



Radiation Safety



RADIATION PROCEDURES MANUAL **Procedure Cover Sheet**

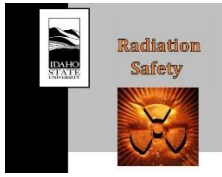
Procedure Title: SNM Physical Inventory

Procedure Number: RS-28 Rev.1

Effective Date: 02/29/2024

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Revision History

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RS 28.0	John Longley	12/10/21	RSC- 11/08/21 ReSC- 12/02/21
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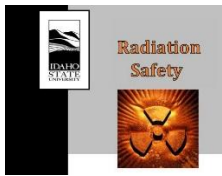
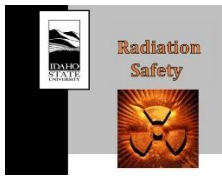


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1. INTRODUCTION

This procedure specifies methods for performing inventory of special nuclear material (SNM) to comply with the requirements of 10 CFR 74.19(c). It applies to all enriched uranium, plutonium, and uranium-233 that is tracked in the NMMSS database for ISU. This procedure supplements Procedure RS-16, Radioactive Material Inventory. The annual physical inventory is conducted in March each year to support the NMMSS reports (742 and 742C) submitted at the end of March. The annual physical inventory serves as one of the inventories specified in RS-16.

2. PURPOSE

This procedure ensures all special nuclear material is present and no SNM has been lost or stolen.

3. SCOPE

This procedure applies to all SNM tracked in the NMMSS database on the following three licenses.

- 11-27380-01 Broad scope
- SNM-1373 Special nuclear material
- R-110 Research and Test Reactor

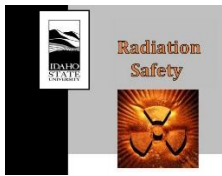
4. ROLES AND RESPONSIBILITIES

Radiation Safety Officer (RSO) – Roles of the RSO also may be performed by the Assistant RSO.

- Maintaining this procedure and superseded versions of this procedure in accordance with 10 CFR 74.19(b).
- Maintaining lists of special nuclear material items.
- Participating in the annual SNM physical inventory.

Authorized Users (AU) with SNM – At the reactor, the reactor supervisor or reactor administrator may perform the roles of Authorized User.

- Participating in the annual SNM physical inventory



5. ACRONYMS/DEFINITIONS

AU:	Authorized User
CMESIC:	Critical Materials and Energy Systems Innovation Center
GM:	Geiger-Mueller
NMMSS:	Nuclear Materials Management and Safeguards System
NRC:	Nuclear Regulatory Commission
RSO:	Radiation Safety Officer
SNM:	Special Nuclear Material
TID:	Tamper Indicating Device

6. REQUIRED MATERIALS(S)

- Balance
- Calibration weight set
- GM frisker
- Contamination swipes
- Steel containers
- Steel cable tamper indicating devices

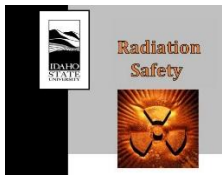
7. REQUIRED TRAININGS(S)

- Radiation Safety Training

8. PROCEDURE

8.1. Inventory of Sealed Items (fuel plates, fission counters, foils, reactor)

- 8.1.1. The RSO will prepare the list of items and will enter the date, item identifier, and HPAssist number on the SNM Sealed Item Inventory Form. If there is no HPAssist number enter NA on the form.
- 8.1.2. The authorized user and the RSO will verify the item is present by item identifier or HPAssist number and will initial the appropriate line.
- 8.1.3. The RSO and AU will examine the item for damage and enter Y or N on the form.
 - 8.1.3.1. If damaged take photographs of the item. Record the photograph numbers on the inventory form. Numbers are consecutive for the date starting with 1. The RSO will determine if additional evaluation steps are needed.



