 176, Subpart M.

6.7.4 Carriage by Public Highway

The requirements for carriage by public highway are covered in 49 *CFR* 177, "Carriage by Public Highway." "General Information and Regulations" are addressed in 49 *CFR* 177, Subpart A; with "Loading and Unloading" being addressed in 49 *CFR* 177 Subpart B; Subpart C being "Segregation and Separation Chart of Hazardous Materials"; Subpart D being Vehicles and Shipments in Transit; and Subpart E addressing hazardous materials in vehicles which carry passengers for hire. With respect to the requirements of loading, the radioactive materials being shipped must be secured against movement within the vehicle. In addition, the requirements for segregation and separation of radioactive materials are specified in 49 *CFR* 177.842, "Class 7 (radioactive) material." Numbers of Yellow-II and Yellow-III labeled packages are limited, as are the distances to people, animals, and photographic film. This section also covers the acceptable exposure rates for occupied locations in exclusive use motor vehicles. It provides for using closed motor vehicles for exclusive use with packages with external radiation levels greater than 2 mSv/hour (200 mrem/hour). In addition, the radiological limits for exclusive use vehicles are specified in 49 *CFR* 177.843, "Contamination of Exclusive Use Vehicles." This section requires surveys and decontamination as necessary prior to putting the vehicle back into service.

Requirements and special conditions for vehicles used solely for transporting radioactive material are specified in 49 *CFR* 177.843. Special "For Radioactive Materials Use Only" marking is required, and the vehicle must be kept closed. Somewhat higher dose rates are also permitted (0.1 mSv/hour [10 mrem/hour]).

6.8 Emergency Response for Radioactive Materials Shipments

Emergency response requirements for shippers of radioactive materials are contained in 49 *CFR* 172, Subpart G, 172.600–172.606. Section 172.600 requires shippers to provide emergency response information on hazardous materials shipments. The regulation applies to any shipment of a hazardous material that is required to have shipping papers. Shipments of excepted radioactive material packages (packages containing limited quantities, instruments or articles, or "Empty" packagings) are excepted from shipping paper requirements and are therefore not subject to the emergency response information requirements unless they contain a hazardous substance.

The information required for emergency response includes the phone number of the site from which the shipment originated and the phone number from which emergency information can be obtained (within 15 minutes). This number is placed on the shipping papers.

Additional information that must be available is contained in the DOT "Emergency Response Guidebook" for the material being shipped. A copy of the information on the applicable page from this book should be made available to the driver. These pages are listed on the checklists.

The following Emergency Response Guides apply to Class 7 (radioactive) materials that could be shipped:

UN Number	Emergency Response Guide	UN Number	Emergency Response Guide
2908	161	2916	163
2910	161	2917	163
2911	161	2918	165
2912	162	2919	163
2913	162	3321	162
2915	163	3322	162

Immediate Notice of Certain Hazardous Material Incidents (49 *CFR* 171.15)

As soon as practical, but no later than 12 hours after the occurrence of any incident described below, each person in physical possession of hazardous materials must provide notice by telephone to the DOT's National Response Center at 800-424-8802 (toll free) or 202-267-2675 (toll call), or online at: *http://www.nrc.uscg.mil*. Each notice must include the following information:

(1) Name of reporter;

(2) Name and address of person represented by the reporter;

(3) Phone number where the reporter can be contacted;

(4) Date, time, and location of incident;

(5) The extent of injury, if any;

(6) Class or division, proper shipping name, and quantity of hazardous materials involved, if such information is available; and

(7) Type of incident and nature of hazardous material involvement, and whether a continuing danger to life exists at the scene.

A telephone report is required whenever any of the following occurs during the course of transportation in commerce (including loading, unloading, and temporary storage). These characteristics describe a *Reportable Incident*:

- As a direct result of a hazardous material—
  - A person is killed;
  - A person receives an injury requiring admittance to a hospital;

- The general public is evacuated for one hour or more;
- A major transportation artery or facility is closed or shut down for one hour or more; or
- The operational flight pattern or routine of an aircraft is altered.

- Fire, breakage, spillage, or suspected contamination occurs involving a radioactive material (see also 49 *CFR* 176.48);
- A situation exists of such a nature (e.g., a continuing danger to life exists at the scene of the incident that, in the judgment of the person in possession of the hazardous material, it should be reported to the National Response Center even though it does not meet the criteria defined in 49 *CFR* 171.15; or
- During transport by aircraft, a fire, violent rupture, explosion, or dangerous evolution of heat occurs as a direct result of a battery or battery-powered device.
- Written report. Each person making a report under 49 *CFR* 171.15 must also make the report required by 49 *CFR* 171.16.

  Note that under 40 *CFR* 302.6, the EPA requires persons in charge of facilities (including transport vehicles, vessels, and aircraft) to report any release of a hazardous substance in a quantity equal to or greater than its reportable quantity, as soon as that person has knowledge of the release. Such reports are to be made via telephone to the National Response Center phone numbers cited previously. In addition, Leidos personnel must be aware that the reports noted herein are in addition to any "Reports" or "Records" mandated by 10 *CFR* 20, Subparts M and L, respectively.

7.0 Records

7.1.1 All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate electronic record system.

7.1.2 Maintain the following records for the radioactive material shipping program:

7.1.2.1 Retain records of surveys for three years as required by 10 *CFR* 20.2103, "Records of Surveys."

7.1.2.2 Maintain copies of all shipping papers generated for all shipments and a listing of the different papers sent or delivered to the carrier or to the disposal or processing company.

7.1.2.3 Retain documentation of calculations of quantities of material and concentrations, and package calculations for IP and Type-A packages.

7.1.2.4 Retain records of any certification for Type-A packages used or certified for use under this procedure for at least one year following the latest packaging use.

7.1.2.5 Retain records for Type-B package use and maintenance for packages used under this procedure for at least one year following the latest packaging use.

7.1.2.6 Maintain records of waste manifests, continuation sheets, and container and waste description sheets.

7.1.2.7 Retain records and reports about any accidents occurring to shipments originating at the site, and retain records and reports of investigations of shipments that were not acknowledged as received in a timely manner.

CHECKLIST FOR SHIPPING EMPTY PACKAGES

SHIPPING NAME:	Radioactive Material, excepted package-empty packaging, 7, UN 2908
PACKAGING:	The package must be empty and tightly closed. The package can be a Type-A, Type-B, IP, or Strong Tight.
CONTAMINATION:	External contamination: 40 Bq/100 cm^2 (2,200 dpm/100 cm^2) beta-gamma, and 4.0 Bq/100 cm^2 (220 dpm/100 cm^2) alpha
RADIATION:	External radiation no greater than 0.005 mSv/hour (0.5 mrem/hour)
MARKING:	None
LABELS:	Empty label covering any old labels
PLACARDS:	None required
ACTIVITY:	Internal activity less than 4,000 Bq/100 cm^2 (220,000 dpm/100 cm^2) beta-gamma or 400 Bq/100 cm^2 (22,000 dpm/100 cm^2) alpha.
PAPERWORK:	Requires certificate per 173.422, "Additional requirements for excepted packages containing Class 7 (radioactive) materials" in the package, on the package, or with the shipment:

"This package conforms to the conditions and limitations specified in 49 *CFR* 173.428 for radioactive material, excepted package - empty packages, UN2908."

EMERGENCY RESPONSE GUIDEBOOK GUIDE NO.: 161

CHECKLIST FOR LSA OR SCO

SHIPPING NAME: Radioactive Material, Low Specific Activity, (LSA-I) non-fissile or fissile exempt, 7, UN 2912, or

Radioactive Material, Low Specific Activity, (LSA-II), non-fissile or fissile exempt, 7 UN 3321, or

Radioactive Material, Low Specific Activity, (LSA-III), non-fissile or fissile exempt, 7, UN 3322, or

Radioactive Material, Surface Contaminated Object, (SCO-I or II), 7, UN 2913.

PACKAGING: Strong tight package for domestic exclusive use shipments.

Type-A or IP for non-exclusive use shipments.

If $>A_2$, an IP or a Specification 7A package must be used.

See 49 *CFR* 173.411 for "Industrial Packagings;" 49 *CFR* 173.427 for transport requirements for LSA and SCO; and Tables 5 and 8 for "Conveyance Activity Limits for LSA Material and SCO" and "General Exemption Values," respectively.

Table 8. Industrial Package Integrity Requirements for LSA Material and SCO (49 *CFR* 173.411 and 173.427)

Contents	Industrial Packaging Type	
	Exclusive Use Shipment	Nonexclusive Use Shipment
LSA-I:		
Solid	IP-1	IP-1
Liquid	IP-1	IP-2
LSA-II:		
Solid	IP-2	IP-2
Liquid and Gas	IP-2	IP-3
LSA-IIII	IP-2	IP-3
SCO-I	IP-1	IP-1
SCO-II	IP-2	IP-2

CONTAMINATION: 40 Bq/100 cm^2 (2,200 dpm/100 cm^2) beta-gamma, and 4.0 Bq/100 cm^2 (220 dpm/100 cm^2) alpha. During transit, the removable contamination can exceed these values by not greater than a factor of 10.

PACKAGE RADIATION: Exclusive Use (Open vehicle): Up to 2 mSv/hour (200 mrem/hour), no TI limit.

