TIDEWATER INC

ENGINEERS / SCIENTISTS / PROGRAM MANAGERS

NIST RADIATION SAFETY PROGRAM ASSESSMENT

For

National Institute of Standards and Technology
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By

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§	Section
AU	Authorized User
ADAMS	Agencywide Documents Access and Management System
AEC	Atomic Energy Commission
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
cpm	counts per minute
CFR	Code of Federal Regulations
cm^2	square centimeters
COMPLY	An EPA computer program to demonstrate compliance with airborne releases
CSO	Chief Safety Officer
DAC	Derived Airborne Concentration
dpm	disintegration per minute
DOT	US Department of Transportation
GRSD	Gaithersburg Radiation Safety Division
HEPA	High Efficiency Particulate Air
HP	Health Physicist
HPI	Health Physics Instruction
IC	Increased Controls
IRSC	Ionizing Radiation Safety Committee
MARSSIM	Multi-Agency Radiation Survey and site Investigation Manual
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NMMSS	Nuclear Materials Management & Safeguards System
NMSS	Nuclear Material Safety and Safeguards
NRC	US Nuclear Regulatory Commission
NUREG	A nuclear regulatory guidance document
DPW	Declared Pregnant Worker
mrem	millirem
MOP	Members of the public

Glossary of Terms, Acronyms and Abbreviations – Continued

OU	Organizational Unit
OSHE	Office of Safety, Health and Environment
PE	Practical Exam
PSG	Police Services Group
Pu	Plutonium
QC	Quality control
RAI	Requests for Additional Information
RAM	Radioactive Material
RAMQC	Radioactive material quantities of concern
RS	Radiation source
RSI	Radiation Safety Instruction
RSO	Radiation Safety Officer
SNM	Special Nuclear Material
SOS	Safety Operational System
SRM	Standard Reference Material
SRO	Senior Reactor Operator
T&R	Trustworthiness and Reliability
TBD	To Be Determined
TLD	Thermoluminescent dosimetry
TOXCO	A radioactive waste processing company

NIST RADIATION SAFETY PROGRAM ASSESSMENT

1.0 EXECUTIVE SUMMARY

1.1 Introduction

As a result of an alternative dispute resolution (ADR) mediation session, the Nuclear Regulatory Commission (NRC) issued a Confirmatory Order (CO) on March 1, 2010 to the U.S. Department of Commerce's National Institute of Standards and Technology (NIST). In this Order, NRC identified numerous actions to be taken by NIST. One action directed NIST to contract with an independent consultant to develop an assessment plan and evaluate NIST's documented radiation safety programs and the overall effectiveness of their implementation of such for NRC licenses SNM-362 and 05-03166-05, with the primary goal of determining whether there is a high assurance of preventing significant radiological events now and in the future. Tidewater, Inc. (Tidewater) was contracted to assist in fulfilling this commitment. The assessment was performed on-site at Boulder, CO on February 25 and 26, 2013 and in Gaithersburg, MD during the periods March 4-15 and March 26-27, 2013. The audit was performed by Tim Kirkham, Auditor, Wayne Gaul, Auditor, and Claude Wiblin (Lead Auditor). Mr. Kirkham was the only auditor to visit the NIST-Boulder site.

1.2 Assessment Purpose and Scope

The Assessment Plan was developed to assess the effectiveness and adequacy of the programmatic and procedural elements of the NIST radiation safety programs. The assessment plan included the elements necessary to assess NIST compliance with federal regulations and the requirements of NRC licenses SNM-362 and 05-03166-05. NIST-Boulder operations were conducted under the byproduct license 05-03166-05 and those at NIST-Gaithersburg under license SNM-362. It must be noted that radioactive materials license 05-03166-05 was terminated on December 27, 2010 and replaced with license 19-03166-06. The new number of the NIST-Boulder license will be referenced throughout this report. This audit did not include an assessment of the NRC License No. 19-23454-01E for distribution of exempt quantities. As an independent consultant to NIST, Tidewater conducted this assessment that discusses findings and recommendations for radiation safety program improvement.

The intent of this assessment was to determine the adequacy and implementation of the NIST radiation safety program, with regard to regulatory compliance and best industry and management practices. This was accomplished through the following activities:

- Detailed analysis of compliance to the NIST Radioactive Materials license conditions for both licenses;
- On-site inspections of required training; receipt, storage and handling of radioactive material, especially special nuclear material (SNM); records; postings; and facilities;
- One-on-one interviews with authorized users (source handlers) and radiation workers to evaluate adequate knowledge of radiation safety principles and regulatory requirements;
- Assess training effectiveness by reviewing user knowledge and practice;
- Review of Emergency and Operational Procedures for compliance and implementation;
- Review of occupational dose records & reporting; and
- Review of previous findings, notices or violations and specific corrective measures implemented.

The primary goal of the audit was to determine whether there is a high assurance of preventing significant radiological events now and in the future.

1.3 Assessment Details

The independent auditors identified in Section 1.1 above performed assessment activities to verify conformance to, and/or identify weaknesses in the NIST Radiation Safety Program as implemented at the Gaithersburg, Maryland and Boulder, Colorado NIST facilities.

The auditors conducted a performance based inspection based on interviews of Gaithersburg Radiation Safety Division (GRSD) personnel, NIST researchers, support personnel and tours of areas where license activities are conducted. During the audit, regulatory compliance was evaluated through observation, document reviews, and personnel interviews. Facilities and equipment were physically inspected. Issues identified were investigated as needed.

Issues were classified into findings or recommendations. For the purposes of this audit, a finding is defined as any condition or action that apparently deviates from an applicable regulation, standard or procedure or adversely impacts the quality or reliability of any aspect of

the radiation-safety program. A recommendation is defined as a suggestion that, when implemented, could improve the performance and effectiveness of a task, process or program. A noteworthy practice is defined as a practice that has resulted in the improvement in the effectiveness or efficiency of the radiation safety program.

For the activities at the Boulder campus, results of the audit activities are presented:

- No findings,
- Twelve recommendations were provided, and
- Five noteworthy practices were identified.

For the activities at the Gaithersburg campus, results of the audit activities are presented.

- Two findings,
- Fifty recommendations were provided, and
- Thirteen noteworthy practices were identified.

Summaries of the findings and recommendations are presented below; however, they are detailed in Section 4.1 and 4.2, respectively. The noteworthy findings are detailed in Section 4.3.

1.3.1 Findings

- NIST Boulder Program -License 19-03166-06

  No items of non-compliance with the various NRC regulations and the license conditions were identified.

- NIST Gaithersburg Program – License SNM-362

  A total of two findings were identified as not being in compliance with the CO which is considered as additional License Conditions; however, there are mitigating comments provided in the report and also shown below in brackets.

  - The Radiation Safety Course did not provide details regarding the consequences of and the potential actions that NRC may take against an individual for willful violations of NRC requirements as required by the CO. *[It should be noted that NIST reported*

that this omission occurred only once and in particular during the training that the lead auditor observed.]

- The Radiation Safety Course did not include a practical exam (PE) for don and duff of personal protective equipment (PPE); there was one skin contamination event in April 2012 for which a cause could not be determined. The lack of a graded PE and use of a take home exam as a method to measure mastery are considered as noncompliance with the CO. [*It should be noted that NIST did require completion and passing other computer based quizzes during the course. Also, an industry standard for mastery was not identified and this finding of noncompliance is a conservative one.*]

1.3.2 Recommendations

The following recommendations were made for the two radiation safety programs.

- NIST Boulder Program – License 19-03166-06

  A total of twelve recommendations were made, see Appendix A, 1556 Audit check list for details. The list in parenthesis presents the finding identification while the number in brackets presents the total for the topic.

Radiation Safety Program Discussion (1, 2, 6)	[3]
Radiation Safety Organization and Staffing (3)	[1]
Radiation Safety Training (4)	[1]
Radiological Instrumentation & Sources (10)	[1]
Radiological Surveys, Contamination Controls & Records (5, 7, 8, 9)	[4]
Radiological Exposure Limits (11, 12)	[2]

- NIST Gaithersburg Program – License SNM-362

  There were fifty (50) recommendations identified. The section number and title and the number of recommendations made within that section are presented in Brackets. Each

specific recommendation is presented in Section 4.2. Several of these recommendations may be cross cutting issues.

2.3.3	Ionizing Radiation Safety Committee	[2]
3.0	Radiation Safety Program Discussion	[2]
3.1	Radiation Safety Organization and Staffing	[2]
3.2	Radiation Safety Culture	[3]
3.3	Radiation Safety Training	[8]
3.5	Engineering Controls	[1]
3.6	Radiological Instrumentation & Sources	[13]
3.7	Radiological Surveys, Contamination Controls & Records	[3]
3.8	Labels and Posting	[4]
3.10	Personnel Monitoring for Radiation Exposure	[6]
3.11	Research and Source Usage	[1]
3.12	Material Control and Accountability	[2]
3.13	Radioactive Material Shipping and Receiving	[1]
3.14	Radioactive Waste Management and Transportation	[1]
3.17	Trustworthiness and Reliability Program for Quantities of Concern	[1]

1.4 Open Issues

The Gaithersburg and Boulder radiation safety programs differ vastly in scope and complexity. The applicability of this assessment to the Boulder program is questionable as the license was terminated. The assessment was made on the current license and existing conditions.

Assessment of the NIST-Gaithersburg radiation safety program for which an application for timely renewal was made in 2007 with recent Requests for Additional Information (RAI) is complicated considering that the 1997 application is actually the major consideration for what is compliant. Best practices developed by the NRC through the NUREG-1556 series were considered and where appropriate included for recommendations. The CO was interpreted by the team in a conservative manner. This audit does not include an assessment of NIST commitments made to the NRC in the renewal application for SNM-362 or NIST responses to the NRC"s Requests for Additional Information (RAI).

1.5 Conclusions

- NIST Boulder Program -License 19-03166-06

  The NIST-Boulder program has only one small radioactive check source. Continuing with the current practice of licensed radioactive material (RAM) stored and locked away when the Radiation Safety Officer (RSO) is absent, the NIST-Boulder program has a very high assurance of no significant radiological event now and in the future.

- NIST Gaithersburg Program – License SNM-362

  Although similar but not identical, five of the eight contributing causes (listed in Section 2.1) to the Boulder Pu event potentially exist at NIST-Gaithersburg. These five are identified as follows with references to both the discussion area and objective evidence in this report within brackets; these issues may be cross-cutting.

  - Personnel Received Inadequate Training or No Training [2.2, 3.0, 3.1 and 3.2]
  - Written Operating Procedures Not Developed [3.1, 3.2, 3.3, 3.6, and 3.10]
  - An Adequate Hazard Analysis Was Not Performed [2.3.3]
  - Poorly Human-Factored Experimental Setup [3.5]
  - Less than Adequate Immediate Emergency Response to the Event [3.2, 3.3, 3.13, and 3.14]

  As pointed out in the NRC's Special Investigation Report dated November 2, 2009, NIST management did not ensure that the deficiencies identified in the Boulder radiation safety program annual audits were fully addressed. Similarly, annual audit reports for NIST Gaithersburg dating to 2007 indicate that procedure documentation is a recurring deficiency. Beyond and including procedure deficiencies, the summary below indicates that NIST efforts need to be enhanced to ensure radiation safety:

  (1) existing contributing causes of the Boulder event,
  (2) the large number and seriousness of recommendations made in this report, and
  (3) the number of tabled items being tracked by the Ionizing Radiation Safety Committee (IRSC) and the (GRSD).

If NIST implements the recommendations contained in this report with a graded approach and in a near term time interval of weeks, a high assurance of preventing significant radiological events now and in the future could be attained at NIST-Gaithersburg.

A caution to the graded approach is added as NIST provides standard reference material that is critical to patient care across the nation. Any change in program emphasis should be made such that this critical service is uninterrupted but conducted safely.

2.0 LICENSE REVIEW

2.1 Amendments and Program Changes

It must be noted that radioactive materials license 05-03166-05 issued for work at NIST-Boulder was terminated on December 27, 2010 and replaced with license 19-03166-06. License 19-03166-06 is not part of the CO but actions taken under the previous -05 status were audited. Inventory of radioactivity received and possessed on the '06 license was one sealed source of Am-241 with an activity of 0.0221 microcuries. Attachment A contains the NUREG-1556 Appendix M check list for the audit conducted at NIST Boulder; minimal comments are made in the body of this report regarding the NIST-Boulder program for radioactive material use as it is greatly limited by the current license.

The last amendment to the SNM-362 radioactive materials license was amendment 3, with an expiration date of July 31, 2007. The radioactive materials license SNM-362 has been in timely renewal since 2007.

The auditors discussed the status of compliance with the Confirmatory Order with the NIST-Gaithersburg and NIST–Boulder Radiation Safety Officers (RSO). The use of radioactive materials at NIST-Boulder is very significantly different and smaller than when the Pu even occurred in Boulder and most of the contributing causes cannot be related. Based on discussions with the NIST-Gaithersburg RSO, CO compliance had been thoroughly reviewed by regional NRC inspectors at their last inspection; however, no documents describing the NRC review of the CO audit were identified. This audit included a review for each of the CO required items as well as the below listed contributing causes to the Pu event in NIST-Boulder as described in the NRC Special Investigation Report 030-03732/2008-001 and Investigation Report 4-2008-062, November 2, 2009. The causes listed were reviewed as general topics with emphasis to the topic and not necessarily to the actual Pu event.

- Personnel Received Inadequate Training or No Training
- Written Operating Procedures Not Developed
- Plutonium Standards Obtained Without Proper Management Approval
- An Adequate Hazard Analysis Was Not Performed
- Poorly Human-Factored Experimental Setup

- Less than Adequate Direct Oversight of Work Involving Plutonium
- Use/Storage of Plutonium Sources in Mixed-Use Laboratory
- Less than Adequate Immediate Emergency Response to the Event

The NIST RSO receives generic NRC communications such as Regulatory Information Summaries, NMSS Newsletter, and other generic NRC communications. The RSO reviews these documents for information pertinent to NIST. All of these documents are filed after RSO review. The NRC has made several Requests for Additional Information (RAI) regarding the renewal application; the RAIs and the NIST responses are available through the NRC's ADAMS web site.

2.2 License Condition Compliance Assessment

Conditions of the CO are considered as license conditions in addition to those already included in Amendment 3 to SNM-362 radioactive materials license. The following two items were identified as not being in total compliance with the CO; however, there are mitigating comments provided in the report and also shown below in brackets.

- The Radiation Safety Course did not provide details regarding the consequences of and the potential actions that NRC may take against an individual for willful violations of NRC requirements as required by the CO. *[It should be noted that NIST reported that this omission occurred only once and in particular in the training that the lead auditor observed.*]
- The Radiation Safety Course did not include a practical exam (PE) for don and duff of personal protective equipment (PPE); there was one skin contamination event in April 2012 for which a cause could not be determined. The lack of a graded PE and use of a take home exam as a method to measure mastery are considered as noncompliance with the CO. [*It should be noted that NIST did require completion and passing computer based quizzes during the course. Also, an industry standard for mastery was not identified and this finding of noncompliance is a conservative approach.*]

A copy of the existing license is not provided with this report for security reasons; however, the audit included a review of the limitations on radioactive material type, chemical and physical

form, maximum amounts, License Condition 9 -Authorized place of use, License Condition 10-Authorized use and related documents, and License Conditions 11-18 regarding specific exemptions to irradiator use requirements of 10 CFR 36. Statements as to compliance are provided in topical sections of this report.

2.3 Management Oversight

The following data was largely taken from the NIST Order 720, dated March 21, 2013, "Ionizing Radiation Safety – Licensed Radioactive Material and Ionizing-Radiation-Producing Machines." The IRSC Chair, IRSC, and RSOs all have the authority to stop immediately any operations involving the use of licensed radioactive material or ionizing-radiation-producing machines in which there are known or potential safety and health or regulatory compliance issues or that may result in exposures to ionizing radiation that are not As Low as Reasonably Achievable (ALARA).

2.3.1 NIST Director

The NIST Director has the ultimate responsibility for establishing and maintaining the ionizing radiation safety program at NIST and provides executive leadership on issues involving compliance with regulatory requirements and the conditions of the license. The Director of NIST appoints the IRSC Chair and Vice Chair for indefinite terms at his/her discretion.

- Ensure the development, implementation, maintenance, and continual improvement of this order and of NIST's ionizing-radiation-safety programs
- Ensure proper allocation of resources for ionizing radiation safety at NIST
- Monitor, ensure, and enforce accountability for meeting NIST's radiation-safety-program requirements
- Provide direction on issues involving worker safety, regulatory compliance, and environmental impacts at NIST
- Provide direction to the Associate Director for Laboratory Programs, Associate Director for Management Resources, Chief Safety Officer (CSO), RSOs, IRSC, and Organizational Unit (OU) Directors, as necessary
- Approve the IRSC charter and changes thereto, subject to NRC license requirements
- Appoint all IRSC members, subject to NRC license requirements
- Review IRSC recommendations and direct action on those recommendations, as necessary

2.3.2 NIST Associate Directors

In accordance with the NIST Order 720, the Associate Directors have an important role in radiation safety at NIST.

- Support the NIST Director in carrying out his or her responsibilities
- Ensure the implementation of NIST's ionizing-radiation-safety programs in their respective directorates
- Ensure proper allocation of resources for ionizing radiation safety in their respective directorates
- Monitor, ensure, and enforce accountability for meeting NIST's radiation-safety-program requirements in their respective directorates
- Provide direction on significant issues involving worker safety, regulatory compliance, and environmental impacts within their respective directorates
- Review the IRSC charter and changes thereto

2.3.3 NIST Chief Safety Officer

In accordance with the CO, the NIST Director has appointed a CSO over the entire safety program including the radiation safety program. The NIST CSO is responsible for submitting applications for renewals of and amendments to NRC License Number SNM-362 pursuant to IRSC review and approval. The CSO also serves as the Directive Owner for all suborders and suborder-specific directives under the NIST Order 720.

The organization chart for NIST's Office of Safety, Health and Environment (OSHE), is provided. This chart shows the relationship of the safety offices of NIST-Boulder and NIST-Gaithersburg to the NIST CSO:

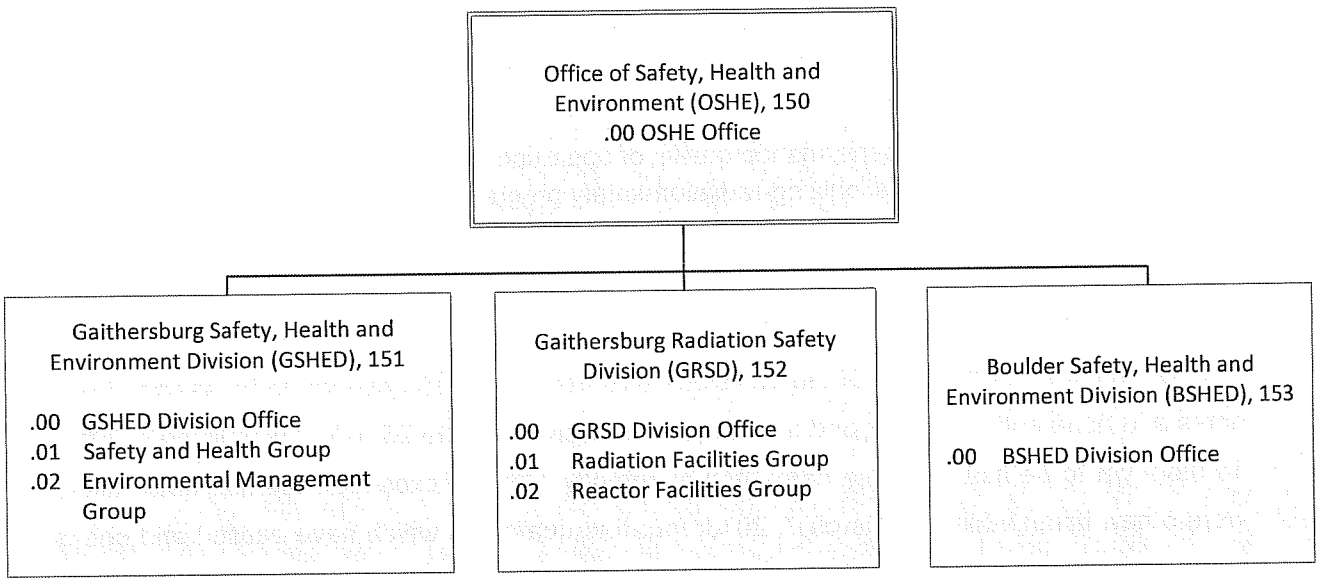

Figure 1. NIST's Office of Safety, Health and Environment (OSHE)

2.3.4 Ionizing Radiation Safety Committee

The IRSC provides oversight of the operations and activities of the NIST radiation safety programs except for those operations and activities conducted under the NRC Test Reactor License (TR-5). The IRSC provides the NIST RSO with independent advice and oversight for the ionizing radiation safety programs at NIST-Gaithersburg and NIST-Boulder.

- Oversee the establishment, implementation, and maintenance of NIST Order 720 and of NIST's ionizing-radiation-safety programs
  - Carry out the program-specific responsibilities delineated for the IRSC in NIST's ionizing-radiation-safety programs
- Recommend actions to the NIST Director and to the RSOs as necessary to assure ionizing radiation safety and regulatory compliance
- Report to the NIST Director at least annually on the status of NIST's ionizing-radiation-safety programs
- Review the circumstances of all occurrences reportable to the NRC, identify root causes and contributing factors, recommend to the NIST Director measures to preclude a recurrence, and track actions on those recommendations as needed

- Review the circumstances of radiological incidents and violations of NIST ionizing-radiation-safety program requirements and track actions resulting from such reviews as needed
- Annually review the performance quality of operations in one or more areas to provide assurance that NIST's ionizing-radiation-safety programs are functioning properly
- Maintain written records documenting IRSC activities

The IRSC maintains an IRSC Action Tracking Table dated March 12, 2013 which is presented as Attachment D, Exhibit 10. Of the 18 listed items from 2012, 15 have yet to be assigned due dates and apparently 3 are beyond the assigned due date. Of the 25 older items listed in 2013, 14 have yet to be assigned due dates and apparently 11 have exceeded the due date. There were 5 new items added on March 7, 2013, four had due dates which have passed and one is yet to be assigned a due date. The tracking table is an excellent tool, but the outstanding items further illustrate a program in a high state of flux or a constantly changing Radiation Safety Program with incomplete documentation and also one that is propped up by the excellent qualification and skill levels of the radiation protection staff. Without assigned due dates, should an item be anticipated to ever close? The IRSC Tracking table is presented as Exhibit E-10 in Attachment D.

Records of IRSC meeting minutes indicated that since October 2012 meetings were held on a weekly basis; records of December and January meetings were reviewed. The IRSC has been conducting a tremendous amount of business in manner consistent with its charter and in response to apparently numerous demands.

NIST is subject to the requirements of 10 CFR 33.13, Requirements for the issuance of a Type A specific license of broad scope and the CO further required institution of a formal radiation hazard analysis process that requires confirmation that the requirements of the hazard analysis have been addressed prior to the commencement of new work. This appears to be a grandfathering for all previous work for which specific Activity Hazard Analyses (AHA) were performed for work with potential exposure greater than 1.25 rem. As the AHA implemented to comply with the CO is more sophisticated than earlier evaluations with a potential 1.25 rem threshold, the viability of those only reviewed by NIST-GRSD and not the IRSC is questioned. Use and storage of sealed sources is the major concern and discussions with the RSO and other members of the IRSC indicated that blanket AHA for specific radioactive processes and sources are under consideration for future approval by the IRSC. There are about 1,400 sealed

sources at NIST and 120 are no longer needed for NIST use. Considering that the ageing process may be detrimental to them and that many have been in storage for over ten years, an upgraded AHA is warranted. All of these sources had been leak tested within the last six months but the consequences of one or more leaking concurrently should be contained in a updated AHA. It is recommended that updated AHA be performed for the sealed sources whether or not in storage including an evaluation of the appropriateness of current storage conditions.

2.3.5 Radiation Safety Officer

The NIST-Gaithersburg RSO must be certified in the professional practice of Health Physics by the American Board of Health Physics or must have a Bachelor's degree in a science or engineering field and have at least five years of professional-level experience in applied Health Physics. The RSO is responsible for managing the radiation safety program and all aspects of the utilization of ionizing radiation sources. The RSO, or designee, has the authority, as delegated by the NIST Director, necessary to meet his responsibilities and to immediately stop any operations that may (1) compromise the health or safety of NIST employees and non-NIST personnel; (2) have an adverse impact on the environment or public; or (3) result in non-compliance with NRC, State, or local requirements.

The RSO responsibilities are numerous and include:

- Establish and maintain NIST's ionizing-radiation-safety programs in accordance with the requirements of this order
- Carry out the program-specific responsibilities delineated for the RSOs in NIST's ionizing-radiation-safety programs
- Work with the Associate Director for Laboratory Programs, the Associate Director for Management Resources, and the OUs as necessary to support their implementation of NIST's ionizing-radiation-safety programs

2.4 Facilities

The facilities are as described in the SNM-362 radioactive materials license application. NIST is a broad scope licensee, which provides NIST with a great deal of flexibility in the management of its configuration of its facilities. During the tour of the facilities the auditors observed various

engineering controls to protect workers for radioactive materials. These engineering controls include shielding, remote handling tools and effective ventilation.

The entire NIST facility is enclosed with a fence. Access to the facility is through several gates which have guards present who check each person's identification. All visitors must stop at the primary entrance guard house to obtain a visitor badge and must be preapproved by a NIST employee.

Sections of Building 245 where radioactive materials are used or stored require a key card to gain access to that area of the building. Once inside this area, a key is required to gain access to the radioactive materials use areas.

Laboratories where radioactive materials are used or stored must be locked when not attended. During the facility tour, all doors to radioactive material laboratories where locked.

Large radioactive material sources are in compliance with the NRC Order for Increased Controls on Quantities of Concern. Access to quantities of concern of radioactive materials is strictly controlled. Only personnel who have job functions requiring access to these sources are provided access to these areas. All other personnel must be escorted by an individual who has unescorted access.

Several of the radioactive materials laboratories contain fume hoods for working with radioactive materials. The air flow through the face of the hoods is checked quarterly by the GRSD staff and a sticker marking the proper height of sash is placed on the hood. GRSD staff run COMPLY code periodically to verify NIST is in compliance with air emission constraints.

3.0 RADIATION SAFETY PROGRAM DISCUSSION

The functional set up of the Radiation Protection Program is organized as depicted in the following diagrams. Please note that the required Chief Safety Officer position is filled and that the RSO-Boulder must have Boulder planned activities approved by the IRSC.

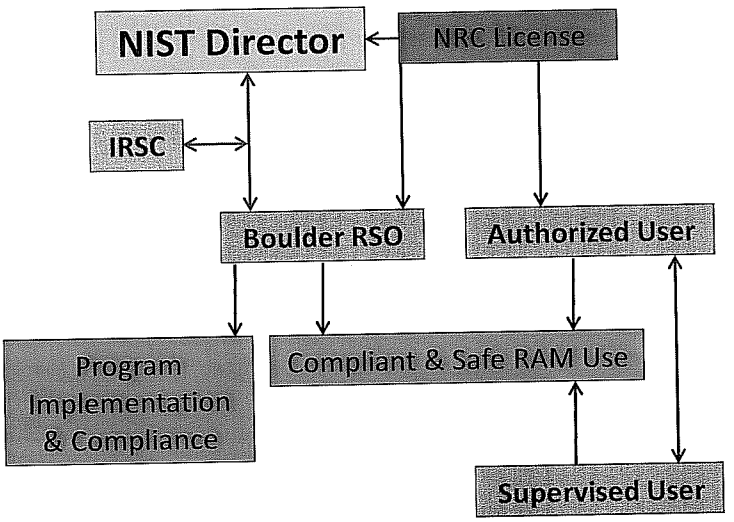

Figure 2a. Components of NIST's Radiation Safety Program - Boulder

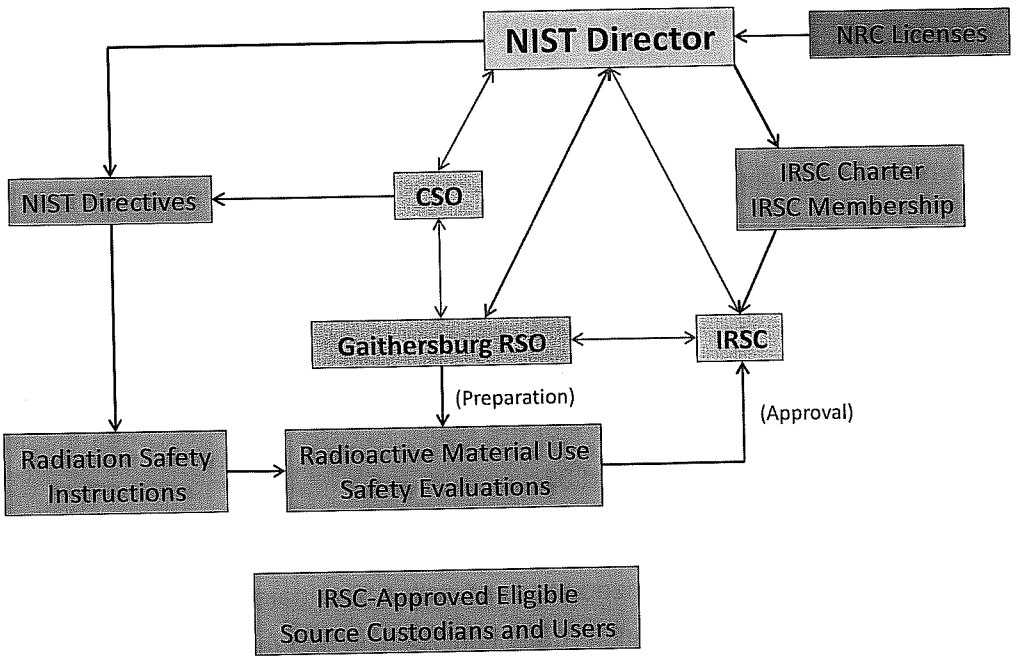

Figure 2b. Components of NIST's Radiation Safety Program - Gaithersburg

Although there are several users of radioactive material outside Building 245, the largest client and major training target of GRSD is the Radiation and Biomolecular Division of the Physical Measurement Laboratory which presents great pride (as they should) in providing the foundation of ionizing radiation measurements for the Nation. This Division is divided into the operational groups as shown below with the identification of the Division Chief and Group leaders

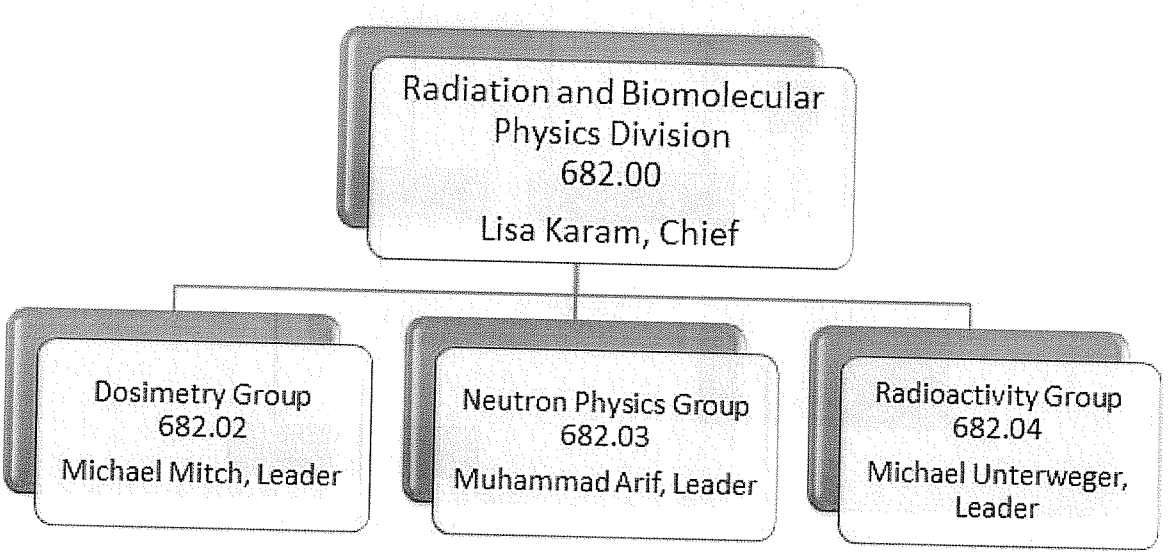

Figure 3. Radiation and Biomolecular Division of the Physical Measurement Laboratory

NUREG 1556, Vol. 7 provides a definition of Authorized User (AU) (also known as "principal investigator") as a person whose training and experience have been reviewed and approved by NRC, who is named on the license, and who uses or directly supervises the use of licensed material. The AU's primary responsibility is to ensure that radioactive materials used in his or her particular lab or areas are used safely and according to regulatory requirements. The AU is also responsible to ensure that procedures and engineering controls are used to keep occupational doses and doses to members of the public ALARA. The IRSC has this authority as a broad scope licensee per 10 CFR part 33.

NIST has a two tier structure for Authorized Users of radioactive material users as shown below. Both types must attend the initial Radiation Protection Training and refreshers.

- **Source Custodian**

  A Source custodian is an individual at NIST approved in writing by the RSO or designee and the NIST IRSC and authorized by management to materially control, use or otherwise manipulated licensed activities and to be responsible for the primary control an accountability of licensed radioactive material.

- **Source User**

  A Source user is an individual at NIST approved in writing by the RSO or designee and the NIST IRSC and authorized by Management and responsible to a designated Source Custodian with respect to the material accountability, control, use or otherwise manipulation of license radioactive material.

Again from NUREG-1556, Vol. 7, NRC believes that to demonstrate adequate training and experience the AU should have (1) a college degree at the bachelor level, or equivalent training and experience in physical, chemical, or biological sciences or in engineering; and (2) training and experience commensurate with the scope of proposed activities. Training should include the following subjects:

- Radiation Protection Principles,
- Characteristics of Ionizing Radiation,
- Units of Radiation Dose and Quantities,
- Radiation Detection Instrumentation,
- Biological Hazards of Exposure to Radiation (appropriate to the types and forms of byproduct material to be used), and
- Hands-on Use of Radioactive Materials.

The amount of training and experience needed will depend upon the type, form, quantity and proposed use of the licensed material requested, but it should cover the subjects stated.

As of January 24, 2013, there were 85 Source Custodians and 230 Source Users approved by the IRSC.

NIST Individuals who wish to be eligible to be Source Users or Source Custodians must meet the following criteria:

a. Have a college degree at the associates level or higher, or equivalent training and experience in the physical, chemical, or biological sciences or in engineering; or

b. Have a high school diploma and knowledge of the physical, chemical, or biological sciences or engineering sufficient to use licensed material.

This appears contrary to the NUREG recommendations but in practice of the 20 records reviewed only 5 individuals did not have a bachelor level degree and most had PhDs. Non-degreed individuals were associated with the reactor and were Senior Reactor Operators (SRO) from the Navy Nuclear Program. The SROs are clearly qualified to perform their work; however, it is recommended that the qualifications specifically provide exemptions for the SROs and other identifiable job titles which might not require a college degree at the bachelor level and further to separate the education requirements of the Source Custodian as a college degree at the bachelor level with Source User requirements to meet the specific protocols. Source Users were described to occasionally be college interns at the undergraduate level and a separate education level is recommended for them.

GRSD maintains a Findings Tracking Table that includes a complete "To-do" list, for corrective actions for items of non-compliance to be taken as a result of prior audits. There are six audit findings. All of them have corrective actions to prevent recurrence while five are described as closed by GRSD. The remaining item are scheduled for close out are being tracked by NIST radiation safety management. The Findings Tracking Table is presented in Attachment D, Exhibit E-8.

GRSD also maintains an Audit and Assessment Recommendations Tracking Table which is presented in Attachment D, Exhibit E-9. As of April 1, 2013, nine of the 23 recommendations listed from the 2012 NUREG-1556 were identified as open. Four of the open items, 6, 7, 8, and 13, relate to safety lighting issues, definition of action levels, and survey techniques which are important to immediate health and safety. However, closure dates for three of them was "TBD" or to be determined while number 6 was set for fall of 2013. This is an illustration that the current staff level is at its maximum work load as the fixes could be performed immediately with enough personnel. It is recommended that the due dates for these 2012 audit items (now known for over three months) be moved up as closing them would provide more assurance that a radiological event would not happen.

3.1 Radiation Safety Organization and Staffing

The RSO was questioned as to the impact of sequestration of federal funding on their program. No immediate impact was noted but funding for training/travel could impact the program's efficacy for radiation safety could be questioned should training funds diminish. This training issue is not solely a NIST issue but one that could negatively impact on various federally sponsored programs.

The RSO and his staff appear to be fully functional and they are attempting to bring the program to a procedural work process base versus just an historical (tribal) knowledge base. A list of RSI procedures is found as Exhibit 1 in Appendix D. The report for the annual audit conducted in December 2012 stated there are key staff members, many assigned recently, who have not yet been given the full opportunity to put in writing (procedures) the full details of all of the functions that the Division performs. To compensate for the individual work load, GRSD has hired additional personnel to develop these procedures. Two draft procedures to control and develop NIST radiation safety procedures were described below and are presented as Exhibits E-2 and E-3 in Attachment D.

- RSI A1-9 GRSD Document Control Program - The purpose of this procedure is to provide GRSD Document Control Program (DCP) and implementation requirements. This DCP establishes basic functions for the processing and controlling of documents.
- RSI A1-10 GRSD Document Development and Maintenance - The purpose of this RSI is to provide the methodology, framework, and minimum requirements for developing and controlling GRSD documents (e.g., policies, procedures, ProNotes and other general documents).

Not already having such procedures in place for such a large program illustrates doing business with a dependency upon tribal knowledge versus procedural requirements. This can lead to unwarranted risk should a replacement perform a job task incorrectly. Open issues regarding the lack of procedure documentation are legacy items related to the status of Radiation Safety Instruction (RSI) procedures that date from 2007, 2009, 2010, 2011 and 2012 annual audits of the program. The procedure index dated March 2013 indicates progress in procedure update by NIST for 14 RSI/IPs in 2012 and 11 more so far in 2013 for a total of 62. Two of the oldest RSIs are listed as 1981. Sections which follow will provide multiple examples of current and

correct work practice which are not in procedure and several examples of not being able to follow a procedure as it is antiquated.

A recommendation is made that the IRSC should immediately review, demand procedure updates, and to provide training in them. If this action overtaxes the staff with the implied implication of reduced radiation safety, there are several reputable consulting firms that could assist.

NIST reported that management has gone to great lengths over the past 3-4 years to recruit and retain highly qualified and skilled health physicists through a rigorous hiring process. Support for the SNM-362 license has grown during this time from two to eight professional health physicists (HP). This increase in the size of the professional HP staff should significantly increase assurance of preventing significant radiological events.

The audit team observed that all staff members appeared to be at a maximum work load limit. Further, the RSO indicated that a time–efficiency study to evaluate staffing needs could tax the program and would be detrimental to the program's success and his assessment further illustrates that the staffing levels are at their maximum work load (see additional discussion on this topic in Section 3.0). Overall, the management elements of the Radiation Safety Program at NIST (Director, CSO, IRSC, and RSO) appear to be adequately structured and but not necessarily staffed to exercise their organizational responsibilities on a long term scale. It is recommended that the IRSC review the current and potential staffing needs. The organization chart illustrating the Radiation Safety Division within OSHE is presented:

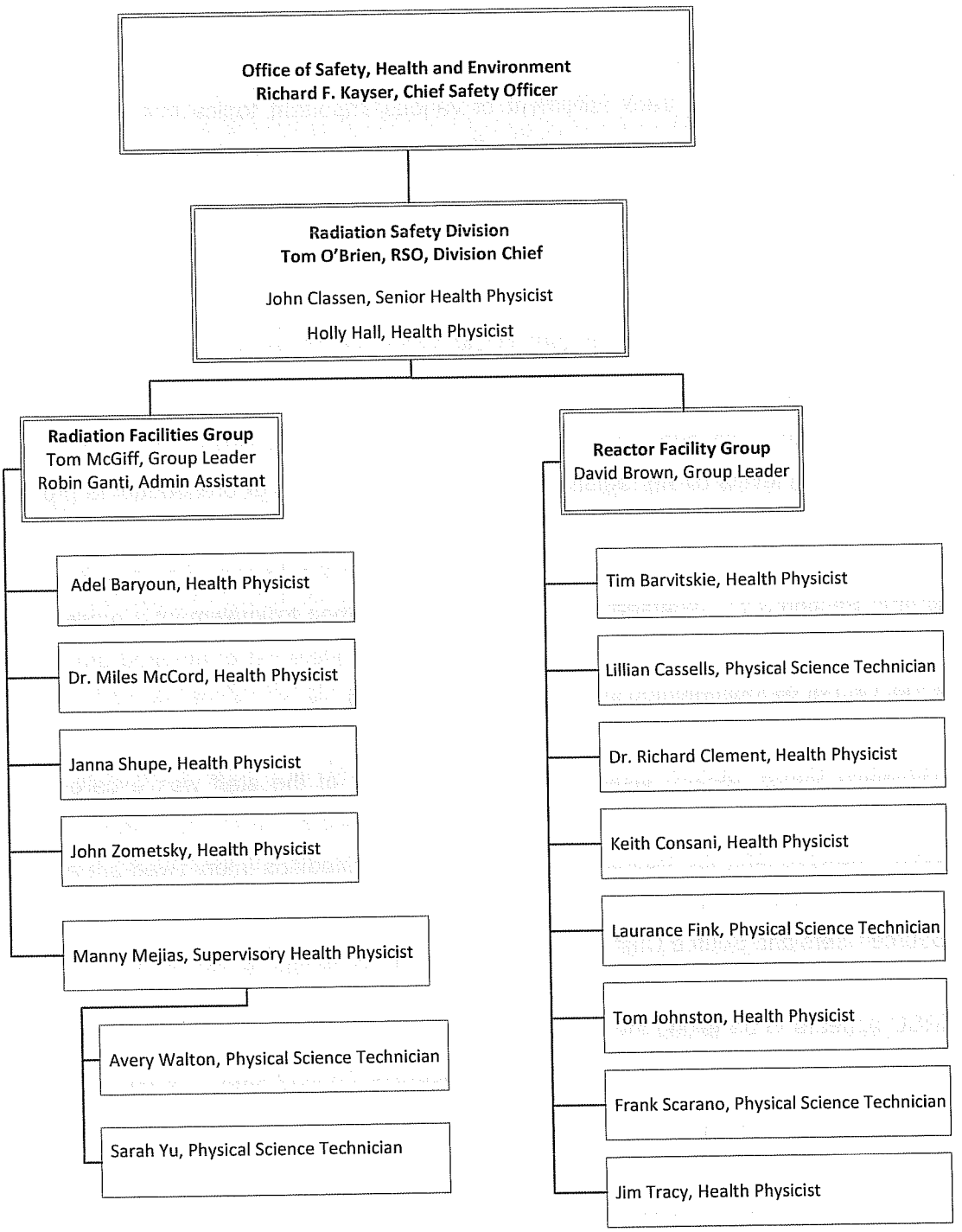

Figure 4. NIST-Gaithersburg Radiation Safety Division

3.2 Radiation Safety Culture

The IRSC and the GRSD track fulfillment of various important topics through the Findings Tracking Table, the Audit and Assessments Recommendation Tracking Table, and the IRSC Actions Tracking Table with 1, 9, and 32 open items, respectively. The 2011 audit stated that issues with procedures which are also an identified theme of this assessment dated back to 2007. The attitude seems to be that placing an item on the "To Do" list will ultimately be resolved by someone and that not closing or finalizing the item will not ultimately cause a radiological event. Many proposed closure dates have not even been decided. This is an incorrect attitude as several of the tracked items bear directly on radiation safety and maintaining radiation exposures as low as reasonably possible (ALARA). Currently, safety is built upon the skill levels of the radiation staff; unfortunately, lack of or inadequate procedures have been identified as issues for the radiation protection staff and also users. Additional comments regarding the NIST radiation safety culture and the Legacy Sources Program are provided in Section 3.11. Management needs to decide when to implement a model program and provide the resources to achieve it; a lack of an incomplete set of required procedures or those that cannot be implemented should never be tolerated.

The Radiation Safety Culture exhibited by each member of the staff was excellent. Each member of the staff knew their job and was willing to assist other staff when needed or requested. Furthermore, the Source Users and Source Custodians interviewed are also highly knowledgeable of the new rules and procedures put in place since the CO. Specific interviews with Source Users and Source Custodians are found in Attachment E.

The IRSC appears to be taking their charter seriously although the number and importance of the outstanding tracking items identified above appears to be very large. At an IRSC meeting the auditors attended, a new protocol was reviewed two days after receipt which appeared to over consume the IRSC meeting time. It is recommended that the IRSC streamline their approach by attempting to resolve most questions prior to a meeting; perhaps employ a minimum period of receipt before review.

There is reason to believe the Stop Work Authority, and responsibility, may not be prevalent within the GRSD. Two of five confidential Interviews indicate that a production mentality is prevalent and that stopping work would not always be supported by management. The RSO

stated that they have a policy to support anyone that would cause work to stop for safety considerations. A recommendation is made that the RSO's policy regarding Stop Work Authority be reinforced through emphasis in the newly designed Radiation Safety Training Course.

3.3 Radiation Safety Training

The main entrances to Building 245 and the Physics Building were posted with a NRC Form 3, a Section 206 notice, employee rights as specified in the Energy Reorganization Act of 1974, and a notice where the license, regulations and radiation safety program documents can be located.

Safety training is required per the CO, NRC and DOT regulations, as well as a license condition for SNM-362 radioactive materials license. GRSD develops and maintains appropriate training materials. Radiation Safety training is provided in combination as computer-base-training (CBT) followed by six hours of classroom lecture including a practical exercise in contamination survey techniques. New employees are required to complete the radiation safety training prior to working with radioactive materials. Records of radiation safety training are maintained by GRSD.

The auditors reviewed training materials used for all new radioactive materials users. Personnel considered as potential users of radioactive material and requiring radiological safety training are generally categorized as follows:

(1) Researchers working directly with radiation sources and radioactive materials;
(2) Radiation Safety staff;
(3) Support staff (firemen, security, janitors, electricians, etc.) who must work in areas where licensed material is in use; and
(4) Administrative staff and visitors who frequent areas using licensed materials.

The CO required a procedure for the indoctrination of new employees and associates with regard to general radiation safety policy and procedure. The procedure is based on Administrative Manual Subchapter 12.01, Safety Operational System (SOS), and NIST Form 1197, Occupational Health and Safety Orientation Checklist; (See Exhibit 16 in Attachment D).

Appendix R of NUREG-1556, Volume 11 provides recommendations and model procedures for handling emergencies. Procedure RSI 1-3, Emergency Response, was reviewed and compared to this Appendix to ensure adequate guidance has been provided by the organization. Even though a procedure is present, it appears it has not been "exercised" to determine or test response of individuals, not just GRSD, or to determine if the responders will respond appropriately and take the expected actions. The NIST Fire Protection Group did participate in an emergency response exercise over two years ago in March 2011 (See Exhibit E-13 in Attachment D).

- As a minimum interval, an annual drill is recommended (as described in the drill report/critique) to be performed which exercises the procedure and different persons in each organization so that each understands their role in a real emergency. These exercises should be performed as soon as possible.
- The drill summary indicated that Montgomery County Advanced Life Support units would not transport contaminated patients. If this refusal to transport a contaminated patient has not been resolved, it is recommended that transport and medical assistance be obtained as a top priority item.

During the assessment, Source Custodians were questioned about emergency procedures. All Source Custodians gave appropriate emergency response answers and they knew how to contact GRSD and the police department if the incident occurred after hours.

Training records were viewed for various GRSD Staff. An ad-hoc training program for the staff exists but needs to be formalized. An "HP Employee Training Check List" was reviewed for 3 staff members; only one was completed in its entirety (with no completion dates listed) and two were partially completed in late 2010/early 2011. Interviews with a Supervisor indicate that these checklists are not used prior to assigning a staff member to perform a given task due his knowledge of each staff members' true qualifications but he does intend to reinstitute use of the Check lists. The danger of not having a formalized training program is that staff personnel languish in their professional and company development, potentially requiring the use of an unqualified worker for an event and if an event does occur having used an "unqualified" worker there would be ramifications for the site. This illustrates the need for a documented program which was previously identified and supports the need for the IRSC to request actions to resolve this matter. It is recommended that GRSD develop a formal program that requires a supervisor

to observe and approve an individual GRSD member performing a task prior to independent assignment.

The previous (1997) license application requires that all authorized individuals requiring training be trained biennially. Further, all individuals approved to work with the irradiators (those sources meeting 10CFR part 36 criterion) shall receive facility specific training annually. Also, all individuals approved to prepare packaging, labeling, and manifests (Shippers Declarations) of sources for shipment regulated by the DOT shall receive training on the appropriate transportation regulations and accountability and control procedures. The model training program in Appendix J, NUREG-1556, Vol. 7 suggests that training shall be required annually (refresher training). This is identified as a weakness in the NIST program and it is recommended that NIST conform to the annual training suggestions contained in the NUREG.

The same NUREG-1556 Vol. 7 identified that a written exam should be used to assess retention of the topics presented. Additionally, the CO required that training include a method to measure the mastery of training objectives. Trainee mastery of the learning objectives should be measured through the use of appropriate evaluations' e.g. written, practical exercises, or oral exams and on-the-job evaluations. The structure of the Radiation Safety Course included:

- Six CBT modules with an exam for each with questions selected randomly from a data bank.
- A six hour class room lecture portion with a lab practical session to identify an unknown number of sources under a cover.
- A take home exam.

The course training material were comprehensive and covers most items listed in the CO, including but not limited to pertinent regulations, license conditions, events, policies and employee rights and responsibilities. Particular attention was given to the June 9, 2008, plutonium spill event. The course did not go into details regarding the consequences of and the potential actions that NRC may take against an individual for willful violations of NRC requirements as required by the CO. It is recommended that the course be upgraded to include the requirement regarding potential actions by the NRC.

The course did not include a practical exam (PE) for don and duff of PPE; there was one skin contamination event during the last year for which a cause could not be determined. The lack of a PE and use of a take home exam as a method to measure mastery are not considered as complying with the CO. The course should be upgraded to include the PE and the take home exam be replaced with a supervised test.

Two formula errors were noted in the classroom lectures involving efficiency calculations:

The first example from page 48 of the handout material was that the formula as shown below had the numerator and denominator reversed:

Efficiency = disintegration per min. /count per min.

It is recommended that the formula be changed to read; not exactly correct but excellent for concepts:

Efficiency = count per min. / disintegration per min.

The second example from page 72 of the training handout could lead to calculation error:

Efficiency = gross cpm – background cpm / dpm

It is recommended that the formula be changed by adding parenthesis to read:

Efficiency = (gross cpm – background cpm) / dpm

Additionally, the lectures did not demonstrate how large an area should be used during smear collection or the technique for medium pressure (wet smears for tritium, etc.). This was the first presentation of this version of training material and it is recommended that techniques for smear collection be included.

