

May 24, 2016



Material Licensing Branch
U.S. Nuclear Regulatory Commission
2443 Warrenton Road, Suite 210
Lisle, Illinois 60532-4352

2827-20160524.001

Subject: NRC Material License No. 24-32591-01 Renewal Application

Dear Material Licensing Section:

Leidos, Inc. (formerly part of Science Applications International Corporation [SAIC]) Division 827, Earth City, Missouri, respectfully requests renewal of our Nuclear Regulatory Commission (NRC) Material License No. 24-32591-01 for the use and/or possession of licensable quantities of byproduct, source, and special nuclear materials in accordance with the provisions of Title 10, *Code of Federal Regulations*.

The purpose for this license is to provide radiological/health physics support services, inclusive of remediation of soil-like media and structures, to organizations/entities located in non-Agreement States or otherwise in areas with exclusive federal jurisdiction. Special emphasis will continue to include environmental sample analysis, site characterization, and decontamination and decommissioning.

License conditions and recent revisions incorporated into the existing NRC license will be carried forward into the license being renewed.

Consistent to direction from NRC Region III staff, one copy of NRC Form 313, together with all supporting documentation, is included in this submittal.

If you have any questions or request additional information, please contact Mr. Dennis R. Chambers, CHP, at (636) 288-2715.

Sincerely,

Leidos, Inc.

A handwritten signature in black ink, appearing to read "John Lynch".

John Lynch
Vice President

Enclosures

RECEIVED MAY 25 2016

NRC FORM 313
(05-2016)
10 CFR 30, 32, 33, 34
35, 36, 37, 38, and 40

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0120

EXPIRES: 06/31/2016



APPLICATION FOR MATERIALS LICENSE

Estimated burden per response to comply with this mandatory collection request: 4.3 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. 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 e-mail: Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0120), 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.

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW. *AMENDMENTS/RENEWALS THAT INCREASE THE SCOPE OF THE EXISTING LICENSE TO A NEW OR HIGHER FEE CATEGORY WILL REQUIRE A FEE.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

MATERIALS SAFETY LICENSING BRANCH
DIVISION OF MATERIAL SAFETY, STATE, TRIBAL AND RULEMAKING PROGRAMS
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

ALABAMA, CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, PUERTO RICO, RHODE ISLAND, SOUTH CAROLINA, TENNESSEE, VERMONT, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA,

SEND APPLICATIONS TO:

LICENSING ASSISTANCE TEAM
DIVISION OF NUCLEAR MATERIALS SAFETY
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
2100 RENAISSANCE BOULEVARD, SUITE 100
KING OF PRUSSIA, PA 19406-2713

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN,
SEND APPLICATIONS TO:

MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MISSISSIPPI, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING,

SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
1600 E. LAMAR BOULEVARD
ARLINGTON, TX 76011-4511

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR (Check appropriate item)

- A. NEW LICENSE
 B. AMENDMENT TO LICENSE NUMBER
 C. RENEWAL OF LICENSE NUMBER

24-32591-01

2. NAME AND MAILING ADDRESS OF APPLICANT (Include ZIP code)

Leidos, Inc.
13397 Lakefront Drive
Suite 100
Earth City, Missouri 63045

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

13397 Lakefront Drive
Suite 100
Earth City, Missouri 63045

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Dennis Chambers, CHP

BUSINESS TELEPHONE NUMBER 6362882715	BUSINESS CELLULAR TELEPHONE NUMBER 6362882715
---	--

BUSINESS EMAIL ADDRESS

Dennis.R.Chambers@leidos.com

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL

- a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSE FEES (Fees required only for new applications, with few exceptions*)
(See 10 CFR 170 and Section 170.31)

FEE CATEGORY	AMOUNT ENCLOSED \$
--------------	--------------------

13. CERTIFICATION. (Must be completed by applicant) THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 37, 38, AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER - TYPED/PRINTED NAME AND TITLE

John Lynch, Vice President

SIGNATURE

DATE

5/23/16

FOR NRC USE ONLY

TYPE OF FEE	FEES LOG	FEES CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
APPROVED BY			\$		DATE



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Health Physics Manual
HP-01, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

Unless this copy is marked with a red stamp indicating it is a controlled copy, it is uncontrolled. Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

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1. PURPOSE

The Leidos Health Physics (HP) Program, as defined within this manual (standard operating procedure [SOP] 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 protection program (RPP) and is implemented through procedures addressing specific categories of radiation safety and regulatory compliance. Note: the terms "HP" and "radiation protection" may be used interchangeably throughout the HP procedures depending on the referenced source document. The program provides for the following commitments:

- radiological safety of occupationally exposed personnel, the public and the environment,
- monitoring of radiation and radioactive materials,
- controlling distribution and releases of radioactive materials, and
- maintaining occupational radiation exposure to individuals within regulatory limits, and at levels as low as reasonably achievable (ALARA).

1.1 Scope and Limitations

This manual and supporting procedures apply to all Leidos and subcontractor personnel at sites or locations implementing the Leidos RPP. 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 RPP provides the following commitments:

- 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.
- Each individual working under this RPP must understand and accept the responsibility to follow all procedures and maintain radiation exposures at levels ALARA.
- Leidos shall comply strictly with all regulatory requirements, radiation exposure limits, and limits regarding release of radioactive materials.
- Leidos shall maintain a comprehensive RPP to keep individual and collective radiation exposures to workers and the public below regulatory limits and ALARA.

This manual and supporting procedures are based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

Access Control Point (ACP) – An area established to maintain contamination control and access control of restricted areas. ACPs are a good HP 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.

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 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.

American National Standards Institute (ANSI) – The primary organization for fostering the development of technology standards in the United States. The ANSI works with industry groups and is the U.S. member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

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.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

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.

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 HP program.

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 RWT.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) – CERCLA provides a federal superfund for planning, characterization, and cleanup of uncontrolled or abandoned hazardous-waste sites, as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment.

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.

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, etc.).

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.

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

Curie (Ci) – A basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion disintegrations per second (dps) (i.e., transformations per second) and is approximately the rate of decay of 1 gram (g) of radium.

Declared Pregnant Woman – A woman who has voluntarily informed the RPM, in writing, of her pregnancy and the estimated date of conception.

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

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

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 m³/hour), results in an intake of one ALI. DAC values are given in 10 CFR 20, Appendix B, Table 1, column 3.

Derived Concentration Guideline Levels (DCGLs) – Radionuclide-specific concentration limits used to guide cleanup of a decommissioning site to meet radiological criteria for license termination. DCGLs are calculated based on an all-pathways dose assessment and represent a concentration limit that could potentially lead to a peak dose over established limits for the average member of a group of individuals reasonably expected to receive the highest dose. DCGL development considers how residual contamination

could move through the environment and which potential receptors could be exposed through various pathways based on reasonable land use scenarios (e.g., external exposure; ingestion of soil, water, plant, and animal products; and inhalation).

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

Electronic Dosimeter (ED) – Devices designed and developed to rapidly and accurately measure a wide range of radiation doses and dose rates over comparatively short durations using electronic detection capabilities.

Engineer Manual (EM) – A document that specifies requirements for organizational activities and operations, including safety and health guidance. EM 385-1-1 describes such requirements for USACE and contractor activities and operations.

Environmental Health and Safety (EHS) – The department in a company or an organization involved in **environmental** protection, **safety** at work, occupational **health and safety**, compliance, and best practices. The EHS department aims to prevent and reduce accidents, emergencies, and health issues at work.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

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

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

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.

Gram(s) (g) – A metric unit of measure for mass equal to one thousandth of a kilogram (kg).

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.

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

Health and Safety Work Permit (HSCP) – 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 HSCP is a primary part of the ALARA program. HSPPs communicate work area radiological hazards to personnel and specify controls and protective equipment necessary for worker protection.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

High Radiation Area (HRA) – 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 cm from the radiation source or from any surface that the radiation penetrates.

International Electrotechnical Commission (IEC) – A standards body that publishes international standards for electrical, electronic, and related technologies.

International Organization for Standardization (ISO) – An independent, non-governmental international organization that brings together experts to share knowledge, develop, and publish voluntary, consensus-based, market-relevant international standards that support innovation and provide solutions to global challenges. ISO, the shortened form of the organization's name, is not an acronym; rather, ISO is derived from the Greek term isos, meaning equal.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Microcurie(s) (μCi) – A unit of measure equal to one-millionth (10^{-6}) Ci.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Millisievert(s) (mSv) – A unit of measure equal to one-thousandth (10^{-3}) sievert.

National Institute of Occupational Safety and Health (NIOSH) – The U.S. federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. The NIOSH is part of the Centers for Disease Control and Prevention within the U.S. Department of Health and Human Services.

National Voluntary Laboratory Accreditation Program (NVLAP) – The NVLAP is a laboratory accreditation program established on the basis of requests and demonstrated need. Each laboratory accreditation program includes specific calibration and/or test standards and related methods and protocols assembled to satisfy the unique needs for accreditation in a field of testing or calibration. The NVLAP accredits public and private laboratories based on evaluation of their technical qualifications and competence to carry out specific calibrations or tests. Accreditation criteria are established in accordance with the 15 CFR 285), NVLAP procedures and general requirements, and encompass the requirements of ISO/IEC 17025. The accreditation is formalized through issuance of a Certificate of Accreditation and Scope of Accreditation.

Personal Protective Equipment (PPE) – Equipment worn to minimize exposure to serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. PPE may include items such as gloves; safety glasses; safety shoes; earplugs

or muffs; hard hats; respirators; or coveralls, vests, or full body suits.

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 HP coverage while the work is in progress.

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

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

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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.

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.

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

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radiation Survey Instrument – Portable radiation detection and measurement instruments used to check personnel, equipment, land areas and facilities for radioactive contamination.

Radiation Worker Training (RWT) – Training inclusive of instructions to workers mandated by 10 CFR 19 to ensure personnel are fully knowledgeable in actions to avoid an unnecessary radiation dose.

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 10 CFR 20, Appendix C.

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

$$\frac{\mu\text{Ci}_{\text{Co}}}{10Q_{\text{Co}}} + \frac{\mu\text{Ci}_{\text{U}}}{10Q_{\text{U}}} \leq 10$$

where:

Q = the quantity shown in 10 CFR 20, Appendix C.

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

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

Radiological Control Technician (RCT) – An individual qualified by education, training, and experience to meet the requirements for designation as an RCT. (See Senior [Level] Health Physics Technician [Sr. HPT]).

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.

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

Resource Conservation and Recovery Act (RCRA) – The principal federal law in the United States governing the disposal of solid waste and hazardous waste. The U.S. Congress enacted the RCRA in 1976 to address the increasing national problems of a growing volume of municipal and industrial waste.

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 face piece under conditions of use.

Respiratory Protective Equipment (RPE) – Devices used to reduce the concentration of airborne contaminants being inhaled. These devices can be either air-purifying respirators that use filters, cartridges, or canisters to remove contaminants from the air you breathe; or supplied air respirators that provide the wearer with clean air from an

uncontaminated source.

Restricted Area – A radioactive 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.

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

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

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

Senior (Level) Health Physics Technician (Sr. HPT) – An individual qualified by virtue of training, education, and experience to perform the functions of a Sr. HPT. A Sr. HPT is also commonly referred to as a RCT.

Site Orientation Training (SOT) – Procedures specific to a given site that define particular, standardized approaches to be employed.

Site Safety and Health Plan (SSHP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Standard Operating Procedure (SOP) – A set of step-by-step instructions to achieve a predictable, standardized, desired result, often within the context of a longer overall process.

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.

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.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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

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.

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Department of Transportation (DOT) – A governmental department with the mission to serve the United States by ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people today and in the future.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

Very High Radiation Area (VHRA) – 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 m from the source or any surface that the radiation penetrates.

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, HRAs, and VHRA.

Week – 7 consecutive days starting on Sunday.

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

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Safety Officer (RSO)

- Developing radiation safety standards and controls.
- Ensuring compliance with the requirements delineated in 10 CFR 20, and other applicable federal and state regulations.
- Making the appropriate notifications in accordance with Leidos EHS-19, "Radiation Protection."
- Ensuring site activities conducted under this RPP are performed in accordance with this manual and supporting procedures.
- Posting a current copy of NRC form 3, "Notice to Employees," for personnel examination at NRC-regulated sites.
- Performing an annual audit of the RPP to identify and address program quality and compliance.
- Reviewing personnel exposures upon availability of monitoring results.
- Supporting and enforcing radiation safety standards and controls outlined in this procedure.
- Assigning a site RPM for each client site working under this RPP.

Site Radiation Protection Manager (RPM)

- Assuming the roles and responsibilities of the RSO at a specific client site. As noted in Section 2.2 of HP-04, "Qualifications and Training," RPM responsibilities specifically exclude:
 - Establishment of or approval to exceed alternate administrative exposure limits;
 - Notifications to regulatory agencies;
 - Approval to dispose of radioactive material, including radioactive waste;
 - Approval authority for SSHPs; and,
 - Approval of HP procedures.

Health Physics Technicians (HPT)

- Implementation of this manual and supporting procedures under the direction of the RPM.
- Reporting non-conformance with HP procedures and policies.
- 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.

Each Radiological Worker

- 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.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE**5.1 Overview**

HP activities shall be governed by written procedures that are available for review and audit.

The HP organization is illustrated graphically on Attachment 1.

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

The Site RPM may delegate responsibilities described in HP procedures to qualified HPTs when specified by this "Health Physics Manual" (HP-01) and its implementing

procedures (i.e., RPM or designee).

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

HPTs are responsible for providing support for job coverage (i.e., HP oversight).

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.")

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

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

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

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.

5.2 Details

5.2.1 Health Physics Training and Qualification

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.

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

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

Prior to allowing unescorted access into the restricted area, personnel are required to successfully complete 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.

HP-04, "Qualifications and Training," outlines the minimum training and qualifications for site personnel (RSO, RPM, HPTs, etc.). 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 EM 385-1-80. All individuals likely to receive a dose equal to or exceeding 100 mrem above background in 1 year shall receive initial training and retraining at least annually thereafter.

Radiation Worker Training

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

- The RPM shall approve all material presented in RWT and the qualifications of instructors who present the material.
- RWT shall meet the requirements of 10 CFR 19.
- Successful completion of the training provides the necessary knowledge to safely work in radiological areas and meets the requirements to become a Radiological Worker.
- 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.
- HP-04, "Qualifications and Training," outlines the content and requirements for successful completion of initial RWT.

Respiratory Protection Training

- The Leidos Respiratory Protection Training Program has been developed in accordance with 10 CFR 20 and 29 CFR 1910.134.
- 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.
- Personnel must successfully complete a refresher training class, and must undergo a fit test and physical examination annually to maintain respiratory protection qualification.
- Detailed requirements for training, qualification, and use of respiratory protection equipment are contained in HP-06, "Radiological Respiratory Protection."

Health Physics Training

- HP training is designed to train and qualify HP 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.
- Contractors or temporary personnel working in the HP organization are required to complete appropriate HP 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.
- Details on HP training requirements are contained in HP-04, "Qualifications and Training."

5.2.2 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 RPP contains guidelines to ensure exposures are maintained ALARA.

Administrative Exposure Limits

- 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.
- 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.
- 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 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.
- In the event of jobs involving comparatively high radiation exposures, for which 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.
- 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."

Health and Safety Work Permits

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 HP requirements such as engineering controls, respiratory protection, protective clothing, and dosimetry based upon current conditions, job scope, and historical information. The following ALARA objectives are incorporated in the HSWP.

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

Health Physics Job Reviews

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 HP 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.

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

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 ensure 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.

- 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 an NVLAP-accredited commercial dosimetry service.
- Personnel will wear whole-body dosimetry on the chest to ensure a representative measurement of whole-body radiation exposure unless otherwise directed by the RPM.
- HP personnel should direct placement of the dosimetry on that portion of the whole body expected to receive the largest exposure during work.
- 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).
- 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.
- 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."
- 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).

- Although personnel dosimetry may not be required if the RPM determines that personnel entering the restricted area are not likely to exceed 500 millirem (mrem)/year DDE, dosimetry will generally be used for projects such that effective doses exceed the general public exposure limits of 0.1 rem/year.

Monitoring for Extremity Exposure

- Monitoring to determine shallow dose equivalent to extremities is required for tasks during which an individual's extremity dose is likely to exceed 5 rem/year.
- Extremity monitoring will generally be conducted using TLDs.
- Extremity dose should be recorded and reported as shallow dose equivalent.
- 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.

Monitoring For External Beta Exposure

- Monitoring to determine shallow dose equivalent to the skin is required for tasks during which an individual's skin dose is likely to exceed 5 rem/year.
- Monitoring to determine dose equivalent to the lens of the eye is required for tasks during which an individual's dose to the lens of the eye is likely to exceed 1.5 rem/year. Radiation exposure to the skin of the whole body from beta radiation is primarily monitored with TLDs.
- 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.
- 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).

Quality Control of Dosimetry

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

Monitoring and Control of Surface Contamination

- 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 DCGLs. Engineering, preventative, and administrative controls are utilized to the extent practical to minimize the spread of contamination.
- 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.
- 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."

Monitoring and Control of Airborne Radioactive Material

- 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 and 2 of Appendix B to 10 CFR 20.

- 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."
- 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."
- 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).
- 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 for which process and engineering controls are not practical or in emergency situations.
- 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 worker's 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 respiratory protection factor).
- The HSWP identifies when the potential exists for airborne radioactive material and specifies the controls used to limit exposure. HP 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.
- When the use of respiratory protection equipment is necessary, only those devices which are 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.
- 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 1 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.

Radiological Posting and Labeling

- Posting requirements are defined in 10 CFR 20, Subpart J, for radiation areas, HRAs, VHRAs, 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 an HRA 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 12 inches (30 cm) from the radiation source or from any surface that the radiation penetrates.
- HRAs are conspicuously posted and barricaded in accordance with 10 CFR 20.
- Control of access to HRAs shall be in accordance with 10 CFR 20.1601. Entryways to HRAs should be locked, except during periods when access to the areas is required. Positive controls shall be maintained during each entry into an HRA.
- 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 posting to alert the individual to potential entry into an HRA. Direct surveillance to prevent unauthorized entry may be substituted for locked areas or flashing lights for temporary HRAs.
- Surveys and Monitoring will comply with 10 CFR 20, Subpart F.
- Any individual or group of individuals entering an HRA 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 Sr. HPT with a radiation exposure rate monitoring device, who is responsible for providing positive control over the activities within the area.
- Areas are posted as VHRAs if dose rates could exceed 500 rads in 1 hour at 1 m from any source.

- In addition to the requirements for HRAs stated in 10 CFR 20.1601, Leidos will institute additional measures to ensure that an individual is not able to gain access to VHRAs.
- VHRAs shall require special posting in accordance with 10 CFR 20, must be locked when not open for access, and require primary HP coverage for each small group entering when open for access. When unlocked, a guard will be posted to prevent unauthorized access.
- 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 VHRAs in which radiation levels could be encountered at 500 rads or more in 1 hour at 1 m from a radiation source or any surface through which the radiation penetrates.
- 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.
- Client sites working under the Leidos RPP shall be posted in accordance with HP-20, "Radiological Posting and Labeling."

5.2.3 Radioactive Material Control

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

Control of Radioactive Material within the Restricted Area

- Radioactive material is maintained within the restricted area of the site or in an RMSA, unless otherwise approved by the RPM or a designated Sr. HPT.
- Labeling is not required if any one of the exceptions delineated in 10 CFR 20 apply.
- The RPM, with the assistance of HPTs, shall control radioactive sources in accordance with HP-23, "Radioactive Source Control."
- 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.
- Movement and storage of radioactive material is monitored by the HP 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 HP procedures and policies.
- Designated RMSAs are posted and controlled in accordance with 10 CFR 20.

Control of Radioactive Material Outside the Restricted Area

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

Control of Radioactive Material Receipt and Shipment

- Receipt and shipment of radioactive material is performed in accordance with DOT regulations contained in 49 CFR, 10 CFR 71, and HP procedures, including:
- HP-50, "Radioactive Material Shipping";

- HP-51, "Limited Quantity Radioactive Material Shipping"; and
- HP-52, "Shipping and Receipt Surveys."
- Leidos personnel will comply with the initial and retraining requirements of 49 CFR 172.704.
- For NRC-licensed material, controls for shipments include package determination and a QA program in accordance with 10 CFR 71.
- 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.
- Radioactive materials are promptly surveyed and normally stored within the restricted area or approved RMSAs after receipt.
- 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.

5.2.4 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."

Routine Surveillance

- 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.
- 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.
- 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.
- 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.
- 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.

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.

Contamination Surveys

- 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.
- 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.
- 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.

Airborne Radioactive Material Surveys

- 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.
- 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 in a location at which a reasonable potential for airborne radioactive material exists to ensure that respiratory protection specified is adequate and that radiological conditions have not deteriorated.
- Air sampling will be accomplished in accordance with NRC Regulatory Guide 8.25 and HP-11, "Radiological Monitoring."

5.2.5 Instrumentation

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

Calibration guidance contained in NRC Regulatory Guide 8.25 and ANSI N323A-1997 is referenced in order to maintain an industry standard calibration program.

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

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

5.2.6 Quality Control

Administration of the internal program for maintaining a high level of quality is accomplished through the organization described in Section 5.1; implementation of the Leidos ESE QA Program; and implementation of site/project-specific QAPP.

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.

Annual audits of the RPP are conducted by the RSO or designee.

5.2.7 Oversight

Oversight is performed to ensure the effectiveness of the HP program through the following measures.

- Identify non-compliance with federal, state, and procedural requirements.
- Identify work practices that could be improved, particularly those which could result in unnecessary exposure.
- Evaluate the effectiveness of HP training.
- Identify radiological control problems and other potential problems.
- The RPM, or another qualified Health Physicist, shall annually review the performance of the RPP.

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 ensure procedural compliance, proper work practices, proper postings, and adequate HP surveillance.

HP 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.

5.2.8 Radiological and Personnel Monitoring Incident Reporting

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.

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

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

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

- Records will be maintained in accordance with 10 CFR 20, Subpart L. These records include:
 - Records of surveys;
 - Determination of prior occupational dose;
 - Records of planned special exposures;
 - Records of individual monitoring results;
 - Records of dose to individual members of the public; and

- Records of waste disposal.
- Records of the RPP shall include the provision of the program and audits and other reviews of program content and implementation.
- Records of audits and reviews of the RPP shall be maintained on file for 3 years. Records of the provisions of the RPP shall be kept on file until the NRC terminates the NRC license (if applicable).
- 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 previously (in parenthesis following the specified unit).
- Information recorded on shipping manifests must be recorded in SI units or in SI units and those units specified in the previous bullet.
- All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management." 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.

8. REFERENCES

- 10 CFR 19, Notices, "Instructions and Reports to Workers: Inspection and Investigations."
- 10 CFR 20, "Standards for Protection against Radiation."
- 10 CFR 20, Appendix G – "Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests."
- 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."
- 10 CFR 33, "Specific Domestic Licenses of Broad Scope for Byproduct Material."
- 10 CFR 40, "Domestic Licensing of Source Material."
- 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," including 10 CFR 61.55, "Waste Classification."
- 10 CFR 70, "Domestic Licensing of Special Nuclear Material."
- 10 CFR 71, "Packaging and Transportation of Radioactive Material."
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- HP-03, "Radiological Limits."***
- HP-04, "Qualifications and Training."****
- HP-06, "Radiological Respiratory Protection."****
- HP-11, "Radiological Monitoring."***
- HP-12, "Health Physics Oversight."****
- HP-20, "Radiological Posting and Labeling."***
- HP-22, "Radiological Reporting."***
- HP-23, "Radioactive Source Control."***

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* Refer to <https://prism.leidos.com/docs/DOC-18653> for the current version of EHS referenced procedures in the *Corporate Environmental Health and Safety Program Manual*.

** Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

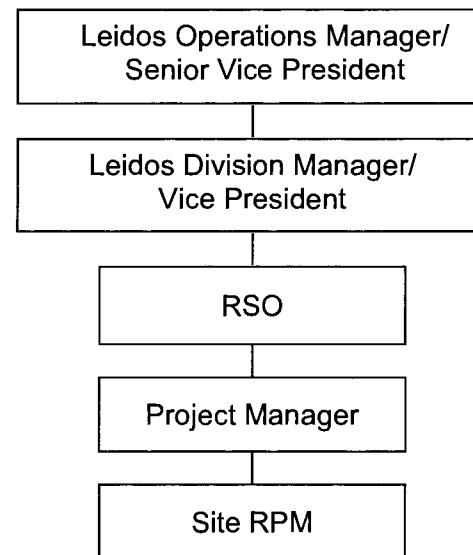
*** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

Attachment 1. Leidos Health Physics Organization

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: LEIDOS HEALTH PHYSICS ORGANIZATION



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

ALARA Program
HP-02, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

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Approved By:

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1. 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.

1.1 Scope and Limitations

This health physics (HP) procedure applies to all Leidos and subcontractor activities that take place involving radioactive material at sites implementing the Leidos Radiation Protection Program (RPP).

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

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 m³/hour), results in an intake of one ALI. DAC values are given in 10 CFR 20, Appendix B, Table 1, column 3.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10^{-3}) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radiation Worker Training (RWT) – Training inclusive of instructions to workers mandated by 10 CFR 19 to ensure personnel are fully knowledgeable in actions to avoid an unnecessary radiation dose.

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

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Incorporate the ALARA concept into training programs developed for site personnel.
- Ensure the ALARA program is implemented in accordance with procedural requirements.
- Establish an ALARA suggestion program.
- Review ALARA suggestions for program incorporation.
- Perform pre- and post-job ALARA reviews, as required by this procedure.

All Site Personnel

- Follow ALARA practices and procedures.
- Incorporate the ALARA concept into everyday work habits and activities.
- Make ALARA suggestions to the RSO when better methods or equipment could be utilized to reduce exposure to ionizing radiation.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated

throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Not Applicable.

5. PROCEDURE

5.1 Overview

ALARA Program Elements

- Develop an ALARA policy statement.
- Post the ALARA policy statement to be accessible to all employees who work with radioactive materials or ionizing radiation.
- 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.
- 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.
- Assess ALARA performance indicators, such as: radiological incident reports, personnel contamination events, and cumulative dose reports.
- Review ALARA suggestions for potential dose reduction, assign responsibility for implementation, and follow up each accepted suggestion to ensure incorporation into the program.

5.2 Details

ALARA Policy Statement

- The ALARA policy statement is contained in Attachment 1 (or equivalent) to this procedure.
- 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.
- The policy statement should be provided to all employees during RWT.

Work Review

Pre- and Post-Job ALARA Reviews

- Pre- and post-job ALARA reviews should be documented using Attachments 2 and 3 (or equivalent), respectively.
- Any work activity 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."
- 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 HSWP.
- Pre- and post-job ALARA reviews, upon completion, will be retained in the project files.

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.

ALARA Suggestion Program

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

References (see Section 8) used to establish this ALARA Program may be used, at the discretion of the RPM, as additional guidance for ALARA implementation.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPPs, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- ESE A17.1, "Project Records Management."*HP-01, "Health Physics Manual."**
- HP-04, "Qualifications and Training."**
- HP-21, "Health and Safety Work Permits."**
- 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.
- 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.

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

* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. ALARA Policy Statement
- Attachment 2. ALARA Pre-Job ALARA Review
- Attachment 3. Post-Job ALARA Review
- Attachment 4. ALARA Suggestion Form

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: ALARA POLICY STATEMENT**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

ATTACHMENT 2: PRE-JOB ALARA REVIEW**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: Routine 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 <input type="checkbox"/> | NO <input type="checkbox"/> | N/A <input type="checkbox"/> |
| • all equipment operable and in good repair | YES <input type="checkbox"/> | NO <input type="checkbox"/> | N/A <input type="checkbox"/> |
| • dry runs or walkthroughs performed | YES <input type="checkbox"/> | NO <input type="checkbox"/> | N/A <input type="checkbox"/> |
| • special ventilation required | YES <input type="checkbox"/> | NO <input type="checkbox"/> | N/A <input type="checkbox"/> |
| • special dosimetry required | YES <input type="checkbox"/> | NO <input type="checkbox"/> | N/A <input type="checkbox"/> |
| • overall safety aspects of the job discussed | YES <input type="checkbox"/> | NO <input type="checkbox"/> | N/A <input type="checkbox"/> |
| • housekeeping responsibilities established | YES <input type="checkbox"/> | NO <input type="checkbox"/> | N/A <input type="checkbox"/> |

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	_____

ATTACHMENT 3: POST-JOB ALARA REVIEW**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: _____

ATTACHMENT 4: ALARA SUGGESTION FORM**ALARA SUGGESTION FORM**

Name: _____ Date: _____

Facility: _____

Suggestion: _____

_____Approve Disapprove Project Manager: _____ /
Signature _____ Date _____Approve Disapprove RPM: _____ /
Signature _____ Date _____Comments: _____



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Radiological Limits
HP-03, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

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1. PURPOSE

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

1.1 Scope and Limitations

This procedure applies to all Leidos and subcontractor personnel at sites implementing the Leidos Radiation Protection Program (RPP).

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

Administrative Exposure Limit – A limit established 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.

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.

American National Standards Institute (ANSI) – The primary organization for fostering the development of technology standards in the United States. The ANSI works with industry groups and is the U.S. member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

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.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Becquerel (Bq) – A unit of measure of radioactivity in the International System of Units (SI), equal to 1 disintegration per second (dps) (i.e., transformation per second).

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

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.

Curie (Ci) – A basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion dps (i.e., transformations per second) and is approximately the rate of decay of 1 gram (g) of radium.

Declared Pregnant Woman – A woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

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 m³/hour), results in an intake of one ALI.

Disintegrations per Minute (dpm) – The average quantity of radiological disintegrations (i.e., transformations) occurring per minute as a result of the spontaneous emission from the atomic nuclei of either alpha or beta particles.

Disintegrations per Second (dps) – The decrease in the amount of any radioactive material with the passage of time (i.e., each second), as a result of the spontaneous emission from an atomic nuclei such as alpha or beta particles. In the SI, 1 dps (i.e., transformation per second) equates to 1 Bq.

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

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Exposure – Being exposed to ionizing radiation or to radioactive materials.

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

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10^{-3}) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

International Electrotechnical Commission (IEC) – A standards body that publishes international standards for electrical, electronic, and related technologies.

International Organization for Standardization (ISO) – An independent, non-governmental international organization that brings together experts to share knowledge, develop, and publish voluntary, consensus-based, market-relevant international standards that support innovation and provide solutions to global challenges. ISO, the shortened form of the organization's name, is not an acronym; rather, ISO is derived from the Greek term isos, meaning equal.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

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).

Microcurie(s) (μCi) – A unit of measure equal to one-millionth (10^{-6}) Ci.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

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

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Shallow Dose Equivalent (SDE) – The dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm² when applied to the external exposure of the skin of the whole body or the skin of an extremity.

Site Safety and Health Plan (SSHP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation’s security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

U.S. Nuclear Regulatory Commission (technical report designation) (NUREG) – A report or brochure on regulatory decisions, results of research, results of incident investigations, and other technical and administrative information.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, “Qualifications and Training.”

