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Instructions and Guidance for Completing Physical Inventory Summary Reports

NRC Form 327

Final Draft Guidance

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ABSTRACT

U.S. Nuclear Regulatory Commission (NRC) regulations (as specified in Title 10 of the *Code of Federal Regulations* (10 CFR) 74.17(a), (b), and (c)) require that certain licensees use NRC Form 327 to report inventory differences (IDs), and associated information needed to evaluate IDs, resulting from any physical inventory required by 10 CFR 74.31(c)(5), 74.33(c)(4), 74.43(c)(7), or 74.59(f)(1). This NUREG contains the reporting instructions for licensees to follow in making the report.

Paperwork Reduction Act Statement

This NUREG contains and references information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collection requirements were approved by the Office of Management and Budget (OMB), approval numbers 3150-0123 and 3150-0139.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

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ABBREVIATIONS

A	additions to inventory
AI	active inventory
AID	adjusted inventory difference
ATP	additions to process
BC	bias correction to the inventory difference
BI	beginning inventory
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DQ	detection quantity
DT	detection threshold
DU	depleted uranium
EI	ending inventory
FKG	formula kilogram
HEU	high enriched uranium
ID	inventory difference
KG	kilogram
LE	limit of error
LEU	low enriched uranium
MC&A	material control and accounting
MD	measured discards
NMMSS	Nuclear Materials Management and Safeguards System
NRC	U.S. Nuclear Regulatory Commission
PPA	prior period adjustment
Pu	plutonium

R	removals from inventory
R&D	research and development
RFP	removals from process
S	shipments
SEID	standard error of the inventory difference
SM	source material
SNM	special nuclear material
SRD	shipper-receiver difference
U	uranium

U.S. NUCLEAR REGULATORY COMMISSION INSTRUCTIONS FOR COMPLETING PHYSICAL INVENTORY SUMMARY REPORTS

NRC Form 327, "Special Nuclear Material (SNM) and Source Material (SM) Physical Inventory Summary Report"

1. INTRODUCTION

U.S. Nuclear Regulatory Commission (NRC) regulations (as specified in Title 10 of the *Code of Federal Reg*ulations (10 CFR) 74.17(a), (b), and (c)) require certain licensees to use NRC Form 327 to report inventory differences (IDs), and associated information needed to evaluate IDs, resulting from any physical inventory required by 10 CFR 74.31(c)(5), 74.33(c)(4), 74.43(c)(7), or 74.59(f)(1).

The use of Form 327 is intended to:

(1) eliminate the need for a licensee to report the same information more than once, by informal means, to different NRC organizational units;

(2) standardize the type of information and format used in reporting physical inventory results; and

(3) allow a more efficient and meaningful evaluation of ID results.

The NRC first issued its material control and accounting (MC&A) regulations in the 1960s, which were designed to protect facilities against internal threats. In 1985, 10 CFR Part 74, "Material Control and Accounting of Special Nuclear Material," was created for special nuclear material (SNM) MC&A requirements to separate them from the other safety requirements and to present the requirements in an orderly format. The NRC has revised the MC&A regulations over the years, in part to incorporate the concept of graded safeguards and to reflect changes in enrichment facilities and technologies. These regulatory requirements and associated NRC technical reports (NUREGs) have focused on preventing an adversary from obtaining sufficient material to construct an improvised nuclear device.

NUREG guidance should be broad enough to address all facilities, during all stages of operation by providing direction for a risk-informed, performance-based MC&A program that could be applied to any nuclear facility under the NRC's authority. The agency's goal is to establish a robust, flexible, and effective regulatory framework. These regulations and associated NUREGs support the timely detection of material theft or unauthorized diversion of materials that could be used to fabricate a viable device of concern.

Concepts of waste and discards are not used consistently across the industry. In an effort to correct these issues, the NRC has revised NUREG/BR-0096 to include definitions for some new terms and to clarify definitions of others. This guidance provides a focal point and complete framework for controlling and accounting for all SNM, source material (SM), and depleted uranium (DU) under NRC oversight.

The NRC staff is issuing this revised NUREG document in conjunction with 10 CFR Part 74 rulemaking to provide specific guidance and instructions on completing Form 327 consistent with revisions to the MC&A requirements.

2. DEFINITIONS

The following terms are used either directly or indirectly with physical inventories. Therefore, they are within the scope of this NUREG and are defined in this section.

ACTIVE INVENTORY (AI)–The sum of additions to inventory (A), beginning inventory (BI), ending inventory (EI), and removals from inventory (R), after all common terms have been excluded. Common terms are any material values which appear in the active inventory calculation more than once and come from the same measurement.

ADDITIONS TO INVENTORY (A)–Quantities of depleted uranium (DU), source material (SM), and special nuclear material (SNM) by a given material type code, added to a plant inventory and which, before such addition, were not part of the plant's total possessed DU, SM, or SNM quantity for the material type code in question. For an enrichment facility conducting a dynamic inventory, "additions to inventory" typically are feeds to the cascade or enrichment equipment.

ADDITIONS TO PROCESS (ATP)–(1) Receipts that are opened, except for receipts opened only for sampling and subsequently maintained under tamper-safing; (2) opened sealed sources; and (3) material removed from process for nonconformance with chemical or physical specifications that is subsequently reprocessed, measured for contained SNM, and reintroduced to process.

ADJUSTED INVENTORY DIFFERENCE (AID)–An inventory difference (ID) that has been adjusted (corrected) for both (1) the net sum of prior period adjustments, and (2) the net sum of bias corrections that were not applied to individual items. The adjusted ID is evaluated against ID limits to determine the ID acceptability.

BEGINNING INVENTORY (BI)–The book inventory quantity at the beginning of an inventory period, and the reconciled physical inventory entered into the books as an adjusted inventory at the completion of the prior inventory period.

BIAS–The deviation of the expected value of a random variable from the corresponding correct or assigned value. See also "MEASUREMENT BIAS."