3.4 ALARA Program

The Personnel Dosimetry program monitors external and internal radiation dose received by individuals at NIST. Preliminary results for 2012 indicated that NIST maintained radiation exposures to individuals below the maximum allowable annual dose limits established by the NRC including ALARA. In 2011, personnel monitoring showed that all radiation exposures to individuals were well below all regulatory limits and were, by most measures, lower than individual doses received in 2009 or 2010.

3.5 Engineering Controls

During the tours of the facilities the auditors observed various engineering controls to protect workers for radioactive materials. These engineering controls include shielding, remote handling tools and effective ventilation. Engineering controls associated with the irradiators include additional shielding to maintain the control rooms and other surrounding areas as a low dose area. Interlocks of equipment are routinely tested and verified, see Appendix F, Figures 23-28. Physical barriers are present and effective during operations. Ventilation is used effectively in labs handling radioactive material that may be volatile.

It was observed in various laboratories that sealed sources were stored inside of lead brick stacks to prevent exposure to users. Potential future use of the sources was often undefined or unplanned; yet these piles of lead bricks continue to be in the floor and present a tripping hazard and potential radiation exposure. These lead brick stacks are considered as an example of poorly human-factored experimental setup; a review of the 2011 audit report indicated that radiation streaming was corrected immediately. A potential for radiation streaming may exist in all of these.

It is recommended that all sealed sources for which no immediate use is known (perhaps six months into the future) be removed from the various laboratories and stored in appropriately labeled lead pigs in another secure location.

3.6 Radiological Instrumentation & Sources

Calibrated and functional survey instrumentation is maintained to support monitoring needs in each Radiation Facility where external dose rates are likely to reach the criteria for a radiation

area as defined in 10 CFR 20 or where surface contamination control limits, as defined in HPI 1-1, are likely to be exceeded. Survey instrumentation was available and on loan from the Radiation Safety office to support required monitoring activities. The current instrument loan process flexibly provides research customers with needed instrumentation.

Calibrations were performed using sources traceable to NIST primary standards (this is the NIST facility providing calibration standards on a worldwide basis). Any instrument that does not meet the calibration and testing requirements is considered to be "out-of-service" until repair and retesting is performed.

Portable survey instruments used for dose rate measurements were calibrated per the manufacturer's recommendations/manual, or after repairs or modifications that could affect response (see table below). However, the SNM-362 License Renewal states that portable survey instruments used for dose rate measurements shall be calibrated annually (the current license states semi-annually). Many portable instruments were observed to have been calibrated outside the strict 6 month procedure requirement but within the license definition of semi-annually. The auditors recommend a true 6-month calibration be instituted, i.e., "date to date" instead of using the current license definition of semi-annual (not to exceed eight months): see Table 1 for details of calibration dates found on current instruments in use. A "date to date" calibration enables the users to know when they are looking at a calibration sticker on an instrument if the instrument is within calibration and therefore usable. Furthermore, a recommendation is made that the HPI 7-0 Quality Assurance procedure require a description of the repair or maintenance be recorded in the calibration records of each instrument. The calibrations are performed in-house by NIST personnel. Records of meter calibrations are available and were reviewed during the audit. Instruments were reported to be evaluated at approximately 20 percent and 80 percent of each scale or decade as practicable. The site practice is that instruments were removed from service if they could not be adjusted to within +10 percent of the expected value. No document was observed that justified the current gamma source being used to calibrate gamma instrumentation. It is recommended that a technical basis document be written that describes the instrument program. Suggestions for topics of the manual include:

- How NIST selects instruments to be used/purchased
- Radionuclides and energies of concern for the program
- Instrumentation Performance, both portable and fixed

- Instrument calibration
- Operability tests
- Maintenance
- Calibration equipment/quality
- Procedures
- Recordkeeping requirements

Table 1. Calibration Dates for Instruments in Use

Instrument	Tracking number	Last Cal date	Status of records
ASP-2e (neutron ball)	9043	10/08/2013	Calibrated as required
TBM	7106	2/8/2013	Calibrated as required
Tennelec	2	1/8/2013	Calibrated as required
ASP-1	210	9/21/2012	Calibrated as required
Argos 4AB			Calibration records are not stored/printed out for this machine – stored within the machine
Victoreen – 450P	1919	10/15/2012	Calibrated as required. Calibration paperwork states this instrument was "repaired" on 4/12/12 but does not state why/or what the repair was. ANSI N323A states that a record be maintained of all maintenance for each instrument. Auditor believes this means more than a statement in the record of "repaired"
Victoreen	727	2/15/2013	Calibrated as required
TBM	3162	11/8/2012	Calibrated as required
ASP-1	2897	9/21/2012	Calibrated as required
Ludlum model 12	154635	9/17/2012	Previous calibration was on 3/7/12. HV was adjusted from 1900 V to 2050 V with no explanation. Adjustment was due to elevation but should have been noted on the calibration sheet.
TBM	3046	11/5/2012	Calibrated as required.

Other instrumentation procedures were reviewed with the following results and recommendations:

- HPI 7-0, Quality Assurance, Section D (Implementation) states that appropriate procedures for *each* (italics added) instrument shall be provided as an enclosure to this HPI or as a separate specific HPI for that instrument. A review of the instrumentation

procedures shows that each *type* of instrument (beta/gamma, alpha, neutron, etc.) has a procedure, not each model of instrument. Furthermore, the procedure states that recalibration is required whenever an instrument fails the quality control procedure, is repaired, or undergoes a modification. This is contrary to ANSI N323A (section 4.9) which states that instruments shall be required at least annually, even when the source response check requirements are met. It is recommended that more guidance be placed in HPI 7-0 that reflects ANSI standard commitments as well as other quality good practices such as documentation requirements, replacement part requirements, etc. This document is also out of date; the current revision is dated 10/95.

- RSI 7-13 states that Co-60 is to be used for the calibration of the Canberra Portal Monitors (PM-7 and GEM-5) but Cs-137 is the true source used (current license requires that Cs-137 be used for photons). In addition to being out of compliance with RSI 7-13, this is contrary to HPI 1-0, Health Physics Policies, Section D, and HPI 1-2, Section C, which both state that procedures shall be followed. RSI 7-13 also states that routine calibrations are not required provided the unit passes the appropriate QA checks (see ANSI N323A section 4.9). It is recommended that procedure RSI 7-13 be revised to be in compliance with the actual source use conditions.

- HPI 7-6, Alpha Survey instrument calibration, one of the precautions instructs the user to use tweezers when handling the alpha source. This is not only unnecessary for ALARA purposes but also increases the chances for the surface of the source to become scratched, i.e., lose integrity of the seal. No calibration frequency is listed for any of the alpha survey instruments. See recommendation above regarding placing calibration frequencies in procedures.

- RSI 7-8A, *Gamma Spectroscopy System*, This procedure does not provide any safety recommendations for filling the dewar with LN such as PPE to be worn, ensuring adequate ventilation in the room, etc. It is recommended that a revision be made to procedure RSI 7-8A which includes safety precautions for filling the dewar i.e., proper gloves, proper apron, face piece, oxygen meter in room, etc.

- HPI 7-3, *Hand and Foot Monitors*; the purpose of the procedure states that it describes proper actions for the discovery of personnel radioactive contamination. Step F.2

suggests that external contamination of 0.1 mrad/hr of beta contamination is acceptable to be left on the skin of a worker (same requirements in HPI 1-1). License Condition 3.2.4 states that a Health Physicist must approve the exit from the controlled area of any individual who is found to be contaminated above background levels. Even though this value is not likely to cause an overexposure, industry good practice dictates that external contamination be removed to the lowest level achievable without causing injury to the skin. If there is contamination detected, the RSO should be notified and only with his permission shall a worker be allowed to go home. It is recommended that procedure HPI 7-3 be revised and updated with information received via benchmarking the industry.

- HPI 7-4, *Gamma Survey Instrument Calibration*, item D.5., states to place the detector at a distance of 150 cm from the source to record the background to be subtracted from the instrument reading – instrument technician stated the background is essentially zero therefore technically does not perform this part of the procedure. It is recommended that this requirement regarding collection of a zero reading be relaxed in procedure HPI 7-4.

- No sections on control of documents generated by these procedures were located. It is recommended that the HPI 7-0 Quality Assurance procedure be revised to provide control and storage of documents generated by the various calibration procedures.

Records of calibrations and instrument QA were retained for inspection for the required three years.

NIST owns several liquid scintillation counters (LSCs) and gamma counters for counting radiological samples such as wipes and bioassay samples. Maintenance of the LSCs is provided via service contracts with instrument manufacturers. The counters used by the GRSD are subject to daily Quality Assurance/Quality Control procedures which ensure the generation of quality data. A Tc-99 source is used for counting efficiency which is appropriate for the average energies at the site.

The whole body and hand-and-foot contamination monitors are calibrated by a pulser and the detectors checked for response to a beta emitting radiation source. No operational checks are made with alpha emitting sources. Auditor observed performance of a source-check on an

ARGOS-4AB personnel contamination monitor. Checks are performed with a 100 cm^2 Tc-99 source and every detector is checked while expecting an alarm condition on each one.

NIST uses a Canberra Accuscan II for whole body, thyroid and waste counting. The phantom used for calibration of body/thyroid counting is the Canberra Realistic Phantom which is appropriate for their use. NIST performs the annual calibrations and the records are appropriate. One of the users was questioned on technical capabilities of the counter as well as its approved uses; user was well-trained and answered all questions with the expected, and correct, responses.

Pocket ion chambers are calibrated annually and records are maintained. It was reported in the 2009 audit that there is no written NIST procedure for this calibration routine and this is still the case. The procedure performed is based on the staff's interpretation of an appropriate ANSI standard and the application of NIST's calibration range capabilities. In general, all licensees should ensure that pocket dosimeters are well maintained, clean, and free of contamination; calibrated at specified frequencies; and checked periodically for proper operation, following the manufacturer's recommended procedures (RegGuide 8.4, 2011). It is recommended that a procedure be developed describing the calibration of PIC's, acceptable drift criteria and time frame associated with the drift.

All instrument procedures assume a good deal of knowledge regarding calibration of each instrument. This system only works if the person performing the calibration is very well trained and qualified. It is recommended that all procedures developed for the instrumentation program only assume a minimally qualified person is performing the tasks.

The GRSD instrumentation staff members are very knowledgeable about the instruments, their use and calibration and limitations. It was reported in 2012 audit that Source Users and Source Custodians indicated minimal training on the use of the instruments and data interpretation. It is recommended to 1) place a notice on the Tennelec system that instructs a user as to when a smear is contaminated; or 2) program the Tennelec system to automatically produce a flag when a given level is exceeded; or 3) train users on the normal background of the system versus a positive smear count.

The calibration of hand held instruments for measurement of surface contamination are performed at NIST based upon a total activity (dpm) of the calibration source. The efficiency of the instrument is then determined as:

Efficiency = cpm/dpm, and

Activity, dpm = cpm/efficiency; as illustrated in the training course.

This calibration and data conversion program is not consistent with the standard industry practices illustrated in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) NUREG-1575, Rev. 1. MARSSIM takes into account both instrument efficiency and source efficiency.

- "The instrument efficiency is defined as the ratio of the net count rate of the instrument and the surface emission rate of a source for a specified geometry. The surface emission rate is defined as the number of particles of a given type above a given energy emerging from the front face of the source per unit time. The surface emission rate is the 2π particle fluence that embodies both the absorption and scattering processes that effect the radiation emitted from the source. Thus, the instrument efficiency is determined by the ratio of the net count rate and the surface emission rate." (MARSSIM Section 6.5.4)

- "...ISO-7503-1 (ISO 1988) makes recommendations for default source efficiencies. A source efficiency of 0.5 is recommended for beta emitters with maximum energies above 0.4 MeV. Alpha emitters and beta emitters with maximum beta energies between 0.15 and 0.4 MeV have a recommended source efficiency of 0.25. Source efficiencies for some common surface materials and overlaying material are provided in NUREG-1507." (MARSSIM Section 6.5.4)

Following calibration and insertion of various know values the activity in terms of dpm per 100 cm^2 may be calculated (MARSSIM Section 6.6.1):

$$\text{Activity } \frac{dpm}{100cm^2} = \frac{\frac{C_s}{T_s} - R_b}{(\varepsilon_{total})\left(\frac{a}{100cm^2}\right)}$$

where

Cs = integrated counts recorded by the instrument
Ts = time period over which the counts were recorded in minutes
R_b = Background count rate
ε_{total} = total efficiency of the instrument in counts per disintegration, effectively the product of the instrument efficiency (εi) and the source efficiency (εs)
a = physical probe area in cm^2

Not implementing MARSSIM calls into question the validity of radiation survey results both in the laboratories and for released material. For example, the nonuse of the recommended alpha source efficiency factor could imply a serious underestimation of alpha surface contamination; experience indicates by a factor of two. As another example, the probe area of the TBM-3SR used for beta surface contamination measurements is about 20 cm^2, the nonuse of the probe area for beta measurements could imply that all beta activity values are being underreported by a factor of five. It is recommended that the standard industry practices which are illustrated in MARSSIM be adopted for calibration and data interpretation with timely training provided, as soon as possible, for both the GRSD staff and radioactive material users.

3.7 Radiological Surveys, Contamination Controls & Records

GRSD technicians perform weekly radiation contamination surveys in laboratories where unsealed radioactive materials are used. Direct radiation dose measurements and wipe surveys are performed in each weekly survey. Weekly surveys are documented and a copy of the latest survey is posted at the entrance of the room. A supervisory health physicist reviews the weekly surveys.

Laboratories that use unsealed radioactive materials are audited by a health physicist quarterly. The audit consists of an independent radiation survey and a review of compliance items. Items of noncompliance are documented on the audit report and entered into the HAPPY database. Completed corrective actions are documented in the HAPPY database. During the next audit all items that have not been corrective are followed up by the health physicist.

Area monitors are placed throughout Building 245. The data from these area monitors shows compliance with 10 CFR 20 public dose limits. GRSD also runs the COMPLY code annually to demonstrate compliance with air emission constraints. GRSD also runs the comply code for individual airborne releases. Although not necessary the results provide NIST with data supporting compliance with 10 CFR 20 public dose criteria. NIST did not release radioactive materials via the sanitary sewer system in 2012.

Material users are trained to perform a daily contamination survey following work with radioisotopes. During the 2012 audit, Source Custodians were asked to describe their work with radioactive materials and what type of radiation surveys they performed. At the conclusion of their work the Source Custodians indicated they performed a wipe survey. Various answers were given by the Source Custodians as to what the trigger level was for a wipe survey. None of the Source Custodians indicated that they are to use a portable radiation survey instrument to survey the work area. At all locations a calibrated portable survey instrument was readily available. Although an observation during the 2012 audit, it is recommended that planned corrective action regarding training and use requirements for portable survey meters be scheduled immediately.

Survey records for weekly surveillances and quarterly audits are maintained and were reviewed. These include direct radiation and contamination surveys. Direct radiation levels and contamination are very low and practically consistent with background in most locations. Low levels of direct radiation, well within limits, are measurable at the surfaces of self-contained irradiators and source storage areas. Surveys appeared adequate to show compliance with 10 CFR Part 20 public dose limits for direct exposure.

Survey requirements for areas where radioactive materials are used and stored were established per the 1997 license renewal application and the HPIs. Survey frequencies are a function of the category of laboratory, which is based on the type and quantity of radioactive material used. For most posted rooms, the program requires that the GRSD conduct and document a weekly survey and/or a quarterly audit. Material users are trained to perform a daily contamination survey following work with radioisotopes. The results from these surveys are stored in the lab where the survey was taken. The individual taking the survey gives the swipes to Health Physics for counting on the Tennelec low background counter. After counting the results are given to the surveyor. No record of review by GRSD or the individual surveyor is documented. It is recommended the surveyor and GRSD take credit for users performing daily contamination surveys via a record of review. Something as simple as a survey log with the time, date, surveyor name, description or comment, date results are received and a satisfactory or unsatisfactory entry being made.

Surveys by the radiation safety staff consist of the collection of smear samples and the use of portable radiation detection equipment to assess ambient radiological conditions and those on work surfaces within posted areas. Additionally, exposure rates are measured to ensure compliance with applicable posting requirements. A check of work place classification, radiological facility conditions, security checks, and other compliance related items are performed during each quarterly audit. All findings from both weekly surveys and quarterly audits are documented on the applicable forms.

Survey records indicated the use of cpm as the contamination level which without a conversion factor, the user would not be aware of what the actual level would be in terms of dpm/100cm^2. It is recommended that both a conversion factor to dpm/100cm^2 and action level (perhaps in cpm) be provided to the lab user with the various survey meters for both alpha meters and beta meters. This recommendation is consistent with NUREG-1556, Vol. 11, Appendix R, that each survey record should include contamination levels with appropriate units. Further, 10 CFR § 20.1005 Units of radioactivity defines one of the activity units to be used is disintegrations per unit of time.

3.8 Labels and Posting

Based on observations, doors to facilities were posted with "Caution- Radioactive Materials" signs and "Caution – Radiation Area" signs as appropriate. Equipment and containers were frequently found labeled with a variety of type of "Caution – Radioactive Materials" postings. Waste containers were also appropriately labeled.

Areas marked "Caution – Radiation Area" were in compliance with the applicable dose rates. The entrances to Buildings were posted with a current copy of NRC Form 3.

The following observations were made:

- Observed weekly survey audit of room C-11 (See Appendix F, Figures 29 – 34). A GRSD Supervisor performed independent dose rate and contamination surveys as well as a general observation of the room. The supervisor did not open any cabinets or drawers to look for unlabeled or unmarked RAM. This auditor opened one drawer and found an item with a RAM tag on it that had been there a while; the drawer was not

labeled with a RAM sticker. This auditor also spotted, through a hole where a drawer had been, some source material (labeled) but the cabinet drawer also was not labeled with a RAM sticker (see Attachment F- Photo 1). Also in the room was a contaminated lead pig that had a sticky-note on it, dated 4/22/11, stating it was contaminated (see Attachment F- Photo 2). When questioned, the Supervisor stated that the Principal Investigator had been talked to about the use of the pig. A cabinet in the back of the room contained several sources; could not tell if they were all being used (see Attachment F- Photo 3). Sources were causing a localized 5 mR/hour field at the front of the cabinet (posted properly).

- Procedure HPI 4-1, *LHP Monitoring*, step D.5 states that "during any laboratory or workplace survey, the surveyor will review the area, containers in the areas, and other items and equipment, or compliance with posting and marking requirements..." Various laboratories were found that had containers containing RAM that were not labeled with the proper label; however, as access was permitted only to authorized individuals and an inventory was available, the requirements for labeling per 10CFR20 appeared to be met.

- Room B-044 is posted as a Radioactive Materials Area and has stored within in it HEPA and Charcoal filters that are awaiting analysis for waste classification. Within that room are several (<20) shipping drums (appear to be 3 gallon containers) which are labeled with a UN number as well as White and Yellow (White I, Yellow II, etc.) labels but also have a piece of paper on top of the stack stating the containers are empty. This room was locked, posted and controlled appropriately.

- B-156 contains an area on a bench-top that is used for contaminated materials. Contrary to proper labeling convention, this bench-top area was not labeled to inform personnel working in the area that this was for RAM (Attachment F- Photo 4). It is recommended that "Contaminated Area" tape be used around areas meant to store contaminated (or potentially contaminated) items.

- Several labels that are not defined in 10CFR20, "Caution Radiation Hazard" (Attachment F- Photo 7) were found in many laboratories; these appear to be left-over labels from history. These containers are accessible only to individuals authorized to handle or use them, or to work in the vicinity of the containers and inventories are available. This is not

a finding of noncompliance with 10 CFR Part 20 labeling requirements but it is recommended that these erroneous labels be found and replaced with labels defined by 10 CFR § 20.1904, Labeling containers, a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL"

- There appears to be a lack of consistency in posting information for rooms posted with "Caution Radioactive Material". Out of 8 rooms chosen in the Basement and Sub-Basement with that posting, 5 had survey maps at the entrance to the room and 3 did not. Furthermore, the survey maps were incomplete; two statements at the bottom of the survey maps were not complied with – one check box stating the database had been updated and a statement that the smear results were attached to the survey map. A PST stated that this form was used for two purposes and the information at the bottom was for use when the rooms were audited. To eliminate inconsistency in posting room survey results, it is recommended that either 1) two separate forms be used OR 2) that section be one-lined and initialed as NA at each posting.

- The auditors went through building 217 and 227 to audit postings, housekeeping and proper use of radioactive material, see Appendix F, Figures 35 - 56. In building 216 labs C103, C105, D101, D104, D113 and F101 were inspected with Abby Lindstrom from Materials Management. These labs had "Caution Radioactive Material" signs. Some labs did not have any radioactive material in the lab at that time but were expected to get some in the future and therefore the sign was left in place. All labs were neat with radioactive waste bins being labeled. No excessive nonradioactive waste was in the rooms. There was no indication of eating or drinking in these rooms. It is recommended that if a room does not have radioactive material the "Caution Radioactive Material" sign be removed.

  In building 227 labs B143, B151, A 230, and A334 were inspected with Manny Mejias. These rooms were the only labs posted with "Caution, Radioactive Material" signs. All labs were neat with radioactive waste bins being labeled. All labs had signs stating "No Entry by Janitors Trash and recyclables will be placed outside." No excessive nonradioactive waste was in the rooms. There was no indication of eating or drinking in these rooms. Drawers with radioactive material were locked when not in use.

The entrances to Buildings were posted with a current copy of NRC Form 3 as well as a statement regarding the location of the license, regulations and inspection results.

3.9 Contamination Control

No food, drinks, or tobacco use was observed in any of the radiological laboratories.

GRSD technicians perform weekly radiation contamination surveys in laboratories where unsealed radioactive materials are used. Direct radiation dose measurements and wipe surveys are performed in each weekly survey. Weekly surveys are documented and a copy of the latest survey is posted at the entrance of most of the rooms (see comment in previous section). A supervisory health physicist reviews the weekly surveys. The survey forms are well designed to include drawings of each room.

Laboratories that use unsealed radioactive materials are audited by a health physicist quarterly. The audit consists of an independent radiation survey and a review of compliance items. Items of noncompliance are documented on the audit report and entered into the HAPPY database. Completed corrective actions are documented in the HAPPY database. During the next audit all items that have not been corrective are followed up by the health physicist.

Source Custodians were asked to describe their work with radioactive materials and what type of radiation surveys they performed. At the conclusion of their work the Source Custodians indicated they performed a wipe survey. No record of review of the survey results is maintained. See the comment in Section 3.7 for the recommendation regarding documentation for this survey. Various answers were given by the Source Custodians as to what the trigger level was for a wipe survey. None of the Source Custodians indicated that they used a portable radiation survey instrument to survey the work area. However, at all locations a calibrated portable survey instrument was readily available.

Two reports regarding leaking sources were made to the NRC during 2012; one of which was untimely and discussed earlier. Copies of one analysis of a leaking source and the report to the NRC are provided as Exhibits 6 and 7 of Attachment D. A variety of routine reports such as NSTS reports, NMSS transaction reports and SRM transfer reports were submitted to the NRC

or their designated contractors in 2012. The RSO was very familiar with the NRC reporting requirements and the NRC Emergency Operations Center phone number.

3.10 Personnel Monitoring for Radiation Exposure

External dosimeters are obtained from the U.S. Navy Medical facility in Bethesda, Maryland. Whole body and/or extremity (ring) dosimeters are provided to workers based on the material (or x-ray generating devices) that they utilize. The decision to provide dose monitoring is part of the hazard assessment done by GRSD upon receipt of a Form 364 or 365 application.

Dosimeters of record (TLDs) are exchanged on a quarterly basis, and workers are provided with a copy of their dose results if their annual dose exceeds 50 mrem or upon request. Typical doses to workers associated with the SNM-362 license are relatively low, with higher doses associated with reactor personnel and some users of high energy gamma-emitting radionuclides.

Records of radiation doses to radiation workers are maintained by GRSD. Dosimetry records are maintained in both hard-copy as well as electronically in the Radiation Safety database. Data from 2012 (third quarter was latest data available) was reviewed and all exposures were below an annual radiation dose in excess of 10 percent of any applicable NRC occupational dose limit: highest TEDE was 67 mrem.

NIST performs and tracks internal dose via a bioassay program consisting of thyroid scans following work with radioactive iodine and urinalysis is performed following work with relatively high quantities of radioisotopes (typically tritium). The thyroid scans are performed typically at one point each year following an annual campaign of work with iodine. Tritium bioassays are more frequent and are documented on Tritium Bioassay Review Pre-Post Report forms. No internal dose was reported for any workers.

There was one declared pregnant worker (DPW) for 2012 and her total dose was less than 10% of the limit for DPW's. Training is provided on this topic in the radiation safety training program. Data from the NIST Dosimetry group (up to third quarter of 2012) indicates:

- Of the 257 workers monitored during 2012, Forty-seven (47) received a measurable whole body dose. Of these only 3 workers exceeded 50 mrem (1 percent of the annual whole body exposure limit) and no workers exceeded 500 mrem (10 percent of the exposure limit).
- In addition to monitoring workers for external whole body exposures, 25 workers were monitored for extremity exposures using finger ring TLDs. One of these workers was exceeding 5,000 mrem at this time and the dosimetrist believes the final dosimetry report will show this worker at less than 10,000 mrem for the year.

The IRSC 2011 Annual report, Section X, In-Plant Monitoring, discusses exposure monitoring outside buildings, in offices, in hallways and in restricted areas. The data in the graphs presented in that report do not subtract background dose so, on the surface, indicates a large amount of ambient dose in those areas (average reading in the guide hall was 116 mrem). Data is also presented as composite data (averages). The purpose of this monitoring is to ensure employees deemed not to be radiation workers are not exposed to a value over the limit for members of the public (MOP) (100 mrem/year). It is recommended that future IRSC annual reports perform an evaluation based upon the general number of hours an employee is expected to be in the area with the greatest exposure as well as subtracting background dose so that an appropriate MOP evaluation can be performed.

Furthermore, the same report states that area monitoring in the construction area outside the guide hall was stopped due to the construction removing the fence the TLD was placed on. It would have seemed prudent to find another location at that construction area to place an area TLD to ensure, and prove, the construction workers were not being exposed to greater than the 100 mrem/year limit for MOP. However, Environs Radiations Surveys required per HPI 8-6, (back to September 2012) were reviewed for the purpose of ensuring compliance with the 100 mrem/year MOP limit. Records indicate the surveys are being performed in a quality manner and are properly documented. Any dose rate results greater than twice background is evaluated for occupancy.

A review of dosimetry procedures was performed with the following recommendation:

It is recommended that procedure revisions be made to HPI 1-1 and 1-7 that goes into more depth regarding personnel contamination, states a limit to when a skin dose assessment will be

performed, actions to take at various levels of dose and requiring count rate measurements at the end of each decontamination cycle.

- HPI 1-1, Health Physics Action Levels, states that decontamination level for beta can be stopped at 0.1mrad/hour. Step F.2. states that "If these levels cannot be achieved a supervisory health physicist must be consulted as soon as practicable".

- HPI 1-7, Personal Decontamination, does not require that facial contamination on an individual require a whole body count. Procedure also does not discuss documentation of the decontamination either for dose assessment purposes or for tracking/trending purposes. Furthermore, this same procedure does not give instructions to record contamination levels such that a skin dose assessment can be performed. .

- No procedures were identified on how to perform a skin dose assessment or when a skin dose assessment would even be required.

Discussions with the Health Physicist responsible for personnel dosimetry yielded statements such as "we don't do it that way anymore" when asked specific questions about procedures that are signed and in place. Replacement procedures are currently being developed which reflect their current method of operations (which are correct) but do not follow currently approved procedures; HPI 2-3, External Dosimetry, is an example of a procedure not reflecting current practices. It is recommended that emphasis be placed to finalize Personnel Monitoring replacement procedures; training should then be conducted on them immediately.

The use of Temporary PIC/TLD packages was discussed with one of the Dosimetry Health Physicists; there are no approved instructions or directions on when or how this Temporary program is to be applied. Dose limits are not established as to when a visitor or employee would need this package, no "rules" such as rooms being worked in or areas being accessed that will strictly be applied. It is recommended that a procedure be developed and implemented for the use of Temporary PIC/TLD packages.

No statement is provided in the training program regarding personnel who are given medical radioisotopes by a physician. However, the practice is that if GRSD becomes aware of such a person, that person's TLD is taken away and instructed not to enter any radiation or radioactive

material areas until they can clear a personal contamination monitor. The training program should include discussion regarding medical radioisotopes use.

A Technical Basis Document (TBD) that discusses the dosimetry program and outlines its reason for existence was asked for but evidently does not exist. It is recommended that an effort be put into developing a TBD; and for more than the dosimetry function. This document would then serve as the basis for the entire program and the underlying procedures would then implement this TBD. Examples of topics in this document include:

- Establishing the need for individual monitoring
- How lost, damaged or contaminated dosimeters are handled
- Planned Special Exposure situations
- External dose evaluations
- Dosimeter quality assurance
- Recordkeeping and Reporting

The air sampling program was evaluated as part of the dosimetry review. The program was evaluated by reading procedures, interviewing personnel involved in the program, reviewing data packages and performing walk downs. The licensee has very little need for in-room air sampling but does provide it when the AHA prompts it be performed. Air sampling is generally performed (physically) both after the HEPA or charcoal filter plenum as well as in the room where the work is being performed. Each charcoal filter is provided with a quality control (QC) stamp for the TEDA charcoal. A double filter (i.e., both charcoal and HEPA) is not used. GRSD is working with the Investigators to standardize given hoods for specific type radionuclides which would remove the inefficiency of changing hood filters for each investigator; only a given hood(s) could be used for Iodine radionuclides and those hoods would be provided the charcoal filters. This is recognized as a noteworthy practice.

A review of the air sample data for 2012 was reviewed. Data is tracked both by Derived Airborne Concentration (DAC) values and potential effluent release; no air samples exceeded any DAC values and all counts appeared to have been performed correctly and the instruments used for analysis were in calibration.

3.11 Research and Source Usage

Auditors reviewed a variety of records, including the hazard review process for approving source acquisition and facility utilization.

Large radioactive material sources are in compliance with the NRC Order for Increased Controls on Quantities of Concern. Access to quantities of concern of radioactive materials is strictly controlled. Only personnel who have job functions requiring access to these sources are provided access to these areas. All other personnel must be escorted by an individual who has unescorted access.

NIST has an inventory of approximately 1400 sealed and non-sealed radioactive sources at the Gaithersburg, Maryland location. These sources are primarily from NIST scientists that have been acquiring radioactive material for use in research supporting a wide range of NIST programs. Approximately 120 sources of the inventory are no longer required to support NIST scientific activities; several of these have been in storage for over ten years and have been leak tested to confirm their integrity. NIST recognizes that a plan for the transfer or disposal of these sources is required; see Attachment D, Exhibit E-14. The exhibit illustrates that no action will be near term as the document discusses funding in FY14 and beyond. NIST needs to make a decision as to when and how to get rid of these legacy sources and drive that decision to closure. It is recommended that detailed plans for these legacy sealed sources, which are no longer wanted or for which plans are not known, be transferred to other authorized licensees or licensed disposal sites immediately.

3.12 Material Control and Accountability

Source acquisition is controlled by NIST Form 364 and procedure HPI 4-8, *Source Receiving and Storage Facility*. This procedure is not up-to-date (revision 12/93) and provides very little instruction; a well-trained worker would be required to perform this task. However, procedure RSI 4-2, *Radioactive Material Package Receipt*, appears to have been written to overlap HPI 4-8 and is a very good procedure for receipt of RAM. It is recommended that HPI 4-8 be deleted and the important sections (such as sections C and D) moved to RSI 4-2. Copies of three RAM receipt and request forms are presented as Exhibits 11 and 12 of Attachment D; respectively.

Interviews with staff indicates there is now a very strong hold on source receipt and any source received will not be provided to a Source Custodian without the proper form completed along with the approved Hazard Analysis. Interviews of Source Custodian provided information that indicates they are well aware of the NIST 364/Hazard Assessment requirements prior to receiving a source. However, Uranium-232 is not an approved source material on the current SNM-362 license and two sealed sources containing 100 microcuries each were received in 2011 and 2012. Receipt of this material is an item of noncompliance with the SNM-362 license and questions the reliability of the NIST 364/Hazard Assessment process.

The source inventory is updated prior to any source ordering to ensure that no license limit will be exceeded when the source arrives on site. At this time, the closest radionuclide to its limit is Thorium (all forms) at 70% of the current license limit. Comparison to the proposed license limits is also tracked; two fuel pellets exist at 84% as well as Radium at 84%. Currently there are 1434 tracked sources; 964 sealed sources and 470 unsealed sources. The current inventory is presented in Attachment D, Exhibit E-15.

Upon receipt the source is given a unique "RS" number for tracking that is kept with the source original activity. A NIST scientist is assigned as the custodian of the source and can take a RS labeled source and use it to manufacture and calibrate smaller sources as Standard Reference Material (SRM) for an outside user. The source custodian is responsible for tracking where the original material goes and is allowed to use their own unique tracking method. When all of the original activity is consumed the custodian notifies Health Physics that the source has been properly handled or disposed and it can be removed from inventory. This provides a level of accountability that maintains the total isotope activity in inventory even though the activity on site is less.

Interviews with several source custodians allowed the auditors to track the RS number assigned to the custodian through the custodian log books to the proper accountability of the activity. For example, RS 12-0115 was tracked through Dan Golas with proper accountability for the I-125 and RS 13-0033 for I-131. His log book had his item number 2273 as the I-125 and item 2291 was associated with the I-131. Other sources reviewed included items 2285-1 and item 2285-10 as mixed gamma SRM. Item 2281-1 was a Lu-177 SRM. Larry Lucas was interviewed to determine his method of accountability for the RS standards in his possession. He used a

tracking system for his SRM as "LL-03-109" to track a dilution of Cd-109. His log book allowed him to track this back to a specific RS number for proper accountability.

During a review of the low level alpha and beta calibration laboratory (Room E107) a spot check of a drawer with calibration sources was done to trace the RS number. One source did not have a RS number but had a unique identifier, with a date of 1968, which looked like it was a SRM dilution done by a NIST scientist. Therefore it was undetermined if the source was in inventory. A similar occurrence of sources without a RS number occurred while reviewing radioactive material storage in room C11 with Dr. Latitia Pibida. For instance one source was labeled 4926 H-3 September 3, 1961 another was PSM 9-2'-A3 and another PSM 9-2'-A4. It is recommended that sources without a RS number be identified and put into inventory. Also a method should be considered to track dilutions back to the RS number.

A review of the leak check records and interviews with personnel indicate all leak checks have been performed in a timely manner. All sources in long-term storage also completed satisfactory leak checks.

The NIST NMMSS reports were reviewed; the report is due annually but NIST performs the inventory and reports on a semi-annual basis which is considered a noteworthy practice although time consuming. All reports appeared to be accurate and submitted in a timely manner.

3.13 Radioactive Material Shipping and Receiving

Radioactive material packages are delivered to a central receiving warehouse, Building 301. NIST employees using a NIST vehicle transfer the radioactive material packages to Building 245. GRSD staff survey and inventory the radioactive materials packages. The packages are delivered to the laboratories by the GRSD staff.

Procedure RSI 4-2, *Radioactive Material Package Receipt* was reviewed. The receiving department has 1 hour to notify the health physics department of an incoming shipment. An HP representative retrieves the package and performs a proper receipt survey within 3 hours of the receipt date/time. A lockable cage is available for the RAM packages as they are awaiting pickup (see Attachment F- Photos 5 and 6. Observed 3 different RAM receipt forms; all had

been surveyed within the 3-hour time limit; see Attachment D Exhibits 11 and 12. The receiving department is open fewer hours than GRSD so any RAM packages arriving within the time frame can be properly surveyed within the 3-hour requirement. All receiving personnel are trained for this function.

NUREG 1556, Volume 11, Appendix P Sample Memorandum states, "If the package appears to be damaged, immediately contact the RSO. Ask the carrier to remain at the facility until it can be determined that neither the carrier nor the vehicle is contaminated." The auditor discussed emergency response with a warehouse employee; employee stated that a package that was offloaded from the carrier that was leaking or damaged would be given back to the shipper. This is contrary to the training and instruction provided to the receiving personnel. A NIST Health Physicist accompanying this interview stated that likely their training needed to be more specific regarding receipt of damaged packages. It is recommended that GRSD ensure that the training is very specific for receipt of RAM packages that are damaged or leaking.

All outgoing SRM shipments of radioactive material must be reviewed by GRSD staff. A copy of the original request form is kept with a copy of the receiving entities radioactive license GRSD staff verifies that a current radioactive materials license is on file at NIST and the receiving facility is licensed to receive both the type and quantity of radioactive material in the SRM source. A record of this verification is reviewed by a second person as a double verification step and these records are maintained. GRSD staff was observed processing SRM shipment requests. The proper use of absorbents, bubble wrap, shipping paperwork and label on the package was verified as correct. Some shipments of SRMs were delayed until GRSD staff could obtain the appropriate radioactive material license from the customer. Shipments of brachytherapy sources do not follow the same formal review procedure as SRMs. However, NIST staff contacts GRSD to verify the customer has a radioactive materials license on file and is authorized to receive the type and quantity of radioactive material being shipped.

Records were reviewed for the 304 materials shipments made in 2012. There were 182 DOT regulated shipments and 122 non haz-mat shipments out of building 245 All shipping records were in compliance with DOT and IATA regulations.

GRSD maintains an inventory of all sealed sources at NIST. Semi-annually all sealed sources are leak tested by GRSD staff. Annually GRSD sends to each Source Custodian a sealed

source inventory. The Source Custodian updates the inventory and returns the updated inventory to GRSD. Leak test records for 2012 were reviewed and determined to be in compliance.

During the audit, the following Source Custodians were asked to provide the inventory of radioactive materials present in a laboratory: Lizabeth Laureano-Perez, Alan Thompson, and Jerome LaRosa. Each Source Custodian was able to provide a radioactive materials inventory. Each Source Custodian was asked to retrieve two sources on the inventory. All Source Custodians were able to locate the requested sources.

NIST maintains records of SNM inventory, receipt and transfers. NIST files semi-annual report in the Nuclear Materials Management and Safeguard System (NMMSS). DOT and IATA trained staff prepare radioactive materials for shipment in room 146, the packaging room. Janet Stann was observed preparing SRMs for shipment. Ms. Stann had all necessary radiation survey equipment, shipping papers, and supplies required to package radioactive material for shipment. Ms. Stann only packages radioactive materials after GRSD has approved the shipment (license verification). She was very knowledgeable regarding DOT and IATA regulations and she was competent in preparing the radioactive materials for shipment.

New employees must complete DOT and IATA training prior to shipping radioactive materials. DOT and IATA refresher training is provided by the GRSD staff every two years.

3.14 Radioactive Waste Management and Transportation

Radioactive waste is stored in Rooms A010 and A012, see Appendix F, Figures 8 - 22. Room A010 is a former accelerator vault. A010 has a fire detection and alarm system but no fire suppression system (no fire sprinkler or automatic fire extinguishers, manual extinguishers are available). Also, this area does not have emergency lighting in the event of a power failure. A010 does not have any windows and is very dark without lighting. It is recommended that temporary lighting be installed in Room A010 until a permanent arrangement is made.

Liquid radioactive waste is stored in A010. The liquid waste was appropriately labeled. Liquid waste containers are stored in plastic pail that acts as a secondary containment. .Waste is characterized in the laboratory that generates the waste and logged onto a Laboratory Waste

Manifest form which details the RS number, nuclide, activity, assay date, physical and chemical form. Health Physics assigns it a Package ID number and does an exposure rate at 30 cm. When enough waste is in storage at A010 it is placed into a bin and coordinated with the waste person in Building 235 for transport and storage/processing and disposal through that facility. Approximately two shipments of waste are made per year.

Radioactive waste which will be shipped for disposal at a commercial disposal facility is transferred to Building 235 room H100 for storage and preparation. Radioactive waste generated under the SNM-362 license is kept separate from waste generated under other radioactive material licenses. The auditors went to the waste storage area and verified the separation of waste from building 245 and radioactive waste generated. The auditor reviewed package Identification data for seven different 55 gallon drums. Waste is typically handled by a broker from Interstate Ventures and sent to TOXCO for processing.

Most solid radioactive waste is compacted into 55 gallon drums prior to shipment to a commercial disposal facility. NIST characterizes the waste as the generator. Waste brokers mark and label the drums for shipment. The waste brokers also prepare the shipping papers based on information provided by NIST. NIST staff regularly performs wipe surveys and exposure rate surveys on the drums. NIST does not perform incineration of radioactive waste.

3.15 Effluents and Environmental Monitoring

GRSD also runs the COMPLY code annually to demonstrate compliance with air emission constraints. The 2011 NESHAP report shows compliance with radioactive air emission constraints. The Comply code is actually run whenever a release is measured. The 2012 NESHAP report shows compliance with radioactive air emissions.

NIST has two liquid waste holdup tanks in Building 245 Room B045 which are in use. Piled in the back of the room are soil samples in cardboard boxes that need to be removed. It could not be determined if these are radioactive waste or not. NIST did not release radioactive materials via the sanitary sewer system in 2011 and 2012 under the SNM-362 license.

3.16 Decommissioning

NIST had a contractor prepare an update to the decommissioning cost estimate report in 2010.

GRSD maintains radioactive materials inventory records, spill records, survey records, and disposal records. All of these records are part of the required decommissioning records.

3.17 Trustworthiness and Reliability Program for Quantities of Concern

A Trustworthiness and Reliability (T&R) Official has been designated through GRSD in a certified letter to the NRC. This person (Elizabeth Zimmerman) meets or exceeds the minimum requirements based upon the NRC criteria and maintains the T&R determinations of individuals at NIST. This determination is based on at least four components:

- Verifying employment history,
- Verifying through personnel references,
- Fingerprinting, and,
- A federal criminal history check.

This individual is trained in working with the Department of Commerce, Office of Security in matters of notifications, fingerprinting and Security Questionnaires. The individual has the ability to access other divisions of the NIST infra-structure to ensure protection of sensitive information, access controls, destruction of documents, information technology requirements along with other necessary items.

Radioactive material quantities of concern (RAMQC) are quantities of radioactive material equal to or exceeding Table 1 values of the NRC Increased Controls (IC) Order. This requires that NIST ensure the safe handling, use and control of material by controlling access at all times to RAMQC. All quantities of nuclides in a storage location are added to determine an area requiring IC. The NIST Gaithersburg Police Services and the Emergency Services Division serve as the local law enforcement agency related to the NRC IC order. Interviews with Chief Clark Price were done to ensure adequate resources and support is available to provide the required security to meet or exceed the requirements of the order. The interview also showed the high quality of interagency support and back up that is provided by the County and City Police agencies. Cross training with these agencies and others are routine and rigorous.

Communication channels have been established through more than one pathway to provide swift and accurate information between these agencies. Response can be complimentary in the event of an emergency. A pre-arranged plan for responding actions of theft, sabotage or diversion of radioactive materials is in place. This plan covers physical inspection of the types and quantities of radioactive materials involved. This was accomplished through training of all applicable police and fire individuals within the Police Services Group (PSD) where the radioactive materials are located. This included walk through of sealed and unsealed laboratories, radioactive materials storage vaults/rooms, IC areas, and radiation producing machines/devices areas. This allowed the individuals to get hands on use of meters and know the relative risk levels.

The storage location for multiple items of RAMQC should be evaluated due to the close proximity of an outside door and loading dock.

3.18 Confirmatory Measurements

Independent and confirmatory measurements were made with a Fluke Biomedical Victoreen 451B serial number 1901 calibrated September 26, 2012. Calibration certificates are presented as Exhibits E-4 and E-5 in Attachment D. All independent and confirmatory measurements indicated postings and measurements by NIST were correct.

3.19 Documents Reviewed

- NRC Confirmatory Order to the U.S. Department of Commerce's National Institute of Standards and Technology (NIST), March 1, 2010
- SNM-362, Amendment 3, dated April 27,2001
- NRC Special Inspection Report dated November 2, 2009
- NRC licenses SNM-362, Amendment 3, for Gaithersburg dated April 27, 2001
- NRC license 05-03166-05 for Boulder and NRC Termination Letter dated Dec. 27, 2010
- NRC license 19-03166-06, dated Dec. 27, 2010 for Boulder
- IRSC Charter, June 2011
- NIST Administrative Manual Sub-Chapter 12.03
- Radiation Safety Instructions (Boulder)
- Radiation Safety Instructions & **Interdivisional Procedures (IP)** (Gaithersburg)
- Radiation Safety Manual (NIST Lab Safety Manual, Chapter 8)
- Radiation Safety Annual Reports -2011
- NRC Special Inspection Report dated November 2, 2009
- Recent Annual Radiation Safety Program Audits

a. NUREG -1556 Audit for Boulder, 2010 by Tidewater, Inc.
b. NUREG -1556 Audit for Gaithersburg 2012 by Dakota Consulting
c. NUREG -1556 Audit for Gaithersburg 2011 by Tidewater, Inc.

- NRC Form 591M Clear Inspection for 19-03166-06 for Audit on June 16, 2011
- NRC Form 591M Clear Inspection for SNM-362 for Audit on July 25-26, 2012
- NRC Form 591M Clear Inspection with closure of previous violation for SNM-362 for Audit on 7/24-25, 8/6-8, 8/15-16, 8-22-23, 9/27 and 9/17/2012
- Various internal NIST-Gaithersburg documents
    a. IP1-1, Procedure for Handling Standard Reference Material
    b. IP 1-2, Effective 01/18/12, Increased Controls Security Program
    c. HPI 4-3, Date 12/93, Large Source Use,
        i. Enclosure 1, Use of 1000 Ci Cs-137 Health Physics Range,
        ii. Enclosure 2, Use of B019 Gamma Calibration Ranges,
        iii. Enclosure 3, Operation of Neutron Calibration Range (Low Scatter Room)
    d. Protocol #846.02-0007, August 12, 2010 Standard Operating Procedure for the ^{60}Co and ^{137}Cs Horizontal Gamma-Ray Beam Facilities Model G90.
    e. Protocol #846.02-0008, August 12, 2010 Standard Operating Procedure for ^{60}Co and ^{137}Cs Vertical Gamma Ray Beam Facilities
    f. Protocol #846.02-0009, August 12, 2010, Standard Operating Procedure for the ^{60}Co Pool Irradiator
    g. Protocol #846.02-0010, August 12, 2010 NIST Gammacell 220 ^{60}Co Irradiator (220-#45 Operating Procedure in 245/B140
    h. Protocol #846.02-0011, August 12, 2010 NIST Gammacell 220 ^{60}Co Irradiator (220-#207 Operating Procedure in 245/B140
    i. Protocol #846.02-0012, August 12, 2010 NIST Gammacell 220 ^{60}Co Irradiator (220-#232 Operating Procedure in 245/B140
    j. Protocol 846.02-025, Standard Operating Procedure for Calibration of Survey Meters and Ion Chambers
    k. Protocol #682.02-0034, November 1, 2010 Standard Operating Procedure for the ^{137}Cs Gamma Beam Facilities Model G90
    l. Health Physics Instrument Calibration Range
    m. NIST Form 1197, Occupational Health and Safety Orientation Checklist
    n. NIST Order 720, dated March 21, 2013 "Ionizing Radiation Safety – Licensed Radioactive Material and Ionizing-Radiation-Producing Machines."

Also see Attachment D for a listing and copies other miscellaneous documents reviewed.

4.0 AUDIT RESULTS

4.1 Findings

Two findings were identified in the NIST-Gaithersburg program as not being in compliance with the CO which is considered as additional License Conditions; however, there are mitigating comments provided in the report and also shown below in brackets.

- The Radiation Safety Course did not provide details regarding the consequences of and the potential actions that NRC may take against an individual for willful violations of NRC requirements as required by the CO. *[It should be noted that NIST reported that this omission occurred only once and in particular during the training that the lead auditor observed.*]
- The Radiation Safety Course did not include a practical exam (PE) for don and duff of PPE; there was one skin contamination event during the last year for which a cause could not be determined. The lack of a graded PE and use of a take home exam as a method to measure mastery are considered as noncompliance with the CO. [*It should be noted that NIST did require completion and passing other computer based quizzes during the course. Also, an industry standard for mastery was not identified and this finding of noncompliance is a conservative one.*]

4.2 Recommendations

The following recommendations are identified with the section title for ease of finding more details in the text. Several of these recommendations may be cross cutting issues.

- 2.3.3 Ionizing Radiation Safety Committee

  A time period should be established for routine receipt of proposed protocols and review/approval by the IRSC.

  It is recommended that updated AHA be performed for the sealed sources whether in storage or not including an evaluation of the appropriateness of current storage conditions.

- 3.0 Radiation Safety Program Discussion

It is recommended that the qualifications specifically provide exemptions for the SROs and other identifiable job titles which might not require a college degree at the bachelor level and further to separate the education requirements of the Source Custodian as a college degree at the bachelor level with Source User requirements to meet the specific protocols. Source Users were described to occasionally be college interns at the undergraduate level and a separate education level is recommended for them.

It is recommended that the due dates for the 2012 audit items (now known for over three months) be moved up as closing them would provide more assurance that a radiological event would not happen.

- 3.1 Radiation Safety Organization and Staffing

A recommendation is made that the GRSD should immediately require procedure updates and training in them. If this action overtaxes the staff with the implied implication of reduced radiation safety, there are several reputable consulting firms that could assist. It is further recommended that the IRSC review the current and potential staffing needs.

It is recommended that the IRSC review the current and potential staffing needs.

- 3.2 Radiation Safety Culture

Management is encouraged to implement a model program following applicable volumes of NUREG-1556 and provide the resources to achieve it.

It is recommended that the GRSD establish a formal program be developed that requires a supervisor to observe and approve an individual GRSD member performing a task prior to independent assignment.

A recommendation is made that the RSO's policy regarding Stop Work Authority be reinforced through emphasis in the newly designed Radiation Safety Training Course.

- 3.3 Radiation Safety Training

As a minimum interval, an annual emergency response drill is recommended (as described in the 2011 drill report) to be performed which exercises the procedure and different persons in each organization so that each understands their role in a real emergency.

If the refusal to transport a contaminated patient has not been resolved, it is recommended that transport and medical assistance be obtained as a top priority item.

It is recommended that the GRSD develop a formal program that requires a supervisor to observe and approve an individual GRSD member performing a task prior to independent assignment.

Biennial training is identified as a weakness in the NIST program and it is recommended that NIST conform to the annual training suggestions contained in the NUREG-1556 volumes 7and 9.

On one occurrence during the audit, the course did not go into details regarding the consequences of and the potential actions that NRC may take against an individual for willful violations of NRC requirements as required by the CO. It is recommended that the course be upgraded to include the requirement regarding potential actions by the NRC. (See finding in Section 1.3.1)

The course should be upgraded to include the PE and the take home exam be replaced with a supervised test. Alternately, the take home exam might be called a required homework assignment with additional computer quizzes. (See finding in Section 1.3.1)

Two formula errors were noted in the classroom lectures involving efficiency calculations It is recommended that the formulas be corrected.