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Calculate or approve existing administrative and/or project limits, and document the limits on Attachment 2 (or equivalent).
- Post Attachment 2 (or equivalent) in an appropriate project work area.

Health Physics Technicians (HPTs)

- Evaluate survey results against the project/site limits of Attachment 2 (or equivalent).

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Not Applicable.

5. PROCEDURE

5.1 Overview

General Requirements

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.

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.

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

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.

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.

5.2 Details

5.2.1 Dose Limits

Regulatory Dose Limits

- Individual doses for occupational workers shall not exceed 5 rem TEDE or 50 rem TODE per calendar year, excluding medical and background radiation exposures.
- Individual doses for visitors and members of the general public shall not exceed 0.1 rem TEDE per calendar year.

- 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.
- Doses to the lens of the eye shall not exceed 15 rem.
- Doses to the skin of the whole body or to the skin of any extremity shall not exceed 50 rem.

Administrative Dose Limits

- 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.
- 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/year.
 - TODE limited to 5.0 rem/year.
 - LDE limited to 1.5 rem/year.
 - SDE limited to 5 rem/year.
 - Extremity Dose limited to 5 rem/year.
 - Declared pregnant women – 500 mrem for the entire gestation period. Declared pregnant women should be limited to exposure rates less than 50 mrem/month unless otherwise approved by the RPM.
 - Cumulative Lifetime Exposure Limit of 1 rem/year of age.
- Approval by the RSO, which is required for any employee to exceed an administrative dose limit, shall be documented in the employee's exposure record.
- 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).

5.2.2 Surficial Contamination Limits

- The RPM shall provide HPTs with project or site-specific surficial contamination limits on Attachment 2 (or equivalent).
- 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.
- 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 (≥ 1 percent abundance)

Limit = The radionuclide surficial contamination limit.

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

5.2.3 Derived Air Concentration and Air Effluent Values

- The RPM shall provide HPTs with project or site-specific DAC values on Attachment 2 (or equivalent).
- 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.
- 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.
- DAC or AE values may be derived by using the most conservative radionuclide present, or by weighting the radionuclides using the following equation:

$$\text{Weighted DAC or AE } (\mu\text{Ci/ml}) = \frac{1}{F_1/\text{DAC}_1 + F_2/\text{DAC}_2 + F_3/\text{DAC}_3}$$

where:

F = The fractional abundance of the radionuclide (≥ 1 percent abundance)

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

- Alternate means of deriving site DAC or AE values may be established by the RPM, as documented in the SSHP, technical work record, or equivalent document.
- In conjunction with establishing site-specific DAC and AE values, the RPM (or designee) shall provide site-specific minimum air sample volumes on Attachment 2 that are based on the established DAC and AE values.

5.2.4 Personnel Release Limits

- The RPM shall provide HPTs with site-specific total (direct frisk) personnel contamination limits on Attachment 2, or equivalent.
- Personnel contamination release criteria should be calculated from the MDA of personnel release detection equipment, in accordance with HP-11, "Radiological Monitoring," Attachment 3, Radiological Survey Calculation (or equivalent).
- Personnel contamination scanning techniques and detection equipment shall be of sufficient sensitivity to detect less than 5,000 dpm/100 cm² beta or 100 dpm/100 cm² alpha.

5.2.5 Additional Guidance

The RPM may use the references listed in Section 8 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.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- ANSI 1999. American National Standards Institute. *Surface and Volume Radioactivity Standards for Clearance*. ANSI 13.12-1999. August 1999.
- ESE A17.1, "Project Records Management."*
- HP-01, "Health Physics Manual."**
- HP-04, "Qualifications and Training."**
- HP-11, "Radiological Monitoring."**
- NRC 1974. U.S. Nuclear Regulatory Commission. *Termination of Operating Licenses for Nuclear Reactors*. Regulatory Guide 1.86. June 1974.
- NRC 2003. U.S. Nuclear Regulatory Commission. *Radiological Assessments for Clearance of Materials from Nuclear Facilities*. NUREG-1640. June 2003.
- USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Safety*. Engineer Regulation. ER 385-1-80. June 30, 2010.
- 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.

* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. NRC Regulatory Guide 1.86 Surface Contamination Limits
- Attachment 2. Site Limits

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: NRC REGULATORY GUIDE 1.86 SURFACE CONTAMINATION LIMITS

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 $\alpha/100\text{ cm}^2$	15,000 dpm $\alpha/100\text{ cm}^2$	1,000 dpm $\alpha/100\text{ cm}^2$
Transuramics, 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 $\beta\text{-}\gamma/100\text{ cm}^2$	15,000 dpm $\beta\text{-}\gamma/100\text{ cm}^2$	1,000 dpm $\beta\text{-}\gamma/100\text{ cm}^2$

^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.

ATTACHMENT 2: SITE LIMITS**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: _____



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Qualifications and Training
HP-04, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

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1. PURPOSE

This health physics (HP) procedure describes the qualifications and training necessary to ensure that radiological workers and the HP staff members can perform their duties in accordance with the Leidos Radiation Protection Program (RPP).

1.1 Scope and Limitations

This procedure applies to all Leidos and subcontractor personnel implementing the Leidos RPP. This procedure does not apply to respiratory protection training.

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Engineering Laboratory Technician (ELT) – An individual trained by the U.S. Navy to

perform specific functions involving operations and maintenance of nuclear-powered ships (e.g., aircraft carriers and submarines).

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10^{-3}) kilogram (kg).

Hazardous Materials (HAZMAT) – 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 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).

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.

Hazardous Materials (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.

Hazardous Waste Operations and Emergency Response (HAZWOPER) – A set of guidelines produced and maintained by the Occupational Health and Safety Administration (OSHA), which regulates hazardous waste operations and emergency services in the United States and its territories.

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

Health Physics (Technician) Supervisor (HPS) – An individual qualified by virtue of education, training, and experience to perform specific duties as listed in applicable U.S. Nuclear Regulatory Commission (NRC) or agreement state licenses or other relevant standards.

High Radiation Area (HRA) – 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 cm from the radiation source or from any surface that the radiation penetrates.

Institute for Nuclear Power Operations (INPO) – An organization with the mission to promote the highest levels of safety and reliability—to promote excellence—in the operation of commercial nuclear power plants.

International Air Transport Association (IATA) – An organization that regulates dangerous goods (e.g., hazardous materials) in international trade and coordinates related environmental evaluations.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Junior (Level) Health Physics Technician (Jr. HPT) – An individual qualified by virtue of training, education, and experience to perform the functions of a Jr. HPT but who does not meet all requirements to serve as a Senior (Level) Health Physics Technician (Sr. HPT).

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

National Registry of Radiation Protection Technologists (NRRPT) – A listing of individuals in the United States and Canada who have demonstrated requisite training, education, and experience for registration as a Radiation Protection Technologist and have successfully demonstrated these skills by passing the requisite examination. A Radiation Protection Technologist is a person engaged in providing radiation protection

to the Radiological Worker, the general public, and the environment from the effects of ionizing radiation.

Occupational Safety and Health Administration (OSHA) – A governmental organization within the U.S. Department of Labor created by the U.S. Congress with the Occupational Safety and Health Act of 1970 to ensure safe and healthful working conditions by establishing and enforcing standards and by providing training, outreach, education, and assistance.

Personal Protective Equipment (PPE) – Equipment worn to minimize exposure to serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. PPE may include items such as gloves; safety glasses; safety shoes; earplugs or muffs; hard hats; respirators; or coveralls, vests, or full body suits.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of this procedure.

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radiation Survey Instrument – Portable radiation detection and measurement instruments used to check personnel, equipment, land areas and facilities for radioactive contamination.

Radiation Worker – An individual, who, by virtue of his/her job assignment, is likely to receive in excess of 100 mrem/year 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.

Radiation Worker Permit (RWP) – A written procedure applicable to a given task to protect personnel and the environment from receiving an unnecessary radiation dose.

Radiation Worker Training (RWT) – Training inclusive of instructions to workers mandated by 10 CFR 19 to ensure personnel are fully knowledgeable in actions to avoid an unnecessary radiation dose.

Radiological Control Technician (RCT) – An individual qualified by education, training, and experience to meet the requirements for designation as an RCT. (See Senior [Level] Health Physics Technician [Sr. HPT]).

Restricted Area – A radiological 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.

Site Orientation Training (SOT) – Procedures specific to a given site that define particular, standardized approaches to be employed.

Site Safety and Health Plan (SSHP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Senior (Level) Health Physics Technician (Sr. HPT) – An individual qualified by virtue of training, education, and experience to perform the functions of a Sr. HPT. A Sr. HPT is also commonly referred to as an RCT.

Task Evaluation Standards (TES) – HPT training standards that describe the knowledge and requirements necessary to perform an individual HP 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.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

Transportation Representative (TR) – An individual maintaining requisite training and qualifications in accordance with 49 CFR 172, Subpart H, and the 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.

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

Very High Radiation Area (VHRA) – 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 m from the source or any surface that the radiation penetrates.

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.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Radiation Safety Officer (RSO)

- 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's degree in HP or another 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.

- The RSO should participate in refresher training. Refresher training may consist of: attendance at seminars or training courses on radiation protection issues, personal development through review of books and literature on radiation protection issues, or attendance at scientific meetings during which radiation protection issues are discussed.
- The RSO may delegate responsibilities described in HP 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, "Health Physics Manual," regulatory agency notification, approval to dispose of radioactive material or radioactive waste, SSHP approval, and HP procedure approval.

Radiation Protection Manager (RPM)

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

- Qualification or designation as a Health Physicist; and
- A 4-year degree in HP, radiation physics, industrial safety, or related field and 1 year of experience as a Sr. HPT; or
- Certification as a registered Radiation Protection Technologist by the NRRPT; or
- Qualification or previous experience as a radiological engineer or an ALARA engineer.

The Site RPM should participate in refresher training.

Transportation Representative (TR)

- 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.

- A TR that directs the work of others shall also have a minimum of 1 year of supervisory experience or, for an entry-level supervisory TR, demonstrated supervisory and leadership capabilities, as determined acceptable by the RSO.
- A TR that also performs package and/or shipment or receipt of radiological surveys shall also meet the qualification requirements of a Sr. HPT.
- 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.
- 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*.

Health Physics (Technician) Supervisor (HPS)

- An HPS shall have the same education and applicable HPT experience as a Sr. HPT. The HPS shall have, in addition to the Sr. 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.
- An HPS also performing Sr. HPT tasks shall complete all TES requirements.

Health Physics Technicians (HPTs)

- The RSO, RPM, or HPS (for HPTs only) shall review prospective or newly hired HP personnel (Leidos and contractor personnel) education and work experience, including employment verification sufficient to validate the minimum experience requirement, and shall classify each as Jr. HPT or Sr. HPT.
 - Sr. HPT shall possess a high school diploma or equivalent and 3 years of applicable HPT experience. Knowledge of HP fundamentals should be demonstrated and verified by the RSO. This may include verification of one of the following:
 - Completion of an associate's or bachelor's degree in HP or nuclear engineering.
 - Completion of HPT training provided through an INPO accredited training program.
 - Registration by the NRRPT.
 - Completion of DOE 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 the oral examination requirement specified in Section 2.1 of this procedure.

- 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.

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

Training/Education	Experience Allowance
Associate's, Bachelor's, or Advanced Degree in HP 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
HP Short Courses	Duration of courses at 1:1 up to a maximum of 1 year

- 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
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

TR, HPS, and HPT Training and Qualification

- 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.
 - The RSO, RPM, or HPS (for HPTs only) shall determine required reading/personal study and identify each using Attachment 2, Health Physics Required Reading (or equivalent).
 - The RSO, RPM, or HPS (for HPTs only) shall determine TES completion requirements and identify each on Attachment 1, or equivalent.
- 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.
- Initial training completion shall be documented on Attachment 1, or equivalent, and include:

- Completion of required reading/self-study assignment, including review of HP-01, "Health Physics Manual," Leidos HP procedures, and applicable federal and state regulations.
- 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.
- Following completion of all training requirements, the employee shall sign and date Attachment 1, or equivalent, indicating successful completion.
- The RSO or RPM shall verify completion of Attachment 1, or equivalent.
- 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.

Retraining

- 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.
- Continuing HPT training shall include:
 - A review of HP-01, "Health Physics Manual," and all HP procedures every 3 years;
 - Review of HP procedure revisions, as documented on Attachment 3, Health Physics Required Reading Log (or equivalent);
 - 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
 - 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 HAZWOPER.
- All HAZMAT employees, including HP personnel and the TR, involved in preparing hazardous material/waste for transport by any mode other than air transport shall complete retraining:
 - Every 3 years at a minimum (49 CFR 172, Subpart H).
 - When conditions, processes, or new transportation hazards are identified, or the individual's job assignment changes, necessitating training.
 - As determined necessary by the RSO or RPM.
- All HAZMAT employees, including HP personnel and the TR, involved in preparing hazardous material/waste for transport by air shall complete retraining:
 - Every 2 years at a minimum to satisfy the requirements of IATA *Dangerous Goods Regulations*.
 - When conditions, processes, or new transportation hazards are identified, or the individual's job assignment changes, necessitating training.
 - As determined necessary by the RSO or RPM.

NOTE: Training specified in Section 2.1 of this procedure shall be commensurate with the employee's assigned duties and responsibilities.

- All employees required to maintain radiation worker qualifications shall complete retraining annually (no later than 12 months from the initial or last retraining date). HP staff members (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 HP staff members.
- 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.

2.2 Responsibilities

Radiation Safety Officer (RSO)

- 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.
- Review the past experience of prospective HPTs to ensure that HPT qualifications meet the requirements of this procedure.
- Provide training to meet the requirements of this procedure.
- Approve all material presented in HP procedures, TES, and RWT.
- Approve the qualifications of individuals who present training material.

Radiation Protection Manager (RPM)

- Assume the roles and responsibilities of the RSO at a designated client site.
- Review and approve all material presented in applicable HSWPs.
- Review and maintain all site RPP documentation (e.g., site surveys and instrument paperwork).
- Maintain accountability of sources and perform semi-annual inventory.
- Maintain up-to-date radiological postings.
- The RPM responsibilities specifically exclude:
 - Establishment of, or approval to exceed, alternate administrative exposure limits;
 - Notifications to regulatory agencies;
 - Approval to dispose of radioactive material, including radioactive waste;
 - Approval authority for SSHPs; and,
 - Approval of HP procedures.

Transportation Representative (TR)

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

- 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.
- 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.

Health Physics Technicians (HPTs)

- Successfully qualify on the requirements of this procedure prior to performing HP tasks.

Project/Employee Supervisors (Radiation Worker and/or HAZMAT Employee Supervisors)

- Identify employees requiring access to a restricted area, ensuring SOT and RWT are scheduled and completed prior to unescorted restricted area access, and ensuring RWT is completed annually.
- Ensure HAZMAT employees receive training required by this procedure at the specified frequency.
- Restrict employees from access to a restricted area or work with hazardous materials, as applicable, if an employee's RWT or HAZMAT training expires.

Radiation Workers (including Health Physics Staff Members)

- Successfully complete SOT and RWT prior to unescorted Restricted Area access.
- Maintain current radiation worker qualifications (complete retraining annually) for the duration of time unescorted restricted area access is required. HP staff members maintain radiation worker qualifications through the maintenance of their individual training programs. Annual radiation worker retraining is not required.

HAZMAT Employees (including Health Physics Personnel)

- 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.
- 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.
- Perform only those functions/tasks trained to complete.
- Successfully complete retraining every 3 years to meet the requirements of 49 CFR 172, Subpart H.
- 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.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory

requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Not Applicable.

5. PROCEDURE

5.1 Overview

General Requirements

Prior to allowing unescorted access into a restricted area, personnel shall successfully complete SOT and RWT.

- 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.
- 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.

5.2 Details

Site Orientation Training (SOT)

- Employees shall successfully complete SOT prior to being allowed unescorted access to restricted areas of the site.
- SOT shall, at a minimum, contain the following information:
 - Names of site HP staff members and designees;
 - Hazards and symptoms of exposure to radiation and/or radioactive materials, including the contaminants present, exposure limits, required monitoring, and pregnancy concerns;
 - Site and task PPE, including training on correct use of PPE;
 - Safe work practices to minimize risk;
 - Safe use of engineering controls and equipment;
 - Medical surveillance requirements and employee medical/exposure records access;
 - Response to abnormal conditions, alarms, and/or other forms of emergency communications;
 - Content of the site emergency response plan, including actions to be taken by employees;
 - Site control measures; and
 - Reporting requirements.

Radiation Worker Training (RWT)

- Shall be completed prior to initial unescorted access to the restricted area and annually thereafter (every 12 months),

- Shall include a written examination in which the trainee is required to answer at least 70 percent of the questions correctly,
- Shall not be required for approved RWT instructors by virtue of their knowledge of the subject matter, and
- Shall contain the following topics at a minimum:
 - The provisions of applicable regulations (and the Leidos RPP and procedures) concerning occupational radiation protection, including employee rights and responsibilities, risks from occupational exposure to ionizing radiation, and prenatal exposure controls;
 - Radiological fundamentals;
 - Biological effects resulting from exposure to sources of ionizing radiation;
 - Exposure limits (administrative and regulatory), including employee responsibilities;
 - ALARA program;
 - Personnel monitoring;
 - Radiological access controls and postings;
 - Radioactive contamination control;
 - Radiological emergencies, including employee actions in the event of an emergency; and
 - 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 Leidos Transportation Security Plan, if applicable.
- RWT for employees at DOE sites, as well as other project sites involving work in contaminated areas, potential contaminated areas, work requiring access to HRAs and/or VHRA or other areas as determined by the RSO, shall include a practical factors evaluation. This shall include demonstration of the following:
 - Ability to read, understand, and comply with the requirement of an RWP or 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 in which the work will be performed;
 - Pre-job briefing requirements;
 - Engineering controls, if specified;
 - Protective clothing, other PPE, and dosimetry requirements;
 - HP 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.

- 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 HP 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; and
 - Demonstrate the ability to determine and record exposure.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RSO or RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations."
- 10 CFR 20, "Standards for Protection against Radiation."

- 49 CFR 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans," Subpart H, "Training."
- 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.
- ESE A17.1, "Project Records Management."*
- HP-01, "Health Physics Manual."**
- IATA 2014. International Air Transport Association. *Dangerous Goods Regulations*. 55th edition. January 1, 2014.
- NRC 1994. U.S. Nuclear Regulatory Commission. *Health Physics Positions (HPPS) Database*. NUREG/CR-5569. Revision 1. 1994.
- 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.
- USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Safety*. Engineer Regulation. ER 385-1-80. June 2010.
- 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.

* Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

** Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

9. ATTACHMENTS

- Attachment 1. Health Physics Training and Qualifications
- Attachment 2. Health Physics Required Reading
- Attachment 3. Health Physics Required Reading Log

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: HEALTH PHYSICS TRAINING AND QUALIFICATIONS**HEALTH PHYSICS TRAINING AND QUALIFICATIONS**

Technician Name (Print):	Employment Date:
Education/work history evaluation: Jr. HPT _____ Sr. HPT _____ HPS _____ TR _____ <i>Attach a copy of resume, work history evaluation, and supporting documents (e.g., TR training certificate, etc.).</i>	
Fundamental knowledge of HP 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 ^a				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.						
Set up and post a radiation area, contamination area, radioactive material area, and airborne radioactivity area.						
Perform job coverage in a radiation area and contamination area.						
Perform job coverage in an HRA, 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 and 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.						

^a 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.).

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

ATTACHMENT 2: HEALTH PHYSICS REQUIRED READING

HEALTH PHYSICS REQUIRED READING

Entire Staff HPS TR Sr. HPT Jr. HPT

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

ATTACHMENT 3: HEALTH PHYSICS REQUIRED READING LOG

HEALTH PHYSICS REQUIRED READING LOG

Entire Staff HPS TR Sr. HPT Jr. HPT

Signature indicates the subject document has been read.



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Personal Protective Equipment
HP-05, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

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1. PURPOSE

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

1.1 Scope and Limitations

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

This procedure applies to Leidos and subcontractor personnel implementing the Leidos Radiation Protection Program (RPP) who wear protective clothing in the performance of their work.

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

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.,

SSHP, Radiation Protection Plan, etc.).

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Doff – To remove protective clothing.

Don – To dress into protective clothing.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10⁻³) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10⁻³) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10⁻³) rem.

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.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a

manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Site Safety and Health Officer (SSHO) – An individual qualified by virtue of education, training, and experience to serve as safety and health lead for a designated site.

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation’s security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, “Qualifications and Training.”

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Prescribe protective clothing requirements.

Personal Protective Equipment (PPE) Wearers

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

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE**5.1 Overview****General Requirements**

- 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 HSWP system.
- PPE requirements will be communicated by: an HSWP, SSHP, area postings, or verbally.
- 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 SSHO, as applicable.
- The PPE wearer will check each PPE item for defects (i.e., tears, holes, defective zippers, etc.) prior to donning. Defective items will be discarded.

5.2 Details**Donning PPE**

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

- Secure dosimetry to the appropriate body location. Dosimetry should be worn under coveralls unless directed otherwise by the RPM.
- Place booties over personal shoes.
- Put on inner gloves.
- Put on coveralls. Tape the coverall cuffs over the booties, as directed by HSWP requirements.
- Place rubber shoes over the booties.
- Don respirator.
- Put on the hood, and secure it to the coveralls.
- Put on required gloves over the cotton glove liners, and tape them over sleeves of the coveralls.

Doffing PPE

- Remove all protective clothing prior to exiting the contamination area.
- Reusable and disposable PPE should be placed in separate containers.
- 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.
 - Remove tape securing protective clothing.
 - Remove rubber shoe covers.
 - Remove outer rubber gloves.
 - Remove cloth hood.
 - Remove respirator.
 - Remove dosimetry and place it outside the contamination area.
 - Remove coveralls.
 - Remove disposable shoe covers, one at a time, placing one foot at a time onto an uncontaminated area.
 - Remove inner gloves.
 - Perform required surveys in accordance with HP-12, "Health Physics Oversight."

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

7. RECORDS

No records are generated by this procedure.

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- 29 CFR 1910, Subpart I, "Personal Protective Equipment."
- HP-01, "Health Physics Manual."^{*}
- HP-03, "Radiological Limits."^{*}
- HP-04, "Qualifications and Training."^{*}
- HP-12, "Health Physics Oversight."^{*}
- HP-21, "Health and Safety Work Permits."^{**}

* Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

Not Applicable.

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Radiological Respiratory Protection
HP-06, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

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1. PURPOSE

This health physics (HP) procedure contains the basic concepts and criteria for a radiological respiratory protection program.

1.1 Scope and Limitations

- This procedure will be used as a supplement to the *Leidos Corporate Environmental, Health and Safety Program Manual*, Environmental Health and Safety (EHS) procedure EHS-9, "Respiratory Protection," when implemented for the protection of personnel from airborne radioactive material.
- This procedure applies to Leidos and subcontractor personnel working under the Leidos Radiation Protection Program (RPP).
- This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.
- 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.
- The use of atmosphere-supplying respirators, self-contained breathing apparatus, and emergency use respiratory protection equipment (RPE) is beyond the scope of this procedure.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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 (CEDE) equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

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.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Depleted Uranium (DU) – Uranium with a percentage of uranium-235 lower than the 0.7 percent (by mass) contained in natural uranium. (The normal residual uranium-235 content in DU is 0.2 to 0.3 percent, with uranium-238 comprising the remaining 98.7 to 98.8 percent.) DU is produced during uranium isotope separation and is typically found in spent fuel elements or byproduct tailings or residues. DU can be blended with highly enriched uranium, such as that from weapons, to make reactor fuel.

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 m³ of air/hour), results in an intake of one ALI.

Disintegrations per Minute (dpm) – The average quantity of radiological disintegrations (i.e., transformations) occurring per minute as a result of the spontaneous emission from the atomic nuclei of either alpha or beta particles.

Environmental Health and Safety (EHS) – The department in a company or an organization involved in **environmental** protection, **safety** at work, occupational **health and safety**, compliance, and best practices. The EHS department aims to prevent and reduce accidents, emergencies, and health issues at work.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10⁻³) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Occupational Safety and Health Administration (OSHA) – A governmental organization within the U.S. Department of Labor created by the U.S. Congress with the Occupational Safety and Health Act of 1970 to ensure safe and healthful working conditions by establishing and enforcing standards and by providing training, outreach, education, and assistance.

Personal Protective Equipment (PPE) – Equipment worn to minimize exposure to serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. PPE may include items such as gloves; safety glasses; safety shoes; earplugs or muffs; hard hats; respirators; or coveralls, vests, or full body suits.

Qualitative Fit Test (QLFT) – An assessment of the adequacy of respirator fit based on a pass/fail fit test that relies on the individual's response to the test agent. Given the subjective test relies on the worker's sense of taste or smell, Occupational Safety and Health Administration (OSHA) regulations limit the use of qualitative testing to respirators that require an Assigned Protection Factor of 100 or less.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

Quantitative Fit Test (QNFT) – An assessment of the adequacy of respirator fit performed by numerically measuring the amount of leakage into the respirator.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, "Qualifications and Training."

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

RESidual RADioactivity (RESRAD)-BUILD – A computer code that is a pathway analysis model designed to analyze the radiological doses resulting from the remediation and occupancy of buildings contaminated with radioactive material.

Respiratory Protective Equipment (RPE) – Devices used to reduce the concentration of airborne contaminants being inhaled. These devices can be either air-purifying respirators that use filters, cartridges, or canisters to remove contaminants from the air you breathe; or supplied air respirators that provide the wearer with clean air from an uncontaminated source.

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.

Site Safety and Health Officer (SSHO) – An individual qualified by virtue of education, training, and experience to serve as safety and health lead for a designated site.

Site Safety and Health Plan (SSHP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

U.S. Nuclear Regulatory Commission (technical report designation) (NUREG) – A report or brochure on regulatory decisions, results of research, results of incident

investigations, and other technical and administrative information.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

Personnel wearing respirators must be trained in respiratory protection, be medically cleared to wear respirators, and must be fit tested for the respirators they wear in accordance with a respiratory protection program that meets the requirements of 29 CFR 1910.134 (e.g., Leidos EHS-9, "Respiratory Protection").

2.2 Responsibilities

Radiation Protection Manager (RPM)

- 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.
- 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.
- Respiratory protection is indicated on the HSWP when required for radiological purposes.
- Radiological air sampling is performed and DAC-hours are tracked as required by HP-11, "Radiological Monitoring."
- The site bioassay program is implemented in accordance with HP-40, "Personnel Exposure Monitoring," to ensure that the respiratory protection program is effective.
- For sites regulated by the NRC, the regional administrator of the appropriate NRC regional office is notified in writing at least 30 days before the date RPE is used for the purpose of limiting intakes of radioactive material.
- The respiratory protection program is implemented, in accordance with Leidos EHS-9, "Respiratory Protection," including:
 - RPE procurement,
 - Respirator issuance,
 - Respirator maintenance,
 - Respirator selection (when not used for radiological protection),
 - Respirator use,
 - Respirator cleaning and disinfection,
 - Respirator equipment return,
 - Respiratory training program implementation,
 - Respirator fit testing,
 - Respiratory protection program surveillances, and
 - Medical surveillance.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted under this program are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into

site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

General Requirements

- Unwarranted use of RPE shall not be permitted and is considered contrary to the ALARA principle due to the increased time required to perform individual tasks and the increase in physiological stress.
- 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.
- When process or engineering controls are not practical to eliminate exposure to airborne radioactive materials and radiation dose rates, ALARA assessments will consider exposure and total risks with and without RPE.
- 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.

5.2 Details

Hazard Assessment

- 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:
 - Survey and bioassay results as necessary to evaluate intakes,
 - Radioactive material sampling results,
 - Removal efficiency of ventilation controls,
 - Removable contamination levels,
 - Radionuclides,
 - Re-suspension factors,
 - Area dose rates,
 - General conditions, including equipment and materials used and worker activity,
 - 10 CFR 20-DACs,
 - The APF for the respirator, and
 - Feasibility of engineering controls to reduce employee exposure to below the exposure limit.

- 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. If the radionuclide of concern is not included in Table 1, the RPM shall calculate the action level for that radionuclide. In the event the action levels are exceeded for work that was not expected to reach the action level, a stop work order shall be initiated so 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.
- 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.
- 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.
- Active processing areas must be decontaminated following any work activity that results in loose surface contamination levels of 10,000 (dpm)/100 cm² beta-gamma and/or 2,000 dpm/100 cm² alpha. If the alpha activity is known to be natural uranium or DU, the beta-gamma action level of 10,000 dpm/100 cm² may be used at the discretion of the HPT for the area.

Table 1. Removable Contamination Action Levels

Radionuclide^a	Action Level^b (dpm/100 cm²)
Americium 241	3.0E+04
Cobalt 60	7.4E+07
Cesium 137	4.3E+08
Iodine 129	7.6E+07
Iodine 131	1.5E+11
Neptunium 237	2.4E+04
Plutonium 238	3.4E+04
Plutonium 239	3.1E+04
Plutonium 240	3.1E+04
Radium 226	1.5E+06
Radium 228	3.2E+05
Strontium 90	1.0E+07
Thorium 228	6.3E+04
Thorium 230	4.0E+04
Thorium 232	8.0E+03
Uranium 234	1.0E+05
Uranium 235	1.1E+05
Uranium 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.

Fit Testing

- A QNFT or QLFT shall be performed if the respirator will be used for the purpose of protecting individuals from airborne radioactive material.
- QNFTs shall achieve an APF of at least 1,000.
- Documentation of QNFT results shall be provided by the QNFT testing vendor.

- QLFTs are authorized for use with negative-pressure respirators only.
- A successful QLFT for a full-face, negative-pressure respirator is assumed to achieve an APF of 100.

APFs

- APFs for respirators are prescribed in 10 CFR 20, Appendix A.
- No adjustment is to be made for the use of sorbents against radioactive material in the form of gases or vapors.
- For particulates, the APF for a full-face, negative-pressure respirator that successfully achieves the QLFT is 100.
- 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.
- 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 maintaining the TEDE ALARA, the RPM may select RPE with a lower APF.
- 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.

Respirator Issuance

- Respirators may be issued to qualified individuals either long term or on a daily basis, as determined by the RPM and SSHO.
- Utilize Attachment 1, Radiological Respiratory Protection Issue Log, (or equivalent) to document the issuance of RPE.
- 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.

Additional Guidance

The RPM may use references listed in Section 8 of this procedure (as appropriate) as additional guidance for implementation of the respiratory protection program.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by RPM until submission to the appropriate electronic record facility in accordance with ESE, A17.1

"Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- 10 CFR, Chapter III, DOE, Part 835, "Occupational Radiation Protection."
- 29 CFR 1910.134, "Respiratory Protection."
- EHS-9, "Respiratory Protection Program."*
- ESE A17.1, "Project Records Management."**
- HP-01, "Health Physics Manual."***
- HP-04, "Qualifications and Training."**
- HP-11, "Radiological Monitoring."***
- HP-40, "Personnel Exposure Monitoring."***
- NRC 1999. U.S. Nuclear Regulatory Commission. *Acceptable Programs for Respiratory Protection*. Regulatory Guide 8.15. Revision 1. October 1999.
- NRC 2001. U.S. Nuclear Regulatory Commission. *Manual of Respiratory Protection against Airborne Radioactive Materials*. NUREG/CR-0041, Revision 1. January 2001.
- USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Safety*. Engineer Regulation. ER 385-1-80. June 30, 2010.
- 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.