- 8.1.4. The RSO will collect a leak test swipe sample and enter the swipe number on the form.
- 8.1.5. The RSO will scan the swipe samples for activity using a GM frisker.
- 8.1.6. The Radiation Safety Department will analyze the swipe samples on the proportional counter or an alpha/beta swipe counter.
 - 8.1.6.1. If any swipes exceed the NRC leak test criteria, 5 nCi, for combined alpha and beta radioactivity, the RSO will evaluate the item to determine if SNM may have been lost or diverted.
- 8.1.7. The RSO will attach the swipe analysis results to the inventory form.
- 8.1.8. The RSO will verify with the Reactor Supervisor that no special nuclear material has been added to or removed from the reactor assembly. Both the RSO and AU will initial on the line for the reactor and enter for NA for damage assessment and swipe number.

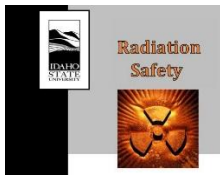
8.2. Inventory of Non-Sealed Items

ISU receives very small quantities of unsealed SNM for materials analysis at the Center for Advanced Energy Studies. These samples are typically too small to measure the SNM amount by gravimetric analysis. For these materials, inventory will be performed as part of the radioactive material inventory (Procedure RS-16) if the sample meets either of the following criteria:

- For materials that are included in the annual material balance report, Form 742, individual items will not be included in the SNM inventory if the SNM mass for the item is less than 0.001 of the reporting criteria for that material type. For example, for MT50, a sample with Pu mass less than $5E-4$ g will be inventoried through the radioactive material inventory process.
- For materials that are not included in the annual material balance report, Form 742, all items will be inventoried through the radioactive material inventory if the total SNM mass for the applicable material type is less than the reporting threshold. For example, if all material in material type E1 contain less than 0.5 g total of U-235, the items containing MTE1 will be inventoried as part of the radioactive material inventory.

Masses should be recorded to the tenths decimal place. Rounding of the hundredth-place decimal is as follows:

- If the hundredths value is less than 5 than the tenths value is retained e.g., 10.54 is 10.5.
- If the hundredths value is greater than 5 than the tenths value is increased by 1 e.g., 10.56 is 10.6.
- If the hundredths value is equal to 5 than the tenths value is increased by 1 if the



tenths value is odd (1, 3, 5, 7, or 9) e.g., 10.75 is 10.8. If the tenths value is even (0, 2, 4, 6, or 8) than the tenths value is retained e.g., 10.65 is 10.6.

8.2.1. Balance Verification

Calibrated balances may be used in place of the balance verification (steps below) if it has been calibrated within the last 12 months and a calibration certificate is available.

- 8.2.1.1. Record the model and serial number of the balance in the Balance Verification Form.
- 8.2.1.2. Obtain the standard mass set e.g., from the Chemistry Department stockroom.
- 8.2.1.3. Measure the following standard masses (grams): 1, 2, 5, 10, 20, 50, 80, 100, 150, 200, 300, 400 and 500. Note standard weights maybe be combined to reach the specified mass. (E.g., 10 g + 20 g + 50 g = 80 g). Give the exact mass values to the tenths place.
- 8.2.1.4. Record the standard mass and measured mass on the balance verification form.
- 8.2.1.5. Record your name and sign the balance verification form.

8.2.2. Inventory

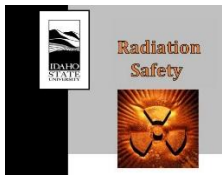
- 8.2.2.1. The RSO will prepare unsealed item inventory forms for each transaction involving unsealed items.

8.2.3. Initial Inventory

- 8.2.3.1. Enter the NMMSS transaction number on the form.
- 8.2.3.2. Enter the item identifier and HPAssist number on the form.
- 8.2.3.3. Weigh items as packaged in bags or vials.
- 8.2.3.4. Record the initial mass on the unsealed item inventory form.