Exclusive Use (Closed vehicle): Up to 10 mSv/hour (1,000 mrem/hour), no TI limit.

Non-Exclusive Use: Up to 2 mSv/hour (200 mrem/hour), up to 10 TI.

MARKING: Exclusive Use, domestic non-bulk package: "RADIOACTIVE LSA" or "RADIOACTIVE SCO."

Non-exclusive use: Use same markings as for radioactive material.

"RQ" for non-bulk packages with greater than RQ quantities.

LABELS: Exclusive use, domestic shipment: None.

Non-exclusive use: White-I, Yellow-II, or Yellow-III.

LOADING AND BRACING AND UNLOADING:

Loaded by consigner. Properly braced to prevent shifting during transit. Unloaded by consignee.

PLACARDS: Radioactive placard required for exclusive use shipments or shipments with Yellow-III labels.

ACTIVITY: Exclusive use domestic shipment in strong tight package: Not greater than A_2. See 173.427, Table 9:

CONVEYANCE DOSE RATES: < 2 mSv/hour (< 200 mrem/hour) at contact,

< 0.02 mSv/hour (< 2 mrem/hour) in the cab, and

< 0.1 mSv/hour (< 10 mrem/hour) at 2 meters from the conveyance.

Table 5. Conveyance Activity Limits for LSA Material and SCO (49 *CFR* 173.411 and 49 *CFR* 173.427)

Nature of Material	Activity Limit for Conveyances
LSA-I	No limit
LSA-II and LSA-III; noncombustible solids	No limit
LSA-II and LSA-III; Combustible solids and all liquids and gases	100 A_2
SCO	100 A_2

PAPERWORK: Manifest for waste, Surveys of truck after loading, Surveys of packages, package certifications, and activity and concentration calculations

EMERGENCY RESPONSE GUIDEBOOK GUIDE NO.: 162

CHECKLIST FOR NORMAL CLASS 7 RADIOACTIVE MATERIAL

SHIPPING NAME:	Radioactive Material, Type A Package, non-special form, non-fissile or fissile-excepted, 7, UN 2915.
PACKAGING:	Type A when package activity is not more than A_1 for special form material or A_2 for normal form material. Type B when package activity is greater than A_1 or A_2 depending on the form.
CONTAMINATION:	0.4 Bq/cm^2 (2,200 dpm/100 cm^2) beta-gamma 0.04 Bq/cm^2 (220 dpm/100 cm^2) alpha
RADIATION:	Radioactive White-I label: Surface: Less than or equal to 0.005 mSv/hour (0.5 mrem/hour) Transport Index: 0 (< 0.05 mrem/hour at 1 m) Radioactive Yellow-II label: Surface: Over 0.005 mSv/hour (0.5 mrem/hour) and not over 0.5 mSv/hour (50 mrem/hour) Transport Index: Over 0 but not over 1 Radioactive Yellow-III label not exclusive use: Surface: Over 0.5 mSv/hour (50 mrem/hour) but not over 2 mSv/hour (200 mrem/hour) Transport Index: Over 1 but not over 10. Surface, exclusive use, open vehicle: Up to 2 mSv/hour (200 mrem/hour), no TI limit Surface, exclusive use, closed vehicle: Up to 10 mSv/hour (1,000 mrem/hour), no TI limit
MARKING:	RQ with packages with reportable quantity Proper shipping name and UN number for non-bulk packages Consignor's name and address and consignee's name and address if the package is shipped non-exclusive use Package gross weight if over 110 lbs Package type, either Type A or Type B
LABELS:	Radioactive White-I, or Yellow-II, or Yellow-III
PLACARDS:	Required for any shipment with a Yellow-III label
ACTIVITY:	Up to A_1 for a Type A package of special form, or Up to A_2 for a Type A package of normal form, or No limit for a Type B package where the limit depends on the package size, weight capacity and shielding capacity
PAPERWORK:	All shipping papers as required by 49 *CFR*

EMERGENCY RESPONSE GUIDEBOOK GUIDE NO.: 163

CHECKLIST FOR SPECIAL FORM RADIOACTIVE MATERIAL

SHIPPING NAME:	Radioactive Material, Type A package, Special Form, non-fissile or fissle-excepted, 7, UN 3332
PACKAGING:	Type-A when package activity is not more than A_1 for special form material. Type B when package activity is greater than A_1 Type-B when package activity is greater than A_1
CONTAMINATION:	0.4 Bq/cm^2 (2,200 dpm/100 cm^2) beta-gamma 0.04 Bq/cm^2 (220 dpm/100 cm^2) alpha
RADIATION:	Radioactive White-I label: Surface: Less than or equal to 0.005 mSv/hour (0.5 mrem/hour) Transport Index: 0 (< 0.05 mrem/hour at 1 m) Radioactive Yellow-II label: Surface: Over 0.005 mSv/hour (0.5 mrem/hour) and not over 0.5 mSv/hour (50 mrem/hour) Transport Index: Over 0 but not over 1 Radioactive Yellow-III label not exclusive use: Surface: Over 0.5 mSv/hour (50 mrem/hour) but not over 2 mSv/hour (200 mrem/hour) Transport Index: Over 1 but not over 10. Surface, exclusive use, open vehicle: Up to 2 mSv/hour (200 mrem/hour), no TI limit Surface, exclusive use, closed vehicle: Up to 10 mSv/hour (1,000 mrem/hour), no TI limit
MARKING:	RQ with packages with reportable quantity Proper shipping name and UN number for non-bulk packages Consignor's name and address and consignee's name and address if the package is shipped non-exclusive use Package gross weight if over 110 lbs Package type, either Type A or Type B
LABELS:	Radioactive White-I, or Yellow-II, or Yellow-III

PLACARDS:	Required for any shipment with a Yellow-III label
ACTIVITY:	Up to A_1 for a Type A package of special form, or
	No limit for a Type B package where the limit depends on the package size, weight capacity and shielding capacity
PAPERWORK:	All shipping papers as required by 49 *CFR*
DOCUMENTATION OF SPECIAL FORM:	Provide documentation that the material meets the requirements of special form radioactive material.

EMERGENCY RESPONSE GUIDEBOOK GUIDE NO.: 164

CHECKLIST FOR GENERAL DESIGN REQUREMENTS FOR RADIOACTIVE SHIPMENT PACKAGES

1. _____ Easily handled?
2. _____ Properly secured?
3. _____ Lifting attachments designed with safety factor of 3?
4. _____ Other potential lifting fittings disabled?
5. _____ External surface free from protruding features?
6. _____ Surface easily decontaminated?
7. _____ No pockets or crevices where water can collect?
8. _____ Added features do not reduce safety?
9. _____ Package can withstand acceleration, vibration, and resonance under normal conditions of transportation?
10. _____ Materials of construction are compatible?
11. _____ Valves protected against unauthorized operation?

GUIDELINES FOR EXCLUSIVE USE VEHICLE INSPECTIONS

Shipment No.: _____ Shipment Date: _____

Carrier: _____ Driver's Name: _____

Tractor Number: _____ Trailer Number: _____

Tractor License No./State _____ Trailer License No./State _____

Trailer Type: ___Van, ___Open Top Van, ___Flatbed, ___Other: _____

INCOMING/OUTGOING INSPECTION CHECKLIST

INSPECTION CHECKS		SAT	UNSAT
1.	Front tire tread: At least 4/32" tread (No recaps)	___	
2.	Other tire tread: At least 3/32" tread	___	
3.	Service brakes: Good condition and properly attached	___	
4.	Parking brake: Operational and on while loading	___	
5.	Steering mechanism: Demonstrated operational	___	
6.	Headlights and front reflectors: Clean and operational	___	
7.	Windshield wipers: Demonstrated operational	___	
8.	Rear vision mirrors: one on each side	___	
9.	Horn: Demonstrated operational	___	
10.	Fire extinguisher: Fully charged	___	
11.	Trailer frame and headboard: Free of visible defects		___
12.	Load tiedowns: Adequate number for load and in good condition	___	
13.	Extra placards	___	
14.	Brake lights: Demonstrated operational	___	
15.	Turn signals: Demonstrated operational	___	
16.	Tail Lights: Demonstrated operational	___	
17.	Reflectors: At proper locations on trailer	___	

Inspected By:_____ Date:_____

CHECKLIST FOR RADIOACTIVE LSA OR SCO SHIPMENTS

Shipment Number: _____ Date: _____

1. ____ Verify consignee's license is:

   ____ a. Current

   ____ b. On file

   ____ c. Appropriate for materials being shipped.

2. ____ Verify each package to be shipped has been:

   ____ a. Packaged according to (Procedure for packaging wastes) and documentation is available.

   ____ b. Quantified according to (Procedure for radioactive material calculations.)

   c. Classified according to (Procedure for waste classification sampling, analysis and reporting.)

   ____ d. Marked "Radioactive-LSA" or "Radioactive-SCO"

   ____ e. Marked "RQ," if package contains more than a Reportable Quantity.

   f. Surveyed for radiation and contamination and acceptable for the mode of transportation.

   ____ g. Marked with container number.

   ____ h. Marked with weight.

3. ____ Is container licensed?; ___NO. If ___ YES, verify:

   ____ a. Site is a registered user of container.

   ____ b. Receipt facility is a registered user of the container.

   ____ c. Certificates of compliance for container and referenced documents are available.

   ____ d. An approved procedure for container is available.

4. ____ Pre-shipment notifications have been performed according to (Procedure for making notifications about shipments.)