* Refer to <https://prism.leidos.com/docs/DOC-18653> for the current version of EHS referenced procedures in the *Corporate Environmental Health and Safety Program Manual*.

** Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

*** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Respiratory Protection Issue Log

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: RESPIRATORY PROTECTION ISSUE LOG

RESPIRATORY PROTECTION ISSUE LOG

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

COMMENTS:

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REVIEWED BY: _____ **DATE** _____



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Personnel and Equipment Decontamination
HP-10, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

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1. PURPOSE

This health physics (HP) procedure establishes guidelines for performing and documenting decontamination of personnel and equipment.

1.1 Scope and Limitations

This procedure applies to decontamination at sites implementing the Leidos Radiation Protection Program (RPP).

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

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.

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

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Disintegrations per Minute (dpm) – The average quantity of radiological disintegrations (i.e., transformations) occurring per minute as a result of the spontaneous emission from the atomic nuclei of either alpha or beta particles.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10^{-3}) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

High-Efficiency Particulate Air (HEPA) filter – Filters designed and constructed to remove a minimum of 99.97 percent of a broad range of airborne contaminants with an activity median aerodynamic diameter of 0.3 micrometers.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Restricted Area – A radioactive 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.

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation’s security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, “Qualifications and

Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Verify compliance with this procedure during planned and periodic audits of the radiation safety program.
- Review incidents involving contamination pursuant to HP-22, "Radiological Reporting."

Health Physics Technicians (HPTs)

- Perform personnel decontamination in accordance with the requirements of this procedure.
- Direct equipment decontamination in accordance with the requirements of this procedure.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

General Requirements

- Personnel or equipment shall be considered contaminated if any surface exceeds the contamination limits specified in HP-03, "Radiological Limits."
- Surveys shall be performed and documented pursuant to HP-11, "Radiological Monitoring."
- Following decontamination, surfaces shall be resurveyed to determine if the surfaces meet release criteria.
- Personnel performing decontamination shall wear protective clothing appropriate for the levels of contamination encountered.
- Decontamination shall be performed starting at areas of low contamination levels and moving to higher levels of contamination.
- The RPM shall be notified of all personnel contamination incidents.

5.2 Details

Personnel Decontamination

- 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.

- 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.
- The temperature of personnel decontamination water should be lukewarm.
- Decontaminate skin in the following manner:
 - Survey the affected area to determine the magnitude and extent of the contamination. Document initial survey results on Attachment 1, Personnel Contamination Report, of HP-11, "Radiological Monitoring" (and/or equivalent forms).
 - Wash the affected area thoroughly using soap and water (or, if water is not available, wipe the area with pre-moistened towelettes).
 - If multiple washings are not effective, consider wrapping the affected area in plastic to induce sweating.
 - Continue the decontamination effort until the contamination has been removed. If the contamination cannot be removed, contact the RPM.
- During the decontamination process, care must 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.

- 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.
- All contamination incidents shall be documented on Attachment 1, Personnel Contamination Report, of this procedure (and/or Attachment 1 of 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.
- 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.
- If personnel contamination activity in excess of 15,000 dpm/100 cm² is encountered, save the decontamination materials for lab analysis to support a skin dose evaluation, at the direction of the RPM.

Personal Clothing Decontamination

Personal clothing may be decontaminated by the following methods:

- Attempt to remove the contamination by tape press.
- Send the contaminated item to a licensed laundering vendor.
- With the owner's permission, cut out the contaminated areas of the clothing or shoes, and dispose of as radioactive waste.
- Other appropriate methods as determined by the RPM.

Equipment Decontamination

- Equipment shall be decontaminated in a restricted area.
- Loose contamination may be removed from equipment surfaces by one of the following methods:
 - Wipe the surface with a moist rag.
 - Vacuum the surface with a HEPA filter equipped vacuum.
 - Spray the equipment with pressurized hot water/steam.
- Liquid waste generated during decontamination shall be collected, so the liquids may be contained, unless waived by the RPM.
- Fixed contamination may be eliminated by removing the top surface layer using abrasive means (i.e., angel grinder, disc sander, sand blaster, etc.).

7. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

8. RECORDS

All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

9. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- ESE A17.1, "Project Records Management."*
- HP-01, "Health Physics Manual."**
- HP-03, "Radiological Limits."**
- HP-04, "Qualifications and Training."**
- HP-11, "Radiological Monitoring."**
- HP-22, "Radiological Reporting."**
- USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Protection*. Engineer Regulation. ER 385-1-80. June 30, 2010.
- 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.

* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

10. ATTACHMENTS

- Attachment 1. Personnel Contamination Report
- Attachment 2. Personnel Contamination Report Log

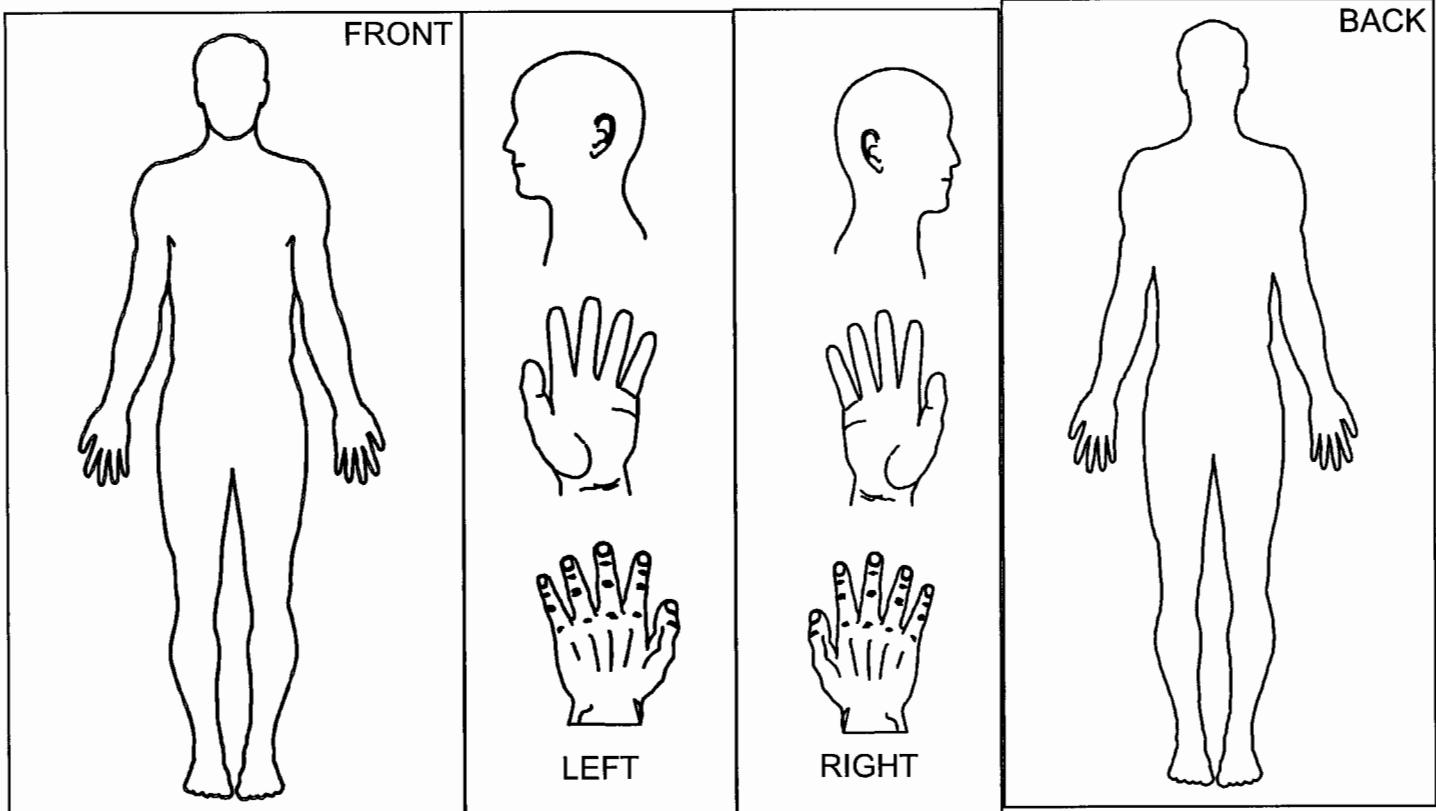
11. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: PERSONNEL CONTAMINATION REPORT**PERSONNEL CONTAMINATION REPORT**

Site: _____

Employee Name	SSN	Company	Date/Time of Occurrence
Health and Safety Work Permit (HSPW) NO.	Inst. Type: _____ Inst. Type: _____	Serial Number: _____ Serial Number: _____	Calibration Due Date: _____ Calibration Due Date: _____



INDICATE THE CONTAMINATED AREAS IN THE DIAGRAM ABOVE

SPECIFY CALCULATED ACTIVITY IN UNITS OF dpm/100 cm²

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: _____

ATTACHMENT 2: PERSONNEL CONTAMINATION REPORT LOG

PERSONNEL CONTAMINATION REPORT LOG

Site: _____ **Year:** _____

REVIEWED BY _____ DATE _____



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Radiological Monitoring
HP-11, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

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1. PURPOSE

The purpose of this health physics (HP) procedure is to provide guidelines for performance and documentation of radiological surveys and sampling.

1.1 Scope and Limitations

This procedure applies to all areas of a site implementing the Leidos Radiation Protection Program (RPP), including those areas in which radioactive materials are not normally stored or handled.

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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
- 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.

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.

All-Terrain Vehicle (ATV) – As defined by the American National Standards Institute (ANSI), an ATV is a vehicle that travels on low-pressure tires, with a seat that is straddled by the operator and handlebars for steering control. As the name implies, an ATV is designed to handle a wider variety of terrain than most other vehicles. Although an ATV is a street-legal vehicle in some countries, it is not street-legal within most of the United States and Canada.

American National Standards Institute (ANSI) – The primary organization for fostering the development of technology standards in the United States. The ANSI works with industry groups and is the U.S. member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

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.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

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.

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.

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

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

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 0.25 inch from the surface or equipment.

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.

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., SSHP, radiation

protection plan, etc.).

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

Counts per Minute (cpm) – A unit of measure for the average quantity of activity units (i.e., disintegrations/transformations) detected per minute.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

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 m³/hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of Appendix B of 10 CFR 20.

Disintegrations per Minute (dpm) – The average quantity of radiological disintegrations (i.e., transformations) occurring per minute as a result of the spontaneous emission from the atomic nuclei of either alpha or beta particles.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

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 (mrem)/hour or microroentgen (μ R)/hour.

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

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10^{-3}) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

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

International Electrotechnical Commission (IEC) – A standards body that publishes international standards for electrical, electronic, and related technologies.

International Organization for Standardization (ISO) – An independent, non-governmental international organization that brings together experts to share knowledge, develop, and publish voluntary, consensus-based, market-relevant international standards that support innovation and provide solutions to global challenges. ISO, the shortened form of the organization's name, is not an acronym; rather, ISO is derived from the Greek term isos, meaning equal.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

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).

Microroentgen (μR) – A unit of measure equal to one-millionth (10^{-6}) roentgen.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Milliroentgen (mR) – A unit of measure equal to one-thousandth (10^{-3}) roentgen.

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

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.

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.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, "Qualifications and Training."

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation

protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radiation Survey Instrument – Portable radiation detection and measurement instruments used to check personnel, equipment, land areas and facilities for radioactive contamination.

Radioactive Material Storage Area (RMSA) – An administratively designated area in which radioactive material is stored and controlled.

Radiological Control Technician (RCT) – An individual qualified by education, training, and experience to meet the requirements for designation as an RCT. (See Senior [Level] Health Physics Technician [Sr. HPT]).

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

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

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.

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.

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.

Senior (Level) Health Physics Technician (Sr. HPT) – An individual qualified by virtue of training, education, and experience to perform the functions of a Sr. HPT. A Sr. HPT is also commonly referred to as a RCT.

Shallow Dose Equivalent (SDE) – The dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm² when applied to the external exposure of the skin or extremity.

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

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

- Unanticipated conditions arise that would result in a significant increase in radiological or industrial safety hazards.
- Working conditions have degraded to the point that the work is not performed

- consistent with the ALARA concept.
- The potential for deterioration of occupational safety exists if the job is continued.
- The work practices may result in violation of regulatory or NRC license requirements or radiation protection procedures.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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

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.

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Assure that all radiological monitoring surveys (i.e., contamination, radiation, airborne concentration, etc.) are performed pursuant to this procedure.
- Verify compliance with this procedure during planned and periodic surveillances of the RPP.
- Specify the types and frequency of air sample collection.
- 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.
- Ensure that radiological monitoring survey documentation is reviewed in accordance with the requirements of this procedure.

Health Physics Technicians (HPTs)

- Perform all radiological monitoring surveys (i.e., contamination, radiation, airborne concentration, etc.) in accordance with the provisions of this procedure.
- Perform air sampling as required by this procedure.
- Perform air sample evaluation as required by this procedure.
- Conduct routine surveillance surveys in accordance with the provisions of HP-12,

“Health Physics Oversight.”

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, health and safety work permits [HSWPs], etc.).

5. PROCEDURE

5.1 Overview

General Requirements

- Maintain exposures ALARA when conducting radiological monitoring surveys.
- Instrumentation referenced in this procedure is to be prepared for use, and used, in accordance with HP-30, “Radiological Instrumentation.”
- Performance requirements for coverage, release, and routine surveillance surveys are defined in HP-12, “Health Physics Oversight.”
- Radiological monitoring surveys shall be performed, as appropriate, to:
 - Establish and maintain HSWPs.
 - Determine whether the confinement of radioactive materials is effective.
 - Measure airborne radioactivity concentrations, radioactive contamination, and radiation levels in the workplace.
 - Estimate worker intakes and/or exposures to radiation.
 - Determine posting requirements.
 - Determine appropriate protective equipment and measures.
 - Warn of elevated radiation, contamination, and/or airborne radioactivity levels.
 - Investigate emergency situations.
 - Investigate abnormal conditions.
 - Release material or equipment for unrestricted use or disposal.
 - Investigate anticipated or changing radiological conditions.
 - Comply with other radiation protection procedures.
 - Comply with regulations or NRC license requirements.
 - Investigate radiological conditions in accordance with HP-12, “Health Physics Oversight,” Attachment 5, Routine Surveillance Frequency.
- In addition to surveys required by the Routine Surveillance Surveys subsection of Section 5.2 of this procedure, the following air sample surveys shall be required:
 - To monitor airborne concentrations of radioactive material to uncontrolled areas (for non-occupational exposure to members of the public), as directed by the RPM.
 - To monitor airborne concentrations of radioactive material in work areas in

- which personnel exposure is likely to exceed 500 mrem/year CEDE, as determined by the RPM.
- To monitor airborne concentrations of radioactive material in work areas in which personnel exposure is not likely to exceed 500 mrem/year CEDE, as determined by the RPM, for the purpose of routine surveillance in accordance with the Routine Surveillance Surveys subsection of Section 5.2 of this procedure.
 - During entries into airborne radioactivity areas.
 - Whenever respirators are worn for the purpose of protecting individuals from airborne radioactive material exposure.
 - As determined by the RPM.
- Each survey shall be planned with regard to:
 - Specific radiation types.
 - Predetermined radiation levels, contamination levels, or airborne concentrations.
 - Locations at which the radiation, contamination, and/or airborne radioactive material is expected.
 - The minimum detection sensitivity for each survey (i.e., survey instrument MDA or MDC based on survey parameters such as instrument background, scan speed, count time, etc.).
 - Radiation and contamination surveys shall be documented on Attachment 1, or equivalent.
 - The RPM, or designee, establishes, and makes 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, "Radiological Limits," Attachment 2, Site Limits.
 - 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 AE concentration, if practical.
 - Airborne radioactive material surveys shall be documented on Attachment 4, or equivalent.
 - The RPM shall evaluate the need for personnel radiation exposure monitoring in accordance with HP-40, "Personnel Radiation Exposure Monitoring."
 - Surveys shall be signed by the individual(s) who performed the survey, and reviewed by the RPM or designee.

5.2 Details

General Area Radiation Surveys 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.
- 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 in which personnel may be working or standing near surfaces that contribute to whole body exposure.
- 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 in which the increased response is noted in order to confirm the response.

- General area surveys will include normally accessible areas in which personnel may be working or standing near surfaces that contribute to whole body exposure.
- Obtain a representative number of general area radiation readings at knee level when the source of radiation is below waist level (i.e., RMSAs). Note the position of the reading on the radiation survey form (i.e., knee level).
- Document radiation levels on Attachment 1, or equivalent. Any comments and notations that may be necessary for interpretation of results will be recorded on the survey form.

Contact Radiation Surveys

- 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.
- Contact surveys should be taken so the detector housing is within 0.25-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.
- A general area survey should be performed each time contact dose rates are measured, as appropriate.
- Dose rate contributors shall be clearly identified on the survey form (i.e., bags, drums, piping, equipment, etc.).

Beta Radiation Surveys

- Beta dose rate contribution is determined by calculating the open window reading and closed window reading difference, multiplied by the appropriate beta correction factor.
- Beta radiation surveys shall be conducted in locations at which bulk beta-emitting radioactive materials are being used, handled, or stored, as determined necessary by the RPM.
- 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.

Removable Contamination (Smear) Surveys

- Smear surveys shall be performed to assess removable contamination on vehicles, equipment, structures, bench tops, fume hoods, and other items.
- Using moderate pressure, wipe the smear over an area of 100 cm². A 100-cm² area is approximated by a 4-inch square or an 18-inch "S" shaped wipe.
- Ensure sufficient quantities of smears are taken to adequately assess the magnitude and extent of contamination.
- Individual smears placed in a sample holder (e.g., smear booklet or glassine envelope) must be separated from each other to prevent cross contamination.
- 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.
- Smear results (i.e., gross cpm) shall be converted to dpm/100 cm², as applicable, in accordance with Attachment 3, Equations 1 and 2. Items with total surface area less than 100 cm² shall be smeared over the entire surface and

- documented as dpm/item. Smear results shall be recorded on Attachment 1 (or equivalent).
- 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.
 - The RPM shall review survey data and implement appropriate controls (i.e., respiratory protection, protective clothing, area entry restrictions, etc.) as necessary.

Total Contamination (Direct Frisk) Surveys

- Direct frisk surveys shall be performed to measure total (fixed plus removable) surficial contamination on personnel, vehicles, equipment, structures, and other items.
- Direct frisk surveys shall be performed with a portable survey instrument (e.g., Geiger Mueller detector, dual-phosphor scintillation detector, gas flow proportional detector, etc.) that is sensitive to the type of radiation expected to be encountered.
- Direct frisk scan surveys shall be conducted by moving the detector at 1 to 2 inches/second and with the active area of the detector at 0.25-inch (alpha) and 0.5-inch (beta) from the surface of interest, as applicable.
- When an increased instrument count rate is detected, the surveyor shall pause to allow the instrument response to stabilize.
- Direct frisk activity (in dpm/100 cm²) shall be calculated in accordance with Attachment 3, Equations 1, 2, and 3.
- Alternate scan speed and/or distance may be implemented at the discretion of the RPM.
- Scan area coverage for release surveys of equipment and materials shall be 100 percent of accessible areas unless otherwise specified by the RPM.
- A fixed-point (stationary) measurement shall be performed for locations at which elevated activity was noted (and confirmed) during a scan survey.
- Survey results shall be recorded on Attachment 1 (or equivalent).
- 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.

Personnel Release Surveys

- A radiological survey is required upon exit from any potentially contaminated area, as determined by the RPM or designee.
- 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, will determine scan area coverage by evaluating the level of removable contamination in the work area, and the likelihood of contact with the contamination.
- 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.

Release Surveys of Equipment/Materials for Unrestricted Use

- Equipment and materials being surveyed for unrestricted release shall be surveyed in accordance with the Removable Contamination (Smear) Surveys and the Total Contamination (Direct Frisk) Surveys subsections of Section 5.2 of this procedure (total and removable contamination surveys).
- Equipment/material release surveys shall be documented on Attachment 1 (or equivalent).
- Release surveys shall be conducted by a Sr. HPT or under the direction of a Sr. HPT.

Airborne Particulate Sampling

- Airborne particulate radioactivity shall be determined using an air pump connected to a filter cartridge.
- In order to meet MDA requirements, verify the required minimum air sample volume from Attachment 2, Site Limits, of HP-03, "Radiological Limits," prior to collecting an air sample, and document the minimum air sample volume on Attachment 4 (or equivalent) of this procedure.
- The flow rate to be used for calculations should be the average of the pre- and post-sampling flow rates.
- The filter cartridge shall contain a membrane filter, rather than a glass fiber filter, unless specified by the RPM.
- Air shall be drawn through the filter for the duration of monitoring, or until visible dust loading or decreased flow is noted.
- The following information is 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.
- 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.

Air Sample Types

- When occupational air sampling is required in the workplace, the RPM shall specify the type of occupational air sample that is required, including:
 - A 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.
 - A general area 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.
 - A work area sample is temporary in nature and is obtained when a sample would be (conservatively) representative of a work crew. The sample will be obtained between the source of airborne exposure and the BZ of the individual with the highest likelihood for exposure. For example, an air sample placed near a drilling mast (or in the BZ of the individual handling the augers) would provide a conservative estimate of exposure for the entire drilling crew.
 - In situations in which a potential exists for accidents to cause intakes exceeding 40 DAC-hours in one day, continuous air monitoring shall be conducted. Monitoring may be performed through the use of BZ, general

- area, or work area samples, as determined appropriate by the RPM.
- 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.

Air Sample Evaluation

- 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.
- 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 to 14 days after collection for accurate indication of actual air concentrations without radon and/or thoron interference.
- In situations in which a potential exists for intakes to exceed 40 DAC-hours in 1 week, air samples will be screened on a daily basis (credit may be taken for assigned protection factors (APFs) if respirator protection is worn).
- Screening air sample results greater than 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.
- 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.
- 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:
 - Place the air sample filter on the count tray, taking care not to disturb the active surface of the filter.
 - Close and lock the count tray,
 - Ensure the sample count time is set correctly to satisfy MDA requirements.
 - Count the sample.
 - Record the results of the count on Attachment 4 (or equivalent).
 - Calculate the air sample activity and DAC-hours in accordance with Attachment 3, Equations 10 and 12, respectively.
 - Document air sample activity and DAC-hours on Attachments 4 and 5, respectively. Equivalent forms may be used at the discretion of the RPM.
- Air samples may also be evaluated (counted) by other methods or sent to a qualified vendor as determined appropriate by the RPM.

DAC-Hour Tracking

- The HPTs shall complete Attachment 5, DAC-Hour Tracking (or equivalent) when:
 - Air monitoring (i.e., required internal monitoring) is conducted.
 - DAC-hour tracking is not required for air sampling conducted solely for routine surveillance purposes.
- DAC-hours should be calculated using formal air sample results.
- All individuals that were in the sampled area during the time frame of the air

- sample shall be entered on Attachment 5 (or equivalent).
- 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-hour tracking results may be maintained by transferring dose information to an electronic dose-tracking database, as determined by the RPM.

Routine Surveillance Surveys

- Routine surveillance surveys shall be conducted to verify that the radiological controls implemented by this Leidos RPP are sufficient to prevent the spread of contamination, generation of airborne radioactivity, or radiation levels greater than 2 mrem/hour outside controlled areas.
- Routine surveillance surveys shall be conducted by HPTs in accordance with the requirements set forth in HP-12, "Health Physics Oversight."

Walkover Surveys

- 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.
- Walkover surveys should be conducted by moving the detector at a rate that does not exceed 1.5 ft/second at 4 inches from the surface.
- An increase in the instrument response or in the needle/indicator movement may indicate the presence of radioactivity above background. The instrument must be held stationary for a time period determined appropriate by the RPM, or designee, at locations at which the increased response is noted in order to determine if the response is above or below the site investigation level.
- Alternate scanning speed, scanning distance, or modes of transport (e.g., ATV) may be implemented, as long as survey data quality objectives are met, at the discretion of the RPM.
- 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.

Radiological Sampling

- Samples (i.e., water, soil, etc.) shall be collected in accordance with the provisions of a site-specific sampling plan, or equivalent document.
- A chain-of-custody record shall be initiated by the individual collecting or overseeing the collection of samples.
- A copy of the chain-of-custody form shall accompany the samples throughout transportation and analyses.
- Any break in custody or evidence of tampering shall be documented and may compromise the validity of the sample results.
- Sample custody shall be assigned to one individual at a time in order to prevent confusion of responsibility.
- Custody is maintained when:
 - The sample is under direct surveillance by the assigned individual.
 - The sample is maintained in a tamper-free or tamper-evident container.
 - The sample is within a controlled-access facility.
- Samples submitted to a radioanalytical laboratory will be accompanied by a Request for Analysis form used by the laboratory, if required.

- The radioanalytical laboratory shall have written procedures that document the laboratory's analytical capabilities for the requested analysis and a QA/QC program that assures the validity of the analytical results.

Additional Guidance

- The RPM may use the references contained in Section 8 of this procedure as additional guidance to determine appropriate elements of the Radiological Monitoring Program for specific client facilities or sites.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

- The RPM shall maintain records of surveys and calibrations required by this procedure for 3 years after the record is made.
- 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:
 - External dose (i.e., DDE, SDE, LDE, dose to extremities, etc.) from radiation sources external to the body;
 - Internal dose (i.e., CEDE, CDE) from the intake of radioactive materials;
 - The release of radioactive effluents to the environment; and
 - Compliance with the dose limit for members of the public.
- All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- ESE A17.1, "Project Records Management."*
- HP-01, "Health Physics Manual."**
- HP-03, "Radiological Limits."**
- HP-04, "Qualifications and Training."**
- HP-10, "Personnel and Equipment Decontamination."**
- HP-20, "Radiological Posting and Labeling."**
- HP-30, "Radiological Instrumentation."**
- HP-40, "Personnel Radiation Exposure Monitoring."**
- 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.
- NRC 1981. U.S. Nuclear Regulatory Commission. *Radiation Safety Surveys at Medical Institutions*. Regulatory Guide 8.23. Revision 1. January 1981.
- NRC 1992. U.S. Nuclear Regulatory Commission. *Air Sampling in the Workplace*.

Regulatory Guide 8.25. Revision 1. June 1992.

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

* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Leidos Radiological Survey Report
- Attachment 2. Leidos Radiological Survey Report Walkover Surveys
- Attachment 3. Radiological Survey Calculations
- Attachment 4. Air Sample Report
- Attachment 5. DAC-Hour Tracking

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: LEIDOS RADIOLOGICAL SURVEY REPORT

LEIDOS RADIOLOGICAL SURVEY REPORT

LEIDOS RADIOLOGICAL SURVEY REPORT (Supplement)

LEIDOS RADIOLOGICAL SURVEY REPORT (Map)

SURVEY LOCATION:	HSPW:	Page	of
LEGEND: (Fill in blank) _____ = Smear Location	DATE:	TIME:	
REMARKS:			
TECHNICIAN(S) SIGNATURE/DATE:	/	/	
REVIEWER SIGNATURE/DATE:	/		

ATTACHMENT 2: LEIDOS RADIOLOGICAL SURVEY REPORT WALKOVER SURVEYS**LEIDOS RADIOLOGICAL SURVEY REPORT WALKOVER SURVEYS****SURVEY LOCATION:**

DATE:	TIME:	HSPW:
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PURPOSE OF SURVEY:

<u>Instrument Type(s):</u> (✓ if used)	<u>Serial Number:</u> (meter/detector)	<u>Cal Due Date:</u> (meter-detector)	<u>Background:</u> (CPM $\alpha/\beta\gamma$)	<u>Efficiency (%)</u> ($\alpha/\beta\gamma$)
Ludlum 2221/44-10				N/A

REMARKS:

TECHNICIAN(S) SIGNATURE/DATE:	/	/	/
-------------------------------	---	---	---

REVIEWER SIGNATURE/DATE:	/
--------------------------	---

ATTACHMENT 3: RADIOLOGICAL SURVEY CALCULATIONS**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

dpm = disintegrations per minute

Ludlum 44-9 probe area = 15.5 cm^2 ε_i = instrument efficiency (cd^{-1})Ludlum 43-89 probe area = 125 cm^2 DA = detector area (cm^2)Ludlum 43-5 probe area = 76 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 is 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 is used to calculate the minimum detection capability of an instrument.

Portable Counter (time count) Minimum Detectable Activity (MDA)
 (Equation 6)

$$MDA \text{ (dpm/100 cm}^2\text{)} = \frac{L_D}{[DA][\epsilon_i][\epsilon_s][T]} \times \frac{100 \text{ cm}^2}{100 \text{ cm}^2}$$

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)

$$\text{Smear MDA (dpm/100 cm}^2\text{)} = \frac{L_D}{(T)(\epsilon_i)}$$

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 ($1-\beta$) 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 NRC Regulatory Guide 1507 (Table 6.5 in the *Multi-Agency Radiation Survey and Site Investigation Manual [MARSSIM]*).

$$\text{MDCR (cpm)} = s_i \times (60/i)$$

Finally, the scan MDAs for surfaces may be calculated:

$$\text{Scan MDA} = \frac{\text{MDCR}}{\sqrt{p} \epsilon_i \epsilon_s DA} \times \frac{100 \text{ cm}^2}{100 \text{ cm}^2}$$

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)

$$\text{Air Sample Activity } (\mu\text{Ci/ml}) = \frac{(\text{NCPM})}{(\varepsilon_i)(\varepsilon_c)(V)(2.22 E^9)}$$

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)

$$\text{DAC Fraction} = \frac{\text{Air Sample Activity } (\mu\text{mL})}{\text{Site (alpha or beta) DAC Value } (\mu\text{Ci/mL})}$$

DAC = derived air concentration

DAC-hours
 (Equation 12)

$$\text{DAC-hours} = (\text{DAC Fraction}) * (\# \text{ hours in monitored work area})$$

Dose Equivalent
 (Equation 13)

$$\text{CEDE} = \text{DAC - hrs} \times 2.5 \frac{\text{mrem}}{\text{DAC - hr}}$$

CEDE = committed effective dose equivalent (mrem)

DAC-hours = derived air concentration hours

ATTACHMENT 4: AIR SAMPLE REPORT

AIR SAMPLE REPORT

Section I

Date:	Sample ID:	HSWP#:			
Occupational: <input type="checkbox"/>	DAC value: <input type="checkbox"/> Ci/m ³	Breathing Zone: <input type="checkbox"/>	General Area: <input type="checkbox"/>	Work Area: <input type="checkbox"/>	
Non-Occupational: <input type="checkbox"/>	AE value: <input type="checkbox"/> Ci/m ³	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 <input type="checkbox"/> (Section II required)			Sent to lab without a screen for final count <input type="checkbox"/> (Section II NOT required)		

Section II

Instrument Information	Serial Number:		Cal. Due Date:				
Instrument Type	meter	detector	meter	detector	1 st Count	2 nd Count	3 rd Count
					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Count Information		ALPHA			BETA		
Variables	Units	1 st Count	2 nd Count	3 rd Count	1 st Count	2 nd Count	3 rd 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)	<input type="checkbox"/> Ci/m ³						
DAC/AE Fraction = (G) / (H)							
Final Count?	Yes / No						
Note: DAC/AE fractions greater than 1.0 requires Immediate RPM notification.					RPM Notified <input type="checkbox"/>		
Calculated By: _____					Date: _____		
Reviewed By: _____					Date: _____		

ATTACHMENT 5: DAC-HOUR TRACKING

DAC-HOUR TRACKING

Site: _____ Air Sample Date/Time: _____ HSWP: _____ Sample ID: _____

^a Total time is to be recorded in hours and fractions of hours (e.g., 1.5).