8.2.4. Routine Inventory

- 8.2.4.1. Enter the NMMSS transaction number on the form.
- 8.2.4.2. Enter the item identifier and HPAssist number on the form.
- 8.2.4.3. Enter the initial mass on the form.
- 8.2.4.4. Weigh items as packaged in bags or vials.
- 8.2.4.5. Record the measured mass on the unsealed item inventory form.
- 8.2.4.6. The RSO will compute the mass difference between the measured mass and the initial mass and record the results on the unsealed item inventory form.
- 8.2.4.7. The RSO will compute the total mass difference and record it on the form.
- 8.2.4.8. The RSO and AU will print and sign their names and enter the date on the form.



8.3. Loading or Opening Containers

The RSO and Authorized User or designee will perform the following steps to load and secure a container.

8.3.1. Loading Containers

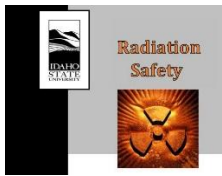
- 8.3.1.1. The RSO will assign a unique number to the container (e.g. REA_01-JAN_2021_01) and will label the container with the number.
- 8.3.1.2. The RSO will prepare the SNM container form with the container number, NMMSS transaction number (741 No.), date, item identifiers, HPAssist numbers, material types, and initial masses (g) for unsealed items.
- 8.3.1.3. The AU will gather the items from a single NMMSS transaction number (741 number) and place them in a steel container. Both the RSO and AU will initial each item row to document the item is present.
- 8.3.1.4. The RSO will apply a steel TID to the container and record the unique number on the container form.
- 8.3.1.5. Both the RSO and the AU will print and sign the form for the loaded container.

8.3.2. Opening Containers

- 8.3.2.1. The RSO and AU will verify the inventory against the container list prepared when the container was loaded and record "Y" on the container form in the Open Verified column.
- 8.3.2.2. Each item will be inventoried as sealed or unsealed following the instructions of sections 8.1 and 8.2.

8.4. Inventory of Sealed Containers

- 8.4.1. The RSO will enter the date and container number(s) on the Sealed Container Inventory Form.
- 8.4.2. The RSO and AU will verify the presence of each container and will each initial the container row on the sealed container inventory form.
- 8.4.3. The RSO and AU will enter the TID number on the sealed container inventory form.
- 8.4.4. The RSO and AU will evaluate the TID condition and enter Y if the TID is intact or N if the TID is broken.
- 8.4.5. If the TID number does not match the value on the SNM_Container Form or if the TID is broken, the RSO and AU will perform a full inventory of the container as specified in section 8.1 and 8.2., as applicable.



8.5. Physical Inventory Report

The RSO will evaluate masses for all non-sealed items to determine if there may be a mass difference that changes the reported isotopic mass value for the NMMSS transaction. This evaluation will include the mass fraction of SNM in the overall material. The evaluation will be documented in the Physical Inventory Report.

- 8.5.1. The RSO will evaluate all damaged or leaking sealed items to determine if material may be missing and will present the evaluation in the physical inventory report.
- 8.5.2. The RSO will assemble all forms and write a summary of the inventory noting any discrepancies and their resolution.
- 8.5.3. If material is missing or additional material is present above the reporting value for isotopic mass, the RSO will report the discrepancy to the NRC.
- 8.5.4. After all material is verified to be present, the RSO will notify the CMESIC safety officer and will collectively prepare the annual NMMSS status report as specified in Procedure RS-05, NMMSS Report.

9. LIST OF FORMS

Sealed Item Inventory Form
Unsealed Item Inventory Form
SNM Container Form
Container Verification Form
Balance Verification Form

10. REFERENCES

Regulatory Guide 5.29, "Special Nuclear Material Control and Accounting Systems for Nuclear Power Plants," Revision 2, issued June 2013. U.S. Nuclear Regulatory Commission, Washington, DC.

11. CHANGE HISTORY

Revision 1 – Added content to Section 8.2 – Inventory of Non-Sealed Items.

Revision 2026 – Updated building name from CAES to CMESIC and added clarification to Section 8.2.1.

12. APPENDICES

None.