5. ____ Quality inspection performed according to Guidelines for Exclusive Use Vehicle Inspections.

____ a. Unsatisfactory items identified and corrected, if necessary, before loading.

HOLD POINT:

Quality Inspector Signature Date

6. ____ Pre-loading survey of vehicle performed and documented.

8. ____ Security notified to allow vehicle entry.

9. ____ Verify applicable safety precautions are followed.

10. ____ Vehicle is placarded "Radioactive."

11. ____ Vehicle is properly loaded.

12. ____ Verify driver is satisfied with arrangement and bracing of load.

HOLD POINT:

Quality Inspector Signature Date

13. ____ Shipment survey of loaded vehicle performed and documented. Conditions are acceptable for transport.

14. ____ Quality inspection performed according to Guidelines for Exclusive Use Vehicle Inspections.

15. ____ Photographs of loaded vehicle have been taken.

16. ____ Verify for each package:

____ a. Packaging is proper for contents to be shipped.

____ b. Packaging is in unimpaired physical condition, except for superficial marks.

____ c. Each closure device, including gaskets, is properly installed, secured and free of defects.

____ d. Each special instruction for filling, closing and preparation of packaging for shipment has been followed.

____ e. External radiation and contamination levels are within regulatory limits.

____ f. Package is properly marked, and sealed, as applicable.

17. ____ Verify for each NRC Certified package:

____ a. Packaging is proper for contents to be shipped.

____ b. Any pressure relief valve is operable and set according to written procedures.

____ c. Package has been loaded and closed according to written procedures.

____ d. Any structural part of the package which could be used to lift or tie down the package during transport is rendered inoperable for that purpose unless it satisfies the design requirements of 10 *CFR* 71.45.

____ e. External radiation and contamination levels are within regulatory limits.

____ f. Packaging is compliant with the Hypothetical accident conditions specified in 10 *CFR* 71.

____ g. Package is properly marked, and sealed.

18. ____ Complete Radioactive Shipment Manifest.

19. ____ Complete Exclusive Use Instructions, with driver's signature.

20. ____ Complete Straight Bill of Lading, with driver's signature.

21. ____ Complete Emergency Response Information for the applicable guide(s).

22. ____ Complete Routing Instructions from Site. (optional)

23. ____ Transportation Representative, Project Manager and/or Radwaste Supervisor review of shipment documentation and loaded transport vehicle done to ensure NRC and DOT requirements have been met.

_____	_____	_____
Signature	Title	Date

24. ____ Place the following documents in the shipment file:

____ a. Container/Package Documentation

____ b. Shipment Notification Forms

____ c. Quantification and Classification Documents

____ d. Radioactive LSA Shipment Checklist

____ e. Guidelines for Exclusive Use Vehicle Inspections

____ f. Exclusive Use Vehicle Survey Form

____ g. Radioactive Shipment Manifest

____ h. Exclusive Use Instructions

____ i. Bill of Lading

____ j. Emergency Response Information for the applicable guide(s).

____ k. Routing Instructions from Site (optional)

____ l. Photographs of Shipment (good practice, optional)

____ m. Advance Notification Form

25. ____ Pre-shipment notifications have been performed.

26. Driver's shipping papers consist of:

____ a. Exclusive Use Vehicle Survey Form

____ b. Radioactive Shipment Manifest

____ c. Exclusive Use Instructions

____ d. Bill of Lading

____ e. Emergency Response Information for the applicable guide(s).

____ f. Routing Instructions from Site (optional)

____ g. Advance Notification Form

27. ____ Consignee's shipment papers (to be delivered by driver):

____ a. Exclusive Use Vehicle Survey Form

____ b. Radioactive Shipment Manifest

____ c. Exclusive Use Instructions

____ d. Bill of Lading

____ e. Emergency Response Information for the applicable guide(s).

____ f. Routing Instructions from Site (optional)

____ g. Advance Notification Form

28. ____ Shipment is logged on Radioactive Shipment Log.

EXCLUSIVE USE VEHICLE – DRIVER'S INSTRUCTIONS

You are required by 49 *CFR* 173.427 (a) (6) (iv) to have these specific instructions for maintenance of exclusive use shipment controls. These instructions must be included with the radioactive materials shipment document. "Exclusive Use" means this vehicle is to transport only those materials loaded under the direction of consignor or his agents and unloaded under the direction of the consignee or his agents.

You must comply with the following instructions for this exclusive use vehicle:

1. Make all required notifications to the following Project Personnel:

   Transportation Representative ( ) _____ - _____; OR

   Project Manager ( ) _____ - _____; OR

   Project Radiation Protection Manager ( ) _____ - _____.

2. If an accident, fire, breakage, spillage, or radioactive contamination occurs, make the required report to the Department of Transportation (800) 424-8802 and notify our project personnel as soon as possible.

3. Notify our project personnel if emergency braking occurred which could have shifted the load.

4. Notify our project personnel of unusual delays during transit such as equipment breakdown, weather related delays or highway closures that may alter the scheduled arrival of the shipment at the destination.

5. The shipment must be braced so as to prevent leakage or shifting of the load under conditions normally incident to transportation.

6. Do not move or transfer packages within the vehicle or between vehicles while in route to the consignee.

7. Do not replace the tractor or change the fifth wheel adjustment on the tractor or change the loading pattern on the vehicle while in route without prior notification and approval of the our project Radiation Protection Manager, so that a decision can be made if the radiation levels inside the tractor could be affected by the change.

8. The vehicle must be placarded "RADIOACTIVE" on all four sides of the vehicle until the shipment is unloaded by the consignee.

REFERENCES: 49 *CFR* 171.15, 171.16, 173.427, 177.861, 177.843

I have read the above instructions and I understand their content and intent.

Driver's Name (Print)

Commercial Driver's License Number and HazMat Authorization: _____

Driver's Signature _____ Date

EMERGENCY RESPONSE INFORMATION FOR
LSA, UN-2912, 3321, 3322, AND SCO, UN-2913
GUIDE 162, RADIOACTIVE MATERIALS (LOW TO MODERATE LEVEL RADIATION)

Shipment No.:

HAZARDOUS MATERIAL DESCRIPTION:

___Radioactive Material, low specific activity (LSA-I), non fissile or fissile-excepted, 7, UN-2912

___Radioactive Material, low specific activity (LSA-II), non fissile or fissile-excepted, 7, UN-3321

___Radioactive Material, low specific activity (LSA-III), non fissile or fissile-excepted, 7, UN-3322

___Radioactive Material, Surface Contaminated Objects (SCO-I or SCO-II), non fissile or fissile-excepted, 7, UN-2913

POTENTIAL HAZARDS

HEALTH

Radiation presents minimal risk to transport workers, emergency response personnel and the public during transportation accidents. Packaging durability increases as potential hazard of radioactive content increases.

Undamaged packages are safe. Contents of damaged packages may cause higher external radiation exposure, or both external and internal radiation exposure if contents are released.

Low radiation hazard when material is inside container. If material is released from package or bulk container, hazard will vary from low to moderate. Level of hazard will depend on the type and amount of radioactivity, the kind of material it is in, and/or the surfaces it is on.

Some material may be released from packages during accidents of moderate severity but risks to people are not great.

Released radioactive materials or contaminated objects usually will be visible if packaging fails.

Some exclusive use shipments of bulk and packaged materials will not have "RADIOACTIVE" labels. Placards, markings and shipping papers provide identification.

Some packages may have a "RADIOACTIVE" label and a second hazard label. The second hazard is usually greater than the radiation hazard; so follow this Guide as well as the response Guide for the second hazard class label.

Some radioactive materials cannot be detected by commonly available instruments.

Runoff from control of cargo fire may cause low-level pollution.

FIRE OR EXPLOSION

Some of these materials may burn, but most do not ignite readily.

Uranium and Thorium metal cuttings or granules may ignite spontaneously if exposed to air (see Guide 136).

Nitrates are oxidizers and may ignite other combustibles (see Guide 141).

PUBLIC SAFETY

CALL EMERGENCY RESPONSE Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover of the Emergency Response Guidebook.

Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.

Radiation Authority must be notified of accident conditions, and is usually responsible for radiological decisions.

Isolate spill or leak area immediately for at least 25 m (75 ft) in all directions. Stay upwind. Keep unauthorized personnel away.

Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleanup until instructions are received from Radiation Authority.

PROTECTIVE CLOTHING

Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection.

EVACUATION

Large Spill

Consider initial downwind evacuation for at least 100 m (330 ft).

Fire

When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 m (1,000 ft) in all directions.

EMERGENCY RESPONSE

FIRE

Presence of radioactive material will not influence the fire control processes and should not influence selection of techniques.

Move containers from fire area if you can do it without risk.

Do not move damaged packages; move undamaged packages out of fire zone.

Small Fire

Dry chemical, CO_2, water spray or regular foam.

Large Fire

Water spray, fog (flooding amounts)

Dike fire-control water for later disposal.

SPILL OR LEAK

Do not touch damaged packages or spilled material.

Cover liquid spill with sand, earth or other noncombustible absorbent material

Dike to collect large liquid spills.