BIAS CORRECTION TO THE ID (BC)–The net algebraic sum of all measurement biases (from measurement control program data) that have not been applied as corrections to individual items. Such net sum (expressed as grams element or grams isotope, as appropriate) is applied as a correction to the initially calculated ID.

BOOK INVENTORY–The total DU, SM, or SNM (of a given material type code) possessed by a plant as indicated by its accountability ledgers. The book inventory quantity is equivalent to the beginning inventory plus additions to inventory, minus shipments and measured discards from inventory, while the physical inventory quantity is the ending inventory.

COMBINED LIMIT OF ERROR–A measurement uncertainty band (at a specified confidence level) derived from the respective limit of error (LE) values associated with each of two measurements (usually independent of each other) performed on a given material quantity. For both measurement values to be considered in agreement, they must not

differ from each other by more than the calculated combined LE, which is normally calculated by taking the square root of the sum of the squared individual LEs. That is:

$$\text{Comb. LE} = [(LE_1)^2 + (LE_2)^2]^{1/2}$$

DEPLETED URANIUM (DU)–The source material uranium in which the isotope uranium-235 is less than 0.711 weight percent of the total uranium present. Depleted uranium does not include special nuclear material.

DETECTION QUANTITY (DQ)–A site-specific U-235 quantity for licensees subject to 10 CFR 74.31, "Nuclear Material Control and Accounting for Special Nuclear Material of Low Strategic Significance," or 10 CFR 74.33, "Nuclear Material Control and Accounting for Uranium Enrichment Facilities Authorized to Produce Special Nuclear Material of Low Strategic Significance." The DQ is normally a function of annual throughput, but for low throughput low enriched uranium (LEU) facilities, the DQ need not be less than 25 kilograms (kg) of U-235. The DQ also can be described as a goal quantity, the loss or theft of which must be detected with a 90 percent (or better) power of detection whenever a physical inventory is taken.

DETECTION THRESHOLD (DT)–An ID limit that will be exceeded, with a 90 percent or higher probability, by an ID (resulting from the taking of a physical inventory) whenever there has been an actual loss of a detection quantity. The DT is a function of both the DQ and the standard error of ID (SEID), as shown by the following equation:

$$DT = DQ - 1.3(SEID)$$

ENDING INVENTORY (EI)–The total itemized quantity of DU, SM, or SNM of a given material type code possessed by a plant at the end of a material balance period, as determined by a physical inventory. The EI quantity for any given material balance period is (by definition) exactly equal to the beginning inventory quantity for the next period.

[NOTE: Physical inventories for normal and depleted uranium are only required for uranium enrichment facilities.]

ENRICHED URANIUM–Any uranium-bearing material that does not qualify as natural or normal uranium, and whose combined U-233 plus U-235 isotopic content is 0.725 percent or higher by weight, relative to total uranium element content.

ENRICHMENT LEVEL CODES–Codes used in place of, or in conjunction with, material type code 20 (enriched uranium) to designate the range of enrichment. Enrichment level codes are used in connection with reports, primarily U.S. Department of Energy (DOE)/NRC Form 742, submitted to the Nuclear Materials Management and Safeguards System (NMMSS), and NRC Form 327 sent to NRC Headquarters. There are four enrichment level codes for Form 742: E1, E2, E3, and E4. There are just two enrichment codes for Form 327 (LEU and high enriched uranium (HEU)) associated with material code 20.

HOLDING ACCOUNT–See "WASTE HOLDING ACCOUNT."

IN-PROCESS HOLDUP–Process-related DU, SM, or SNM that has not been drained or discharged from its processing equipment at the time of physical inventory. The quantity of any in-process holdup must be included in the physical inventory determination.

[NOTE: The term "in-process holdup" should not be confused with the term "residual holdup."]

INVENTORY DIFFERENCE (ID)–The arithmetic difference obtained by subtracting the quantity of SNM tabulated from a physical inventory from the book inventory quantity. Book inventory quantity is equivalent to the beginning inventory (BI) plus additions to inventory (A) minus removals from inventory (R), while the physical inventory is the ending inventory (EI) for the material balance period in question (as physically determined). Thus mathematically, ID = (BI + A - R) - EI or ID = BI + A - R - EI.

ID LIMIT–(1) For licensees that conduct physical inventories in accordance with 10 CFR 74.31(c)(5), the ID limit is the DT. The DT is calculated by subtracting 1.3 times SEID from the licensee's applicable DQ.

(2) For licensees that conduct static physical inventories in accordance with 10 CFR 74.33(c)(4), associated with any material-type code other than "uranium in cascades," the ID limit is the DT (in which DT equals DQ minus 1.3 times SEID). For dynamic physical inventories required by 10 CFR 74.33(c)(4) for "uranium in cascades," the ID limit is the DT minus the cumulative ID for the 10-month period just before the current 65 calendar day period.

(3) For licensees that conduct physical inventories in accordance with 10 CFR 74.43(c), the ID limit is the greater of (i) 200 grams plutonium (Pu) or U-233, 300 grams HEU or U-235 contained in HEU, or 9,000 grams U-235 contained in LEU, as appropriate, or (ii) 3.00 times the SEID.

(4) For licensees that conduct physical inventories in accordance with 10 CFR 74.59(f), the ID limit is the greater of (i) 200 grams Pu or U-233, 300 grams HEU or U-235 contained in HEU, as appropriate, or (ii) 3.00 times the SEID.

INVENTORY RECONCILIATION–The adjustment of the book inventory of both element and fissile isotope, to reflect the results of a physical inventory. In a broad sense, inventory reconciliation involves calculating (1) the ID for the material balance period in question, (2) the uncertainty value (SEID) associated with the ID, (3) the AI for the period, and (4) any bias adjustment or prior period adjustment (PPA) associated with the ID value.

MATERIAL BALANCE–The determination of an inventory difference (ID).

MATERIAL BALANCE PERIOD–The time span to which a material balance or physical inventory pertains.