The lectures did not demonstrate how large an area should be used during smear collection or the technique for medium pressure (wet smears for tritium, etc.). This was

the first presentation of this version of training material and it is recommended that techniques for smear collection be included.

- 3.5 Engineering Controls

It is recommended that all sealed sources for which no immediate use is known (perhaps six months into the future) be removed from the various laboratories and stored in another secure location. Consideration should be given to the use of large lead pigs versus stacked lead bricks to reduce potential radiation streaming and trip/fall hazards.

- 3.6 Radiological Instrumentation & Sources

A "date-to-date" calibration period should be instituted versus the current "not to exceed" concept.

The HPI 7-0 Quality Assurance procedure should include a description of the repair or maintenance be recorded in the calibration records of each instrument.

The HPI 7-0 Quality Assurance procedure should be revised to provide control and storage of documents generated by the various calibration procedures.

It is recommended that a technical basis document be written that describes, in detail, the instrument program.

It is recommended that more guidance be placed in HPI 7-0 that reflects ANSI standard commitments as well as other quality good practices such as documentation requirements, replacement part requirements, etc. This document is also out of date; the current revision is dated 10/95.

It is recommended that procedure RSI 7-13 be revised to be in compliance with the actual source use conditions.

It is recommended that a revision be made to procedure RSI 7-8A which includes safety precautions for filling the dewar i.e., proper gloves, proper apron, face piece, oxygen meter in room, etc.

It is recommended that procedure HPI 7-3 be revised and updated with information received via benchmarking the industry.

It is recommended that this requirement regarding collection of a zero reading be eliminated in procedure HPI 7-4.

It is recommended that a procedure be developed describing the calibration of PIC's, acceptable drift criteria and time frame associated with the drift.

It is recommended that all procedures developed for the instrumentation program only assume a minimally qualified person is performing the tasks.

It is recommended to 1) place a notice on the Tennelec system that instructs a user as to when a smear is contaminated; or 2) program the Tennelec system to automatically produce a flag when a given level is exceeded; or 3) train users on the normal background of the system versus a positive smear count.

It is recommended that the standard industry practices which are illustrated in MARSSIM be adopted for calibration and data interpretation with timely training provided, as soon as possible, for both the GRSD staff and radioactive material users. This recommendation may be applied for decontamination/decommission as well as with action levels needed in laboratory use.

- 3.7 Radiological Surveys, Contamination Controls & Records

It is recommended the surveyor and GRSD take credit for users performing daily contamination surveys via a record of review. Something as simple as a survey log with the time, date, surveyor name, description or comment, date results are received and a satisfactory or unsatisfactory entry being made.

Although an observation during the 2012 audit, it is recommended that planned corrective action regarding training and use requirements for portable survey meters be rescheduled immediately.

It is recommended that both a conversion factor to dpm/100cm^2 and action level (perhaps in cpm) be provided to the lab user with the various survey meters for both alpha meters and beta meters.

- 3.8 Labels and Posting

It is recommended that "Contaminated Area" tape be used around areas meant to store contaminated (or potentially contaminated) items.

This is not a finding of noncompliance with 10 CFR Part 20 labeling requirements but it is recommended that the erroneous labels "CAUTION RADIATION HAZARD" be found and replaced with labels defined by 10 CFR § 20.1904, Labeling containers, a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL".

To eliminate inconsistency in posting room survey results, it is recommended that either 1) two separate forms be used OR 2) that section be one-lined and initialed as NA at each posting.

It is recommended that if a room in Building 217 or Building 223 does not have radioactive material the "Caution Radioactive Material" sign be removed.

- 3.10 Personnel Monitoring for Radiation Exposure

It is recommended that future IRSC annual reports perform an evaluation based upon the general number of hours an employee is expected to be in the area with the greatest exposure as well as subtracting background dose so that an appropriate MOP evaluation can be performed.

It is recommended that procedure revisions be made to HPI 1-1 and 1-7 that goes into more depth regarding personnel contamination, states a limit to when a skin dose assessment will be performed, actions to take at various levels of dose and requiring count rate measurements at the end of each decontamination cycle.

It is recommended that emphasis be placed to finalize draft Personnel Monitoring replacement procedures; training should then be conducted on them immediately.

It is recommended that a procedure be developed and implemented for the use of Temporary PIC/TLD packages.

The training program should include discussion regarding personnel receiving medical treatment with radioisotopes.

It is recommended that an effort be put into developing a technical basis document for the dosimetry function. This document would then serve as the basis for the entire program and the underlying procedures would then implement this TBD. Examples of topics suggested for this document are detailed in Section 3.10.

- 3.11 Research and Source Usage

It is recommended that the legacy sealed sources which are no longer wanted or for which plans are not known be transferred to other authorized licensees or licensed disposal sites immediately.

- 3.12 Material Control and Accountability

It is recommended that HPI 4-8 be deleted and the important parts (such as sections C and D) moved to RSI 4-2.

It is recommended that sources without a RS number be identified and put into inventory. Also a method should be considered to track dilutions back to the RS number.

- 3.13 Radioactive Material Shipping and Receiving

  It is recommended that GRSD ensure that the training is very specific for receipt of RAM packages that are damaged or leaking.

- 3.14 Radioactive Waste Management and Transportation

  It is recommended that temporary lighting be installed in Rooms A010 and A10 until a permanent arrangement is made.

- 3.17 Trustworthiness and Reliability Program for Quantities of Concern

  The storage location for multiple items of RAMQC should be evaluated due to the close proximity of an outside door and loading dock.

4.3 Noteworthy Practices

A noteworthy practice is defined as a practice that has resulted in the improvement in the effectiveness or efficiency of the radiation safety program. The following noteworthy practices were observed during this assessment and the annual audits for the years indicated.

- **2013**

  - GRSD is working with the material users to standardize given hoods for specific type radionuclides which would remove the inefficiency of changing hood filters for each investigator; only a given hood(s) could be used for Iodine radionuclides and those hoods would be provided the charcoal filters.
  - While observing staff survey audits of laboratories, found at least one staff member performing battery checks on instruments meant for laboratory use – this is recognized as a good practice.
  - The NIST NMMSS reports were reviewed; the report is due annually but NIST performs the inventory and reports on a semi-annual basis which is considered a good practice although time consuming.
  - Two new RSIs are being developed regarding document control and review of

procedures.

- Individuals with high extremity dose have been assigned extremity badges on a project basis versus a quarterly basis in an effort to establish which procedures generate the most dose and how reductions can be made.
- Researchers were noted with increased awareness of radiation safety in other buildings than Building 245 which will increase assurance that a radioactive material contamination event will not occur.
- Attention to the RAM Quantities of Concern program was exemplary.

- **2012**

  - GSRD had instituted a very comprehensive and aggressive survey program and schedule. This will serve the program well to identify issues at the earliest opportunity.
  - Radioactive waste pickup in radioactive materials laboratories is working extremely well. The auditors found all waste containers to be empty, vice earlier findings on the previous audit.
  - Based on interviews with numbers personnel, NIST researchers and employees know to call GSRD with questions, concerns or in the event of an incident.

- **2011**

  - NIST laboratories are designed to reduce dose to workers through the use of shielding, remote handling/observation, and efficient ventilation systems. Staff do not occupy laboratories in which radiochemistry is performed except when they are actually performing the work. These actions contribute to the low radiation exposures of the staff.
  - Facility security for radioactive materials was excellent. NIST requires card key access throughout the facility and also that doors to posted laboratories remain locked. There were no instances of lack of security of radioactive materials observed during the audit.
  - GRSD provides an explanation of NIST radiation safety training requirements for source custodians and source users on its web page along with information about the training programs that are available to meet them. GRSD develops and maintains the necessary training materials and provides them in both on-line and instructor-led formats.

4.4 Conclusions

- NIST Boulder Program -License 19-03166-06

The NIST-Boulder is considered in its infancy as far as the radiation protection program. It does have a well-qualified RSO. Perhaps the biggest concern at this time is his replacement during illness or vacation. Conversation during the IRSC meeting the auditors attended included several suggestions such as a formal arrangement with the University of Colorado for staffing coverage and also temporary assignment of a NIST-Gaithersburg health physicist. Considering the work load ahead for the NIST-Gaithersburg staff, the former proposal appears to be best.

The NIST-Boulder program has only one small radioactive check source. Continuing with the current practice of licensed RAM stored and locked away when the Radiation Safety Officer (RSO) is absent, the NIST-Boulder program has a very high assurance of no significant radiological event now and in the future.

- NIST Gaithersburg Program – License SNM-362

NIST-Gaithersburg is a very large broad scope program which is currently successful in large part due to the excellent work of the radiation staff. However, the NIST-Gaithersburg Radiation Safety Program is best described as struggling to meet current and implied future requirements. The radiation protection staff appears eager to implement any directive that management places to them; it should be noted that thirteen noteworthy practices were identified.

Although similar but not identical, five of the eight contributing causes (listed in Section 2.1) to the Boulder Pu event potentially exist at NIST-Gaithersburg. These five are identified as follows with references to both the discussion area and objective evidence in this report within brackets; these issues may be cross-cutting.

- Personnel Received Inadequate Training or No Training [2.2, 3.0, and 3.1]
- Written Operating Procedures Not Developed [3.1, 3.2, 3.3, 3.6, and 3.10]
- An Adequate Hazard Analysis Was Not Performed [2.3.3]
- Poorly Human-Factored Experimental Setup [3.5]

- Less than Adequate Immediate Emergency Response to the Event [3.3, 3.13, and 3.14]

As pointed out in the NRC's Special Investigation Report dated November 2, 2009, NIST management did not ensure that the deficiencies identified in the Boulder radiation safety program annual audits were fully addressed. Similarly, annual audit reports for NIST Gaithersburg dating to 2007 indicate that procedure documentation is a recurring deficiency. Beyond and including procedure deficiencies, the objective evidence listed below indicate that efforts need to be increased for necessary and timely changes:

(1) Existing contributing causes of the Boulder event,
(2) The large number of recommendations made in this report, and
(3) The number of tabled items being tracked by the IRSC and the GRSD

As NIST provides standard reference material that is critical to patient care across the nation, emphasis should be placed such that this critical service is uninterrupted but conducted safely.

If NIST implements the recommendations contained in this report with a graded approach and in a near term time interval of weeks, a high assurance of preventing significant radiological events now and in the future could be attained at NIST-Gaithersburg.

Attachment A

NUREG -1556 Volume 7, Appendix L

NIST-Boulder

Sample Checklist

Audit Report No. NIST Deep Cut License No. 19-03166-06

Licensee's name and mailing address:

National Institute of Standards and Technology
325 Broadway
Boulder, Colorado 80305-3337

Audit of activities at (Address):

Same as the licensee address

Contact at Audit Location: **Tom Grove** Telephone No. **303-497-6540**

Date of this Audit: **February 25 and 26, 2013 (onsite portion of audit)**

Summary of Findings and Action:

[X] No deficiencies
[ ] Deficiencies
[ ] Action on previous deficiencies

Recommendations:

1 – **Place words in document control procedure that ensures the license requirement that radiation safety program procedure changes do not degrade the effectiveness of the program.**
2 – **Procedure RSI 3-3, Radioactive Material Inventory and Leak Test: revise License Condition referenced in step 6.4, 1st Berger dot to state "LC 13G &15A, Item *10* E2". Makes the reference easier to find, and more accurate.**
3 – **Procedure RSI 3-1, Radioactive Material Accountability, Control and Safe Use: revise step 6.2.3, 7th Berger Dot to state "Radioactive sources can be handled by the RSO *or designee* for purposes…" Enables someone else to handle sources if the RSO is not onsite or able to perform the required duties.**
4 – **Recommend using emergency drills or exercises to "practice" the response teams on proper response to the events describes in RSI 1-3, Radiological Events and Emergency Response. In the experience of the auditor responders that have not had an opportunity to practice the expected response will not provide that response. This also allows offsite responders to feel more comfortable when responding. This action also will find problems with response either from onsite or offsite responders.**
5 – **Recommend that the RSO not exempt himself from source sign-in/sign-out requirements of procedure 3-1, Radioactive Material Accountability, Control and Safe Use.**
6 – **RSI 0-1, Radiation Safety Policies, step 6.1 states "The RSO can suspend or alter the contents of these RSIs on a case-by-case basis at his discretion to ensure exposure remains ALARA". Depending upon how this statement is used, this is contrary to 10CFR20§1101(b) which states "(b) The licensee shall use, to the**

extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

7 – RSI 4-1, Laboratory Surveillance, Section 4 specifies periods of time. Suggest that a grace period be allowed in those definitions to allow for unforeseen circumstances thereby allowing a non-intentional "missed surveillance" to not be a procedure violation. This is a very common action in the industry except in the case of license requirements.

8 - RSI 4-1, Laboratory Surveillance, Section 6 discusses type of surveillances. Recommend that instrument surveillance be added to this list; calibration of meters as well as source checks of those meters.

9 – Records required by the NRC should be placed into a fire-proof cabinet for storage.

10 - Procedure RSI 5-1, Portable Instrument Tests and Calibrations, step 6.3.4 state "To ensure calibrated instruments are readily available, the RSO may reduce the frequency based upon historical "as found" calibration data" but does not state that this evaluation of calibration frequency should be documented.

11 - RSI 2-1, Exposure Evaluation Statement for License 19-03166-06, provides a very nice evaluation of a source currently in use at NIST-Boulder; one 0.0223 μCi Am-241 source. However, the license allows up to 0.045 μCi of Am-241. Suggest the evaluation be re-performed to account for the total license activity or provide a justification why two of the same sources would not ever be used at the same time.

12 RSI 1-1, Radiation Exposure Limits, step 6.3 states "To release a person, material, or an area from the controls necessary to prevent the spread of contamination, the contamination levels shall be ≤ background radiation as detected by swipe and/or direct frisk using portable, hand-held instrumentation". Recommend using the word distinguishable from background instead of ≤ background due to a potential question as to "what is background?"

Noteworthy Practices:

1. Documenting license requirements in procedures is a noteworthy practice. It helps to ensure these steps are not modified without the assurance the license commitment is still being met.
2. Very comprehensive prospective evaluation of potential dose at NIST-Boulder.
3. Procedure RSI 4-1 is a great tool for performing self-assessments; is good guidance and ticklers into what is important to observe.
4. The use of sign-in/sign-out logs are a good practice, especially considering that level of control for exempt sources is not required.
5. Package receiving employees are knowledgeable and maintain very good logs.

Auditor: _____ Date: 2/28/2013

1. AUDIT HISTORY [ ] N/A (N/A means "Not applicable" - Initial Audit)

A. Last audit of this location conducted: December 2012

B. Problems/deficiencies identified during last two audits or two years, whichever is longer
[ ] Y [X] N

C. Open problems/deficiencies from previous audits: **No deficiencies found during last audit, only recommendations. All recommendations were evaluated for implementation.**

D. Any previous problem/deficiency not corrected or repeated [ ] Y [X] N [ ] N/A
Explain:

2. ORGANIZATION AND SCOPE OF PROGRAM

A. Briefly describe organizational structure

1. Structure is as described in license documents [X] Y [ ] N

2. Multiple authorized locations of use [ ] Y [X] N

3. Briefly describe scope of activities involving byproduct material, frequency of use, staff size, etc.

Program currently involves only one licensed source and that is used for source checking of instruments. Other sealed sources are in use but are exempt quantity values (all sources regardless of activity are stored in shielded safes). RSO is the only Radiation protection staff member onsite.

B. Radiation Safety Officer [X] Y [ ] N

1. Authorized on license [X] Y [ ] N

2. Fulfills duties as RSO [X] Y [ ] N

C. Use only by authorized individuals [X] Y [ ] N
Remarks: **None**

3. TRAINING, RETRAINING, AND INSTRUCTIONS TO WORKERS

A. Instructions to workers per [10 CFR 19.12] [X] Y [ ] N

B. Training program required [X] Y [ ] N

C. Training records maintained [X] Y [ ] N

D. Evaluation of individuals' understanding of procedures and regulations based on interviews, observation of selected workers [X] Y [ ] N

1. Each has an up-to-date copy of the licensee's safe use and emergency procedures [X] Y [ ] N

If they don't have own copy, they know where to find the most recent version

2. Adequate understanding of:
Current safe use procedures [X] Y [ ] N

Emergency procedures [X] Y [ ] N

E. Revised Part 20

Workers cognizant of requirements for:

1. Radiation Safety Program [20.1101] [X] Y [ ] N

2. Annual dose limits [20.1301, 20.1302] [X] Y [ ] N

3. New NRC Forms 4 and 5 [X] Y [ ] N

4. 10% monitoring threshold [20.502] [X] Y [ ] N

5. Dose limits to embryo/fetus and declared pregnant women [20.1208] [X] Y [ ] N

6. Procedures for opening packages [20.1906] [X] Y [ ] N

All packages are routed to the shipping/receiving facility. Interviewed various workers there and found they are aware of requirements for initial receiving: RSO notification. RSO performs the surveys on packages received within 3 hours.

Remarks:

4. INTERNAL AUDITS, REVIEWS OR INSPECTIONS

A. Audits are conducted [X] Y [ ] N

1. Audits conducted by: **RSO conducts many of the audits along with chosen Authorized Users such that the program gets a "clean" look. The annual audit was performed by selected Division Safety Representatives.**

2. Frequency: **Annually and then whenever deemed appropriate by the RSO.**

B. Content and implementation of the radiation protection program reviewed annually [20.1101(c)] [X] Y [ ] N

C. Records maintained [20.2102] [X] Y [ ] N

5. FACILITIES

A. Facilities as described in license application [X] Y [ ] N

Remarks: **None**

6. MATERIALS

Isotopes, quantities, and use as authorized on license [X] Y [ ] N

Remarks:
Boulder is licensed for twice the amount of Am-241 that is currently onsite.

7. LEAK TESTS

A. Leak test performed as described in correspondence with NRC (consultant; leak test kit; licensee performed) [X] Y [ ] N

B. Frequency: every 6 months or other interval, as approved by NRC or Agreement State [X] Y [ ] N

C. Records with appropriate information maintained [X] Y [ ] N

Remarks: **None**

8. INVENTORIES

A. Conducted at 6-month intervals [X] Y [ ] N

B. Records with appropriate information maintained [X] Y [ ] N

Remarks: **None**

9. RADIATION SURVEYS

A. Instruments and Equipment: [X] Y [ ] N

1. Appropriate operable survey instrumentation possessed or readily available [X] Y [ ] N

2. Calibrated as required [20.1501] [X] Y [ ] N

3. Calibration records maintained [20.2103(a)] [X] Y [ ] N

Calibration records are kept as required. Recommendation to the RSO to keep records in fireproof cabinets to ensure survivability.

B. Briefly describe survey requirements [20.1501(a)]: **Only sealed sources are used onsite and none can create a radiation area according to their source strength.**

Therefore, surveys are more of an observational nature to ensure sources are under observation and that housekeeping is acceptable.

C. Performed as required [20.1501(a)] [X] Y [ ] N

1. Radiation levels within regulatory limits [X] Y [ ] N

2. Corrective action taken and documented [X] Y [ ] N

D. Records maintained [20.2103] [X] Y [ ] N

E. Protection of members of the public

1. Adequate surveys made to demonstrate either (a) that the TEDE to the individual likely to receive the highest dose does not exceed 100 mrem in a year, or (b) that if an individual were continuously present in an unrestricted area, the external dose would not exceed 2 mrem in any hour and 50 mrem in a year [20.1301(a)(1), 20.1302(b)] [X] Y [ ] N

2. Unrestricted area radiation levels do not exceed 2 mrem in any one hour [20.1301(a)(2)] [X] Y [ ] N

3. Records maintained [20.2103, 20.2107] [X] Y [ ] N

Remarks:
A Noteworthy practice – The RSO performed a worst-case calculation for external and internal exposure situations where the licensed source was broken and cause exposure to surrounding workers. A recommendation was made to re-evaluate the exposure assuming the entire licensed quantity of source material were to be broken.

10. RECEIPT AND TRANSFER OF RADIOACTIVE MATERIAL (INCLUDES WASTE DISPOSAL)

A. Procedures describe how packages are received and by whom: [X] Y [ ] N

B. Written package opening procedures established and followed [20.1906(e)] [X] Y [ ] N

C. If package shows evidence of degradation, monitor for contamination and radiation levels [X] Y [ ] N [ ] N/A

D. Monitoring of degraded packages performed within time specified [20.1906(c)] [X] Y [ ] N [ ] N/A

E. Transfer(s) between licensees (including "disposal") performed per [30.41] [X] Y [ ] N [ ] N/A

F. Records of receipt/transfer maintained [20.2103(a), 30.51] [X] Y [ ] N

G. Transfers within licensee's authorized users or locations performed as required [L/C] [X] Y [ ] N [ ] N/A

H. Package receipt/distribution activities evaluated for compliance with [20.1301, 20.1302] [X] Y [ ] N [ ] N/A

Remarks:
Interviews were conducted with receiving personnel (Roland Siebold and George Angel) and were questioned as to their methods for receiving and notification of the RSO. Both persons showed me the locked cages for RAM packages and provided the correct answers to questions such as 1) when does the RSO get notified (immediately), 2) what are the actions taken if a package is leaking or open (detain the driver and notify the RSO and 3) where are RAM packages stored once they are received and logged into the system (locked cages). All personnel knew where the procedure was. I observed the RAM receiving log and ensured all receiving information was recorded as per the procedure.

Discussed contract receiving personnel with Mail Room Supervisor (Bill Klibbe); contracted receiving personnel are trained NOT to handle RAM shipments.

11. TRANSPORTATION (10 CFR 71.5(a) and 49 CFR 170-189)

A. Licensee shipments are: [ ] N/A

1. Delivered to common carriers [X] Y [ ] N [ ] N/A

2. Transported in licensee's own private vehicle [ ] Y [X] N [ ] N/A

3. No shipments since last audit [ ] Y [X] N [ ] N/A

B. Packages [ ] N/A

1. Authorized packages used [173.415, 173.416(b)] [X] Y [ ] N [ ] N/A

2. Closed and sealed during transport [173.475(f)] [X] Y [ ] N

C. Shipping Papers [ ] N/A

1. Prepared and used [172.200(a)] [X] Y [ ] N

2. Proper {Shipping name, Hazard Class, UN Number, Quantity, Package Type, Nuclide, RQ, Radioactive Material, Physical and Chemical Form, Activity, category of label, T1, Shipper's Name, Certification and Signature, Emergency Response Phone Number,
"Cargo Aircraft Only" (if applicable)} [172.200-204] [X] Y [ ] N

3. Readily accessible during transport [177.718(e)] [X] Y [ ] N

D. Vehicles [ ] Y [ ] N

1. Cargo blocked and braced [177.842(d)] [ ] Y [ ] N
Not required

2. Placarded, if needed [172.504] [ ] Y [ ] N
Not required

3. Proper overpacks, if used (shipping name, UN Number, labeled, statement indicating that inner package complies with specification package) [173.25]
[ ] Y [ ] N
Not required

E. Any incidents reported to DOT [171.15, 171.16] [ ] Y [ ] N
No incidents to report

Remarks:
The only shipments since the last audit were shipment of sources to the NIST-Gaithersburg facility.

12. PERSONNEL RADIATION PROTECTION

A. ALARA considerations are incorporated into the Radiation Protection Program [20.1101(b)] [X] Y [ ] N

B. Adequate documentation of determination that unmonitored occupationally individuals are not likely to receive >10% of allowable limit [20.1502(a)] [X] Y [ ] N [ ] N/A

OR
C. External dosimetry provided and required [ ] Y [ ] N [X] N/A

1. Supplier **Landauer** Frequency **Quarterly**

2. Supplier is NVLAP-approved [20.1501(c)]] [X] Y [ ] N

3. Dosimeters exchanged at required frequency [L/C] [X] Y [ ] N

D. Occupational intake monitored and assessed [20.1502(b)] [ ] Y [ ] N [X] N/A
Only sealed sources are in use

E. Reports [X] N/A

1. Reviewed by _____ Frequency _____

2. Auditor reviewed personnel monitoring records for period _____ to _____

3. Prior dose determined for individuals likely to receive doses [20.2104] [ ] Y [ ] N

4. Maximum exposures TEDE_____ Other _____

5. NRC Forms or equivalent [20.2104(d), 20.2106(c)]

a. NRC Form 4 "Cumulative Occupational Exposure

History" [ ] Y [ ] N
Complete: [ ] Y [ ] N

b. NRC Form 5 "Occupational Exposure Record for a Monitoring Period" [ ] Y [ ] N
Complete: [ ] Y [ ] N

6. Worker declared her pregnancy in writing during inspection period (review records) [ ] Y [ ] N [ ] N/A

If yes, determine compliance with [20.1208] [ ] Y [ ] N
check for records per [20.2106(e)] [ ] Y [ ] N

F. Records of exposures, surveys, monitoring, and evaluations maintained [20.2102, 20.2103, 20.2106, L/C] [X] Y [ ] N

Remarks:
TLD's are provided but only for the x-ray and DPW purposes. There is not enough source material onsite to provide a dose of greater than 100 mR in a year.

13. AUDITOR'S INDEPENDENT MEASUREMENTS (IF MADE)
None made; only sealed sources are used and they are stored in metal safes.

A. Survey instrument _____ Serial No._____ Last calibration_____

B. Auditor's measurements compared to licensee's [ ] Y [ ] N

C. Describe the type, location, and results of measurements:

14. NOTIFICATION AND REPORTS [X] N/A

A. Licensee in compliance with [19.13, 30.50] (reports to individuals, public and occupational, monitored to show compliance with Part 20) [ ] Y [ ] N [X] N/A

B. Licensee in compliance with [20.2201, 30.50] (theft or loss) [ ] Y [ ] N [X] None

C. Licensee in compliance with [20.2202, 30.50] (incidents) [ ] Y [ ] N [X] None

D. Licensee in compliance with [20.2203, 30.50] (overexposures and high radiation levels) [ ] Y [ ] N [X] None

E. Licensee aware of telephone number for NRC Emergency Operations Center [(301) 816-5100] [X] Y [ ] N

15. POSTING AND LABELING

A. NRC-Form 3 "Notice to Workers" is posted [19.11] [X] Y [ ] N

B. Parts 19, 20, 21, Section 206 of Energy Reorganization Act, procedures adopted pursuant to Part 21, and license documents are posted, or a notice indicating where documents can be examined is posted [19.11, 21.6] [X] Y [ ] N

C. Other posting and labeling per [20.1902, 1904] and the license is not exempted by [20.1903, 1905] [X] Y [ ] N

Remarks:
None

16. RECORD KEEPING FOR DECOMMISSIONING (if needed) [ ] N/A

A. Records of information important to the safe and effective decommissioning of the facility maintained in an independent and identifiable location until license termination [X] Y [ ] N

B. Records include all information outlined in [30.35(g)] [X] Y [ ] N

Remarks:
Records are kept but not in fireproof containers.

17. BULLETINS AND INFORMATION NOTICES

A. Receipt of NRC Bulletins, NRC Information Notices, NMSS Newsletters, etc. [X] Y [ ] N

B. Appropriate action taken in response to Bulletins, Information Notices, etc. [X] Y [ ] N

Remarks:
No actions were required of NRC information.

18. SPECIAL LICENSE CONDITIONS OR ISSUES [X] N/A

A. Review special license conditions or other issues, and describe findings:
The license requirements of the former license did not survive the issuance of the new license therefore the Confirmatory Order requirements do not exist in the new license.

B. Problems/deficiencies identified at licensee facilities other than at audit location:

C. Evaluation of compliance:

19. CONTINUATION OF REPORT ITEMS [X] N/A
(If more space is needed, use separate sheets and attach to report.)

20. PROBLEMS OR DEFICIENCIES NOTED; RECOMMENDATIONS [ ] N/A

Note: Briefly state (1) the requirement and (2) how and when violated. Provide recommendations for improvement.

1 – Place words in document control procedure that ensures the license requirement that radiation safety program procedure changes do not degrade the effectiveness of the program.

2 – Procedure RSI 3-3, Radioactive Material Inventory and Leak Test: revise License Condition referenced in step 6.4, 1st Berger dot to state "LC 13G &15A, Item *10* E2". Makes the reference easier to find, and more accurate.

3 – Procedure RSI 3-1, Radioactive Material Accountability, Control and Safe Use: revise step 6.2.3, 7th Berger Dot to state "Radioactive sources can be handled by the RSO *or designee* for purposes...". Enables someone else to handle sources if the RSO is not onsite or able to perform the required duties.

4 – Recommend using emergency drills or exercises to "practice" the response teams on proper response to the events describes in RSI 1-3, Radiological Events and Emergency Response. In the experience of the auditor responders that have not had an opportunity to practice the expected response will not provide that response. This also allows offsite responders to feel more comfortable when responding. This action also will find problems with response either from onsite or offsite responders.

5 – Recommend that the RSO not exempt himself from source sign-in/sign-out requirements of procedure 3-1, Radioactive Material Accountability, Control and Safe Use.

6 – RSI 0-1, Radiation Safety Policies, step 6.1 states "The RSO can suspend or alter the contents of these RSIs on a case-by-case basis at his discretion to ensure exposure remains ALARA". Depending upon how this statement is used, this is contrary to 10CFR20§1101(b) which states "(b) The licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

7 – RSI 4-1, Laboratory Surveillance, Section 4 specifies periods of time. Suggest that a grace period be allowed in those definitions to allow for unforeseen circumstances thereby allowing a non-intentional "missed surveillance" to not be a procedure violation. This is a very common action in the industry except in the case of license requirements.

8 - RSI 4-1, Laboratory Surveillance, Section 6 discusses type of surveillances. Recommend that an instrument surveillance be added to this list; calibration of meters as well as source checks of those meters.9 – Records required by the NRC should be placed into a fire-proof cabinet for storage.

9 - Procedure RSI 5-1, Portable Instrument Tests and Calibrations, step 6.3.4 state "To ensure calibrated instruments are readily available, the RSO may reduce the frequency based upon historical "as found" calibration data" but does not state that this evaluation of calibration frequency should be documented.

10 - RSI 2-1, Exposure Evaluation Statement for License 19-03166-06, provides a very nice evaluation of a source currently in use at NIST-Boulder; one 0.0223 μCi Am-241 source. However, the license allows up to 0.045 μCi of Am-241. Suggest the evaluation be re-performed to account for the total license activity or provide a

justification why two of the same sources would not ever be used at the same time.

11- RSI 1-1, Radiation Exposure Limits, step 6.3 states "To release a person, material, or an area from the controls necessary to prevent the spread of contamination, the contamination levels shall be ≤ background radiation as detected by swipe and/or direct frisk using portable, hand-held instrumentation". Recommend using the word distinguishable from background instead of ≤ background due to a potential question as to "what is background?"

21. EVALUATION OF OTHER FACTORS

A. Senior licensee management is appropriately involved with the radiation safety program and/or Radiation Safety Officer (RSO) oversight [X] Y [ ] N

B. RSO has sufficient time to perform his/her radiation safety duties and is not too busy with other assignments [X] Y [ ] N

C. Licensee has sufficient staff [X] Y [ ] N

Remarks/recommendations:
The Senior licensee management is very supportive of the RSO and his program. Furthermore, interviews with selected user indicate a high degree of confidence in the RSO and the program that currently exists.

DOCUMENTS CONSIDERED IN REVIEW

Policies, Regulations and Requirements

1. NIST Admin Manual, Subchapter 12.03, Ionizing Radiation Safety, 9-16-10

Procedures

1. RSI 0-1, Radiation Safety Policies, 1/19/2012
2. RSI 0-3, Definitions and Acronyms, 10/20/2012
3. RSI 1-1, Radiation Exposure Limits, 4/23/2012
4. RSI 1-2, Radiation Safety Training – Radioactive Material, 10/20/2012
5. RSI 1-3, Radiological Events and Emergency Response, 6/24/2010
6. RSI 2-1, Exposure Evaluation Statement for License 19-03166-06, 4/23/2012
7. RSI 2-2, Exposure Monitoring, 4/23/2012
8. RSI 3-1, Radioactive Material Accountability, Control and Safety Use, 3/1/2012
9. RSI 3-2, Radioactive Material Acquisition and Receipt, 3/1/2012
10. RSI 3-3, Radioactive Material Inventory and Leak Test, 3/1/2012
11. RSI 4-1, Laboratory Surveillance, 10/20/2012
12. RSI 5-1, Portable Instrument Tests and Calibrations, 10/20/2012

Attachment B

NUREG-1556 Volume 6, Appendix K - Suggested Audit Checklist for 10 CFR Part 36 Irradiators

NIST- Gaithersburg

Removed from pubic document for security reasons.

Attachment C

NUREG 1556 Volume 11, Appendix M

Sample Audit Program Non-Medical

NIST-Gaithersburg

Program-Specific Guidance About Licenses of Broad Scope (NUREG-1556, Vol. 11), Appendix M Sample Audit Program for Non-Medical Licensees

The Assessment Plan was developed to assess the effectiveness and adequacy of the programmatic and procedural elements of the NIST radiation safety programs. The assessment plan included the elements necessary to assess NIST compliance with federal regulations and the requirements of NRC licenses SNM-362. Program-Specific Guidance About Licenses of Broad Scope (NUREG-1556, Vol. 11), Appendix M Sample Audit Program for Non-Medical Licensees was used in part for that assessment. All information contained in this appendix is contained in the main report but is repeated here for contractual obligations.

The assessment was performed on-site in Gaithersburg, MD during the periods March 4-15 and March 26-27, 2013. The audit was performed by Tim Kirkham, Auditor, Wayne Gaul, Auditor, and Claude Wiblin (Lead Auditor).

1. MANAGEMENT OVERSIGHT:

(Management support to radiation safety; RSC; RSO; program audits, including annual reviews of program and ALARA reviews; control by authorized users; appropriate follow up on events and previous audit/inspection findings)

NIST Director

The NIST Director has the ultimate responsibility for establishing and maintaining the ionizing radiation safety program at NIST and provides executive leadership on issues involving compliance with regulatory requirements and the conditions of the license. The Director of NIST appoints the Ionizing Radiation Safety Committee (IRSC) Chair and Vice Chair for indefinite terms at his/her discretion.

- Ensure the development, implementation, maintenance, and continual improvement of this order and of NIST's ionizing-radiation-safety programs
- Ensure proper allocation of resources for ionizing radiation safety at NIST
- Monitor, ensure, and enforce accountability for meeting NIST's radiation-safety-program requirements
- Provide direction on issues involving worker safety, regulatory compliance, and environmental impacts at NIST
- Provide direction to the Associate Director for Laboratory Programs, Associate Director for Management Resources, Chief Safety Officer (CSO), RSOs, IRSC, and Organizational Unit (OU) Directors, as necessary
- Approve the IRSC charter and changes thereto, subject to NRC license requirements
- Appoint all IRSC members, subject to NRC license requirements

- Review IRSC recommendations and direct action on those recommendations, as necessary

NIST Associate Directors

In accordance with the NIST Order 720, the Associate Directors have an important role in radiation safety at NIST.

- Support the NIST Director in carrying out his or her responsibilities
- Ensure the implementation of NIST's ionizing-radiation-safety programs in their respective directorates
- Ensure proper allocation of resources for ionizing radiation safety in their respective directorates
- Monitor, ensure, and enforce accountability for meeting NIST's radiation-safety-program requirements in their respective directorates
- Provide direction on significant issues involving worker safety, regulatory compliance, and environmental impacts within their respective directorates
- Review the IRSC charter and changes thereto

NIST Chief Safety Officer

In accordance with the CO, the NIST Director has appointed a CSO over the entire safety program including the radiation safety program. The NIST CSO is responsible for submitting applications for renewals of and amendments to NRC License Number SNM-362 pursuant to IRSC review and approval. The CSO also serves as the Directive Owner for all suborders and suborder-specific directives under the NIST Order 720.

The organization chart for NIST's Office of Safety, Health and Environment (OSHE), is provided. This chart shows the relationship of the safety offices of NIST-Boulder and NIST-Gaithersburg to the NIST CSO:

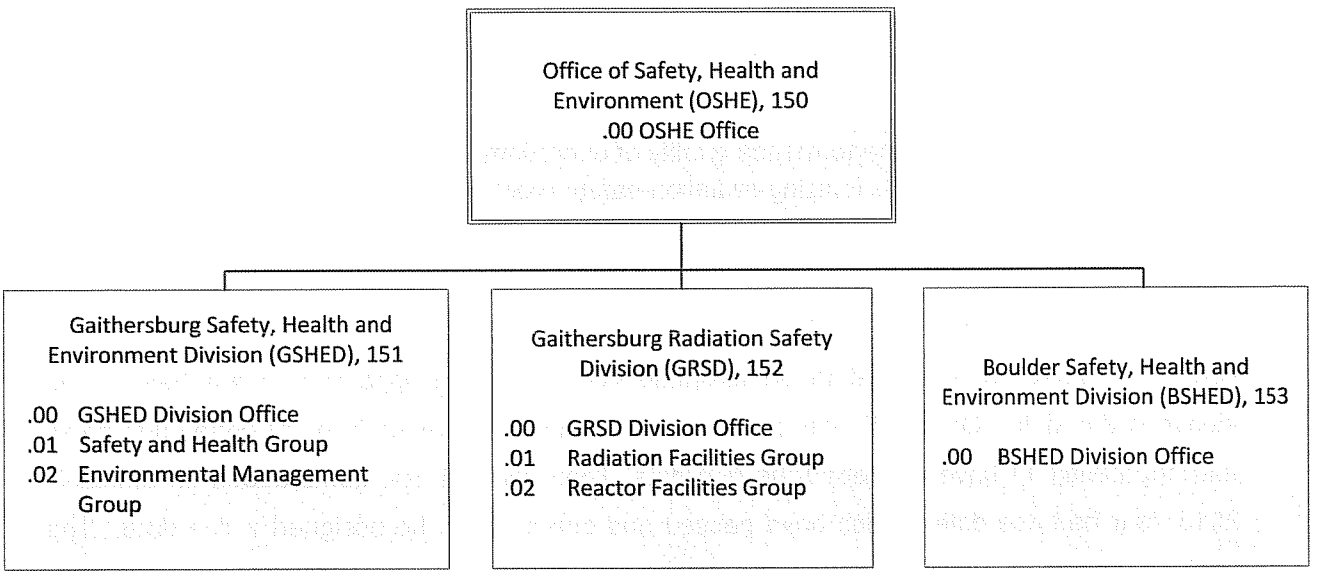

Figure 1. NIST's Office of Safety, Health and Environment (OSHE)

Ionizing Radiation Safety Committee

The IRSC provides oversight of the operations and activities of the NIST radiation safety programs except for those operations and activities conducted under the NRC Test Reactor License (TR-5). The IRSC provides the NIST Radiation Safety Officer (RSO) with independent advice and oversight for the ionizing radiation safety programs at NIST-Gaithersburg and NIST-Boulder.

- Oversee the establishment, implementation, and maintenance of NIST Order 720 and of NIST's ionizing-radiation-safety programs
  - Carry out the program-specific responsibilities delineated for the IRSC in NIST's ionizing-radiation-safety programs
- Recommend actions to the NIST Director and to the RSOs as necessary to assure ionizing radiation safety and regulatory compliance
- Report to the NIST Director at least annually on the status of NIST's ionizing-radiation-safety programs
- Review the circumstances of all occurrences reportable to the NRC, identify root causes and contributing factors, recommend to the NIST Director measures to preclude a recurrence, and track actions on those recommendations as needed

- Review the circumstances of radiological incidents and violations of NIST ionizing-radiation-safety program requirements and track actions resulting from such reviews as needed
- Annually review the performance quality of operations in one or more areas to provide assurance that NIST's ionizing-radiation-safety programs are functioning properly
- Maintain written records documenting IRSC activities

The IRSC maintains an IRSC Action Tracking Table dated March 12, 2013. Of the 18 listed items from 2012, 15 have yet to be assigned due dates and apparently 3 are beyond the assigned due date. Of the 25 older items listed in 2013, 14 have yet to be assigned due dates and apparently 11 have exceeded the due date. There were 5 new items added on March 7, 2013, four had due dates which have passed and one is yet to be assigned a due date. The tracking table is an excellent tool but the outstanding items further illustrate a program in a high state of flux or a constantly changing Radiation Safety Program with incomplete documentation and also one that is propped up by the excellent qualification and skill levels of the radiation protection staff. Without assigned due dates, should an item be anticipated to ever close?

Records of IRSC meeting minutes indicated that since October 2012 meetings were held on a weekly basis; records of December and January meetings were reviewed. The IRSC has been conducting a tremendous amount of business in manner consistent with its charter and in response to apparently numerous demands.

NIST is subject to the requirements of 10 CFR 33.13, Requirements for the issuance of a Type A specific license of broad scope and the CO further required institution of a formal radiation hazard analysis process that requires confirmation that the requirements of the hazard analysis have been addressed prior to the commencement of new work. This appears to be a grandfathering for all previous work for which specific AHAs were performed for work with potential exposure greater than 1.25 rem. As the AHA implemented to comply with the CO is more sophisticated than earlier evaluations with a potential 1.25 rem threshold, the viability of those only reviewed by NIST-GRSD and not the IRSC is questioned. Use and storage of sealed sources is the major concern and discussions with the RSO and other members of the IRSC indicated that blanket AHA for specific radioactive processes and sources are under consideration for future approval by the IRSC. There are about 1,400 sealed sources at NIST and 120 are no longer needed for NIST use. Considering that the ageing process may be detrimental to them and that many have been in storage for over ten years, an upgraded AHA is

warranted. All of these sources had been leak tested within the last six months but the consequences of one or more leaking concurrently should be contained in a updated AHA. It is recommended that updated AHA be performed for the sealed sources whether or not in storage including an evaluation of the appropriateness of current storage conditions.

Radiation Safety Officer

The NIST-Gaithersburg RSO must be certified in the professional practice of Health Physics by the American Board of Health Physics or must have a Bachelor's degree in a science or engineering field and have at least five years of professional-level experience in applied Health Physics. The RSO is responsible for managing the radiation safety program and all aspects of the utilization of ionizing radiation sources. The RSO, or designee, has the authority, as delegated by the NIST Director, necessary to meet his responsibilities and to immediately stop any operations that may (1) compromise the health or safety of NIST employees and non-NIST personnel; (2) have an adverse impact on the environment or public; or (3) result in non-compliance with NRC, State, or local requirements.

The RSO responsibilities are numerous and include:

- Establish and maintain NIST's ionizing-radiation-safety programs in accordance with the requirements of this order
- Carry out the program-specific responsibilities delineated for the RSOs in NIST's ionizing-radiation-safety programs
- Work with the Associate Director for Laboratory Programs, the Associate Director for Management Resources, and the OUs as necessary to support their implementation of NIST's ionizing-radiation-safety programs

2. <u>AMENDMENTS AND PROGRAM CHANGES:</u>
(Amendments to the license were properly implemented; if applicable, program and procedural changes were approved and implemented in accordance with license condition).

The last amendment to the SNM-362 radioactive materials license was amendment 3, with an expiration date of July 31, 2007. The radioactive materials license SNM-362 has been in timely renewal since 2007.

The auditors discussed the status of compliance with the Confirmatory Order with the NIST-Gaithersburg and NIST–Boulder Radiation Safety Officers (RSO). Based on discussions with

the NIST-Gaithersburg RSO, CO compliance had been thoroughly reviewed by regional NRC inspectors at their last inspection; however, no documents describing the NRC review of the CO audit were identified. This audit included a review for each of the CO required items as well as the below listed contributing factors to the Pu event in NIST-Boulder:

- Personnel Received Inadequate Training or No Training
- Written Operating Procedures Not Developed
- Plutonium Standards Obtained Without Proper Management Approval
- An Adequate Hazard Analysis Was Not Performed
- Poorly Human-Factored Experimental Setup
- Less than Adequate Direct Oversight of Work Involving Plutonium
- Use/Storage of Plutonium Sources in Mixed-Use Laboratory
- Less than Adequate Immediate Emergency Response to the Event

The NIST RSO receives generic NRC communications such as Regulatory Information Summaries, NMSS Newsletter, and other generic NRC communications. The RSO reviews these documents for information pertinent to NIST. All of these documents are filed after RSO review. The NRC has made several Requests for Additional Information (RAI) regarding the renewal application; the RAIs and the NIST responses are available through the NRC's ADAMS web site.

3. FACILITIES:
(Facilities as described in license; uses; control of access; engineering controls; calibration facilities; shielding; air flow)

The facilities are as described in the SNM-362 radioactive materials license application. NIST is a broad scope licensee, which provides NIST with a great deal of flexibility in the management of its configuration of its facilities. During the tour of the facilities the auditors observed various engineering controls to protect workers for radioactive materials. These engineering controls include shielding, remote handling tools and effective ventilation.

The entire NIST facility is enclosed with a fence. Access to the facility is through several gates which have guards present who check each person's identification. All visitors must stop at the primary entrance guard house to obtain a visitor badge and must be preapproved by a NIST employee.

Sections of Building 245 where radioactive materials are used or stored require a key card to gain access to that area of the building. Once inside this area, a key is required to gain access to the radioactive materials use areas.

Laboratories where radioactive materials are used or stored must be locked when not attended. During the facility tour, all doors to radioactive material laboratories where locked.

Large radioactive material sources are in compliance with the NRC Order for Increased Controls on Quantities of Concern. Access to quantities of concern of radioactive materials is strictly controlled. Only personnel who have job functions requiring access to these sources are provided access to these areas. All other personnel must be escorted by an individual who has unescorted access.

Several of the radioactive materials laboratories contain fume hoods for working with radioactive materials. The air flow through the face of the hoods is checked quarterly by the GRSD staff and a sticker marking the proper height of sash is placed on the hood. GRSD staff run COMPLY code periodically to verify NIST is in compliance with air emission constraints.

4. EQUIPMENT AND INSTRUMENTATION:
(Operable and calibrated survey equipment; procedures; 10 CFR Part 21)

Calibrated and functional survey instrumentation is maintained to support monitoring needs in each Radiation Facility where external dose rates are likely to reach the criteria for a radiation area as defined in 10 CFR 20 or where surface contamination control limits, as defined in HPI 1-1, are likely to be exceeded. Survey instrumentation was available and on loan from the Radiation Safety office to support required monitoring activities. The current instrument loan process flexibly provides research customers with needed instrumentation.

Calibrations were performed using sources traceable to NIST primary standards (this is the NIST facility providing calibration standards on a worldwide basis). Any instrument that does not meet the calibration and testing requirements is considered to be "out-of-service" until repair and retesting is performed.

Portable survey instruments used for dose rate measurements were calibrated per the manufacturer's recommendations/manual, or after repairs or modifications that could affect response (see table below). However, the SNM-362 License Renewal states that portable

survey instruments used for dose rate measurements shall be calibrated annually (the current license states semi-annually). Many portable instruments were observed to have been calibrated outside the strict 6 month procedure requirement but within the license definition of semi-annually. The auditors recommend a true 6-month calibration be instituted, i.e., "date to date" instead of using the current license definition of semi-annual (not to exceed eight months): see Table 1 for details of calibration dates found on current instruments in use. A "date to date" calibration enables the users to know when they are looking at a calibration sticker on an instrument if the instrument is within calibration and therefore usable. Furthermore, a recommendation is made that the HPI 7-0 Quality Assurance procedure require a description of the repair or maintenance be recorded in the calibration records of each instrument. The calibrations are performed in-house by NIST personnel. Records of meter calibrations are available and were reviewed during the audit. Instruments were reported to be evaluated at approximately 20 percent and 80 percent of each scale or decade as practicable. The site practice is that instruments were removed from service if they could not be adjusted to within +10 percent of the expected value. No document was observed that justified the current gamma source being used to calibrate gamma instrumentation. It is recommended that a technical basis document be written that describes, in detail, the instrument program. Suggestions for topics of the manual include:

- How NIST selects instruments to be used/purchased
- Radionuclides and energies of concern for the program
- Instrumentation Performance, both portable and fixed
- Instrument calibration
- Operability tests
- Maintenance
- Calibration equipment/quality
- Procedures
- Recordkeeping requirements

Table 1. Calibration Dates for Instruments in Use

Instrument	Tracking number	Last Cal date	Status of records
ASP-2e (neutron ball)	9043	10/08/2013	Calibrated as required
TBM	7106	2/8/2013	Calibrated as required
Tennelec	2	1/8/2013	Calibrated as required
ASP-1	210	9/21/2012	Calibrated as required
Argos 4AB			Calibration records are not stored/printed out for this machine – stored within the machine
Victoreen – 450P	1919	10/15/2012	Calibrated as required. Calibration paperwork states this instrument was "repaired" on 4/12/12 but does not state why/or what the repair was. ANSI N323A states that a record be maintained of all maintenance for each instrument. Auditor believes this means more than a statement in the record of "repaired"
Victoreen	727	2/15/2013	Calibrated as required
TBM	3162	11/8/2012	Calibrated as required
ASP-1	2897	9/21/2012	Calibrated as required
Ludlum model 12	154635	9/17/2012	Previous calibration was on 3/7/12. HV was adjusted from 1900 V to 2050 V with no explanation. Adjustment was due to elevation but should have been noted on the calibration sheet.
TBM	3046	11/5/2012	Calibrated as required.

Other instrumentation procedures were reviewed with the following results and recommendations:

- HPI 7-0, Quality Assurance, Section D (Implementation) states that appropriate procedures for *each* (italics added) instrument shall be provided as an enclosure to this HPI or as a separate specific HPI for that instrument. A review of the instrumentation procedures shows that each *type* of instrument (beta/gamma, alpha, neutron, etc.) has a procedure, not each model of instrument. Furthermore, the procedure states that recalibration is required whenever an instrument fails the quality control procedure, is repaired, or undergoes a modification. This is contrary to ANSI N323A (section 4.9) which states that instruments shall be required at least annually, even when the source response check requirements are met. It is recommended that more guidance be placed in HPI 7-0 that reflects ANSI standard commitments as well as other quality good

practices such as documentation requirements, replacement part requirements, etc.. This document is also out of date; the current revision is dated 10/95.

- RSI 7-13 states that Co-60 is to be used for the calibration of the Canberra Portal Monitors (PM-7 and GEM-5) but Cs-137 is the true source used (current license requires that Cs-137 be used for photons). In addition to being out of compliance with RSI 7-13, this is contrary to HPI 1-0, Health Physics Policies, Section D, and HPI 1-2, Section C, which both state that procedures shall be followed. RSI 7-13 also states that routine calibrations are not required provided the unit passes the appropriate QA checks (see ANSI N323A section 4.9). It is recommended that procedure RSI 7-13 be revised to be in compliance with the actual source use conditions.

- HPI 7-6, Alpha Survey instrument calibration, one of the precautions instructs the user to use tweezers when handling the alpha source. This is not only unnecessary for ALARA purposes but also increases the chances for the surface of the source to become scratched, i.e., lose integrity of the seal. No calibration frequency is listed for any of the alpha survey instruments. See recommendation above regarding placing calibration frequencies in procedures.

- RSI 7-8A, *Gamma Spectroscopy System*, This procedure does not provide any safety recommendations for filling the dewar with LN such as PPE to be worn, ensuring adequate ventilation in the room, etc. It is recommended that a revision be made to procedure RSI 7-8A which includes safety precautions for filling the dewar i.e., proper gloves, proper apron, face piece, oxygen meter in room, etc.