Cover powder spill with plastic sheet or tarp to minimize spreading.

FIRST AID

Call 911 or emergency medical service.

Medical problems take priority over radiological concerns.

Use first aid treatment according to the nature of the injury.

Do not delay care and transport of a seriously injured person.

Give artificial respiration if victim is not breathing.

Administer oxygen if breathing is difficult.

In case of contact with substance, wipe from skin immediately; flush skin or eyes with running water for at least 20 minutes.

Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment or facilities.

Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves and prevent the spread of contamination.

(Information taken from DOT Emergency Response Guide 162, ERG2012)

RADIOACTIVE SHIPMENT MANIFEST EXAMPLE

SHIPPED TO:
ADDRESS:
CONSIGNEE LIC. NO.

EXPIRATION DATE:

TRAILER ID:
TRACTOR NO.:
CARRIER:

CONSIGNOR:

TELEPHONE:
LICENSE NO.:
EMERGENCY CONTACT:

SHIPMENT NO.:
DATE:
PACKAGE TYPE:

PACKAGE CERTIFICATE OF COMPLIANCE NO.:
EXCLUSIVE USE SHIPMENT 9

NUMBER OF PACKAGES	HM	PROPER SHIPPING NAME & HAZARD CLASS (49 *CFR* 172.101)	IDENTIFICATION NUMBER	TOTAL WEIGHT IN POUNDS / kg	TOTAL ACTIVITY (Ci / mCi / Tbq)
		Radioactive Material, Low Specific Activity, , 7	UN-2912		
		Radioactive Material, Surface Contaminated Object, 7	UN-2913		

ITEM NO.	TYPE OF CONTAINER	CONTAINER VOLUME (cu ft / m^3)	WEIGHT (lb / kg)	PHYSICAL FORM	CHEMICAL FORM	RADIO-NUCLIDE	ACTIVITY (Tbq / Ci / mCi)	SPECIAL NUCLEAR MATERIAL (g)	SOURCE MATERIAL (kg)	RADIATION LEVEL (mSv/hour / mR/hour)		CONTAMINATION (Bq/cm^2 / dpm/100 cm^2)		TRANS-PORT INDEX	RADIO-ACTIVE LABEL USED	FISSILE CLASS
										AT SURFACE	AT 1 METER	Alpha	Beta-Gamma			
PAGE TOTALS																

I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transportation by highway according to applicable international and national governmental regulations.

Authorized Signature/ Title/Date

Driver's Signature / Date
Acknowledges Receipt of Load

RADIOACTIVE SHIPMENT MANIFEST EXAMPLE - Continuation page

Shipment No.:_____ Date:_____ Page ___ of

ITEM NO.	TYPE OF CONTAINER	CONTAINER VOLUME (cu ft / m^3)	WEIGHT (lb / kg)	PHYSICAL FORM	CHEMICAL FORM	RADIO-NUCLIDE	ACTIVITY (Tbq / Ci / mCi)	SPECIAL NUCLEAR MATERIAL (g)	SOURCE MATERIAL (kg)	RADIATION LEVEL (mSv/hour / mR/hour)		CONTAMINATION (Bq/cm^2 / dpm/100 cm^2)		TRANS-PORT INDEX	RADIO-ACTIVE LABEL USED	FISSILE CLASS
										AT SURFACE	AT 1 METER	Alpha	Beta-Gamma			
PAGE TOTALS																

GENERAL PACKAGING REQUIREMENTS

All packages containing radioactive material shall be packaged to prevent leakage or spillage during transportation. The following guidelines shall be met for any package regardless of the classification of the material. These guidelines shall be used in addition to the requirements of the specific hazard class for the shipment.

1. The packaging or the radioactive material itself shall be marked with some form of unique sample or identification number or some other identifying marks in order to confirm that the correct materials are being packaged for shipment.

2. For liquids, the lid on each container or inner package shall be secured in order to minimize the likelihood that the liquid leaks during shipment. Tape or some other adhesive plastic may be used to secure the lid.

3. The inner packages shall be separated by material that is capable of protecting the containers from striking each other during normal conditions of transport.

4. For liquids or sludge, the material used as package cushioning shall be absorbent and of sufficient volume to absorb two times the volume of liquid in the container.

5. Double wraps of tape shall be used for each opening or seam for cardboard boxes or other containers.

6. Each package shall be legibly marked to show the correct shipping address including but not limited to, the name of the person or department to which the material is being shipped.

7. Marks and labels shall be legible and neat in appearance. No extraneous marks or labels are permitted. Letters and numerals that are used to define the proper shipping name, UN identification number, and weight shall be at least two inches tall.

8. Markings and labels shall be placed on at least two opposing sides of the shipping package.

9. All packages shall meet the general design requirements of 49 *CFR* 173.410.

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-51

REV. 0

LIMITED QUANTITY RADIOACTIVE MATERIAL SHIPPING

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LIST OF ATTACHMENTS

1. CHECKLIST FOR SHIPPING LIMITED QUANTITIES OF RADIOACTIVE MATERIAL
2. CHECKLIST FOR INSTRUMENTS OR ARTICLES
3. LIMITED QUANTITY CERTIFICATE
4. INSTRUMENTS AND ARTICLES: LIMITED QUANTITY CERTIFICATE
5. EXAMPLE DETERMINATION OF EXCEPTED QUANTITY FOR AIR OR INTERNATIONAL SHIPMENT

1.0 Purpose

This procedure provides the guidelines and requirements necessary to maintain compliance with the U.S Department of Transportation's (DOT's) Hazardous Materials Regulations when shipping excepted quantities of radioactive materials. Excepted quantities of radioactive material can be shipped in non-specification packaging; however, if specification packaging is available and suitable for this material, it can also be shipped in full compliance with the DOT regulations according to the specific instructions contained in HP-50. This procedure should be used in conjunction with the requirements noted in HP-50 and HP-52, as appropriate. Note that additional limitations apply to those materials shipped via the U.S. Postal Service (USPS), by air, or to foreign destinations.

2.0 Scope

The policies and requirements in this procedure apply to all personnel who generate, handle, package, and ship limited quantities of radioactive materials under the direction of the Leidos Radiation Safety Officer (RSO).

3.0 References

3.1 10 *Code of Federal Regulations (CFR)* 20, "Standards for Protection against Radiation."

3.2 10 *CFR* 71, "Packaging and Transportation of Radioactive Material."

3.3 10 *CFR* 835, "Occupational Radiation Protection."

3.4 49 *CFR,* Subtitle B, Chapter I, Subchapter C, Parts 171 through 178, "Hazardous Materials Regulations."

3.5 DOT 2012. U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. *2012 Emergency Response Guidebook: A Guidebook for First Responders during the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident.* ERG2012. 2012.

3.6 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01. Revision 1.

3.7 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radioactive Material Shipping." Leidos St. Louis Health Physics Procedure. HP-50.

3.8 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Shipping and Receipt Surveys." Leidos St. Louis Health Physics Procedure. HP-52.

3.9 IATA 2014. International Air Transport Association. *Dangerous Goods Regulations.* 55th edition. January 1, 2014.

3.10 IAEA 2004. International Atomic Energy Agency. Regulations for the Safe Transport of Radioactive Material: 1996 Edition (As Amended 2003). Safety Standards Series No. TS R-1.

3.11 NRC and DOT 1990. U.S. Nuclear Regulatory Commission and U.S. Department of Transportation. *U.S. Schedules of Requirements for Transport of Specified Types of Radioactive Material Consignments.* NUREG-1660. January 1999.

3.12 USPS 2003. U.S. Postal Service. *Domestic Mail Manual.* Issue 58, C021, "Articles and Substances Generally," Section 1.0, Restricted Matter. August 10, 2003.

A more comprehensive listing of references for transportation of radioactive materials is contained in HP-50, "Radioactive Materials Shipping."

4.0 Definitions

4.1 **Common Carrier** – A person or entity engaged in the transportation of property by water or land for hire to any person (e.g., Federal Express).

4.2 **Excepted Package** – A packaging, together with its excepted Class 7 (radioactive) material, as specified in 49 *CFR* 173.421 to 49 *CFR* 173.426, and 49 *CFR* 173.427.

4.3 **Limited Quantity** – A package of Class 7 (radioactive) material may be categorized as limited quantity if:

4.3.1 The package contents do not exceed the limits of 49 *CFR* 173.425, "Table of Activity Limits--Excepted Quantities and Articles," and

4.3.2 The package with contents meets the requirements of 49 *CFR* 173.421, "Excepted Packages for Limited Quantities of Class 7 (Radioactive) Materials."

4.4 **Package** – The packaging, together with its radioactive contents, as presented for transport.

4.5 **Packaging** – The assembly of components necessary to comply with the packaging requirements of 10 *CFR* 71, "Packaging and Transportation of Radioactive Material," or 49 *CFR*, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177, "Hazardous Materials Regulations".

4.6 **Transportation Representative (TR)** – The individual responsible for maintaining training qualifications in accordance with 49 *CFR* 172, Subpart H, and for packaging and transportation of radioactive materials. The TR is also responsible for the assessment of incoming radioactive material manifests to ensure compliance with regulatory requirements.