[Note: For bimonthly dynamic physical inventories at enrichment facilities, the material balance period is 65 calendar days.]

MATERIAL-TYPE CODES–Number codes for identifying basic material types with respect to source material, special nuclear material, and byproduct materials. The NMMSS uses the

codes for tracking materials nationwide. There are seven material type codes for DU, SM, and SNM, as follows:

CODE	MATERIAL TYPE
10	depleted uranium
20	enriched uranium (*)
50	plutonium
70	uranium-233 (**)
81	normal uranium
83	plutonium-238 (***)
89	uranium in cascades

(*) For DOE/NRC Form 742 purposes, material code 20 has four subcodes (E1, E2, E3, and E4) to denote enrichment range. For NRC Form 327 purposes, code 20 has two subcodes, namely LEU and HEU.

(**) Uranium materials should be regarded as material code 70 if the U-233 isotopic distribution is greater than (1) 10.00 weight percent relative to total uranium element content, or (2) both the U-235 isotopic concentration and 5.00 percent by weight of the total uranium; otherwise report as material code 10, 20, or 81, as appropriate.

(***) Plutonium materials should be regarded as material code 83 if the Pu-238 isotopic distribution is greater than 10.00 weight percent relative to total plutonium element content. Otherwise, report as material code 50.

MEASURED DISCARD (MD)–A measured quantity of gaseous, liquid, or solid waste that a facility no longer possesses, or which has been transferred (accounting-wise) to a waste holding account through a DOE/NRC Form 741 transaction.

MEASUREMENT BIAS–A unidirectional component of error that affects (to the same degree) all members of a measurement data set. As such, bias can be estimated from the deviation of the mean of several measurements of a representative standard from the reference value (or assigned value) of such standard. If a bias is large enough to have an effect on the recorded value of DU, SM, or SNM items, the accountability values of such items should be adjusted appropriately. If a bias is too small to affect individual items, its effect across all measured items (or material quantities) should be determined as an absolute quantity (e.g., as grams U and grams U-235). The net sum of all biases (as absolute quantities) not applied as corrections to individual items is then applied as a bias correction to inventory difference.

NATURAL URANIUM–Any uranium-bearing material whose uranium isotopic distribution has not been altered from its natural occurring state. Natural uranium is nominally 99.283 percent U-238, 0.711 percent U-235, and 0.006 percent U-234 (by weight relative to total uranium element).

NORMAL URANIUM–Any uranium-bearing material with a uranium isotopic weight distribution that can be described as being (1) 0.700 to 0.724 percent in combined U-233 plus U-235; and (2) at least 99.200 percent in U-238.

[NOTE: All natural uranium with a U-235 isotopic concentration in the range of 0.700 to 0.724 percent is normal uranium, but not all normal uranium is natural uranium.]

PLANT–A set of processes or operations (on the same site, but not necessarily all in the same building) coordinated into a single manufacturing, R&D, or testing effort. A scrap recovery

operation, or an analytical laboratory, serving both onsite and offsite customers (or more than one onsite manufacturing effort) should be treated as a separate plant.

PRIOR-PERIOD ADJUSTMENT (PPA)–For Form 327 purposes, PPAs are limited to corrections (adjustments) applied to an ID value because of a correction applied to a BI component, after the inventory period began. PPAs can arise only from (1) corrections of recording or measurement errors associated with material on BI, (2) resolution within the current period of statistically significant shipper-receiver differences (SRDs) involving material that was on BI, and (3) adjustments to initial receipt values pertaining to scrap, received in a prior period, because of better measurement after dissolution of such scrap in the current period. Since these types of corrections have nothing to do with the current-period losses or errors, and since the official BI value is not adjusted, an adjustment to the ID value (derived from the equation ID = BI + A - R - EI) is necessary to obtain an ID that reflects only current-period activity.

REMOVALS FROM INVENTORY–Measured quantities of SNM contained in: (1) shipments; (2) waste materials transferred to an onsite holding account via a DOE/NRC Form 741 transaction; (3) measured discards transported offsite; and (4) effluents released to the environment.

REMOVALS FROM PROCESS (RFP)–Measured quantities of SNM contained in: (1) effluents released to the environment ; (2) previously unencapsulated materials that have been encapsulated as sealed sources; (3) waste materials that will not be subject to further onsite processing and which are under tamper-safing; (4) ultimate product placed under tamper-safing; and (5) any materials (not previously designated as removals from process) shipped offsite.

RESIDUAL HOLDUP–Any DU, SM, or SNM that remains within processing equipment (including ventilation filters and ductwork) after system draindown or cleanout. If, at the time of physical inventory, the total quantity of residual holdup is significant, such holdup must be measured (or estimated on the basis of partial measurements and engineering calculations) and included in the physical inventory listing. The uncertainty associated with a total measured or estimated residual holdup quantity must be included in the SEID calculation.

SEID LIMIT– The SEID limit for 10 CFR 74.31 licensees is the greater of (1) 4,500 grams U-235 for isotope and 100,000 grams uranium for element, when assuming that the measurement and nonmeasurement contributions to SEID are equal; or (2) 0.125 percent of active inventory (for both element and isotope), when assuming that the measurement and nonmeasurement contributions to SEID are equal.

For licensees subject to 10 CFR 74.33, the limit for SEID is the greater of (1) 2,500 grams for U-235 and 60,000 grams for uranium element, when assuming that measurement and nonmeasurement contributions to SEID are equal; or (2) 0.125 percent of active inventory (for both element and isotope), when assuming that measurement and nonmeasurement contributions to SEID are equal.

For 10 CFR 74.41, “Nuclear Material Control and Accounting for Special Nuclear Material of Moderate Strategic Significance,” licensees, the limit for SEID is the greater of (1) 9,000 grams U-235 contained in LEU; or (2) 200 grams for plutonium or U-233 (both

element and isotope), or 300 grams for both HEU and U-235 contained in HEU; or (3) 0.125 percent of active inventory (for both element and isotope).