- HPI 7-3, *Hand and Foot Monitors*; the purpose of the procedure states that it describes proper actions for the discovery of personnel radioactive contamination. Step F.2 suggests that external contamination of 0.1 mrad/hr of beta contamination is acceptable to be left on the skin of a worker (same requirements in HPI 1-1). License Condition 3.2.4 states that a Health Physicist must approve the exit from the controlled area of any individual who is found to be contaminated above background levels. Even though this value is not likely to cause an overexposure, industry good practice dictates that external contamination be removed to the lowest level achievable without causing injury to the skin. If there is contamination detected, the RSO should be notified and only with his permission shall a worker be allowed to go home. It is recommended that procedure

HPI 7-3 be revised and updated with information received via benchmarking the industry.

- HPI 7-4, *Gamma Survey Instrument Calibration*, item D.5., states to place the detector at a distance of 150 cm from the source to record the background to be subtracted from the instrument reading – instrument technician stated the background is essentially zero therefore technically does not perform this part of the procedure. It is recommended that this requirement regarding collection of a zero reading be relaxed in procedure HPI 7-4.

- No sections on control of documents generated by these procedures were located. It is recommended that the HPI 7-0 Quality Assurance procedure be revised to provide control and storage of documents generated by the various calibration procedures.

Records of calibrations and instrument QA were retained for inspection for the required three years.

NIST owns several liquid scintillation counters (LSCs) and gamma counters for counting radiological samples such as wipes and bioassay samples. Maintenance of the LSCs is provided via service contracts with instrument manufacturers. The counters used by the GRSD are subject to daily Quality Assurance/Quality Control procedures which ensure the generation of quality data. A Tc-99 source is used for counting efficiency which is appropriate for the average energies at the site.

The whole body and hand-and-foot contamination monitors are calibrated by a pulser and the detectors checked for response to a beta emitting radiation source. No operational checks are made with alpha emitting sources. Auditor observed performance of a source-check on an ARGOS-4AB personnel contamination monitor. Checks are performed with a 100 cm^2 Tc-99 source and every detector is checked while expecting an alarm condition on each one.

NIST uses a Canberra Accuscan II for whole body, thyroid and waste counting. The phantom used for calibration of body/thyroid counting is the Canberra Realistic Phantom which is appropriate for their use. NIST performs the annual calibrations and the records are appropriate. One of the users was questioned on technical capabilities of the counter as well as its approved uses; user was well-trained and answered all questions with the expected, and

correct, responses.

Pocket ion chambers are calibrated annually and records are maintained. It was reported in the 2009 audit that there is no written NIST procedure for this calibration routine and this is still the case. The procedure performed is based on the staff's interpretation of an appropriate ANSI standard and the application of NIST's calibration range capabilities. In general, all licensees should ensure that pocket dosimeters are well maintained, clean, and free of contamination; calibrated at specified frequencies; and checked periodically for proper operation, following the manufacturer's recommended procedures (RegGuide 8.4, 2011). It is recommended that a procedure be developed describing the calibration of PIC's, acceptable drift criteria and time frame associated with the drift.

All instrument procedures assume a good deal of knowledge regarding calibration of each instrument. This system only works if the person performing the calibration is very well trained and qualified. It is recommended that all procedures developed for the instrumentation program only assume a minimally qualified person is performing the tasks.

The GRSD instrumentation staff members are very knowledgeable about the instruments, their use and calibration and limitations. It was reported in 2012 audit that Source Users and Source Custodians indicated minimal training on the use of the instruments and data interpretation. It is recommended to 1) place a notice on the Tennelec system that instructs a user as to when a smear is contaminated; or 2) program the Tennelec system to automatically produce a flag when a given level is exceeded; or 3) train users on the normal background of the system versus a positive smear count.

The calibration of hand held instruments for measurement of surface contamination are performed at NIST based upon a total activity (dpm) of the calibration source. The efficiency of the instrument is then determined as:

Efficiency = cpm/dpm, and

Activity, dpm = cpm/efficiency; as illustrated in the training course.

This calibration and data conversion program is not consistent with the standard industry practices illustrated in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) NUREG-1575, Rev. 1. MARSSIM takes into account both instrument efficiency and source efficiency.

- "The instrument efficiency is defined as the ratio of the net count rate of the instrument and the surface emission rate of a source for a specified geometry. The surface emission rate is defined as the number of particles of a given type above a given energy emerging from the front face of the source per unit time. The surface emission rate is the 2π particle fluence that embodies both the absorption and scattering processes that effect the radiation emitted from the source. Thus, the instrument efficiency is determined by the ratio of the net count rate and the surface emission rate." (MARSSIM Section 6.5.4)

- "...ISO-7503-1 (ISO 1988) makes recommendations for default source efficiencies. A source efficiency of 0.5 is recommended for beta emitters with maximum energies above 0.4 MeV. Alpha emitters and beta emitters with maximum beta energies between 0.15 and 0.4 MeV have a recommended source efficiency of 0.25. Source efficiencies for some common surface materials and overlaying material are provided in NUREG-1507." (MARSSIM Section 6.5.4)

Following calibration and insertion of various know values the activity in terms of dpm per 100 cm^2 may be calculated (MARSSIM Section 6.6.1):

$$\text{Activity } \frac{dpm}{100cm^2} = \frac{\frac{C_s}{T_s} - R_b}{(\varepsilon_{total})\left(\frac{a}{100cm^2}\right)}$$

where

Cs = integrated counts recorded by the instrument
Ts = time period over which the counts were recorded in minutes
R_b = Background count rate
ε_{total} = total efficiency of the instrument in counts per disintegration, effectively the product of the instrument efficiency (εi) and the source efficiency (εs)
a = physical probe area in cm^2

Not implementing MARSSIM calls into question the validity of radiation survey results both in the laboratories and for released material. For example, the nonuse of the recommended alpha source efficiency factor could imply a serious underestimation of alpha surface contamination; experience indicates by a factor of two. As another example, the probe area of the TBM-3SR used for beta surface contamination measurements is about 20 cm^2, the nonuse of the probe area for beta measurements could imply that all beta activity values are being underreported by

a factor of five. It is recommended that the standard industry practices which are illustrated in MARSSIM be adopted for calibration and data interpretation with timely training provided, as soon as possible, for both the GRSD staff and radioactive material users.

5. MATERIAL USE, CONTROL, AND TRANSFER:
(Materials and uses authorized; security and control of licensed materials; and procedures for receipt and transfer of licensed material)

Source acquisition is controlled by NIST Form 364 and procedure HPI 4-8, *Source Receiving and Storage Facility*. This procedure is not up-to-date (revision 12/93) and provides very little instruction; a well-trained worker would be required to perform this task. However, procedure RSI 4-2, *Radioactive Material Package Receipt*, appears to have been written to overlap HPI 4-8 and is a very good procedure for receipt of RAM. It is recommended that HPI 4-8 be deleted and the important sections (such as sections C and D) moved to RSI 4-2.

Interviews with staff indicates there is now a very strong hold on source receipt and any source received will not be provided to a Source Custodian without the proper form completed along with the approved Hazard Analysis. Interviews of Source Custodian provided information that indicates they are well aware of the NIST 364/Hazard Assessment requirements prior to receiving a source. However, Uranium-232 is not an approved source material on the current SNM-362 license and two sealed sources containing 100 microcuries each were received in 2011 and 2012. Receipt of this material is an item of noncompliance with the SNM-362 license and questions the reliability of the NIST 364/Hazard Assessment process.

The source inventory is updated prior to any source ordering to ensure that no license limit will be exceeded when the source arrives on site. At this time, the closest radionuclide to its limit is Thorium (all forms) at 70% of the current license limit. Comparison to the proposed license limits is also tracked; two fuel pellets exist at 84% as well as Radium at 84%. Currently there are 1434 tracked sources; 964 sealed sources and 470 unsealed sources.

Upon receipt the source is given a unique "RS" number for tracking that is kept with the source original activity. A NIST scientist is assigned as the custodian of the source and can take a RS labeled source and use it to manufacture and calibrate smaller sources as Standard Reference Material (SRM) for an outside user. The source custodian is responsible for tracking where the original material goes and is allowed to use their own unique tracking method. When all of the original activity is consumed the custodian notifies Health Physics that the source has been

properly handled or disposed and it can be removed from inventory. This provides a level of accountability that maintains the total isotope activity in inventory even though the activity on site is less.

Interviews with several source custodians allowed the auditors to track the RS number assigned to the custodian through the custodian log books to the proper accountability of the activity. For example, RS 12-0115 was tracked through Dan Golas with proper accountability for the I-125 and RS 13-0033 for I-131. His log book had his item number 2273 as the I-125 and item 2291 was associated with the I-131. Other sources reviewed included items 2285-1 and item 2285-10 as mixed gamma SRM. Item 2281-1 was a Lu-177 SRM. Larry Lucas was interviewed to determine his method of accountability for the RS standards in his possession. He used a tracking system for his SRM as "LL-03-109" to track a dilution of Cd-109. His log book allowed him to track this back to a specific RS number for proper accountability.

During a review of the low level alpha and beta calibration laboratory (Room E107) a spot check of a drawer with calibration sources was done to trace the RS number. One source did not have a RS number but had a unique identifier, with a date of 1968, which looked like it was a SRM dilution done by a NIST scientist. Therefore it was undetermined if the source was in inventory. A similar occurrence of sources without a RS number occurred while reviewing radioactive material storage in room C11 with Dr. Latitia Pibida. For instance one source was labeled 4926 H-3 September 3, 1961 another was PSM 9-2'-A3 and another PSM 9-2'-A4. It is recommended that sources without a RS number be identified and put into inventory. Also a method should be considered to track dilutions back to the RS number.

A review of the leak check records and interviews with personnel indicate all leak checks have been performed in a timely manner. All sources in long-term storage also completed satisfactory leak checks.

The NIST NMMSS reports were reviewed; the report is due annually but NIST performs the inventory and reports on a semi-annual basis which is considered a noteworthy practice although time consuming. All reports appeared to be accurate and submitted in a timely manner.

6. <u>AREA RADIATION SURVEYS AND CONTAMINATION CONTROL:</u>
(Radiological surveys; air sampling; leak tests; inventories; handling of radioactive

materials; contamination controls; records; and public doses)

GRSD technicians perform weekly radiation contamination surveys in laboratories where unsealed radioactive materials are used. Direct radiation dose measurements and wipe surveys are performed in each weekly survey. Weekly surveys are documented and a copy of the latest survey is posted at the entrance of the room. A supervisory health physicist reviews the weekly surveys.

Laboratories that use unsealed radioactive materials are audited by a health physicist quarterly. The audit consists of an independent radiation survey and a review of compliance items. Items of noncompliance are documented on the audit report and entered into the HAPPY database. Completed corrective actions are documented in the HAPPY database. During the next audit all items that have not been corrective are followed up by the health physicist.

Area monitors are placed throughout Building 245. The data from these area monitors shows compliance with 10 CFR 20 public dose limits. GRSD also runs the COMPLY code annually to demonstrate compliance with air emission constraints. GRSD also runs the comply code for individual airborne releases. Although not necessary the results provide NIST with data supporting compliance with 10 CFR 20 public dose criteria. NIST did not release radioactive materials via the sanitary sewer system in 2012.

Material users are trained to perform a daily contamination survey following work with radioisotopes. During the 2012 audit, Source Custodians were asked to describe their work with radioactive materials and what type of radiation surveys they performed. At the conclusion of their work the Source Custodians indicated they performed a wipe survey. Various answers were given by the Source Custodians as to what the trigger level was for a wipe survey. None of the Source Custodians indicated that they are to use a portable radiation survey instrument to survey the work area. At all locations a calibrated portable survey instrument was readily available. Although an observation during the 2012 audit, it is recommended that planned corrective action regarding training and use requirements for portable survey meters be scheduled immediately.

Survey records for weekly surveillances and quarterly audits are maintained and were reviewed. These include direct radiation and contamination surveys. Direct radiation levels and contamination are very low and practically consistent with background in most locations. Low levels of direct radiation, well within limits, are measurable at the surfaces of self-contained

irradiators and source storage areas. Surveys appeared adequate to show compliance with 10 CFR Part 20 public dose limits for direct exposure.

Survey requirements for areas where radioactive materials are used and stored were established per the 1997 license renewal application and the HPIs. Survey frequencies are a function of the category of laboratory, which is based on the type and quantity of radioactive material used. For most posted rooms, the program requires that the GRSD conduct and document a weekly survey and/or a quarterly audit. Material users are trained to perform a daily contamination survey following work with radioisotopes. The results from these surveys are stored in the lab where the survey was taken. The individual taking the survey gives the swipes to Health Physics for counting on the Tennelec low background counter. After counting the results are given to the surveyor. No record of review by GRSD or the individual surveyor is documented. It is recommended the surveyor and GRSD take credit for users performing daily contamination surveys via a record of review. Something as simple as a survey log with the time, date, surveyor name, description or comment, date results are received and a satisfactory or unsatisfactory entry being made.

Surveys by the radiation safety staff consist of the collection of smear samples and the use of portable radiation detection equipment to assess ambient radiological conditions and those on work surfaces within posted areas. Additionally, exposure rates are measured to ensure compliance with applicable posting requirements. A check of work place classification, radiological facility conditions, security checks, and other compliance related items are performed during each quarterly audit. All findings from both weekly surveys and quarterly audits are documented on the applicable forms.

Survey records indicated the use of cpm as the contamination level which without a conversion factor, the user would not be aware of what the actual level would be in terms of dpm/100cm^2. It is recommended that both a conversion factor to dpm/100cm^2 and action level (perhaps in cpm) be provided to the lab user with the various survey meters for both alpha meters and beta meters. This recommendation is consistent with NUREG-1556, Vol. 11, Appendix R, that each survey record should include contamination levels with appropriate units. Further, 10 CFR § 20.1005 Units of radioactivity defines one of the activity units to be used is disintegrations per unit of time.

No food, drinks, or tobacco use was observed in any of the radiological laboratories.

7. TRAINING AND INSTRUCTIONS TO WORKERS:
(Training and retraining requirements and documentation; interviews and observations of routine work; staff knowledge of all routine activities; 10 CFR Parts 19 and 20 requirements; emergency situations; and supervision by authorized users)

The main entrances to Building 245 and the Physics Building were posted with a NRC Form 3, a Section 206 notice, employee rights as specified in the Energy Reorganization Act of 1974, and a notice where the license, regulations and radiation safety program documents can be located.

Safety training is required per the CO, NRC and DOT regulations, as well as a license condition for SNM-362 radioactive materials license. GRSD develops and maintains appropriate training materials. Radiation Safety training is provided in combination as computer-base-training (CBT) followed by six hours of classroom lecture including a practical exercise in contamination survey techniques. New employees are required to complete the radiation safety training prior to working with radioactive materials. Records of radiation safety training are maintained by GRSD.

The auditors reviewed training materials used for all new radioactive materials users. Personnel considered as potential users of radioactive material and requiring radiological safety training are generally categorized as follows:

(1) Researchers working directly with radiation sources and radioactive materials;
(2) Radiation Safety staff;
(3) Support staff (firemen, security, janitors, electricians, etc.) who must work in areas where licensed material is in use; and
(4) Administrative staff and visitors who frequent areas using licensed materials.

The CO required a procedure for the indoctrination of new employees and associates with regard to general radiation safety policy and procedure; NIST developed a process but no detailed procedure for the process was identified.

Appendix R of NUREG-1556, Volume 11 provides recommendations and model procedures for handling emergencies. Procedure RSI 1-3, Emergency Response, was reviewed and compared to this Appendix to ensure adequate guidance has been provided by the organization. Even though a procedure is present, it appears it has not been "exercised" to

determine or test response of individuals, not just GRSD, or to determine if the responders will respond appropriately and take the expected actions. The NIST Fire Protection Group did participate in an emergency response exercise over two years ago in March 2011.

- As a minimum interval, an annual drill is recommended (as described in the drill report/critique) to be performed which exercises the procedure and different persons in each organization so that each understands their role in a real emergency. These exercises should be performed as soon as possible.
- The drill summary indicated that Montgomery County Advanced Life Support units would not transport contaminated patients. If this refusal to transport a contaminated patient has not been resolved, it is recommended that transport and medical assistance be obtained as a top priority item.

During the assessment, Source Custodians were questioned about emergency procedures. All Source Custodians gave appropriate emergency response answers and they knew how to contact GRSD and the police department if the incident occurred after hours.

Training records were viewed for various GRSD Staff. An ad-hoc training program for the staff exists but needs to be formalized. An "HP Employee Training Check List" was reviewed for 3 staff members; only one was completed in its entirety (with no completion dates listed) and two were partially completed in late 2010/early 2011. Interviews with a Supervisor indicate that these checklists are not used prior to assigning a staff member to perform a given task due his knowledge of each staff members' true qualifications but he does intend to reinstitute use of the Check lists. The danger of not having a formalized training program is that staff personnel languish in their professional and company development, potentially requiring the use of an unqualified worker for an event and if an event does occur having used an "unqualified" worker there would be ramifications for the site. This illustrates the need for a documented program which was previously identified and supports the need for the IRSC to request actions to resolve this matter. It is recommended that the IRSC require a formal program be developed that requires a supervisor to observe and approve an individual GRSD member performing a task prior to independent assignment.

The previous (1997) license application requires that all authorized individuals requiring training be trained biennially. Further, all individuals approved to work with the irradiators (those sources meeting 10CFR part 36 criterion) shall receive facility specific training annually. Also, all individuals approved to prepare packaging, labeling, and manifests (Shippers Declarations) of

sources for shipment regulated by the DOT shall receive training on the appropriate transportation regulations and accountability and control procedures. The model training program in Appendix J, NUREG-1556, Vol. 7 suggests that training shall be required annually (refresher training). This is identified as a weakness in the NIST program and it is recommended that NIST conform to the annual training suggestions contained in the NUREG.

The same NUREG-1556 Vol. 7 identified that a written exam should be used to assess retention of the topics presented. Additionally, the CO required that training include a method to measure the mastery of training objectives. Trainee mastery of the learning objectives should be measured through the use of appropriate evaluations' e.g. written, practical exercises, or oral exams and on-the-job evaluations. The structure of the Radiation Safety Course included:

- Six CBT modules with an exam for each with questions selected randomly from a data bank.
- A six hour class room lecture portion with a lab practical session to identify an unknown number of sources under a cover.
- A take home exam.

The course training material were comprehensive and covers most items listed in the CO, including but not limited to pertinent regulations, license conditions, events, policies and employee rights and responsibilities. Particular attention was given to the June 9, 2008, plutonium spill event. The course did not go into details regarding the consequences of and the potential actions that NRC may take against an individual for willful violations of NRC requirements as required by the CO. It is recommended that the course be upgraded to include the requirement regarding potential actions by the NRC.

The course did not include a practical exam (PE) for don and duff of personal protective equipment; there was one skin contamination event during the last year for which a cause could not be determined. The lack of a PE and use of a take home exam as a method to measure mastery are not considered as complying with the CO. The course should be upgraded to include the PE and the take home exam be replaced with a supervised test.

Two formula errors were noted in the classroom lectures involving efficiency calculations:

The first example from page 48 of the handout material was that the formula as shown below

had the numerator and denominator reversed:

Efficiency = disintegration per min. /count per min.

It is recommended that the formula be changed to read; not exactly correct but excellent for concepts:

Efficiency = count per min. / disintegration per min.

The second example from page 72 of the training handout could lead to calculation error:

Efficiency = gross cpm – background cpm / dpm

It is recommended that the formula be changed by adding parenthesis to read:

Efficiency = (gross cpm – background cpm) / dpm

Additionally, the lectures did not demonstrate how large an area should be used during smear collection or the technique for medium pressure (wet smears for 3H, etc.). This was the first presentation of this version of training material and it is recommended that techniques for smear collection be included.

8. <u>RADIATION PROTECTION:</u>
(Radiation protection program with ALARA provisions; external and internal dosimetry; exposure evaluations; dose and survey records and reports; annual notifications to workers; bulletins and other generic communications)

External dosimeters are obtained from the U.S. Navy Medical facility in Bethesda, Maryland. Whole body and/or extremity (ring) dosimeters are provided to workers based on the material (or x-ray generating devices) that they utilize. The decision to provide dose monitoring is part of the hazard assessment done by GRSD upon receipt of a Form 364 or 365 application.

Dosimeters of record (TLDs) are exchanged on a quarterly basis, and workers are provided with a copy of their dose results if their annual dose exceeds 50 mrem or upon request. Typical doses to workers associated with the SNM-362 license are relatively low, with higher doses associated with reactor personnel and some users of high energy gamma-emitting

radionuclides.

Records of radiation doses to radiation workers are maintained by GRSD. Dosimetry records are maintained in both hard-copy as well as electronically in the Radiation Safety database. Data from 2012 (third quarter was latest data available) was reviewed and all exposures were below an annual radiation dose in excess of 10 percent of any applicable NRC occupational dose limit: highest TEDE was 67 millirem.

NIST performs and tracks internal dose via a bioassay program consisting of thyroid scans following work with radioactive iodine and urinalysis is performed following work with relatively high quantities of radioisotopes (typically H-3). The thyroid scans are performed typically at one point each year following an annual campaign of work with iodine. Tritium bioassays are more frequent and are documented on Tritium Bioassay Review Pre-Post Report forms. No internal dose was reported for any workers.

There was one declared pregnant worker for 2012 and her total dose was less than 10% of the limit for DPW's. Training is provided on this topic in the radiation safety training program. Data from the NIST Dosimetry group (up to third quarter of 2012) indicates:

- Of the 257 workers monitored during 2012, Forty-seven (47) received a measurable whole body dose. Of these only 3 workers exceeded 50 mrem (1 percent of the annual whole body exposure limit) and no workers exceeded 500 mrem (10 percent of the exposure limit).
- In addition to monitoring workers for external whole body exposures, 25 workers were monitored for extremity exposures using finger ring TLDs. One of these workers was exceeding 5,000 mrem at this time and the dosimetrist believes the final dosimetry report will show this worker at less than 10,000 mrem for the year.

The IRSC 2011 Annual report, Section X, In-Plant Monitoring, discusses exposure monitoring outside buildings, in offices, in hallways and in restricted areas. The data in the graphs presented in that report do not subtract background dose so, on the surface, indicates a large amount of ambient dose in those areas (average reading in the guide hall was 116 millirem). Data is also presented as composite data (averages). The purpose of this monitoring is to ensure employees deemed not to be radiation workers are not exposed to a value over the limit for members of the public (MOP) (100 millirem/year). It is recommended that future IRSC

annual reports perform an evaluation based upon the general number of hours an employee is expected to be in the area with the greatest exposure as well as subtracting background dose so that an appropriate MOP evaluation can be performed.

Furthermore, the same report states that area monitoring in the construction area outside the guide hall was stopped due to the construction removing the fence the TLD was placed on. It would have seemed prudent to find another location at that construction area to place an area TLD to ensure, and prove, the construction workers were not being exposed to greater than the 100 mrem/year limit for members of the public. However, Environs Radiations Surveys required per HPI 8-6, (back to September 2012) were reviewed for the purpose of ensuring compliance with the 100 mrem/year MOP limit. Records indicate the surveys are being performed in a quality manner and are properly documented. Any dose rate results greater than twice background is evaluated for occupancy.

A review of dosimetry procedures was performed with the following recommendation:

It is recommended that procedure revisions be made to HPI 1-1 and 1-7 that goes into more depth regarding personnel contamination, states a limit to when a skin dose assessment will be performed, actions to take at various levels of dose and requiring count rate measurements at the end of each decontamination cycle.

- HPI 1-1, Health Physics Action Levels, states that decontamination level for beta can be stopped at 0.1mrad/hour. Step F.2. states that "If these levels cannot be achieved a supervisory health physicist must be consulted as soon as practicable".

- HPI 1-7, Personal Decontamination, does not require that facial contamination on an individual require a whole body count. Procedure also does not discuss documentation of the decontamination either for dose assessment purposes or for tracking/trending purposes. Furthermore, this same procedure does not give instructions to record contamination levels such that a skin dose assessment can be performed. .

- No procedures were identified on how to perform a skin dose assessment or when a skin dose assessment would even be required.

Discussions with the Health Physicist responsible for personnel dosimetry yielded statements such as "we don't do it that way anymore" when asked specific questions about procedures that are signed and in place. Replacement procedures are currently being developed which reflect their current method of operations (which are correct) but do not follow currently approved procedures; HPI 2-3, External Dosimetry, is an example of a procedure not reflecting current practices. It is recommended that emphasis be placed to finalize Personnel Monitoring replacement procedures; training should then be conducted on them immediately.

The use of Temporary PIC/TLD packages was discussed with one of the Dosimetry Health Physicists; there are no approved instructions or directions on when or how this Temporary program is to be applied. Dose limits are not established as to when a visitor or employee would need this package, no "rules" such as rooms being worked in or areas being accessed that will strictly be applied. It is recommended that a procedure be developed and implemented for the use of Temporary PIC/TLD packages.

No statement is provided in the training program regarding personnel who are given medical radioisotopes by a physician. However, the practice is that if GRSD becomes aware of such a person, that person's TLD is taken away and instructed not to enter any radiation or radioactive material areas until they can clear a personal contamination monitor. The training program should include discussion regarding medical radioisotopes use.

A Technical Basis Document (TBD) that discusses the dosimetry program and outlines its reason for existence was asked for but evidently does not exist. It is recommended that an effort be put into developing a TBD; and for more than the dosimetry function. This document would then serve as the basis for the entire program and the underlying procedures would then implement this TBD. Examples of topics in this document include:

- Establishing the need for individual monitoring
- How lost, damaged or contaminated dosimeters are handled
- Planned Special Exposure situations
- External dose evaluations
- Dosimeter quality assurance
- Recordkeeping and Reporting

The air sampling program was evaluated as part of the dosimetry review. The program was

evaluated by reading procedures, interviewing personnel involved in the program, reviewing data packages and performing walk downs. The licensee has very little need for in-room air sampling but does provide it when the Hazard Analysis prompts it be performed. Air sampling is generally performed (physically) both after the HEPA or charcoal filter plenum as well as in the room where the work is being performed. Each charcoal filter is provided with a QC stamp for the TEDA charcoal. A double filter (i.e., both charcoal and HEPA) is not used. GRSD is working with the Investigators to standardize given hoods for specific type radionuclides which would remove the inefficiency of changing hood filters for each investigator; only a given hood(s) could be used for Iodine radionuclides and those hoods would be provided the charcoal filters. This is recognized as a noteworthy practice.

A review of the air sample data for 2012 was reviewed. Data is tracked both by DAC values and potential effluent release; no air samples exceeded any DAC values and all counts appeared to have been performed correctly and the instruments used for analysis were in calibration.

9. <u>RADIOACTIVE WASTE MANAGEMENT:</u>
(Disposal; effluent pathways and control; storage areas; transfer; packaging, control, and tracking procedures; equipment; incinerators, hoods, vents, and compactors; license conditions for special disposal method)

Radioactive waste is stored in Room A010. Room A010 is a former accelerator vault. A010 has a fire detection and alarm system but no fire suppression system (no fire sprinkler or automatic fire extinguishers, manual extinguishers are available). Also, this area does not have emergency lighting in the event of a power failure. A010 does not have any windows and is very dark without lighting. It is recommended that temporary lighting be installed in Room A010 until a permanent arrangement is made.

Liquid radioactive waste is stored in A010. The liquid waste was appropriately labeled. Liquid waste containers are stored in plastic pail that acts as a secondary containment. .Waste is characterized in the laboratory that generates the waste and logged onto a Laboratory Waste Manifest form which details the RS number, nuclide, activity, assay date, physical and chemical form. Health Physics assigns it a Package ID number and does an exposure rate at 30 cm. When enough waste is in storage at A010 it is placed into a bin and coordinated with the waste person in Building 235 for transport and storage/processing and disposal through that facility. Approximately two shipments of waste are made per year.

Most solid radioactive waste is compacted into 55 gallon drums prior to shipment to a commercial disposal facility. NIST characterizes the waste as the generator. Waste brokers mark and label the drums for shipment. The waste brokers also prepare the shipping papers based on information provided by NIST. NIST staff regularly performs wipe surveys and exposure rate surveys on the drums. NIST does not perform incineration of radioactive waste.

GRSD also runs the COMPLY code annually to demonstrate compliance with air emission constraints. The 2011 NESHAP report shows compliance with radioactive air emission constraints. The Comply code is actually run whenever a release is measured. The 2012 NESHAP report shows compliance with radioactive air emissions.

NIST has two liquid waste holdup tanks in building 245 room B045. These are not in use. Piled in the back of the room are soil samples in cardboard boxes that need to be removed. It could not be determined if these are radioactive waste or not. NIST did not release radioactive materials via the sanitary sewer system in 2011 and 2012 under the SNM-362 license.

10. DECOMMISSIONING:
(Records relevant to decommissioning; decommissioning plan/schedule; notification requirements; cost estimates; funding methods; financial assurance; and Timeliness Rule requirements; changes in radiological conditions since decommissioning plan was submitted)

NIST had a contractor prepare an update to the decommissioning cost estimate report in 2010.

GRSD maintains radioactive materials inventory records, spill records, survey records, and disposal records. All of these records are part of the required decommissioning records.

11. TRANSPORTATION:
(Quantities and types of licensed material shipped; packaging design requirements; shipping papers; hazardous materials (HAZMAT) communication procedures; return of sources; procedures for monitoring radiation and contamination levels of packages; HAZMAT training; and records and reports)

Radioactive waste which will be shipped for disposal at a commercial disposal facility is transferred to Building 235 room H100 for storage and preparation. Radioactive waste generated under the SNM-362 license is kept separate from waste generated under other radioactive material licenses. The auditors went to the waste storage area and verified the separation of waste from building 245 and radioactive waste generated. The auditor reviewed

package Identification data for seven different 55 gallon drums. Reviewed transfer information to waste container and identified as dry active waste. Waste is typically handled by a broker from Interstate Ventures and sent to TOXCO for processing.

Training comments are provided earlier.

12. NOTIFICATIONS AND REPORTS:
(Reporting and followup of theft, loss, incidents and overexposures. Notification of change in RSO and/or authorized user. Radiation exposure reports provided to individuals.)

A leaking Uranium-232 source, greater than 0.005 microcuries, was discovered on March 2, 2012 but not reported to the NRC until September 7, 2012. Not reporting within 5 days is a violation of the SNM-362 license requirements; however, the NRC did assist NIST with the development of the report.

No overexposure or incidents were reported.

13. POSTING AND LABELING:
(Notices; license documents; regulations; bulletins and generic information; posting of radiation areas; and labeling of containers of licensed material)

Based on observations, doors to facilities were posted with "Caution- Radioactive Materials" signs and "Caution – Radiation Area" signs as appropriate. Equipment and containers were frequently found labeled with a variety of type of "Caution – Radioactive Materials" postings. Waste containers were also appropriately labeled.

Areas marked "Caution – Radiation Area" were in compliance with the applicable dose rates. The entrances to Buildings were posted with a current copy of NRC Form 3.

The following observations were made:

- Observed weekly survey audit of room C-11. A GRSD Supervisor performed independent dose rate and contamination surveys as well as a general observation of the room. The supervisor did not open any cabinets or drawers to look for unlabeled or unmarked RAM. This auditor opened one drawer and found an item with a RAM tag on it that had been there a while; the drawer was not labeled with a RAM sticker. This auditor also spotted, through a hole where a drawer had been, some source material

(labeled) but the cabinet drawer also was not labeled with a RAM sticker Also in the room was a contaminated lead pig that had a sticky-note on it, dated 4/22/11, stating it was contaminated. When questioned, the Supervisor stated that the Principal Investigator had been talked to about the use of the pig. A cabinet in the back of the room contained several sources; could not tell that they were all being used. Sources were causing a localized 5 mR/hour field at the front of the cabinet (posted properly).

- Procedure HPI 4-1, *LHP Monitoring*, step D.5 states that "during any laboratory or workplace survey, the surveyor will review the area, containers in the areas, and other items and equipment, or compliance with posting and marking requirements..." Various laboratories were found that had containers containing RAM that were not labeled with the proper label; however, as access was permitted only to authorized individuals and an inventory was available, the requirements for labeling per 10CFR20 appeared to be met.

- Room B-044 is posted as a Radioactive Materials Area and has stored within in it HEPA and Charcoal filters that are awaiting analysis for waste classification. Within that room are several (<20) shipping drums (appear to be 3 gallon containers) which are labeled with a UN number as well as White and Yellow (White I, Yellow II, etc.) labels but also have a piece of paper on top of the stack stating the containers are empty. This room was locked, posted and controlled appropriately.

- B-156 contains an area on a bench-top that is used for contaminated materials. Contrary to proper labeling convention, this bench-top area was not labeled to inform personnel working in the area that this was for RAM. It is recommended that "Contaminated Area" tape be used around areas meant to store contaminated (or potentially contaminated) items.

- Several labels that are not defined in 10CFR20, "Caution Radiation Hazard" were found in many laboratories; these appear to be left-over labels from history. These containers are accessible only to individuals authorized to handle or use them, or to work in the vicinity of the containers and inventories are available. This is not a finding of noncompliance with 10 CFR Part 20 labeling requirements but it is recommended that these erroneous labels be found and replaced with labels defined by 10 CFR § 20.1904,

Labeling containers, a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL"

- There appears to be a lack of consistency in posting information for rooms posted with "Caution Radioactive Material". Out of 8 rooms chosen in the Basement and Sub-Basement with that posting, 5 had survey maps at the entrance to the room and 3 did not. Furthermore, the survey maps were incomplete; two statements at the bottom of the survey maps were not complied with – one check box stating the database had been updated and a statement that the smear results were attached to the survey map. A PST stated that this form was used for two purposes and the information at the bottom was for use when the rooms were audited. To eliminate inconsistency in posting room survey results, it is recommended that either 1) two separate forms be used OR 2) that section be one-lined and initialed as NA at each posting.

- The auditors went through building 217 and 227 to audit postings, housekeeping and proper use of radioactive material. In building 216 labs C103, C105, D101, D104, D113 and F101 were inspected with Abby Lindstrom from Materials Management. These labs had "Caution Radioactive Material" signs. Some labs did not have any radioactive material in the lab at that time but were expected to get some in the future and therefore the sign was left in place. All labs were neat with radioactive waste bins being labeled. No excessive nonradioactive waste was in the rooms. There was no indication of eating or drinking in these rooms. It is recommended that if a room does not have radioactive material the "Caution Radioactive Material" sign be removed.

  In building 227 labs B143, B151, A 230, and A334 were inspected with Manny Mejias. These rooms were the only labs posted with "Caution, Radioactive Material" signs. All labs were neat with radioactive waste bins being labeled. All labs had signs stating "No Entry by Janitors Trash and recyclables will be placed outside." No excessive nonradioactive waste was in the rooms. There was no indication of eating or drinking in these rooms. Drawers with radioactive material were locked when not in use.

The entrances to Buildings were posted with a current copy of NRC Form 3 as well as a statement regarding the location of the license, regulations and inspection results.

14. INDEPENDENT AND CONFIRMATORY MEASUREMENTS:
(Areas surveyed, both restricted and unrestricted, and measurements made; comparison of data with staff's results and regulations)

Independent and confirmatory measurements were made with a Fluke Biomedical Victoreen 451B serial number 1901 calibrated September 26, 2012. All independent and confirmatory measurements indicated postings and measurements by NIST were correct.

15. AUDIT FINDINGS:

Two findings were identified in the NIST-Gaithersburg program as not being in compliance with the CO which is considered as additional License Conditions; however, there are mitigating comments provided in the report and also shown below in brackets.

- The Radiation Safety Course did not provide details regarding the consequences of and the potential actions that NRC may take against an individual for willful violations of NRC requirements as required by the CO. *[It should be noted that NIST reported that this omission occurred only once and in particular during the training that the lead auditor observed.*]

- The Radiation Safety Course did not include a practical exam (PE) for don and duff of personal protective equipment (PPE); there was one skin contamination event during the last year for which a cause could not be determined. The lack of a graded PE and use of a take home exam as a method to measure mastery are considered as noncompliance with the CO. [*It should be noted that NIST did require completion and passing other computer based quizzes during the course. Also, an industry standard for mastery was not identified and this finding of noncompliance is a conservative one.*]

There were fifty (50) recommendations identified. Several of these recommendations may be cross cutting issues.

- Ionizing Radiation Safety Committee

  A time period should be established for routine receipt of proposed protocols and review/approval by the IRSC.

  It is recommended that updated AHA be performed for the sealed sources whether in storage or not including an evaluation of the appropriateness of current storage

conditions.

- Radiation Safety Program Discussion

  It is recommended that the qualifications specifically provide exemptions for the SROs and other identifiable job titles which might not require a college degree at the bachelor level and further to separate the education requirements of the Source Custodian as a college degree at the bachelor level with Source User requirements to meet the specific protocols. Source Users were described to occasionally be college interns at the undergraduate level and a separate education level is recommended for them.

  It is recommended that the due dates for the 2012 audit items (now known for over three months) be moved up as closing them would provide more assurance that a radiological event would not happen.

- Radiation Safety Organization and Staffing

  A recommendation is made that the GRSD should immediately require procedure updates and training in them. If this action overtaxes the staff with the implied implication of reduced radiation safety, there are several reputable consulting firms that could assist. It is further recommended that the IRSC review the current and potential staffing needs.

  It is recommended that the IRSC review the current and potential staffing needs.

- Radiation Safety Culture

  Management is encouraged to implement a model program following applicable volumes of NUREG-1556 and provide the resources to achieve it.

  It is recommended that the GRSD establish a formal program be developed that requires a supervisor to observe and approve an individual GRSD member performing a task prior to independent assignment.

  A recommendation is made that the RSO's policy regarding Stop Work Authority be reinforced through emphasis in the newly designed Radiation Safety Training Course.

- Radiation Safety Training

As a minimum interval, an annual emergency response drill is recommended (as described in the 2011 drill report) to be performed which exercises the procedure and different persons in each organization so that each understands their role in a real emergency.

If the refusal to transport a contaminated patient has not been resolved, it is recommended that transport and medical assistance be obtained as a top priority item.

It is recommended that the GRSD develop a formal program that requires a supervisor to observe and approve an individual GRSD member performing a task prior to independent assignment.

Biennial training is identified as a weakness in the NIST program and it is recommended that NIST conform to the annual training suggestions contained in the NUREG-1556 volumes 7and 9.

On one occurrence during the audit, the course did not go into details regarding the consequences of and the potential actions that NRC may take against an individual for willful violations of NRC requirements as required by the CO. It is recommended that the course be upgraded to include the requirement regarding potential actions by the NRC. (See finding in Section 1.3.1)

The course should be upgraded to include the PE and the take home exam be replaced with a supervised test. Alternately, the take home exam might be called a required homework assignment with additional computer quizzes. (See finding in Section 1.3.1)

Two formula errors were noted in the classroom lectures involving efficiency calculations It is recommended that the formulas be corrected.

The lectures did not demonstrate how large an area should be used during smear collection or the technique for medium pressure (wet smears for 3H, etc.). This was the first presentation of this version of training material and it is recommended that

techniques for smear collection be included.

- Engineering Controls

  It is recommended that all sealed sources for which no immediate use is known (perhaps six months into the future) be removed from the various laboratories and stored in another secure location. Consideration should be given to the use of large lead pigs versus stacked lead bricks to reduce potential radiation streaming and trip/fall hazards.

- Radiological Instrumentation & Sources

  A "date-to-date" calibration period should be instituted versus the current "not to exceed" concept.

  The HPI 7-0 Quality Assurance procedure should include a description of the repair or maintenance be recorded in the calibration records of each instrument.

  The HPI 7-0 Quality Assurance procedure should be revised to provide control and storage of documents generated by the various calibration procedures.

  It is recommended that a technical basis document be written that describes, in detail, the instrument program.

  It is recommended that more guidance be placed in HPI 7-0 that reflects ANSI standard commitments as well as other quality good practices such as documentation requirements, replacement part requirements, etc. This document is also out of date; the current revision is dated 10/95.

  It is recommended that procedure RSI 7-13 be revised to be in compliance with the actual source use conditions.

  It is recommended that a revision be made to procedure RSI 7-8A which includes safety precautions for filling the dewar i.e., proper gloves, proper apron, face piece, oxygen meter in room, etc.

It is recommended that procedure HPI 7-3 be revised and updated with information received via benchmarking the industry.

It is recommended that this requirement regarding collection of a zero reading be eliminated in procedure HPI 7-4.

It is recommended that a procedure be developed describing the calibration of PIC's, acceptable drift criteria and time frame associated with the drift.

It is recommended that all procedures developed for the instrumentation program only assume a minimally qualified person is performing the tasks.

It is recommended to 1) place a notice on the Tennelec system that instructs a user as to when a smear is contaminated; or 2) program the Tennelec system to automatically produce a flag when a given level is exceeded; or 3) train users on the normal background of the system versus a positive smear count.

It is recommended that the standard industry practices which are illustrated in MARSSIM be adopted for calibration and data interpretation with timely training provided, as soon as possible, for both the GRSD staff and radioactive material users. This recommendation may be applied for decontamination/decommission as well as with action levels needed in laboratory use.

- Radiological Surveys, Contamination Controls & Records

It is recommended the surveyor and GRSD take credit for users performing daily contamination surveys via a record of review. Something as simple as a survey log with the time, date, surveyor name, description or comment, date results are received and a satisfactory or unsatisfactory entry being made.

Although an observation during the 2012 audit, it is recommended that planned corrective action regarding training and use requirements for portable survey meters be rescheduled immediately.

It is recommended that both a conversion factor to dpm/100cm^2 and action level (perhaps in cpm) be provided to the lab user with the various survey meters for both alpha meters and beta meters.

- Labels and Posting

It is recommended that "Contaminated Area" tape be used around areas meant to store contaminated (or potentially contaminated) items.

This is not a finding of noncompliance with 10 CFR Part 20 labeling requirements but it is recommended that the erroneous labels "CAUTION RADIATION HAZARD" be found and replaced with labels defined by 10 CFR § 20.1904, Labeling containers, a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL".

To eliminate inconsistency in posting room survey results, it is recommended that either 1) two separate forms be used OR 2) that section be one-lined and initialed as NA at each posting.

It is recommended that if a room in Building 217 or Building 223 does not have radioactive material the "Caution Radioactive Material" sign be removed.

- Personnel Monitoring for Radiation Exposure

It is recommended that future IRSC annual reports perform an evaluation based upon the general number of hours an employee is expected to be in the area with the greatest exposure as well as subtracting background dose so that an appropriate MOP evaluation can be performed.

It is recommended that procedure revisions be made to HPI 1-1 and 1-7 that goes into more depth regarding personnel contamination, states a limit to when a skin dose assessment will be performed, actions to take at various levels of dose and requiring count rate measurements at the end of each decontamination cycle.

It is recommended that emphasis be placed to finalize draft Personnel Monitoring replacement procedures; training should then be conducted on them immediately.

It is recommended that a procedure be developed and implemented for the use of Temporary PIC/TLD packages.

The training program should include discussion regarding personnel receiving medical treatment with radioisotopes.

It is recommended that an effort be put into developing a technical basis document for the dosimetry function. This document would then serve as the basis for the entire program and the underlying procedures would then implement this TBD. Examples of topics suggested for this document are detailed in Section 3.10.

- Research and Source Usage

It is recommended that the legacy sealed sources which are no longer wanted or for which plans are not known be transferred to other authorized licensees or licensed disposal sites immediately.

- Material Control and Accountability

It is recommended that HPI 4-8 be deleted and the important parts (such as sections C and D) moved to RSI 4-2.

It is recommended that sources without a RS number be identified and put into inventory. Also a method should be considered to track dilutions back to the RS number.

- Radioactive Material Shipping and Receiving

It is recommended that GRSD ensure that the training is very specific for receipt of RAM packages that are damaged or leaking.

- Radioactive Waste Management and Transportation

  It is recommended that temporary lighting be installed in Rooms A010 and A10 until a permanent arrangement is made.

- Trustworthiness and Reliability Program for Quantities of Concern

  The storage location for multiple items of RAMQC should be evaluated due to the close proximity of an outside door and loading dock.

Attachment D

Miscellaneous Exhibits

E-1 RSI IP Index Mar 12, 2013

E-2 RSI A1-9 GRSD Document Control – Draft

E-3 RSA A1-10 GRSD Document Development and Maintenance – Draft

E-4 Independent Measurement Calibration for Ludlum Model 19

E-5 Independent Measurement Calibration for EXP-1

E-6 Informational Report on Possible Leaking Source

E-7 Email Notification to NRC of Leaking Source

E-8 Findings Tracking Table

E-9 Recommendations Tracking Table 3-13-13

E-10 IRSC Action Tracking Table 3-12-13

E-11 Three RAM Receipt Forms

E-12 Three RAM Request Forms

E-13 Drill 2011 Building 245 Final

E-14 Legacy Sources FY13 Plan

E-15 License Inventory Compliance

E-16 NIST Form 1197, Occupational Health and Safety Orientation Checklist

RADIATION SAFETY INSTRUCTIONS

and

Interdivisional Procedures (IP)

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UPDATED 3/12/2013

PERSONNEL MONITORING — TAB C

RSI #	Title	Date
2-1	Personnel Monitoring Notifications	12/93
2-2	Personnel Monitoring Issuance/Return	12/93
2-3	External Dosimetry	12/93
2-5	Internal Dose Assessment	12/93
2-7	Visitor Dosimetry	12/93
6-6	Tritium Dose Assessment	02/28/12

MATERIAL ACCOUNTABILITY & CONTROL — TAB D

RSI #	Title	Date
1-5	Special Nuclear Material Accountability	03/01
4-4	Radioactive Material Acquisition and Usage Control	02/28/13
4-2	Radioactive Material Package Receipt	2/21/13
4-5	Sealed Source Leak Testing	08/08/12
4-8	B131 Controls	12/93
4-9	Transfer Protocol for Exempt Quantities	06/04
4-10	Special Nuclear Material Security Requirements	07/91
4-15	Radiological Hazard Review	09/02/10
4-16	Radiological Facility Commissioning	03/01/13
8-3	Radioactive Waste Disposal	12/93
IP 1-1	Radioactive Standard Reference Materials	03/05/13
IP 1-2	Increased Controls Security Program	1/18/12

RAD MONITORING — TAB E

RSI #	Title	Date
4-1	Radiation Facility Audits	03/08/2013
4-3	Large Source Usage	12/93
4-7	Air Sampling	10/25/12
5-1	Diffraction & Fluorescence X-ray Surveys	08/81
5-6	Co-60 Water Well Facility	06/02
5-7	Hood Filter Surveys	03/07
3-1	Reactor In-Plant Monitoring Summary	12/93
3-2	Radiation Work Permit	03/01
3-3	Reactor Survey Operations	03/01
3-5	Coolant Sampling	12/93
3-8	Contaminated Materials at NBSR	03/01

ENVIRONMENTAL MONITORING — TAB F

RSI #	Title	Date
8-1	Liquid Radioeffluent Releases	02/27/13
8-2	Environmental Sampling	12/93
8-4	Reactor Stack Monitoring	3/22/12
8-5	Environmental Thermoluminescent Dosimetry	2/28/12
8-6	Environs Radiation Surveys	12/93
8-7	Bldg. 245 Liquid Waste System	03/96

RADIOLOGICAL INSTRUMENTATION		TAB G
RSI #	**Title**	**Date**
7-0	Quality Assurance	10/95
7-1	Beckman Liquid Scintillation Spectrometer	03/89
7-2	NMC Gas Flow Proportional Counters	10/95
7-3	Hand and Shoe Monitors	11/81
7-4	Gamma Survey Instrument Calibration	10/95
7-5	Neutron Survey Instrument Calibration	01/90
7-6	Alpha Survey Instrument Calibration	01/90
7-7	Low Level Alpha/Beta Analysis	10/25/12
7-8	Gamma Spectroscopy System (Bldg 235)	2/28/12
7-8A	Gamma Spectroscopy System (Bldg 245)	10/25/12
7-10	Staplex Air Sampler Calibration	10/25/12
7-11	Pulser Calibration of Count Rate Instruments	03/96
7-12	Packard and Perkin Elmer LS Counters (Bldg 235)	2/28/12
7-12A	Packard and Perkin Elmer LS Counters (Bldg 245)	10/25/12
7-13	Radiological Portal Monitors	2/28/12
7-15	Calibration of Air Sampling Pumps	10/25/12

Distribution:

Controlled Copy #1 of #4 Bldg. 245, Room C121
Controlled Copy #2 of #4 Bldg. 245, Room C108
Controlled Copy #3 of #4 Bldg. 235, Room B105
Controlled Copy #4 of #4 Bldg. 245, Room B116

Title:	GRSD DOCUMENT CONTROL PROGRAM		
Document Number:	RSI A 1-9	Revision Number:	0
Effective Date:	xx-xx-2013		
Review Cycle:	☐ 1 yr	☐ 2 yr	☒ 3 yr
Document Type:	☐ GRSD Policy	☐ Manual	☐ Desktop Instruction
	☐ GRSD Position Paper	☒ Radiation Safety Instruction (RSI)	☐ Job Aid
	☐ Interdivisional Procedure (IP)	☐ Procedural Note (ProNote)	☐ Good Working Practice Guide
Status:	☒ New	☐ Minor revision	☐ Deactivate / Cancel
	☐ Major revision	☐ Reviewed, no revision	☐ IRSC Concurrence
Type of Training:	☒ Required Reading	☐ Briefing / Classroom	
	☐ On-Job-Training	☐ Self-paced Instruction	

Title	Name (Print)	Title	Signature	Date
Author:				
Technical Reviewer:				
GRSD GL				
GRSD GL				
GRSD Chief				
Interdivisional OU GL				
Interdivisional OU GL*				

* Additional signatures as applicable

Revision History

Revision	Date	Comments
0	xx/xx/13	Original document

A. GENERAL

1. Purpose

The purpose of this procedure is to provide GRSD Document Control Program (DCP) and implementation requirements. This DCP establishes basic functions for the processing and controlling of documents.

The intent of a document control program is to provide a systematic and deliberate process for the development, review, approval, communication, use, and revision of formal documents (e.g., policies, desktop instructions, procedures, plans, drawings, and contracts) that prescribe processes, specify requirements, or establish design.

Documents determined by the Chief, GRSD to be subject to increased levels of analysis, management control, documentation or actions shall be placed under a formal change control process.

2. Scope

This procedure applies to GRSD personnel who develop, control, and use documents that govern activities in support of NIST Gaithersburg Radiation Safety Program.

All new or revised GRSD documents are subject to the requirements of this RSI. Documents developed and approved using earlier processes are exempted from the requirements of this RSI until such documents require maintenance (e.g., revision or cancellation).

This procedure addresses process steps after a document has been created, cancelled or revised with subsequent approval. The process prior to approval is addressed in RSI A 1-10 GRSD Document Development and Maintenance.

This procedure does not address the specific requirements for records, forms or correspondence or document control outside of GRSD.