4.7 **Type A Package** – a package that, together with its radioactive contents (limited to A_1 or A_2 as appropriate), meets the requirements of 49 *CFR* 173.410 and 49 *CFR* 173.412, and is designed to retain the integrity of containment and shielding required by 49 *CFR* under conditions of transport as demonstrated by the test set forth in 49 *CFR* 173.465 or 49 *CFR* 173.426. The quantity of radioactive material cannot exceed the A_1 value for special form radioactive material or the A_2 value for normal form radioactive material.

5.0 Responsibilities

5.1 The Transportation Representative is responsible for implementation of this procedure.

5.2 Health Physics Technicians are responsible for conducting the radiological surveys necessary to maintain compliance with this procedure.

6.0 Procedure

6.1 General Requirements

6.1.1 All activities under this procedure are conducted according to existing work instructions and the activity hazard analysis (AHA) for the operation that necessitates the need for shipment of radioactive materials.

6.1.2 All personnel who handle radioactive materials during shipment preparation, packaging, transfer, or receipt shall be trained in accordance with 49 *CFR* 172, Subpart H, "Training."

6.1.3 All records of shipments of radioactive materials, except surveys, must be documented using SI units. Conventional US units in parentheses may be documented in addition to the SI units.

6.1.4 Materials containing radionuclides such that either the activity concentration or the total activity in the consignment is below the values specified in the table in 49 *CFR* 173.436 are not defined as radioactive material for the purposes of transport. Materials which are not defined as radioactive for the purposes of transport may be defined as radioactive for possession or disposal. In addition, packages that satisfy the definition of another hazard must be packaged and offered for transport in full compliance with the hazardous materials regulations applicable to each applicable hazard class.

6.2 Excepted Package Determinations

6.2.1 When a small fraction of the A_1 or A_2 activity is being shipped, some shipments are excepted from some of the requirements of the Department of Transportation Hazardous Materials Regulation and can be shipped in an "excepted package."

6.2.2 Consult the International Air Transport Association (IATA) Dangerous Goods Regulations or the International Atomic Energy Agency (IAEA) Transportation Safety IATA Limitations for specific provisions for transportation of radioactive materials.

6.3 Limited Quantity Material Categorization

6.3.1 A limited quantity is a quantity of Class 7 (radioactive) material not exceeding the material's package limits specified in 49 *CFR* 173.425, Table 4, and conforming with the requirements specified in 49 *CFR* 173.421. Limits for excepted quantities in solid form are 10^{-3} A_1 for special form and 10^{-3} A_2 for normal form. A_1 and A_2 values are listed in 49 *CFR* 173.435.

6.3.2 Requirements for "Excepted Packages for Limited Quantities of Class 7 (Radioactive) Materials" and "Additional Requirements for Excepted Packages Containing Class 7 (Radioactive) Materials" are contained in 49 *CFR* 173.421 and 49 *CFR* 173.422, respectively.

6.3.3 Establishing a material classification and associated proper shipping name is an iterative process conducted to best balance the shipping needs with the available resources. Although qualifying a material for a packaging exception is usually cost-effective, using specification packaging and one of the listed radioactive material proper shipping names can sometimes be justified when time is a consideration.

6.3.4 Classification of mixtures of nuclides in low specific activity (LSA), surface contaminated object (SCO), limited quantity, or instruments and articles, special form, or normal form radioactivity is based on the sum of fractions method, as described in 49 *CFR* 173.433, in conjunction with "Requirements for Determining A_1 and A_2 Values for Radionuclides and for Listing of Radionuclides on Shipping Papers and Labels." The sum of fractions must include 95 percent of the most significant nuclides. If all the nuclides are not quantified, special rules apply.

6.3.5 Hazardous materials may be present in waste or other shipments. These materials must be identified on the shipping papers and shipped in full compliance with all requirements applicable to both the radioactive and non-radioactive constituents. (See 49 *CFR* 172.101, "Hazardous Materials Table," for a summary of packaging, marking, and labeling requirements.)

6.3.6 Limited quantity packages may not contain more than 15 grams of U-235.

6.3.7 For airfreight (or air express) or international shipments, radionuclide-specific activity concentrations and IAEA consignment activity limits apply.

6.3.8 Instruments and articles are instruments or devices that contain built-in radioactive materials (e.g., smoke detectors or sealed radioactive sources). Instruments and articles must comply with limits applicable to both the individual instrument or article and to total package contents with package limits of A_1 and A_2 for special form and normal form, respectively. In addition, the radiation level at 10 centimeters (cm) from the external surface of any instrument or article must not exceed 0.1 millisieverts per hour (mSv/hour) (10 millirem per hour [mrem/hour]).

6.4 Receiving Limited Quantities of Radioactive Materials

A limited quantity package known to contain radioactive material shall be monitored for radiation and contamination in accordance with HP-52, "Shipping Surveys," with special emphasis on any packages that exhibit evidence of degradation of package integrity (e.g., packages that are crushed, wet, or damaged).

6.5 Shipping Limited Quantities of Radioactive Materials

6.5.1 The TR shall obtain written evidence that the transferee's license authorizes the receipt of the type, form, and quantity of the byproduct material transferred.

6.5.2 Radiological surveys shall be performed in accordance with HP-52, "Shipping and Receipt Surveys."

6.5.3 The TR shall verify that the radioactive material packaging conforms to the requirements of 49 *CFR* 173.410 (see also Attachment 5 of HP-50).

6.5.4 The shipping package shall be, at least, a strong, tight container with outer dimensions greater than 4 inches on a side. An inner container shall be used to hold the sample or material. A sealed cardboard box, sealed metal can, or taped cooler can be used as a strong tight container. Type A containers can be used as strong tight containers.

6.5.5 The package shall be marked as "Radioactive." This marking may be placed on the inner or outer package, as applicable.

6.5.6 A limited quantity certificate shall be placed in or on the package as required by 49 *CFR* 173.422, "Additional Requirements for Excepted Packages Containing Class 7 (Radioactive) Materials." Examples of limited quantity certificates are provided on Attachments 3 and 4. Every limited quantity certificate shall include the name of the consignor and consignee.

6.5.7 Labeling is not required on a limited quantity package unless the package contains a hazardous substance or hazardous waste, in which case the package shall be labeled according to the requirements for the other hazardous material.

6.5.8 Radioactive placards are not required for limited quantity shipments.

6.5.9 A hazardous material bill of lading is not required. However, if the package meets other hazard classes, it must be classified and shipped to meet the other hazard(s) per Reference 3.4, 49 *CFR* 173.423.

6.5.10 If the material is a waste, a hazardous waste manifest (40 *CFR* 262) and/or radioactive waste manifest (NRC-540/541) is required.

6.6 Additional Guidance

6.6.1 The TR and/or RPM may use the references listed in Section 3.0 of this procedure (as appropriate) as additional guidance for implementation of this procedure.

6.6.2 The TR will comply with IATA and DOT retraining requirements and will maintain a comprehensive knowledge of current transportation requirements.

7.0 Records

Records generated as a result of this procedure shall be maintained by the RSO until transmitted to the appropriate electronic record system.

CHECKLIST FOR SHIPPING LIMITED QUANTITIES OF RADIOACTIVE MATERIAL

SHIPPING NAME:	Radioactive Material, excepted package-limited quantity of material, 7, UN 2910
PACKAGING:	Must meet 173.410, General Design Requirements. (See checklist) Package must be closed, strong, and tight.
CONTAMINATION:	Non-fixed external radioactive contamination limits for packages are defined in 49 *CFR* 173.443, Table 9. Forty (40) Bq/100 cm^2 (2,200 dpm/100 cm^2) beta-gamma and low toxicity alpha emitters; and 4.0 Bq/100 cm^2 (220 dpm/100 cm^2) for all other alpha emitting radionuclides.
RADIATION:	No greater than 0.005 mSv/hour (0.5 mrem/hour)
MARKING:	"RADIOACTIVE"
LABELS:	None
PLACARDS:	None
ACTIVITY:	For solid material, $<10^{-3}A_1$ or $<10^{-3}A_2$ depending on the form. See Table 7, 173.425, Table of activity limits - excepted quantities and articles for limits for liquids and gasses.
PAPERWORK:	Requires a certificate (per 49 *CFR* 173.421 and 49 *CFR* 173.422) in, or on, the package. No hazardous bill of lading is required. A manifest is required only if shipping as waste.

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CHECKLIST FOR INSTRUMENTS OR ARTICLES

SHIPPING NAME:	Radioactive Material, excepted package, instruments or articles, 7, UN 2910
PACKAGING:	Must meet 173.410, General Design Requirements. Package must be closed, strong, and tight.
CONTAMINATION:	40 Bq/100 cm^2 (2,200 dpm/100 cm^2) beta-gamma and low toxicity alpha emitters, and 4.0 Bq/100 cm^2 (220 dpm/100 cm^2) for all other alpha emitting radionuclides.
RADIATION:	No greater than 0.005 mSv/hour (0.5 mrem/hour)
MARKING:	The source or its container must be marked "radioactive." It is not necessary to mark the outer package.
LABELS:	None
PLACARDS:	None
ACTIVITY:	For solid material, the activity from all the instruments or articles in the package must be no greater than A_1 or A_2, depending on the form. See Table 173.425 for the activity limits for liquid and gases. For each single instrument or article containing solid radioactive material, the limit is 10^{-2} A_1 or 10^{-2} A_2, depending on the form.
PAPERWORK:	Requires certificate (per 173.421) on the package. No hazardous bill of lading is required. Manifest required only if shipping as waste.