For 10 CFR 74.51, "Nuclear Material Control and Accounting for Strategic Special Nuclear Material," licensees, the limit for SEID is the greater of (1) 200 grams for plutonium or U-233 (both element and isotope), or 300 grams for both HEU and U-235 contained in HEU; or (2) 0.100 percent of active inventory (for both element and isotope).

SHIPMENT (S)–Any transfer of DU, SM, or SNM, other than measured waste discards, to another onsite "plant" or to an offsite location. For enrichment facilities with uranium in cascades, shipments include any depleted or normal uranium or any SNM (low enriched uranium) removed from the cascade system.

SHIPPER-RECEIVER DIFFERENCE (SRD)–The difference between what a sending facility (shipper) claims was contained in a shipment (of DU, SM, or SNM) and what the receiving facility claims was received, where both shipper and receiver values are based on measurements.

STANDARD ERROR OF THE INVENTORY DIFFERENCE (SEID)–The standard deviation of an inventory difference that takes into account measurement error contributions to the components of the ID.

WASTE–Any DU, SM, or SNM that (1) is not suitable (in its present form) for the production of product material, and (2) is not regarded as economically recoverable for reuse.

WASTE HOLDING ACCOUNT–An accounting ledger, separate from a facility's book-inventory account, which shows the total current quantity of declared and measured waste stored on site (but not within any processing area) and awaiting final disposition. All such waste must have been generated while being part of the facility's book inventory, and transferred to the waste holding account through a DOE/NRC Form 741 transaction.

[NOTE: Waste holding accounts for liquid waste stored in ponds or lagoons are sometimes designated as "Lagoon Accounts" or "Lagoon Holding Accounts."]

3. GENERAL GUIDANCE

3.1 Reporting Requirements

Special nuclear material (SNM) licensees required to use NRC Form 327 to report the results of physical inventories are those subject to any of the following regulations within Title 10 of the *Code of Federal Regulations* (10 CFR):

(a) 10 CFR 74.31(c)(5)
(b) 10 CFR 74.33(c)(4)
(c) 10 CFR 74.43(c)(7)
(d) 10 CFR 74.59(f)(1)

Regulations in 10 CFR 74.17(a), (b), and (c) specifically require such licensees to submit Form 327 reports. These report forms should be completed in accordance with the instructions provided in this NUREG document. A separate Form 327 report should be used for each material-type code within each plant (see definitions for "material type codes" and "plant").

For example, let's assume that XYZ Nuclear Corporation conducts the following operations under a single license at a single site:

> OPERATION A—Conversion of high enriched uranium (HEU) hexafluoride to high enriched uranium metal.
>
> OPERATION B—Fabrication of mixed plutonium oxide or uranium oxide fuel rods, in which some of the uranium oxide is enriched between 1.00 and 3.50 percent in U-235, while the remaining is either normal or depleted uranium.
>
> OPERATION C—Recovery of high enriched uranium scrap generated from both operation A and from offsite facilities.
>
> OPERATION D—Analytical laboratory that provides sample analyses on samples generated from operations A, B, and C.

Operations A and B are separate and independent of each other (with no SNM flowing between the two operations). Therefore, under the Form 327 report requirements, A and B must be considered separate plants. Although part of the uranium that operation C processes relates to operation A, operation C should be considered a separate plant because it processes scrap generated from both onsite and offsite operations (i.e., from more than one plant). Likewise, operation D should be considered a separate plant because it receives samples (i.e., SNM) from more than one plant. Therefore, the four above operations can be designated as Plants A, B, C, and D, and in this hypothetical example, a separate Form 327 report would be necessary for each of the following:

(a) any HEU physical inventory conducted in Plant A
(b) any plutonium physical inventory conducted in Plant B
(c) any LEU physical inventory conducted in Plant B
(d) any HEU physical inventory conducted in Plant C
(e) any LEU physical inventory conducted in Plant D

(f) any HEU physical inventory conducted in Plant D
(g) any plutonium physical inventory conducted in Plant D

In addition to LEU, HEU and plutonium, as used in the example above, separate 327 forms should be used for reporting any physical inventories associated with (1) uranium-233, (2) plutonium-238, (3) uranium in cascades, (4) normal uranium at an enrichment facility, and (5) depleted uranium (DU) at an enrichment facility.

For each material type, inventory results need to be reported for both element and isotope, as shown in the table below.

MATERIAL TYPES TO BE INVENTORIED SEPARATELY				
MATERIAL TYPE	MATERIAL CODE	REPORTING WEIGHT UNIT (to nearest)	WEIGHT ELEMENT	WEIGHT ISOTOPE
Depleted Uranium (1)	10	kilogram	uranium	U-235
Normal Uranium (1)	81	kilogram	uranium	U-235
Low Enriched Uranium (2)	20	gram	uranium	U-235 or U-233 + U-235
High Enriched Uranium (2)	20	gram	uranium	U-235 or U-233 + U-235
Uranium in Cascades (1)	89	gram	uranium	U-235
Uranium-233 (3)	70	gram	uranium	U-233
Plutonium-238 (4)	83	0.1 gram	plutonium	Pu-238
Plutonium	50	gram	plutonium	Pu-239 + 241

(1) Certain facilities (e.g., uranium enrichment facilities subject to 10 CFR 74.33(c)(4)) are required to conduct physical inventories for material codes 10, 81, and 89.

(2) For Form 327 purposes, LEU and HEU are two subcodes of material code 20, and physical inventories for LEU and HEU should be conducted and reported separately, in accordance with 10 CFR 74.17, "Special nuclear material physical inventory summary report," and the physical inventory requirements of 10 CFR Part 74 Subpart C, "Special Nuclear Material of Low Strategic Significance," Subpart D, "Special Nuclear Material of Moderate Strategic Significance," and Subpart E, "Formula Quantities of Strategic Special Nuclear Material."

