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# LICENSED FUEL FACILITY STATUS REPORT

INVENTORY DIFFERENCE DATA  
JULY 1987 - DECEMBER 1987

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UNITED STATES NUCLEAR REGULATORY COMMISSION



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INVENTORY DIFFERENCE DATA  
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OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS  
U.S. NUCLEAR REGULATORY COMMISSION  
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## ABSTRACT

NRC is committed to the periodic publication of licensed fuel facilities' inventory difference data, following agency review of the information and completion of any related investigations. Information in this report includes inventory difference data for active fuel fabrication facilities possessing more than one effective kilogram of high enriched uranium, low enriched uranium, plutonium, or uranium-233.

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## ABBREVIATIONS

CFR	Code of Federal Regulations
HEU	high enriched uranium
ID	inventory difference
LEID	limit of error of the inventory difference
LEU	low enriched uranium
MUF	material unaccounted for
NRC	U.S. Nuclear Regulatory Commission
Pu	plutonium
SEID	standard error of inventory difference
SNM	special nuclear material
S-R	shipper-receiver
U-235	uranium-235

LICENSED FUEL FACILITY STATUS REPORT  
INVENTORY DIFFERENCE DATA

Inventory Difference Data

An inventory difference (ID), also referred to as material unaccounted for (MUF), is the difference between the quantity of special nuclear material (SNM) that a licensee's accounting records show should be on hand and that which a licensee's physical inventory shows is actually on hand.

The ID data presented are for active, licensed facilities that are authorized to possess, in an unsealed form, at least one effective kilogram of SNM. The U.S. Nuclear Regulatory Commission (NRC) uses a graded approach in applying safeguards requirements for such licensees depending on the strategic significance of the possessed SNM. Licensees possessing significant quantities of high enriched uranium (HEU), plutonium, or uranium-233 are required to conduct physical inventories every two months. Facilities possessing one or more effective kilograms of SNM of moderate strategic significance conduct inventories every six months, while licensees whose holdings are restricted to SNM of low strategic significance perform physical inventories every 12 months.

It is important to understand the distinction between the low strategic significance of low enriched uranium (LEU) and the higher strategic significance of HEU and plutonium. Most LEU is enriched to a level of 1 to 4 percent in the isotope uranium-235. At this level of enrichment, the uranium is not capable of sustaining the kind of nuclear reaction that takes place in a nuclear explosion.

NRC safeguards requirements covering LEU are graded to reflect its low strategic significance. They include a formal structured system for material control and accounting and basic industrial security measures. On the other hand, because of the higher strategic significance of HEU and plutonium, NRC requires licensees to provide substantial physical protection of this material in addition to controlling and accounting for it. Physical protection of this material includes safeguards measures such as barriers, intrusion alarms, armed guards, and offsite police response capabilities. Internal systems to control the movement of HEU are also required.

IDs arise when nuclear materials are processed, particularly when chemical operations are involved. These differences can result from variations in measuring and processing, measurement inaccuracy or imprecision, unmeasured flows from the process, unmeasured inventory, bookkeeping errors, loss or theft. Although an ID larger than its overall measurement uncertainty may signal an abnormal situation requiring determination of the cause, the fact that an ID falls within its associated limit of error--even an ID of zero--provides no automatic or conclusive proof that loss or theft of material has not occurred. Therefore, NRC relies on information provided not only by the material accounting system but also by the internal control system, the physical security system, NRC inspections and evaluations, and NRC and licensee investigations.

The concept of the limit of error of the inventory difference (LEID) is a method that licensees subject to 10 CFR 70.51 and NRC use to determine the significance of the ID. LEID is a calculated estimate of the measurement uncertainty (at the 95% Confidence Level [C.L.]) that is associated with the plant's ID. The ID should be less than the LEID 19 out of 20 times, if the ID results only from measurement uncertainty.

For 10 CFR §70.51 licensees, an ID that exceeds its associated LEID may be an indication of processing problems, biased or otherwise inaccurate measurements, bookkeeping errors, loss or theft of material, NRC accordingly requires licensees to take increasingly stronger investigative actions depending on how much the inventory difference exceeds both LEID and minimum quantities specified in 10 CFR §74.13(b), (namely, 200 grams of plutonium, 300 grams of uranium-235 contained in HEU, or 9,000 grams of uranium-235 contained in LEU). If the ID exceeds its LEID, but does not exceed the minimum quantities, no formal investigation is required. However, the licensee is required to try to determine why the ID exceeded the LEID.