^b Protection Factor (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

c Calculate DAC-Hours by multiplying the total time by the Corrected DAC Fraction.

^d Calculate CEDE by multiplying DAC-hours by (2.5 mrem per DAC-hour).

Reviewed by RPM: _____ Date: _____

If monitoring is required and ≥ 0.4 DAC-hours calculated (i.e., 1 mrem), dose records updated by: _____ Date: _____



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

**Health Physics Oversight
HP-12, Rev 0**

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

Unless this copy is marked with a red stamp indicating it is a controlled copy, it is uncontrolled. Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

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1. PURPOSE

This health physics (HP) procedure establishes guidelines and requirements for HP oversight, including restricted area requirements, job coverage, stop-work, release surveys, and routine surveillance

1.1 Scope and Limitations

This procedure applies to HP oversight at sites implementing the Leidos Radiation Protection Program (RPP).

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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 10 CFR 20, Appendix B, or
- 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 1 week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

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.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal*

Register by the executive departments and agencies of the federal government of the United States.

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.

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.

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.

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., SSHP, radiation protection plan, etc.).

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

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

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 m³/hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of Appendix B of 10 CFR 20.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10⁻³) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

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.

- 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).
- 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.

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).

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.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Personal Protective Equipment (PPE) – Equipment worn to minimize exposure to serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. PPE may include items such as gloves; safety glasses; safety shoes; earplugs or muffs; hard hats; respirators; or coveralls, vests, or full body suits.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.Radiation Area – An area, accessible to individuals, in which 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.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, "Qualifications and Training."

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radiation Worker Training (RWT) – Training inclusive of instructions to workers mandated by 10 CFR 19 to ensure personnel are fully knowledgeable in actions to avoid an unnecessary radiation dose.

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-60), the following relationship must be used to determine if the area must be posted as an RMA:

$$\frac{\mu\text{Ci}_{\text{Co}}}{10Q_{\text{Co}}} + \frac{\mu\text{Ci}_{\text{U}}}{10Q_{\text{U}}} \leq 10$$

where:

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

Radioactive Material Storage Area (RMSA) – An administratively designated area in which radioactive material is stored and controlled.

Radiological Control Technician (RCT) – An individual qualified by education, training, and experience to meet the requirements for designation as an RCT. (See Senior [Level] Health Physics Technician [Sr. HPT]).

Removable Contamination – Radioactive material easily transferred by normal handling and contact.

Respiratory Protective Equipment (RPE) – Devices used to reduce the concentration of airborne contaminants being inhaled. These devices can be either air-purifying respirators that use filters, cartridges, or canisters to remove contaminants from the air you breathe; or supplied air respirators that provide the wearer with clean air from an uncontaminated source.

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.

Self-Reading Dosimeter (SRD) – Pocket ionization chamber used to monitor X-ray or

gamma radiation.

Senior (Level) Health Physics Technician (Sr. HPT) – An individual qualified by virtue of training, education, and experience to perform the functions of a Sr. HPT. A Sr. HPT is also commonly referred to as a RCT.

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

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

- Unanticipated conditions arise that would result in a significant increase in radiological or industrial safety hazards.
- Working conditions have degraded to the point that the work is not performed consistent with the ALARA concept.
- The potential for deterioration of occupational safety exists if the job is continued.
- The work practices may result in violation of regulatory or NRC license requirements or radiation protection procedures.

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.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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.

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

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

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 m from the source or any surface that the radiation penetrates.

Volumetric Material – Material that takes the shape of its container, such as water,

sand, or soil.

Work Plan (WP) – A detailed accounting of how an individual or group proposes to accomplish a specific task, approach a project, or pitch a new business concept. Sometimes referred to as a “statement of work,” a WP generally includes an introduction or overview of a project or job, a breakdown of how individual project-related tasks will be accomplished, a timeline for completion, and cost projections for implementation. People use WPs for different purposes, each carrying a slightly different definition of content depending on the circumstances.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, “Qualifications and Training.”

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Verify compliance with this procedure during planned and periodic audits of the RPP.
- 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.
- Specify job coverage requirements on an SSHP, WP, HSWP, or equivalent.
- Ensure that radiological workers are trained on restricted area requirements.

Health Physics Technicians (HPTs)

- Shut down or prevent a task from starting if the task may violate regulatory requirements for radiological protection.
- Perform job coverage, release surveys, and routine surveillance in accordance with the requirements of this procedure.
- Initiate stop-work orders in accordance with the provisions of this procedure.

Radiation Workers

- Comply with the requirements in Attachment 1, Radworker Restricted Area Requirements, of this procedure (or equivalent).
- Shut down or prevent a task from starting if the task may violate regulatory requirements for radiological protection.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into

site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

General Requirements

- Radiation and contamination surveys shall be performed in accordance with HP-11, "Radiological Monitoring."
- Airborne radioactivity surveys shall be performed in accordance with HP-11, "Radiological Monitoring."
- Survey results shall be compared against the criteria specified in HP-03, "Radiological Limits."
- Respiratory protection shall be considered and used in accordance with the provisions of HP-06, "Radiological Respiratory Protection."

5.2 Details

Restricted Area Requirements

- Prior to allowing unescorted access into the restricted area, personnel are required to successfully complete Site Orientation Training and 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).
- No entry is permitted into the restricted area without sufficient cause for the entry (i.e., no "sightseeing" in contamination, airborne radioactivity, radiation, or HRAs).
- Individuals with accumulated exposure greater than 70 percent of allowable administrative exposure limits will be restricted from entry into HRAs.
- Approval by the 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.
- Individuals shall follow restricted area requirements in accordance with Attachment 1 of this procedure (or equivalent) while working in restricted areas.

Job Coverage

- Job-specific surveys shall be performed as frequently as necessary to document the level of radiological hazards in the work area.
- 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.
- Intermittent coverage shall be provided for entries into restricted areas with little or no potential to change radiological conditions.

HRAs and VHRAs

- HRAs and VHRAs shall be conspicuously posted and barricaded in accordance with 10 CFR 20.
- Entryways to HRAs and VHRAs shall be locked, except during periods when access to the areas is required. Positive controls shall be maintained during each entry into an HRA.

- 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.
- To prevent unauthorized entry into temporary HRAs or VHRA, direct surveillance may be substituted for locked areas or flashing lights.
- Personnel entering an HRA or VHRA shall have one or more of the following:
 - A radiation monitoring device that continuously indicates the radiation exposure rate in the area.
 - 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.
 - 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.
- In addition to the requirements for entry into HRAs, the following requirements shall apply for entry into VHRA:
 - Areas are posted as VHRA if dose rates could exceed 500 rads in 1 hour at 1 m from any source.
 - 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 VHRA in which radiation levels could be encountered at 500 rads or more in 1 hour at 1 m from a radiation source or any surface through which the radiation penetrates.

Stop-Work

- All employees shall have the responsibility and authority to initiate a stop-work order.
- If radiological conditions exceed expected levels to an extent at which additional protection measures may be required, a stop-work order shall be initiated and the RPM notified immediately.
- 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.
- Specific work activities shall be permitted to proceed to a safe condition after issuance of the stop-work order. The RPM (or designee) will supervise specific work activities as they proceed to a safe shut down.
- Stop-work orders shall be documented in accordance with HP-22, "Radiological Reporting."

Personnel Release Surveys

- 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).
- Radiological workers may perform personnel frisks unless otherwise specified on the task-specific HSWP.

- A whole-body frisk should take approximately 2 to 3 minutes and will 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.
- 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.
- 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."

Surficial Material and Equipment Release Surveys

- Material and equipment that may be unconditionally released include sampling equipment, PPE, monitoring equipment, or any other solid item.
- 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.
- 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.
- A surficial total and removable contamination survey must be performed prior to unconditional release.
- Only HP personnel may perform material or equipment release surveys.
- 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.
- 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.
- Release survey results shall be compared to the surficial contamination limits provided by the RPM on Attachment 2, Site Limits, of HP-03, "Radiological Limits" (or equivalent).

Material Conditional Release Surveys

- At no time shall materials/items conditionally released from the restricted area be removed from the site without approval of the RPM.
- 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:
 - Radioactive source standards must be under continuous control of HPTs.
 - 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.
 - Packages of radioactive material offered for transport in accordance with 49 CFR shall meet the removable contamination limits.

Vehicle Release Surveys

- Vehicles shall be surveyed for removable and total contamination prior to release from a restricted area.
- Only HP personnel may perform vehicle release surveys.
- 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.
- Surfaces shall be reasonably free of material that will prohibit the detection of radioactivity, such as mud.
- Vehicle identifying information (e.g., license plate number, rental agency, or company name, etc.) will be noted on the survey form.

Volumetric Material Release Surveys

- A surficial survey may not be representative of volumetric material radioactivity; HPTs shall contact the 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.
- 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.
- An unopened container of volumetric material, such as a bag of sand, may be released using standard survey techniques.
- Materials and equipment requiring volumetric release surveys may also require surficial release surveys, as determined by the RPM (or designee).

Routine Surveillance

- At projects/sites controlled by this radiation safety program with an expected duration longer than 3 months, the RPM shall specify the frequency of routine surveys by completion of Attachment 2, Routine Surveillance Frequency, of this procedure (or equivalent).
- 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.
- 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.
- When performing a routine surveillance survey, the area and type of work in the area should be considered, specifically:
 - 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.
 - Work areas should routinely have hand tools, control panels, or other frequently handled items smeared, because these areas are most likely to become contaminated.

- Consideration should be given to all likely areas in which contamination may have been spread rather than exclusively those areas through which personnel walk.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- ESE A17.1, "Project Records Management."*
- HP-01, "Health Physics Manual."**
- HP-03, "Radiological Limits."**
- HP-05, "Personal Protective Equipment."**
- HP-06, "Radiological Respiratory Protection."**
- HP-10, "Personnel and Equipment Decontamination."**
- HP-11, "Radiological Monitoring."**
- HP-20, "Radiological Posting and Labeling."**
- HP-22, "Radiological Reporting."**

* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Radworker Restricted Area Requirements
- Attachment 2. Routine Surveillance Frequency

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: RADWORKER RESTRICTED AREA REQUIREMENTS**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 Sr. 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 an HPT re-zero the dosimeter prior to entering the restricted area if the dosimeter reads greater than 0.5 full scale.
 - Exit the area and have an HPT document exposure and re-zero the dosimeter, if a dosimeter reads 0.75 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.

Sign out of the HSWP (as required), and return your dosimetry to the issue point.

ATTACHMENT 2: ROUTINE SURVEILLANCE FREQUENCY**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 (BZ) (occupational), work area (occupational), general area (occupational), and/or perimeter (non-occupational) air samples.



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Radiological Reporting
HP-22, Rev 0

Effective 01 May 2016

Approved By:

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Unless this copy is marked with a red stamp indicating it is a controlled copy, it is uncontrolled. Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

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1. PURPOSE

The purpose of this health physics (HP) 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 Protection Program (RPP).

1.1 Scope and Limitations

This procedure applies to unsatisfactory radiological conditions at all sites where work is performed under the Leidos RPP.

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

Corrective Action Report (CAR) – Procedure used in response to a defect. This implies a nonconformance has occurred and a root cause has been identified to preclude recurrence. The process involves identification of nonconformance, corrective/preventative action, disposition, and termination of nonconformance.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Environmental Health and Safety (EHS) – The department in a company or an organization involved in **environmental** protection, **safety** at work, occupational **health and safety**, compliance, and best practices. The EHS department aims to prevent and reduce accidents, emergencies, and health issues at work.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10⁻³) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

High Radiation Area (HRA) – 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 millirem (mrem) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Immediate Actions – Those actions taken to halt the progress of a radiological incident and recover normal or stable radiological conditions.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

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/cm²).

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10⁻³) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10⁻³) rem.

Non-Conformance Report (NCR) – Documentation including identification/description of the nonconformance, corrective/preventive action, and disposition and actions to close the nonconformance.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

Radiation Protection Manager (RPM) – An individual who, by virtue of qualifications and experience, assumes the role and responsibilities of the RSO at a specific client site. The site RPM is delegated the authority to implement the Leidos RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radiological Event – A condition or occurrence that reduces the radiological safety provided to site personnel or the public, or indicates an adverse trend in RPP performance. These include:

- Occupational radiation exposures exceeding administrative exposure limits;
- Unplanned intakes of radioactive material in excess of 10 percent of an ALI;
- Unmonitored radiation exposure (i.e., exposure received without appropriate monitoring equipment) estimated to exceed 100 mrem total effective dose equivalent (TEDE), 1,500 mrem LDE, 5,000 mrem total organ dose equivalent (TODE), or shallow dose equivalent (SDE);
- Radiological areas not properly controlled or posted;
- HRAs or very high radiation areas (VHRAs) not properly controlled, guarded, or locked, as required;
- Uncontrolled radioactive material resulting in loose surface contamination exceeding the criteria established in HP-03, “Radiological Limits”;
- 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;
- An issued “Stop Work Order,” due to unexpected or degrading radiological work conditions or unsafe radiological work practices;
- 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.
- Personnel contamination events resulting in calculated skin exposure exceeding 5,000 mrem SDE; or
- Any significant event as determined by the RSO or RPM.

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.

Radiological Occurrence Report (ROR) – Official notification through predesignated channels of radiological events (e.g., accidents and incidents) pursuant to established requirements such as those contained in 10 CFR 19 and specified in license conditions.

Shallow Dose Equivalent (SDE) – The dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm² when applied to the external exposure of the skin or extremity.

Site Safety and Health Plan (SSHP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

Very High Radiation Area (VHRA) – 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 m from the source or any surface that the radiation penetrates.

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.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Corporate Environmental, Health, and Safety (EHS) Manager

- Make all regulatory-required radiological incident notifications required by Leidos EHS procedures, as applicable.
- Determine the need for and generate or direct the generation of (as necessary) NCRs in accordance with Leidos ESE QA Procedure, ESE A16.1, "Nonconformance and Corrective Action."

Radiation Safety Officer (RSO) or Radiation Protection Manager (RPM)

- Notify project management and the Corporate EHS Manager of all radiological incidents in accordance with the requirements in Leidos EHS procedures EHS-19, "Radiation Protection," and EHS-21, "Regulatory Agency Inspections and Related Reporting."
- Coordinate with the Corporate EHS Manager to assure timely notifications of radiological incidents in accordance with federal, state, local, and client requirements.
- Initiate a CAR, as necessary, in accordance with Leidos ESE A16.1, "Nonconformance and Corrective Action," for RORs generated in accordance with this procedure.
- Assign corrective actions and verify completion/closure for RORs.
- Review, at least quarterly, all generated RORs for adverse trends and common or recurrent problems.

Health Physics Technicians (HPTs)

- Immediately notify the RSO or RPM of any unsatisfactory radiological condition.
- Take immediate actions to establish safe radiological conditions during a radiological incident or event.
- Implement or verify implementation of corrective actions as assigned by the RSO or RPM.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Not Applicable.

5. PROCEDURE

5.1 Overview

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 NRC (or agreement state).

- When any unsatisfactory radiological condition is identified, it will be brought to the immediate attention of the RSO or RPM.
- 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.
 - If no action is warranted, then exit this procedure.
 - 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 subsections.

5.2 Details

Radiological Incident

- The RSO or RPM will utilize Section 1.3 (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).
- If the condition is a radiological incident, then:
 - 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.
 - If a telephone report is required, then:
 - The RSO or RPM will gather the minimum information needed for a telephone report, as provided in Attachment 5 or equivalent.
 - 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.
 - 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.
 - 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.

Radiological Event

- The RSO or RPM will utilize Section 1.3 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.
- 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.

Investigation, Documentation, and Response Actions

- If the condition is a radiological incident or radiological event, then the RSO, RPM, or designee will investigate by:
 - Gathering written statements from witnesses, as necessary;
 - Collecting or preserving evidence, as necessary;
 - Interviewing involved parties, as necessary; and/or
 - Conducting a fact-finding investigation and/or fact-finding meeting, as necessary.
- If the condition is a radiological incident or radiological event, then the RSO, RPM, or designee will document the condition by:
 - Completing the applicable portions of Attachment 1, Radiological Occurrence Report (ROR) (or equivalent);
 - Attaching appropriate supplementary documentation to the ROR;
 - Entering the appropriate information on Attachment 2, Radiological Occurrence Report Log (or equivalent); and
 - If the ROR documents a radiological incident, then forwarding a draft copy of the ROR to the Corporate EHS Manager.
- The RSO, RPM, or designee, and 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 at which Leidos is providing subcontracted HP support only, or Leidos is working under a client's NRC license, alternative 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 the bulleted entry preceding this Note.

- If the condition was a radiological incident, then the RSO, RPM, or designee will 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.
- If the condition was a radiological event, then the RSO, RPM, or designee will complete the investigation by determining the apparent cause(s) of the incident. The apparent cause(s) shall be documented in the ROR.
- The RSO, RPM, or designee shall specify corrective actions that address the root or apparent cause(s) and which are:
 - Specific, measurable, contain action statements, are relevant to the condition and cause(s), and are timely;
 - Documented in the ROR; and
 - Approved by the Project Manager, the client (if applicable), and the Corporate EHS Manager (if a radiological incident).
- 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).

- The RSO, RPM, or designee will 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.
- The report will 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.
- The report will be approved by the Project Manager, the Corporate EHS Manager, and the client (if applicable) prior to being issued to the regulatory agency.
- The Corporate EHS Manager will determine who will send the 30-day written report to the regulatory agency.
- The RSO, RPM, or designee will maintain the ROR up-to-date and will:
 - Ensure all corrective actions generated as a result of an ROR are completed in accordance with the established schedule; and
 - Verify corrective action implementation adequately resolves the deficiencies.
- When all corrective actions are complete, the RSO, RPM, or designee will complete the ROR form and:
 - Update the ROR log; and
 - Ensure that lessons learned as a result of an ROR are incorporated into employee continuing training, as appropriate.
- 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:
 - The affected individual(s) is/are provided access to a copy of any written report that was provided to the NRC;
 - 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
 - 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.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RSO or RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- 10 CFR 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material."
- 10 CFR 40, "Domestic Licensing of Source Material."
- 10 CFR 70, "Domestic Licensing of Special Nuclear Material."
- 49 CFR, Subtitle B, Chapter I, Subchapter C, Hazardous Material Regulations. Part 171, "General Information, Regulations, and Definitions."
- EHS-19, "Radiation Protection."*
- EHS-21, "Regulatory Agency Inspections and Related Reporting."*
- ESE A17.1, "Project Records Management."**
- ESE A16.1, "Nonconformance and Corrective Action."**
- HP-01, "Health Physics Manual."***
- HP-03, "Radiological Limits."***
- HP-30, "Radiological Instrumentation."***
- USACE 1997. U.S. Army Corps of Engineers. *Safety: Radiation Protection Manual*. Engineer Manual. EM 385-1-80. Sections 6-12. May 30, 1997.
- USACE 2010. U.S. Army Corps of Engineers. *Safety: Ionizing Radiation Safety*. Section 19, "Reports." Engineer Regulation. ER 385-1-80. June 30, 2010.
- 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.

* Refer to <https://prism.leidos.com/docs/DOC-18653> for the current version of EHS referenced procedures in the *Corporate Environmental Health and Safety Program Manual*.

** Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

*** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Radiological Occurrence Report (ROR)
- Attachment 2. Radiological Occurrence Report Log
- Attachment 3. Leidos Notification Information
- Attachment 4. Regulatory Reporting Requirements Summary
- Attachment 5. Information to be Provided in Telephone Reports

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: RADIOLOGICAL OCCURRENCE REPORT (ROR)**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 NOTIFICATIONSType of Condition: Radiological Incident (complete Part 4) Radiological Event

Trigger Criteria (alpha-numeric from Attachment 4): _____

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 CLOSURERequired 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

ATTACHMENT 2: RADIOLOGICAL OCCURRENCE REPORTING LOG

RADIOLOGICAL OCCURRENCE REPORTING LOG

Site: _____

Year: _____

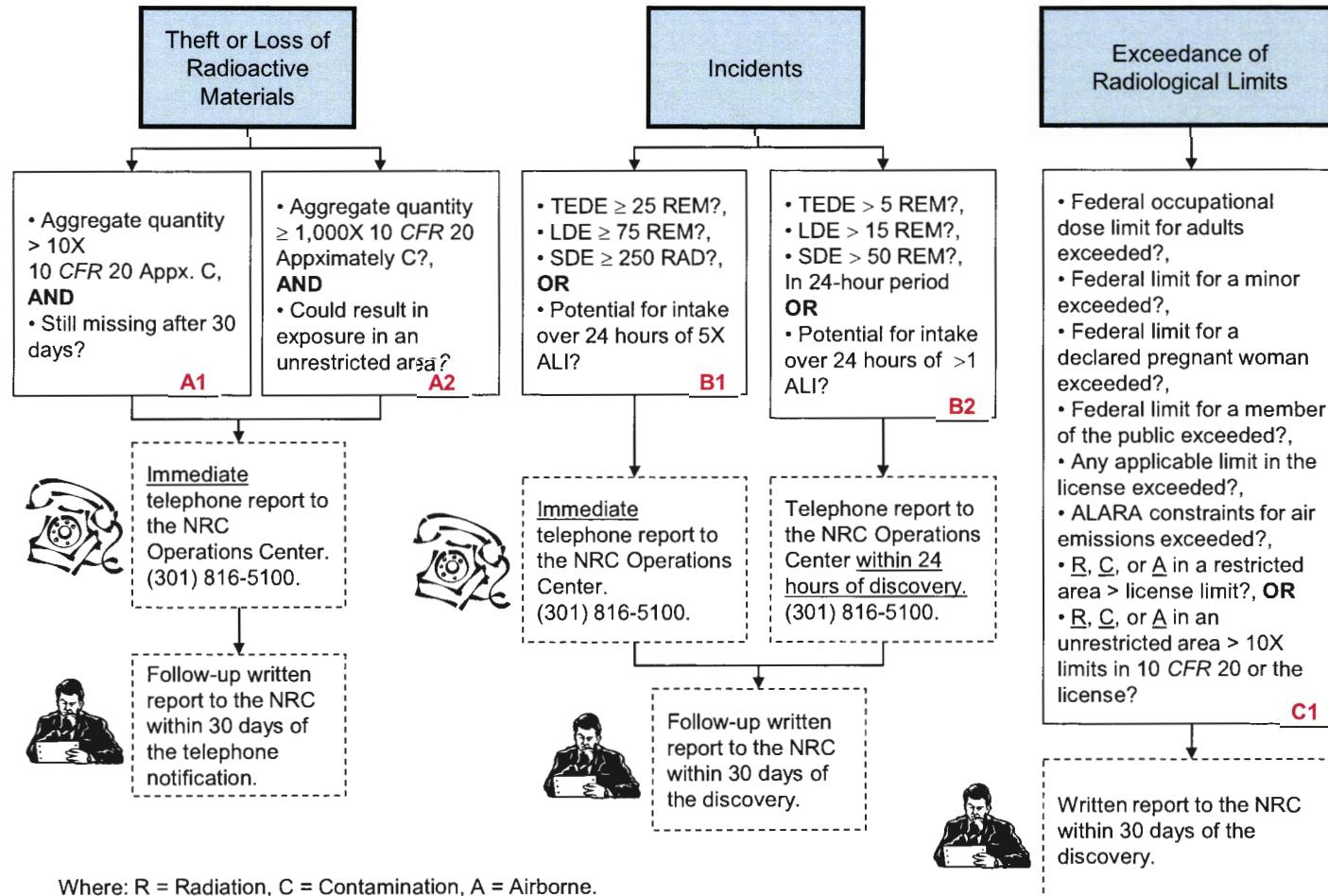
ATTACHMENT 3: LEIDOS NOTIFICATION INFORMATION**LEIDOS NOTIFICATION INFORMATION**

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

ATTACHMENT 4: REGULATORY REPORTING REQUIREMENTS SUMMARY

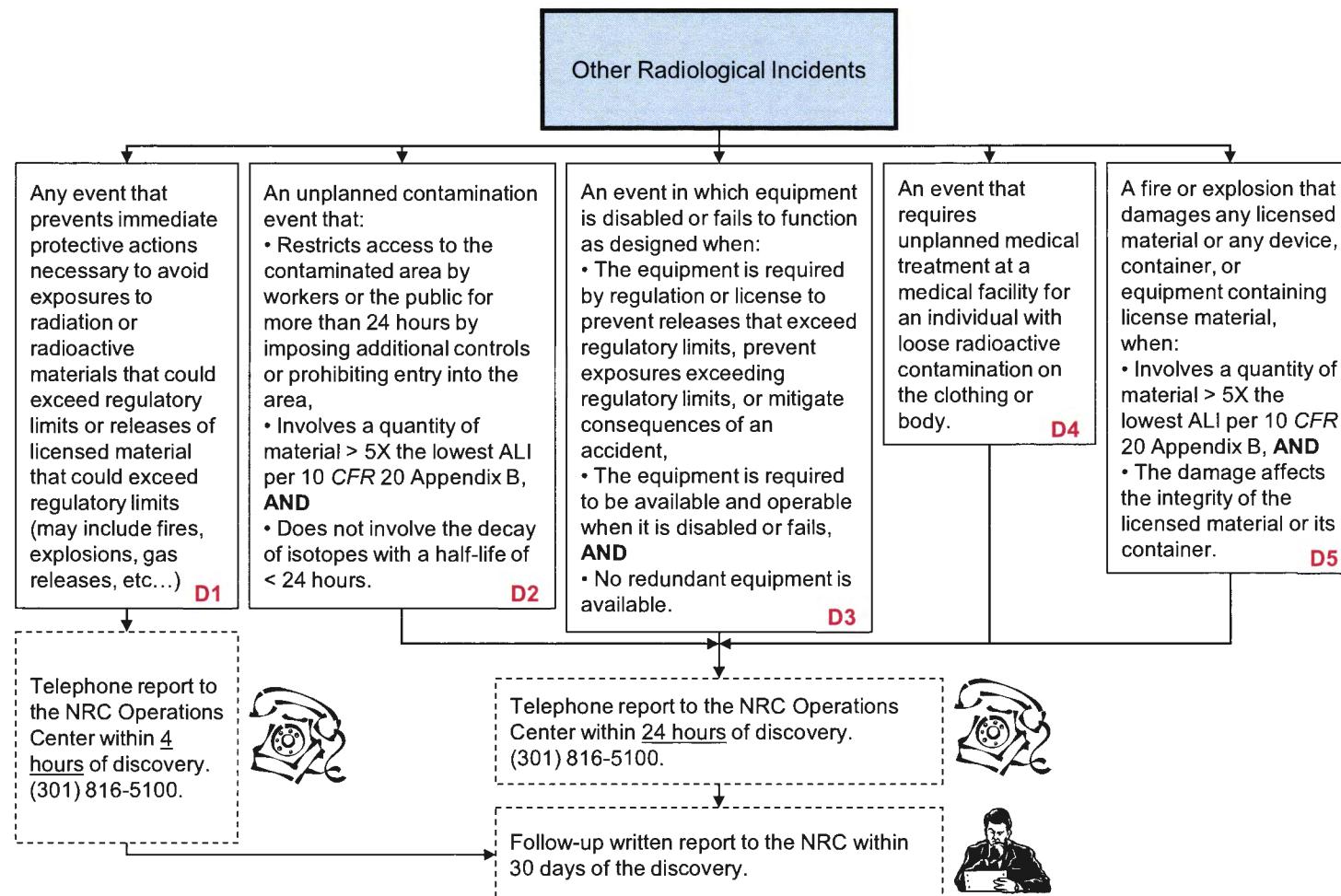
REGULATORY REPORTING REQUIREMENTS SUMMARY

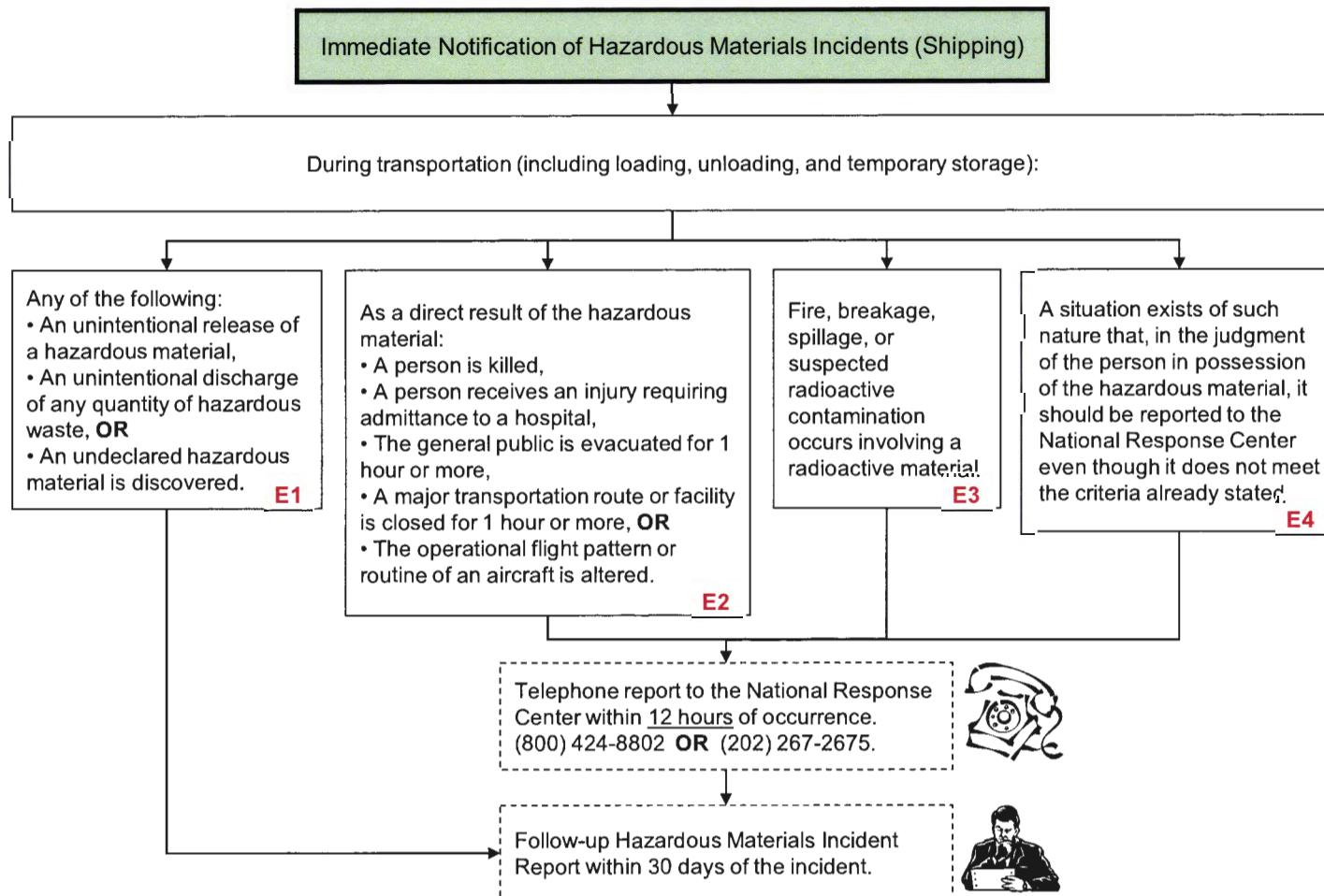
10 CFR 20.2201, 2202, and 2203



Where: R = Radiation, C = Contamination, A = Airborne.