EMERGENCY RESPONSE GUIDEBOOK GUIDE NO.: 161

LIMITED QUANTITY CERTIFICATE
(EXAMPLE)

To: _____ From: _____
_____ _____

This package conforms to the conditions and limitations specified in 49 *CFR* 173.324 for radioactive material, excepted package-limited quantity of material, UN2910.

INSTRUMENTS AND ARTICLES: LIMITED QUANTITY CERTIFICATE (EXAMPLE)

To: _____ From: _____
_____ _____

This package conforms to the conditions and limitations specified in 49 *CFR* 173.421 for radioactive material, excepted package - instruments or articles, UN2910.

EXAMPLE DETERMINATION OF EXCEPTED QUANTITY FOR AIR OR INTERNATIONAL SHIPMENT

For a mixture of radionuclides, use the sum of the fractions rule from 49 *CFR* 173.433.

For a single radionuclide, determine if it meets the limited quantity or excepted quality limitation by comparing the concentration and total radioactivity with the values in Table 1 from the Regulations for the Safe Transport of Radioactive Material (TS R-1). A few examples of the excepted value concentration and conveyance limits and limited quantity values appear in the table below.

Radionuclide	Concentration Limit	Conveyance Limit/Package	Limited Quantity/Package*
Carbon-14	10,000 Bq/gm	10,000,000 Bq	3,000,000,000 Bq
Cobalt-60	100 Bq/gm	100,000 Bq	40,000,000 Bq
Cesium-137	10 Bq/gm	10,000 Bq	60,000,000 Bq
Depleted Uranium	1 Bq/gm	1,000 Bq	Unlimited
Natural Thorium	1 Bq/gm	1,000 Bq	Unlimited
Natural Uranium	1 Bq/gm	1,000 Bq	Unlimited
U-235 (20% or less)	1 Bq/gm	1,000 Bq	Unlimited
Technetium-99	10,000 Bq/gm	10,000,000 Bq	900,000,000 Bq
Tritium	1,000,000 Bq/gm	1,000,000,000 Bq	40,000,000,000 Bq

* For liquids or shipment via USPS this limit is reduced by a factor of 10.

LEIDOS ST. LOUIS

HEALTH PHYSICS PROCEDURE

HP-52

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SHIPPING AND RECEIPT SURVEYS

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LIST OF ATTACHMENTS

1. SAMPLE PACKAGE RADIOLOGICAL SURVEY
2. VEHICLE RADIOLOGICAL SURVEY

1.0 Purpose

This procedure establishes the basic health physics requirements and provides guidance for personnel to follow when radioactive material is received or transferred from sites working under the Leidos Radiation Safety Program.

2.0 Scope

This procedure applies to all personnel receiving or shipping radioactive material (equal to or greater than 70 becquerels per gram (bq/g) (2,000 picocuries per gram [pCi/g]) at sites working under the Leidos Radiation Safety Program.

3.0 References

3.1 10 *Code of Federal Regulations (CFR 20),* "Standards for Protection against Radiation."

3.2 10 *CFR* 71, "Packaging and Transportation of Radioactive Material."

3.3 49 *CFR,* Subtitle B, Chapter I, Subchapter C, Parts 171 through 177, "Hazardous Materials Regulations."

3.4 Leidos 2014a. *Leidos St. Louis Health Physics Manual.* "Health Physics Manual." "Health Physics Manual." Leidos St. Louis Health Physics Procedure. HP-01.

3.5 Leidos 2014b. *Leidos St. Louis Health Physics Manual.* "Radioactive Material Shipping." Leidos St. Louis Health Physics Procedure. HP-50.

3.6 Leidos 2014c. *Leidos St. Louis Health Physics Manual.* "Limited Quantity Radioactive Material Shipping." Leidos St. Louis Health Physics Procedure. HP-51. Revision 1.

3.7 NRC and DOT 1999. U.S. Nuclear Regulatory Commission and U.S. Department of Transportation. *U.S.-Specific Schedules of Requirements for Transport of Specified Types of Radioactive Material Consignments.* NUREG-1660. January 14, 1999.

4.0 Definitions

4.1 **A_1 Value** – The maximum activity of special form Class 7 (radioactive) material permitted in a Type A package. These values are listed in References 3.2 & 3.3.

4.2 **A_2 Value** – The maximum activity of Class 7 (radioactive) material, other than special form radioactive material, permitted in a Type A package. These values are listed in References 3.2 and 3.3.

4.3 **Closed Transport Vehicle** – A transport vehicle or conveyance equipped with a securely attached exterior enclosure that, during normal transportation, restricts the access of unauthorized persons to the cargo space containing the Class 7 (radioactive) materials. The enclosure may be either temporary or permanent; in the case of packaged materials, may be of the "see-through" type; and must limit access from the top, sides, and bottom.

4.4 **Common Carrier** – Person or entity engaged in the transportation of property by water or land for hire to any person (e.g., Federal Express).

4.5 **Exclusive Use (sole use)** – Sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must issue specific instructions, in writing, for maintenance of exclusive use shipment controls, and must include them with the shipping paper information provided to the carrier by the consignor.

4.6 **Limited Quantity** – A package of Class 7 (radioactive) material may be classified as limited quantity if:

4.6.1 The package contents do not exceed the limits of 49 *CFR* 173.425, and

4.6.2 The package, with contents, meets the requirements of 49 *CFR* 173.421.

4.7 **Low Specific Activity (LSA)** – Class 7 (radioactive) material with limited specific activity that satisfies the descriptions and limits set forth in 49 *CFR* 173.403.

4.8 **Package** – The packaging, together with its radioactive contents, as presented for transport.

4.9 **Packaging** – The assembly of components necessary to comply with the packaging requirements of Reference 3.3 or Reference 3.4. In accordance with Reference 3.4, the packaging may include multiple receptacles, the conveyance, tie-down system, and auxiliary equipment.

4.10 **Transport Index (TI)** – A dimensionless number (rounded up to the first decimal place) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is the maximum radiation level, (if ≥ 0.5 millirem per hour [mrem/hour]) in mrem/hour, found 1 meter (m) from the external surface of the package.

4.11 **Transportation Representative (TR)** – The individual responsible for maintaining training qualifications in accordance with 49 *CFR* 172, Subpart H, and for the determination and implementation of container and package labeling, shipment placarding, and manifesting of radioactive material offered for transport. Additionally, the TR is responsible for the assessment of incoming radioactive material manifests to ensure compliance with regulatory requirements.

4.12 **Type A Quantity** – A quantity of radioactive material, the aggregate radioactivity of which does not exceed the A_1 value for special form radioactive material or the A_2 value for normal form radioactive material.

4.13 **Type B Quantity** – Any quantity of radioactive material greater than a Type A quantity.

5.0 Responsibilities

5.1 The Radiation Safety Officer (RSO) shall ensure the health physics staff is trained on the aspects of this procedure, and shall periodically audit compliance with this procedure.

5.2 Health physics staff is responsible for conducting the radiological surveys necessary to maintain compliance with this procedure.

5.3 All requirements of this procedure pertaining to radioactive material that are assigned to specific job titles may be performed by designated alternates, provided the individual is qualified in the respective task.

6.0 Procedure

6.1 General

6.1.1 All personnel who package, handle, or ship radioactive material are to be trained in compliance with 49 *CFR* 172, Subpart H, "Training." Only trained and fully qualified personnel shall perform radiological shipment or receipt surveys.

6.1.2 Shipment and receipt radiation and contamination surveys shall be performed at sufficient locations to ensure compliance with 49 *CFR* and 10 *CFR* 71, as applicable.

6.1.3 Completed survey documentation must be routed to the Radiation Protection Manager (RPM) for review. The approved survey documentation shall then be forwarded to the TR.

6.1.4 If any of the radiological survey results are ≥ 80 percent of the applicable limits, the RPM and/or the TR are to be notified prior to shipment or receipt.

6.1.5 All radioactive material received at the site shall be received in accordance with the receipt requirements defined in HP-50 or HP-51, as applicable.

6.1.6 If radioactive material arrives at the site and is not in conformance with prior site approval, the RPM and the TR shall determine the need for returning the material to the shipper and whether the non-conformance is subject to notification of the appropriate regulatory authorities.

6.1.7 If radioactive material arrives and is not in conformance with appropriate transport regulations:

6.1.7.1 The RPM and the TR shall be immediately notified and the vehicle shall be held for regulatory inspection.

6.1.7.2 The RPM and the TR shall contact the RSO and the Project Manager for a collective determination on the need for notification of the shipper, Department of Transportation (DOT), and any relevant client of the non-conformance.

6.1.8 Any transportation accident resulting in the release of a Reportable Quantity (RQ) (49 *CFR* 171.101, Table 1) of an applicable radioactive material is to be immediately reported to the RSO and TR. The RSO shall immediately notify the Program Manager, Corporate Environmental Compliance and Health and Safety (EHS) Manager, the National

Response Center, and any other appropriate regulatory agency or authority. Notifications shall be performed and documented in accordance with HP-24, "Radiological Reporting."