The concept of the standard error of inventory difference (SEID) is a method that the NRC and licensees subject to either 10 CFR §74.31 or 10 CFR §74.59 use to determine the significance of an ID. For 10 CFR §74.31 licensees, SEID is a calculated estimate of the total uncertainty (at the 67% C.L.) due to both measurement and non-measurement contributors. Thus, for 10 CFR §74.31 licensees, ID should be less than SEID two times out of three, or less than twice SEID 19 times out of 20. For 10 CFR §74.59 licensees, SEID is the calculated estimate of the measurement uncertainty (at the 67% C.L.) that is associated with an ID. Hence, for 10 CFR §74.59 licensees, the ID should be less than SEID two times out of three, and less than twice SEID 19 times out of 20 if the IDs result only from measurement uncertainties.

For 10 CFR §74.31 licensees (whose operations are limited to low enriched uranium), ID must exceed its threshold quantity (a site specific value that is considerably larger than SEID) before investigative action is required. For 10 CFR §74.59 licensees, investigative actions are required whenever an ID exceeds both (1) 200 grams plutonium or uranium-233 or 300 grams uranium-235, and (2) three times SEID.

The IDs for this reporting period (July 1 through December 31, 1987) are indicated in the Tabulation of Inventory Differences that begins on page 5 of this report. An explanation of the significance, and in some cases, the source of the IDs is included in the last column of the table.



## Definitions of Terms

1. Special nuclear material (SNM): (1) Plutonium, uranium-233, uranium enriched in the isotope uranium-235, and any other material that the Commission, pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, determined to be SNM, but does not include source material; or (2) any material artificially enriched in any of the foregoing, but does not include source material.
2. Source material: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) uranium, (ii) thorium, or (iii) any combination thereof. Source material does not include SNM.
3. Effective kilogram of SNM: (1) For plutonium and uranium-233, their weight in kilograms; (2) for uranium with an enrichment in the isotope uranium-235 of 0.01 (1%) and above, its element weight in kilograms multiplied by the square of its enrichment expressed as a decimal weight fraction; and (3) for uranium with an enrichment in the isotope uranium-235 below 0.01 (1%), its element weight in kilograms multiplied by 0.0001.
4. Strategic special nuclear material: Uranium-235 (contained in uranium enriched to 20 percent or more in the uranium-235 isotope), uranium-233, or plutonium.
5. Isotope: One of two or more atoms with the same number of protons, but different numbers of neutrons in their nuclei.
6. High enriched uranium (HEU): Uranium whose isotope content is 20 percent or more uranium-235 by weight.
7. Low enriched uranium (LEU): Uranium whose isotope content is less than 20 percent uranium-235 by weight.
8. Inventory difference (ID): The arithmetic difference between a book inventory and the corresponding physical inventory, calculated by subtracting ending inventory (EI) plus removals (R) from beginning inventory (BI) plus additions (A). Mathematically, this becomes
$$ID = (BI + A) - (EI + R).$$
9. Limit of error of the inventory difference (LEID): Twice the standard error of the estimated measurement uncertainty associated with the inventory difference.

10. Standard error of the inventory difference (SEID):  
(a) For licensees subject to 10 CFR §74.31, SEID is equal to the square root of the sum of both measurement and non-measurement variances associated with ID.  
(b) For licensees subject to 10 CFR §74.51, SEID is equal to the square root of the measurement variance (only) associated with ID.
11. The inventory difference is deemed acceptable: The ID is less than its associated LEID or SEID, and/or is less than 200 grams plutonium, 300 grams uranium-235 contained in HEU or 9000 grams uranium-235 contained in LEU (as appropriate).
12. The inventory difference falls within its applicable limit: The ID exceeds both (1) 200 grams plutonium, 300 grams uranium-235 contained in HEU or 9000 grams uranium-235 contained in LEU, and (2) its associated LEID or SEID, but is less than 1.5 times the limit for LEID (for 10 CFR §70.51 licensees) or less than the ID limit (for 10 CFR §74.31 and 10 CFR §74.59 licensees).  
  
For 10 CFR §74.31 licensees, the ID limit is a site specific threshold quantity which is considerably larger than SEID. For 10 CFR §74.59 licensees, the ID limit is three times SEID.
13. Negative inventory difference: A situation that occurs when the amount of material on hand, as determined by physical inventory, exceeds the amount of material being carried on the books (that is, there appears to be a gain of material). Mathematically, a negative ID is written as -ID or is shown in parentheses. A negative ID is also referred to as an "ID gain."
14. Positive inventory difference: A situation that occurs when the amount of material on hand, as determined by physical inventory, is less than the amount of material being carried on the books (that is, there appears to be a loss of material). Mathematically, a positive ID is written as +ID or ID (without designation of sign). A positive ID is also referred to as an "ID loss."
15. Shipper-receiver difference (S-R difference): The arithmetic difference between the quantity of SNM measured by the shipper and the quantity measured by the receiver.