(3) As specified in the guidance definition, material code 70 means U-233 that is greater than 10.00 weight percent of the total uranium content or greater than both the U-235 content and 5.00 weight percent of the total uranium content. Otherwise, report as material code 10, 81, or 20, as appropriate.

(4) As specified in the guidance definition, material code 83 means plutonium-238, if the plutonium-238 isotopic distribution is greater than 10.00 weight percent relative to total plutonium element content. Otherwise, report as material code 50.

3.2 Instructions for Blocks A–H of Form 327

All the blocks ("A" through "H") on the upper portion of Form 327 are to be completed as follows:

Block A "Licensee Name"—Name of corporation or company to which license is issued.

Block B "Facility Location"—Nearest town to which facility site is located, or licensee's mailing address.

Block C "Docket No."—List appropriate U.S. Nuclear Regulatory Commission (NRC) docket number.

Block D "SNM License No."—List SNM license number under which possession and use of SNM is authorized.

Block E "Plant Designation"—For licensees conducting only a single operation, enter "single plant operation." For licensees authorized to operate two or more plants, as described within their approved MC&A plan, designate the plant (by code or name as given in the MC&A plan) to which the Form 327 report pertains.

Block F "Beginning Date" and "Ending Date"—For the ending date, enter the cutoff date for the physical inventory in question. For the beginning date, enter the cutoff date for the physical inventory just previous to the one in question.

Block G "Material Type"—Place an "X" in one of the eight boxes, to indicate which material type to which the Form 327 report pertains.

[NOTE: Do not mark more than one box per form, except in the case of a total material balance inventory difference report associated with a uranium enrichment facility, which must be reported in addition to the individual material type reports.]

Block H "Licensee's Certifying Official and Date"—Enter the printed name and signature of a licensee supervisor or manager. By signing this block, an individual is certifying that he or she has reviewed and checked all entries, and that to the best of their knowledge, all entries are correct. The date when the 327 Form is signed also should be entered.

3.3 General Instructions for Lines 1–13 of Form 327

For lines 1 through 13, enter the appropriate value for both the "Grams Element" and "Grams Isotope" columns. Immediately under the grams isotope heading, enter a 0, 2, 3, 5, or 8 in the isotope code box, to indicate the isotope being reported. The isotope codes are as follows:

0 = Pu-239 plus Pu-241 content
2 = U-233 plus U-235 content
3 = U-233 content
5 = U-235 content
8 = Pu-238 content

For physical inventories of either DU or normal uranium at uranium enrichment facilities, both element and isotope quantities are to be reported to the nearest kilogram (kg). For physical inventories pertaining to plutonium-238, both element and isotope quantities are to be reported to the nearest tenth of a gram. All other material types are to be reported to the nearest gram. When reporting the results of DU or normal uranium physical inventories (at enrichment facilities), either (1) cross out the "GRAMS" at the top of both column headings and write in "KG," or (2) add three zeros after each rounded kg quantity.

For lines 6, 7, 8, and 9, a plus ("+") or minus ("-") sign, as appropriate, should precede each entered quantity for both element and isotope, under Form 327 report requirements. Specific instructions given in the next section provide guidance for determining whether a sign should be positive or negative.

3.4 Transmittal of Completed Forms

Completed 327 forms are to be mailed to the NRC and addressed as follows:

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Washington, DC 20555
ATTENTION: Director, NMSS

To satisfy the time frame cited in 10 CFR 74.17(a), (b), or (c), as appropriate, for transmitting the completed form, the transmittal letter must be postmarked on or before the last day of the specified time period.

Any Form 327 that reports information associated with a strategic special nuclear material physical inventory must be properly identified as "CONFIDENTIAL, National Security Information" (see 10 CFR 95.37, "Classification and Preparation of Documents").

4. SPECIFIC INSTRUCTIONS FOR FORM 327

Line 1—Beginning Inventory

The beginning inventory (BI) value is identical to the previous period's "ending inventory" value. If, after the start of the current period, adjustments were made to items on the BI (because of errors discovered in recording or measurement, or a resolution of one or more shipper-receiver differences (SRDs)), the net sum of such adjustments should be reflected in Line 8 instead of adjusting the BI value itself.

NOTES: (1) Do not include in the BI quantity any waste material that was on hand at the start of the inventory period, but which had been measured and transferred to a waste holding account before the BI date. (See definition for "Waste Holding Account.")

(2) As used in these instructions, the term "current period" means the material balance period that ended on the cutoff date for the physical inventory being reported.

Line 2—Additions to Inventory

Additions to inventory (A) represent the total of all depleted uranium (DU), or source material (SM) (in the case of enrichment facilities), or special nuclear material (SNM) of a particular material-type code received during the current period—either from offsite suppliers or other onsite plants (that are not being covered by the specific Form 327 report). For enrichment facility reports dealing with uranium in cascades, additions to inventory include any depleted or normal uranium or any SNM (low enriched uranium (LEU)) fed into the cascade system, except for material withdrawn from the cascade system and recycled back to the cascade(s) during the same material balance period. For enrichment facility Form 327 reports dealing with LEU, additions to inventory represent all LEU withdrawn from the cascade system during the material balance period, plus any LEU received as a shipment from an offsite supplier.

NOTES: (1) For LEU reports, additions to inventory also should include any normal, depleted, or high enriched uranium blended with LEU (during the current period within the plant to which Form 327 pertains), if the resulting blend is greater than 0.724 weight percent, but less than 20.00 weight percent in combined U-233 plus U-235, relative to the total uranium content.

(2) For high enriched uranium (HEU) reports, additions to inventory also should include any normal, depleted, or low enriched uranium blended with HEU (during the current period within the plant to which the Form 327 report pertains), if the resulting blend is 20.00 weight percent or higher in combined U-233 plus U-235, relative to the total uranium content.