B. ACRONYMS AND DEFINITIONS

1. Acronyms

CFR	Code of Federal Regulations
DCC	Document Control Coordinator
DCP	Document Control Program
GRSD	Gaithersburg Radiation Safety Division
MS	MicroSoft
PDF	Portable Document Format
RSI	Radiation Safety Instruction

2. Definitions

Change	Any modification to an existing document. A change may make major or minor modifications to the document, modify a document's effective date, or cancel the document.
Controlled Documents	Revision-controlled documents that are distributed through a Controlled Distribution Process whenever changes or revisions occur.
Document	Recorded information (e.g. procedures, policies, etc.), administrative or technical in nature including requirements, specifications and inspection instructions, and drawings, which may be in hard copy form or electronic form. This would include, but is not limited to, policies, Manuals, Procedures, RSIs, ProNotes, Desktop Instructions and Job Aides
Document Control	The task of identifying, reviewing, processing, distributing, controlling, protecting, and maintaining of documents that prescribe processes, specify requirements, or establish design.
Document Control Coordinator (DCC)	A person designated by management to serve as the GRSD's coordinator of document control activities and processes. This includes, but is not limited to the processing, distributing, controlling, protecting, and maintenance of documents.
Functional Title	Functional titles instead of GRSD titles are sometimes used to describe document performers. Functional titles describe responsibilities based on the role that an individual assumes in a document, which may not match the GRSD responsibilities of the individual. Individuals selected to fulfill the responsibilities of a functional title are selected based on their qualifications.
Management	Within the context of this document, refers to the GRSD Division Chief and/or both Group Leaders.
Revision	A change to an existing document (includes rescinding of a document) that requires GRSD inputs and/or concurrence(s).
should, shall and may	**should:** In regulatory compliance indicates an action is desirable but not mandatory. **shall:** In regulatory compliance means an action is mandatory. **may:** In regulatory applications implies an action is not mandatory, but is permissible.

C. Responsibilities

NOTE *Some of the positions listed are designated as functional titles rather than GRSD position titles, and describe functional responsibilities.*

1. GRSD Chief

a. Approve or reject new documents and document modifications (i.e., new documents, document revisions and changes, and document cancellations).

b. Designate and appoint a GRSD DCC that is responsible for the management and oversight of the GRSD's document control program.

c. Specifies document periodic review freqeuency.

2. Document Control Coordinator (DCC)

a. Maintains the GRSD's document control system, which manages and controls all organizational GRSD documents, as appropriate.

b. Serves as the GRSD's main point of contact for all GRSD documents and record retention management that are submitted by GRSD staff.

c. Participates in the GRSD's management assessments of document control activities and assists management in the development of corrective action plans, as appropriate. This also includes providing feedback to management for the continuous quality improvement of document control activities.

d. Provides the adequate protection and access controls to documents and records in the GRSD's document control system.

D. INSTRUCTIONS

Once a document is approved, the DCC will follow the instructions of this section as applicable.

1. Cancellation

This section is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

a. The electronic form of the document is removed from the Controlled Copy area of the GRSD website and moved to the Archived area.

b. Document hardcopies are removed from Controlled Copy binders. The original (signed) document shall be archived for a period of at least the term of the NRC license.

2. Addition

This section is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

a. The electronic (i.e. MS WORD) version of the document is converted to a fixed document format that cannot be edited by the GRSD staff (i.e. Adobe Acrobat PDF).

b. The Title page (original signature page) is scanned and replaces the converted unsigned Title page.

c. The new document is then added to the Controlled Copy area of the GRSD website. The fix format document is made available to the GRSD staff. The editable version is stored for future use and is access restricted.

d. Hard copies are then added to Controlled Copy binders. The original signed copy is kept in Binder 4 of 4.

3. Changes

This section is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

a. The electronic form of the previous document revision is removed from the Controlled Copy area of the GRSD website and moved to the Archived area.

b. The electronic (i.e. MS WORD) version of the new changed document is converted to a fixed document format that cannot be edited by the GRSD staff (i.e. Adobe Acrobat PDF).

c. The Title page (signature page) is scanned and replaces the converted Title page.

d. The revised document is then added to the Controlled Copy area of the GRSD website. The fix format document is made available to the GRSD staff. The editable version is stored for future use and is access restricted.

e. Previous document revision hardcopies are removed from Controlled Copy binders. The original (signed) document shall be archived for a period of at least the term of the NRC license.

f. Hard copies of the revised document are then added to Controlled Copy binders. The original signed copy is kept in Binder 4 of 4.

E. REFERENCES

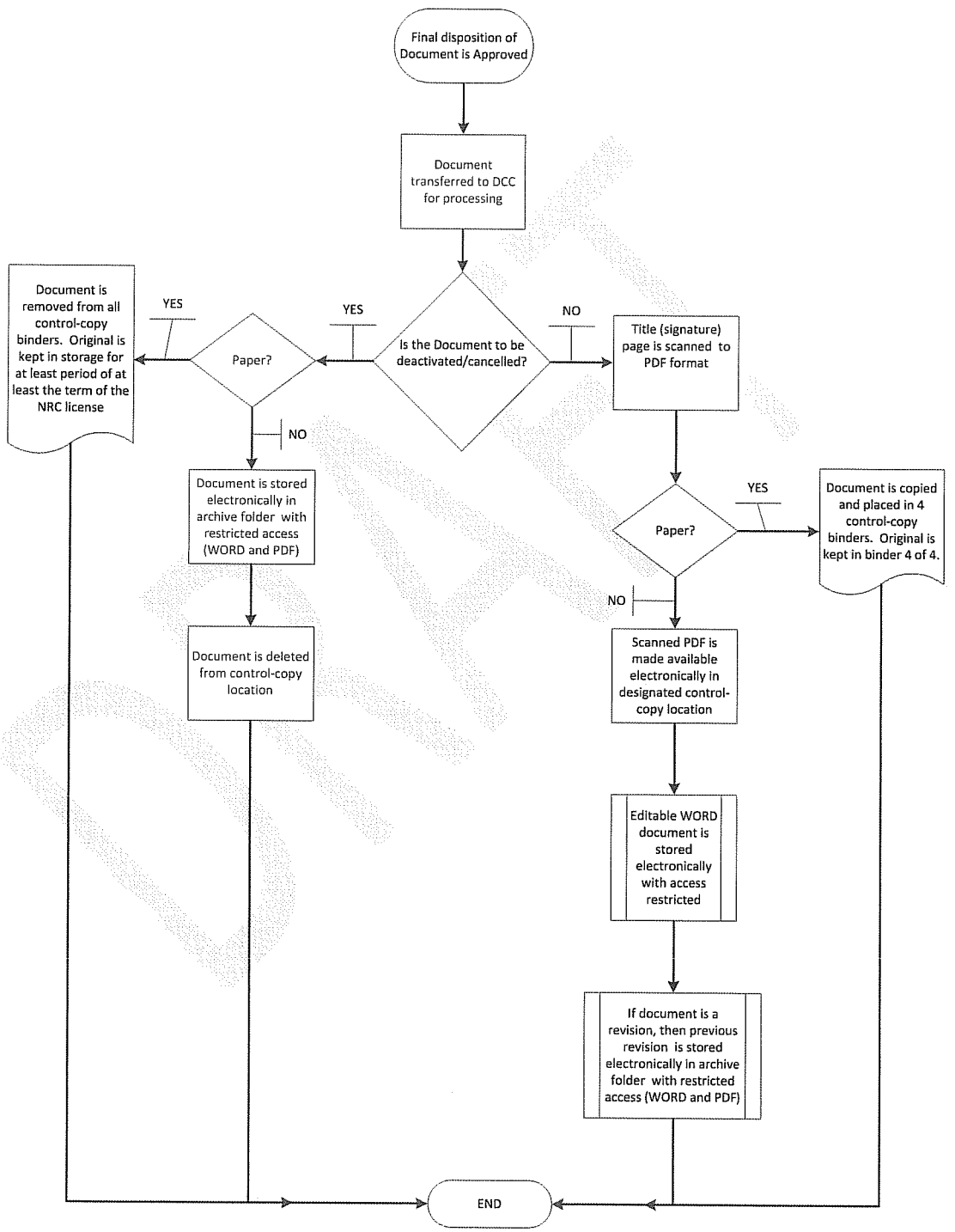
1. American National Standard – Quality Management Systems – Requirements; ANSI/ISO/ASQ Q9001-2000

2. 10 CFR 20.2102

3. RSI A 1-10 GRSD Document Development and Maintenance

APPENDIX A

DOCUMENT CONTROL LIFECYCLE FLOW-DIAGRAM



Title:	GRSD DOCUMENT DEVELOPMENT AND MAINTENANCE		
Document Number:	RSI A 1-10	Revision Number:	0
Effective Date:	XX-X-2013		
Review Cycle:	☐ 1 yr	☐ 2 yr	☒ 3 yr
Document Type:	☐ GRSD Policy	☐ Manual	☐ Desktop Instruction
	☐ GRSD Position Paper	☒ Radiation Safety Instruction (RSI)	☐ Job Aid
	☐ Interdivisional Procedure (IP)	☐ Procedural Note (ProNote)	☐ Good Work Practice Guide
Status:	☒ New	☐ Minor revision	☐ Deactivate / Cancel
	☐ Major revision	☐ Reviewed, no revision	☐ IRSC Concurrence
Type of Training:	☐ Required Reading	☒ Briefing / Classroom	
	☐ On-Job-Training	☐ Self-paced Instruction	

Title	Name (Print)	Title	Signature	Date
Author:				
Technical Reviewer:				
GRSD GL				
GRSD GL				
GRSD Chief				
Interdivisional OU GL				
Interdivisional OU GL*				

* Additional signatures as applicable

Revision History

Revision	Date	Comments
0	xx/xx/13	Original document DRAFT

Table of Contents

A. General

1. Purpose

The purpose of this RSI is to provide the methodology, framework, and minimum requirements for developing and controlling Gaithersburg Radiation Safety Division (GRSD) documents (e.g., policies, procedures, ProNotes and other general documents). This RSI implements the applicable guidance in support of, of the following:

- NIST Policies
- NIST Orders
- NIST Sub-orders
- NIST NRC License SNM-362
- NIST NRC License 19-23454-01E

2. Scope

This procedure applies to GRSD personnel who develop, control, and use documents that govern GRSD activities.

All new GRSD documents and revisions to approved documents shall follow the requirements in this RSI. Documents developed and approved using earlier processes are exempted from the requirements of this RSI until a previously approved document requires maintenance (e.g., revision or cancellation).

This RSI details the development, review, approval, and maintenance of the documents used by GRSD. GRSD documents provide a level of detail that takes into account the target audience of the document, the complexity of the task, the frequency of the task performed, the records required, the degree of standardization required, the radiological hazards associated with performing the activity and the controls necessary to mitigate the associated hazards.

New and revised documents (e.g. IPs) that directly impact organizations outside of GRSD shall be reviewed and concurred by those organizations.

The following documents are excluded from the requirements of this RSI, but the processes of this RSI may be adopted:

- Documents outside GRSD purview
- Radiological Work Permits (RWPs)

This RSI does <u>not</u> address requirements for how documents are to be utilized.

B. ACRONYMS AND DEFINITIONS

1. Acronyms

CFR	Code of Federal Regulations
DOC	Department of Commerce
DOE	Department of Energy
GL	Group Leader
GRSD	Gaithersburg Radiation Safety Division
GWPG	Good Work Practices Guide
IP	Interdepartmental Procedure
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
OJT	On-the-Job Training
OU	Organizational Unit
RSI	Radiation Safety Instruction (procedure)
RWP	Radiation Work Permit
SME	Subject Matter Expert
SNM	Special Nuclear Material
STD	Standard

2. Definitions

Approval	The acquisition of signature and/or agreement that the reviewer has accepted the technical content and intent of the document in full on behalf of the organization/group they represent. Approval of a document may be documented by email or phone conversation to be followed by signature during document finalization.
Author	The functional title for the individual assigned to write a document. The Author completes the process for new and revised documents. The Author works closely with Technical Reviewers, SMEs, and management during the writing process.
Change	Any modification to an existing document. A change may make major or minor modifications to the document, modify a document's effective date, or cancel the document.
Concurrence	The acquisition of signature and/or agreement that the reviewer has accepted the technical content and intent of the document.
Document	Recorded information (e.g. procedures, policies, etc.), administrative or technical in nature including requirements, specifications and inspection instructions, and drawings, which may be in hard copy or electronic form.
Effective Date	The date on which the provisions/requirements for a document become mandatory for the activity and training.

Functional Title	Functional titles, instead of GRSD titles, are sometimes used to describe individuals who participate in the document development process. Functional titles describe responsibilities based on the role that an individual assumes in a document, which may not match the GRSD responsibilities of the individual. Individuals selected to fulfill the responsibilities of a functional title are selected based on their qualifications.
Hazard Analysis	A technique used to assist in identifying hazards. The types of techniques include What-If/Checklist, Hazard and Operability analysis, and Failure Modes and Effects Analysis. An outcome of the hazard analysis may include residual risk level determination.
Major Revision	A change to a document that affects the original purpose, scope, safety, hazards, hazard controls, technical content, or intent of the approved document that cannot be characterized as a Minor Revision. Any change that addresses any regulatory requirement or NIST policy.
Management	Within the context of this document, refers to the GRSD Division Chief and/or Group Leaders.
Minor Revision	Any of the following: ❖ Correcting grammar or spelling, without changing the meaning (editorial correction). ❖ Renumbering sections or attachments. ❖ Updating titles without changing assigned responsibilities. ❖ Updating the number or title of other documents referenced in the document. ❖ Revising or reformatting forms, providing the original intent of the form has not been altered. ❖ Changes to attachments marked "Example", "Sample", or exhibits that are clearly intended to be representative only. ❖ Minor clarification changes ("clarification" cannot add or delete steps, change the step-by-step process of the work, or change the scope/applicability of any steps). ❖ A change in an GRSD title that is not accompanied by a change in responsibilities.
Revision	A change to an existing document (includes rescinding of a document) that requires affected organization(s) inputs and/or concurrence(s).
should, shall and may	**should:** In regulatory compliance indicates an action is desirable but not mandatory. **shall:** In regulatory compliance means an action is mandatory. **may:** In regulatory applications implies an action is not mandatory, but is permissible.
Subject Matter Expert (SME)	The SME demonstrates technical expertise and knowledge in a specific subject area and provides technical, system, and process information.
Technical Reviewer	The functional title for the designated SME who assists the author in developing the technical-basis documentation and the document drafts.

C. Responsibilities

NOTE *Some of the positions listed are designated as functional titles rather than GRSD position titles, and describe functional responsibilities. The GRSD* may *select a qualified individual to fill any of these roles. Assignment* may *vary from document to document.*

1. GRSD Chief

a. Approve or reject new documents.

b. Approve or reject document modifications (i.e. document revisions and cancellations).

c. Delegate authority to GRSD Group Leader(s) for approval or rejection of:

   i. Minor revisions of documents providing the change does not affect regulatory compliance or NIST policy.

   ii. ProNotes

   iii. Desktop Instructions

   iv. Job Aids

d. Assigns individuals to act as Authors and Technical Reviewers as well as ensure that they are trained, as necessary. to perform their roles.

e. Primarily responsible for coordinating the activities of personnel assigned to develop, revise, change, and review documents, and ensuring required development activities are performed.

f. Ensures appropriate training is conducted.

g. Ensures that necessary organizations or individuals review and concur with documents and that revisions are identified to ensure accuracy, usability and compliance with applicable requirements.

h. Ensures that the activities of personnel assigned to develop, revise, change and review documents are coordinated, and ensure required development activities are performed and documented.

i. Responsible and accountable for the quality, accuracy, usability, and compliance of documents and changes to existing documents.

j. Determines whether documents will either meet license requirements or requires the submittal of a license amendment.

k. Confirms the type of document is appropriate.

l. Specifies document periodic review frequency based on GRSD policy.

2. GRSD Group Leaders (GL)

a. Concurs or rejects new documents.

b. Concurs or rejects document modifications (i.e. document major revisions, cancellations, etc.).

c. Approval or rejection of:

i. Minor revisions of documents.

ii. ProNotes

iii. Desktop Instructions

iv. Job Aids

d. Assigns necessary training (OJT, Classroom, etc.) as determined by GRSD Chief.

3. GRSD Staff

a. Assigns document numbers (when applicable) in accordance with established GRSD practises.

b. Initiates the development of new documents, the periodic revision of existing documents and the cancellation of documents that are no longer required.

c. Ensures that documents are cancelled when they are obsolete or no longer required.

d. Ensures resolution of review comments.

e. Ensures that the target audience for documents (e.g., Document Users) is identified.

f. Ensures the quality, accuracy, usability, and compliance of documents and changes.

g. Identifies specific requirements/drivers for the document development.

h. Responsible for routine maintenance of documents.

4. Author

a. Functional title.

b. Ensures that documents are prepared in accordance with this RSI.

c. Ensures that documents are written in an understandable way for the Document User(s).

d. Proposes the type of document needed.

e. Ensures that document comments are incorporated or resolved.

f. Ensures that technical documents incorporate the identification of hazardous associated with the activity (hazard analysis) and that the appropriate hazard controls are incorporated into the document.

g. Incorporates applicable regulatory and administrative requirements into documents.

h. May identify the sequential steps required for the activity/task.

i. Reviews documents (e.g., NIST policies, RSIs, etc.) for process specific requirements and hazards.

j. Reviews documents for completeness and accuracy.

5. Technical Reviewer

a. Functional title.

b. SME who assists the Author in resolving comments during the review process of document development.

c. Concurs with the final version of the document.

d. Incorporates applicable contractual, regulatory, and administrative requirements into documents and revisions.

e. Reviews the document for completeness and accuracy, and provides comments.

f. Reviews documents (e.g., NIST policies, RSIs, etc.) for process specific requirements and hazards.

g. Is not needed to review Desktop Instructions or Job Aides. Appendix A provides a summary of documents and their respective review, concurrence and approval authorities.

D. INSTRUCTIONS

Previously approved documents are modified as described in Section 2 of this part, Document Maintenance.

The appropriate document should satisfy the need of the GRSD as well as the user. The document selection process allows for a variety of document types to control work. Each

document type is designed to satisfy the necessary and sufficient standards for the specific work that is being controlled.

1. New Document

This section is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

a. A new need for a consistent controlled process is identified by GRSD staff.

b. The document selection is accomplished by using the table, Document Hierarchy (refer to Appendix A), which summarizes the type, purpose, applicability and signature requirements for the different applicable document types.

c. Refer to Appendix B New Document Development Flow Diagram.

d. GRSD Chief assigns an Author and Technical Reviewer (if applicable).

e . GRSD Chief approves the recommended type of document (refer to Appendix A).

f. IF the document affects organizations outside of the GRSD (e.g. IPs), THEN notify the affected organization's management of the need to identify individuals to participate in the document development/review, and of the proposed development schedule. Signature approval is required from the OU GL.

g. Before beginning the process of developing a document; the basis (e.g., regulatory requirements and standards) for the document must be identified. The process of establishing the basis for a document involves researching and planning the content of the document. The extent of research and planning depends on the complexity of the activity being documented and whether a new document is being created or an existing document is being modified. Generating this basis is typically performed by initial interactions between the Author, Technical Reviewer and identified SMEs. For documents that have direct regulatory impact, it is recommended that a matrix be created to show each basis element identified for the document and how each basis element is to be implemented within the document.

h. Author should consider generating the initial document development information for assessment by Technical Reviewers and SMEs. NOTE: The following topics should be considered when preparing document content:

   i. Roles and responsibilities

   ii. Applicability

   iii. Scope/Boundaries

   iv. Hazards and controls

v. Prerequisites

vi. Implementation requirements

vii. Training

i. For technical documents used to perform a physical task; the author should include the necessary controls for those hazards identified in the applicable hazard analysis to prevent personnel injury and reduce the risk of damage to equipment.

j. Forms may be included in documents as appendixes/attachments, with the appendix/attachment being the actual form used or a sample copy of the form that is to be obtained from another location (e.g., webpage). Forms generated from an appendix/attachment are identified in the footer of the form with the associated document number left justified; appendix/attachment number centered; and associated document revision number right justified.

Forms obtained from another location should have an example as appendix/attachments with "Sample Copy" clearly watermarked on the form. A description of how the form can be located should also be included.

k. If available, an electronic document template should be obtained.

l. Prepare a draft document of the sequential steps necessary to perform the activity/task (Refer Appendix C) and to satisfy identified requirements, as applicable, ensuring that all of the following applicable components are included in the document (refer to Appendix C for quick reference).

m. Document Components

i. Title Page (required):

(1) Document title

(2) Document number

(3) Revision number (0 for draft, 1 for finalized)

(4) Effective date

(5) Periodic review cycle (e.g., 2 yr)

(6) Document type (e.g., policy, RSI)

(7) Status (e.g., new, major revision, or cancellation)

(8) Training (e.g., required reading)

(9) Author's signature

(10) Technical Reviewer's signature (if applicable)

(11) Management signature(s)

(12) Interdivisional organization signature(s) (if applicable)

ii. Revision History (required)

iii. Table of Contents (optional)

iv. List of Figures (optional)

v. List of Tables (optional)

vi. General (required except for job aids)

(1) Purpose

(2) Scope

vii. Policy (for policies only)

viii. Definitions/Acronyms (required except for desktop instructions and job aids). IF a separate Definitions/Acronyms document exists, THEN reference can be made to it instead.

ix. Responsibilities (required except for RSIs, GWPGs, desktop instructions, ProNotes and job aids)

x. Instructions (required for RSIs and ProNotes only):

(1) Instruction sections are written to be used independently. The following statement should appear before Instructions section. Notation should be in italics as follows:

This section is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

(2) Tasks formatted as action statements with performance clearly identified, and

(3) Tasks numbered where the order of performance is mandatory unless specifically noted otherwise. Notation should be in italics as follows:

This section is a stand-alone section and may be performed out of sequence.

(4) When physical tasks are performed, ensure that the hazards and hazard controls associated with the activity are incorporated into the document

xi. The identification of records generated by the document (required except for desktop instructions and job aids). IF there are no records created, THEN this section shall be omitted.

xii. References, including drivers for the document, as applicable (required except for desktop instructions and job aids)

(1) Regulatory (e.g. Code of Federal Regulations (CFRs), Department of Commerce (DOC) Directives, NIST Policies]

(2) Technical (e.g. industry or technical standards, and contractual requirements]

xiii. Training Program (optional)

xiv. Appendixes/Attachments (optional)

(1) Forms / Samples

(2) Compliance matrices

(3) Flow charts

(4) Other

xv. Each page (except the title page) is to contain the following information in the header (required):

(1) Document title
(a) Left justified

(2) Document number
(a) First line
(b) Right justified

(3) Revision number
(a) Second line
(b) Right justified

(4) Page number
(a) Third line
(b) Right justified
(c) Format is: Page X of Y (extended throughout entire document).

n. Document Review and Approval

i. Author distributes the draft document and forms (if applicable) clearly indicated as a DRAFT to identified reviewers.

ii. Technical Reviewer will, if applicable, review and evaluate the document and forms, as it applies to areas of expertise, for technical adequacy, accuracy, completeness, and compliance with established requirements. Document with or without comments are returned to the author.

iii. Author makes changes, if any, to the document in response to Technical Reviewer comments. Once final resolution has been met; the document is then sent for management approval.

iv. Author and Technical Reviewer assess management comments (if any). Once concurrence is met from Author, Technical Reviewer and management; the following steps are taken:

(1) IF document requires approval from outside GRSD, THEN the document is made available to outside stakeholders for approval. The Author, Technical Reviewer or GRSD manager will interact with outside stakeholders to ensure timely resolution. Signature approval is required from the OU GL.

(2) IF document is a Desktop Instruction or Job Aide, THEN "Not applicable" is written in the Technical Reviewer Signature block.

(3) IF document is not an IP, THEN "Not applicable" is written in the Interdivisional OU GL Signature blocks.

(4) IF a new document or modification affects the contents of other documents, THEN initiate revisions to the affected documents.

(5) Determine the appropriate review cycle (refer GRSD policy). Review cycles may be shorter if desired.

(6) Determine the type of training needed:
- (a) Required Reading
- (b) On-Job-Training
- (c) Briefing / Classroom
- (d) Self-paced Instruction

(7) Determine an effective date for the document that takes into account the training and implementation schedules.

o. Author generates the final document and obtains authorizing signatures. Job Aids that are not part of an approved document is documented by signing and dating the Job Aid.

2. Document Maintenance

This section is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

After a document is approved, it is maintained to ensure that it continues to be accurate and applicable. Document maintenance activities include major and minor revisions, cancellations and periodic review.

a. Refer to Appendix D, Document Maintenance Flow Diagram.

b. A procedural change is identified by GRSD staff. This change may take the form of a major revision, minor revision or cancellation.

c. GRSD Chief assigns an Author and Technical Reviewer (if applicable).

d. Author confirms the form of the procedural change.

e. Cancellation

This subsection is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

i. For cancellation a Technical Reviewer is not required.

ii. Author reviews document and determines if it is no longer relevant or if it is superseded by other document(s).

iii. IF the document is superseded, THEN the Author confirms that all requirements set forth in the document have been addressed in its superseding document(s). If not all requirements of the document have been addresses, the Author will confer with management and determine an appropriate success path.

iv. Management reviews the Author's report confirming that either the document has been superseded appropriately or that the document is no longer relevant.

v. On the Title page, Status section, the "Deactivation/cancellation" checkbox is checked. The Author and Manager agree on an effective cancellation date and sign. "Not applicable" is written in the Technical Reviewer Signature block. Document stakeholders are then notified of the cancellation.

vi. Revision History is updated with reasons for the cancellation and references made to concepts that are moved to other superseding documents.

vii. For cancellation, Interdivisional OU GL approval is not required. "Not applicable" is written in the Interdivisional OU GL Signature blocks.

f. Minor Revision

This subsection is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

i. For Minor Revision a Technical Reviewer is not required.

ii. Refer to the definitions section for Minor Revision.

iii. Author reviews the document and makes the appropriate changes.

iv. Author adds each change to the Revision History section of the document. Very minor changes such as the addition of a comma need not be documented.

v. Management reviews the changes and works with the Author on any outstanding items.

vi. On the Title page, Status section, the "Minor Revision" checkbox is checked. The Author and Manager agree on an effective date and sign. Document stakeholders are then notified of the new revision.

vii. For minor revision, Technical Reviewer approval is not required. "Not applicable" is written in the Technical Reviewer Signature blocks.

viii. For minor revision, Interdivisional OU GL approval is not required. "Not applicable" is written in the Interdivisional OU GL Signature blocks.

g. Major Revision

This subsection is a stand-alone section and may be performed independently of, or in conjunction with other Instructions sections.

i. This subsection follows, in general, the logic path for new documents and is reiterated here for clarity.

ii. Refer to the definitions section for Major Revision.

iii. IF the document affects organizations outside of the GRSD, THEN notify the affected organization's management of the need to identify individuals to participate in the document development/review, and of the proposed development schedule. Signature approval is required from the OU GL.

iv. Before beginning major revision of a document; the basis (e.g., regulatory requirements and standards) for the document must be identified. The process of establishing the basis for a document involves researching and planning the content of the document. The extent of research and planning depends on the complexity of the activity being documented and whether a new document is being created or an existing document is being modified. Generating this basis is typically performed by initial interactions between the Author, Technical Reviewer and SMEs. For documents that have direct regulatory impact, it is recommended that a matrix be created to show each basis element identified for the document and how each basis element is to be implemented within the document.

v. Author should consider generating the document development information for assessment. NOTE: The following topics should be considered when preparing document content:

(1) Roles and responsibilities

(2) Applicability

(3) Scope/Boundaries

(4) Hazards and controls

(5) Prerequisites

(6) Implementation requirements

(7) Training

vi. For technical documents used to perform a physical task; the author should include the necessary controls for those hazards identified in the applicable hazard analysis to prevent personnel injury and reduce the risk of damage to equipment.

vii. Forms may be included in documents as appendixes/attachments, with the appendix/attachment being the actual form used or a sample copy of the form that is to be obtained from another location (e.g., webpage). Forms generated from an appendix/attachment are identified in the footer of the form with the associated document number left justified; appendix/attachment number centered; and associated document revision number right justified.

Forms obtained from another location should have an example as appendix/attachments with "Sample Copy" clearly watermarked on the form. A description of how the form can be located should also be included.

viii. Ensure the sequential steps necessary to perform the activity/task and to satisfy identified requirements, as applicable, are appropriate and confirm that all of the following applicable document components are included and updated in the document:

(1) Title Page (required):
- (a) Document title remains the same. IF the changes create a broadening of scope or a change in direction leading to the necessity of a title change, THEN the existing document should be cancelled and a new document created
- (b) Document number remains the same
- (c) Revision number is incremented by one
- (d) Effective date is determined
- (e) Periodic review cycle (e.g., 2 yr) is reassessed
- (f) Document type (e.g., policy, RSI) remains the same
- (g) Status is major revision
- (h) Training (e.g., required reading) is reassessed
- (i) Author's signature
- (j) Technical Reviewer's signature (if applicable)
- (k) Management signature(s)
- (l) Concurring organization signature(s) (if applicable)

(2) Author adds each change to the Revision History section of the document. Very minor changes such as the addition of a comma need not be documented.

(3) Table of Contents (updated as necessary).

(1) List of Figures (updated as necessary).

(2) List of tables (updated as necessary).

(3) General (updated as necessary)
  (a) Purpose
  (b) Scope

(4) Policy (for polices only)

(5) Definitions/Acronyms (updated as necessary)

(6) Responsibilities (updated as necessary)

(7) Instructions (updated as necessary)

(8) The identification of records generated by the document (required except for desktop instructions and job aids). IF there are no records created, THEN this section shall be omitted (updated as necessary).

(9) References, including drivers for the document, as applicable (updated as necessary)

(10) Training Program (updated as necessary)

(11) Appendixes/Attachments (updated as necessary)

(12) Header information remains consistent (when applicable) with existing document.

ix. Document review and approval Document Review and Approval

(1) Author distributes the Major Revision document and forms (if applicable) clearly indicated as a Major Revision to identified reviewers.

(2) Technical Reviewer will, if applicable, review and evaluate the document and forms, as it applies to areas of expertise, for technical adequacy, accuracy, completeness, and compliance with established requirements. Document with or without comments are returned to the author.

(3) Author makes changes, if any, to the document in response to Technical Reviewer comments. Once final resolution has been met; the document is then sent for management approval.

(4) Author and Technical Reviewer assess management comments (if any). Once concurrence is met from Author, Technical Reviewer and management; the following steps are taken:
  (a) IF document requires approval from outside GRSD, THEN the document is made available to outside stakeholders for approval. The Author, Technical Reviewer or GRSD manager will interact with outside stakeholders to ensure timely resolution. Signature approval is required from the OU GL.

(b) IF document is a Desktop Instruction or Job Aide, THEN "Not applicable" is written in the Technical Reviewer Signature block.

(c) IF document is not an IP, THEN "Not applicable" is written in the Interdivisional OU GL Signature blocks.

(d) IF a modification affects the contents of other documents, THEN initiate revisions to the affected documents.

(e) Determine the appropriate review cycle (refer GRSD policy). Review cycles may be shorter if desired.

(f) Determine the type of training needed:
- (i) Required Reading
- (ii) On-Job-Training
- (iii) Briefing / Classroom
- (iv) Self-paced Instruction

(g) Determine an effective date for the document that takes into account the training and implementation schedules.

x. Author generates the final document and obtains authorizing signatures. Job Aids that are not part of an approved document is documented by signing and dating the Job Aid.

h. Periodic Review

i. For Periodic Review a Technical Reviewer is not required.

ii. Refer to Appendix E, Document Maintenance Flow Diagram Periodic Review.

iii. Author reviews the document.

iv. IF a need for revision or cancellation is identified, THEN the author confers with management and agrees on the appropriate path.

v. Management reviews the changes and works with the Author on any outstanding items.

vi. Include applicable Title page changes

E. REFERENCES

1. **DOE-STD-1029-92, Writers Guide for Technical Procedures**
2. **SNM – 362**
3. **GRSD Policy**

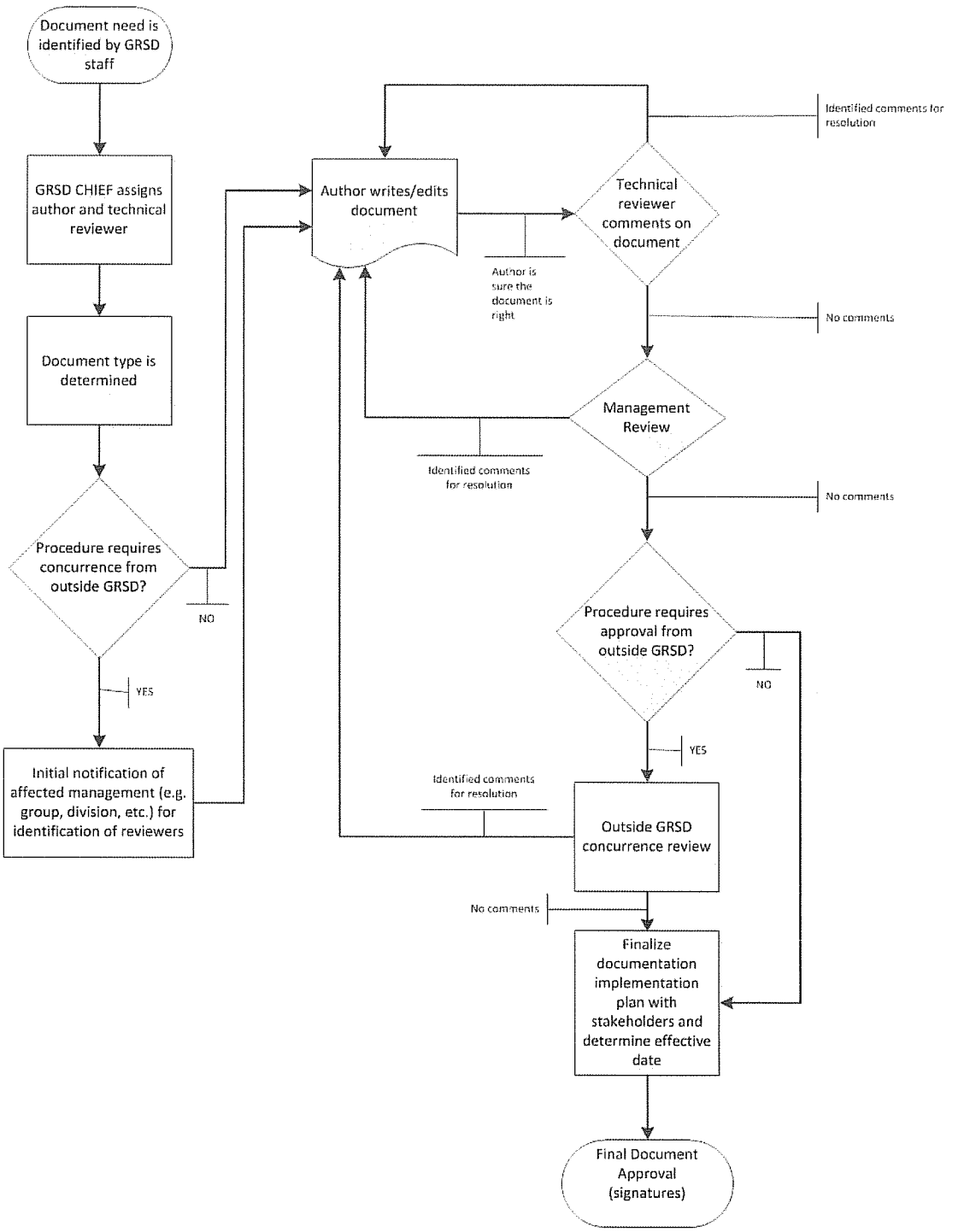
APPENDIX A Document Hierarchy

Document Type	Purpose	Applicability	Review / Concurrence	Review / Approval
Policy	Convey GRSD management's expectations for GRSD regarding values, principles, philosophies, goals, standards or accepted practices.	All affected GRSD staff and subcontractor employees	Technical Reviewer Author	Division Chief Group Leader(s)
Position Paper	Policy which focuses on a specific subject or single process.	All affected GRSD staff, all NIST personnel that use Radioactive Material under the SNM-362 License and subcontractor employees	Technical Reviewer Author	Division Chief Group Leader(s)
Interdivisional Procedure	Provide detailed steps and necessary information for performing a task or activity which may have moderate to high potential for risk, hazards, and consequences in a consistent and safe manner.	Any person who performs or has responsibilities within the associated task or activity	Technical Reviewer Author	Division Chief Group Leader(s) Affected OU GL
Manual	Incorporate the necessary and sufficient requirements needed to define and implement programs or facility safety envelopes, and identify roles and responsibilities.	All GRSD employees and subcontractor employees	Technical Reviewer Author	Division Chief Group Leader(s)
RSI	Provide detailed steps and necessary information for performing a task or activity with moderate to high potential for risk, hazards, and consequences in a consistent and safe manner.	Any person who performs or has responsibilities within the associated task or activity	Technical Reviewer Author	Division Chief Group Leader(s)
ProNote	Provide detailed steps and necessary information for performing a task or activity with low potential for risk, hazards, and consequences in a consistent and safe manner. Document is designed to obtain quick approval with minimal review for the purpose of stopgap. Scope should include a description of violation or finding and fix. Maximum effective period is 3 months.	Any person who performs or has responsibilities within the associated task or activity	Technical Reviewer Author	Group Leader(s)
Desktop Instruction	Describes activities or actions where: • No external or Safety Basis (SB) requirements are implemented • No hazard controls are required (other than to control routine hazards such as slips, trips, falls, pinching, and sharp edges) • No required (i.e., quality) data or records are developed, recorded.	Any person needing the assistance of the desktop instruction to perform the task or activity	Technical Reviewer Author	Group Leader(s)

Document Type	**Purpose**	**Applicability**	**Review / Concurrence**	**Review / Approval**
Job Aid	Provide individual instructions to perform a routine task or activity (eg flow chart, picture, list, etc.) that, if performed incorrectly, will have minimal consequences.	Any person performing a task or activity	Author	Group Leader(s)
Good Working Practices Guide	Goals, standards or accepted practices that may include specific instructions that establish good working practices but do not formal compliance.	All affected GRSD staff, all NIST personnel that use Radioactive Material under the SNM-362 License and subcontractor employees	Technical Reviewer Author	Division Chief Group Leader(s)

APPENDIX B

NEW DOCUMENT DEVELOPMENT FLOW DIAGRAM

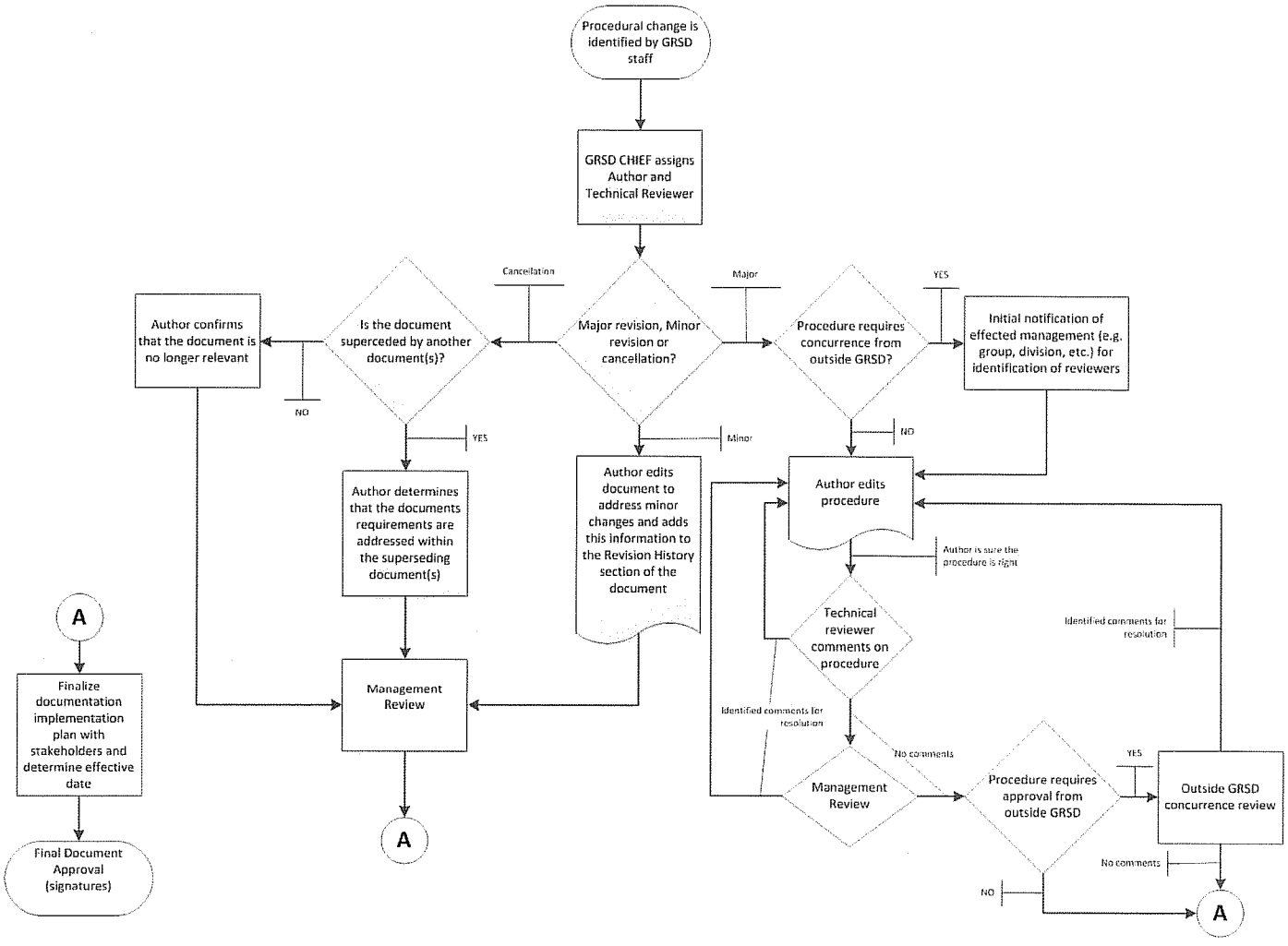


APPENDIX C Document Components Requirements Table

	Policy	Position Paper	IP	Manual	RSI	ProNote	Desktop Instruction	Job Aid	GWPG
Title Page	required	required	required	required	required	required	required	required	required
Revision History	required	required	required	required	required	required	required	required	required
Table of Contents	*optional*	*optional*	required	required	required	required	*optional*	*optional*	required
List of Figures	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*
List of Tables	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*
Purpose and Scope	required	required	required	required	required	required	required	*optional*	required
Policy	required	*optional*	NA	NA	NA	NA	NA	NA	NA
Definitions/Acronyms	required	required	required	required	required	required	*optional*	*optional*	required
Responsibilities	required	required	required	required	*optional*	*optional*	*optional*	*optional*	*optional*
Instructions	*optional*	*optional*	*optional*	*optional*	required	required	*optional*	*optional*	*optional*
Records	required	required	required	required	required	required	*optional*	*optional*	required
References	required	required	required	required	required	required	*optional*	*optional*	required
Training Program	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*
Appendixes/Attachments	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*	*optional*

APPENDIX D

DOCUMENT MAINTENANCE FLOW DIAGRAM



APPENDIX E

DOCUMENT MAINTENANCE FLOW DIAGRAM
Periodic Review

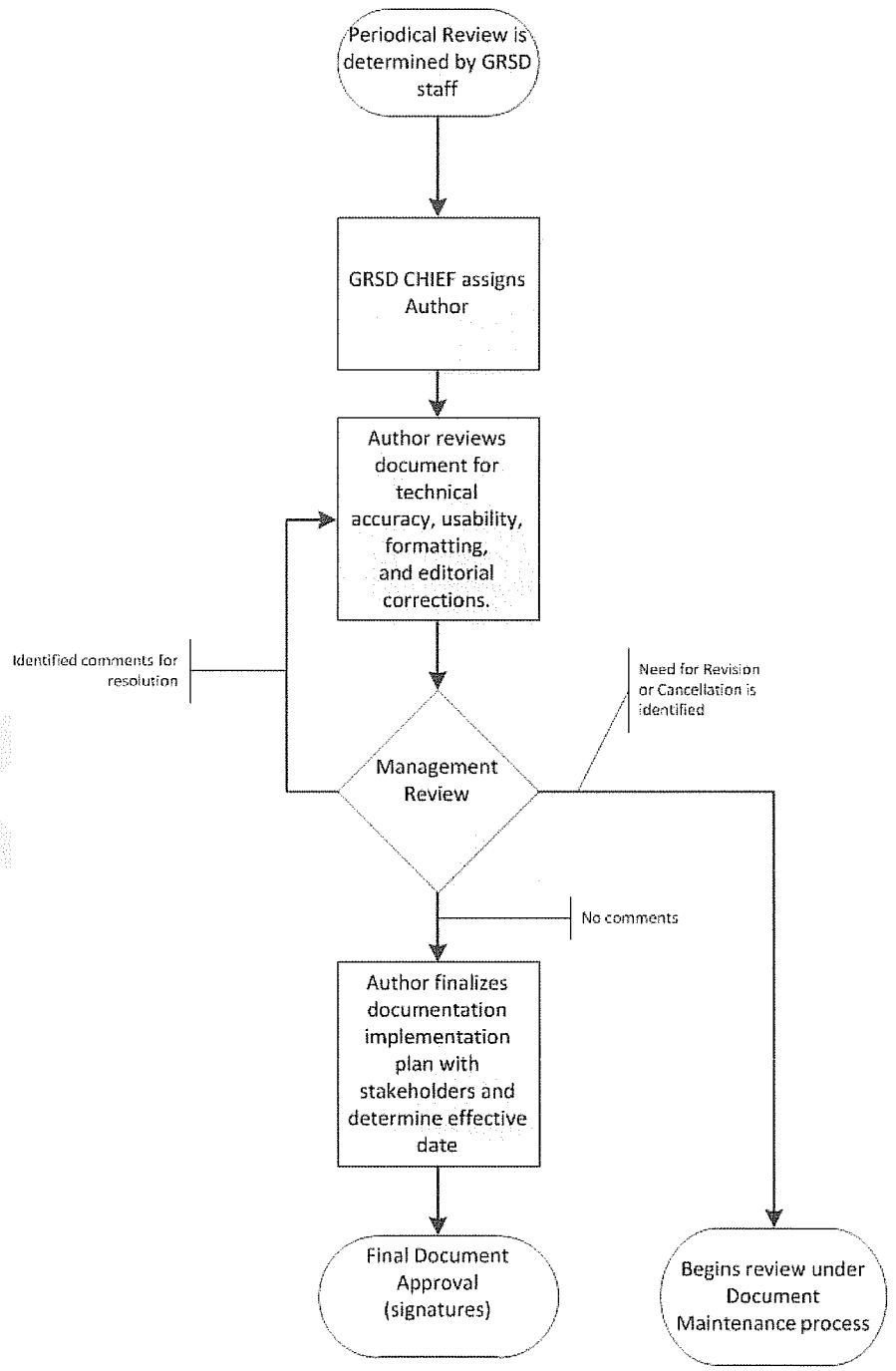


Exhibit 4

RSO, Inc.
P.O. Box 1450
Laurel, MD 20725
(301) 953-2482

RSO Job No. 10325

Certificate of Calibration

ISSUED TO: Tidewater, Inc.
7161 Columbia Gateway Dr.
Columbia, MD 21046

CONTACT: Claude Wiblin
PHONE: (410) 353-6450

INSTRUMENT: LUDLUM
MODEL: 19
TYPE: MICRO R
SN: 34880

PO NO: N214-001

RSO, Inc. certifies that on 03/07/2013 the above described instrument was calibrated in a known radiation field using Cs-137 (662 keV) beam calibrator (J.L. Shepherd Model 28-6A, S/N 10056), RSO # CS-7A, RSO # 378 Certified check sources.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data

RANGE	EXPECTED	OBSERVED	C.F.
25	5	5 * uR/hr	1.00
	20	20 * uR/hr	1.00
50	10	10 * uR/hr	1.00
	40	40 * uR/hr	1.00
250	50	50 * uR/hr	1.00
	200	200 uR/hr	1.00
500	100	110 uR/hr	0.91
	400	390 uR/hr	1.03
5000	1000	1000 uR/hr	1.00
	4000	3900 uR/hr	1.03
		C.F. AVERAGE	1.00

* Electronically pulsed.
*

Probe type(s) Probe1: SCINTILLATOR Probe2: Probe3:

MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1	EFF.(%)	ISOTOPE 2	EFF.(%)	ISOTOPE 3	EFF.(%)	ISOTOPE 4	EFF.(%)
INTERNAL		NONE	FRONT	771								

Note: "As Found" condition +/- 10% of Expected values unless indicated.

INSTRUMENT CHECKS

BATTERY CHECK: NORMAL
CHECK SOURCE 1: N/A READING:
CHECK SOURCE 2: N/A READING:

ENVIRONMENTAL

TEMP: 23°C
PRESS: 765 mmHg
HUMID: 28 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS 03/07/2014

Calibrated By: Richard Emmons Reviewed By: Cal Date: 03/07/2013

Richard Emmons

Maryland License MD-33-021-01

13551

Exhibit 5

CERTIFICATE OF CONFORMANCE

S.E. International, Inc.
P.O. Box 39, 436 Farm Rd. Summertown, TN 38483
1.800.293.5759 | Fax: 1.931.964.3564
www.seintl.com | radiationinfo@seintl.com

This is to certify that this instrument was manufactured using the standards of MIL-45208-A, and that the instrument was tested using standards whose accuracies are traceable to the National Institute of Standards and Technology. The accuracy is typically ± 15% of reading relative to Cs137. This Electronic Calibration complies with ANSI-Z-540.

This certificate warrants that the factory calibration is valid for 12 months from the date placed in service. If you would like to receive a notice for annual calibration service, please fill out the calibration database form in the back of the operation manual and send it to the address above.

NOTICE: ** The "Due Date of Recalibration" may be established (by the customer) by adding the "Cal Interval" to the "Date (the instrument) is Placed in Service" (Battery Installed).*

* Date Placed in Service: 3/8/13
* Due Date of Recalibration: 3/8/14

Respectfully
Submitted by:
Robbin Cramer
Quality Assurance

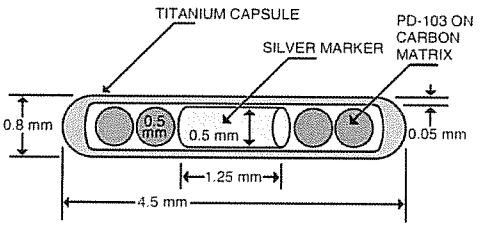
R. Cramer

(Place sticker on instrument)

Informational Report on Possible Leaking Source

Source Description

The brachytherapy sources used in NIST facilities are small titanium or plastic encapsulated cylinders approximately 5 mm in length and 0.8 mm in diameter. The diagram below shows an example of a Pd-103 brachytherapy seed, the IsoAid Model IAPd-103A.



A description of each source of Pd-103 that was received since May 2012 is provided below along with dates that the source was received and shipped.