10 CFR 30.50, 40.60, and 70.50



49 CFR 171.15 and 171.16

ATTACHMENT 5: INFORMATION TO BE PROVIDED IN TELEPHONE REPORTS**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 and 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.



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Radioactive Source Control
HP-23, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

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1. PURPOSE

This health physics (HP) procedure establishes the requirements for the control, accountability, and leak testing of radioactive sources.

1.1 Scope and Limitations

This procedure applies to the inventory and leak testing of radioactive sources controlled under the Leidos Radiation Protection Program (RPP).

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

Becquerel (Bq) – A unit of measure of radioactivity in the International System of Units (SI), equal to 1 disintegration per second (dps) (i.e., transformation per second).

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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

Curie (Ci) – A basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion dps (i.e., transformations per second) and is approximately the rate of decay of 1 gram (g) of radium.

Disintegrations per Minute (dpm) – The average quantity of radiological disintegrations (i.e., transformations) occurring per minute as a result of the spontaneous emission from the atomic nuclei of either alpha or beta particles.

Disintegrations per Second (dps) – The decrease in the amount of any radioactive material with the passage of time (i.e., each second), as a result of the spontaneous emission from an atomic nuclei such as alpha or beta particles. In the SI, 1 dps (i.e., transformation per second) equates to 1 Bq.

Environmental Health and Safety (EHS) – The department in a company or an organization involved in ***environmental*** protection, ***safety*** at work, occupational ***health and safety***, compliance, and best practices. The EHS department aims to prevent and reduce accidents, emergencies, and health issues at work.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10^{-3}) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Microcurie(s) (μCi) – A unit of measure equal to one-millionth (10^{-6}) Ci.

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

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

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

materials.

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.

Semi-Annual – A time period that consists of 6 months.

Site Safety and Health Plan (SSHP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Source Housing – Device designed to support, shield, and/or contain a sealed radiation source.

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

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Secure from unauthorized access radioactive sources stored in controlled areas or restricted areas.
- Authorize source purchases.
- Verify that leak tests are performed at the frequency specified by this procedure.
- Evaluate the disposition of leaking or degraded sources.
- Direct a search, make notifications, and evaluate potential consequences in the event of a lost source.
- Verify that the source inventory is current.
- Verify that sources under their control are stored, issued, and used in accordance with this procedure.

Health Physics Technicians (HPTs)

- Perform source leak test surveys.
- Perform source inventories.
- Maintain a current inventory of sources, as directed by the RPM.

- Forward a copy of all survey and related documentation to the RPM (or designee) for review.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Not Applicable.

5. PROCEDURE

5.1 Overview

Radioactive Source Accountability

- 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.
- 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.
- The source tracking number shall be indicated on the source Certificate of Calibration and source container.
- Source storage locations shall be posted; lockable; and controlled to prevent loss, theft, or unauthorized use.
- The source or source holder will be physically labeled with the assigned number and placed in the source storage location.
- A physical inventory will be conducted at least semi-annually and documented on Attachment 3 (or equivalent) in accordance with the Inventory of Sources subsection of Section 5.2 of this procedure to account for all radioactive sources.
- The results of the inventory shall be entered into the current source inventory file.
- 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.

5.2 Details

Leak Tests

- 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."
- 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.

- Leak test surveys will be documented on Attachment 2 (or equivalent). Activity results shall be converted from dpm to 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.
- If the survey results indicate removable activity above the MDA: (1) contain (i.e., in a radioactive material bag or other appropriate method) the source, (2) conspicuously label the source as "Out of Service," and (3) notify the RPM. The equipment or area associated with the leaking source shall be surveyed and decontaminated, if required.
- The RPM (or designee) will 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.

Issuance of Sources

- Sources will be issued only to response test and calibrate radiation measuring instruments, unless otherwise authorized by the RPM.
- 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).
- Sources in use shall be under the constant surveillance and control of the authorized user.
- The source must be signed in when returned to its designated storage location.

Inventory of Sources

- Obtain a list of sources from the Source Inventory Database or a photocopy of the current Attachment 3, Radioactive Source Log and Inventory (or equivalent).
- Perform a physical inventory of each source, and document the inventory on Attachment 3 (or equivalent).
- 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.
- Notify the RPM if any sources are unaccounted for, physically degraded, or not at the location specified on Attachment 3 (or equivalent).

Disposal of Radioactive Sources

- The RSO shall approve the disposal of all sources.
- Sources shall be disposed of in accordance with applicable shipping procedures.
- Indicate source disposal on Attachment 3 (or equivalent).
- The disposal of sources shall be performed in accordance with state and federal regulations, after approval from the RSO and the Corporate EHS Manager.

Reports of Theft or Loss of Radioactive Material

- 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."
- The RSO shall provide reports of lost or stolen radioactive material to the appropriate regulatory authorities in accordance with HP-22, "Radiological Reporting."

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- ESE A17.1, "Project Records Management."*
- HP-01, "Health Physics Manual."**
- HP-04, "Qualifications and Training."**
- HP-11, "Radiological Monitoring."**
- HP-22, "Radiological Reporting."**

* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Radioactive Sealed Source Leak Test Frequency
- Attachment 2. Radioactive Sealed Source Leak Test Survey
- Attachment 3. Radioactive Source Log and Inventory
- Attachment 4. Radioactive Source Issue Log

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: RADIOACTIVE SEALED SOURCE LEAK TEST FREQUENCY**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

ATTACHMENT 2: RADIOACTIVE SEALED SOURCE LEAK TEST SURVEY

RADIOACTIVE SEALED SOURCE LEAK TEST SURVEY

Technician Name: _____ Date: _____

Instrument/Detector _____ Serial # _____ / _____ Calibration Due Date _____ / _____

Instrument/Detector _____ Serial # _____ / _____ Calibration Due Date _____ / _____

^a Conversion from dpm to μ Ci is calculated as follows: Activity (μ Ci) = Activity (dpm) * (1 μ Ci/2.22E6 dpm)

REVIEWED BY: _____ **DATE:** _____

ATTACHMENT 3: RADIOACTIVE SOURCE LOG AND INVENTORY

RADIOACTIVE SOURCE LOG AND INVENTORY^{a,b}

SOURCE LOG _____ INVENTORY

^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: _____
RPM

DATE: _____

ATTACHMENT 4: RADIOACTIVE SOURCE ISSUE LOG

RADIOACTIVE SOURCE ISSUE LOG

LOCATION:

YEAR:

REVIEWED BY: _____

DATE: _____

RPM



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Contamination Control
HP-24, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

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1. PURPOSE

This health physics (HP) procedure outlines the methods for preventing the spread of radioactive contamination and controlling contaminated or potentially contaminated areas, equipment, and materials.

1.1 Scope and Limitations

This procedure applies to all personnel, areas, equipment, and materials at a site implementing the Leidos Radiation Protection Program (RPP).

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

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., SSHP, radiation protection plan, etc.).

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

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10⁻³) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10⁻³) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10⁻³) rem.

Personal Protective Equipment (PPE) – Equipment worn to minimize exposure to serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. PPE may include items such as gloves; safety glasses; safety shoes; earplugs or muffs; hard hats; respirators; or coveralls, vests, or full body suits.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Removable Contamination – Radioactive material easily transferred by normal handling and contact.

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.

Site Safety and Health Plan (SSHP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

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.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation’s security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

Work Plan (WP) – A detailed accounting of how an individual or group proposes to accomplish a specific task, approach a project, or pitch a new business concept. Sometimes referred to as a “statement of work,” a WP generally includes an introduction or overview of a project or job, a breakdown of how individual project-related tasks will be accomplished, a timeline for completion, and cost projections for implementation. People use WPs for different purposes, each carrying a slightly different definition of content depending on the circumstances.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, “Qualifications and Training.”

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Approve PPE, internal and external radiation exposure monitoring, HSWP, and SSHP contamination control requirements.

Health Physics Technicians (HPTs)

- Perform surveys in accordance with HP-11, “Radiological Monitoring,” to identify the presence of contamination.
- Provide direction to radiological workers to control the spread of contamination.

Radiological Workers

- Wear protective clothing and respirators properly and when required by signs, HSWPs, HPTs, procedures, or instructions.
- Minimize the spread of a known or possible radioactivity spill, and promptly notify the HPT covering the activity.
- Avoid unnecessary contact with contaminated surfaces, including clothing (if contaminated), tools, and other equipment.
- Minimize the amount of uncontaminated materials brought into contamination areas.
- Maintain good housekeeping practices to minimize the spread of contamination.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into

site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

The RPM, HPTs, and Radiological Workers will implement the methods provided in Section 5.2 for preventing the spread of radioactive contamination and controlling contaminated or potentially contaminated areas, equipment, and materials.

Removable contamination shall be controlled to the extent practical to prevent:

- Personnel contamination events.
- The spread of contamination within restricted areas.
- The spread of contamination to the environment.
- Unnecessary airborne exposure.

5.2 Details

- The RPM (or designee) shall specify contamination control requirements on HSWPs, WPs, SSHPs, or verbally.
- Every contamination control situation cannot be procedurally anticipated; however, the following shall be considered in the control of radioactive contamination:
 - Temporary enclosures to separate highly contaminated work from adjacent areas.
 - Establishing a step-off pad or separate area between contaminated and uncontaminated areas to prevent the spread of contamination.
 - Ventilating areas and enclosures.
 - Keeping potentially contaminated soil wet.
 - Minimizing dust.
 - Wrapping items before taking them into a contamination area.
 - Containerizing contaminated material.
 - Covering contaminated material.
 - Monitoring the site regularly.
 - Decontaminating areas and items.
 - Practicing good housekeeping.
 - Implementing administrative and engineering controls.
- Contamination surveys shall be performed in accordance with HP-11, "Radiological Monitoring."
- Contamination areas shall be surveyed routinely in accordance with the requirements of HP-12, "Health Physics Oversight."
- Contamination areas shall be controlled and posted in accordance with HP-20, "Radiological Posting and Labeling."
- When entering a contamination area, PPE must be worn in accordance with HP-05, "Personnel Protective Equipment," and HSWP requirements.
- Items taken into a contamination area shall be treated as potentially contaminated until surveys are performed to demonstrate compliance with site-specific release criteria for unrestricted use.

- 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."
- Personnel shall conduct a frisk survey, or be surveyed by an HPT, in accordance with HP-12, "Health Physics Oversight," and HSWP requirements.
- Contaminated personnel shall be decontaminated in accordance with HP-10, "Personnel and Equipment Decontamination."
- Contaminated equipment/material shall be either containerized or decontaminated in accordance with HP-10, "Personnel and Equipment Decontamination."
- Radioactive wastes shall be controlled in accordance with HP-25, "Storage and Control of Radioactive Waste."

7. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

8. RECORDS

No records are generated as a result of this procedure.

9. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- HP-01, "Health Physics Manual."*
- HP-03, "Radiological Limits."*
- HP-04, "Qualifications and Training."*
- HP-05, "Personnel Protective Equipment."*
- HP-10, "Personnel and Equipment Decontamination."*
- HP-11, "Radiological Monitoring."*
- HP-12, "Health Physics Oversight."*
- HP-20, "Radiological Posting and Labeling."*
- HP-25, "Storage and Control of Radioactive Waste."*

* Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

10. ATTACHMENTS

Not Applicable.

11. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Storage and Control of Radioactive Waste **HP-25, Rev 0**

Effective 01 May 2016

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Unless this copy is marked with a red stamp indicating it is a controlled copy, it is uncontrolled. Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

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1. PURPOSE

This health physics (HP) procedure describes the methods for the storage, control, segregation, characterization, and disposal of radioactive waste.

1.1 Scope and Limitations

This procedure applies to waste materials at sites implementing the Leidos Radiation Protection Program (RPP).

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

Acceptance Criteria – Specified limits placed on characteristics of an item, process, or service defined in codes, standards, or other required documents.

Activity – The rate of disintegration (i.e., 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.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Becquerel (Bq) – A unit of measure of radioactivity in the International System of Units (SI), equal to 1 dps (i.e., transformation per second).

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

Curie (Ci) – A basic unit used to describe the intensity of radioactivity in a sample of

material. The curie is equal to 37 billion dps (i.e., transformations per second) and is approximately the rate of decay of 1 gram (g) of radium.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Disintegrations per Second (dps) – The decrease in the amount of any radioactive material with the passage of time (i.e., each second), as a result of the spontaneous emission from an atomic nuclei such as alpha or beta particles. In the SI, 1 dps (i.e., transformation per second) equates to 1 Bq.

Environmental Compliance Manager (ECM) – Ensures individual and organizational compliance with environmental regulations. Oversees company activities related to environmental regulations. Monitors organizational performance, develops compliance strategies, and maintains necessary environmental permits.

Environmental Health and Safety (EHS) – The department in a company or an organization involved in **environmental** protection, **safety** at work, occupational **health and safety**, compliance, and best practices. The EHS department aims to prevent and reduce accidents, emergencies, and health issues at work.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10⁻³) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

Health and Safety Work Permit (HWP) – 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 HWP is a primary part of the ALARA program. HWPs communicate work area radiological hazards to personnel and specify controls and protective equipment necessary for worker protection.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

High-Efficiency Particulate Air (HEPA) filter – Filters designed and constructed to remove a minimum of 99.97 percent of a broad range of airborne contaminants with an activity median aerodynamic diameter of 0.3 micrometers.

International Air Transport Association (IATA) – An organization that regulates dangerous goods (e.g., hazardous materials) in international trade and coordinates related environmental evaluations.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the

metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

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.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Liter (L) – A base SI unit of volume equating to 1,000 milliliters (mL).

Microcurie(s) (μ Ci) – A unit of measure equal to one-millionth (10^{-6}) Ci.

Millicurie(s) (mCi) – A unit of measure equal to one-thousandth (10^{-3}) Ci.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Milliliter(s) (mL) – A unit of measure equal to one-thousandth (10^{-3}) L.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Nanocurie(s) (nCi) – A unit of measure equal to one-billionth (10^{-9}) Ci.

Personal Protective Equipment (PPE) – Equipment worn to minimize exposure to serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. PPE may include items such as gloves; safety glasses; safety shoes; earplugs or muffs; hard hats; respirators; or coveralls, vests, or full body suits.

Picocurie(s) (pCi) – A unit of measure equal to one-trillionth (10^{-12}) Ci.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radioactive Material Storage Area (RMSA) – An administratively designated area in which radioactive material is stored and controlled.

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 curies and in terabecquerels [TBq], for radionuclides listed in column 1.)

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.

Sewer Release Criteria – Minimum requirements for release or discharge of liquid effluent into the waters of the state or the sanitary sewer system.

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Sum of Ratios (SOR) – The sum of the ratios of each contaminant to its corresponding concentration or quantity limit. May also be referred to as the “unity rule.”

Terabecquerels (TBq) – A unit of measure equal to 10^{12} Bq (10^{12} dps [i.e., transformations per second]).

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

Transportation Representative (TR) – An individual maintaining requisite training and qualifications in accordance with 49 CFR 172, Subpart H, and the 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.

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation’s security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Verify compliance with this procedure during planned and periodic audits of the RPP.
- Identify waste collection points and supervise the storage of radioactive wastes at these locations.
- Make final waste disposal arrangements with vendors, as necessary.
- Maintain records of packaged waste.

Health Physics Technicians (HPTs)

- Ensure that only suitable containers are used for collection of contaminated waste.
- Direct handling of radioactive waste in a manner that prevents the spread of contamination and minimizes direct radiation exposure.
- Direct segregation of wastes into appropriately marked containers.

Transportation Representative (TR)

- Coordinate with the client transportation representative, as applicable, to prepare radiological waste for shipment to a licensed disposal facility.
- 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.

Environmental Compliance Manager (ECM)

- 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.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

The RPM, HPTs, TR, and Radiological Workers will implement the methods provided in

Section 5.2 for the storage, control, segregation, characterization, and disposal of radioactive waste.

5.2 Details

Control of Waste

- Control of radioactive waste materials (i.e., waste minimization) should be accomplished by preventing materials from becoming unnecessarily and/or excessively contaminated.
- Additional control methods shall include, but are not limited to:
 - Decontaminating and reusing radioactive materials such as tools and equipment;
 - Recycling;
 - Using waste volume reduction techniques when practical; and,
 - Monitoring materials for radioactivity and removing non-radioactive materials prior to disposal.

Collection of Waste

- Each restricted area that generates radioactive waste shall have designated waste collection locations.
 - Suitable containers should be staged at each collection location or a location convenient to the generation point.
 - At the discretion of the RPM, a container inventory form (Attachment 1 or equivalent form) may be initiated and affixed to the container.
- Precautions shall be instituted to prevent mixing of various hazardous substances when organizing the waste disposal area.
- If a bag tears during collection, the waste shall be repackaged and the area surveyed for contamination as determined appropriate by the responsible HPT.
- Liquid radioactive wastes shall be stored in a secondary containment to prevent the spread or leakage of material.
- If required by the RPM, each item added to a container must be recorded on a container inventory form (Attachment 1 or equivalent form). Examples of item listings include: bag of PPE, rags, mop heads, HEPA filter, Tygon® tubing, bag of poly trash, bag of cardboard trash, etc.
- When required by the RPM, an estimate of the activity contained in each item shall be included on the container inventory form.
- Items should be added to the container in a manner that minimizes void spaces and volume.

Waste Tracking

- The waste tracking and documentation requirements contained in the subsequent bulleted entries in this Waste Tracking subsection of Section 5.2 are applicable for management of Leidos-generated waste or when Leidos is responsible for management of client-generated waste.
- 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.
- Containers staged at temporary waste collection locations (e.g., PPE waste containers at egress point from restricted area) do not require a tracking number.

- The radiological contents of contaminated waste staged for storage shall be documented on Attachment 4, Waste Transfer Form, and Attachment 2, Leidos Waste Characterization Form (or equivalent forms), unless the ECM does not require such forms, such as for a continuing waste stream previously characterized. Copies of the completed forms shall be forwarded to the ECM..
- 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, Waste Transfer Form (or equivalent), unless the ECM does not require such forms, such as for a continuing waste stream previously characterized.
- Shipping papers/manifests supercede the requirement to complete Attachment 4 (i.e., for a waste broker or licensed disposal facility).
- Radioactive waste that is transferred directly to another person in accordance with the fifth bulleted entry in this Waste Tracking subsection of Section 5.2 does not require a tracking number.
- Management of IDW shall be conducted in accordance with Leidos EHS Procedure EHS-280, "Investigative-Derived Waste."
- Tracking of radiological waste shall be conducted in accordance with EHS Procedure EHS-7, "Hazardous Waste Management."
- The RPM or designee shall contact the ECM (or designee) to obtain a transfer log number for contaminated radioactive waste.

Preparation to Characterize Waste

- The physical and radiological contents of all containerized waste staged for storage or disposal shall be documented.
- Waste being prepared for shipment shall be characterized in accordance with HP-50, "Radioactive Material Shipping," if not previously characterized.
- The following steps shall be taken in preparation for characterization:
 - Record a unique identification number of the container to be characterized on the Leidos Waste Characterization Form (Attachment 2 or equivalent form).
 - 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.
- Record a description of the container contents on the Leidos Waste Characterization Form.
 - The container may be a candidate to be opened and inspected if it does not have a Radioactive Waste Container Inventory Form (Attachment 1 or equivalent) affixed to it. Attempts to determine the history of the container shall be made prior to opening.
 - If the container is leaking, off-gassing, or bulging, it must not be opened, and the RPM shall be notified.
 - If the RPM has confidence that the Radioactive Waste Container Inventory Form is accurate, the activity estimate shall be made based on the inventory in the container.
 - If the RPM does not have confidence that the Radioactive Waste Container Inventory Form is accurate, a plan shall be developed for opening and sampling the container.

- When required, an estimate of the volume of each type of material comprising the waste shall be included on the Radioactive Waste Container Inventory Form.
- The Radioactive Waste Container Inventory Form, if available, shall be maintained with the Leidos Waste Characterization Form.
- The container shall be placed in its designated storage location, which is recorded on the Leidos Waste Characterization Form. If the container is subsequently moved to another storage location, the Leidos Waste Characterization Form for that container shall be updated to reflect the new storage location.
- Copies of the Radioactive Waste Container Inventory Form and Leidos Waste Characterization Form shall be forwarded to and maintained by the RPM.

General Disposal Requirements

- Containerized radioactive waste stored on site must be in a posted RMSA.
- At the discretion of the RPM, alternative means of disposal may be implemented, including the following:
 - 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;
 - Transfer to the original supplier if properly licensed to receive radioactive materials;
 - Transfer to an authorized recipient per 10 CFR 20.2001 or applicable state, federal, and local regulations;
 - Release into the sanitary sewer in accordance with 10 CFR 20.2003 or applicable state, federal, and local regulations;
 - Segregate and store short-lived radionuclides until the level of residual radioactivity permits conventional disposal;
 - Recycle; or
 - Other means specifically approved in advance by the NRC, pursuant to 10 CFR 20, Subpart K, or by other applicable state or federal agencies.

Off-Site Radioactive Waste Disposal

- For off-site disposal, the RPM will coordinate with the TR to perform the following:
 - Contract an independent, licensed vendor to seal, survey, pick up, and transport filled waste containers to a final disposal facility.
 - Perform and document all analyses on the waste required by the licensed vendor.
 - 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.

- Arrange transfer and disposal of sealed, surveyed, and manifested waste containers to a disposal facility.
- Ensure that all waste transporters meet the applicable requirements of HP-50, "Radioactive Material Shipping."

- 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.
- 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.
- The RPM shall provide the disposal vendor with the inventory of radioactive materials contained in the waste containers.
- 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.

Disposal into Sanitary Sewerage

- The liquid waste to be discharged shall be confirmed:
 - To be soluble (or readily dispersible biological material) in water.
 - To meet the monthly and annual discharge limits specified in 10 CFR 20.2003(a)(4) and 10 CFR 20, Appendix B.
 - To have an SOR not exceeding unity (1.0) when multiple radionuclides are discharged pursuant to 10 CFR 20.2003(a)(3).
 - To meet all applicable state and local discharge permitting requirements prior to discharge.
- Discharges shall be released into only the discharge points authorized by the RPM.
- During discharge:
 - Turn on water from the faucet for 10 seconds prior to discharge.
 - Pour liquid waste slowly into the drain.
 - Leave water running from faucet for 30 seconds after discharge.
- After discharge:
 - Survey the discharge point and surrounding work surfaces to confirm no residual radioactivity remains.
 - Decontaminate surfaces as necessary.
 - Record the activity concentration volume and total activity of the material discharged in the Monthly Radioisotope Sewer Discharge Log (Attachment 3), or equivalent document.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- 10 CFR 71, "Packaging and Transportation of Radioactive Material."
- 10 CFR 835 "Occupational Radiation Protection."
- 40 CFR, Part 240 through 281, "Resource Conservation and Recovery Act."
- 49 CFR, Subpart C, Parts 171 through 177, "Hazardous Materials Regulations."
- 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.
- EHS-7, "Hazardous Waste Management."*
- EHS-280, "Investigation-Derived Waste."*
- ESE A17.1, "Project Records Management."**
- HP-01, "Health Physics Manual."***
- HP-04, "Qualifications and Training."***
- HP-11, "Radiological Monitoring."***
- HP-50, "Radioactive Material Shipping."****
- HP-51, "Limited Quantity Radioactive Material Shipping."****
- HP-52, "Shipping and Receipt Surveys."****

* Refer to <https://prism.leidos.com/docs/DOC-18653> for the current version of EHS referenced procedures in the *Corporate Environmental Health and Safety Program Manual*.

** Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

*** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

- Site-specific, disposal-site waste acceptance criteria.
- 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.

9. ATTACHMENTS

- Attachment 1. Radioactive Waste Container Inventory Form
- Attachment 2. Leidos Waste Characterization Form
- Attachment 3. Monthly Radioisotope Sewer Discharge Log
- Attachment 4. Waste/Transfer Form

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: RADIOACTIVE WASTE CONTAINER INVENTORY FORM

RADIOACTIVE WASTE CONTAINER INVENTORY FORM

^a 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.

ATTACHMENT 2: LEIDOS WASTE CHARACTERIZATION FORM**LEIDOS WASTE CHARACTERIZATION FORM**

Container Number:	Container Type:	Container Weight:
Description of Contents:		Container Location:
<input type="checkbox"/> Container Inventory Form Attached		

Activity Determination

Method (attach all documentation): Analytical Results Microshield Calculation Other

Describe:

Curie Content:

Activity determination performed by:	Date:
Activity determination reviewed by:	Date:

ATTACHMENT 3: MONTHLY RADIOISOTOPE SEWER DISCHARGE LOG

MONTHLY RADIOISOTOPE SEWER DISCHARGE LOG

Year: _____ Month: _____

Monthly Facility Water Usage: _____

Instructions to calculate total monthly activity discharge per nuclide:

1. Calculate activity/discharge/nuclide: Activity concentration ($\mu\text{Ci/mL}$) * Volume discharged (mL)
 2. Calculate total monthly activity discharged/nuclide (μCi): Σ (Total activity per discharge)
 3. Monthly activity concentration/nuclide ($\mu\text{Ci/mL}$): Activity Concentration ($\mu\text{Ci/mL}$) * Volume (mL)/Monthly Facility Water Usage

Limits for Total Activity Discharged

5 Ci/yr-H³

1 Ci/yr-C¹⁴

1 Ci/yr-All other radionuclides combined

Monthly Activity Concentration Limits

ATTACHMENT 4: WASTE/TRANSFER FORM**WASTE/TRANSFER FORM****SECTION I****PART 1 GENERAL INFORMATION**

TRANSFER LOG #	TRACKING #'s		
Present location:	Area/Code:	CONTROL #:	
Container Description:	Quantity:	Units: <input type="checkbox"/> KG <input type="checkbox"/> YD ³ <input type="checkbox"/> FT ³ <input type="checkbox"/> GA	Accumulation Date:
Category:	Sub-Category:		
Class:	Sub-Class:		

PART 2 REQUESTED ACTION: [check all that apply]

<input type="checkbox"/> Add New Record	<input type="checkbox"/> Transfer to: _____	Area/Code: _____
initials		Storage Area Manager
<input type="checkbox"/> Change Existing Records		
<input type="checkbox"/> Create Labels	<input type="checkbox"/> Consolidated with TRACKING No: _____	

PART 3 REGULATORY INFORMATION

Regulation Class:	<input type="checkbox"/> Not Regulated	<input type="checkbox"/> DOT <small>[Fill in Blocks 1, 3, 4, & 5]</small>	<input type="checkbox"/> MDNR/State regulated <small>[Fill in Block 6 MDNR WASTE ID]</small>	<input type="checkbox"/> NESHAP
(If regulated, justify in Comments field)		<input type="checkbox"/> RCRA/DOT <small>[Fill in Blocks 1, 3, 4, 5, & 6]</small>	<input type="checkbox"/> TSCA	<input type="checkbox"/>

SPECIAL

[1] DOT PSN or Description:			
[2] DOT Technical Name:	<input type="checkbox"/> 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]

<input type="checkbox"/> PCBs [concentration _____ PPM]	<input type="checkbox"/> Radioactive Material Contamination
<input type="checkbox"/> Friable Asbestos >1%	<input type="checkbox"/> Non-Friable Asbestos
<input type="checkbox"/> Characteristic or Listed Hazardous Waste [RCRA]	<input type="checkbox"/> Contains an RQ of a Hazardous Substance
<input type="checkbox"/> Petroleum Products or Residues	

PART 5 REQUESTER'S COMMENTS AND DATA

Requester's NAME [printed]:	Signature:	Date:
-----------------------------	------------	-------

SECTION II TRANSFER APPROVAL AND CERTIFICATION [complete only for transfers]

<input type="checkbox"/> Approved	<input type="checkbox"/> 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	Reviewer Initials:	Date Entered:	Data Entered by [initials]:
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Shaded areas require exact nomenclature



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Radiological Instrumentation
HP-30, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

Unless this copy is marked with a red stamp indicating it is a controlled copy, it is uncontrolled. Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

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1. PURPOSE

This health physics (HP) procedure establishes the guidelines and requirements for the calibration, setup, operation, and quality control (QC) of radiological survey instruments.

1.1 Scope and Limitations

This procedure applies to all radiation survey instruments utilized at locations at which the Leidos Radiation Protection Program (RPP) is implemented.

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations* (CFR) Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

American National Standards Institute (ANSI) – The primary organization for fostering the development of technology standards in the United States. The ANSI works with industry groups and is the U.S. member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

Background Test – Daily verification of satisfactory count rate instrument operation by measuring background counts at a fixed location.

Bench Counter – Alpha and/or beta scintillation (non-portable) counting system.

Calibration – Adjustment of instrumentation so the accuracy and performance meet requirements specified by procedures.

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.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the

United States.

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.

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.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

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 m³/hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of Appendix B of 10 CFR 20.

Due Date – The next date an instrument is due to be calibrated.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Frisker – Geiger Mueller, alpha and/or beta scintillation, or other appropriate portable contamination survey instruments.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10⁻³) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

International Electrotechnical Commission (IEC) – A standards body that publishes international standards for electrical, electronic, and related technologies.

International Organization for Standardization (ISO) – An independent, non-governmental international organization that brings together experts to share knowledge, develop, and publish voluntary, consensus-based, market-relevant international standards that support innovation and provide solutions to global challenges. ISO, the shortened form of the organization's name, is not an acronym;

rather, ISO is derived from the Greek term *isos*, meaning equal.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

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.

National Institute of Standards and Technology (NIST) – Founded in 1901, the NIST is a non-regulatory federal agency within the U.S. Department of Commerce. The NIST mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. NIST missions include administration of the National Voluntary Laboratory Accreditation Program (NVLAP).

National Voluntary Laboratory Accreditation Program (NVLAP) – The NVLAP is a laboratory accreditation program established on the basis of requests and demonstrated need. Each laboratory accreditation program includes specific calibration and/or test standards and related methods and protocols assembled to satisfy the unique needs for accreditation in a field of testing or calibration. The NVLAP accredits public and private laboratories based on evaluation of their technical qualifications and competence to carry out specific calibrations or tests. Accreditation criteria are established in accordance with the 15 CFR 285), NVLAP procedures and general requirements, and encompass the requirements of ISO/IEC 17025. The accreditation is formalized through issuance of a Certificate of Accreditation and Scope of Accreditation.