6.2 Radiological Shipment Survey of a Package

6.2.1 Radiological surveys in support of transportation must be performed within 24 hours of the shipment. Contamination surveys will not be considered valid for shipment after 24 hours unless specifically excepted by the RPM.

6.2.2 Radioactive material packages offered for transport shall comply with the regulatory removable contamination limits specified in this procedure. However, as a standard of good practice, packages should be offered at contamination levels less than site release limits unless approved by the RSO.

6.2.3 All package surveys shall be documented on Attachment 1, or equivalent.

6.2.4 If the package is to be transported Exclusive Use, the following limits shall apply:

6.2.4.1 Removable contamination not to exceed 0.4 becquerels per square centimeter (Bq/cm^2) (2,200 disintegrations per minute per square centimeter [$dpm/100\ cm^2$]) beta/gamma and low toxicity alpha emitters,

6.2.4.2 Removable contamination not to exceed 0.04 Bq/cm^2 (220 $dpm/100\ cm^2$) all other alpha emitting radionuclides,

6.2.4.3 Open transport vehicle less than or equal to 2 millisieverts per hour (mSv/hour) (200 mrem/hour) on contact, and

6.2.4.4 Closed transport vehicle 10 mSv/hour (less than or equal to 1,000 mrem/hour) on contact.

6.2.5 If the package is to be transported by Common Carrier, Limited Quantity, the following shall apply:

6.2.5.1 Removable contamination not to exceed 0.4 Bq/cm^2 (2,200 $dpm/100\ cm^2$) beta/gamma and low toxicity alpha emitters,

6.2.5.2 Removable contamination not to exceed 0.04 Bq/cm^2 (220 $dpm/100\ cm^2$) for all other alpha emitting radionuclides, and

6.2.5.3 Less than or equal to 0.005 mSv/hour (0.5 mrem/hour) on contact.

6.2.6 If the package is to be transported by Common Carrier, LSA quantity or greater, the following limits shall apply:

6.2.6.1 Removable contamination not to exceed 0.4 Bq/cm^2 (2,200 $dpm/100\ cm^2$) beta/gamma or low toxicity alpha emitter,

6.2.6.2 Removable contamination not to exceed 0.04 Bq/cm^2 (220 dpm/100 cm^2) for all other alpha emitting radionuclides,

6.2.6.3 Less than or equal to 2 mSv/hour (200 mrem/hour) on contact, and

6.2.6.4 Less than or equal to 0.1 mSv/hour (10 mrem/hour) at 1 m for the Transport Index.

6.3 Radiological Shipment Survey of a Vehicle

6.3.1 All vehicle surveys shall be documented on Attachment 2 or equivalent.

6.3.2 If the shipment is being transported by Common Carrier as limited quantity, no vehicle survey is necessary. All radiological limitations are placed on the package(s).

6.3.3 If the shipment is being transported by Exclusive Use conveyance, or greater, the following limits shall apply:

6.3.3.1 Removable radioactive contamination limit of less than or equal to 0.4 Bq/cm^2 (2,200 dpm/100 cm^2) beta/gamma and low toxicity alpha emitters, and less than or equal to 0.04 Bq/cm^2 (220 dpm/100 cm^2) for all other alpha emitting radionuclides;

6.3.3.2 Radiation level on vehicles shall not exceed 2 mSv/hour (200 mrem/hour) for any point on the external surface of the vehicle, and in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle;

6.3.3.3 Radiation levels shall not exceed 0.1 mSv/hour (10 mrem/hour) at 2 m from any point on the external surface of the vehicle, and in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle; and;

6.3.3.4 Radiation levels shall not exceed 0.02 mSv/hour (2 mrem/hour) for any normally occupied area of the vehicle.

6.4 Radiological Receipt Survey of a Vehicle

6.4.1 If a shipment transported by Common Carrier, is received, no vehicle survey is necessary. Nonetheless, except for packages containing gaseous or special form radioactive material, packages bearing any of the three categories of "Radioactive" labels must be surveyed for external surface contamination upon receipt.

6.4.2 If the shipment was transported by Exclusive Use conveyance as an LSA quantity or greater, the following limits shall apply when surveying the vehicle to ensure compliance with 49 *CFR* and 10 *CFR* 71:

6.4.2.1 Removable radioactive contamination limit of less than or equal to 4 Bq/cm^2 (22,000 dpm/100 cm^2) beta/gamma and low toxicity alpha emitters, and less than or equal to 0.4 Bq/cm^2 (2,200 dpm/100 cm^2) for all other alpha emitting radionuclides.

6.4.2.2 Radiation levels on vehicles shall not exceed 2 mSv/hour (200 mrem/hour) for any point on the external surface of the vehicle, and in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle.

6.4.2.3 Radiation levels shall not exceed 0.1 mSv/hour (10 mrem/hour) at 2 m from any point on the external surface of the vehicle, and in the case of an open vehicle, at any point 2 m from the vertical planes projected from the outer edges of the vehicle.

6.4.2.4 Radiation levels shall not exceed less than 0.02 mSv/hour (less than 2 mrem/hour) in any normally occupied area of the vehicle.

6.4.3 All vehicle surveys shall be documented on Attachment 2, or equivalent.

6.5 Radiological Receipt Survey of the Radioactive Material Package(s) (10 *CFR* 20.1906)

6.5.1 Monitor the external surfaces of a labeled[1] package for radioactive contamination unless the package contains only radioactive material in the form of a gas or in special form as defined in 10 *CFR* 71.4;

6.5.2 Monitor the external surfaces of a labeled[1] package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, as defined in 10 *CFR* 71.4 and 10 *CFR* 71, Appendix A; and

6.5.3 Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged.

[1]A labeled package as used herein is a package with a Radioactive White-I, Yellow-II or Yellow-III label as specified in U.S. Department of Transportation regulations at 49 *CFR* 172.403 and 172.436-440.

6.6 Receiving Material in Excess of a Type A Quantity

Leidos health physics personnel who expect to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in 10 *CFR* 71.4 and 10 *CFR* 71, Appendix A, must make arrangements to receive:

- The package when the carrier offers it for delivery; or
- Notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously.

6.6.1 Limited quantity (excepted) packages require a receipt survey if the package arrives in an obviously damaged condition or shows evidence of any leakage.

6.6.2 If the package is received during working hours, qualified health physics personnel shall monitor a radioactive materials package as soon as practical after receipt of the package but **no more than 3 hours** after the

package is received at the Leidos (or client) site. If the package is not received during normal working hours, monitoring shall occur **no later than 3 hours** after the beginning of the next working day. Qualified health physics personnel performing surveys of incoming packages of radioactive material will immediately notify the Leidos St. Louis RSO if:

- Removable radioactive surface contamination exceeds the limits of 10 *CFR* 71.87(i); or
- External radiation levels exceed the limits of 10 *CFR* 71.47.
- The RSO will, in turn, promptly notify final delivery carrier and the NRC Operations Center by phone (301-816-5000). If the RSO is not immediately available, the senior corporate individual present in the Leidos St. Louis Office will make the required notifications to both the final delivery carrier and the NRC Operations Center.

The provisions of 10 *CFR* 71.87(i) mandate that the level of non-fixed (removable) radioactive contamination on the external surfaces of each package is as low as reasonably achievable (ALARA) and within the limits specified by the DOT in 49 *CFR* 173.443. The external radiation standards prescribed by 10 *CFR* 71.47 limit:

6.6.2.1 Dose rates under conditions normally incident to transportation to a maximum of 2 mSv/hour (200 mrem/hour) at any point on the external surface of the package;

6.6.2.2 Limit the TI to "10";

6.6.2.3 Preclude transport except by exclusive use shipment if radiation levels exceed 2 mSv/hour (200 mrem/hour) on the external surface of the package, unless the following conditions are met, in which case the limit is 10 mSv/hour (1,000 mrem/hour):

- The shipment is made in a closed transport vehicle;
- The package is secured within the vehicle so that its position remains fixed during transportation; and
- There are no loading or unloading operations between the beginning and end of the transportation;

6.6.2.4 Dose rate limitations are 2 mSv/hour (200 mrem/hour) at any point on the outer surface of the vehicle, including the top and underside of the vehicle; or in the case of a flat-bed style vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load or enclosure, if used, and on the lower external surface of the vehicle; and 0.1 mSv/hour (10 mrem/hour) at any point 2 m (80 inches) from the outer lateral surfaces of the vehicle (excluding the top and underside of the vehicle); or in the case of a flat-bed style vehicle, at any point 2 meters (6.6 feet) from the vertical planes

projected by the outer edges of the vehicle (excluding the top and underside of the vehicle); and 0.02 mSv/hour (2 mrem/hour) in any normally occupied space, except that this provision does not apply to private carriers, if exposed personnel under their control wear radiation dosimetry devices in conformance with 10 *CFR* 20.1502.

6.6.2.5 For shipments made under the provisions of paragraph (b) of 10 *CFR* 20, the shipper shall provide specific written instructions to the carrier for maintenance of the exclusive use shipment controls. The instructions must be included with the shipping paper information.

6.6.2.6 The written instructions required for exclusive use shipments must be sufficient that, when followed, they will cause the carrier to avoid actions that will unnecessarily delay delivery or unnecessarily result in increased radiation levels or radiation exposures to transport workers or members of the general public.