IsoAid LLC, Model IAPd-103A, Source ID # CN3815, Pd-103, A_{app} = 5.5 mCi at 00:00:01 EST, 29 June 2012. Status: source received in 245/B08 on 6/29/12, shipped back to IsoAid on 7/9/12

IsoAid, LLC, Model IAPd-103A, Source ID # CN3975, Pd-103, A_{app} = 4.6 mCi at 00:00:01 EST, 7 September 2012. Status: source received in 245/B08 on 9/7/12, shipped back to IsoAid on 9/13/12

CivaTech Oncology, Model CivaString 10, Source ID # 11-1, Pd-103, A_{app} = 3.2 mCi at 00:00:01 EST, 13 July 2012. Status: source received in 245/B08 on 7/13/12, shipped to the University of Wisconsin on 7/19/12

CivaTech Oncology, Model CivaString 10, Source ID # 24-1, Pd-103, A_{app} = 3.5 mCi at 00:00:01 EST, 16 August 2012. Status: source received in 245/B08 on 8/16/12, shipped to the University of Wisconsin on 8/23/12

CivaTech Oncology, Model CivaString 10, Source ID # 28-1, Pd-103, A_{app} = 3.2 mCi at 00:00:01 EST, 24 September 2012. Status: source received in 245/B08 on 9/24/12, shipped to the University of Wisconsin on 10/1/12

Best Medical International Inc., Model 2335, Source ID # 14495A, Pd-103, A_{app} = 2.8 mCi at 00:00:01 EST, 17 September 2012. Status: source received in 245/B08 on 9/17/12, shipped to the University of Wisconsin on 10/9/12; shipped by University of Wisconsin to K & S Associates on 10/11/12

Best Medical International Inc., Model 2335, Source ID # 14495B, Pd-103, A_{app} = 2.7 mCi at 00:00:01 EST, 17 September 2012. Status: source received in 245/B08 on 9/17/12, shipped to the University of Wisconsin on 10/9/12; shipped by University of Wisconsin to K & S Associates on 10/11/12

Best Medical International Inc., Model 2335, Source ID # 14495C, Pd-103, A_{app} = 2.6 mCi at 00:00:01 EST, 17 September 2012. Status: source received in 245/B08 on 9/17/12, shipped to the University of Wisconsin on 10/9/12; shipped by University of Wisconsin to K & S Associates on 10/11/12

Source Leak Test Results

The source descriptions above provide the source receipt dates. The packages for all incoming shipments of these sources were checked and found to be free of contamination. All sources were either leak-tested by NIST upon receipt or were within the required leak test frequency based on leak test information supplied by the shipper. None of the above sources were identified as leaking or contaminated upon receipt. However, because NIST detected Pd-103 during a contamination survey (as described below), it is presumed that there may have been cross contamination present (from the manufacturing and handling process) or a leaking source. In the interest of maintaining open communication with the NRC, we are submitting this report for informational purposes.

Extent of Contamination

Routine surveillance of a NIST Radiation Facility used exclusively for calibration of sealed sources (245/B08) detected contamination on an implement used to manipulate brachytherapy seeds. A smear taken on the implement was found to have approximately 4×10^{-3} microcuries of Pd-103. Smears of other areas in the facility were negative for contamination.

Cause of Source Failure

Unknown

Corrective Actions

NIST has contacted each of the organizations that the sources were shipped to and advised them of the discovery of contamination. These organizations responded to NIST that they detected no contamination from any of these sources. The manufacturers of the sources were also advised of the contamination.

From: O'Brien, Thomas
Sent: Friday, June 17, 2011 12:17 PM
To: Kayser, Richard F.; Unterweger, Michael P.; McCord, Miles; Mitch, Michael G. Dr.
Cc: Pibida, Leticia; McGiff, Thomas James; Brown, David R.; Dimeo, Robert M; O'Kelly, Sean; Karam, Lisa R. Dr.
Subject: NRC Notification of Leaking Source

At approximately 11:20 am on 6/17/11, I called NRC Operations Center to advise them that NIST had discovered and was in possession of (under the SNM 362 license)at least one leaking U-232 source.

I faxed them Source Certificate information and additional information from Eckert & Ziegler.

The NRC Operations Center linked me to Sophie Holliday of NRC's Office of Federal and State Materials and Environmental Management Programs (FSME).

FSME is the office to which one reports leaking sources. The Operations Center is passing on the Source Certificate information and additional information from Eckert & Ziegler to FSME.

Ms. Holliday indicated that she would review the information and advise me of any further action needed.

GRSD is continuing decon work and will provide a summary report to the IRSC.

Rob/Sean- You are cc'd as FYI.

R/Tom
****

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Radiation Safety Program - Findings Tracking Table As of 3/14/2013

Finding # and Type	Finding Description	Regulatory Reference	Auditor's Recommendations	Contributing Factors
1 -SIV	Package receipt exceeding monitoring requirement	10 CFR 20.1906 (c) The licensee shall perform the monitoring required by paragraph (b) of this section as soon as practical after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.	The three hour survey requirement should be considered to start when Shipping/Receiving personnel sign for the material.	GRSD's procedure was based on the 3 hour requirement starting when packages were received in building 245.
2-SIV	Containers with radiation labels in unrestricted areas	10 CFR 20.1904(b) Each licensee shall, prior to removal or disposal of empty uncontaminated containers to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials.	The pigs need to be surveyed to verify that they do not contain residual material or contamination. Labels need to be defaced, removed or the containers need to be marked as "EMPTY".	Users did not deface or remove radiation symbols nor documented any surveys prior to moving containers out of a registered lab. GRSD training did not explicitly indicate unrestricted release requirements.
3-SIV	Required radiation facility posting not present	10 CFR 20.1902 (a) Posting of radiation areas. The licensee shall post each radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."	The GSRD technician and the auditor located sign inside the fenced area adjacent to the rollup door for the Neutron Calibration facility. The technician indicated that he would replace the sign as soon	Exterior postings were not weather-proof. Signs were not routinely checked.
4-SIV	Facility radiation postings having unauthorized colors	10 CFR 20.1901(a)	Clearly, the intent of hazard communication is being met by these signs. This is more a narrow regulatory compliance	GRSD staff understood the regulatory requirements; however the combination of magenta on a yellow background produced a red color contrary to the regulatory requirements.
5-SIV	The report (as required by § 110.23(a)) of all americium and neptunium shipments during the previous calendar year has not been submitted by NIST until CY 2012.	10 CFR 110.54(b) Persons making exports under the general license established by § 110.23(a) or under a specific license shall submit by February 1 of each year one copy of a report of all americium and neptunium shipments during the previous calendar year. This report shall be submitted to the Deputy Director, Office of International Programs at the address provided in § 110.4.	N/A	The scope of internal and external program assessments did not include verification of compliance with the reporting requirements of export activities. Export activities were performed under general license of 110.23 and not captured during review of the license renewal application.
6-RAI		10 CFR 73.67		Failure to recognize the applicability of 10 CFR 73.67.

Finding # and Type	Root Cause	Interim Corrective Measures	Corrective Actions to Prevent Recurrence	GRSD Closure Date	IRSC Concurrence Date
1 -SIV	GRSD incorrectly interpreted the term "licensee's facility" as being Building 245 (the final destination of the material) and not Building 301 where it is initially processed.	GRSD communicated with stakeholders (mail services, GRSD personnel at buildings 235 and 245) and immediately implemented a practice of delivery or notification to GRSD within one hour of receipt allowing for timely	GRSD developed a memorandum of understanding between the organization and the Division responsible for mail services at the Gaithersburg campus that will ensure compliance with the requirements of 10 CFR 20.1906 (c)	2/6/2013	
2-SIV	Unrestricted release requirements were not fully understood by the users.	GRSD communicated with stakeholders (RBPD staff and line management) and immediately started a process to survey the area and its contents to confirm that no radioactive material was present in the area. RBPD defaced all radiation symbols in the room.	RBPD management reminded users on labeling, unrestricted release, and facility authorization requirements. GRSD updated training slides to include explicit coverage of unrestricted release.	2/5/2013	
3-SIV	Routine building exterior surveillance procedures did not require verification of exterior postings.	Exterior postings have been laminated and replaced.	Personnel performing routine surveillance have been retrained to check for postings presence and conditions. The environmental survey forms have been updated to include verification of signs presence and conditions.	1/31/2013	
4-SIV	Inattention to the difference between red and magenta colors.	GRSD developed new signs that conform to the color requirements of 10 CFR 20.1901 (a). The new signs	GRSD identified and replaced all affected signs on campus. Staff has been instructed to include checking for compliance with posting color requirements during surveillance activities.	2/22/13	
5-SIV	GRSD, RBPD, and MSD failure to recognize the applicability of 10 CFR 110.54(b) to SRM export activities.	GRSD produced and submitted the required report for CY12. GRSD informed RBPD and MSD of the need to continue tracking the exports of americium and neptunium.	In coordination with RBPD and MSD, GRSD revised the procedure for processing SRM transfer requests to establish roles and responsibilities to maintain the necessary information to produce the required annual report per 110.54 and to submit such report in a timely and consistent manner.	2/11/2013	
6-RAI	No regulatory gap analysis has been performed. This is indicative of an incomplete management oversight program where regulatory	1. GRSD has performed an Initial review identifying all affected material.	1. Perform a confirmatory review of the inventory include materials that are exempt. 2. Assess the history of the storage of these materials for report to IRSC.		

Exhibit 9

Radiation Safety Program (GRSD) - Audit and Assessment Recommendations Tracking Table As of 4/1/2013

Number	Recommendation	Source	Assigned To	Due Date	Remarks	Date Completed
2012-5	**Recommendation:** Shipments of brachytherapy sources; typically returns to licensees; do not follow the same formal review procedure as SRMs. However, NIST research staff contacts GRSD to verify the customer has a radioactive materials license on file and is authorized to receive the type and quantity of radioactive material being shipped. NIST has an effective program that reviews and stores copies of licenses prior to shipment of SRMs. NIST should expand the SRM shipment review procedure to all shipments of radioactive materials.	NUREG 1556 Audit	Janna	7/1/13	NIST has an alternativ process for shipment of RAM that is not SRM. The process verifies licenses for brachyterapy sources prior to shipment and tracks the required information in hard-copy records. This process achieves compliance, but is not easy to monitor or audit. Therefore, GRSD will evaluate the costs/benefits to creating a new process (using the SRM process as a guide) that utilizes electronic data management. If the evaluation is favorable, GRSD will proceed to implment a new process. **As of 4/8/13,** no additional progress has been made.	
2012-6	**Recommendation:** Source Custodians were asked to describe their work with radioactive materials and what type of radiation surveys they performed. At the conclusion of their work the Source Custodians indicated they performed a wipe survey. Various answers were given by the Source Custodians as to what the trigger level was for a wipe survey. None of the Source Custodians indicated that they used a portable radiation survey instrument to survey the work area. At all locations a calibrated portable survey instrument was readily available. GRSD should consider emphasizing survey requirements in the next annual radiation safety training. Proper use of a survey meter can prevent the spread of contamination from the laboratory to the hallways or whole body counters.	NUREG 1556 Audit	Adel	Fall 2013	GRSD will emphasize survey requirements in the next annual radiation safety training. The hands-on portion of the current initial training already provides extensive information on instrument surveys and GRDS will place additional emphasis on the need to actually use survey instruments during post-use surveys. GRSD is also expanding emphasis on performing post-use surveys in safety evaluations. **As of 4/8/13,** Adel is planning on incorperating it into the refresher training curriculum in September timeframe.	
2012-7	**Recommendation:** GSRD technicians perform meter, wipe and compliance surveys of assigned areas on a routine basis. GSRD health physicists perform independent meter, wipe and compliance surveys and audits of assigned areas on a routine basis. The survey is well documented with a map of the area that clearly indicates where assessments were performed. Lab users had performed swipe surveys only, however the documentation reviewed did not include a map and was often challenging to interpret for individuals who did not actually perform the wipe surveys. Recommend the lab users use the same preprinted laboratory forms generated by GSRD to document survey locations.	NUREG 1556 Audit	Tom / TBD	TBD	GRSD will recommend the use of the GRSD survey form to all Group Leaders suprevising the use of radioactive sources. **As of 4/8/13,** this task needs to be assigned by Tom.	
2012-8	**Recommendation:** Radioactive waste is stored in A010, which is a former accelerator vault. Room A010 has a fire detection and alarm system but no fire suppression system (no fire sprinkler or fire extinguishers). Also, this area does not have emergency lighting in the event of a power failure. A010 does not have any windows and is very dark without lighting. GRSD should consult with the fire safety group about placing fire extinguishers in A010. GRSD should consider installing emergency lighting in this area.	NUREG 1556 Audit	Miles	TBD (Awaiting action by Plant and Fire Protection Services)	GRSD has requested the installation of both fire extinguishers and emergency lighting in A010. **As of 4/8/13,** the fire extenguishers have been installed. A work order has been submitted to plant for lighting. No schedule for the lighting has been created yet.	

Exhibit 9

Radiation Safety Program (GRSD) - Audit and Assessment Recommendations Tracking Table As of 4/1/2013

Number	Recommendation	Source	Assigned To	Due Date	Remarks	Date Completed
2012-9	**Recommendation:** Liquid radioactive waste is stored in A010. The liquid waste was appropriately labeled. However, the waste container was not in a secondary containment. Secondary containment is a cost effective preventative measure that can minimize the spread of radioactive material in the event of a container failure. GRSD should consider storing all liquid radioactive waste containers in secondary containment in the waste area.	NUREG 1556 Audit	Manny		The finding was after an observation of one container that was not in compliance with our procedures. GRSD's current procedures agree with the auditor's recommendation.	3/11/2013
2012-10	**Recommendation:** GSRD maintains surveillance of a large number of areas, but we could not identify how GSRD could determine when they needed to initiate decommissioning activities in the event all licensed activities stopped in a building. GRSD should consider implementing footprint management for all locations of radioactive materials use. At least annually GRSD should provide a list of rooms and buildings where radioactive materials are used or stored. During this review, GRSD should look for any buildings where radioactive materials are no longer being used. NRC regulations require decommissioning activities to begin in buildings, where radioactive materials operations have ceased, within 24 months. Effective footprint management will alert GRSD staff that buildings meet the decommissioning criteria.	NUREG 1556 Audit	Miles / T	5/1/13	GRSD's database keeps track of all rooms/buildings authorized for rad work. In the event that the last room authorized in a building is to be decommissioned, GRSD will start the 24-month clock. **As of 4/8/13,** A preliminary evaluation of decommissioned facilities was completed. Miles sent T an email on 4/1/13 with this information. T is to determine a continued path forward.	
2012-11	**Recommendation:** Labeling of containers of radioactive materials is required to contain information such as isotope, activity, exposure rate in order to inform a person of the nature of the radiation hazards that may be present. Labeling of containers is not performed in a consistent manner. In one laboratory, this accomplished with "post-it" notes that sometimes list a source number or at other times lists an isotope and activity. Recommend a more consistent approach for labeling containers. This should be part of the hazard review for the laboratory. The hazard review process be expanded to specify appropriate labeling for containers of radioactive materials such as isotope, activity, assay date, dose rate or special instructions to provide researchers, GSRD staff or first responders with information to more adequately communicate any hazards that may be present. A more consistent labeling approach may be easier to audit and inventory.	NUREG 1556 Audit	Tee		GRSD is expanding the container labeling guidance via safety evaluations, facility audits, and additional slides in training. Factors that impact labeling of sorces (size, number, impact of affixing labels on measurement accuracy, etc.) vary a great deal throughout NIST. Sources Users need latitude in methods for labeling containers. However, only methods that allow reliable communication of the isotope and activity are acceptable to GRSD.	3/11/2013
2012-12	**Recommendation:** Security seals were installed on irradiators in a variety of locations. Often these seals were intact, but we found several instances where they had been opened indicating access to a device. Based on discussions with the staff, we could not determine who ownership for this process. If it is determined that security seals are required, the program needs to be effectively managed. If it is determined that security seals are not required, we recommend removal of all seals.	NUREG 1556 Audit	John		GRSD determined that the security seals were legacy from procedures prior to IC. All seals have been removed.	3/11/2013

Exhibit 9

Radiation Safety Program (GRSD) - Audit and Assessment Recommendations Tracking Table As of 4/1/2013

Number	Recommendation	Source	Assigned To	Due Date	Remarks	Date Completed
2012-13	**Recommendation:** GSRD calibrates and repairs survey instruments in Room A10 of Building 245, which is a former part of the Linac. This area does not have emergency lighting in the event of a power failure. As demonstrated to the GSRD technician, the rooms does not have any windows and is very dark without lighting. GRSD should consider installing emergency lighting in this area.	NUREG 1556 Audit	Miles	TBD (Awaiting action by Plant and Fire Protection Services)	GRSD has requested the installation of emergency lighting in AO10.	
2012-14	**Recommendation:** Building 245 Room B131 is the entrance to the package receipt and source storage area. To the left of the door, a sign indicating "NBS Radiation Hazard Control Area" is posted to the right of the door, the posting is blocked by equipment. Recommend relocation of the equipment or removal of the signage if it is no longer applicable to the program.	NUREG 1556 Audit	Manny		Outdated signs have been defaced.	3/11/2013
2012-15	**Recommendation:** Room B143 of Building 245 contains a variety of neutron sources. One drum on the floor had a metal "Caution – Radioactive Materials" sign lying on top of the shielded drum. A "Caution- Radioactive Materials" tag listing an isotope with an RS number was not on the drum. A tag was found on the floor in close proximity to the source. Recommend that GSRD and the source custodian verify that the source tag matches the source in the drum.	NUREG 1556 Audit	Tee	3/13/13	GRSD needs to confirm with SC. **As of 4/8/13,** no additional progress has been made.	
2012-16	**Recommendation:** The pool irradiator facility doors in Building 245, Room F101 are not marked with a "Caution – Radioactive Materials" sign on either door. However, Building 245, Room B143 is marked with a "Caution – Radioactive Materials" sign. The deck to the pool irradiator is appropriately marked with a "Caution – Radioactive Materials" sign. We recommend the facility either post both doors to the pool irradiator area with a "Caution – Radioactive Materials" sign (preferred) or remove the sign from Room B143 on the exterior of the building. This is a more consistent approach.	NUREG 1556 Audit	John		GRSD posted both doors as recommended.	3/11/2013
2012-17	**Recommendation:** The outside pool irradiator facility doors in Building 245, Room F101 and the outside calibration lab door in Building 245, Room B143 both list emergency contact information which may be out of date. The information on the door to Room B143 is in marginal condition. GSRD should work with the source custodians to update information on these signs.	NUREG 1556 Audit	Holly	4/1/13	GRSD needs to coordinate with RBPD's DSR. Item has been verbally discussed with DSR and Group Leader. **As of 4/8/13,** GRSD has discussed this issue with RBPD's Division Safety Representative. RBPD's DSR is reviewing the door signs for necessary updates.	

Exhibit 9

Radiation Safety Program (GRSD) - Audit and Assessment Recommendations Tracking Table As of 4/1/2013

Number	Recommendation	Source	Assigned To	Due Date	Remarks	Date Completed
2012-18	**Recommendation:** On the outside loading dock to Building 245 we found a closed 55 gallon drum that had no markings. Recommend GSRD determine the contents of the drum and take appropriate actions to store or dispose as needed.	NUREG 1556 Audit	Manny		GRSD consulted with RBPD and the drum was determined to contain oil from work on elevator (not radioactive material). RBPD assumed responsibility for the drum and removed from loading dock for disposal via hazardous waste group.	3/11/2013
2012-19	**Recommendation:** The SNM and NMSS databases were examined for completeness. The database printout dated July 11, 2012 listed a series of items in Building 245, Room A0101. The worksheet printout dated June 30, 2012 listed the same series of items in Building 245, Room B132. On the date of the audit; December 21, 2012, the series of items were listed in a different database and were actually located in Building 245, Room B132. Recommend a more uniform approach to recordkeeping and multiple database reconciliation for this process.	NUREG 1556 Audit	Manny		GRSD uses only one database for inventory control (HAPPY). The discrepancy identified was on the hard-copies. It was corrected to identify B132 as the source location.	3/11/2013
2012-20	**Recommendation:** The current forms used by GSRD for surveys contain a wealth of information. However items that are not present on the form are current action levels for contamination or dose rate. Based on discussions with staff, it was determined that the current procedure lists the action levels for contamination or dose rate. Staff members are familiar with these action levels as well. However, these survey documents could be used many years in the future in support of decommissioning. Without an attached procedure, a future user may have difficulty in determining action levels that may be needed in support of decommissioning. Recommend adding action levels for contamination or dose rate.	NUREG 1556 Audit	Tee		RSI 4-1 contains the action levels for contamination and dose rate; therefore it is not needed to have the information on every sheet. GRSD will archive facility audit packages with the action levels attachment per auditor's recommendation.	3/11/2013
2012-21	**Recommendation:** The main entrances to Building 245 and the Physics Building were posted with a NRC Form 3, a Section 206 notice, employee rights as specified in the energy Reorganization Act of 1974, and a notice where the license, regulations and radiation safety program documents can be located. Other entrances to Building 245 (as shown in Figure 22) did not include a notice where the license, regulations and radiation safety program documents can be located. The requirement for having all posted information available is being met by having at least one full posting set at the entrance to each building. A more consistent approach is recommended by having the same information at all entrances when posted or removal of extra postings at extra entrances.	NUREG 1556 Audit	Miles	4/1/13	GRSD will follow the auditor's recommendation and remove extra posting from secondary entrances. **As of 4/8/13**, no additional progress has been made.	

IRSC Actions Tracking Table

3/12/2013

Yellow Highlight Indicates High Priority

Exhibit 10

Action Number	Action	Action Origin	Assigned To	Date Assigned	Due Date	IRSC Approval Required	IRSC Concurrence Required	Remarks	Date Completed
2011-009	Propose changes to 12.03 that address responsibilities associated with the SRM program	IRSC Meeting	T. O'Brien	1/20/11	TBD	Yes	No	(Update 7/16/12) 12.03 is being transformed into Policy/Order/Program documents under the new NIST Directives System. The Program document for the SNM-362 materials will address responsibilities associated with the SRM program	
2011-020	Submit draft of Subchapter 12.03 (SNM & EQD licenses) to the Committee via RFK	IRSC Meeting	T. O'Brien	4/26/11	TBD	Yes	No	(Update 7/16/12) 12.03 is being transformed into Policy/Order/Program documents under the new NIST Directives System. The Program document for the SNM-362 and E License materials is currently being drafted	
2011-023	Submit draft of Subchapter 12.03 (Ionizing Rad Producing Machines -GRSD) to the Committee via RFK	IRSC Meeting	T. O'Brien	4/26/11	TBD	Yes	No	(Update 7/16/12) 12.03 is being transformed into Policy/Order/Program documents under the new NIST Directives System. GB and B RSOs will develop the Program document for IRPMs in parallel.	
2011-51	Based on the issues identified in the 2011 annual inventory, formalize the inventory process with respect to categories of sources and the requirements associated with each category. Work on this action item will begin after the 11.28.11 deadline for submission of the 2011 Inventory reports to the GRSD. Also, provide clarification on the use of Form 364 vs. Form 365 and the connection between the two forms in the inventory tracking process.	IRSC Meeting	T. O'Brien	10/13/11	TBD	No	No	(Update 7/16/12) Four categories (GL, RS#, non-RS#, & SNM) of sources have been designated and each category's specific requirements (including the applicability and scope of Forms 364 and 365) will be formalized via revisions to RSI's 1-5 and 4-4.	
2012-12	Recommendation: Part of the training required for an ionizing radiation producing machine should include clarification that an SOP (including radiation safety) is mandatory under any operational circumstances. On 3/1/12, the Committee directed GRSD to not approve an IRPM unless appropriate SOPs are in place.	2011 IRSC Assessment	T. O'Brien	1/19/12	TBD	No	No	A statement that an SOP is mandatory for operating ionizing radiation producing equipment will be included in the training program being developed for this equipment.	
2012-14	Submit the revisions of 12.03 for Boulder (Ionizing Radiation Producing Machines-BSHED) to the Committee	IRSC Meeting	R. Kayser	3/1/12	TBD	Yes	No	(Update 7/16/12) 12.03 is being transformed into Policy/Order/Program documents under the new NIST Directives System. GB and B RSOs will develop the Program document for IRPMs in parallel.	
2012-16	Complete the individual policy documents that will comprise the new Radiation Safety Manual. Submit them to the Committee as information items as they are completed.	IRSC Meeting	T. O'Brien	3/1/12	12/31/12	No	Yes	(Update 7/16/12) In consideration of the new NIST Directives System, GRSD recommends that the individual policy documents (previously identified as GRSD Policies) that will comprise the new Radiation Safety Manual, be treated as NIST Procedures requiring IRSC concurrence.	
2012-17A	Review the roles and responsibilities of Source Custodians in 12.03 to ensure that the content is complete and communicated clearly.	IRSC Meeting	R. Kayser	3/1/12	TBD	No	Yes	(Update 7/16/12) 12.03 is being transformed into Policy/Order/Program documents under the new NIST Directives System. The Program document for the SNM-362 materials will address the roles and responsibilities of Source Custodians in 12.03 to ensure that the content is complete and communicated clearly.	
2012-26	Provide details to the IRSC of how all the content from 12.03 will be captured in the NIST Directives Management System.	IRSC Meeting	T. O'Brien	7/26/12	12/31/12	No	No		
2012-45	Coordinate with the Radioactive SRM Program to develop language for the certificates and MSDSs and provide this to the Committee	IRSC Meeting	T. O'Brien	9/6/12	TBD	No	No	Language for the certificates and MSDSs will be provided at the 01/03/13 meeting.	

Action Number	Action	Action Origin	Assigned To	Date Assigned	Due Date	IRSC Approval Required	IRSC Concurrence Required	Remarks	Exhibit 10 Date Completed
2012-47	Distribute the revised procedures referenced in the RAI responses to the IRSC as the revisions are completed	IRSC Meeting	T. O'Brien	10/4/2012; 10/11/12	10/16/12	No	Yes	Completed for all RAI responses except for RAI#1 which requires review of RSI 4-16 (Facilities) and RSI 1-4 B (Training).	
2012-51	Write up rules to implement a Boulder radiation safety program, including limitations for x-ray systems.	IRSC Meeting	T. Grove	6/25/09	TBD	Yes	No	This Action Item was created after the closure of Action Item 2009-036	
2012-61	Develop an IRSCI for audits, including a requirement to audit the approval of Source Users and Uses	IRSC Meeting	TBD	11/1/12	TBD	Yes	No		
2012-64	Create a log of approved uses and either GRSD or IRSC should create a source use category approval code to facilitate approval of future uses that are covered by a category.	email from R. Kayser	T. O'Brien	11/12/12	TBD	Yes	No	Ongoing binning of Safety Evaluations	
2012-66	Revise NIST 364/5 forms to reflect new procedures.	email from R. Kayser	T. O'Brien	11/12/12	TBD	No	Yes	Modify Form 364 to include a mechanism to identify new uses. Add instructions to the 364 review process for GRSD to ensure a new use will be compliant with our license. Also, modify the Attestation Instructions on NIST Forms 364 and 365 to clarify the OU is attesting the User has the expertise necessary for the particular source use requested. Needs to be completed prior to LRA approval. A procedure or checklist to process a 364/5 will be developed. **2/25/13.... A procedure or checklist to process a 364/5 was developed in RSI 4-4. The revisions to NIST Forms 364 and 365 are in progress.**	
2012-67	Develop a Safety Evaluation for the low risk activities that would have used the "interim approval by the RSO" approach	IRSC Meeting	T. O'Brien	11/15/12	TBD	Yes	No		
2012-78	Discuss the definitions of Source Custodian and Source User.	IRSC Meeting	R. Kayser	11/29/12	TBD	No	No	(Update 1/3/13) The discussion about the definitions of Source Custodian and Source User will occur with Action Item 2012-17A. For this action item, R. Kayser will ensure the definitions of Source User/Custodian in IRSCI 1-1 and 2-1 are consistent with 12.03	
2012-79	Capture the Sealed Source Definition in 12.03 or Ionizing Radiation Safety Order.	IRSC Meeting	T. O'Brien	11/29/12	TBD	No	Yes		
2013-06	Develop a process and renewal frequency for the re-approval of existing RSO-approved safety evaluations.	IRSC Meeting	T. O'Brien	1/10/13	TBD	Yes	No		
2013-11	Revise IRSCI 1-1 to reflect the update of HPI 1-4 to RSI 1-4b, or the final current version when available.	2012 Review	IRSC	1/15/13	TBD	Yes	No		
2013-16	Review the SNM 362 license conditions and determine what should be added to training materials.	2012 Review	GRSD	1/15/13	TBD	No	No	**After the renewal is issued, the license will be reviewed in this context and training updated accordingly.**	
2013-17	Revise RSI 1-4b to contain a complete description of the scope of the training program.	2012 Review	GRSD	1/15/13	TBD	No	No	**RSI 1-4 will be revised to reflect the action.**	
2013-18	Revise RSI 1-4b to contain a list of training requirements for staff.	2012 Review	GRSD	1/15/13	TBD	No	No	**(From the CY12 Review)** This RSI does not cover the Radiation Safety Awareness Training that is provided to new employees and associates (that have joined NIST since June 28, 2010) as required by the NRC-issued CO. **RSI 1-4 will be revised to reflect the action.**	

Action Number	Action	Action Origin	Assigned To	Date Assigned	Due Date	IRSC Approval Required	IRSC Concurrence Required	Remarks	Completed
2013-20	Revise RSI 1-4b to contain a list of training requirements for radiation facility owners.	2012 Review	GRSD	1/15/13	TBD	No	No	**(From the CY12 Review)** There is no mention of the training requirements for radiation facility owners or radiation facility users. Training for radiation facility owners and user should include radiation safety awareness and training on source security requirements, at a minimum. Refresher requirements for these individuals should be added to this RSI. **12.03's successor (i.e., a Sub-Order) will reflect revisions to requirements for radiation facility owners. The appropriate RSI will then be revised to reflect the specific training for such individuals.**	
2013-28	Verify the training dates of the Source Users/Custodians approved by the Committee.	IRSC Meeting	T. O'Brien	1/17/13	1/24/13	No	No		
2013-38	Re-submit the Source User/Source Custodian approval forms from the 1/24/13 meeting that were withdrawn because they are GL Users only. These individuals were: C. Neary, J. Reiner, J. Murray, and M. Sehantz.	IRSC Meeting	T. O'Brien	1/31/13	2/7/13	Yes	No		
2013-40	Develop a draft document for self-identifying violations	IRSC Meeting	R. Kayser	1/31/13	TBD	Yes	No	Requirement for IRSC approval or concurrence will depend on the type of document developed (e.g., procedure vs. guidance)	
2013-46B	Incorporate the Committee's comments and revised NIST Form 364/365s into RSI 4-4, and present a new version of RSI 4-4 at a future IRSC meeting	IRSC Meeting	T. O'Brien	2/7/13	TBD	No	No		
2013-52	Update the IRSC procedures to reflect the minors policy if needed	IRSC Meeting	IRSC	2/14/13	TBD	Yes	No		
2013-54	Draft a question for the NRC regarding SRMs distributed under the E License that may be licensed material and send to L. Karam for review and then present to the Committee	IRSC Meeting	T. O'Brien	2/14/13	2/21/13	No	Yes	Contact made on 2/15/13 with NRC on how to proceed. NRC will advise. **NRC responded on 2/21/13 with a FRN citation. The applicability to NIST SRMs is being determined.**	
2013-56B	Provide "show-stoppers" on the Ionizing Radiation Order to R. Kayser.	IRSC Meeting	IRSC	2/21/13	3/5/13	No	Yes	Showstoppers due COB Tuesday 2/26/13. **Update from 2/28/13 Meeting: New due date 3/5/13.**	
2013-59	Verify on the previously approved Source User/Custodian Approval Forms that managers who signed from units that do not have Group Leaders/Division Chiefs were in equivalent (or higher) positions to Group Leaders/Division Chiefs	IRSC Meeting	GRSD	2/21/13	TBD	No	No		
2013-60	Modify the Source User/Custodian Approval Forms to allow for signature positions equivalent to Group Leader/Division Chiefs from units that do not have Group Leaders/Division Chiefs	IRSC Meeting	GRSD	2/21/13	TBD	No	No		
2013-62	Delete any emails that contain security related information relative to the Part 36 Exemption Request	IRSC Meeting	IRSC and GRSD	2/21/13	2/21/13	No	No		
2013-67	Provide the methodology for the IRSC review and approval of a 365 for an existing RSO-approved use to E. Mackey for incorporation into IRSCI 2-1	IRSC Meeting	M. Mejias	2/28/13	TBD	No	No		

Action Number	Action	Action Origin	Assigned To	Date Assigned	Due Date	IRSC Approval Required	IRSC Concurrence Required	Remarks	Date Completed
2013-68	Revise IRSCI 2-1 to include the methodology for IRSC review and approval of a 365 for an existing RSO-approved use until all 364s have been migrated into the new process. The revision should also document the justification for using this interim process	IRSC Meeting	E. Mackey	2/28/13	TBD	Yes	No		
2013-69	Contact CNST to determine the management levels that are equivalent to Group Leader/Division Chiefs	IRSC Meeting	T. O'Brien	2/28/13	3/7/13	No	No		
2013-72	Revise the Safety Evaluation for the Preparation of Mn-54 Liquid Scintillation with the changes discussed at the 2/28/13 IRSC Meeting and incorporate B. Brass's comments as deemed appropriate	IRSC Meeting	M. Mejias	2/28/13	3/7/13	No	No		
2013-73	Revise the Safety Evaluation for the D-T Neutron Generator to include the change discussed at the 2/28/13 IRSC Meeting	IRSC Meeting	T. McGiff	2/28/13	3/7/13	No	No		
2013-74	Revise the Part 36 Exemption Request cover letter for grammar and to indicate that the request contains Security Related Information and send to the NRC by 3/1/13	IRSC Meeting	R. Kayser	2/28/13	3/1/13	No	No		
2013-77	Revise the Standing Reporting Requirements table to add any recurring reporting requirements from the SNM-362 license and separate out or remove the requirements for the support of the TR-5 license	IRSC Meeting	T. O'Brien	2/28/13	TBD	No	No		
2013-78	Post the table summarizing requests approved under existing IRSC-approved safety evaluations to SharePoint	IRSC Meeting	T. O'Brien	2/28/13	3/7/13	No	No		
2013-79	Post the E License Distribution Report to SharePoint.	IRSC Meeting	T. O'Brien	1/24/13	3/7/13	No	No	*RETROACTIVE ACTION ITEM* Identified from the 1/24/13 meeting minutes.	
New Items									
2013-81	Provide copy of IRSCI 2-1 Appendix C to T. Gentile	IRSC Meeting	S. Dewey	3/7/13	3/8/13	No	No		
2013-84	Create a plan (vetted through GRSD) to capture the Source Uses approved prior to 2/14/2013 under the IRSC approval process	IRSC Meeting	E. Mackey	3/7/13	TBD	No	Yes		
2013-87	If feasible, divide IRSC Action Items 2011-51 and 2012-66 into specific individual Action Items	IRSC Meeting	T. O'Brien	3/7/13	3/14/13	No	Yes		
2013-89	Retain 7-RAI as a Finding, and expand the corrective actions to cover both the current source use & users approval and previous source use approval processes and present at the 3/14/13 IRSC meeting for IRSC concurrence	IRSC Meeting	T. O'Brien	3/7/13	3/14/13	No	Yes		
2013-91	Populate the Recommendations Tracking Table for the 3/14/13 IRSC meeting	IRSC Meeting	T. O'Brien	3/7/13	3/12/13	No	Yes		
Completed Items									
2013-80	Develop a document listing all of the standing reporting requirements	IRSC Meeting	T. O'Brien	2/7/13	TBD	No	No	***RETROACTIVE ACTION ITEM*** **Completed.** Presented at the 2/28/13 IRSC Meeting. This action item was retroactively identified from the 2/7/13 IRSC Meeting minutes.	2/28/13

Exhibit 10

Action Number	Action	Action Origin	Assigned To	Date Assigned	Due Date	IRSC Approval Required	IRSC Concurrence Required	Remarks	Date Completed
2013-85	Complete E-Vote for two week extension on the commissioning SOP for the pulsed laser x-ray device by COB 3/7/13	IRSC Meeting	IRSC	3/7/13	3/7/13	Yes	No	**Completed.** Approved 3/7/13.	3/7/13
2013-82	Revise IRSCI 2-1 Appendix C to incorporate the recommended IRSC changes	IRSC Meeting	E. Mackey	3/7/13	3/14/13	Yes	No	**Completed.**	3/8/11
2013-83	Incorporate the revised Appendix C into IRSCI 2-1	IRSC Meeting	R. Kayser	3/7/13	3/14/13	Yes	No	**Completed.** Distributed 3/11/13.	3/11/13
2013-86	Provide the revised operations SOP for the pulsed laser x-ray device in tracked changes format to the IRSC for discussion at the 3/14/13 IRSC meeting	IRSC Meeting	T. Grove	3/7/13	3/12/13	Yes	No	**Completed.** Distributed 3/11/13.	3/11/13
2013-90	Revise the Ionizing Radiation Order to incorporate the IRSC recommended changes and forward to the IRSC for concurrence	IRSC Meeting	R. Kayser	3/7/13	3/12/13	No	Yes	**Completed.** Distributed 3/11/13.	3/11/13
2013-88	Post the IRSC Annual Review to SharePoint	IRSC Meeting	T. O'Brien	3/7/13	3/12/13	No	No	**Completed.** Uploaded 3/12/13 to https://safetyp.nist.gov/oshe/grsd/Test%20List/Program%20References/IRSC%20Reviews/IRSC_CY12_Review_Report_010812-amended_030513%20(2).docx	3/12/13

Exhibit 11

PR 2011

RADIOACTIVE MATERIAL RECEIPT FORM

ATE SOURCE RECEIVED	RADIONUCLIDE & ACTIVITY RECEIVED (1)	# OF INDIVIDUAL SOURCES RECEIVED
3/8/13	I-125 0.3 each	3

DIOACTIVE SOURCE NUMBER (RS#)	MANUFACTURER IDENTIFICATION NUMBER
13-0132 A, B, C	

PACKAGE SPECIFICATION

☒ NON-SPEC (INDUSTRIAL/STRONG, TIGHT) ☐ TYPE A ☐ TYPE B (QUALITY ASSURANCE MANAGER NOTIFIED)

PACKAGE MARKING

☒ LIMITED QUANTITY UN2910 ☐ UN2915 ☐ SPECIAL FORM UN3332 ☐ OTHER (SPECIFY) ______

PACKAGE LABELING

☒ NONE ☐ WHITE-I ☐ YELLOW-II TRANSPORT INDEX (TI) ______ ☐ YELLOW-III TRANSPORT INDEX (TI) ______

PACKAGE MONITORING

SURVEY POINT	DOSE RATE GAMMA (mR/hr)	DOSE RATE NEUTRON (mrem/hr)	REMOVABLE ACTIVITY ALPHA dpm or ncpm per 100cm2	REMOVABLE ACTIVITY BETA dpm or ncpm per 100cm2
PACKAGE. Exterior				
(*)ON CONTACT	0.04	/	Ø	Ø
(*)AT 1 METER	~~0.02~~ 0.01 sy	/		
PACKAGING		/	0	2
SOURCE CONTAINER		/	1	2
SOURCE LEAK TEST(2)			A 0	4
			B 0	0
			C 1	0

(*)INSTRUMENT DATA MAKE	MODEL #	SERIAL #
VIC	950P	1919

(*)CONTACT DOSE RATE ≤200 mR/hr and TI ≤10
☒ YES ◯ NO

(*)CORRECT PACKAGE LABELING OR MARKING
☒ YES ◯ NO

(*)CONTAINER ≤ D.O.T. CONTAMINATION LIMITS
☒ YES ◯ NO

(1) NOTIFY THE RSO IF THE DELIVERED ACTIVITY IS GREATER THAN THE APPROVED AMOUNT
(2) AS REQUIRED IF A SEALED SOURCE
(*) Required as a minimum within 3 hours of receipt

NOTIFY THE RSO IF "NO" IS SELECTED FOR ANY OF THE ABOVE.

IF A SNM TRANSACTION 741 FORM ACCOMPANIES THE SOURCE, RECORD THE TRANSACTION IDENTIFICATION NUMBER HERE: ______

HEALTH PHYSICS REMARKS: Tracking # = FedEx 7949-1214-0019

A = ~~0.656 mCi~~

LSC results = BKGD

Sarah Yu — (*)INITIAL SURVEYOR'S PRINTED NAME | Sarah Yu — (*)SIGNATURE | 3/8/13 11:30 — (*)DATE & TIME

______ SURVEYOR'S PRINTED NAME | ______ SIGNATURE | ______ DATE & TIME

TRANSFERRED FROM HEALTH PHYSICS (RECIPIENT'S PRINTED NAME, SIGNATURE, & DATE): Jason Wallo [signature] 3/11/13

Exhibit 11

SendSuite Tracking - [Oem_ViewDetails_1]

PitneyBowes SendSuite™ Tracking

Receive | Delivery | View Packages | Reports | Utilities

View | Tracking Details

View Packages -> View

CARTRK

Display Log

Log Summary Report

VIEW PACKAGE DETAILS

Tracking Number: 007949121400l9

Piece ID: DWRRM03814764

Carrier: FEX Federal Express

Recipient:

Service:

Sender:

Package Type: Package (PKG)

# of Pieces: 1

Date Received: 3/8/2013

Date 3/8/2

PO Number:

Delivery Status | Package Details | Images | Recipient | Sender | Pouch

Status: DELIVERED

Current Location:

	Date	Time	Clerk Name
Received:	3/8/2013	10:30	Noaa
1st Attempted:			
Last Attempted:			
Delivered:	3/8/2013	11:25	Michael Johnson
Last Updated:	3/8/2013	11:25	Michael Johnson

Exhibit 11

SendSuite Tracking - [Oem_ViewDetails_1]

PitneyBowes SendSuite™ Tracking

Receive | Delivery | View Packages | Reports | Utilities

View | Tracking Details

View Packages -> View

CARTRK

Display Log

Log Summary Report

VIEW PACKAGE DETAILS

Tracking Number: 00794912140019

Piece ID: DWRRM03814764

Carrier: FEX Federal Express

Recipient:

Service:

Sender:

Package Type: Package (PKG)

# of Pieces: 1

Date Received: 3/8/2013

Date: 3/8/2

PO Number:

Delivery | Status | Package Details | Images | Recipient | Sender | Pouch

Delivered To: Yu, Sarah

Delivered By: JOHNSONM Michael Johnson

Date: 3/8/2013

Time: 11:25

Signed: Y

Signature: Sarah Yu

Exhibit 11

RADIOACTIVE MATERIAL RECEIPT FORM

DATE SOURCE RECEIVED	RADIONUCLIDE & ACTIVITY RECEIVED (1)	# OF INDIVIDUAL SOURCES RECEIVED
2/13	I-125 3 mCi each	3

RADIOACTIVE SOURCE NUMBER (RS#)	MANUFACTURER IDENTIFICATION NUMBER
13-0078 A, B, C	

PACKAGE SPECIFICATION

☒ NON-SPEC (INDUSTRIAL/STRONG, TIGHT) ☐ TYPE A ☐ TYPE B (QUALITY ASSURANCE MANAGER NOTIFIED)

PACKAGE MARKING

☒ LIMITED QUANTITY UN2910 ☐ UN2915 ☐ SPECIAL FORM UN3332 ☐ OTHER (SPECIFY) _____

PACKAGE LABELING

☒ NONE ☐ WHITE-I ☐ YELLOW-II TRANSPORT INDEX (TI) _____ ☐ YELLOW-III TRANSPORT INDEX (TI) _____

PACKAGE MONITORING

SURVEY POINT	DOSE RATE GAMMA (mR/hr)	DOSE RATE NEUTRON (mrem/hr)	REMOVABLE ACTIVITY ALPHA dpm or ~~ncpm~~ per 100cm2	REMOVABLE ACTIVITY BETA dpm or ~~ncpm~~ per 100cm2
PACKAGE, Exterior				
(*)ON CONTACT	<0.01	/	0	6
(*)AT 1 METER	<0.01	/		
PACKAGING		/	0	3
SOURCE CONTAINER		/	0	3
SOURCE LEAK TEST(2)			0	9

(*)INSTRUMENT DATA		
MAKE	MODEL #	SERIAL #
Vic	450P	1919

(*)CONTACT DOSE RATE ≤200 mR/hr and TI ≤10
☑ YES ○ NO

(*)CORRECT PACKAGE LABELING OR MARKING
☑ YES ○ NO

(*)CONTAINER ≤ D.O.T. CONTAMINATION LIMITS
☑ YES ○ NO

NOTIFY THE RSO IF "NO" IS SELECTED FOR ANY OF THE ABOVE.

(1) NOTIFY THE RSO IF THE DELIVERED ACTIVITY IS GREATER THAN THE APPROVED AMOUNT
(2) AS REQUIRED IF A SEALED SOURCE
(*) Required as a minimum within 3 hours of receipt

IF A SNM TRANSACTION 741 FORM ACCOMPANIES THE SOURCE, RECORD THE TRANSACTION IDENTIFICATION NUMBER HERE:

HEALTH PHYSICS REMARKS: Tracking # FedEx: 4874-4273-1958
ISC - BLDG

(*)INITIAL SURVEYOR'S PRINTED NAME	(*)SIGNATURE	(*)DATE & TIME
Sarah Yu	Sarah Yu	2/12/13 11:45
SURVEYOR'S PRINTED NAME	SIGNATURE	DATE & TIME
Jason Walia Sy	Jason Walia Sy	~~2/14/13~~ Sy

TRANSFERRED FROM HEALTH PHYSICS (RECIPIENT'S PRINTED NAME, SIGNATURE, & DATE) Jason Walia 2/19/13

Exhibit 11

SendSuite Tracking - [Oem_ViewDetails_1]

PitneyBowes SendSuite™ Tracking

Receive | Delivery | View Packages | Reports | Utilities

View | Tracking Details

View Packages -> View

CARTRK

Display Log

Log Summary Report

VIEW PACKAGE DETAILS

Tracking Number: 00487442731958

Piece ID: DW3RQ03836758

Carrier: FEX Federal Express

Recipient:

Service:

Sender:

Package Type: Package (PKG)

# of Pieces: 1

Date Received: 2/12/2013

Date 2/12/

PO Number:

Delivery Status | Package Details | Images | Recipient | Sender | Pouch

Status: DELIVERED

Current Location:

	Date	Time	Clerk Name
Received:	2/12/2013	10:34	Paul Thompson
1st Attempted:			
Last Attempted:			
Delivered:	2/12/2013	11:31	Noaa
Last Updated:	2/12/2013	11:31	Noaa

Exhibit 11

SendSuite Tracking - [Oem_ViewDetails_1]

PitneyBowes SendSuite™ Tracking

Receive | Delivery | View Packages | Reports | Utilities

View | Tracking Details

View Packages -> View

CARTRK

Display Log

Log Summary Report

VIEW PACKAGE DETAILS

Tracking Number: 00487442731958

Piece ID: DW3RQ03836758

Carrier: FEX Federal Express

Recipient:

Service:

Sender:

Package Type: Package (PKG)

# of Pieces: 1

Date Received: 2/12/2013

Date 2/12/

PO Number:

Delivery | Status | Package Details | Images | Recipient | Sender | Pouch

Delivered To: Yu, Sarah

Delivered By: NOAA Noaa

Date: 2/12/2013

Time: 11:31

Signed: Y

Signature: Sarah Yu Sarah Yu

Exhibit 11

RADIOACTIVE MATERIAL RECEIPT FORM

DATE SOURCE RECEIVED	RADIONUCLIDE & ACTIVITY RECEIVED (1)	# OF INDIVIDUAL SOURCES RECEIVED
1/25/13	I-131 116.14 GBq	

RADIOACTIVE SOURCE NUMBER (RS#)	MANUFACTURER IDENTIFICATION NUMBER
12-033	

PACKAGE SPECIFICATION

☐ NON-SPEC (INDUSTRIAL/STRONG, TIGHT) ☑ TYPE A ☐ TYPE B (QUALITY ASSURANCE MANAGER NOTIFIED)

PACKAGE MARKING

☐ LIMITED QUANTITY UN2910 ☑ UN2915 ☐ SPECIAL FORM UN3332 ☐ OTHER (SPECIFY) _____

PACKAGE LABELING

☐ NONE ☐ WHITE-I ☐ YELLOW-II TRANSPORT INDEX (TI) _____ ☑ YELLOW-III TRANSPORT INDEX (TI) 1.3

PACKAGE MONITORING

	DOSE RATE		REMOVABLE ACTIVITY	
SURVEY POINT	GAMMA (mR/hr)	NEUTRON (mrem/hr)	ALPHA dpm or ncpm per 100cm2	BETA dpm or ncpm per 100cm2
PACKAGE, Exterior				
(*)ON CONTACT	12.5	N/A	0	8
(*)AT 1 METER	1.3	N/A		
PACKAGING			0	8
SOURCE CONTAINER	N/A		0	5
SOURCE LEAK TEST(2)			NC	

(*)INSTRUMENT DATA		
MAKE	MODEL #	SERIAL #
[illegible]	[illegible]	[illegible]

(*)CONTACT DOSE RATE ≤200 mR/hr and TI ≤10
☑ YES ○ NO

(*)CORRECT PACKAGE LABELING OR MARKING
☑ YES ○ NO

(*)CONTAINER ≤ D.O.T. CONTAMINATION LIMITS
☑ YES ○ NO

NOTIFY THE RSO IF "NO" IS SELECTED FOR ANY OF THE ABOVE.

(1) NOTIFY THE RSO IF THE DELIVERED ACTIVITY IS GREATER THAN THE APPROVED AMOUNT
(2) AS REQUIRED IF A SEALED SOURCE
(*) Required as a minimum within 3 hours of receipt

IF A SNM TRANSACTION 741 FORM ACCOMPANIES THE SOURCE, RECORD THE TRANSACTION IDENTIFICATION NUMBER HERE:

HEALTH PHYSICS REMARKS:

IF CONTAMINATION CHECK OF THE SOURCE SHALL INSIDE A FILTERED FUME HOOD. THE CONTAMINATION CHECK CAN BE PERFORMED BY THE LISTED USERS OR BY GCSD BY REQUEST.