Out-of-Calibration (OOC) – Instrument removed from service due to a lapsed calibration due date.

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.

Out-of-Specification Condition – Status of instrument that does not meet calibration criteria or QC checks.

Portable Scaler – Frisker instrument with a timed integrated count function.

Pre-Operational Checks (POCs) – Checks performed on any portable instrument daily or prior to use.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

Quality Control Checks – Daily response checks on radiation survey instrumentation to verify acceptable instrument performance.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radiation Survey Instrument – Portable radiation detection and measurement instruments used to check personnel, equipment, land areas and facilities for radioactive contamination.

Radiological Control Technician (RCT) – An individual qualified by education, training, and experience to meet the requirements for designation as an RCT. (See Senior [Level] Health Physics Technician [Sr. HPT]).

Senior (Level) Health Physics Technician (Sr. HPT) – An individual qualified by virtue of training, education, and experience to perform the functions of a Sr. HPT. A Sr. HPT is also commonly referred to as a RCT.

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Source Test – Verification of satisfactory instrument operation using a radioactive source.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to

advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Approve of instrument calibration laboratories, after verifying that they meet the requirements of this procedure.
- Review and approve instrument background acceptance criteria, source test acceptance criteria, instrument efficiency, and MDCs.

Radiological Workers and Health Physics Technicians (HPTs)

- Perform pre-operational and QC checks on radiation survey instruments in accordance with this procedure.
- Maintain instrument accountability in accordance with this procedure.
- Operate radiation survey instruments in accordance with this procedure or technical manual guidance.

3. HEALTH AND SAFETY

For locations at which potential exposure to ionizing radiation is a hazard, the Leidos RRP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

The RPM and HPTs will implement the guidelines and requirements provided in Section 5.2 for the calibration, setup, operation, and QC of radiological survey instruments.

5.2 Details

Instrument Calibration

- Radiation survey instruments shall be calibrated under any of the following conditions:

- Prior to calibration due date,
- After maintenance and repair that may affect calibration, or
- 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.
- 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.
- Instruments shall be calibrated in accordance with the guidance of ANSI N323A-1997.
- Upon completion of calibration, each instrument shall be labeled with the following information:
 - Instrument serial number,
 - Initials or other specific identifying mark of the calibrator, and
 - Calibration due date.
- Radiation survey instruments shall be uniquely identified on the instrument housing.

Source Decay Corrections

- 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 shall be calculated by the formula provided in Attachment 4, Equation 3.

Determination of Acceptance Criteria

- Instrument Setup General Requirements
 - 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.
 - QC parameters may be updated due to change in instrument location, area background, or other parameters that affect instrument response.
 - Source tests shall be performed in a consistent and reproducible manner.
- Bench Counter Setup
 - Bench counter background, source, and efficiency data shall be recorded on Attachment 3 (or equivalent).
 - 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
 - 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.
- 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.
- 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 shall be calculated as shown on Attachment 4, Equation 6, or by other methods as determined appropriate by the RPM.
- 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.
- 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 DAC. If necessary, increase the minimum sample volume and/or count time to achieve an MDC less than 0.10 DAC, as practical.
- Bench counter MDC data shall be recorded on Attachment 3, Bench Counter MDC Record (or equivalent).
- Portable Scaler Setup
 - Portable scaler setup data shall be recorded on Attachment 2 (or equivalent).
 - Portable scaler background acceptance criteria, source test acceptance criteria, and efficiency are set up 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 gamma walkover survey instruments.
- Frisker Setup
 - Friskers with a timed scaler function shall be set up as a portable scaler.
 - Friskers without a timed scaler function are set up 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.
- Exposure Ratemeter Setup
 - Exposure ratemeter setup data shall be recorded on Attachment 1, or equivalent.
 - Observe ratemeter source response on the most appropriate scale (i.e., the scale on which the response is nearest the mid-scale reading).
 - Exposure ratemeter source acceptance criteria shall be determined as ±20 percent of ratemeter source response using an appropriate gamma emitting check source.

Pre-Operational Checks

- Pre-operational checks shall be performed prior to instrument use. The following pre-operational checks shall be satisfactorily completed:
 - Verify instrument calibration is current.
 - Check the instrument for physical damage that may affect correct operation.
 - Battery check the instrument.
 - Verify all external cable connections are hand tight, as applicable.
 - Check zero adjustment of instrument, as applicable.
 - 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.
- 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 the first bulleted entry in the Instrument Operational Status subsection of Section 5.2 of this procedure.

QC Checks

- General Requirements
 - 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 the Pre-Operational Checks subsection of Section 5.2 of this procedure, as appropriate;
 - Background Test (except exposure ratemeters); and
 - Source Test.
 - 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).
 - Instruments failing a QC check shall be tagged OOS, and an investigation will be performed, as required by the Instrument Investigations subsection of Section 5.2 of this procedure.
 - Relocation of a bench counter instrument may require re-verification of acceptable QC checks.
- Background Test
 - Background tests shall be performed in a consistent manner and location.
 - The instrument background shall be verified to respond within background acceptance criteria.
 - Background tests are not required for exposure rate instruments.
- Source Test

- Source tests shall be performed in a consistent and reproducible manner.
- The following source tests are required:
 - For exposure rate and count rate instruments, one point shall be verified to respond within source acceptance criteria.

Instrument Operation

- 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.

Instrument Operational Status

- Attachment 6, Out of Service Tag (Example), (or equivalent) shall be attached to an instrument if any of the following occur:
 - The calibration interval has expired.
 - Maintenance or major repair is required.
 - The instrument has failed a QC check or pre-operational check, as determined by the RPM or HPT.
- 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.
- 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.
- Equipment considered to be out-of-specification shall be tagged OOS until proper disposition is determined by the RPM or Sr. HPT. Disposition may include any of the following:
 - Recalibration,
 - Repair,
 - Replacement of the equipment, or
 - Re-evaluation or revision of the acceptance criteria for the equipment as determined by the RPM.

Instrument Investigations

- 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:
 - Loose cable connectors.
 - Meter light not operational.
 - Plastic or rubber covers not pertaining to radiation detector, torn, or missing.
 - 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).
 - Other conditions, as determined by the RPM.
- Investigations shall determine if the instrument was used for any of the following:
 - Assigning permanent record exposure.
 - Unconditional releases of equipment, material, or personnel.

- Determining radioactive effluent concentrations.
- Shipping, receiving, or labeling radioactive material.
- If any condition of the preceding bulleted entry in this Instrument Investigations subsection of Section 5.2 of this procedure is applicable, Attachment 7, Defective Instrument Report, (or equivalent form) shall be completed, and the need for a Radiological Incident Report (HP-22) shall be evaluated by the RPM.
- 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.

Instrument Accountability

- Instrument accountability is maintained by documenting instrument sign-out and return on Attachment 9, Instrument Sign-Out Log, (or equivalent form).
- The RPM may waive the use of Attachment 9, as appropriate.

6. QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance (QA)/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- ANSI 1997. American National Standards Institute. *American National Standard Radiation Protection Instrumentation Test and Calibration*. ANSI N323A-1997. April 3, 1997.
- 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.
- ESE A17.1, "Project Records Management."*
- HP-01, "Health Physics Manual."**
- HP-03, "Radiological Limits." **
- HP-04, "Qualifications and Training."**
- HP-22, "Radiological Incident Report."**
- 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.

- 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.
- * Refer to <https://apps.prism.leidos.com/ eiapps/qa/ESE home.asp> for the current version of ESE referenced procedures.
- ** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Exposure Ratemeter Setup Record
- Attachment 2. Initial Instrument Check In (Example)
- Attachment 3. Bench Counter MDC Record
- Attachment 4. Instrument Setup Calculations
- Attachment 5. Radiation Survey Instrument Calibration Frequency
- Attachment 6. Instrument Out-of-Service Tag (Example)
- Attachment 7. Defective Instrument Report
- Attachment 8. Instrument QC Check Log
- Attachment 9. Instrument Sign-Out Log
- Attachment 10. Ludlum Models – Operating Instructions
- Attachment 11. Frisker Setup Record

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: EXPOSURE RATEMETER SETUP RECORD**EXPOSURE RATEMETER SETUP RECORD**

Date: _____ Location: _____

Instrument Type: _____ Instrument Serial Number: _____

Instrument Range	Source ID/Serial #	Source Position	Observed Exposure Rate ^a mR/hour μ R/hour	Acceptance Criteria ^{a,b} mR/hour μ R/hour

^a Circle correct units.^b \pm 20 percent of observed exposure rateNote: mR – millirem; μ R - microrem**Comments/Restrictions:** _____

Calculated By: _____ Date: _____

Approved: _____ RPM/Designee _____ Date: _____

ATTACHMENT 2: INITIAL INSTRUMENT CHECK IN (EXAMPLE)**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
ALPHA	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		
ALPHA	2,058	0.3	20% of Bkg.	NA
ALPHA	2,082	0.2	1 Standard Deviation of Bkg.	0.1
ALPHA	2,131	0.3	3 Standard Deviations of Bkg.	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
BETA	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		
BETA	2,295	220	20% of Bkg.	47
BETA	2,340	240	1 Standard Deviation of Bkg.	18
BETA	2,416	203	3 Standard Deviations of Bkg.	55

Calculated By: _____ Date: _____

Approved: _____ Date: _____

RPM/Designee

ATTACHMENT 3: BENCH COUNTER MDC RECORD**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/100 cm ²	Smear MDC ^a		dpm/100 cm ²
Release limit		dpm/100 cm ²	Release limit		dpm/100 cm 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 (0.99)	Collection efficiency (ϵ_c)		fraction (0.99)
Minimum sample volume		liters	Minimum sample volume		liters
Air sample MDC		$\mu\text{Ci}/\text{ml}$	Air sample MDC		$\mu\text{Ci}/\text{ml}$
Air sample DAC		$\mu\text{Ci}/\text{ml}$	Air sample DAC		$\mu\text{Ci}/\text{ml}$
DAC fraction MDC			DAC fraction MDC		

^a This calculation assumes the smear was taken over a 100 cm² area. Smears taken over different sized areas will be normalized to 100 cm² 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 (0.99)	Collection efficiency (ε_c)		fraction (0.99)
Minimum sample volume		liters	Minimum sample volume		liters
Air sample MDC		$\mu\text{Ci}/\text{ml}$	Air sample MDC		$\mu\text{Ci}/\text{ml}$
Air sample AE		$\mu\text{Ci}/\text{ml}$	Air sample AE		$\mu\text{Ci}/\text{ml}$
AE fraction MDC			AE fraction MDC		

Calculated By: _____ Date: _____

Approved: _____ Date: _____
RPM/Designee

ATTACHMENT 4: INSTRUMENT SETUP CALCULATIONS**INSTRUMENT SETUP CALCULATIONS**

Portable Counter (timed count) Minimum Detectable Concentration (MDC)
 (Equation 1)

$$\text{MDC (dpm/100 cm}^2\text{)} = \frac{3 + 3.29 \sqrt{(R_b)(T_g)(1 + \frac{T_g}{T_b})}}{\frac{[DA]}{100} [\varepsilon_i] [\varepsilon_s] [T_g]}$$

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)

$$\text{Smear MDC (dpm/100 cm}^2\text{)} = \frac{3 + 3.29 \sqrt{(R_b)(T_g)(1 + \frac{T_g}{T_b})}}{(T_g)(\varepsilon_i)}$$

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.

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 following:

$$s_i = d\sqrt{b'}$$

The minimum detectable count rate (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 NRC Regulatory Guide (NUREG)-1507. The value of 1.38 was obtained from Table 6.1 in NUREG-1507 (Table 6.5 in the *Multi-Agency Radiation Survey and Site Investigation Manual [MARSSIM]*).

$$\text{MDCR (cpm)} = s_i \times (60/i)$$

Finally, the scan MDCs for surfaces may be calculated:

$$\text{Scan MDC} = \frac{\text{MDCR}}{\sqrt{p \epsilon_i \epsilon_s} \frac{\text{DA}}{100 \text{ cm}^2}}$$

MDCR = 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)

$$\text{Air Sample MDC } (\mu\text{Ci/mL}) = \frac{3 + 3.29 \sqrt{(R_b)(T_g)(1 + \frac{T_g}{T_b})}}{(T_g)(\varepsilon_i)(\varepsilon_c)(V)(2.22E^9)}$$

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 ft³, multiply ft³ 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.

INSTRUMENT SETUP CALCULATIONS

Radioactive Sealed Source Activity Determination (Equation 6)

Strontium (Sr)/yttrium (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 is doubled and then decay is 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 National Council on Radiation Protection (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 no concern for daughter product in-growth exists). If surface alpha emission rate is given, then you have to double it to calculate the source 4π activity.

ATTACHMENT 5: RADIATION SURVEY INSTRUMENT CALIBRATION FREQUENCY**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

ATTACHMENT 6: INSTRUMENT OUT-OF-SERVICE TAG (EXAMPLE)**INSTRUMENT OUT-OF-SERVICE TAG**

OUT-OF-SERVICE Model type meter _____ detector _____ S/N meter _____ detector _____ Calibration due date _____	
(check all that apply) REASON FOR TAGGING <input type="checkbox"/> Out of calibration <input type="checkbox"/> Broken <input type="checkbox"/> Failed QC check <input type="checkbox"/> Other _____	
PROBLEMS FOUND <input type="checkbox"/> Bad cable <input type="checkbox"/> Light leak <input type="checkbox"/> Probe/detector <input type="checkbox"/> Broken switch _____ <input type="checkbox"/> No response <input type="checkbox"/> Erratic response <input type="checkbox"/> Pegs high <input type="checkbox"/> Physical damage _____ <input type="checkbox"/> Speaker <input type="checkbox"/> Other _____	
Defective Instrument Report completed? <input type="checkbox"/> yes Tagged by: _____	
Print/Signature	Date

ATTACHMENT 7: DEFECTIVE INSTRUMENT REPORT**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)

ATTACHMENT 8: INSTRUMENT QC CHECK LOG

INSTRUMENTATION QC CHECK LOG

METER:

DATE (MO/YR):

^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): _____

^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): _____

Reviewed By: _____

Date: _____

ATTACHMENT 9: INSTRUMENT SIGN-OUT LOG

INSTRUMENT SIGN-OUT LOG

Location: _____

Month/Year: _____

ATTACHMENT 10: 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 to 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 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 to 500 cpm, 0 to 2.5 kV, BAT OK

MULTIPLIERS: X1, X10, X100, X1,000

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 to 11 seconds from

10 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 1,000 events-per-click (*beta channel only*).

METER DIAL: 0 - 500 cpm, 0 - 2 kV, BAT OK, OL (*overload*).

MULTIPLIERS: X1, X10, X100, X1,000.

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 to 11 seconds from 10 to 90 percent of final reading.

POWER: 2 each D-cell batteries (*housed in compartment 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 out tray.
- 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 zinc sulfide (ZnS[Ag]) adhered to plastic scintillation material

SAMPLE HOLDER: Anodized aluminum tray with 1-inch diameter sample ring to allow for 1-inch or 2-inch diameter samples

SAMPLE SIZE (maximum): 2-inch (5.1-cm) diameter X 0.4-inch (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 each 6-digit LED displays providing a range of 0 to 999999 counts (*controlled by COUNT and HOLD buttons*)

TIMER: Thumbwheel adjustment from 0 to 99 minutes with selectable divisions of X0.1, X1, X10, or EXT for manual timing

METER DIAL: 0 to 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 (μ R) gamma survey

METER DIAL: 0 to 25 μ R/hour, 0 to 50 μ R/hour, BAT TEST, High Voltage Test

RANGE SELECTIONS: 0 to 25, 0 to 50, 0 to 250, 0 to 500, 0 to 5,000 μ R/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)

ATTACHMENT 11: FRISKER SETUP RECORD**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 _____



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Personnel Radiation Exposure Monitoring
HP-40, Rev 0

Effective 01 May 2016

Approved By:

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1. PURPOSE

The purpose of this health physics (HP) procedure is to provide the requirements and guidelines for monitoring employee occupational exposure to ionizing radiation.

1.1 Scope and Limitations

This procedure applies to all personnel working in radiological areas under the Leidos Radiation Protection Program (RPP). Planned special exposures are not within the scope of this procedure.

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

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.

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
- 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.

American National Standards Institute (ANSI) – The primary organization for fostering the development of technology standards in the United States. The ANSI works with industry groups and is the U.S. member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

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.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Background Radiation – The ambient radiation field to which we are exposed daily, originating from cosmic sources, naturally occurring radionuclides (potassium 40, etc.), and human endeavors (fallout, fuel cycle, etc.).

Baseline Monitoring – Monitoring performed prior to the start of work in a radiological area.

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.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

Confirmatory Monitoring – Monitoring carried out in situations in which workers are unlikely to be exposed to significant intakes, in order to demonstrate satisfactory work conditions.

Declared Pregnant Woman – A woman who has voluntarily informed the RPM, in writing, of her pregnancy and the estimated date of conception.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

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 m³/hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of Appendix B of 10 CFR 20.

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."

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out

research addressing some of the major science and engineering challenges of our time.

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10^{-3}) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

High Radiation Area (HRA) – 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 cm from the radiation source or from any surface that the radiation penetrates.

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.

- A full 24-hour bioassay sample is defined as all voids collected within a 24-hour period.
- 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.
- A spot bioassay sample is defined as any single void collected.

International Electrotechnical Commission (IEC) – A standards body that publishes international standards for electrical, electronic, and related technologies.

International Organization for Standardization (ISO) – An independent, non-governmental international organization that brings together experts to share knowledge, develop, and publish voluntary, consensus-based, market-relevant international standards that support innovation and provide solutions to global challenges. ISO, the shortened form of the organization’s name, is not an acronym; rather, ISO is derived from the Greek term isos, meaning equal.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

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).

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

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.

National Voluntary Laboratory Accreditation Program (NVLAP) – The NVLAP is a laboratory accreditation program established on the basis of requests and demonstrated need. Each laboratory accreditation program includes specific calibration and/or test standards and related methods and protocols assembled to satisfy the unique needs for accreditation in a field of testing or calibration. The NVLAP accredits public and private laboratories based on evaluation of their technical qualifications and competence to carry out specific calibrations or tests. Accreditation criteria are established in accordance with the 15 CFR 285), NVLAP procedures and general requirements, and encompass the requirements of ISO/IEC 17025. The accreditation is formalized through issuance of a Certificate of Accreditation and Scope of Accreditation.

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Radiation Worker Training (RWT) – Training inclusive of instructions to workers mandated by 10 CFR 19 to ensure personnel are fully knowledgeable in actions to avoid an unnecessary radiation dose.

Radioactive Material (RAM) – 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.

Radiological Control Technician (RCT) – An individual qualified by education, training, and experience to meet the requirements for designation as an RCT. (See Senior [Level] Health Physics Technician [Sr. HPT]).

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.

Routine Monitoring – Monitoring carried out at regular intervals during normal operations.

Senior (Level) Health Physics Technician (Sr. HPT) – An individual qualified by virtue of training, education, and experience to perform the functions of a Sr. HPT. A Sr. HPT is also commonly referred to as a RCT.

Shallow Dose Equivalent (SDE) – The dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm² when applied to the external exposure of the skin or extremity.

Special Monitoring – Monitoring carried out in actual or suspected abnormal conditions.

Termination Monitoring – Monitoring carried out shortly after all work in a radiological area ceases.

Thermoluminescent 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.

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

U.S. Nuclear Regulatory Commission (technical report designation) (NUREG) – A report or brochure on regulatory decisions, results of research, results of incident investigations, and other technical and administrative information.

Very High Radiation Area (VHRA) – 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 m from the source or

any surface that the radiation penetrates.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Administer industry-standard internal and external radiation exposure monitoring programs.
- Determine if internal and/or external monitoring is required pursuant to 10 CFR 20, or perform monitoring, as appropriate.
- Review monitoring results from the internal and external radiation exposure monitoring programs.
- Review the results of all unusual exposure incidents and make notifications as required by HP-22, "Radiological Reporting."
- Note any special dosimetry requirements (i.e., extremity dosimeters) on HSWPs.
- 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.

Health Physics Technician (HPT)

- Follow ALARA practices and procedures.
- Control their own exposure to radiation hazards such that their annual dose remains below the administrative limits and are ALARA.
- Provide past exposure history for employee exposure history files.
- Plan and perform work involving radioactive materials in a fashion that minimizes the radiation exposures received.
- 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.

Monitored Personnel

- Comply with the requirements of this procedure while participating in the internal and external radiation exposure monitoring programs, as applicable.
- Provide baseline, confirmatory routine, special, and termination bioassays, as directed by the RPM.
- Provide past exposure history for employee exposure history files.
- Notify the RPM, or designee, immediately upon arrival at the workplace following administration of a radiopharmaceutical.
- Plan and perform work involving radioactive materials in a fashion that minimizes the radiation exposures received.
- Control their own exposure to radiation hazards such that their annual dose remains below the administrative limits and are ALARA.
- 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.

- Use dosimetry in accordance with this procedure and HSWP requirements.
- Report missing dosimetry to the RPM, or designee.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

The RPM, HPTs, and monitored personnel will implement the requirements and guidelines provided in Section 5.2 for monitoring employee occupational exposure to ionizing radiation.

5.2 Details

General Requirements

- Refer to HP-03, "Radiological Limits," for federal and administrative exposure limits.
- No one under the age of 18 will be allowed access to a restricted area if the work being performed is at a USACE site.
- 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 mrem TEDE/month.
- Upon notification of medical administration of a radioisotope, the RPM shall remove the affected individual's dosimetry from use until the activity retained in the individual's body is not detectable utilizing a personnel contamination monitor.
- 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.
- 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.
- 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.
- 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.

Internal Radiation Monitoring

- General
 - If internal exposure monitoring is required, individuals shall participate in the bioassay and/or air monitoring programs as directed by the RPM.
 - If internal exposure monitoring is not required, BZ 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).
 - Air monitoring shall be conducted in accordance with HP-11, "Radiological Monitoring."
- Bioassay Monitoring
 - 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.
 - 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:
 - Meets the performance specifications for indirect bioassay recommended in ANSI N13.30.
 - Has written procedures that document the laboratory's analytical capabilities and a QA/QC program that ensures the validity of the analytical results.
- Bioassay Sampling (Urine Bioassay)
 - Bioassay samples shall be either 24-hour samples or simulated 24-hour samples, as defined in Section 1.3 of this procedure.
 - The RPM, or designee, shall issue sample containers and Attachment 7, Bioassay Instructions/Chain of Custody, (or equivalent) to the monitored employee.
 - The monitored employee shall collect the specified urine sample(s) and return the container(s) and completed bioassay instructions/chain-of-custody form to the RPM, or designee.
 - 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 Attachment 7), and forward the sample to the analytical laboratory.
 - Each bioassay sample chain-of-custody form must provide the following sample information:
 - Monitored individual's name,
 - Date and time of voids,
 - Required analysis
- Monitoring Frequency
 - Baseline bioassays for monitored employees shall be performed at the start of employment, unless waived by the RPM on Attachment 3 (or equivalent).
 - Routine bioassay monitoring will be performed at a frequency specified by the RPM, as appropriate.
 - If monitoring is required, routine air sampling shall be conducted daily when radionuclides are being used or handled, as determined appropriate by the RPM.

- 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."
- Special or non-routine bioassays will 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.
- Assessment of Internal Dose
 - 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.
 - CEDE and/or CDE for radionuclide intakes detected through bioassay and/or air monitoring is 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.
 - 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 is based on the data considered to be most accurate as determined by the RPM.

External Radiation Monitoring

- General
 - 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.
 - TLDs are processed in quarterly monitoring periods, unless determined otherwise by the RPM.
 - TLD storage area exposure rates shall not be distinguishable from background.
 - TLDs in storage or transit shall be accompanied with a control TLD to monitor accumulated dose while in storage or transit.
 - 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.
- Monitoring for Extremity Exposure
 - Radiological workers likely to exceed 5 rem/year to the extremities shall wear extremity dosimeters (ring badges) to evaluate the dose to extremities, as determined by the RPM.
 - When ring badges are required, each hand shall be provided with a dosimetry device unless an alternate approach is justified and documented.
 - 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).

- Monitoring for Skin Exposure
 - Radiological workers likely to exceed 5 rem/year to the skin shall be monitored for SDE.
 - The RPM, or designee, controls skin dose rates primarily by using appropriate protective equipment (shielding and protective clothing such as gloves) and decontamination.
 - 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.
 - The RPM, or designee, shall calculate the skin dose (e.g., SDE) if it is suspected that a worker may have received greater than 5,000 mrem SDE from skin contamination, or if detectable skin contamination cannot be removed by decontamination pursuant to HP-10, "Personnel and Equipment Decontamination."
- Monitoring for Exposure to the Lens of the Eye
 - Radiological workers likely to exceed 1,500 mrem/year LDE shall be monitored.
 - The RPM, or designee, controls dose to the lens of the eye primarily by using protective equipment (shielding and protective clothing such as safety glasses), as appropriate.
 - 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.
- Equipment Specifications
 - Dosimetry services shall be accredited by the NVLAP.
 - 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.
- Estimating External Dose
 - 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 previously specified methods.
 - Dose estimates for DDE and/or SDE shall be documented on Attachment 8, External Dose Estimation (or equivalent).
- External Dose Assessment
 - The dose of record for DDE, SDE, and extremity dose is that which is recorded from processing of the TLD, unless determined otherwise by the RPM.
 - 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.

Short-Term Visitor Access Requirements

- Short-term visitors are administratively limited to 50 mrem TEDE, and are normally limited to escorted touring inside of a restricted area.
- Short-term visitors are not considered monitored employees.

- Short-term visitors shall not enter contamination areas, radiation areas, HRAs, VHRA, or airborne radioactivity areas unless escorted by a Sr. HPT. Entry requirements in other restricted areas shall be determined by the site RPM, as appropriate.
- Short-term visitors and escorts shall read, understand, and sign Attachment 1, Visitor Log (or equivalent).

Employee Radiation Exposure Monitoring Participation

- In order to determine monitoring requirements, the RPM (or designee) must anticipate individual exposure using dose modeling, historical monitoring data, and/or professional judgment. Anticipated exposure is evaluated using one of, or a combination of, the following factors:
 - Expected duration within the restricted area for a given activity.
 - Expected dose rates in work areas for the radionuclide of concern.
 - Expected or historical air particulate concentrations in the work areas.
 - Historical exposure performing similar work.
- 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).
- A declared pregnant woman shall participate in a radiation monitoring program if she is 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.
- A minor shall participate in the radiation monitoring program if the individual is performing work on a non-USACE site and is likely to receive 100 mrem/year DDE, an LDE of 150 mrem/year, an SDE of 500 mrem/year, or 500 mrem/year CEDE.
- The RPM may elect to conduct monitoring in lieu of performing an assessment to determine monitoring requirements.

Monitored Employee Processing Requirements

- Each Monitored Employee shall:
 - Provide documentation indicating successful completion of RWT.
 - Complete applicable sections of Attachment 3, Monitored Employee Information (or equivalent).
 - 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 form, 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).
 - Be issued a TLD and extremity dosimeter (if required), unless waived by the RPM.
- Each monitored employee previously monitored for radiation exposure shall:
 - Provide a completed NRC Form 4 (or equivalent).
 - Provide a signed Attachment 2, Request for Radiation Exposure Records, form (or equivalent).

- 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).
- 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.
- If the individual's available dose balance is insufficient for the exposure anticipated, then the individual shall be denied access to the restricted area.
- The RPM (or designee) shall enter the individual into the monitoring program by completing Attachment 4, Monitored Employee Log (or equivalent).

Termination of Monitoring

- 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 form.
- 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.

Radiation Exposure Reports

- Within 30 days of receipt of dosimetry and bioassay results, employee radiation exposure is assessed.
- The results of annual radiation exposure monitoring shall be documented on Attachment 5, NRC Form 5, (or equivalent) and forwarded to the monitored individual.
- The RPM utilizes the guidance contained in HP-22 "Radiological Reporting," if applicable, for recording and reporting occupational radiation exposure data.

Additional Guidance

- The RPM may use the references listed in Section 8 of this procedure (as appropriate) as additional guidance for implementation of the personnel monitoring program and for calculation of occupational radiation exposure.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

- 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, SDE, LDE).

- Records of the results of surveys, air sampling, measurements, and calculations shall be maintained until the NRC terminates the license requiring the record (if applicable), if used, to determine:
 - External dose (i.e., DDE, shallow dose equivalent, LDE, dose to extremities, etc.) from radiation sources external to the body; and
 - Internal dose (i.e., CEDE or CDE) from the intake of radioactive materials.
- Records of individual monitoring results shall be reported to individuals and maintained for each individual for whom monitoring was required in accordance with the Leidos RPP.
- All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 19, "Notices, Instructions and Reports to Workers: Inspections and Investigations."
- 10 CFR 20, "Standards for Protection against Radiation."
- 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.
- ESE A17.1, "Project Records Management."*
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- HP-03, "Radiological Limits."**
- HP-04, "Qualifications and Training."**
- HP-10, "Personnel and Equipment Decontamination."**
- HP-11, "Radiological Monitoring."**
- HP-12, "Health Physics Oversight."**
- HP-20, "Radiological Posting and Labeling."**
- HP-22, "Radiological Reporting."**
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* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Visitor Log
- Attachment 2. Request for Radiation Exposure Records
- Attachment 3. Monitored Employee Information
- Attachment 4. Monitored Employee Log
- Attachment 5. Occupational Dose Record for a Monitoring Period
- Attachment 6. Cumulative Occupational Dose History
- Attachment 7. Bioassay Instructions/Chain of Custody
- Attachment 8. External Dose Estimation

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: VISITOR LOG

VISITOR LOG

***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.

ATTACHMENT 2: REQUEST FOR RADIATION EXPOSURE RECORDS

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

ATTACHMENT 3: MONITORED EMPLOYEE INFORMATION

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: _____

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	<input type="checkbox"/>
				Written Estimate	<input type="checkbox"/>
				Best Personal Est.	<input type="checkbox"/>
				Record	<input type="checkbox"/>
				Written Estimate	<input type="checkbox"/>
				Best Personal Est.	<input type="checkbox"/>
				Record	<input type="checkbox"/>
				Written Estimate	<input type="checkbox"/>
				Best Personal Est.	<input type="checkbox"/>
				Record	<input type="checkbox"/>
				Written Estimate	<input type="checkbox"/>
				Best Personal Est.	<input type="checkbox"/>

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.

Individual's 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.