Tabulation of Inventory Differences

Licensee	Licensee No. SNM-	Material Type	Inventory Date	Inventory Difference (Grams of U-235 or Pu)	Explanation
Advanced Nuclear Fuels Corp. Richland, WA	1227	LEU	7/31/87	-3474	The inventory difference is deemed acceptable.
Babcock & Wilcox, Naval Nuclear Fuel Div., Lynchburg, VA	42	HEU	8/30/87	809	The inventory difference is deemed acceptable.
		HEU	10/31/87	397	The inventory difference is deemed acceptable.
		HEU	12/31/87	-363	The inventory difference is deemed acceptable.
Babcock & Wilcox, Commercial Nuclear Fuel Plant, Lynchburg, VA	1168	LEU	11/11/87	1,182	The inventory difference is deemed acceptable.
Cintichem, Inc. Tuxedo, NY	639	HEU	7/1/87	-40	The inventory difference is deemed acceptable.
		HEU	8/31/87	14	The inventory difference is deemed acceptable.
		HEU	11/4/87	-39	The inventory difference is deemed acceptable.

Licensee	Licensee No. SNM -	Material Type	Inventory Date	Inventory Difference (Grams of U-235 or Pu)	Explanation
Combustion Engineering, Hematite, MO	33	LEU	-----	-----	The licensee was not required to conduct an inventory during this period.
Combustion Engineering, Windsor, CT	1067	LEU	-----	-----	The licensee was not required to conduct an inventory during this period.
General Atomics, La Jolla, CA	696	HEU	7/20/87	10	The inventory difference is deemed acceptable.
		Pu	7/20/87	0	The inventory difference is deemed acceptable.
		U-233	7/20/87	0	The inventory difference is deemed acceptable.
		Pu-238	7/20/87	0	The inventory difference is deemed acceptable.
		HEU	9/21/87	-5	The inventory difference is deemed acceptable.
		Pu	9/21/87	0	The inventory difference is deemed acceptable.
		Pu-238	9/21/87	0	The inventory difference is deemed acceptable.
		U-233	9/21/87	0	The inventory difference is deemed acceptable.
		LEU	9/21/87	-56	The inventory difference is deemed acceptable.

Licensee	Licensee No. SNM-	Material Type	Inventory Date	Inventory Difference (Grams of U-235 or Pu)	Explanation
General Atomics, La Jolla, CA	696	HEU	11/16/87	-2	The inventory difference is deemed acceptable.
		Pu	11/16/87	0	The inventory difference is deemed acceptable.
		U-233	11/16/87	0	The inventory difference is deemed acceptable.
		Pu-238	11/16/87	0	The inventory difference is deemed acceptable.
General Electric, Wilmington, NC	1097	LEU	8/3/87	56,206	The inventory difference is deemed acceptable.
Nuclear Fuel Services, Erwin, TN	124	HEU	8/12/87	-2537	The inventory difference falls within its applicable limit.
		HEU	10/14/87	1550	The inventory difference falls within its applicable limit.
		HEU	12/16/87	2872	The inventory difference falls within its applicable limit.
		LEU	12/31/87	-67	The inventory difference is deemed acceptable.

Licensor	Licensee No. SNM-	Material Type	Inventory Date	Inventory Difference (Grams of U-235 or Pu)	Explanation
Rockwell International Santa Susana, CA	21	HEU	7/31/87	0	The inventory difference is deemed acceptable.
		LEU	7/31/87	0	The inventory difference is deemed acceptable.
		Pu	7/31/87	0	The inventory difference is deemed acceptable.
		HEU	9/30/87	0	The inventory difference is deemed acceptable.
		LEU	9/30/87	0	The inventory difference is deemed acceptable.
		Pu	9/30/87	0	The inventory difference is deemed acceptable.
		HEU	11/30/87	0	The inventory difference is deemed acceptable.
		Pu	11/30/87	0	The inventory difference is deemed acceptable.
		LEU	11/30/87	0	The inventory difference is deemed acceptable.
United Nuclear Corp., Montville, CT	368	HEU	7/17/87	241	The inventory difference is deemed acceptable.
		HEU	9/18/87	173	The inventory difference is deemed acceptable.
		HEU	11/20/87	127	The inventory difference is deemed acceptable.

Licensee	Licensee No. SNM-	Material Type	Inventory Date	Inventory Difference (Grams of U-235 or Pu)	Explanation
Westinghouse, Columbia, SC	1107	LEU	12/29/87	-52,844	The inventory difference is deemed acceptable.

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