(3) Whenever a correction (adjustment) is made during the current period to a DU, SM, or SNM quantity received in a prior period, such adjustment should be included in the total additions to inventory quantity for Line 2 because of the requirements that the Nuclear Materials Management and Safeguards System (NMMSS) imposes. That is, such an adjustment is not really a current period receipt, but NMMSS requires a U.S. Department of Energy/U.S. Nuclear Regulatory Commission (DOE/NRC) Form 741 transaction to be executed and submitted in computer-readable format (in accordance with 10 CFR 74.15(a)) to reflect such an adjustment. Further, NMMSS

does not distinguish between actual receipts and corrections to previous receipts when totaling Form 741 transactions. Hence, licensees should treat current period adjustments to prior period receipts as though they were actual current period receipts so that their unadjusted inventory difference (ID) agrees with what NMMSS shows. Also see instructions for Line 8, Prior Period Adjustments.

Line 3—Shipments

Shipments (S) represent the total of all DU, SM, or SNM, of a given material-type code, shipped off site or to other onsite plants during the current period with the exception of (1) prior-period waste shipped from a waste holding account; and (2) any current period waste that was shipped. For enrichment facility reports dealing with uranium in cascades, shipments include any depleted or normal uranium or any SNM (LEU) removed from the cascade system.

NOTE: If a correction (adjustment) is made in the current period to an SNM (or SM) quantity shipped in a prior period, such adjustment should be included in the shipments (Line 3) total for the current period because of the requirements that NMMSS imposes. That is, such an adjustment is not really a current period shipment, but NMMSS requires a DOE/NRC Form 741 transaction to be executed and submitted in computer-readable format (in accordance with 10 CFR 74.15(a)) to reflect such an adjustment, and NMMSS does not distinguish between actual shipments and corrections to previous shipments when totaling Form 741 transactions. Hence, licensees should treat current period adjustments to prior period shipments as though they were actual current period shipments so that their unadjusted ID agree with what NMMSS shows. Also see instructions pertaining to Line 8, Prior Period Adjustments.

Line 4—Measured Discards

Measured discards (MD) include all DU, SM, or SNM waste (solid, liquid, and gaseous) of a given material-type code generated, measured, and removed from the accounting ledgers during the current period. Whether the waste was shipped, discharged to the environment, or stored on site as part of a waste holding account is irrelevant to this line entry.

NOTE: Any waste (liquid or solid) stored on site, but which has not been transferred to a waste holding account, is to be considered part of the ending inventory.

Line 5—Ending Inventory

The ending inventory (EI) value is the total of all DU, SM, or SNM of a given material-type code, on hand at the cutoff time, as determined by the physical inventory, except for any waste stored on site as part of a waste holding account.

Line 6—Inventory Difference

The inventory difference (ID) is the mathematical combination of the five preceding lines. That is, ID = BI + A - S - MD - EI. A negative ID suggests a gain in material (i.e., the physical inventory total was more than the amount shown on the accounting books). A positive ID implies a loss of material (i.e., the physical inventory total was less than the accounting ledgers indicated). Some prefer to define ID as being equal to book inventory minus physical inventory, which is identical to the ID equation given above. That is, the book inventory is the same as BI plus A minus S minus MD, and the physical inventory is the same as EI.

Line 7—Bias Correction to the ID

Bias corrections to the inventory difference (BC) are to be made in accordance with a licensee's MC&A plan commitments. Any bias correction that has been applied to individual DU, SM, or SNM items (thus resulting in the changing of accounting ledger entries) should not be applied as a correction to ID under Form 327 report requirements. Most biases are too small to affect individual items, but their effect over many items can have a significant effect on the ID value. For those biases that are to be applied as adjustments to ID, the methodology used to derive the overall net bias correction adjustment should satisfy (or approximate) the following model:

BC = [Net Bias Corr. BI] + [Net Bias Corr. A] – [Net Bias Corr. S] – [Net Bias Corr. MD] – [Net Bias Corr. EI]

NOTE: If bias is negative (causing an understatement), the bias correction is positive. If bias is positive (causing an overstatement), the bias correction is negative. The BI bias correction is due to biases that existed during prior periods. The S and EI bias corrections can be a combination of prior and current period biases. The A and MD bias corrections are due to biases that existed during the current period only.

Line 8—Prior Period Adjustments

There are two general types of prior period adjustments (PPAs), which can be referred to as Type A PPAs and Type B PPAs. Type A are true PPAs, while Type B are adjustments needed to compensate for NMMSS requirements and practices. Type A PPAs are changes (made during the current period) to accountability values assigned during previous periods and which pertain to items or material that are part of BI. Type A PPAs can arise only from:

(1) Corrections of a recording or measurement error associated with BI material

(2) Resolution within the current period of a statistically significant SRD involving BI material

(3) An adjustment to the initial receipt value pertaining to scrap, received in a prior period, because of better measurement following dissolution of such scrap in the current period

NOTE: If an accountability value generated in a prior period causes BI to be overstated, the associated PPA is given a negative sign. If BI is understated, the PPA is positive.

Type B PPAs are changes made in the current period to SNM, SM, or DU quantities that are not part of BI and were either received or shipped in a prior period. Under the Form 327 report requirements, Type B PPAs should be made because NMMSS does not distinguish between actual receipts and corrections to previous receipts; likewise, it does not distinguish between actual shipments and corrections to previous shipments. The algebraic (+ or -) given to a particular Type B PPA is the opposite of the sign given to the corresponding adjustment to the prior period receipt or shipment in question.

Line 9—Adjusted Inventory Difference

The adjusted inventory difference (AID) is the algebraic sum of the amounts entered on Lines 6, 7, and 8. This final AID value is compared to:

(i) a licensee's detection threshold value when subject to either 10 CFR 74.31(c)(5) or 10 CFR 74.33(c)(4), or

(ii) three times the standard error of inventory difference (SEID) when subject to either 10 CFR 74.43(c) or 10 CFR 74.59(f)(1)(i).