Individual's Signature

Date

MONITORED EMPLOYEE INFORMATION**EMPLOYEE ID: _____ (Page 2 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 rem 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
(Administrative limit - current year whole body exposure: Use 100 mrem if administrative 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

ATTACHMENT 4: MONITORED EMPLOYEE LOG

MONITORED EMPLOYEE LOG

Year: _____ Page #: _____

ATTACHMENT 5: OCCUPATIONAL DOSE RECORD FOR A MONITORING PERIOD

OCCUPATIONAL DOSE RECORD FOR A MONITORING PERIOD				
1. NAME (LAST, FIRST, MIDDLE INITIAL)		2. INDENTIFICATION NUMBER	3. ID TYPE	4. SEX <input type="checkbox"/> MALE <input type="checkbox"/> FEMALE
6. MONITORING PERIOD TO		7. LICENSEE NAME	8. LICENSE NUMBER(S)	9A 9B <input type="checkbox"/> RECORD <input type="checkbox"/> ROUTINE <input type="checkbox"/> ESTIMATE <input type="checkbox"/> PSE
INTAKES				DOSES (in rem)
10A. RADIONUCLIDE	10B. CLASS	10C. MODE	10D. INTAKE in μCi	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)

- | <ol style="list-style-type: none"> 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: <table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">CODE</th> <th style="width: 85%;">ID TYPE</th> </tr> <tr> <td>SSN</td> <td>U.S. Social Security Number</td> </tr> <tr> <td>PPN</td> <td>Passport Number</td> </tr> <tr> <td>CSI</td> <td>Canadian Social Insurance Number</td> </tr> <tr> <td>WPN</td> <td>Work Permit Number</td> </tr> <tr> <td>PADS</td> <td>PADS Identification Number</td> </tr> <tr> <td>OTH</td> <td>Other</td> </tr> </table> <ol style="list-style-type: none"> 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. | 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 | <ol style="list-style-type: none"> 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. | <ol style="list-style-type: none"> 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. |
|---|----------------------------------|---------|-----|-----------------------------|-----|-----------------|-----|----------------------------------|-----|--------------------|------|----------------------------|-----|-------|---|---|
| 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 | | | | | | | | | | | | | | | |

ATTACHMENT 6: CUMULATIVE OCCUPATIONAL DOSE HISTORY

NRC FORM 4 (08-2014) 10 CFR PART 20			U.S. NUCLEAR REGULATORY COMMISSION			APPROVED BY OMB NO. 3150-0005		EXPIRES: 08/31/2017	
						<p>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.</p>			
CUMULATIVE OCCUPATIONAL DOSE HISTORY									
1. NAME (LAST, FIRST, MIDDLE INITIAL)			2. IDENTIFICATION NUMBER		3. ID TYPE	MALE	5. DATE OF BIRTH (MM/DD/YYYY)		
						4. SEX	<input type="checkbox"/> FEMALE	<input type="checkbox"/> MALE	<input type="checkbox"/>
6. MONITORING PERIOD (MM/DD/YYYY – MM/DD/YYYY)			7. LICENSEE NAME		8. LICENSE NUMBER	9. RECORD ESTIMATE NO RECORD	10. ROUTINE		
							<input type="checkbox"/>	<input type="checkbox"/> PSE	<input type="checkbox"/>
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. ROUTINE		
							<input type="checkbox"/>	<input type="checkbox"/> PSE	<input type="checkbox"/>
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. ROUTINE		
							<input type="checkbox"/>	<input type="checkbox"/> PSE	<input type="checkbox"/>
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. ROUTINE		
							<input type="checkbox"/>	<input type="checkbox"/> PSE	<input type="checkbox"/>
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. ROUTINE		
							<input type="checkbox"/>	<input type="checkbox"/> PSE	<input type="checkbox"/>
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 whose 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.

ATTACHMENT 7: BIOASSAY INSTRUCTIONS/CHAIN OF CUSTODY**BIOASSAY INSTRUCTIONS/CHAIN OF CUSTODY
(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 the 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:

ATTACHMENT 8: EXTERNAL DOSE ESTIMATION**EXTERNAL DOSE ESTIMATION**

Employee Name:	Social Security No.
Assessment Period (dates):	
Computed Dose (mrem DDE):	
Reason (check): <input type="checkbox"/> Lost Dosimeter <input type="checkbox"/> Damaged Dosimeter <input type="checkbox"/> Other (describe): <hr/>	Basis (check): <input type="checkbox"/> Prior exposure history <input type="checkbox"/> Comparison with coworkers <input type="checkbox"/> Ambient exposure rate and stay time analysis <input type="checkbox"/> Other (describe): <hr/> <hr/>
Notes and Calculations:	
Assessment Performed by (name and signature):	
Assessment Date:	
RPM Approval (name and signature):	



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Radioactive Material Shipping **HP-50, Rev 0**

Effective 01 May 2016

Approved By:

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Unless this copy is marked with a red stamp indicating it is a controlled copy, it is uncontrolled. Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

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1. PURPOSE

This health physics (HP) 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 of radioactive materials within or between buildings or facilities are subject to on-site requirements.

1.1 Scope and Limitations

The policies and requirements in this procedure apply to all personnel who generate, handle, package, and ship radioactive materials from a site implementing the Leidos Radiation Protection Program (RPP). 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 shall follow the requirements contained in HP-51, "Limited Quantity Radioactive Material Shipping."

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations* (CFR) Part 20, "Standards for Protection Against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

A₁ Value – The maximum activity of special form Class 7 (radioactive) material permitted in a Type-A package. These values are listed in 10 CFR 71 and 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177.

A₂ 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 10 CFR 71 and 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Becquerel (Bq) – A unit of measure of radioactivity in the International System of Units (SI), equal to 1 disintegration per second (dps) (i.e., transformation per second).

Carrier (Common Carrier) – Person or entity who transports passengers or property in commerce by rail car, aircraft, motor vehicle, or vessel (e.g., Federal Express)

(49 CFR 171.8).

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).

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

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.

Consignment – A package, group of packages, or load of radioactive material offered for transport in the same shipment (49 CFR 173.403).

Curie (Ci) – A basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion dps (i.e., transformations per second) and is approximately the rate of decay of 1 gram (g) of radium.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Disintegrations per Minute (dpm) – The average quantity of radiological disintegrations (i.e., transformations) occurring per minute as a result of the spontaneous emission from the atomic nuclei of either alpha or beta particles.

Disintegrations per Second (dps) – The decrease in the amount of any radioactive material with the passage of time (i.e., each second), as a result of the spontaneous emission from an atomic nuclei such as alpha or beta particles. In the SI, 1 dps (i.e., transformation per second) equates to 1 Bq.

Environmental Health and Safety (EHS) – The department in a company or an organization involved in **environmental** protection, **safety** at work, occupational **health and safety**, compliance, and best practices. The EHS department aims to prevent and reduce accidents, emergencies, and health issues at work.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Excepted Package – The packaging, together with its excepted Class 7 (radioactive) material contents, as specified in 49 CFR 173.421-427.

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 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).

Fissile Material – Any plutonium-239, plutonium-241, uranium-233, uranium-235 or any combination of these radionuclides. See 49 CFR 173.453 for “Fissile Materials-exceptions.”

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10^{-3}) kilogram (kg).

Hazardous Material (HAZMAT) – 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 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).

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.

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

Highway Route Controlled Quantity – A quantity of radioactive material within a single package that exceeds 3,000 times the applicable A₁ value specified in 49 CFR 173.435 for special form Class 7 (radioactive) material; 3,000 times the applicable A₂ value of the radionuclides specified in 49 CFR 173.435 for normal form Class 7 (radioactive) material; or 1,000 terabecquerels (TBq) (27,000 Ci), whichever is least (49 CFR 173.403).

In Commerce – The movement of materials or goods in trade over public roadways, air, or water and over railroad properties.

Industrial Package (IP) – A package designed and constructed to meet transportation requirements, particularly those defined in 10 CFR, 49 CFR, and related international standards for these types of packages.

International Air Transport Association (IATA) – An organization that regulates dangerous goods (e.g., hazardous materials) in international trade and coordinates related environmental evaluations.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Limited Quantity (LQ) – A quantity of Class 7 (radioactive) material not exceeding the material's package limits specified in 49 CFR 173.425, "Table of Activity Limits—Excepted Quantities and Articles," and conforming with the requirements specified in 49 CFR 173.421, "Excepted Packages for Limited Quantities of Class 7 (Radioactive) Materials." (Also see HP-51, "Limited Quantity Radioactive Material Shipping.")

Liter (L) – A base SI unit of volume equating to 1,000 milliliters (mL).

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.

Microcurie(s) (μ Ci) – A unit of measure equal to one-millionth (10^{-6}) Ci.

Millicurie(s) (mCi) – A unit of measure equal to one-thousandth (10^{-3}) Ci.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Milliliter(s) (mL) – A unit of measure equal to one-thousandth (10^{-3}) L.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Milliroentgen (mR) – A unit of measure equal to one-thousandth (10^{-3}) roentgen.

Millisievert(s) (mSv) – A unit of measure equal to one-thousandth (10^{-3}) sievert.

Motor Carrier (MC) – A company that provides truck transportation. The two types of motor carriers are private carriers and for-hire carriers.

Package – The packaging, together with its radioactive contents, as presented for transport (49 CFR 173.403).

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).

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

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.

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 curies and in terabecquerels, for radionuclides listed in column 1.)

Site Safety and Health Plan (SSHP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Surface Contaminated Object (SCO) – A solid object which is not itself radioactive, but which has radioactive material distributed on its surface.

Terabecquerels (TBq) – A unit of measure equal to 10^{12} Bq (10^{12} dps [i.e., transformations per second]).

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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 TI is determined by multiplying the maximum radiation level (in mSv/hour) at 1 m from the external surface of the

package by 100 (equivalent to the maximum radiation level [in mrem/hour] at 1 m) (49 CFR 173.403).

Transportation Representative (TR) – An individual maintaining requisite training and qualifications in accordance with 49 CFR 172, Subpart H, and the 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.

Type-A Package – The packaging, together with its radioactive contents limited to A₁ or A₂ 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 A₁ for special form Class 7 (radioactive) material or A₂ for normal form Class 7 (radioactive) material where A₁ and A₂ values are given in 49 CFR 173.435 or are determined in accordance with 49 CFR 173.433.

In 10 CFR 71.4, the NRC defines A₁ as the maximum activity of special form radioactive material permitted in a Type-A package, and A₂ as the maximum activity of radioactive materials, *other than special form material, LSA, and SCO material*, permitted in a Type-A package.

Type-B Package – A packaging designed to transport greater than an A₁ or A₂ 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.

Type-B(U) Package – A Type-B packaging that, together with its radioactive contents, for international shipments requires unilateral approval only of the package design and of any stowage provisions that may be necessary for heat dissipation.

Type-B(M) Package – A Type-B packaging that, together with its radioactive contents, for international shipments requires multilateral approval of the package design, and may require approval of the conditions of shipment. Type-B(M) packages are those Type-B package designs with a maximum normal operating pressure of more than 700 kilopascal/cm² (100 pounds/square inch) gauge or a relief device which would allow the release of Class 7 (radioactive) material to the environment under the hypothetical accident conditions specified in 10 CFR 71.

Type-A Quantity – A quantity of radioactive material in a single package, of which the aggregate radioactivity does not exceed the A₁ value for special form radioactive material or the A₂ value for normal form radioactive material.

Type-B Quantity – Any quantity of radioactive material greater than a Type-A quantity (49 CFR 173.403).

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our

nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Department of Transportation (DOT) – A governmental department with the mission to serve the United States by ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people today and in the future.

U.S. Environmental Protection Agency (USEPA) – The federal governmental agency with the mission to protect human health and the environment.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

U.S. Nuclear Regulatory Commission (technical report designation) (NUREG) – A report or brochure on regulatory decisions, results of research, results of incident investigations, and other technical and administrative information.

United Nations (UN) number or identification (ID) – A UN number or UN ID is a four-digit code used to identify flammable and harmful chemicals. UN numbers are assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods and range from UN 0001 to about UN 3500.

Waste Acceptance Criteria (WAC) – Requirements established by waste disposal sites in coordination with federal, state, and local regulators pursuant to detail provisions applicable to waste disposal.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Verify compliance with this procedure during periodic audits.

Radiation Safety Officer (RSO)

- Generally qualified both as RSO and as TR, and may serve concurrently in both roles.
- In coordination with the TR, will revise this procedure in response to regulatory changes or to accommodate feedback from field operations.

Transportation Representative (TR)

- 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.

Health Physics Technicians (HPTs)

- Responsible for conducting the radiological surveys necessary to maintain compliance with this procedure.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted under this program are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

General

- 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 NRC in 10 CFR Part 71" (49 CFR 173.401).
- 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.
- Transportation records, including those involving radioactive materials, will be documented using SI units consistent with the provisions of 49 CFR 171.10. Conventional U.S. units will generally be documented in parentheses in addition to the SI units.
- Additional limitations and requirements for airfreight or international shipments shall be addressed during shipment planning.
- 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.
- The requirements for classification, marking, labeling, receiving, and shipping limited quantities of radioactive materials are covered in HP-51, "Limited Quantity Radioactive Material Shipping."

5.2 Details

5.2.1 Receiving Radioactive Materials

- 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."

- Guidance on receiving and opening packages is contained in 10 CFR 20.1906, "Procedures for Receiving and Opening Packages," and includes the following:
 - Requirements for receiving radioactive material expeditiously;
 - Surveying packages, when received, for radiation and contamination;
 - Notifying authorities if excessive contamination or radiation is found;
 - Using written procedures for receiving radioactive materials; and
 - Following any special instructions provided for opening packages.

5.2.2 Material Characterization

- Isotopic content, concentration, and total activity of each package or bulk shipment must be determined prior to classification and packaging of the shipment.
- 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 must 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.
- Classification thresholds for shipments via airfreight or with international destinations will vary and shall be made according to the requirements of HP-51, "Limited Quantity Radioactive Material Shipping."
- If the material is characterized as radioactive, as described herein, 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.
- If other hazardous materials are contained in the radioactive material being shipped or are being shipped with radioactive material(s), 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 USEPA hazardous waste code (e.g., "mixed waste") shall also be prepared in accordance with 40 CFR 261 and be documented on an approved hazardous waste manifest in accordance with 40 CFR 262.

5.2.3 Material Classification

- 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.

- 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 A₁ and A₂ values contained in 49 CFR 173.435, "Table of A₁ and A₂ Values for Radionuclides." Unless the radioactive material meets the requirements of 49 CFR 173.403 for special form, it is defined as normal form material.
- 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 A₁ and A₂ 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.
- 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.
- Title 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," provides information for classification of wastes.
- Waste materials being shipped for disposal are classified as waste. The word "Waste" must appear before the proper shipping name for the material.

5.2.4 Packaging, Marking, and Labeling Radioactive Materials

Empty Packages (See 49 CFR 173.428 and Attachment 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 requirements (except for the UN identification number marking requirement described in 49 CFR 173.422(a)), provided that the packaging meets the requirements of 49 CFR 173.421(a) (2), (3) and (5).
- 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.
- 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, limit residual removable radioactivity on the outside of the package to the standards prescribed in 49 CFR 173.443(a), and prohibit the presence of fissile material unless excepted by 49 CFR 173.453. In addition, the package must be securely closed and unimpaired so that it will not leak residual activity under conditions normally incident to transportation.

- 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 cm² for beta-gamma emitters and low toxicity alpha emitters, and 2,200 dpm/100 cm² 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.
- 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.
- If the empty package is not hazardous waste itself, no manifest is required.

Low Specific Activity (LSA) and Surface Contaminated Object (SCO)

- 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 TBq/L (20.0 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 $2 \times 10^{-3} \text{ A}_2/\text{g}$.
- 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 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed $4 \text{ Bq/cm}^2 (10^{-4} \mu\text{Ci/cm}^2)$ for beta and gamma and low toxicity alpha emitters, or $0.4 \text{ Bq/cm}^2 (10^{-5} \mu\text{Ci/cm}^2)$ 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 $4 \times 10^4 \text{ Bq/cm}^2 (1.0 \mu\text{Ci/cm}^2)$ for beta and gamma and low toxicity alpha emitters, or $4 \times 10^3 \text{ Bq/cm}^2 (0.1 \mu\text{Ci/cm}^2)$ 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 $4 \times 10^4 \text{ Bq/cm}^2 (1 \mu\text{Ci/cm}^2)$ for beta and gamma and low toxicity alpha emitters, or $4 \times 10^3 \text{ Bq/cm}^2 (0.1 \mu\text{Ci/cm}^2)$ 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 $400 \text{ Bq/cm}^2 (10^{-2} \mu\text{Ci/cm}^2)$ for beta and gamma and low toxicity alpha emitters, or $40 \text{ Bq/cm}^2 (10^{-3} \mu\text{Ci/cm}^2)$ 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 $8 \times 10^5 \text{ Bq/cm}^2 (20 \mu\text{Ci/cm}^2)$ for beta and gamma and low toxicity alpha emitters, or $8 \times 10^4 \text{ Bq/cm}^2 (2 \mu\text{Ci/cm}^2)$ 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 $8 \times 10^5 \text{ Bq/cm}^2 (20 \mu\text{Ci/cm}^2)$ for beta and gamma and low toxicity alpha emitters, or $8 \times 10^4 \text{ Bq/cm}^2 (2 \mu\text{Ci/cm}^2)$ for all other alpha emitters (49 CFR 173.403) (see Attachment 2).
- 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, 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 II) non-fissile or fissile excepted, 7, UN 2913
- 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 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 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/cm² for beta and gamma emitters and low toxicity alpha emitters and 0.4 Bq/cm² 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.
- 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 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.

- Domestic shipments containing less than an A₂ 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.
- Placards are required for exclusive use shipments of LSA and SCO materials, except shipments of unconcentrated uranium and thorium ores.
- 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.
- 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.
- LSA-III Class 7 (radioactive) material must meet the test requirement of Paragraph (b), 49 CFR 173.468, "Test for LSA-III Material."
- 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 kg (110 pounds);
 - "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.

Labeling

Labeling requirements are stated in 49 CFR 172, Subpart E – "Labeling." Labeling requirements for radioactive material are stated in 49 CFR 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 opposite sides of each package. The TR will enter the radionuclides and the TI on the labels based on information from HP staff, then 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 mSv/hour at 1 m (3.3 ft) 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
Greater than zero, but not greater 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
Greater than 1, but not greater 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
Greater 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.

5.2.5 Shipping

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 radioactive 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 to a foreign destination shall be made according to the limitations of HP-51, "Limited Quantity Radioactive Material Shipping."

Shipping Documentation

- 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 will maintain checklists for each shipment. Shipping checklists are located in the attachments of this procedure. Documentation of package certification shall be maintained for at least one year following the shipment.
- Copies of the package surveys and truck surveys shall be maintained with the shipment documentation.

- A loading diagram showing the package number(s) and placement on the vehicle shall be maintained with the shipment documentation.
- Certification that the shipment meets the requirements for transportation shall be maintained. These requirements are described as follows.

Shipping Papers

- Requirements 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.
- 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.
- Hazardous materials, including radioactive materials, must be identified using the proper shipping names listed in the hazardous materials table contained in 49 CFR 172.101.
- Hazardous materials must be entered first on the shipping papers if other kinds of materials are included on the documents.
- 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 an RQ, 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.”
- Show the label (i.e., Radioactive White-I, Yellow-II, or Yellow-III) used on the package on the shipping papers.
- 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.
- 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.
- Shippers must certify that the shipment is prepared in accordance with 49 CFR. The certification must say: “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.”
- Shipping paper pages must be numbered with the page number and number of pages (e.g., Page 1 of 4).
- The shipping papers required for a shipment are listed on the attached checklists for different kinds of radioactive material shipments.

- 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 contained in 49 CFR 173.435, Table of A₁ and A₂ 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.
- The shipping paper requirements for airfreight shipment are contained in the IATA's *Dangerous Goods Regulations*. The shipping paper requirements for shipment by vessel (water) are contained in the International Maritime Associated Dangerous Goods Code.
- All Leidos hazardous material shipping papers require review and approval by Corporate EHS prior to release of the shipment.
- 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).

Shipping Radioactive Materials to Other Licensees

- 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 parts and subparts.
- 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.
- 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."

- When shipping hazardous materials listed in 49 CFR 172.101, "Hazardous Materials Table," the requirements applicable to both radioactivity and other hazards apply.
- 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 WAC. Upon documentation that the wastes comply with the WAC, disposal authorization will be provided by the disposal site.
- Radiological surveys shall be performed in accordance with HP-52, "Shipping and Receipt Surveys."
- For non-exclusive use shipments, the number of packages in the conveyance must be limited so that the total 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.
- 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.
- 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 ALARA.
- 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.

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.
 - 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.
 - 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.
 - If the shipment has not been received at the consignee's facility, do the following:
 - 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."
 - 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).

5.2.6 Radioactive Material Transportation

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 material 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.

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. Postal Service, the package contents must not exceed 10 percent of the LQ amount. The shipment must be described on the "Shippers Declaration for Dangerous Goods."

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.

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. A 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]).

5.2.7 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 will 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 when 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 longer;
 - A major transportation artery or facility is closed or shut down for one hour or longer; 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 USEPA 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.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, “Project Records Management.”

7. RECORDS

All records generated as a result of this procedure shall be maintained by the RPM until submission to the appropriate electronic record system in accordance with ESE A17.1, “Project Records Management.”

Maintain the following records for the radioactive material shipping program:

- Retain records of surveys for three years as required by 10 CFR 20.2103, "Records of Surveys."
- 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.
- Retain documentation of calculations of quantities of material and concentrations, and package calculations for IP and Type-A packages.
- 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.
- 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.
- Maintain records of waste manifests, continuation sheets, and container and waste description sheets.
- 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.

8. REFERENCES

- 10 CFR 20.1906, "Procedures for Receiving and Opening Packages."
- 10 CFR 20.2006, "Transfer for Disposal and Manifests."
- 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."
- 10 CFR 61.55, "Waste Classification."
- 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste."
- 10 CFR 71, "Packaging and Transportation of Radioactive Material."
- 10 CFR 835, "Occupational Radiation Protection."
- 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177, "Hazardous Materials Regulations."
 - 49 CFR 171, "General Information, Regulations, and Definitions."
 - 49 CFR 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements, and Security Plans."
 - Subpart A – "General."
 - Subpart B – "Table of Hazardous Materials and Special Provisions."
 - Subpart C – "Shipping Papers."
 - Subpart D – "Marking."
 - Subpart E – "Labeling."
 - Subpart F – "Placarding."
 - Subpart G – "Emergency Response Information."
 - Subpart H – "Training."
 - Subpart I – "Safety and Security Plans."
 - 49 CFR 173, "Shippers – General Requirements for Shipments and Packagings."
 - Subpart A – "General."
 - Subpart B – "Preparation of Hazardous Materials for Transportation."
 - Subpart I – "Class 7 (Radioactive) Materials."
 - 49 CFR 174, "Carriage by Rail."

- Subpart A – “General Requirements.”
- Subpart B – “General Operating Requirements.”
- Subpart C – “General Handling and Loading Requirements.”
- Subpart D – “Handling of Placarded Rail Cars, Transport Vehicles and Freight Containers.”
- Subpart K – “Detailed Requirements for Class 7 (Radioactive) Materials.”
- 49 CFR 177, “Carriage by Public Highway.”
 - Subpart A – “General Information and Regulations.”
 - Subpart B – “Loading and Unloading.”
 - Subpart C – “Segregation and Separation Chart of Hazardous Materials.”
 - Subpart D – “Vehicles and Shipments in Transit; Accidents.”
- 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. 2012.
- 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.
- ESE A17.1, “Project Records Management.”*
- HP-01, “Health Physics Manual.”**
- HP-04, “Qualifications and Training.”***
- HP-51, “Limited Quantity Radioactive Material Shipping.”***
- HP-52, “Shipping and Receipt Surveys.”***
- 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.
- 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.
- NRC 1998b. U.S. Nuclear Regulatory Commission. Categorizing and Transporting Low Specific Activity Materials and Surface Contaminated Objects. NUREG-1608. July 1998.
- 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.

* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Checklist for Shipping Empty Packages
- Attachment 2. Checklist for LSA or SCO
- Attachment 3. Checklist for Normal Class 7 Radioactive Material
- Attachment 4. Checklist for Special Form Radioactive Material
- Attachment 5. Checklist for General Design Requirements for Radioactive Shipment Packages

- Attachment 6. Guidelines for Exclusive Use Vehicle Inspections
- Attachment 7. Checklist for Radioactive LSA or SCO Shipments
- Attachment 8. Exclusive Use Vehicle – Driver's Instructions
- Attachment 9. Emergency Response Information for LSA, UN 2912, UN 3321, UN 3322, and SCO, UN 2913 Guide 162, Radioactive Materials (Low to Moderate Level Radiation)
- Attachment 10. Radioactive Shipment Manifest Example
- Attachment 11. General Packaging Requirements

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2015, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

ATTACHMENT 1: 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 cm² (2,200 dpm/100 cm²) beta-gamma, and 4.0 Bq/100 cm² (220 dpm/100 cm²) 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 cm² (220,000 dpm/100 cm²) beta-gamma or 400 Bq/100 cm² (22,000 dpm/100 cm²) 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, UN 2908."

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ATTACHMENT 2: 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, SCO, (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-III	IP-2	IP-3
SCO-I	IP-1	IP-1
SCO-II	IP-2	IP-2

- CONTAMINATION:** 40 Bq/100 cm² (2,200 dpm/100 cm²) beta-gamma, and 4.0 Bq/100 cm² (220 dpm/100 cm²) 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 A₂. 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 m 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

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ATTACHMENT 3: 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 greater than A₁ for special form material or A₂ for normal form material. Type-B when package activity is greater than A₁ or A₂ depending on the form.

CONTAMINATION: 0.4 Bq/cm² (2,200 dpm/100 cm²) beta-gamma
0.04 Bq/cm² (220 dpm/100 cm²) 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: Greater than 0.005 mSv/hour (0.5 mrem/hour) and not greater than 0.5 mSv/hour (50 mrem/hour)
Transport Index: Greater than 0 but not greater than 1

Radioactive Yellow-III label not exclusive use:
Surface: Greater than 0.5 mSv/hour (50 mrem/hour) but not greater than 2 mSv/hour (200 mrem/hour)
Transport Index: Greater than 1 but not greater than 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 RQ
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 greater than 110 pounds
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 A₁ for a Type A-package of special form, or
Up to A₂ 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

ATTACHMENT 4: CHECKLIST FOR SPECIAL FORM RADIOACTIVE MATERIAL

SHIPPING NAME:	Radioactive Material, Type-A package, Special Form, non-fissile or fissile-exception, 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
CONTAMINATION:	Type-B when package activity is greater than A ₁ 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:	<u>Radioactive White-I label:</u> Surface: Less than or equal to 0.005 mSv/hour (0.5 mrem/hour) Transport Index: 0 (<0.05 mrem/hour at 1 m) <u>Radioactive Yellow-II label:</u> Surface: Greater than 0.005 mSv/hour (0.5 mrem/hour) and not greater than 0.5 mSv/hour (50 mrem/hour) Transport Index: Greater than 0 but not greater than 1 <u>Radioactive Yellow-III label not exclusive use:</u> Surface: Greater than 0.5 mSv/hour (50 mrem/hour) but not greater than 2 mSv/hour (200 mrem/hour) Transport Index: Greater than 1 but not greater than 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 greater than 110 pounds 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

**ATTACHMENT 5: CHECKLIST FOR GENERAL DESIGN REQUIREMENTS FOR
RADIOACTIVE SHIPMENT PAKCAGES**

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?

ATTACHMENT 6: 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

<u>INSPECTION CHECKS</u>	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: _____

ATTACHMENT 7: CHECKLIST FOR RADIOACTIVE LSA OR 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.

7. Security notified to allow vehicle entry.

8. Verify applicable safety precautions are followed.

9. Vehicle is placarded "Radioactive."

10. Vehicle is properly loaded.

11. Verify driver is satisfied with arrangement and bracing of load.

HOLD POINT: _____

Quality Inspector Signature

Date

12. Shipment survey of loaded vehicle performed and documented. Conditions are acceptable for transport.

13. Quality inspection performed according to Guidelines for Exclusive Use Vehicle Inspections.

14. Photographs of loaded vehicle have been taken.

15. 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.

16. 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.

17. Complete Radioactive Shipment Manifest.

18. Complete Exclusive Use Instructions, with driver's signature.

19. Complete Straight Bill of Lading, with driver's signature.

20. Complete Emergency Response Information for the applicable guide(s).

21. Complete Routing Instructions from Site. (optional)

22. 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
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23. 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
24. Pre-shipment notifications have been performed.
25. 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
26. 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
27. Shipment is logged on Radioactive Shipment Log.

ATTACHMENT 8: 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 Hazardous Material Authorization:

Driver's Signature: _____ Date: _____

**ATTACHMENT 9: EMERGENCY RESPONSE INFORMATION FOR LSA, UN 2912,
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, 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, carbon dioxide (CO₂), 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)

ATTACHMENT 10: RADIOACTIVE SHIPMENT MANIFEST EXAMPLE

SHIPPED TO:
ADDRESS:
CONSIGNEE LIC. NO.
EXPIRATION DATE:

CONSIGNOR:

SHIPMENT NO.:
DATE:
PACKAGE TYPE:

TRAILER ID:
TRACTOR NO.:
CARRIER:

TELEPHONE:
LICENSE NO.:
EMERGENCY CONTACT:

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 (ft ³ / m ³)	WEIGHT (pounds / 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 m	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 ___

ATTACHMENT 11: 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.



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Limited Quantity Radioactive Material Shipping HP-51, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

Kimberly C. Murphree, QA/QC Manager

Unless this copy is marked with a red stamp indicating it is a controlled copy, it is uncontrolled. Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

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1. PURPOSE

This health physics (HP) procedure provides the guidelines and requirements necessary to maintain compliance with the U.S. Department of Transportation (DOT) Hazardous Materials Regulations when shipping excepted quantities of radioactive material. 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, "Radioactive Material Shipping." This procedure shall be used in conjunction with the requirements noted in HP-50, "Radioactive Material Shipping," and HP-52, "Shipping and Receipt Surveys," as appropriate. Note that additional limitations apply to those materials shipped via the U.S. Postal Service, by air, or to foreign destinations.

1.1 Scope and Limitations

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).

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in Title 10 *Code of Federal Regulations (CFR)* Part 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

A₁ Value – The maximum activity of special form Class 7 (radioactive) material permitted in a Type-A package. These values are listed in 10 CFR 71 and 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177.

A₂ 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 10 CFR 71 and 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177.

Activity Hazard Analysis (AHA) – The first step in a process used to assess risk. Hazard analysis results in identification of different types of potential hazards, which may exist alone or in combination with other hazards and may become an actual functional failure or accident. Potential hazards are also assigned a classification, based on the worst-case severity of the end condition. Risk is the combination of probability and severity and may be provided in the hazard analysis.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Becquerel (Bq) – A unit of measure of radioactivity in the International System of Units (SI), equal to 1 disintegration per second (dps) (i.e., transformation per second).

Carrier (Common Carrier) – Person or entity who transports passengers or property in commerce by rail car, aircraft, motor vehicle, or vessel (e.g., Federal Express) (49 CFR 171.8).

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

Disintegrations per Second (dps) – The decrease in the amount of any radioactive material with the passage of time (i.e., each second), as a result of the spontaneous emission from an atomic nuclei such as alpha or beta particles. In the SI, 1 dps (i.e., transformation per second) equates to 1 Bq.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

Excepted Package – The packaging, together with its excepted Class 7 (radioactive) material content, as specified in 49 CFR 173.421-427.

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.