Tracking #: 5040-9914-1501

(*)INITIAL SURVEYOR'S PRINTED NAME	(*)SIGNATURE	(*)DATE & TIME
[illegible]	[signature]	1/25/13 @ 1132
SURVEYOR'S PRINTED NAME	SIGNATURE	DATE & TIME

TRANSFERRED FROM HEALTH PHYSICS (RECIPIENT'S PRINTED NAME, SIGNATURE, & DATE) [illegible] 2/25/13

Exhibit 11

SendSuite Tracking - [Oem_ViewDetails_1]

PitneyBowes SendSuite™ Tracking

Receive | Delivery | View Packages | Reports | Utilities

View | Tracking Details

View Packages -> View

CARTRK

Display Log

Log Summary Report

VIEW PACKAGE DETAILS

Tracking Number: 00504099141501

Piece ID: DWGRO03772750

Carrier: FEX Federal Express

Recipient:

Service:

Sender:

Package Type: Package (PKG)

# of Pieces: 1

Date Received: 2/25/2013

Date 2/25/

PO Number:

Delivery Status | Package Details | Images | Recipient | Sender | Pouch

Status: DELIVERED

Current Location:

	Date	Time	Clerk Name
Received:	2/25/2013	10:21	Kyle Gladhill
1st Attempted:			
Last Attempted:			
Delivered:	2/25/2013	11:05	Howard Rothmel
Last Updated:	2/25/2013	11:05	Howard Rothmel

Exhibit 11

SendSuite Tracking - [Oem_ViewDetails_1]

PitneyBowes SendSuite™ Tracking

Receive | Delivery | View Packages | Reports | Utilities

View | Tracking Details

View Packages -> View

CARTRK

Display Log

Log Summary Report

VIEW PACKAGE DETAILS

Tracking Number: 0050409914150l

Piece ID: DWGRO03772750

Carrier: FEX Federal Express

Recipient:

Service:

Sender:

Package Type: Package (PKG)

# of Pieces: 1

Date Received: 2/25/2013

Date 2/25/

PO Number:

Delivery | Status | Package Details | Images | Recipient | Sender | Pouch

Delivered To: Young, Rheannan

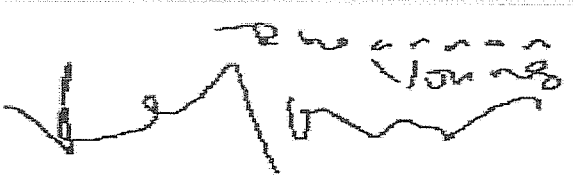
Delivered By: HROTHMEL Howard Rothmel

Date: 2/25/2013

Time: 11:05

Signed: Y

Signature:



NIST-364
(REV. 08-23-2010)
ADMAN 12.03

Exhibit 12

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

RADIOACTIVE MATERIAL REQUEST

REQUESTOR (NAME & EXT)	SUPPLIER	RADIOACTIVE SOURCE NUMBER (RS#) (HP USE)
Rheannan Young x5255	MDS Nordion Kanata, Ontario, Canada	12-0132

METHOD OF ACQUISITION

◯ PURCHASE ◯ FOR CALIBRATION ◉ GIFT ◯ LOAN ◯ PRODUCED AT NIST ◯ OTHER _____

◯ RETURN TO NIST RS# (IF ALREADY ASSIGNED) _____

DESCRIPTION OF SOURCE	Liquid		
RADIONUCLIDE & ASSOCIATED NUCLIDES	Mo-99		
ACTIVITY/AMOUNT (i.e., Ci, Bq, or g)	250 mCi(530 mCi at receipt)		
CHEMICAL FORM	Molydate in 3M HNO3		
CARRIER MASS (g) or VOLUME (ml)	3 mL		

PHYSICAL FORM ◯ SOLID ◉ LIQUID ◯ GAS ◯ POWDER ◯ OTHER --->EXPLAIN _____

SOURCE CONTAINMENT (E.G., PLATED, AMPOULE, FOIL, ETC. INCLUDE REGISTERED SEALED SOURCE NUMBER IF ASSIGNED.)

Vial

SOURCE USE - IDENTIFY RADIOLOGICAL HAZARDS & PROVIDE SOURCE USE PROTOCOL(S); ATTACH ADDITIONAL PAGES AS NEEDED.

The material will be prepared according to SOPs "846.04-0029 4400 series 21JUN2010, 846.04-0033 4400high 21JUN2010, Manual Ion Chambers 30July2010 and 846.04- 0038 4400low 23JUN2010."
The material will also be submitted for impurity analysis according to SOP "846.01-0023 gspec 13MAY2010"
SRM will be sold and any left material will be sent to waste.

SOURCE CUSTODIAN/INITIALS	SOURCE USER(S)	USE LOCATION(S)	STORAGE LOCATION
Dan Golas DG	D. Golas, R. Fitzgerald, B. Norman, L. Perez, R. Young, L. King, L. Pibida, R. Colle	C-11, C-25, B-47, B46, B146, B-156	B-156

GROUP LEADER AND DIVISION CHIEF AUTHORIZATION

I authorize this request pending approval by the RSO, acceptance by the Source Custodian, and authorization by OU Management and will carry out my responsibilities with regard to the requested material in accordance with NIST Administrative Manual Subchapter 12.03.

Michael Unterweger 682	[signature]	12/17/12
GROUP LEADER PRINTED NAME & DIVISION	SIGNATURE	DATE
Lisa Karam 682	[signature]	17 Dec 12
DIVISION CHIEF PRINTED NAME & DIVISION	SIGNATURE	DATE

DO NOT ACQUIRE OR USE THE SOURCE UNTIL APPROVED BY THE RSO, ACCEPTED BY THE SOURCE CUSTODIAN, AND AUTHORIZED BY MANAGEMENT

RADIATION SAFETY OFFICER APPROVAL

I approve this request subject to the requirements specified in this form, including the hazard mitigation plan and all other attachments.

Manuel Mejias SHP	[signature]	1/8/13
RSO OR DESIGNEE PRINTED NAME AND TITLE	SIGNATURE	DATE

SOURCE CUSTODIAN ACCEPTANCE

I understand and shall carry out my responsibilities with regard to the requirements specified in this form and as detailed in NIST Administrative Manual Subchapter 12.03.

Dan Golas 682	[signature]	1/8/13
SOURCE CUSTODIAN PRINTED NAME	SIGNATURE	DATE

OU MANAGEMENT AUTHORIZATION

I authorize this request subject to the requirements specified in this form and shall ensure that these requirements have been met prior to the commencement of work.

Lisa Karam, Chief 682	[signature]	8 Jan 2013
MANAGEMENT PRINTED NAME AND TITLE	SIGNATURE	DATE

Number of Attachments: _____

Exhibit 12

RADIOACTIVE MATERIAL HAZARD MITIGATION PLAN

RADIOACTIVE SOURCE NUMBER (RS#) or PROTOCOL NUMBER	ISOTOPE(S) and ACTIVITY
12-0132 846.04-0029,33, and supporting SOPs.	Mo-99 19.61 GBq (530 mCi)

RADIOLOGICAL HAZARDS

Maximum Calculated Doses

Type of Exposure	mrem
Full Inhalation	2.65E+06
Partial Inhalation	2.65E+01
Full Ingestion	2.65E+06
Partial Ingestion	8.83E+04

Maximum Calculated Dose Rates

Dose Rates	mrem/hr
Dose Rate @ 30 cm	6.43E+02
Dose Rate @ 1 cm	8.01E+07
Skin Dose Rate	3.17E+08

* Source Integrity Shall Not Be Compromised

Emissions
- [ ] Alpha
- [x] Beta
- [x] Gamma
- [ ] Neutron
- [x] X-Ray

Source Type
- [ ] Sealed*
- [x] Unsealed
- [ ] Category I
- [ ] Category II
- [ ] NSTS 10* - 24 hour report

Radiotoxicity
- [ ] I
- [ ] II
- [x] III
- [ ] IV

SOURCE CUSTODIAN / SOURCE USER MITIGATION PLAN REQUIREMENTS

- [ ] MITIGATION PLAN REQUIREMENTS ARE PROVIDED IN STANDING APPROVED PROTOCOLS

If not checked, the requirements below apply

EXPOSURE MONITORING

- [x] WHOLE BODY [x] EXTREMITY [x] BIOASSAY [ ] DIRECT READING [ ] AIR SAMPLING [ ] NONE

PERSONAL PROTECTIVE MEASURES/TECHNIQUES

- [x] GLOVES (1pr/2 pr) [x] LAB COAT [ ] APRON [x] SAFETY GLASSES [ ] FACE SHIELD [ ] SHOE COVERS
- [x] DISPOSABLE/ABSORBENT SURFACES [x] SPILL CONTAINMENT TRAY [ ] SECURITY
- [x] REMOTE HANDLING TOOLS _____ [x] SHIELDING Lead [ ] HOOD [ ] GLOVE BOX
- [x] SURVEY INSTRUMENTS AVAILABLE - TYPE(S): GM + Ion chamber
- [x] MONITOR WHOLE BODY [x] MONITOR HANDS & FEET

ADDITIONAL REQUIREMENTS (Attach documentation as needed; indicate the number of pages attached)

See attached list (4 additional pages).

RADIOLOGICAL HAZARD REVIEW COMPLETED BY

Manuel Mejias		1/3/13
RADIATION SAFETY (PRINTED NAME)	RADIATION SAFETY (SIGNATURE)	DATE

RADIOACTIVE MATERIAL HAZARD MITIGATION PLAN

RADIOACTIVE SOURCE NUMBER (RS#) or PROTOCOL NUMBER	ISOTOPE(S) and ACTIVITY
12-0132 846.04-0029,33, and supporting SOPs.	Mo-99 19.61 GBq (530 mCi)

RADIATION SAFETY REQUIREMENTS

☐ GLOVE BOX ☒ HOOD ☒ POSTING RA, CRAM

☐ ONE PASS ROOM VENTILATION ☒ FILTRATION HEPA

☒ MONITOR HANDS & FEET ☒ MONITOR WHOLE BODY ☒ SURVEY INSTRUMENTS GM + Ion chamber

CONTAMINATION/RADIATION MONITORING

☒ WEEKLY HP SURVEY ☐ MONTHLY HP SURVEY ☐ QUARTERLY HP SURVEY ☐ EFFLUENT MONITORING ☐ LEAK TEST

SPECIAL/SPECIFIC ADMINISTRATIVE PROCEDURES OR REQUIREMENTS (ATTACH OR PROVIDE BELOW)

☐ SPECIAL TRAINING ☐ SPECIFIC ACCESS CONTROLS ☐ WASTE DISPOSAL CONSIDERATIONS ☐ EMERGENCY PROCEDURES

FACILITY REQUIREMENTS

☐ SOURCE CONTROL INTERLOCK ☐ SOURCE CONTROL WARNING LIGHTS/HORNS

☐ RADIOACTIVE WASTE CONTAINERS (Specify Liquid and/or Solid) _____

ADDITIONAL REQUIREMENTS (Attach documentation as needed; indicate the number of pages attached)

Instructions for GRSD:

Issue project-specific finger rings to Source Users working with the stock solution and primary dilutions (materials ≥ 3 GBq or 81 mCi).

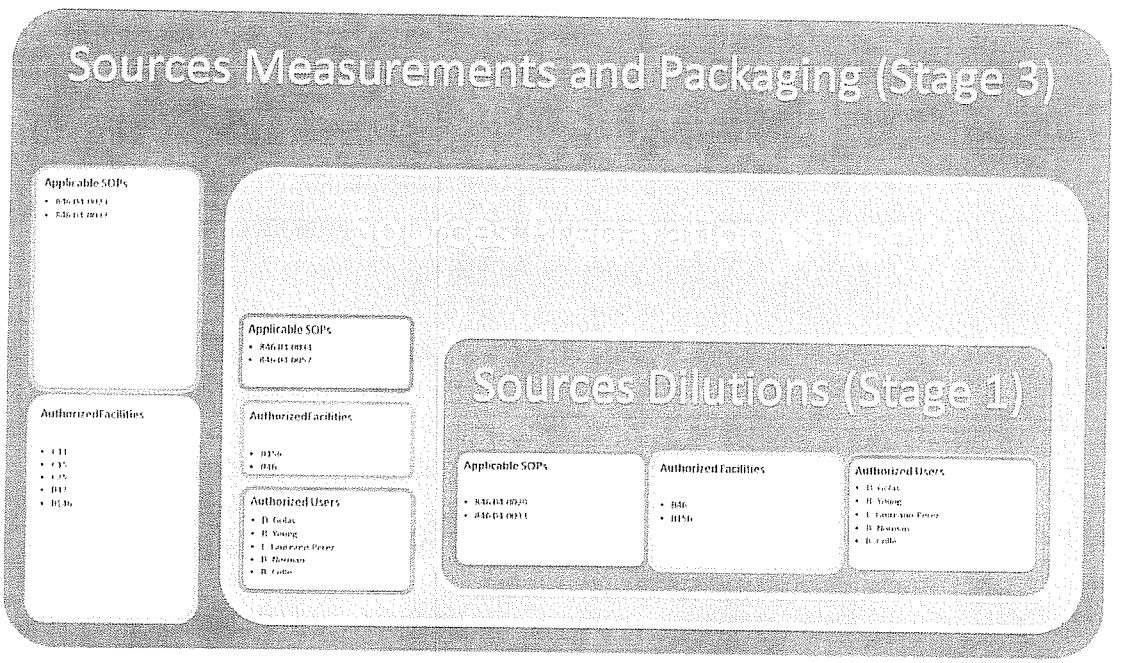
Radiation Safety Requirements for

Mo-99 SRM Preparation

RS# 12-0132

- Pre-experiment requirements
  - Ensure that all involved persons are trained in the hazards, safety precautions, and proper use of the material.
  - Ensure all personnel involved have been issued dosimetry
    - Persons working with the stock solution and primary dilutions (materials ≥ 3 GBq) shall wear project-specific dosimetry
    - Persons handling materials ≥ 74 MBq shall wear extremity dosimetry
  - Contact GRSD prior to work to arrange for:
    - Waste decay-in-storage and/or disposal
    - Obtain project-specific finger-ring dosimeters
  - Minimum PPE Requirements
    - Gloves – All stages
      - Some Molybdenum compounds may penetrate gloves and skin when handling them in unsealed form (Stages 1 & 2). Therefore, these compounds should be handled indirectly by using tools and wearing two pairs of gloves.
    - Lab coat – Required for Stages 1 and 2
    - Safety Glasses – Required for Stages 1 and 2
    - Follow any requirements posted at the facility entrance

- Project Diagram



- Stage 1 and 2 Requirements (Source dilutions and Source preparation)

  - Manipulation of the stock solution (250-530 mCi from MDS Nordion) is ONLY authorized in room B156.
    - Sources capable of producing a significant external dose to personnel shall be handled inside the Hot Cell.
    - Manipulation of any unsealed high-activity primary dilutions (> 10 mCi or 370 MBq) is ONLY authorized in rooms B46 and B156.
      - B156 and B46 shall be posted restricting access to personnel not authorized via this 364 and Hazard Mitigation Plan while unsealed high-activity primary dilutions are in progress.
    - Sources (ampoules or vials) capable of producing a significant external dose to personnel shall be shielded.
    - Inspect for the following:
      - Broken ampoules or bottles of solution held in storage
      - Breaking or cracking of a flame-sealed ampoule during use

- A broken pycnometer
- Leaking of the dispenser lines

- Cap any solutions that have not been flame-sealed and are manipulated in the lab.

- Avoid skin contamination [absorption], injection, inhalation or ingestion of the material by closely following procedures, particularly while handling the material in unsealed liquid form.

    - This material contains activity that is equivalent to:
        - 5.30 E+02 times the Annual Limit of Intake for Ingestion
        - 5.30 E+02 times the Annual Limit of Intake for Inhalation.

- Maintain contamination control by regularly monitoring gloves and work area with a shielded GM detector instrument.

- Use the principles of time, distance, and shielding to maintain doses ALARA
    - Minimize exposure handling times
    - Use remote handling tools when handling high activity sources (e.g. capable of producing a high-radiation area)
    - Use lead shielding taking into consideration the Half Value Layer (TVL) for this material is 0.083 cm (0.033inches).

- Perform a survey of the work area and materials, including at a minimum the floor space near the work area and the lab exit, when the room is to be left unattended. Smears using LSC and contamination monitor for direct reading shall be used; document for GRSD review. Unless otherwise indicated the smear results shall be in dpm/100cm2.

- Clearly label any areas, equipment or materials with radioactive contamination while the room is unattended as following:
    - The radiation symbol, the words "Caution Radioactive Material", the isotope, the approximate amount or count rate, contact information (name & phone number) and the date the area was labeled.

- An attempt shall be made at decontaminating non-disposable surfaces to a level below 200 dpm/100 cm2. If contamination remains above this level in non-disposable surfaces, the area shall be designated as a contamination control area (CCA).Notification to GRSD is required during business hours or next business day if after-hours.

    - Discard as radioactive waste any disposable items that become contaminated.

        - Coordinate with GRSD for any items that need to be designated as decay-in-storage (e.g. lab coat, dispenser).

    - Upon exiting the lab use the personal contamination monitors to verify that there is no personnel contamination; if contamination is identified beyond PPE, contact GRSD immediately.

    - Transfer of the contained solutions between stages 1 and 2, and 2 and 3, shall be done in a secure way (e.g. tray, carrying case, closed plastic container)
        - Consider shielding to maintain dose rates below 2 mrem (.02 mSv) per hour at 30 cm when transporting material between laboratories.

    - Isolate waste in sealed, clearly labeled bags or containers. Store in ventilated enclosure.

    - In case of an accident where the stock solution or a high activity dilution breaks, evacuate the room closing the door behind, prevent entry by other personnel to the lab and immediately contact GRSD at extension 5800 (7am-5pm) or 2222 (after-hours).

- Stage 3 Requirements (Source Measurements)

    - Materials inspection
        - Inspect for the following:
            - Broken ampoules or bottles of solution held in storage
            - Breaking or cracking of a flame-sealed ampoule during use.
    - Upon exiting the lab use the personal contamination monitors to verify that there is no personnel contamination; if contamination is identified beyond PPE, contact GRSD immediately.

    - Transfer of the contained solutions between stages 1 and 2, and 2 and 3, shall be done in a secure way (e.g. tray, carrying case, closed plastic container)
        - Consider shielding to maintain dose rates below 2 mrem (.02 mSv) per hour at 30 cm when transporting material between laboratories.

D. DELACROIX, J.P. GUERRE, P. LEBLANC AND C. HICKMAN

Molybdenum - 99 / Technetium - 99m

$^{99}Mo_{42}/^{99m}Tc_{43}$

Half life: 2.75 days
Specific activity: 1.77E+16 Bq.g^{-1}

Risk group: 3
Risk colour: Yellow

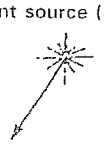
Main emissions (keV)								
	Gamma or X		Beta (Emax)		Electrons		Alpha	
	E	%	E	%	E	%	E	%
E1	141	89	436	17	120	9		
E2	740	12	848	1	138	1		
E3	778	4	1214	82				
% omitted		20.1		<1		1		

Exemption levels	
Quantity (Bq)	1E+06
Concentration (Bq.g^{-1})	1E+02

Transport (TBq)	
IAEA ST1 A_1 value	1E+0
IAEA ST1 A_2 value	6E-1

EXTERNAL EXPOSURE (mSv.h^{-1}) for an activity of 1 MBq or 1 MBq.m^{-2} (as appropriate)

Point source (30 cm)



Betas, electrons (skin dose): 1.08E-1

Gammas, X rays (deep tissue dose): 5.43E-4

Infinite plane source

Betas, electrons (skin)

10 cm	1.1E-01
1 m	1.8E-02

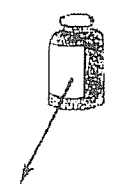
Photons (skin)

10 cm	3.7E-03
1 m	2.9E-03

Photons (deep dose)

10 cm	3.5E-03
1 m	2.8E-03

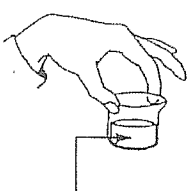
10 ml glass vial



100 cm

4.61E-5

Contact with 50 ml glass beaker



1.62E-1

Contact with 5 ml plastic syringe

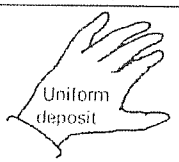
7.43E+0

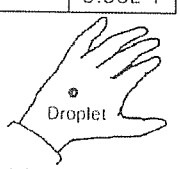
The values above do not include Bremsstrahlung radiation.

CONTAMINATION

Contamination skin dose (mSv.h^{-1})

Uniform deposit (1kBq.cm^{-2})	1.89E+0
0.05 ml droplet (1 kBq)	9.96E-1





Detection

Recommended probes*	
Alpha	
Beta	+ +
Gamma	+
X rays	+ +

Derived limits (Bq.cm^{-2})

Removable contamination
6E+1
Fixed contamination
2E+2

* If no probes are indicated the recommended technique is to use a wipe test in association with a probe or liquid scintillation technique

SHIELDING (mm)		
Betas and electrons (Total absorption)		
Glass	2.2	
Plastic	4.0	
Gamma and X rays (half and tenth value thickness)		
	½	1/10
Lead	1	19
Steel	13	55

INTERNAL EXPOSURE FOR WORKERS

COMMITTED EFFECTIVE DOSE PER UNIT INTAKE (Sv.Bq^{-1})

Ingestion	f_1	
All unspec. compounds	0.800	7.4E-10
Molybdenum sulphide	0.050	1.2E-09

Inhalation		1 µm	5 µm
All unspec. compounds	F	2.3E-10	3.6E-10
	M		
Molyb. sulphide, oxid. & hydrox.	S	9.7E-10	1.1E-09

Highest dose organ: Lower large intestine — 20 mSv $ALI_{ingestion}$: 1.7E+07 (Bq) — 20 mSv $ALI_{inhalation}$: 1.8E+07 (Bq)

MAXIMUM RECOMMENDED ACTIVITIES IN LOW LEVEL OR INTERMEDIATE LEVEL LABORATORIES (Bq)

PHYSICOCHEMICAL STATE	*Subject to external exposure requirements which may be more restrictive*					
	Volatility factor (k)	Supervised area		Controlled area		
		Bench	Fume hood	Bench	Fume hood	Glove box
All compounds	0.01	5E+05	5E+06	2E+06	2E+07	2E+09

NIST-364
(REV. 08-23-2010)
ADMAN 12.03

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
Exhibit 12

RADIOACTIVE MATERIAL REQUEST

REQUESTOR (NAME & EXT)	SUPPLIER	RADIOACTIVE SOURCE NUMBER (RS#) (HP USE)
Michael Mitch x5491	IsoRay	13-0135A, B, C

METHOD OF ACQUISITION

◯ PURCHASE ◉ FOR CALIBRATION ◯ GIFT ◯ LOAN ◯ PRODUCED AT NIST ◯ OTHER _____

◯ RETURN TO NIST RS# (IF ALREADY ASSIGNED) A B C

DESCRIPTION OF SOURCE	CS-1 Rev. 2 brachy seed	CS-1 Rev. 2 brachy seed	CS-1 Rev. 2 brachy seed
RADIONUCLIDE & ASSOCIATED NUCLIDES	Cs-131	Cs-131	Cs-131
ACTIVITY/AMOUNT (i.e., Ci, Bq, or g)	30 mCi	30 mCi	30 mCi
CHEMICAL FORM	solid, metal	solid, metal	solid, metal
CARRIER MASS (g) or VOLUME (ml)	5 mg	5 mg	5 mg

PHYSICAL FORM ◉ SOLID ◯ LIQUID ◯ GAS ◯ POWDER ◯ OTHER --->EXPLAIN _____

SOURCE CONTAINMENT (E.G., PLATED, AMPOULE, FOIL, ETC. INCLUDE REGISTERED SEALED SOURCE NUMBER IF ASSIGNED.)

titanium encapsulation; proper handling instructions included in protocol to prevent compromising source containment

SOURCE USE - IDENTIFY RADIOLOGICAL HAZARDS & PROVIDE SOURCE USE PROTOCOL(S); ATTACH ADDITIONAL PAGES AS NEEDED.

Sources will be calibrated using the Wide-Angle Free-Air Chamber (WAFAC) as described in the Standard Operating Procedures, Protocol # 846.02-0001 seed 10AUG2010, Protocol # 846.02-0002 well 10AUG2010, and Protocol # 846.02-0003 film 10AUG2010, approved by Health Physics on 8/10/2010.

SOURCE CUSTODIAN/INITIALS	SOURCE USER(S)	USE LOCATION(S)	STORAGE LOCATION
Jason Walia JW	Jason Walia Michael Mitch	245/B06, B08, B25	245/B08

GROUP LEADER AND DIVISION CHIEF AUTHORIZATION

I authorize this request pending approval by the RSO, acceptance by the Source Custodian, and authorization by OU Management and will carry out my responsibilities with regard to the requested material in accordance with NIST Administrative Manual Subchapter 12.03.

Michael Mitch, 682 GROUP LEADER PRINTED NAME & DIVISION	SIGNATURE	3/7/13 DATE
Lisa Karam, 682 DIVISION CHIEF PRINTED NAME & DIVISION	SIGNATURE	7 March 13 DATE

DO NOT ACQUIRE OR USE THE SOURCE UNTIL APPROVED BY THE RSO, ACCEPTED BY THE SOURCE CUSTODIAN, AND AUTHORIZED BY MANAGEMENT

RADIATION SAFETY OFFICER APPROVAL

I approve this request subject to the requirements specified in this form, including the hazard mitigation plan and all other attachments.

Joanna Shupe, NP RSO OR DESIGNEE PRINTED NAME AND TITLE	SIGNATURE	8 Mar 13 DATE

SOURCE CUSTODIAN ACCEPTANCE

I understand and shall carry out my responsibilities with regard to the requirements specified in this form and as detailed in NIST Administrative Manual Subchapter 12.03.

Jason Walia SOURCE CUSTODIAN PRINTED NAME	SIGNATURE	3/8/13 DATE

OU MANAGEMENT AUTHORIZATION

authorize this request subject to the requirements specified in this form and shall ensure that these requirements have been met prior to the commencement of work.

Lisa Karam, Chief 682 MANAGEMENT PRINTED NAME AND TITLE	SIGNATURE	8 March 13 DATE

Number of Attachments: _____

Exhibit 12

RADIOACTIVE MATERIAL HAZARD MITIGATION PLAN

RADIOACTIVE SOURCE NUMBER (RS#) or PROTOCOL NUMBER	ISOTOPE(S) and ACTIVITY
13-0135A, B, & C	Cs-131, 30 mCi each

RADIOLOGICAL HAZARDS

Maximum Calculated Doses

Type of Exposure	mrem
Full Inhalation	5.0 E3
Partial Inhalation	5.0 E-2
Full Ingestion	7.5 E3
Partial Ingestion	7.5 E3

Maximum Calculated Dose Rates

Dose Rates	mrem/hr
Dose Rate @ 30 cm	40
Dose Rate @ 1 cm	8.6 E4
Skin Dose Rate	3.7 E5

* Source Integrity Shall Not Be Compromised

Emissions
- ☐ Alpha
- ☐ Beta
- ☒ Gamma
- ☐ Neutron
- ☐ X Ray

Source Type
- ☒ Sealed*
- ☐ Unsealed
- ☐ Category I
- ☐ Category II
- ☐ NSTS HP 24 hour report

Radiotoxicity
- ☐ I
- ☐ II
- ☐ III
- ☒ IV

☐ Potential for airborne radioactivity

SOURCE CUSTODIAN / SOURCE USER MITIGATION PLAN REQUIREMENTS

☐ MITIGATION PLAN REQUIREMENTS ARE PROVIDED IN STANDING APPROVED PROTOCOLS
If not checked, the requirements below apply

EXPOSURE MONITORING

☐ WHOLE BODY ☐ EXTREMITY ☐ BIOASSAY ☐ DIRECT READING ☐ AIR SAMPLING ☐ NONE

PERSONAL PROTECTIVE MEASURES/TECHNIQUES

☐ GLOVES (1 pr/2 pr) ☐ LAB COAT ☐ APRON ☐ SAFETY GLASSES ☐ FACE SHIELD ☐ SHOE COVERS

☐ DISPOSABLE/ABSORBENT SURFACES ☐ SPILL CONTAINMENT TRAY ☐ SECURITY

☐ REMOTE HANDLING TOOLS _____ ☐ SHIELDING _____ ☐ HOOD ☐ GLOVE BOX

☐ SURVEY INSTRUMENTS AVAILABLE - TYPE(S): _____

☐ MONITOR WHOLE BODY ☐ MONITOR HANDS & FEET

ADDITIONAL REQUIREMENTS (Attach documentation as needed; indicate the number of pages attached)

Mitigation Plan Requirements are provided in their entirety in the Safety Evaluation for Brachytherapy Seed and Beta Source Calibration.

RADIOLOGICAL HAZARD REVIEW COMPLETED BY

Janna Shupe		8 Mar 2013
HEALTH PHYSICS (PRINTED NAME)	HEALTH PHYSICS SIGNATURE	DATE

Exhibit 12

RADIOACTIVE MATERIAL HAZARD MITIGATION PLAN

RADIOACTIVE SOURCE NUMBER (RS#) or PROTOCOL NUMBER	ISOTOPE(S) and ACTIVITY
13-0135A, B, & C	Cs-131, 30 mCi each

HEALTH PHYSICS REQUIREMENTS

☐ GLOVE BOX ☐ HOOD ☐ POSTING _____

☐ ONE PASS ROOM VENTILATION ☐ FILTRATION _____

☐ MONITOR HANDS & FEET ☐ MONITOR WHOLE BODY ☐ SURVEY INSTRUMENTS _____

CONTAMINATION/RADIATION MONITORING

☐ WEEKLY HP SURVEY ☐ MONTHLY HP SURVEY ☐ QUARTERLY HP SURVEY ☐ EFFLUENT MONITORING ☐ LEAK TEST

SPECIAL/SPECIFIC ADMINISTRATIVE PROCEDURES OR REQUIREMENTS (ATTACH OR PROVIDE BELOW)

☐ SPECIAL TRAINING ☐ SPECIFIC ACCESS CONTROLS ☐ WASTE DISPOSAL CONSIDERATIONS ☐ EMERGENCY PROCEDURES

FACILITY REQUIREMENTS

☐ SOURCE CONTROL INTERLOCK ☐ SOURCE CONTROL WARNING LIGHTS/HORNS

☐ RADIOACTIVE WASTE CONTAINERS (Specify Liquid and/or Solid) _____

ADDITIONAL REQUIREMENTS (Attach documentation as needed; indicate the number of pages attached)

Exhibit 12

NIST-364
(REV. 08-23-2010)
ADMAN 12.03

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

RADIOACTIVE MATERIAL REQUEST

REQUESTOR (NAME & EXT)	SUPPLIER	RADIOACTIVE SOURCE NUMBER (RS#) (HP USE)
Lynne King	Eckert & Ziegler	12-0126

METHOD OF ACQUISITION

◯ PURCHASE ◉ FOR CALIBRATION ◯ GIFT ◯ LOAN ◯ PRODUCED AT NIST ◯ OTHER

◯ RETURN TO NIST RS# (IF ALREADY ASSIGNED)

DESCRIPTION OF SOURCE	large-area 134-285		
RADIONUCLIDE & ASSOCIATED NUCLIDES	Pu-239		
ACTIVITY/AMOUNT (i.e., Ci, Bq, or g)	2.4 kBq		
CHEMICAL FORM	metal		
CARRIER MASS (g) or VOLUME (ml)	~7 g		

PHYSICAL FORM ◉ SOLID ◯ LIQUID ◯ GAS ◯ POWDER ◯ OTHER --->EXPLAIN

SOURCE CONTAINMENT (E.G., PLATED, AMPOULE, FOIL, ETC. INCLUDE REGISTERED SEALED SOURCE NUMBER IF ASSIGNED.)

electrodeposited

SOURCE USE - IDENTIFY RADIOLOGICAL HAZARDS & PROVIDE SOURCE USE PROTOCOL(S); ATTACH ADDITIONAL PAGES AS NEEDED.

846.04-0024 fuji 17MAY2010
846.04-0025 Al-Be 17MAY2010

SOURCE CUSTODIAN/INITIALS	SOURCE USER(S)	USE LOCATION(S)	STORAGE LOCATION
Lynne King LK	Lynne King Michael Unterweger	245, E107	245, E107

GROUP LEADER AND DIVISION CHIEF AUTHORIZATION

I authorize this request pending approval by the RSO, acceptance by the Source Custodian, and authorization by OU Management and will carry out my responsibilities with regard to the requested material in accordance with NIST Administrative Manual Subchapter 12.03.

Michael Unterweger 682.04 GROUP LEADER PRINTED NAME & DIVISION	SIGNATURE	11/21/12 DATE
Lisa Karam 682.00 DIVISION CHIEF PRINTED NAME & DIVISION	SIGNATURE	27 Nov 12 DATE

DO NOT ACQUIRE OR USE THE SOURCE UNTIL APPROVED BY THE RSO, ACCEPTED BY THE SOURCE CUSTODIAN, AND AUTHORIZED BY MANAGEMENT

RADIATION SAFETY OFFICER APPROVAL

I approve this request subject to the requirements specified in this form, including the hazard mitigation plan and all other attachments.

Tanya Shupe, HP RSO OR DESIGNEE PRINTED NAME AND TITLE	SIGNATURE	12/10/12 DATE

SOURCE CUSTODIAN ACCEPTANCE

I understand and shall carry out my responsibilities with regard to the requirements specified in this form and as detailed in NIST Administrative Manual Subchapter 12.03.

Lynne King SOURCE CUSTODIAN PRINTED NAME	SIGNATURE	11/21/2012 DATE

OU MANAGEMENT AUTHORIZATION

I authorize this request subject to the requirements specified in this form and shall ensure that these requirements have been met prior to the commencement of work.

Lisa Karam, Chief 682 MANAGEMENT PRINTED NAME AND TITLE	SIGNATURE	17 Dec 12 DATE

Number of Attachments:

Exhibit 12

RADIOACTIVE MATERIAL HAZARD MITIGATION PLAN

RADIOACTIVE SOURCE NUMBER (RS#) or PROTOCOL NUMBER	ISOTOPE(S) and ACTIVITY
12-0126	Pu-239, 2.4 kBq

RADIOLOGICAL HAZARDS

Maximum Calculated Doses

Type of Exposure	mrem
Full Inhalation	5.4 E4
Partial Inhalation	0.54
Full Ingestion	410
Partial Ingestion	5.8

Maximum Calculated Dose Rates

Dose Rates	mrem/hr
Dose Rate @ 30 cm	2.1 E-5
Dose Rate @ 1 cm	2.3 E-2
Skin Dose Rate	2.9 E-2

* Source Integrity Shall Not Be Compromised

Emissions	Source Type	Radiotoxicity
☒ Alpha	☒ Sealed*	☒ I
☐ Beta	☐ Unsealed	☐ II
☐ Gamma	☐ Category I	☐ III
☐ Neutron	☐ Category II	☐ IV
☐ X-Ray	☐ NSTS 10P - 21 hour report	

☐ Potential for airborne radioactivity

SOURCE CUSTODIAN / SOURCE USER MITIGATION PLAN REQUIREMENTS

☐ MITIGATION PLAN REQUIREMENTS ARE PROVIDED IN STANDING APPROVED PROTOCOLS

If not checked, the requirements below apply

EXPOSURE MONITORING

☒ WHOLE BODY ☐ EXTREMITY ☐ BIOASSAY ☐ DIRECT READING ☐ AIR SAMPLING ☐ NONE

PERSONAL PROTECTIVE MEASURES/TECHNIQUES

☒ GLOVES (1pr/2 pr) ☐ LAB COAT ☐ APRON ☐ SAFETY GLASSES ☐ FACE SHIELD ☐ SHOE COVERS

☐ DISPOSABLE/ABSORBENT SURFACES ☐ SPILL CONTAINMENT TRAY ☐ SECURITY

☐ REMOTE HANDLING TOOLS _____ ☐ SHIELDING _____ ☐ HOOD ☐ GLOVE BOX

☒ SURVEY INSTRUMENTS AVAILABLE - TYPE(S): Alpha

☐ MONITOR WHOLE BODY ☐ MONITOR HANDS & FEET

ADDITIONAL REQUIREMENTS (Attach documentation as needed; indicate the number of pages attached)

Sources shall never be purposefully unsealed.

When not performing measurements, sources will be stored in a manner to keep doses ALARA.

At no time shall contact be made with the active area of the sources since the sources tend to have thin windows that can be easily damaged.

The equipment shall be surveyed after use.

RADIOLOGICAL HAZARD REVIEW COMPLETED BY

Janna Shupe		12/10/12
HEALTH PHYSICS (PRINTED NAME)	HEALTH PHYSICS SIGNATURE	DATE

RADIOACTIVE MATERIAL HAZARD MITIGATION PLAN

RADIOACTIVE SOURCE NUMBER (RS#) or PROTOCOL NUMBER	ISOTOPE(S) and ACTIVITY
12-0126	Pu-239, 2.4 kBq

HEALTH PHYSICS REQUIREMENTS

☐ GLOVE BOX ☐ HOOD ☒ POSTING Radioactive Materials

☐ ONE PASS ROOM VENTILATION ☐ FILTRATION _____

☐ MONITOR HANDS & FEET ☐ MONITOR WHOLE BODY ☐ SURVEY INSTRUMENTS _____

CONTAMINATION/RADIATION MONITORING

☐ WEEKLY HP SURVEY ☐ MONTHLY HP SURVEY ☐ QUARTERLY HP SURVEY ☐ EFFLUENT MONITORING ☐ LEAK TEST

SPECIAL/SPECIFIC ADMINISTRATIVE PROCEDURES OR REQUIREMENTS (ATTACH OR PROVIDE BELOW)

☐ SPECIAL TRAINING ☐ SPECIFIC ACCESS CONTROLS ☐ WASTE DISPOSAL CONSIDERATIONS ☐ EMERGENCY PROCEDURES

FACILITY REQUIREMENTS

☐ SOURCE CONTROL INTERLOCK ☐ SOURCE CONTROL WARNING LIGHTS/HORNS

☐ RADIOACTIVE WASTE CONTAINERS (Specify Liquid and/or Solid) _____

ADDITIONAL REQUIREMENTS (Attach documentation as needed; indicate the number of pages attached)

Emergency Response Personnel
NIST Fire Protection Group

Radiation Safety Training - Practical Exercise

3/16/11

Purpose and Scope

This is a practical exercise limited to utilizing some basic radiation safety principles. It is not intended to be an incident that would require a hazmat operational response (e.g., chemical or airborne hazmat). All activities associated with the practical exercise will be limited to those at the scene (i.e., there will not be any need or request for an Incident Command or other outside support). No radio communications will be needed or utilized.

Scenario

A radioactive waste container is being loaded on a truck at the loading dock outside Bld 245 for transfer to Building 235. As a rad technician moves the container onto the truck, he loses his balance and falls from the loading dock into the bed of the truck along with the rad waste container. He is unconscious but his vital signs are good. Some of the radwaste in the container has spilled out onto the victim. A simulated call is made to x2222.

Parameters

Radiation Safety Division (RSD) staff will control the execution of the drill and keep all exposures ALARA. The victim has measurable radioactivity due to a recent medical treatment using medical radionuclides (we do not expect any staff to receive a measurable radiation dose, contact dose rates on the victim do not exceed 0.3 mR/hr). Although RSD personnel would normally be present if such an incident were to occur, we will allow the responders to "direct" their activities with minimal guidance provided by RSD.

No radioactive material was used except for the medically administered radioactive material in the victim.

The practical will be considered completed when patient is loaded onto the stretcher. After completion of the practical, a discussion and review of the practical will be conducted.

Primary Objectives

To demonstrate the difference between monitoring for contamination and measuring radiation dose levels.

To demonstrate the capabilities and limitations of the FPG survey meters.

To demonstrate how to balance radiological versus medical concerns.

To demonstrate how to deal with a radiologically contaminated patient that requires ambulance transport.

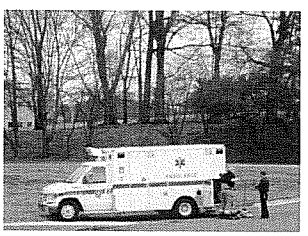
Practical Objectives Checklist

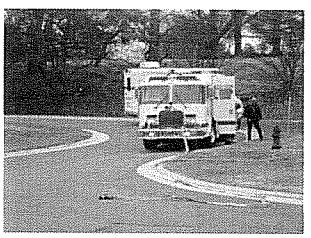
Was there a radiation level survey?
Were actions taken commensurate with the rad level present?
Was there a contamination level survey?
Were actions taken commensurate with the contamination level present?
Did victim receive prompt treatment?
Was contamination detected on the victim?
Was medical care a priority over rad concerns?
Were reasonable contamination control measures put in place?
Were the appropriate survey meters used?

Drill Summary -

- 1:02pm – Event Occurs

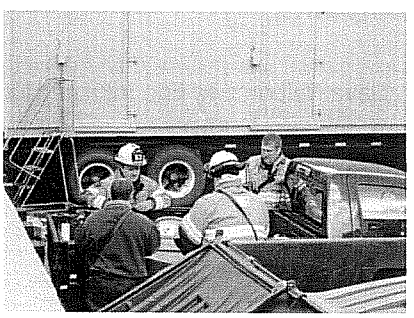
- 1:05pm
  - Fire crew arrives on scene
  - Fire crew lay down hose for decon purposes and don PPE in preparation to entering incident area
  - Fire crew are wearing dosimeters



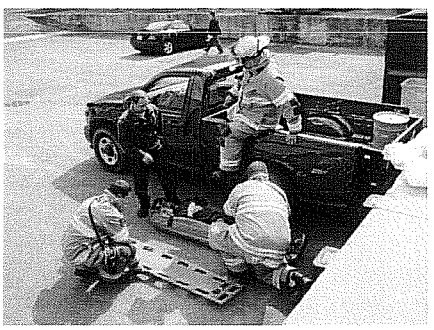


  - Fire Chief receives assistance in the operation of the detectors from RSD

- 1:09pm
  - Firefighters detect the presence of radioactive materials on the victim
  - A decision is made to clear away some of the waste containers surrounding the victim



- 1:14pm
  - Victim moved to stretcher
  - Clothes taken off
  - Lower radiation readings are observed on victim, still unconscious



- 1:19 pm timeout for discussion
  - Observations:
    - Fire department indicates to RSD that Montgomery county would reject any victim unless victim is decontaminated
    - Discussion around priorities rises: radiological vs. medical emergency taking precedence

- 1:29 Discussion continues with the mention of a need to establish a hot zone boundary
  - Observation
    - ER protocol should provide guidance on different radiation levels, potentially establish with the assistance of police and RSD a 2mR/hr boundary for non-emergency personnel
    - Discussion revolves around daytime response, protocols should be reviewed for an after-hours scenario

- 1:38 Discussion on triage/decon area

- 1:47 Drill ends

Drill Participants

Ivan Todd, Dave Nalborczyk, Eric InKrote, Justin Grossnickle, and Steve Teagarden, FPG
Tom O'Brien, Sarah Yu, RSD
Bruce Norman, IRD

Key Issues Identified

During the drill and at the termination of the drill, several questions were raised by both the FPG and RSD. Discussions followed and the primary points of those discussions are provided below.

1. Individuals performing rad surveys did not always perform extensive enough surveys to determine the exact source of the radiation level readings (e.g., the area and extent of contamination). If manpower allows, designate one individual as primary for monitoring exposures during the on-going incident. The same individual should set the boundary for hot/cold zones.

2. There was some confusion in the dose rate readings scale (uR/hr versus mR/hr)

3. There was a strong desire to perform a quick washdown of the patient despite a significant medical status. This desire was apparently driven by the understanding that Montgomery County ALS would respond for EMS/unconscious patients and would not transport a contaminated patient.

4. The Double/Triple Blanket method can be used to contain the contamination and prevent cross-cross contamination of other items and equipment during transport of the patient.

5. FPG should attempt to monitor themselves (i.e., perform a contamination survey) with the survey meter after each time any radioactive material is handled (e.g., when FPG removed the RAM labeled items from the truck)

Summary

The FPG was fully engaged during the drill and acted very professionally. Although training of the FPG is performed every two years, there have only been two drills conducted for the FPG since 2006. Except for the issue of the Montgomery County ALS apparently not transporting contaminated patients, all other identified issues can be addressed through improved and more frequent training of the FPG by RSD.

Action Items

The RSD training program shall be revised with the goal of conducting mandatory annual training that includes classroom presentation, hands on practical training with survey instruments and a table-top or a real life scenario drill. Consideration shall be given to RSD conducting more frequent (possibly quarterly) hands-on mini-training sessions that

focus on the use of survey instrumentation (contamination and dose rate) and the subsequent actions needed based on the survey instrumentation readings.

Assess and define the scope and frequency of radiological emergency response training needed for the Police Services Group.

Determine the needs of, and guidelines under which, Montgomery County Advanced Life Support units operate with respect to contaminated injured patient treatment and transport.

Coordinate the above actions with NCNR training requirements and NCNR drill/exercise outcomes.

Legacy Sources – Action Plan

4/2/13

The National Institute of Standards and Technology (NIST) has an inventory of approximately 1400 sealed and non-sealed radioactive sources at the Gaithersburg, Maryland location. These sources are primarily from NIST scientists that have been acquiring radioactive material for use in research supporting a wide range of NIST programs. Approximately 120 sources of the inventory are no longer required to support NIST scientific activities. Therefore, a plan for the transfer or disposal of these sources is needed.

The removal of radioactive material has, over time, become a highly regulated, complex, and difficult process performed by a small number of corporations and Federal Agencies. The Gaithersburg Radiation Safety Division (GRSD) identified that contractor support is required to investigate potential removal options and make recommendations for the most cost effective, ecologically sound, and safest method of removal for these sources.

In FY13, a determination of the available options for managing each source shall be performed via GRSD and contract support. This information will allow for the investigation of potential removal options (including recycling, recovery, disposal, and continued storage at NIST recycling, recovery, disposal, and continued storage at NIST). This effort will take into consideration costs, technical and administrative issues, legal and regulatory liabilities. NIST executive management shall be advised of the funding need for the removal/disposal of the legacy sources so that appropriate funding levels for FY14 and beyond can be allocated.

The FY14 and beyond funding allocations will include contractor support in areas such as those listed below.

1. Analysis of options available for the management/disposal of the sources including the regulatory, legal, and financial status of each facility where sources are (potentially) to be sent.
2. Technical and administrative issues or obstacles for each source.
3. Potential legal and regulatory liabilities
4. Estimated costs associated with preparation, transportation, and fees.

SNM-362 License Compliance of RAM Recieved or Loaned

LicCat	Nuclide	Category Description	Unit	Current Qnty	% of Limit	Source Count
11		LEU <20% U-235 BY WT.	G	1.725E+01	57.5%	10
12		HEU >=20% U-235 BY WT.	G	1.120E+02	48.7%	52
13		U-233, ANY FORM	G	6.865E-03	0.1%	6
14		PLUTONIUM (except PU-238)	G	8.419E+00	21.0%	41
15		PLUTONIUM, SEALED SOURCE	G	6.991E-03	0.0%	88
16		Pu-238 ENRICHED >80%	G	4.000E-02	40.0%	12
21		NATURAL URANIUM (soluble)	G	1.447E+03	16.1%	24
211		NATRL URANIUM (insoluble)	G	2.786E+03	1.9%	28
22		DEPLETED URANIUM(soluble)	G	2.634E+02	6.6%	16
221		DEPLT URANIUM (insoluble)	G	2.753E+04	65.6%	25
23		ANY FORM OF THORIUM	G	4.825E+04	69.9%	29
31	CS131	OTHER BP HALFLIFE LT 30D	CI	0.000E+00	0.0%	3
31	F18	OTHER BP HALFLIFE LT 30D	CI	0.000E+00	0.0%	14
31	I123	OTHER BP HALFLIFE LT 30D	CI	0.000E+00	0.0%	3
31	I124	OTHER BP HALFLIFE LT 30D	CI	3.053E-13	0.0%	1
31	I131	OTHER BP HALFLIFE LT 30D	CI	3.879E-02	1.0%	2
31	IN111	OTHER BP HALFLIFE LT 30D	CI	9.236E-23	0.0%	1
31	LU177	OTHER BP HALFLIFE LT 30D	CI	3.198E-03	0.1%	3
31	PD103	OTHER BP HALFLIFE LT 30D	CI	2.216E-04	0.0%	21
31	SR82	OTHER BP HALFLIFE LT 30D	CI	1.788E-04	0.0%	2
31	Y90	OTHER BP HALFLIFE LT 30D	CI	3.660E-19	0.0%	4
32	AG108M	OTHER BP HALFLIFE GT 30D	CI	9.595E-07	0.0%	1
32	AG110M	OTHER BP HALFLIFE GT 30D	CI	4.657E-15	0.0%	1
32	AL26	OTHER BP HALFLIFE GT 30D	CI	5.000E-07	0.0%	1
32	BA133	OTHER BP HALFLIFE GT 30D	CI	8.985E-02	9.0%	39
32	BE10	OTHER BP HALFLIFE GT 30D	CI	5.000E-08	0.0%	1
32	BI207	OTHER BP HALFLIFE GT 30D	CI	7.033E-05	0.0%	7
32	CD109	OTHER BP HALFLIFE GT 30D	CI	1.052E-02	1.1%	22
32	CE139	OTHER BP HALFLIFE GT 30D	CI	1.175E-07	0.0%	3
32	CE144	OTHER BP HALFLIFE GT 30D	CI	8.051E-10	0.0%	1
32	CL36	OTHER BP HALFLIFE GT 30D	CI	7.489E-05	0.0%	10
32	CO57	OTHER BP HALFLIFE GT 30D	CI	2.084E-02	2.1%	36
32	CS134	OTHER BP HALFLIFE GT 30D	CI	1.412E-05	0.0%	4
32	EU152	OTHER BP HALFLIFE GT 30D	CI	1.322E-02	1.3%	20
32	EU154	OTHER BP HALFLIFE GT 30D	CI	2.375E-05	0.0%	2
32	EU155	OTHER BP HALFLIFE GT 30D	CI	1.587E-06	0.0%	1
32	FE55	OTHER BP HALFLIFE GT 30D	CI	7.474E-02	7.5%	17
32	GD148	OTHER BP HALFLIFE GT 30D	CI	3.456E-06	0.0%	2
32	GD153	OTHER BP HALFLIFE GT 30D	CI	4.286E-08	0.0%	1
32	GE68	OTHER BP HALFLIFE GT 30D	CI	6.144E-03	0.6%	7
32	HG203	OTHER BP HALFLIFE GT 30D	CI	1.103E-17	0.0%	1
32	HO166M	OTHER BP HALFLIFE GT 30D	CI	9.911E-04	0.1%	2
32	I125	OTHER BP HALFLIFE GT 30D	CI	7.491E-02	7.5%	17
32	I129	OTHER BP HALFLIFE GT 30D	CI	4.117E-04	0.0%	6
32	IR192	OTHER BP HALFLIFE GT 30D	CI	9.518E-06	0.0%	13

LicCat	Nuclide	Category Description	Unit	Current Qnty	% of Limit	Source Count
32	MN54	OTHER BP HALFLIFE GT 30D	CI	1.170E-04	0.0%	13
32	NA22	OTHER BP HALFLIFE GT 30D	CI	1.259E-04	0.0%	13
32	NB93M	OTHER BP HALFLIFE GT 30D	CI	1.440E-02	1.4%	1
32	NB94	OTHER BP HALFLIFE GT 30D	CI	1.005E-03	0.1%	3
32	NI63	OTHER BP HALFLIFE GT 30D	CI	5.207E-01	52.1%	48
32	PB205	OTHER BP HALFLIFE GT 30D	CI	6.000E-07	0.0%	1
32	PB210	OTHER BP HALFLIFE GT 30D	CI	8.517E-04	0.1%	19
32	PM147	OTHER BP HALFLIFE GT 30D	CI	6.274E-01	62.7%	12
32	PO208	OTHER BP HALFLIFE GT 30D	CI	2.769E-10	0.0%	1
32	PO209	OTHER BP HALFLIFE GT 30D	CI	3.858E-06	0.0%	3
32	PO210	OTHER BP HALFLIFE GT 30D	CI	5.412E-06	0.0%	2
32	RU106	OTHER BP HALFLIFE GT 30D	CI	4.767E-04	0.0%	6
32	SB125	OTHER BP HALFLIFE GT 30D	CI	1.029E-07	0.0%	1
32	SC46	OTHER BP HALFLIFE GT 30D	CI	1.608E-07	0.0%	1
32	SN113	OTHER BP HALFLIFE GT 30D	CI	4.440E-05	0.0%	10
32	SR85	OTHER BP HALFLIFE GT 30D	CI	0.000E+00	0.0%	1
32	SR89	OTHER BP HALFLIFE GT 30D	CI	0.000E+00	0.0%	1
32	SR90	OTHER BP HALFLIFE GT 30D	CI	3.659E-02	3.7%	14
32	TC99	OTHER BP HALFLIFE GT 30D	CI	1.004E-01	10.0%	14
32	TE123M	OTHER BP HALFLIFE GT 30D	CI	7.916E-10	0.0%	1
32	TL204	OTHER BP HALFLIFE GT 30D	CI	2.747E-05	0.0%	8
32	Y88	OTHER BP HALFLIFE GT 30D	CI	4.563E-05	0.0%	10
32	ZN65	OTHER BP HALFLIFE GT 30D	CI	1.647E-05	0.0%	3
33		H-3, ANY FORM	CI	5.520E+00	0.3%	33
34		C-14, ANY FORM	CI	2.025E-02	0.4%	22
35		Co-60, ANY FORM	CI	1.011E-03	0.0%	25
36		Kr-85, ANY FORM	CI	1.232E-01	0.4%	24
37		Mo-99, ANY FORM	CI	0.000E+00	0.0%	1
39		Xe-133, ANY FORM	CI	1.399E-05	0.0%	3
40		Cs-137, ANY FORM	CI	3.380E-02	0.2%	44
42		Am-241, ANY FORM	CI	3.498E-04	1.4%	21
43		Am-243, ANY FORM	CI	1.201E-03	4.8%	7
45		Cm-244, ANY FORM	CI	3.371E-05	0.1%	7
46		Cf-252, ANY FORM	CI	9.781E-05	0.4%	3
51		MIXED BYPROD MAT, Z<82	CI	2.045E-02	20.4%	49
52		MIXED ACTIVIATION PRODUCT	CI	8.599E-06	0.0%	7
54		MIXED ALPHA & BETA	CI	1.580E-09	0.0%	2
57		Cm-243, ANY FORM	CI	2.436E-07	0.0%	1
64		Np-237, ANY FORM	CI	8.832E-04	3.5%	16
71		Co-60, SEALED	CI	1.299E+04	22.4%	96
72		Cs-137, SEALED	CI	3.164E+03	35.2%	97
73		Po-210, SEALED	CI	1.098E-02	0.1%	16
74		Am-241, SEALED	CI	1.001E+01	25.0%	33
75		Cf-252, SEALED	CI	5.580E-02	0.6%	36
76		Sr-90, SEALED	CI	5.824E-01	11.6%	36
91		IRRADIATED FUEL	G	2.100E-01	84.0%	2
98		NIST ADMIN CONTROL, RADIU	CI	5.836E+00	83.4%	68

LicCat	Nuclide Category Description	Unit	Current Qnty	% of Limit	Source Count
99	TR-5 REACTOR LICENSE	CI	1.856E+00	18.6%	1

NIST-1197 Gaithersburg
(Rev. 06-09-2010)
ADMIN 1120

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

OCCUPATIONAL HEALTH AND SAFETY ORIENTATION CHECKLIST

Supervisors must instruct all new or transferred appointees (employees and associates) assigned to their units in the specific occupational health and safety requirements applicable to the job, preferably on the first day, but in any event during the first week of such assignment. As part of this instruction, Supervisors must complete Form NIST-1197 with the appointee, place a copy in the appointee's personnel file, and send a copy to the Safety Office within no more than 5 days of the appointee entering on duty.