Line 10a—Standard Error of the ID

For licensees subject to 10 CFR 74.31, "Nuclear material control and accounting for special nuclear material of low strategic significance," or 10 CFR 74.33, "Nuclear material control and accounting for uranium enrichment facilities authorized to produce special nuclear material of low strategic significance" the SEID is the square root of the sum of both measurement and nonmeasurement variances associated with the ID.

For licensees subject to 10 CFR 74.41, "Nuclear material control and accounting for special nuclear material of moderate strategic significance," or 10 CFR 74.51, "Nuclear material control and accounting for strategic special nuclear material," the SEID is the square root of measurement variances associated with the ID.

Line 10b—Limit of Error of the ID

Limit of error of the inventory difference (LEID) is not applicable

Line 11a—Active Inventory

Licensees subject to 10 CFR 74.31, 10 CFR 74.33, 10 CFR 74.41, or 10 CFR 74.51 are to complete Line 11a. Active inventory is the summation of BI plus A plus R plus EI after deducting all covariant items (or material quantities) from each of the preceding terms. That is, any item appearing twice among the five terms (with both listings based on the same measurement, or set of measurements) is not to be included within any of the terms when determining active inventory.

Line 11b—The Larger of "Additions to Process" or "Removals from Process"

Additions to material in process and additions to process have the same meaning. Also, removals of material from process and removals from process have the same meaning. Enter the larger value between the two calculated processes.

Line 12a—SEID Limit

For 10 CFR 74.31 licensees, the SEID limit is the greater of (1) 4,500 grams U-235 for isotope and 100,000 grams uranium for element, when assuming that measurement and nonmeasurement contributions to SEID are equal; or (2) 0.125 percent of Line 11a (for both element and isotope), when assuming that measurement and nonmeasurement contributions to SEID are equal.

For licensees subject to 10 CFR 74.33, the SEID limit is the greater of (1) 2,500 grams U-235 for isotope and 60,000 grams uranium for element, when assuming that the measurement and nonmeasurement contributions to SEID are equal; or (2) 0.125 percent of Line 11a (for both element and isotope), when assuming that measurement and nonmeasurement contributions to SEID are equal.

For 10 CFR 74.41 licensees, the SEID limit is the greater of (1) 9,000 grams U-235 contained in LEU or (2) 200 grams for plutonium or U-233 (both element and isotope), or 300 grams for both HEU element and U-235 contained in HEU, or (3) 0.125 percent of Line 11a (for both element and isotope).

For 10 CFR 74.51 licensees, the SEID limit is the greater of (1) 200 grams for plutonium and U-233 (both element and isotope), or 300 grams for both HEU element and U-235 contained in HEU, or (2) 0.100 percent of Line 11a (for both element and isotope).

Line 12b—LEID Limit

LEID limit is not applicable.

Line 13—ID Limit

When conducting annual physical inventories, licensees subject to either 10 CFR 74.31 or 10 CFR 74.33 should enter their U-235 detection threshold (DT) value, where DT equals the site-specific U-235 DQ minus 1.3 times the U-235 SEID. For dynamic inventories (for "uranium in cascades") that 10 CFR 74.33 licensees conduct, the ID limit is the DT minus the cumulative ID for the 10-month period just before the current 65 calendar day period. The limits just described are U-235 ID limits. For 10 CFR 74.31 and 10 CFR 74.33 licensees, there are no uranium element ID limits. Therefore, always enter "NA" in the element column for Line 13.

Licensees subject to 10 CFR 74.41 (and thus 10 CFR 74.43(c)) should enter the greater of:

(i) 200 grams Pu or U-233, 300 grams HEU or U-235 contained in HEU, or 9,000 grams U-235 contained in LEU, as appropriate

(ii) 3.00 times the SEID.

NOTE: When the U-235 ID limit for LEU inventories is 9,000 grams, there is no uranium element ID limit. Therefore, in this situation, enter "NA" in the element column for Line 13.

Licensees subject to 10 CFR 74.51 (and thus 10 CFR 74.59 (f)) should enter the larger of: (1) 200 grams Pu or U-233, 300 grams HEU or U-235 contained in HEU, as appropriate, or (2) three times the SEID.

5 RESPONSE ACTIONS FOR EXCESSIVE INVENTORY DIFFERENCES

5.1 General

Whenever a finally determined inventory difference (ID) value is in excess of its regulatory limit, the licensee should do the following:

(a) Immediately notify the appropriate U.S. Nuclear Regulatory Commission (NRC) safeguards licensing authority by telephone of such a situation, even if the regulatory time limit for reconciling and reporting the ID has not expired.

(b) Initiate an investigation to determine the probable cause of the excessive ID, even though the regulatory time limit for reconciling and reporting the ID has not yet expired.

(c) When officially reporting the ID on NRC Form 327, attach an official letter to the form that (1) acknowledges that the ID limit has been exceeded, (2) confirms that investigative activities, as required by the licensee's Material Control and Accounting (MC&A) plan or NRC regulations, have been initiated, and (3) provides the status of the investigation and investigative findings, if the investigation has been completed.

5.2 For 10 CFR 74.31 Licensees

The ID limit for licensees subject to 10 CFR 74.31, "Nuclear material control and accounting for special nuclear material of low strategic significance," is the calculated U-235 detection threshold (DT) value for the inventory period in question (see "Detection Threshold," "Detection Quantity," and "Standard Error of the Inventory Difference" in Section 2). For 10 CFR 74.31 licensees, while both element and isotope IDs are to be reported, only the isotope ID has an ID limit. Because of the low strategic significance of the special nuclear material (SNM) that 10 CFR 74.31 licensees possess, the ID limit in most cases is greater than five times standard error of inventory difference (SEID). However, if an ID (either positive or negative) equals or exceeds the ID limit, the NRC normally would regard such a situation as very serious, and a lengthy process shutdown and extensive NRC investigation would be a likely consequence. In any event, the licensee's response actions for an ID that equals or exceeds its associated DT should be well defined in its MC&A plan.