6.6.3 If the shipment was transported as limited quantity by Common Carrier, and if there is evidence of degradation of package integrity (e.g., packages that are crushed, wet, or damaged), the following shall apply:

6.6.3.1 Removable contamination shall not exceed 0.4 Bq/cm^2 (2,200 dpm/100 cm^2) beta/gamma or low toxicity alpha emitters;

6.6.3.2 Removable contamination shall not exceed 0.04 Bq/cm^2 (220 dpm/100 cm^2) from all other alpha emitting radionuclides; and

6.6.3.3 Dose rates shall not exceed less than or equal to 0.005 mSv/hour (0.5 mrem/hour) on contact.

6.6.4 If the shipment was transported by Common Carrier, LSA quantity or greater, the following limits shall apply:

6.6.4.1 Removable contamination shall not exceed 0.4 Bq/cm^2 (2,200 dpm/100 cm^2) beta/gamma,

6.6.4.2 Removable contamination shall not exceed 0.04 Bq/cm^2 (220 dpm/100 cm^2) alpha,

6.6.4.3 Radiation level less than or equal to 2 mSv/hour (200 mrem/hour) on contact,

6.6.4.4 Radiation level less than or equal to 0.1 mSv/hour (10 mrem/hour) at 1 m for the TI, and

6.6.4.5 The sum of the TIs from all of the packages is limited so that the total TI does not exceed 50.

6.6.5 If the shipment was transported Exclusive Use, then the "radiation level limitations and exclusive use provisions" of 49 *CFR* 173.441 shall apply:

6.6.5.1 In accordance with 49 *CFR* 173.443, non-fixed external radioactive contamination is limited to Bq/cm^2 (22,000 dpm/100 cm^2) beta/gamma and low toxicity alpha emitters, and 0.4 Bq/cm^2 (2,200 dpm/100 cm^2) for all other alpha-emitting radionuclides.

6.6.5.2 Radiation level at any point on the outer surfaces of an open vehicle, including the top and underside, shall not exceed 2 mSv/hour (200 mrem/hour). The radiation dose limit on the outer surface of a closed transport vehicle cannot exceed 10 mSv/hour (1,000 mrem/hour). In addition, the package must be secured such that it remains fixed during transportation and may not be loaded or unloaded between the beginning and end of the transportation.

6.6.6 All package surveys shall be documented on Attachment 1, or equivalent.

6.7 Release Survey of an Empty Vehicle (49 *CFR* 173.443)

6.7.1 A vehicle used for the exclusive use shipment of Class 7 (radioactive) materials must be surveyed after receipt and off-loading, and may not be returned to service until:

6.7.1.1 The radiation dose rates at any surface point of the vehicle do not exceed 0.005 mSv/hour (0.5 mrem/hour); and

6.7.1.2 Removable contamination does not exceed 0.4 Bq/cm^2 (2,200 dpm/100 cm$^{2)}$ for beta/gamma or low toxicity alpha, and 0.04 Bq/cm^2 (220 dpm/100 cm^2) for all other alpha emitting radionuclides.

6.7.2 If the vehicle is used solely for the transportation of Class 7 (radioactive) materials by rail or highway and is stenciled "For Radioactive Materials Use Only" in letters at least 76 millimeters (3 inches) high, then the following limits apply:

6.7.2.1 The interior of the vehicle shall not exceed 0.1 mSv/hour (10 mrem/hour) on contact with any surface or 0.02 mSv/hour (2 mrem/hour) at 1 m, and

6.7.2.2 Removable contamination levels shall be less than or equal to 4 Bq/cm^2 (22,000 dpm/100 cm^2) beta/gamma and low toxicity alpha emitters, and less than or equal to 0.4 Bq/cm^2 2,200 dpm/100 cm^2 for all other alpha emitting radionuclides.

6.7.2.3 Sole use vehicles must be kept locked except for loading or unloading.

Note: When Leidos is transferring special form sources in Leidos-owned or Leidos-operated vehicles to and from the work site, they are exempt from the contamination monitoring requirements of paragraph b of 10 *CFR* 71 but are not exempt

from the survey requirement for measuring radiation levels, which is required to ensure that the source is still properly lodged in its shield.

7.0 Records

All records generated in support of transfer or receipt of radioactive material shall be maintained by the TR and forwarded to the designated electronic record retention system in accordance with Quality Assurance Administrative Procedure (QAAP) 17.1, "Records Management."

SAMPLE PACKAGE RADIOLOGICAL SURVEY

HSWP NUMBER _____ **TECHNICIAN NAME** _____ **DATE**_____ **TIME**_____	**Site:**_____	**PAGE** ___ **OF** ___

Package radiation levels: _____ **mr/hour contact** _____ **mr/hour at 1 m**	INSTRUMENT_____ INSTRUMENT_____	S/N_____CAL DUE_____ S/N_____CAL DUE_____
LEGEND **Δ = Smear Location** **# = G/A Dose Rate (mr/hour)**	INSTRUMENT_____ INSTRUMENT_____	S/N_____CAL DUE_____ S/N_____CAL DUE_____

Package contents:_____

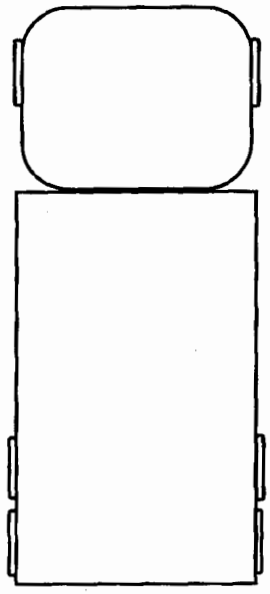
Comments

ITEM	Removable α (dpm/100 cm²)	Removable β (dpm/100 cm²)	ITEM	Removable α (dpm/100 cm²)	Removable β (dpm/100 cm²)
1.			10.		
2.			11.		
3.			12.		
4.			13.		
5.			14.		
6.			15.		
7.			16.		
8.			17.		
9.			18.		

Reviewed By:_____ Date:_____

VEHICLE RADIOLOGICAL SURVEY

HSWP NUMBER _____ **TECHNICIAN NAME** _____ **DATE**_____ **TIME**_____	**Site:** _____	**PAGE** ___ **OF** ___
Vehicle Contents: _____	INSTRUMENT_____ INSTRUMENT_____	S/N_____ CAL DUE_____ S/N_____ CAL DUE_____
LEGEND **Δ = Smear Location** **# = G/A Dose Rate (mr/hour)**	INSTRUMENT_____ INSTRUMENT_____	S/N_____ CAL DUE_____ S/N_____ CAL DUE_____



Comments

Highest Radiation Levels

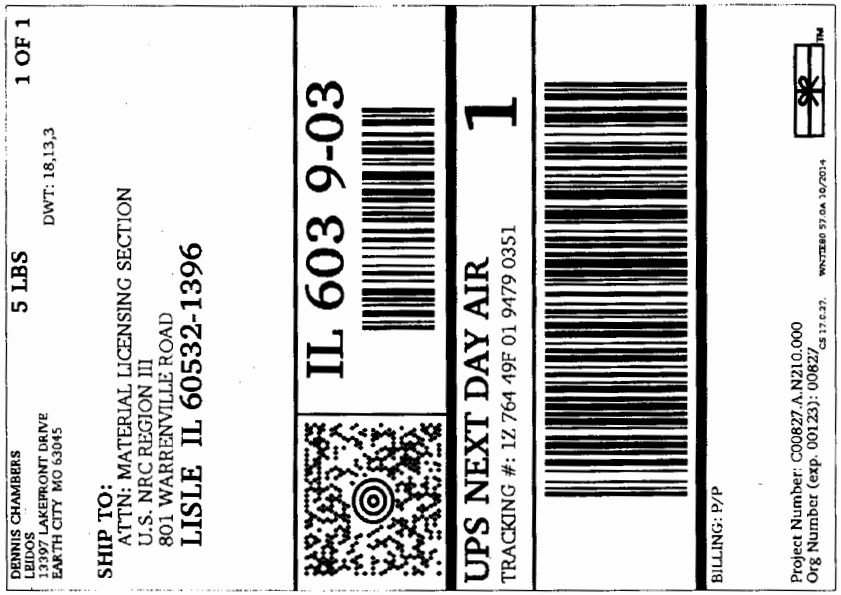
In Cab _____ mr/hour

Contact _____ mr/hour

At 2 m _____ mr/hour

ITEM	Removable α (dpm/100 cm²)	Removable β (dpm/100 cm²)	ITEM	Removable α (dpm/100 cm²)	Removable β (dpm/100 cm²)
1.			10.		
2.			11.		
3.			12.		
4.			13.		
5.			14.		
6.			15.		
7.			16.		
8.			17.		
9.			18.		

Reviewed By:_____ Date:_____


DENNIS CHAMBERS
LEIDOS
13397 LAKEFRONT DRIVE
EARTH CITY MO 63045
5 LBS
1 OF 1
DWT: 18,13,3
SHIP TO:
ATTN: MATERIAL LICENSING SECTION
U.S. NRC REGION III
801 WARRENVILLE ROAD
LISLE IL 60532-1396
IL 603 9-03
UPS NEXT DAY AIR
1
TRACKING #: 1Z 764 49F 01 9479 0351
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