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

International Air Transport Association (IATA) – An organization that regulates dangerous goods (e.g., hazardous materials) in international trade and coordinates related environmental evaluations.

International Atomic Energy Agency (IAEA) – An organization that works for the safe,

secure, and peaceful uses of nuclear science and technology. The IAEA's key roles contribute to international peace and security, and to the world's millennium goals for social, economic, and environmental development.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Limited Quantity (LQ) – A quantity of Class 7 (radioactive) material not exceeding the material's package limits specified in 49 CFR 173.425, "Table of Activity Limits—Excepted Quantities and Articles," and conforming with the requirements specified in 49 CFR 173.421, "Excepted Packages for Limited Quantities of Class 7 (Radioactive) Materials." (Also see HP-51, "Limited Quantity Radioactive Material Shipping.")

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.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Millisievert(s) (mSv) – A unit of measure equal to one-thousandth (10^{-3}) sievert.

Package – The packaging, together with its radioactive contents, as presented for transport.

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," or Leidos ESE A17.1. These components 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).

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, "Qualifications and Training."

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

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.

Type-A Package – The packaging, together with its radioactive contents limited to A₁ or A₂ 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 A₁ for special form Class 7 (radioactive) material or A₂ for normal form Class 7 (radioactive) material where A₁ and A₂ values are given in 49 CFR 173.435 or are determined in accordance with 49 CFR 173.433.

In 10 CFR 71.4, the NRC defines A₁ as the maximum activity of special form radioactive material permitted in a Type-A package, and A₂ as the maximum activity of radioactive materials, *other than special form material, LSA, and surface contaminated object material*, permitted in a Type-A package.

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Department of Transportation (DOT) – A governmental department with the mission to serve the United States by ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people today and in the future.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

U.S. Nuclear Regulatory Commission (technical report designation) (NUREG) – A report or brochure on regulatory decisions, results of research, results of incident investigations, and other technical and administrative information.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Verify compliance with this procedure during periodic audits.

Radiation Safety Officer (RSO)

- Generally qualified both as RSO and as TR, and may serve concurrently in both roles.
- In coordination with the TR, will revise this procedure in response to regulatory changes or to accommodate feedback from field operations.

Transportation Representative (TR)

- 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.

Health Physics Technicians

- Responsible for conducting the radiological surveys necessary to maintain compliance with this procedure.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted are performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE

5.1 Overview

General Requirements

- All activities under this procedure are conducted according to existing work instructions and the AHA for the operation that necessitates the need for shipment of radioactive materials.
- 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."

- All records of shipments of radioactive materials, except surveys, must be documented using SI units. Conventional U.S. units in parentheses may be documented in addition to the SI units.
- Materials containing radionuclides such that either the activity concentration or the total activity in the consignment is below the values specified in the table contained 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 hazard class.

5.2 Details

Excepted Package Determinations

- When a small fraction of the A₁ or A₂ activity is being shipped, some shipments are excepted from some of the requirements of the DOT Hazardous Materials Regulation and can be shipped in an "excepted package."
- Consult the IATA *Dangerous Goods Regulations* or the IAEA *Transportation Safety IATA Limitations* for specific provisions for transportation of radioactive materials.

Limited Quantity Material Categorization

- An LQ 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 A₁ for special form and 10⁻³ A₂ for normal form. A₁ and A₂ values are listed in 49 CFR 173.435.
- 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.
- 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.
- Classification of mixtures of nuclides in LSA, surface contaminated object, 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, in conjunction with "Requirements for Determining A₁ and A₂ 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.
- 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.)

- LQ packages may not contain more than 15 grams of uranium 235.
- For airfreight (or air express) or international shipments, radionuclide-specific activity concentrations and IAEA consignment activity limits apply.
- 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 A₁ and A₂ for special form and normal form, respectively. In addition, the radiation level at 10 cm from the external surface of any instrument or article must not exceed 0.1 mSv/hour (10 mrem/hour).

Receiving Limited Quantities of Radioactive Materials

- An LQ package known to contain radioactive material shall be monitored for radiation and contamination in accordance with HP-52, "Shipping and Receipt Surveys," with special emphasis on any packages that exhibit evidence of degradation of package integrity (e.g., packages that are crushed, wet, or damaged).

Shipping Limited Quantities of Radioactive Materials

- 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.
- Radiological surveys shall be performed in accordance with HP-52, "Shipping and Receipt Surveys."
- 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).
- 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.
- The package shall be marked as "Radioactive." This marking may be placed on the inner or outer package, as applicable.
- An LQ 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 LQ certificates are provided on Attachments 3 and 4. Every LQ certificate shall include the name of the consignor and consignee.
- Labeling is not required on an LQ package unless the package contains a hazardous substance or hazardous waste, in which case the package shall be labeled according to the requirements of the hazardous substance/waste.
- Radioactive placards are not required for LQ shipments.
- 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, specifically 49 CFR 173.423.
- If the material is a waste, a hazardous waste manifest (40 CFR 262) and/or radioactive waste manifest (NRC-540/541) is required.

Additional Guidance

- The TR and/or RPM may use the references listed in Section 8 of this procedure (as appropriate) as additional guidance for implementation of this procedure.

- The TR will comply with IATA and DOT retraining requirements and will maintain a comprehensive knowledge of current transportation requirements.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. RECORDS

Records generated as a result of this procedure shall be maintained by the RSO, or designee, until submission to the appropriate electronic record system in accordance with ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- 10 CFR 71, "Packaging and Transportation of Radioactive Material."
- 10 CFR 835, "Occupational Radiation Protection."
- 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 178, "Hazardous Materials Regulations."
- 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.
- ESE A17.1, "Project Records Management."*
- HP-01, "Health Physics Manual."**
- HP-04, "Qualifications and Training."**
- HP-50, "Radioactive Material Shipping."**
- HP-52, "Shipping and Receipt Surveys."**
- 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.
- IATA 2014. International Air Transport Association. *Dangerous Goods Regulations*. 55th edition. January 1, 2014.
- 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.
- 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 Material Shipping."

* Refer to https://apps.prism.leidos.com/eiapps/qa/ESE_home.asp for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Checklist for Shipping Limited Quantities of Radioactive Material
- Attachment 2. Checklist for Instruments or Articles
- Attachment 3. Limited Quantity Certificate
- Attachment 4. Instruments and Articles: Limited Quantity Certificate
- Attachment 5. Example Determination of Excepted Quantity for Air or International Shipment

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

**ATTACHMENT 1: 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 cm² (2,200 dpm/100 cm²) beta-gamma and low toxicity alpha emitters, and 4.0 Bq/100 cm² (220 dpm/100 cm²) 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, <10⁻³A₁ or <10⁻³A₂ depending on the form. See Table 7, 173.425, Table of Activity Limits for 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.

EMERGENCY RESPONSE GUIDEBOOK GUIDE NO.: 161

ATTACHMENT 2: 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:** Forty (40) Bq/100 cm² (2,200 dpm/100 cm²) beta-gamma and low toxicity alpha emitters, and 4.0 Bq/100 cm² (220 dpm/100 cm²) 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 A₁ or A₂, depending on the form. See Table 7, 173.425, Table of Activity Limits for the activity limits for liquid and gases. For each single instrument or article containing solid radioactive material, the limit is 10⁻² A₁ or 10⁻² A₂, 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

ATTACHMENT 3: 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, UN 2910.

**ATTACHMENT 4: 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, UN 2910.

ATTACHMENT 5: 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 ^a
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
Uranium 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

^a For liquids or shipment via U.S. Postal Service this limit is reduced by a factor of 10.



ST. LOUIS HEALTH PHYSICS PROCEDURES

STANDARD OPERATING PROCEDURE

Shipping and Receipt Surveys HP-52, Rev 0

Effective 01 May 2016

Approved By:

Dennis R. Chambers, Radiation Safety Officer

Approved By:

Randy Hansen, Environmental, Health, and Safety Manager

Approved By:

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Unless this copy is marked with a red stamp indicating it is a controlled copy, it is uncontrolled. Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

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1. PURPOSE

This procedure establishes the basic health physics (HP) requirements and provides guidance for personnel to follow when radioactive material is received or transferred from sites working under the Leidos Radiation Protection Program (RPP).

1.1 Scope and Limitations

This procedure applies to all personnel receiving or shipping radioactive material (any material containing radionuclides for which both the activity concentration and the total activity in the consignment exceed the values specified in the table in Title 49 *Code of Federal Regulations (CFR)* Part 173.436 or values derived according to the instructions in 49 CFR 173.433) at sites implementing the Leidos RPP.

This procedure supports the Leidos "Health Physics Manual" (HP-01) and is based on the requirements set forth in 10 CFR 20, "Standards for Protection against Radiation." Sites other than those regulated by the U.S. 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) (or in other appropriate documents) for that site, as applicable.

1.2 Regulations or Standards

Not Applicable.

1.3 Definitions/Acronyms and Abbreviations

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

A₁ Value – The maximum activity of special form Class 7 (radioactive) material permitted in a Type-A package. These values are listed in 10 CFR 71 and 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177.

A₂ 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 10 CFR 71 and 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177.

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 and 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 (H&S), and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and radioactive material in the public interest.

Becquerel (Bq) – A unit of measure of radioactivity in the International System of Units (SI), equal to 1 disintegration per second (dps) (i.e., transformation per second).

Carrier (Common Carrier) – Person or entity who transports passengers or property in commerce by rail car, aircraft, motor vehicle, or vessel (e.g., Federal Express) (49 CFR 171.8).

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.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules and regulations (sometimes called administrative law) published in the *Federal Register* by the executive departments and agencies of the federal government of the United States.

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.

Curie (Ci) – A basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion dps (i.e., transformations per second) and is approximately the rate of decay of 1 gram (g) of radium.

Deep Dose Equivalent (DDE) – External whole body dose equivalent at a tissue depth of 1 cm (1,000 milligrams [mg]/cm²).

Disintegrations per Minute (dpm) – The average quantity of radiological disintegrations (i.e., transformations) occurring per minute as a result of the spontaneous emission from the atomic nuclei of either alpha or beta particles.

Disintegrations per Second (dps) – The decrease in the amount of any radioactive material with the passage of time (i.e., each second), as a result of the spontaneous emission from an atomic nuclei such as alpha or beta particles. In the SI, 1 dps (i.e., transformation per second) equates to 1 Bq.

Environmental Health and Safety (EHS) – The department in a company or an organization involved in **environmental** protection, **safety** at work, occupational **health and safety**, compliance, and best practices. The EHS department aims to prevent and reduce accidents, emergencies, and health issues at work.

Environmental Science and Engineering (ESE) – A Leidos program that reaches across traditional disciplinary boundaries to provide a comprehensive understanding of our complex environment and to offer efficient and effective engineering solutions for environmental problems. Engineers in this field receive a broad education and carry out research addressing some of the major science and engineering challenges of our time.

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 with 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) as applicable, and must include these instructions with the shipping paper information provided to the carrier by the consignor (49 CFR 173.403).

Gram(s) (g) – A metric unit of measure for mass equal to one-thousandth (10⁻³) kilogram (kg).

Health and Safety (H&S) – The internal company department that focuses on hazards and associated controls related to work performed within the organization.

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.

Health Physics (HP) – The science concerned with recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Health Physics Technician (HPT) – Individual knowledgeable in the field of HP, responsible for implementation of RPP and procedure requirements.

International System of Units (SI) – A system of units adopted in 1960 by the 11th General Conference on Weights and Measurements, based on the metric system, and developed and refined by international convention especially for scientific work. This system of physical units is based on the meter, kilogram, second, ampere, kelvin, candela, and mole, along with a set of prefixes to indicate multiplication or division by powers of ten.

Kilogram(s) (kg) – A base SI unit of mass equating to 1,000 g.

Limited Quantity (LQ) – A quantity of Class 7 (radioactive) material not exceeding the material's package limits specified in 49 CFR 173.425, "Table of Activity Limits—Excepted Quantities and Articles," and conforming with the requirements specified in 49 CFR 173.421, "Excepted Packages for Limited Quantities of Class 7 (Radioactive) Materials." (Also see HP-51, "Limited Quantity Radioactive Material Shipping.")

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.

Microcurie(s) (μ Ci) – A unit of measure equal to one-millionth (10^{-6}) Ci.

Milligram(s) (mg) – A unit of measure equal to one-thousandth (10^{-3}) g.

Millirem (mrem) – A unit of measure equal to one-thousandth (10^{-3}) rem.

Millisievert(s) (mSv) – A unit of measure equal to one-thousandth (10^{-3}) sievert.

Package – The packaging, together with its radioactive contents, as presented for transport.

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," or Leidos ESE A17.1. These components 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).

Quality Assurance (QA) – A process-centered approach to ensure individuals and organizations provide the best possible products or services.

Quality Assurance Project Plan (QAPP) – A document outlining the procedures a project will use to ensure the data collected and analyzed meet project requirements.

Quality Control (QC) – A procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of a given client or customer.

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 RPP, except for the responsibilities listed in Section 2.2 of HP-04, “Qualifications and Training.”

Radiation Protection Program (RPP) – Comprehensive, written, programmatic radiation protection procedures to ensure radiation doses to personnel and the environment are fully compliant with applicable regulations and license requirements and are as low as reasonably achievable.

Radiation Safety Officer (RSO) – An individual who, by virtue of qualifications and experience, has been given the authority to implement the RPP. 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 an RPP to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation protection operations.

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 curies and in terabecquerels [TBq], for radionuclides listed in column 1.)

Site Safety and Health Plan (SSHOP) – A planning document addressing all occupational safety and health hazards and defining procedures to be implemented at a given site for the execution of the proposed work.

Terabecquerels (TBq) – A unit of measure equal to 10^{12} Bq (10^{12} dps [i.e., transformations per second]).

Total Effective Dose Equivalent (TEDE) – The sum of the DDE (for external exposures) and the CEDE (for internal exposures).

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 TI is determined by multiplying the maximum radiation level (in mSv/hour) at 1 m from the external surface of the package by 100 (equivalent to the maximum radiation level [in mrem/hour] at 1 m) (49 CFR 173.403).

Transportation Representative (TR) – An individual maintaining requisite training and qualifications in accordance with 49 CFR 172, Subpart H, and the 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.

Type-A Package – The packaging, together with its radioactive contents limited to A₁ or A₂ 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 A₁ for special form Class 7 (radioactive) material or A₂ for normal form Class 7 (radioactive) material where A₁ and A₂ values are given in 49 CFR 173.435 or are determined in accordance with 49 CFR 173.433.

In 10 CFR 71.4, the NRC defines A₁ as the maximum activity of special form radioactive material permitted in a Type-A package, and A₂ as the maximum activity of radioactive materials, *other than special form material, LSA, and SCO material*, permitted in a Type-A package.

Type-A Quantity – A quantity of radioactive material, the aggregate radioactivity of which does not exceed the A₁ value for special form radioactive material or the A₂ value for normal form radioactive material.

Type-B Quantity – Any quantity of radioactive material greater than a Type-A quantity (49 CFR 173.403).

U.S. Army Corps of Engineers (USACE) – A U.S. federal agency under the U.S. Department of Defense and a major Army command that provides engineering, design, and construction management services. The USACE mission is to deliver vital public and military engineering services, partnering in peace and war to strengthen our nation's security, energize the economy, and reduce risks from disasters. Environmental programs are integral to the overall USACE mission.

U.S. Department of Energy (DOE) – A governmental department with the mission is to advance energy technology and promote energy-related innovation in the United States.

U.S. Department of Transportation (DOT) – A governmental department with the mission to serve the United States by ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people today and in the future.

U.S. Nuclear Regulatory Commission (NRC) – Regulatory agency for nuclear power production and other civilian uses of nuclear materials pursuant to the Atomic Energy Act, as amended.

U.S. Nuclear Regulatory Commission (technical report designation) (NUREG) – A report or brochure on regulatory decisions, results of research, results of incident investigations, and other technical and administrative information.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Qualification and training requirements are provided in HP-04, "Qualifications and Training."

2.2 Responsibilities

Radiation Protection Manager (RPM)

- Verify compliance with this procedure during periodic audits.

Radiation Safety Officer (RSO)

- Generally qualified both as RSO and as TR, and may serve concurrently in both roles.
- In coordination with the TR, the RSO will revise this procedure in response to regulatory changes or to accommodate feedback from field operations.

Transportation Representative (TR)

- 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.

Designated Alternates

- 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.

Health Physics Technicians (HPTs)

- Responsible for conducting the radiological surveys necessary to maintain compliance with this procedure.

3. HEALTH AND SAFETY

For situations in which potential exposure to ionizing radiation is a hazard, the Leidos RPP is intended to supplement the overall H&S program of a site/project to ensure the activities conducted re performed in accordance with applicable regulatory requirements and the potential ionizing radiation hazard is appropriately controlled. H&S requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific H&S programs (e.g., specific requirements, by reference, etc.).

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, HSWPs, etc.).

5. PROCEDURE**5.1 Overview****General**

- All personnel who package, handle, or ship radioactive material shall be trained in compliance with 49 CFR 172, Subpart H, "Training." Only trained and fully qualified personnel shall perform radiological shipment or receipt surveys.
- 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.
- Completed survey documentation must be routed to the RPM for review. The approved survey documentation shall then be forwarded to the TR.
- If any of the radiological survey results are ≥80 percent of the applicable limits, the RPM and/or the TR shall be notified prior to shipment or receipt.

- All radioactive material received at the site shall be received in accordance with the receipt requirements defined in HP-50, "Radioactive Material Shipping," or HP-51, "Limited Quantity Radioactive Material Shipping," as applicable.
- 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.
- If radioactive material arrives and is not in conformance with appropriate transport regulations:
 - The RPM and the TR shall be immediately notified and the vehicle shall be held for regulatory inspection.
 - 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, DOT, and any relevant client of the non-conformance.
- Any transportation accident resulting in the release of a 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, Division 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."
- NOTE: When Leidos is transferring special form sources in Leidos-owned or Leidos-operated vehicles to and from the work site, Leidos is exempt from the contamination monitoring requirements of Paragraph b of 10 CFR 71 but not from the survey requirement for measuring radiation levels (this is required to ensure that the source is still properly lodged in its shield).

5.2 Details

5.2.1 Radiological Shipment Survey of a Package

- 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.
- 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 otherwise approved by the RSO.
- All package surveys shall be documented on Attachment 1 (or equivalent).
- If the package is to be transported Exclusive Use, the following limits shall apply:
 - Removable contamination not to exceed 0.4 Bq/cm² (2,400 dpm/100 cm²) beta/gamma and low toxicity alpha emitters,
 - Removable contamination not to exceed 0.04 Bq/cm² (240 dpm/100 cm²) all other alpha emitting radionuclides,
 - Open transport vehicle less than or equal to 2 mSv/hour (200 mrem/hour) on contact, and
 - Closed transport vehicle 10 mSv/hour (less than or equal to 1,000 mrem/hour) on contact.
- If the package is to be transported by Common Carrier, LQ, the following shall apply:

- Removable contamination not to exceed 0.4 Bq/cm^2 ($2,400 \text{ dpm}/100 \text{ cm}^2$) beta/gamma and low toxicity alpha emitters,
- Removable contamination not to exceed 0.04 Bq/cm^2 ($240 \text{ dpm}/100 \text{ cm}^2$) for all other alpha emitting radionuclides, and
- Less than or equal to $0.005 \text{ mSv}/\text{hour}$ ($0.5 \text{ mrem}/\text{hour}$) on contact.
- If the package is to be transported by Common Carrier, LSA quantity or greater, the following limits shall apply:
 - Removable contamination not to exceed 0.4 Bq/cm^2 ($2,400 \text{ dpm}/100 \text{ cm}^2$) beta/gamma or low toxicity alpha emitter,
 - Removable contamination not to exceed 0.04 Bq/cm^2 ($240 \text{ dpm}/100 \text{ cm}^2$) for all other alpha emitting radionuclides,
 - Less than or equal to $2 \text{ mSv}/\text{hour}$ ($200 \text{ mrem}/\text{hour}$) on contact, and
 - Less than or equal to $0.1 \text{ mSv}/\text{hour}$ ($10 \text{ mrem}/\text{hour}$) at 1 m for the TI.

5.2.2 Radiological Shipment Survey of a Vehicle

- All vehicle surveys shall be documented on Attachment 2 (or equivalent).
- If the shipment is being transported by common carrier as LQ, no vehicle survey is necessary. All radiological limitations are placed on the package(s).
- If the shipment is being transported by exclusive use conveyance the following limits shall apply:
 - Removable radioactive contamination limit of less than or equal to 0.4 Bq/cm^2 ($2,400 \text{ dpm}/100 \text{ cm}^2$) beta/gamma and low toxicity alpha emitters, and less than or equal to 0.04 Bq/cm^2 ($240 \text{ dpm}/100 \text{ cm}^2$) for all other alpha emitting radionuclides;
 - Radiation level on vehicles shall not exceed $2 \text{ mSv}/\text{hour}$ ($200 \text{ mrem}/\text{hour}$) 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;
 - Radiation levels shall not exceed $0.1 \text{ mSv}/\text{hour}$ ($10 \text{ mrem}/\text{hour}$) 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;
 - Radiation levels shall not exceed $0.02 \text{ mSv}/\text{hour}$ ($2 \text{ mrem}/\text{hour}$) for any normally occupied area of the vehicle.

5.2.3 Radiological Receipt Survey of a Vehicle

- 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 (Radioactive White-I, Yellow-II, or Yellow-III) must be surveyed for external surface contamination upon receipt.
- 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:
 - Removable radioactive contamination limit of less than or equal to 4 Bq/cm^2 ($24,000 \text{ dpm}/100 \text{ cm}^2$) beta/gamma and low toxicity alpha emitters, and less than or equal to 0.4 Bq/cm^2 ($2,400 \text{ dpm}/100 \text{ cm}^2$) for all other alpha emitting radionuclides.

- 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.
- 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.
- Radiation levels shall not exceed less than 0.02 mSv/hour (less than 2 mrem/hour) in any normally occupied area of the vehicle.
- All vehicle surveys shall be documented on Attachment 2 (or equivalent).

5.2.4 Radiological Receipt Survey of the Radioactive Material Package(s) (10 CFR 20.1906)

5.2.4.1 General Radiological Receipt Survey Requirements

- Monitor the external surfaces of a labeled package (Radioactive White-I, Yellow-II or Yellow-III) 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.;
- Monitor the external surfaces of a labeled package (Radioactive White-I, Yellow-II or Yellow-III) 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
- Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity (e.g., packages that are crushed, wet, or damaged).
- NOTE: LQ (excepted) packages require a receipt survey only if the package arrives in an obviously damaged condition or shows evidence of any leakage. However, as a "Best Management Practice," the RPM may require receipt surveys for all radioactive material packages, including LQ (excepted) packages.
- All package surveys shall be documented on Attachment 1 (or equivalent).

5.2.4.2 Receiving Material in Excess of a Type-A Quantity

- Leidos HP 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
 - Receive notification of the arrival of the package at the carrier's terminal and take possession of the package expeditiously.
- If a radioactive materials package is received during working hours, qualified HP personnel shall survey the package **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, surveying shall occur **no later than 3 hours** after the beginning of the next working day.
- Qualified HP personnel performing surveys of incoming packages of radioactive material will immediately notify the Leidos 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.

5.2.4.3 Package Contamination Survey Limits (10 CFR 71.87(i))

- 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 ALARA and within the limits specified by the DOT in 49 CFR 173.443 (Table 5-1).

Table 5-1: Non-Fixed External Radioactive Contamination Limits for Packages

Contaminant	Maximum Permissible Limits		
	Bq/100 cm ²	µCi/100 cm ²	dpm/100 cm ²
Beta and gamma emitters and low toxicity alpha emitters	4	10 ⁻⁴	240
All other alpha emitting radionuclides	0.4	10 ⁻⁵	24

- For packages transported as exclusive use shipments by rail or public highway only, except as provided in 49 CFR 173.443(d), at no time during transport may the non-fixed contamination on the external surface of any package, or on the associated accessible internal surfaces of any conveyance, overpack, or freight container, exceed ten times the levels prescribed in Table 5-1. The levels at the beginning of transport may not exceed the levels prescribed in Table 5-1.
- If the shipment was transported as LQ by Common Carrier, and if there is evidence of degradation of package integrity (e.g., packages that are crushed, wet, or damaged), the external surfaces of each package may not exceed the levels prescribed in Table 5-1.

5.2.4.4 Package Radiation Limits (10 CFR 71.47)

- If the shipment was transported as LQ by Common Carrier, and if there is evidence of degradation of package integrity (e.g., packages that are crushed, wet, or damaged), dose rates shall not exceed 0.005 mSv/hour (0.5 mrem/hour) on contact.
- The external radiation standards prescribed by 10 CFR 71.47 limit:
 - 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;
 - The TI to "10" (i.e., radiation level less than or equal to 0.1 mSv/hour [10 mrem/hour] at 1 m);
 - The sum of the TIs from all of the packages, so the total TI does not exceed 50.
 - Paragraph (b) of 10 CFR 71.47
 - 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;
 - 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 m (6.6 ft) 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 accordance with 10 CFR 20.1502.
- For shipments made under the provisions of paragraph (b) of 10 CFR 71.47, 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.
- 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.

Release Survey of an Empty Vehicle (49 CFR 173.443)

- A conveyance, overpack, freight container, tank, or intermediate bulk container 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:
 - The radiation dose rates at any surface point of the vehicle do not exceed 0.005 mSv/hour (0.5 mrem/hour); and
 - Removable contamination are ALARA and within the limits specified in Table 5-1.
- 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 3 inches high, then the following limits apply:
 - 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
 - Removable contamination levels shall be less than or equal to 10 times the limits specified in Table 5-1.
 - Sole-use vehicles must be kept closed and locked except for loading and unloading.

6. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements associated with implementation of the Leidos RPP are integrated throughout individual RPP procedures and will be incorporated into site/project-specific plans (e.g., H&S programs, sampling and analysis plans, QAPP, and implementation of the ESE QA Program).

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with ESE A17.1, "Project Records Management."

7. 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 ESE A17.1, "Project Records Management."

8. REFERENCES

- 10 CFR 20, "Standards for Protection against Radiation."
- 10 CFR 71, "Packaging and Transportation of Radioactive Material."
- 49 CFR, Subtitle B, Chapter I, Subchapter C, Parts 171 through 177, "Hazardous Materials Regulations."
- ESE A17.1, "Project Records Management."
- HP-01, "Health Physics Manual."**
- HP-04, "Qualifications and Training."**
- HP-24, "Radiological Reporting."**
- HP-50, "Radioactive Material Shipping."**
- HP-51, "Limited Quantity Radioactive Material Shipping."**
- 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.

* Refer to <https://apps.prism.leidos.com/ eiapps/qa/ESE home.asp> for the current version of ESE referenced procedures.

** Contact the RSO or RPM to confirm you are using the most current revision of HP referenced procedures.

9. ATTACHMENTS

- Attachment 1. Sample Package Radiological Survey
- Attachment 2. Vehicle Radiological Survey

10. DOCUMENT CHANGE RECORD

Revision 0, dated 5/1/2016, is the original procedure issued under Leidos for the *St. Louis Health Physics Procedures*.

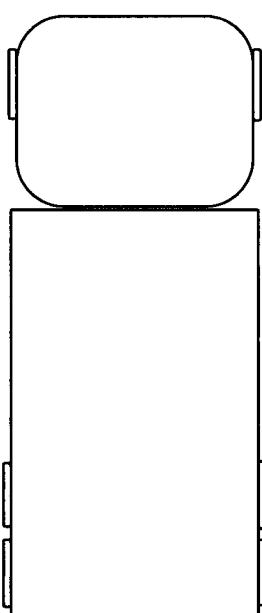
ATTACHMENT 1: SAMPLE PACKAGE RADIOLOGICAL SURVEY

HSWP NUMBER _____ TECHNICIAN NAME _____ DATE _____ TIME _____		Site: _____		PAGE _____ OF _____	
Package radiation levels: _____ mrem/hour contact _____ mrem/hour at 1 m		INSTRUMENT _____ -	S/N _____ CAL DUE _____		
		INSTRUMENT _____ -	S/N _____ CAL DUE _____		
LEGEND Δ = Smear Location # = G/A Dose Rate (mrem/hour)		INSTRUMENT _____ -	S/N _____ CAL DUE _____		
		INSTRUMENT _____ -	S/N _____ CAL DUE _____		
				Comments	
Package contents: _____					
ITEM	Removable α (dpm/100 cm ²)	Removable β (dpm/100 cm ²)	ITEM	Removable α (dpm/100 cm ²)	Removable β (dpm/100 cm ²)
1.			10.		
2.			11.		
3.			12.		
4.			13.		
5.			14.		
6.			15.		
7.			16.		
8.			17.		
9.			18.		

Reviewed By: _____

Date: _____

ATTACHMENT 2: VEHICLE RADIOLOGICAL SURVEY

HSPW NUMBER _____ TECHNICIAN NAME _____ DATE _____ TIME _____	Site: _____	PAGE OF _____
Vehicle Contents:		INSTRUMENT _____ INSTRUMENT _____
LEGEND Δ = Smear Location $\#$ = G/A Dose Rate (mr/hour)		S/N _____ CAL DUE _____ S/N _____ CAL DUE _____
		INSTRUMENT _____ INSTRUMENT _____
		S/N _____ CAL DUE _____ S/N _____ CAL DUE _____
		
Comments		
Highest Radiation Levels In Cab _____ mrem/hour Contact _____ mrem/hour At 2 m _____ mrem/hour		

ITEM	Removable α (dpm/100 cm ²)	Removable β (dpm/100 cm ²)	ITEM	Removable α (dpm/100 cm ²)	Removable β (dpm/100 cm ²)
1.			10.		
2.			11.		
3.			12.		
4.			13.		
5.			14.		
6.			15.		
7.			16.		
8.			17.		
9.			18.		

Reviewed By: _____

Date: _____

UPS CampusShip: View/Print Label

- Ensure there are no other shipping or tracking labels attached to your package.** Select the Print button on the print dialog box that appears. Note: If your browser does not support this function select Print from the File menu to print the label.

2. Fold the printed label at the solid line below. Place the label in a UPS Shipping Pouch. If you do not have a pouch, affix the folded label using clear plastic shipping tape over the entire label.

3. GETTING YOUR SHIPMENT TO UPS**Customers with a Daily Pickup**

Your driver will pickup your shipment(s) as usual.

Customers without a Daily Pickup

Take your package to any location of The UPS Store®, UPS Access Point™ location, UPS Drop Box, UPS Customer Center, UPS Alliances (Office Depot® or Staples®) or Authorized Shipping Outlet near you. Items sent via UPS Return Services(SM) (including via Ground) are also accepted at Drop Boxes. To find the location nearest you, please visit the Resources area of CampusShip and select UPS Locations.

Schedule a same day or future day Pickup to have a UPS driver pickup all your CampusShip packages.

Hand the package to any UPS driver in your area.

UPS Access Point™	UPS Access Point™
THE UPS STORE	THE UPS STORE
498 S 5TH ST	12685 DORSETT RD
SAINT CHARLES ,MO 63301	2025 ZUMBEHL RD
MARYLAND HEIGHTS ,MO 63043 SAINT CHARLES ,MO 63303	

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