Licensees should respond to other action limits as indicated in their approved MC&A plan, which is incorporated as a license condition.

5.3 For 10 CFR 74.33 Licensees

As to static physical inventories associated with any material-type code other than uranium in cascades, the ID limit is equal to the DT value for the inventory period in question (see "Detection Threshold," "Detection Quantity," and "Standard Error of the Inventory Difference" in Section 2). For dynamic physical inventories (for uranium in cascades), the ID limit is the DT minus the cumulative ID for the 10-month period just before the current 65 calendar day period. Because of the low strategic significance of low enriched uranium (LEU) that 10 CFR 74.33, "Nuclear material control and accounting for uranium enrichment facilities authorized to produce special nuclear material of low strategic significance," licensees produce, the ID limit in most cases is greater than five times SEID. However, if an ID equals or exceeds its ID limit, the NRC normally would regard such a situation as very serious. Depending on the circumstances, a

complete process shutdown might be deemed necessary. In any event, the licensee's response actions for an ID that equals or exceeds its associated DT should be well defined in its MC&A plan.

Licensees should respond to other action limits as indicated in their approved MC&A plan, which is incorporated as a license condition.

5.4 For 10 CFR 74.41 Licensees

The ID limit for licensees subject to the physical inventory requirements of 10 CFR 74.43(c) is the larger of (i) 200 grams Pu or U-233, 300 grams HEU or U-235 contained in HEU, or 9,000 grams U-235 contained in LEU, as appropriate, and (2) three times the SEID. Whenever an ID result (regardless of its algebraic sign) exceeds its limit, an investigation is to be initiated, in accordance with 10 CFR 74.43(c)(8)(iii). The investigation report shall include a statement of the probable reasons for the excessive ID and the corrective actions taken or planned.

Licensees should respond to other action limits as indicated in their approved MC&A plan, which is incorporated as a license condition.

5.5 For 10 CFR 74.51 Licensees

The ID limit for those licensees subject to the physical inventory requirements of 10 CFR 74.59(f) is the larger of (1) 200 grams of plutonium or U-233, or 300 grams-of HEU or U-235 contained in HEU, as appropriate; and (2) three times the SEID. Whenever an ID result (regardless of its algebraic sign) exceeds its limit, an investigation is to be initiated in accordance with 10 CFR 74.59(f)(1)(i). The investigation must include a determination, as required by 10 CFR 74.59(f)(1)(ii), of the historical standard deviation of ID (see NUREG-1280, "Acceptable Standard Format and Content for the Material Control and Accounting (MC&A) Plan Required for Strategic Special Nuclear Materials," for more specific guidance). Such an investigation should be initiated as soon as a final, official ID result is known to be in excess of its limit. When reporting an ID value that has exceeded its limit, a cover letter should accompany the Form 327, in which the excessive ID is acknowledged, and the status of the investigation noted. If, after determining that an ID has exceeded its limit, it is also determined that the ID also exceeds three times the historical standard deviation of ID, that fact must be reported to the NRC, in accordance with 10 CFR 74.59(f)(1)(iii).

APPENDIX
Sample NRC Form 327

NRC FORM 327 (8-2008) **U.S. NUCLEAR REGULATORY COMMISSION**

10 CFR 74.31(c)(5), 74.33(c)(4), 74.41(c)(7), and 74.59(f)(1)

SPECIAL NUCLEAR MATERIAL (SNM) AND SOURCE MATERIAL (SM) PHYSICAL INVENTORY SUMMARY REPORT

(Physical inventories of SM pertain only to uranium enrichment facilities.)
(See NUREG/BR-0096 for instruction and guidance for completing this form.)

APPROVED BY OMB: NO. 3150-0139 EXPIRES: MM/DD/YYYY

Estimated burden per response to comply with this mandatory collection request: 4 hours. This information is submitted by fuel facility licensees to account for special nuclear material. Send comments regarding burden estimate to the Records and FOIA/Privacy Services Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0139), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

A. LICENSEE NAME	B. FACILITY LOCATION

C. DOCKET NUMBER	D. SNM LICENSE NUMBER	E. PLANT DESIGNATION

F. MATERIAL BALANCE REPORT	BEGINNING DATE	ENDING DATE

G. MATERIAL TYPE

☐ LEU ☐ HEU ☐ U-233 ☐ PLUTONIUM ☐ Pu-238 ☐ URANIUM IN CASCADES ☐ NORMAL URANIUM ☐ DEPLETED URANIUM

H. LICENSEE'S CERTIFYING OFFICIAL *(Printed Name and Signature)*	DATE

* Indicate whether the entered values are positive or negative by use of appropriate "+" or "-" signs.

LINE NUMBER	DESCRIPTION		GRAM ELEMENTS (U or Pu)	GRAMS ISOTOPE ***Isotope Code***
1	BEGINNING INVENTORY	(BI)		
2	PLUS ADDITIONS TO INVENTORY	(A)		
3	MINUS SHIPMENTS	(S)		
4	MINUS MEASURED DISCARDS	(MD)		
5	MINUS ENDING INVENTORY	(EI)		
* 6	EQUALS INVENTORY DIFFERENCE	(ID)		
* 7	PLUS BIAS CORRECTION TO ID (Net sum of all bias corrections pertaining to, but not included in the above quantities)	(BC)		
* 8	PLUS SUM OF PRIOR PERIOD AJUSTMENTS THAT AFFECT THE CURRENT PERIOD ID	(PPA)		
* 9	EQUALS ADJUSTED INVENTORY DIFFERENCE	(AID)		
10a	STANDARD ERROR OF THE ID	(SEID)		
10b	LIMIT OF ERROR OF THE ID	(LEID)		
11a	ACTIVE INVENTORY	(AI)		
11b	THE LARGER OF "ADDITIONS TO PROCESS" OR REMOVALS FROM PROCESS"	(ATP) (RFP)		
12a	SEID LIMIT			
12b	LEID LIMIT			
13	ID LIMIT			