PLEASE PRINT OR TYPE

APPOINTEE (Last Name, First, Initial)	POSITION TITLE	DIVISION	SUPERVISOR (NAME)

Appointment Category — Entry On Duty/Reassignment Date _____

New Employee	Reassigned Employee	Contractor/Consultant	IPA
Guest Researcher	Research Associate	Faculty Appointee	Fellowship
Summer Employee	Student	Volunteer	Other

New Employee/Associate/SURF Student Safety Orientation — Date Attended _____

Division Safety Check the item when completed or put N/A on the line if the item does not apply.

Emergencies at NIST

_____ Inform appointee that all emergency situations on the NIST site, such as fires, chemical spills/leaks, injuries/illnesses requiring an ambulance, etc., are to be reported immediately by calling the EMERGENCY NUMBER, extension 3333.
_____ Inform appointee about the NIST fire detection and alarm systems.
_____ Tell the appointee who the evacuation coordinator is and what their role is in an evacuation.
_____ Explain building evacuation procedures include the location of exits and place to meet after leaving the building.
_____ Explain severe weather alarm notification and evacuation procedures (go to lowest floor, center of the building).

General Safety

_____ Discuss with appointee that all incidents (injuries, illnesses, and near misses) must be reported.
_____ Explain to the appointee that unsafe conditions can be reported to the Trouble Desk – x6928 or the Safety Office – x6375.
_____ Explain the OU and Division Safety Policies and Organization and tell them who the Division and OU Safety Representatives are.
_____ Show the appointee how to obtain web-based safety information from the Division, OU and NIST Safety web site, http://safety.nist.gov/.
_____ Have the appointee complete the mandatory Radiation Safety Awareness training in the Commerce Learning Center.
Date completed: _____

Job Safety

_____ Describe the major hazards of work done in the Division and how they are controlled.
_____ Discuss the Health and Safety Instructions (HSIs) that apply to the work the appointee will do.
_____ List the HSI numbers: _____

Slips, Trips & Falls

_____ Emphasize the need for good housekeeping to prevent slips, trips and falls.
_____ Discuss the need to keep containers with liquid covered and secured when transporting them in hallways and common areas.
_____ Emphasize the need to use ladders and stools to reach high places and not to use chairs.
_____ Remind the appointee not to drape cords, cables or hose across the floor. If necessary, use a cable protector.

Hazardous Materials ☐ N/A

_____ Discuss the hazardous materials used and what safeguards and procedures are used to control the hazard.
_____ Review procedures for correctly operating equipment and tools used to perform job tasks.
_____ Discuss the procedures for working with a chemical fume hood, if applicable.
_____ Review procedures for labeling hazardous materials.
_____ Discuss procedures for proper disposal of hazardous chemical materials and review the Waste Disposal Procedure Manual.

Dispersible Engineered Nanomaterials (DENMs) ☐ N/A

_____ Describe the major hazards of work done in the Division and how they are controlled.
_____ Discuss the procedures for working with, handling, and disposing of DENMs.
_____ Discuss applicable HSIs, including HSI 33, HSI 32, HSI 15, and HSI 7.

Biohazards ☐ N/A

_____ Review procedures for working with blood borne pathogens.
_____ Discuss the procedures for working with a biological safety cabinet.
_____ Discuss the procedures for handling and disposing of biohazard/special medical waste.

Compressed Gases ☐ N/A

_____ Review the hazards of the compressed gases that will be used. Include the PPE required for tasks involving the compressed gas.
_____ Review division procedures for managing compressed gas cylinders.
_____ Review procedures for securing of compressed gas cylinders in the laboratory.
_____ Review procedures for getting and connecting regulators and piping.

Ionizing Radiation and Laser Safety ☐ N/A

_____ Will the appointee work with or near radioactive materials or radiation sources such as an irradiator, reactor, X-Ray device, or accelerator?
_____ Will the appointee require access to posted radiation facilities?
_____ Will the appointee prepare or handle radioactive materials in transit?
_____ Will the appointee work with or near Class IIIb or IV Lasers?

If any of the above are checked, call Health Physics (x5806) to arrange for radiation/laser safety training.

Attachment E

Completed Questionnaires

QUESTIONNAIRE FOR PERSONNEL INVOLVED WITH RADIOACTIVE MATERIALS

The purpose of this questionnaire is to assist TIDEWATER, Inc. in collecting information in support of a US government required audit regarding use of radioactive material and radiation safety at NIST. Please complete this questionnaire to the best of your recollection, and include any additional explanations in the Additional Notes/Comments section on the last page of this questionnaire or on an attached sheet of paper.

Date: 3/13/2013

Mode of Communication(s): Personal interview

1. What is your name and what is/was your job title/position? Jeff Cessna, Research Physicist

Contact Information: Phone: 301-975-5539
E-mail:

2. During what span of years have you worked, or did you work, at this facility with radioactive materials? Since 1988

3. Can you name or identify the radioactive material or devices that you might have worked on within the selected installation? What isotopes were involved? He has worked with many different radionuclides; any radioisotope used for calibration or for medical medicine.

Radionuclide Quantity

Were there alpha emitters? __X_Yes ___No If yes, which ones? Ra-223, As-211

Any sealed sources? ___ Yes _X__No
Any leak tests results 0.005 uCi? ____ Yes __X__No

Were there detector cells? Were titanium tritide foil or scandium tritide foils vented to outside?
____ Yes _X___No __ Unknown

4. Was a hazard analysis performed for your protocol or work? If so, please provide a copy.
Yes, can get copies from GRSD

5. Was radioactive material ordered prior to completion of the hazard analysis? ____ Yes _X__No
Not recently (since the change in process)

6. Where and how was the shipping and receiving of radioactive material handled (central location, straight to lab, etc.)? Building 301 and then to GRSD

7. Was work performed in fume or biological hoods? _X___ Yes ____No (assumption)
If Yes, please answer the following:

Exhaust Ductwork? __X__ Yes ____No ___Unknown
Exhaust filters? __X__ Yes ____No ___Unknown
Reactive chemicals (perchloric acid, picrates and azides)? ____ Yes _X___No ___Unknown

8. Did you use a vacuum system? ____ Yes ____No ___Unknown

9. Was radioactive material disposed into sinks? ____ Yes _X___No ___Unknown

If Yes, were special sinks designated? Were disposal logs kept and where might they be today?

Does the building have hold-up tanks for laboratory waste? _X___ Yes ____No ___Unknown
If Yes, please provide a general location.
In the B wing

Is there a special washing location for lab dishware and equipment? _X___ Yes ___No
If Yes, please provide a location. E-106, B-156, B-48

10. Where did laboratory waste go; interim storage? All waste goes to GRSD
< 120 day half-life material _____
> 120 day half-life material (H-3, C-14, etc.) ___Pick up by waste vendor___

Are you aware of any burial, disposal, or incineration, of radioactive material? No

Are you aware of any planned or accidental environmental releases? No

11. Was animal research, with radioactive material, ever performed at the site? Where were animals kept during studies? Animal carcasses? Please describe.
____ Yes _X_No ___Unknown

12. Do you recall any instance of broken or leaking sources or any other contamination incidents or accidents? Where there ever small spills or large ones? __X__ Yes ____No

Describe as accurately as can be recalled, including dates, specific rad materials and forms, contamination levels, areal extent of contamination, and disposition.
A small spill of Fe-55 occurred in his laboratory about 7 years. HP cleaned up the spill.

13. Are you aware of any studies/reports that may have identified contaminated areas and the isotopes activated? __X__ Yes ____No Please describe if yes. The Cl-36 spill. I did not ask any further questions that that is well known and characterized.

Where are records of survey kept? Yes and were made available.

14. Are you aware of any chemical use/storage/spills/releases involving any type of solvents or fuels? ____ Yes _X_No Please describe if yes.

15. When did you receive radiation safety training? What about refresher courses

Yes, and the last training attended was in December 2012.

16. Additional Notes / Comments:

Name of Interviewer: Tim Kirkham

QUESTIONNAIRE FOR PERSONNEL INVOLVED WITH RADIOACTIVE MATERIALS

The purpose of this questionnaire is to assist TIDEWATER, Inc. in collecting information in support of a US government required audit regarding use of radioactive material and radiation safety at NIST. Please complete this questionnaire to the best of your recollection, and include any additional explanations in the Additional Notes/Comments section on the last page of this questionnaire or on an attached sheet of paper.

Date: March 13, 2013

Mode of Communication(s): In person interview concerning radioactive materials quantities of concern RAMQC.

1. What is your name and what is/was your job title/position? Richard Clement, Health Physicist

Contact Information: Phone: (301) 975 3571
E-mail: richard.clement@nist.gov

2. During what span of years have you worked, or did you work, at this facility with radioactive materials?

At NIST from 2003 – 2008 and back July 2011 to present

3. Can you name or identify the radioactive material or devices that you might have worked on within the selected installation? What isotopes were involved?

Associated with irradiators Co-60 and Cs-137. Reactor activities are outside this interview.

Radionuclide Quantity
Co-60 > 8.1 Ci and Cs-137 > 27 Ci

Were there alpha emitters? ____Yes _X__No If yes, which ones?

Any sealed sources? __X __ Yes ____No
Any leak tests results 0.005 uCi? ____ Yes __X__No Through indirect methods.

Were there detector cells? Were titanium tritide foil or scandium tritide foils vented to outside?
____ Yes __X__No __ Unknown

4. Was a hazard analysis performed for your protocol or work? If so, please provide a copy.
Yes, Cs-137 Irradiator Room B014
Yes, Cs-137 and Co-60 irradiators Room B015, B019, and B021
Yes, Cs-137 and Co-60 irradiators Room B034, B035, and B036
Yes, Co-60 irradiators in B140

5. Was radioactive material ordered prior to completion of the hazard analysis? ____ Yes __X_No

6. Where and how was the shipping and receiving of radioactive material handled (central location, straight to lab, etc)? Irradiator in B014 shipped to installation location

7. Was work performed in fume or biological hoods? ____ Yes _X___No (assumption)
If Yes, please answer the following: Unknown

Exhaust Ductwork? ____ Yes ____No ___Unknown
Exhaust filters? ____ Yes ____No ___Unknown
Reactive chemicals (perchloric acid, picrates and azides)? ____ Yes ____No ___Unknown

8. Did you use a vacuum system? ____ Yes _X___No ___Unknown

9. Was radioactive material disposed into sinks? ____ Yes __X__No ___Unknown

If Yes, were special sinks designated? Were disposal logs kept and where might they be today?
Does the building have hold-up tanks for laboratory waste? ____ Yes ____No ___Unknown
If Yes, please provide a general location.
Is there a special washing location for lab dishware and equipment? ____ Yes ___No
If Yes, please provide a location.

10. Where did laboratory waste go; interim storage? None, sealed sources.
< 120 day half-life material _____
> 120 day half-life material (H-3, C-14, etc.) ___Pick up by waste vendor___

Are you aware of any burial, disposal, or incineration, of radioactive material? No

Are you aware of any planned or accidental environmental releases? None, sealed sources.

11. Was animal research, with radioactive material, ever performed at the site? Where were animals kept during studies? Animal carcasses? Please describe.
____ Yes _X___No ____Unknown

12. Do you recall any instance of broken or leaking sources or any other contamination incidents or accidents? Where there ever small spills or large ones? ____ Yes _X___No

Describe as accurately as can be recalled, including dates, specific rad materials and forms, contamination levels, areal extent of contamination, and disposition.

13. Are you aware of any studies/reports that may have identified contaminated areas and the isotopes activated? ____ Yes _X___No Please describe if yes.

Where are records of survey kept? Maintained in the routine weekly and monthly survey data.

14. Are you aware of any chemical use/storage/spills/releases involving any type of solvents or

fuels? ____ Yes __X__No Please describe if yes.

15. When did you receive radiation safety training? What about refresher courses

January 2013, specific irradiator training

16. Additional Notes / Comments:

None

Name of Interviewer: Wayne Gaul

QUESTIONNAIRE FOR PERSONNEL INVOLVED WITH RADIOACTIVE MATERIALS

The purpose of this questionnaire is to assist TIDEWATER, Inc. in collecting information in support of a US government required audit regarding use of radioactive material and radiation safety at NIST. Please complete this questionnaire to the best of your recollection, and include any additional explanations in the Additional Notes/Comments section on the last page of this questionnaire or on an attached sheet of paper.

Date: 3/13/2013

Mode of Communication(s): Personal interview

1. What is your name and what is/was your job title/position? Dan Golas, Research Associate in Measurement Assurance

Contact Information: Phone: 301-975-5540
E-mail:

2. During what span of years have you worked, or did you work, at this facility with radioactive materials? November 1976 to present

3. Can you name or identify the radioactive material or devices that you might have worked on within the selected installation? What isotopes were involved? 27 different radiopharmaceuticals and the ANSI N42.22 radionuclides

Radionuclide Quantity

Were there alpha emitters? __X_Yes ___No If yes, which ones? Cm, Am, Pu

Any sealed sources? _ ___ Yes _ X__No
Any leak tests results 0.005 uCi? ____ Yes __X__No

Were there detector cells? Were titanium tritide foil or scandium tritide foils vented to outside?
____ Yes _X___No __ Unknown

4. Was a hazard analysis performed for your protocol or work? If so, please provide a copy.
Yes, now. Can get copies from GRSD

5. Was radioactive material ordered prior to completion of the hazard analysis? ____ Yes _X__No
Not now

6. Where and how was the shipping and receiving of radioactive material handled (central location, straight to lab, etc.)? via GRSD

7. Was work performed in fume or biological hoods? _ X___ Yes ___No (assumption)
Except for when weighing materials.
If Yes, please answer the following:

Exhaust Ductwork? __X__ Yes ____No ___Unknown
Exhaust filters? __X__ Yes ____No ___Unknown
Reactive chemicals (perchloric acid, picrates and azides)? ____ Yes _X_No ___Unknown

8. Did you use a vacuum system? ____ Yes _X_No ___Unknown

9. Was radioactive material disposed into sinks? ____ Yes _X_No ___Unknown

If Yes, were special sinks designated? Were disposal logs kept and where might they be today?

Does the building have hold-up tanks for laboratory waste? _X___ Yes ____No ___Unknown
If Yes, please provide a general location.
In B wing

Is there a special washing location for lab dishware and equipment? ____ Yes _X__No
If Yes, please provide a location.

10. Where did laboratory waste go; interim storage? segregated and then picked up by GRSD
< 120 day half-life material _____
> 120 day half-life material (H-3, C-14, etc.) ___Pick up by waste vendor___

Are you aware of any burial, disposal, or incineration, of radioactive material? No

Are you aware of any planned or accidental environmental releases? No, except for the planned Xenon releases from lab C11

11. Was animal research, with radioactive material, ever performed at the site? Where were animals kept during studies? Animal carcasses? Please describe.
____ Yes _X_No ____Unknown

12. Do you recall any instance of broken or leaking sources or any other contamination incidents or accidents? Where there ever small spills or large ones? _X___ Yes ____No

Describe as accurately as can be recalled, including dates, specific rad materials and forms, contamination levels, areal extent of contamination, and disposition.
Described the incidents that are already known.

13. Are you aware of any studies/reports that may have identified contaminated areas and the isotopes activated? ____ Yes _X___No Please describe if yes.

Where are records of survey kept? Yes and were made available.

14. Are you aware of any chemical use/storage/spills/releases involving any type of solvents or fuels? ____ Yes _X_No Please describe if yes.

15. When did you receive radiation safety training? What about refresher courses

About 6 months ago took a refresher training course.

16. Additional Notes / Comments:

Name of Interviewer: Tim Kirkham

QUESTIONNAIRE FOR PERSONNEL INVOLVED WITH RADIOACTIVE MATERIALS

The purpose of this questionnaire is to assist TIDEWATER, Inc. in collecting information in support of a US government required audit regarding use of radioactive material and radiation safety at NIST. Please complete this questionnaire to the best of your recollection, and include any additional explanations in the Additional Notes/Comments section on the last page of this questionnaire or on an attached sheet of paper.

Date: March 13, 2013

Mode of Communication(s): In person interview at NIST.

1. What is your name and what is/was your job title/position? Kenneth Inn, Research Chemist

Contact Information: Phone: (301) 975 5541
E-mail: kenneth.inn@nist.gov

2. During what span of years have you worked, or did you work, at this facility with radioactive materials?

At NIST from 1978 to present

3. Can you name or identify the radioactive material or devices that you might have worked on within the selected installation? What isotopes were involved?
Numerous and varied amounts over the years

Radionuclide Quantity
Vast number at environmental and lower levels.

Were there alpha emitters? _X___Yes ___No If yes, which ones?
All nuclides associated with low level alpha spectroscopy

Any sealed sources? ____ Yes _X ___No Check sources only.

Any leak tests results 0.005 uCi? ___✓Yes __X__No Through indirect methods.

Were there detector cells? Were titanium tritide foil or scandium tritide foils vented to outside?
____ Yes __X__No __ Unknown

4. Was a hazard analysis performed for your protocol or work? If so, please provide a copy.
Protocols, hazard analysis and Form 364 have been provided recently as the group got into the proper reporting regime.

5. Was radioactive material ordered prior to completion of the hazard analysis? _X__ Yes ___No
Only in the distant past.

6. Where and how was the shipping and receiving of radioactive material handled (central location, straight to lab, etc)? In the past since the activity levels of the materials received were below DOT radioactive material levels the sample could be received by the Chemist.

Due to the receipt of environmental levels the material being shipped which are not DOT radioactive material, notification of health physics or the delivery driver may deliver the package to a researchers address without knowing HP should be in the loop.

7. Was work performed in fume or biological hoods? ____ Yes _X___No (assumption)
If Yes, please answer the following: Unknown

Exhaust Ductwork? ____ Yes ____No ___Unknown
Exhaust filters? ____ Yes ____No ___Unknown
Reactive chemicals (perchloric acid, picrates and azides)? ____ Yes ____No ___Unknown

8. Did you use a vacuum system? ____ Yes _X___No ___Unknown

9. Was radioactive material disposed into sinks? ____ Yes __X__No ___Unknown

If Yes, were special sinks designated? Were disposal logs kept and where might they be today?
Does the building have hold-up tanks for laboratory waste? _X___ Yes ____No ___Unknown
If Yes, please provide a general location. Sub basement in Room B 045
Is there a special washing location for lab dishware and equipment? ____ Yes _X__No
If Yes, please provide a location.

10. Where did laboratory waste go; interim storage? To the rad waste consolidation building for shipment off site after storage in A010.
< 120 day half-life material _____
> 120 day half-life material (H-3, C-14, etc.) ___Pick up by waste vendor___

Are you aware of any burial, disposal, or incineration, of radioactive material? No, accept through proper channels.

Are you aware of any planned or accidental environmental releases? No.

11. Was animal research, with radioactive material, ever performed at the site? Where were animals kept during studies? Animal carcasses? Please describe.
____ Yes _X___No ____Unknown
No direct animal research. Tried to perform secondary human measurements after nuclear medicine tests.

12. Do you recall any instance of broken or leaking sources or any other contamination incidents or accidents? Where there ever small spills or large ones? ____ Yes _X___No

Describe as accurately as can be recalled, including dates, specific rad materials and forms, contamination levels, areal extent of contamination, and disposition.

13. Are you aware of any studies/reports that may have identified contaminated areas and the isotopes activated? ____ Yes _X___No Please describe if yes.

Where are records of survey kept? Maintained in the routine weekly and monthly survey data.

14. Are you aware of any chemical use/storage/spills/releases involving any type of solvents or fuels? _X___ Yes ____No Please describe if yes.

Back in the 1980's none since then.

15. When did you receive radiation safety training? What about refresher courses

Initial training 1978 with annual updates since. Last update was September 2012

16. Additional Notes / Comments:

None

Name of Interviewer: Wayne Gaul

QUESTIONNAIRE FOR PERSONNEL INVOLVED WITH RADIOACTIVE MATERIALS

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Date: March 14, 2013

Mode of Communication(s):

1. What is your name and what is/was your job title/position? Ronnie MInniti, Researcher

Contact Information: Phone:301 975 5586
E-mail:rminniti@nist.gov

2. During what span of years have you worked, or did you work, at this facility with radioactive materials? Since 2000

3. Can you name or identify the radioactive material or devices that you might have worked on within the selected installation? What isotopes were involved?

Radionuclide Quantity

Mostly high range irradiators, Co-60 and Cs-137

Were there alpha emitters? ____Yes __X_No If yes, which ones?

Any sealed sources? __X __ Yes ____No
Any leak tests results 0.005 uCi? ____ Yes _X___No

GRSD conducts leak checks , he knows of none

Were there detector cells? Were titanium tritide foil or scandium tritide foils vented to outside?
____ Yes _X___No __ Unknown

4. Was a hazard analysis performed for your protocol or work? If so, please provide a copy.
Copies provided for

Protocol #846.02-0010, August 12, 2010 NIST Gammacell 220 ^{60}Co Irradiator (220-#45 Operating Procedure in 245/B140

Protocol #846.02-0011, August 12, 2010 NIST Gammacell 220 ^{60}Co Irradiator (220-#207 Operating Procedure in 245/B140

Protocol #846.02-0012, August 12, 2010 NIST Gammacell 220 ^{60}Co Irradiator (220-#232 Operating Procedure in 245/B140

Protocol #846.02-0008, August 12, 2010 Standard Operating Procedure for ^{60}Co and ^{137}Cs Vertical Gamma Ray Beam Facilities

Protocol #682.02-0034, November 1, 2010 Standard Operating Procedure for the ^{137}Cs Gamma Beam Facilities Model G90.

Protocol #846.02-0007, August 12, 2010 Standard Operating Procedure for the ^{60}Co and ^{137}Cs Horizontal Gamma-Ray Beam Facilities Model G90

5. Was radioactive material ordered prior to completion of the hazard analysis? ____ Yes ____No
IRSC approved protocol for source delivery.

6. Where and how was the shipping and receiving of radioactive material handled (central location, straight to lab, etc)? Received in normal channels then delivered to room.

7. Was work performed in fume or biological hoods? ____ Yes _X___No (assumption)
If Yes, please answer the following: Unknown

Exhaust Ductwork? ____ Yes __X__No ___Unknown
Exhaust filters? ____ Yes __X__No ___Unknown
Reactive chemicals (perchloric acid, picrates and azides)? ____ Yes __X__No ___Unknown

8. Did you use a vacuum system? ____ Yes _X___No ___Unknown

9. Was radioactive material disposed into sinks? ____ Yes _X___No ___Unknown

If Yes, were special sinks designated? Were disposal logs kept and where might they be today?

Does the building have hold-up tanks for laboratory waste? __X__ Yes ____No ___Unknown
Is there a special washing location for lab dishware and equipment? ____ Yes _X__No
If Yes, please provide a location.

10. Where did laboratory waste go; interim storage?
< 120 day half-life material _____
> 120 day half-life material (H-3, C-14, etc.) ___Pick up by waste vendor___

Are you aware of any burial, disposal, or incineration, of radioactive material?
No
Are you aware of any planned or accidental environmental releases?
No

11. Was animal research, with radioactive material, ever performed at the site? Where were animals kept during studies? Animal carcasses? Please describe.
_____ Yes __X__No ____Unknown

12. Do you recall any instance of broken or leaking sources or any other contamination incidents or accidents? Where there ever small spills or large ones? _____ Yes X_____No

Describe as accurately as can be recalled, including dates, specific rad materials and forms, contamination levels, areal extent of contamination, and disposition.

13. Are you aware of any studies/reports that may have identified contaminated areas and the isotopes activated? _____ Yes __X__No Please describe if yes.
Not in facilities under his supervision.

Where are records of survey kept? Yes and were made available.

GRSD keeps

14. Are you aware of any chemical use/storage/spills/releases involving any type of solvents or fuels? _____ Yes _____No Please describe if yes.

Not in facilities under his supervision

15. When did you receive radiation safety training? What about refresher courses

Annually for rad refresher and irradiatior training.

He provides irradiator training.

16. Additional Notes / Comments:

None

Name of Interviewer: Wayne Gaul

QUESTIONNAIRE FOR PERSONNEL INVOLVED WITH RADIOACTIVE MATERIALS

The purpose of this questionnaire is to assist TIDEWATER, Inc. in collecting information in support of a US government required audit regarding use of radioactive material and radiation safety at NIST. Please complete this questionnaire to the best of your recollection, and include any additional explanations in the Additional Notes/Comments section on the last page of this questionnaire or on an attached sheet of paper.

Date: March 14, 2013

Mode of Communication(s): In person interview at NIST.

1. What is your name and what is/was your job title/position? Janet Stann, Physical Science Technician

Contact Information: Phone: (301) 975 4476
E-mail: janet.stann@nist.gov

2. During what span of years have you worked, or did you work, at this facility with radioactive materials?

Started as a student assistant in 2001 to present.

3. Can you name or identify the radioactive material or devices that you might have worked on within the selected installation? What isotopes were involved?
As the shipper of all Standard Reference Material (SRM) the nuclides and activities are numerous and varied amounts over the years.

Radionuclide Quantity
Vast number associated with the SRM shipments.

Were there alpha emitters? _X___Yes ___No If yes, which ones?
All nuclides associated with SRM samples.

Any sealed sources? _X___ Yes ____No

Any leak tests results 0.005 uCi? ____ Yes __X__No .

Were there detector cells? Were titanium tritide foil or scandium tritide foils vented to outside?
____ Yes __X__No __ Unknown

4. Was a hazard analysis performed for your protocol or work? If so, please provide a copy.
Protocols, hazard analysis and Form 364 have been provided with the original RS nuclide. These are not needed with the SRM.

5. Was radioactive material ordered prior to completion of the hazard analysis? ___ Yes _X__No

6. Where and how was the shipping and receiving of radioactive material handled (central location, straight to lab, etc)? As the shipper of all SRM Janet packages and labels the boxes of material and takes them over to the shipping location where they are sent by FedEx, typically. Rarely have boxes come back, but when they do the problem, such as incorrect address, is addressed without unpacking the boxes. HP surveys the box in and out.

7. Was work performed in fume or biological hoods? ____ Yes _X___No (assumption)
If Yes, please answer the following: Unknown

Exhaust Ductwork? ____ Yes ____No ___Unknown
Exhaust filters? ____ Yes ____No ___Unknown
Reactive chemicals (perchloric acid, picrates and azides)? ____ Yes ____No ___Unknown

8. Did you use a vacuum system? ____ Yes _X___No ___Unknown

9. Was radioactive material disposed into sinks? ____ Yes __X__No ___Unknown

If Yes, were special sinks designated? Were disposal logs kept and where might they be today?
Does the building have hold-up tanks for laboratory waste? _X___ Yes ____No ___Unknown
If Yes, please provide a general location. Sub basement in Room B 045
Is there a special washing location for lab dishware and equipment? ____ Yes _X__No
If Yes, please provide a location.

10. Where did laboratory waste go; interim storage? To the rad waste consolidation building for shipment off site after storage in A010.
< 120 day half-life material _____
> 120 day half-life material (H-3, C-14, etc.) ___Pick up by waste vendor___

Are you aware of any burial, disposal, or incineration, of radioactive material? No.

Are you aware of any planned or accidental environmental releases? No.

11. Was animal research, with radioactive material, ever performed at the site? Where were animals kept during studies? Animal carcasses? Please describe.
____ Yes _X___No ___Unknown

12. Do you recall any instance of broken or leaking sources or any other contamination incidents or accidents? Where there ever small spills or large ones? ____ Yes _X___No

Describe as accurately as can be recalled, including dates, specific rad materials and forms, contamination levels, areal extent of contamination, and disposition.

13. Are you aware of any studies/reports that may have identified contaminated areas and the isotopes activated? ____ Yes _X___No Please describe if yes.

Where are records of survey kept? Maintained in the routine weekly and monthly survey data.

14. Are you aware of any chemical use/storage/spills/releases involving any type of solvents or fuels? _____ Yes _X___No Please describe if yes.

15. When did you receive radiation safety training? What about refresher courses

Rad worker refresher in February 2013.

16. Additional Notes / Comments:

No protocol, procedure, instruction or written guidence.

Name of Interviewer: Wayne Gaul

QUESTIONNAIRE FOR PERSONNEL INVOLVED WITH RADIOACTIVE MATERIALS

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Date: 3/13/2013

Mode of Communication(s): Personal interview

1. What is your name and what is/was your job title/position? Avery Walton, Physical Science Technician

Contact Information: Phone: 301-975-5809
E-mail:

2. During what span of years have you worked, or did you work, at this facility with radioactive materials? 2004 to present

3. Can you name or identify the radioactive material or devices that you might have worked on within the selected installation? What isotopes were involved? Mixed gamma and alpha radionuclides used for calibrations

Radionuclide Quantity

Were there alpha emitters? __X_Yes ___No If yes, which ones? Po, Am, Pu, U

Any sealed sources? ___ Yes _X __No
Any leak tests results 0.005 uCi? ____ Yes __X__No

Were there detector cells? Were titanium tritide foil or scandium tritide foils vented to outside?
____ Yes _X___No __ Unknown

4. Was a hazard analysis performed for your protocol or work? If so, please provide a copy.
Yes, can get copies from GRSD

5. Was radioactive material ordered prior to completion of the hazard analysis? ____ Yes _X__No

6. Where and how was the shipping and receiving of radioactive material handled (central location, straight to lab, etc.)? Building 301 and then to GRSD

7. Was work performed in fume or biological hoods? _ ___ Yes _X___No (assumption)
Avery does not work with unsealed sources. Hoods are used when opening RAM shipments
If Yes, please answer the following:

Exhaust Ductwork? __X__ Yes ____No ___Unknown
Exhaust filters? __X__ Yes ____No ___Unknown
Reactive chemicals (perchloric acid, picrates and azides)? ____ Yes _X_No ___Unknown

8. Did you use a vacuum system? ____ Yes _X___No ___Unknown

9. Was radioactive material disposed into sinks? ____ Yes _X___No ___Unknown

If Yes, were special sinks designated? Were disposal logs kept and where might they be today?

Does the building have hold-up tanks for laboratory waste? _X___ Yes ____No ___Unknown
If Yes, please provide a general location.
B-045

Is there a special washing location for lab dishware and equipment? ____ Yes _X__No
If Yes, please provide a location. Contaminated wares are thrown away

10. Where did laboratory waste go; interim storage? GRSD to A010 then to reactor for disposal
< 120 day half-life material _____
> 120 day half-life material (H-3, C-14, etc.) ___Pick up by waste vendor___

Are you aware of any burial, disposal, or incineration, of radioactive material? No

Are you aware of any planned or accidental environmental releases? No

11. Was animal research, with radioactive material, ever performed at the site? Where were animals kept during studies? Animal carcasses? Please describe.
____ Yes _X_No ___Unknown

12. Do you recall any instance of broken or leaking sources or any other contamination incidents or accidents? Where there ever small spills or large ones? ____ Yes _X___No

Describe as accurately as can be recalled, including dates, specific rad materials and forms, contamination levels, areal extent of contamination, and disposition.
No spills that have not already been known

13. Are you aware of any studies/reports that may have identified contaminated areas and the isotopes activated? ____ Yes _X___No Please describe if yes.

Where are records of survey kept? Yes and were made available.

14. Are you aware of any chemical use/storage/spills/releases involving any type of solvents or fuels? ____ Yes _X_No Please describe if yes.

15. When did you receive radiation safety training? What about refresher courses

November 13, 2012 and then refresher every 2 years

16. Additional Notes / Comments:

Name of Interviewer: Tim Kirkham

QUESTIONNAIRE FOR PERSONNEL INVOLVED WITH RADIOACTIVE MATERIALS

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Date: March 13, 2013

Mode of Communication(s): In person interview concerning radioactive materials quantities of concern RAM-QC.

1. What is your name and what is/was your job title/position? John Zometsky, Health Physicist

Contact Information: Phone: (301) 975 5573
E-mail: john.zometsky@nist.gov

2. During what span of years have you worked, or did you work, at this facility with radioactive materials?

At NIST from December 2010 to present

3. Can you name or identify the radioactive material or devices that you might have worked on within the selected installation? What isotopes were involved?

Associated with irradiators Co-60 and Cs-137. Especially in room A-10.

Radionuclide Quantity
Co-60 > 8.1 Ci and Cs-137 > 27 Ci

Were there alpha emitters? ____Yes _X__No If yes, which ones?

Any sealed sources? _X_ __ Yes _ ___No
Any leak tests results 0.005 uCi? ____ Yes __X__No Through indirect methods.

Were there detector cells? Were titanium tritide foil or scandium tritide foils vented to outside?
____ Yes __X__No __ Unknown

4. Was a hazard analysis performed for your protocol or work? If so, please provide a copy.
Yes, Cs-137 Irradiator Room B014
Yes, Cs-137 and Co-60 irradiators Room B015, B019, and B021
Yes, Cs-137 and Co-60 irradiators Room B034, B035, and B036
Yes, Co-60 irradiators in B140

5. Was radioactive material ordered prior to completion of the hazard analysis? ____ Yes __X_No

6. Where and how was the shipping and receiving of radioactive material handled (central location, straight to lab, etc)? Irradiator in B014 shipped to installation location.

7. Was work performed in fume or biological hoods? ____ Yes _X___No (assumption)
If Yes, please answer the following: Unknown

Exhaust Ductwork? ____ Yes ____No ___Unknown
Exhaust filters? ____ Yes ____No ___Unknown
Reactive chemicals (perchloric acid, picrates and azides)? ____ Yes ____No ___Unknown

8. Did you use a vacuum system? ____ Yes _X___No ___Unknown

9. Was radioactive material disposed into sinks? ____ Yes __X__No ___Unknown

If Yes, were special sinks designated? Were disposal logs kept and where might they be today?
Does the building have hold-up tanks for laboratory waste? ____ Yes ____No ___Unknown
If Yes, please provide a general location.
Is there a special washing location for lab dishware and equipment? ____ Yes ___No
If Yes, please provide a location.

10. Where did laboratory waste go; interim storage? To the rad waste consolidation building for shipment off site after storage in A10.
< 120 day half-life material _____
> 120 day half-life material (H-3, C-14, etc.) ___Pick up by waste vendor___

Are you aware of any burial, disposal, or incineration, of radioactive material? No

Are you aware of any planned or accidental environmental releases? None, sealed sources.

11. Was animal research, with radioactive material, ever performed at the site? Where were animals kept during studies? Animal carcasses? Please describe.
____ Yes _X___No ____Unknown

12. Do you recall any instance of broken or leaking sources or any other contamination incidents or accidents? Where there ever small spills or large ones? ____ Yes _X___No

Describe as accurately as can be recalled, including dates, specific rad materials and forms, contamination levels, areal extent of contamination, and disposition.

13. Are you aware of any studies/reports that may have identified contaminated areas and the isotopes activated? ____ Yes _X___No Please describe if yes.

Where are records of survey kept? Maintained in the routine weekly and monthly survey data.

14. Are you aware of any chemical use/storage/spills/releases involving any type of solvents or fuels? ____ Yes __X__No Please describe if yes.

15. When did you receive radiation safety training? What about refresher courses

January 2013, specific irradiator training.

16. Additional Notes / Comments:

None

Name of Interviewer: Wayne Gaul

Attachment F

Photographs

Figure 1: Sources in drawer without label on drawer

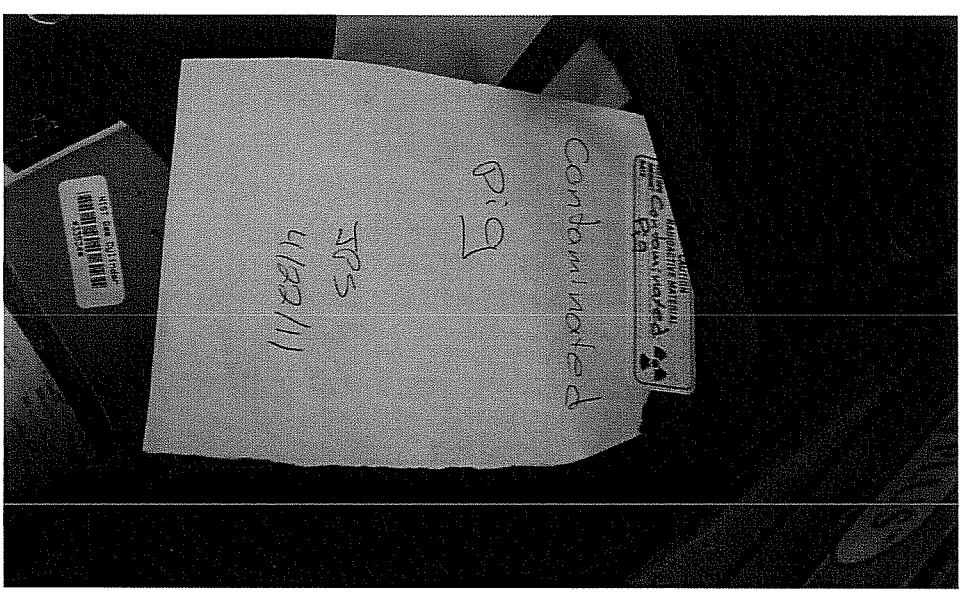

Figure 2: Contaminated Pig (since 4/22/2011)

Figure 3: Source cabinet with many sources

Figure 4: Storage of contaminated equipment without demarcation of CA

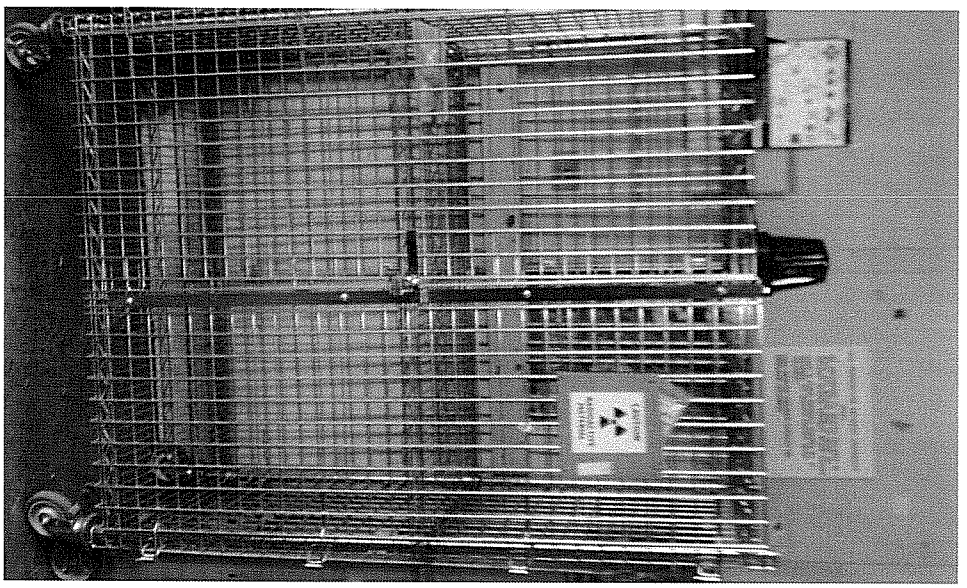

Figure 5: RAM storage in shipping/receiving building

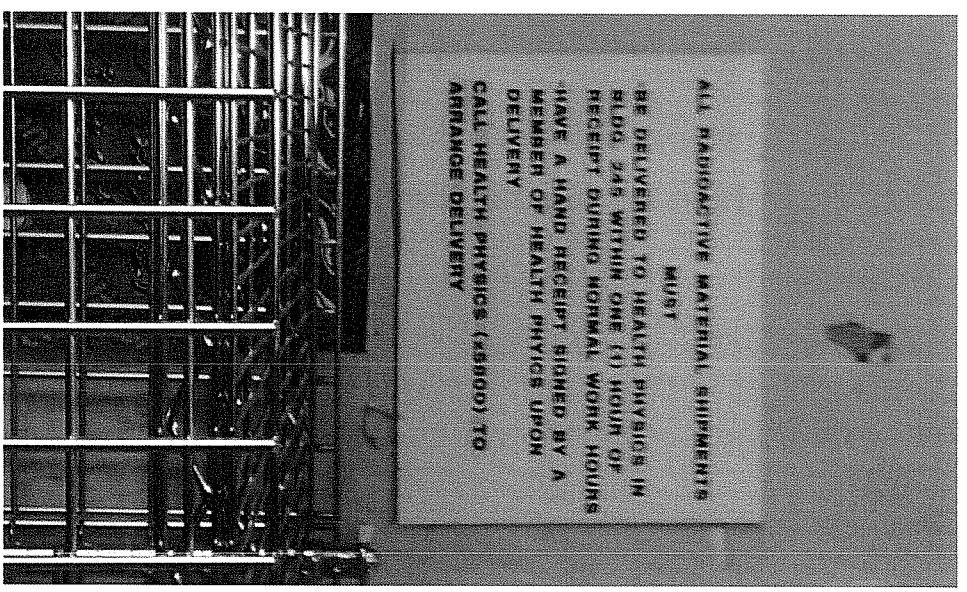

Figure 6: sign about RAM storage reminding of 1 hour time limit to call GRSD

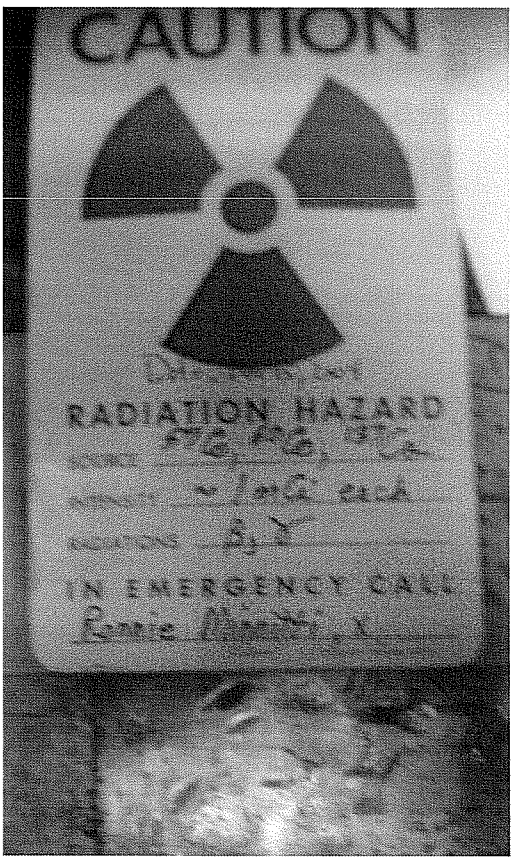

Figure 7: "Caution Radiation Hazard" label

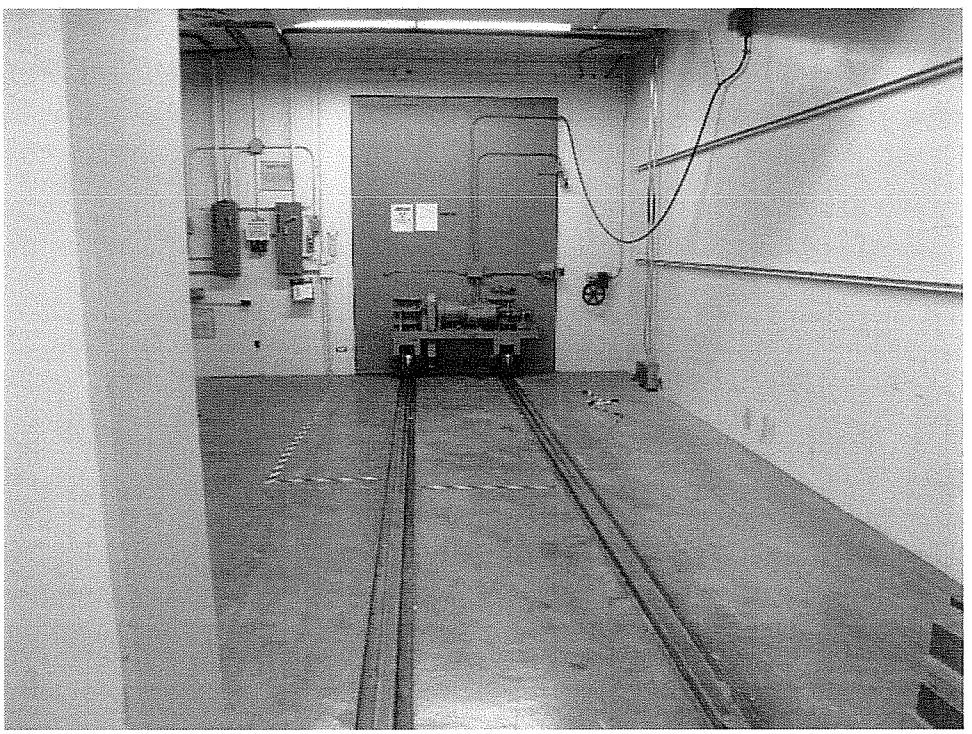

Figure 8, A010 Door in place

Figure 9, A010 Ram Storage entrance door

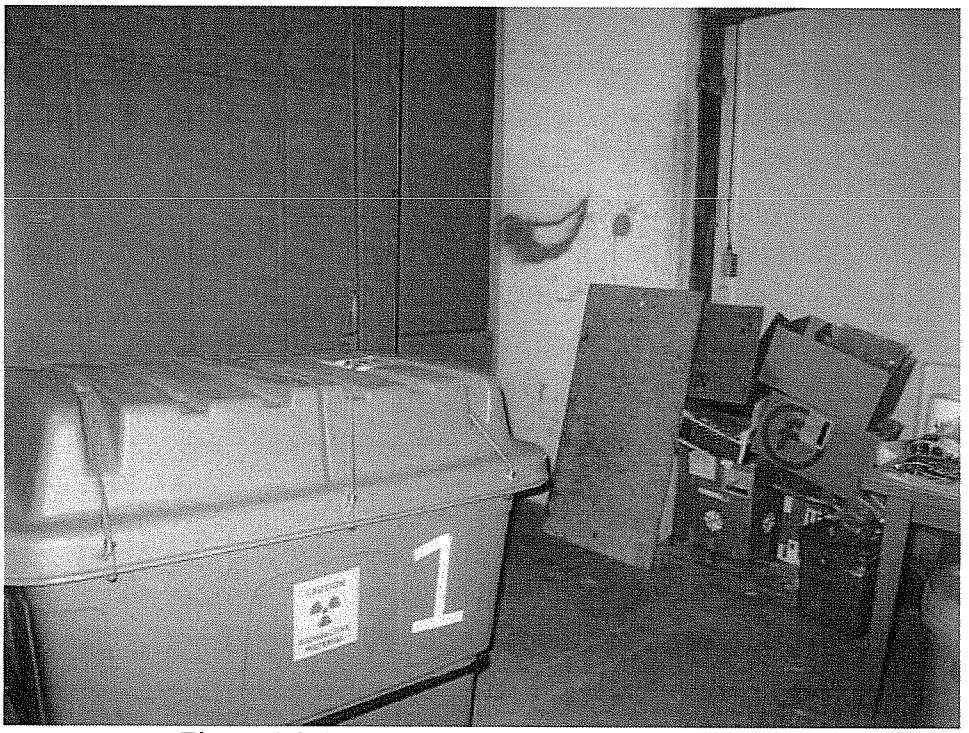

Figure 1,0 A010 Transport container and storage

Figure 11, A010 Flammable waste storage