LANMAS Decay and Rounding

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LANMAS Decay and Rounding Methodology

- Decay Calculation
- LANMAS factors
- Example Decay Calculations
- LANMAS Rounding Calculations

How is Material Represented in LANMAS

- Discrete quantity or container of special nuclear material or source material
- At least one element
- Each element at least one isotope
- Each isotope has a Decay Start Date and Decay Start Weight

Decay Calculation

Daily Decay Constant = (Ln(2)/(Half life x 365.2422))

- LANMAS stores half life in days
  (Values from DOE M 470.4-6 Table XV-4/Wallet Cards)
- LANMAS defines year = 365.242199
- LANMAS uses the SQL function for the natural log of 2
  ln2 = (0.69314718055994529)
- Decay calculated at the item level
- Decay Start Date/Decay Start Isotope Weight

Decay Factors

Isotope	Half Life in Days	In Growth
Am241	157857.6745	
Bk249	330	
Cf252	966.0655926	
Cm242	162.8	
Cm244	6610.883639	
H3	4503.436203	
Pu238	32031.74006	
Pu241	5219.310895	0.9999754

Calculation of Decay Constant

Example Tritium

= ((0.6931471805994529) / (4503.4362027))

T3 Decay Constant

= 0.000153915

Table XV-4. Half Life and Daily Decay Factors.

Radioactive Half-life and Decay Constants

Source: Brookhaven National Laboratory, National Nuclear Data Center, Nuclear Wallet Cards, 6th Edition, January 2000

Element	Isotope	Half-Life	Standard Deviation	Daily Decay Constant ($days^{-1}$)
Americium	241	432.2 y	0.700 y	0.00000439
Curium	242	162.8 d	0.200 d	0.00425766
Curium	244	18.10 y	0.020 y	0.00010485
Berkelium	249	330 d	4.000 d	0.00210045
Californium	252	2.645 y	0.008 y	0.00071749
Plutonium	238	87.7 y	0.300 y	0.00002164
Plutonium	241	14.290 y	0.006 y	0.00013280
Hydrogen (Tritium)	3	12.33 y	0.060 y	0.00015392

LANMAS Tritium Decay Calculation

Tritium	Decay Start Date: 04/01/07	Decay Start Weight 100.00	Value on Books
			100.00
April			
	100 x 0.000153915	= 0.0153915 x 30 days	
		= 0.461745	
		= 100 - 0.46	99.54
		= 0.46 reported Decay	
May			
	100 x 0.000153915	= 0.0153915 x 61 days	
		= 0.93888150	
		= 100 - 0.94	99.06
		= 0.48 reported Decay	
June			
	100 x 0.000153915	= 0.0153915 x 91 days	
		= 1.40062650	
		= 100 - 1.40	98.60
		= 0.46 reported Decay	

Values are fictitious for example only

In-growth of Americium

- LANMAS will calculate ingrowth of Americium on an item:
  - Pu241 decays to Americium if a gram or more
  - An Americium element and isotope preexist on material
  - May or May not be reported
    - Americium as part of natural in-growth from Plutonium is not required to be reported.

How Do We Determine the Amount of Rounding?

- Determine what is your baseline
- Determine what has been reported
- Calculate Difference
- Generate Rounding Transaction

What are Site Inventory Baseline Values?

38. DONATED MATERIAL – FROM U.S. GOVT TO OTHERS		
39. DONATED MATERIAL – FROM OTHERS TO U.S. GOVT		
40. TOTAL *(Lines 8 - 39)*		5342.06
	REMOVALS	
41. EXPENDED IN SPACE PROGRAMS		
42. SALES TO U.S. GOVT RIS TO:	RIS	
TO:		
43. SALES TO OTHERS FOR THE ACCOUNT OF U.S. GOVT	RIS	
TO:		
44. DOD – USE A		
45. DOD – USE B		
46. DOD – OTHER USES		
47. EXPENDED IN U.S. GOVT TESTS		
48. ROUTINE TESTS		
49. SHIPPER – RECEIVER DIFFERENCE		
51. SHIPMENTS REPORTED TO NRC/DOE ON NRC/DOE 741 *(not listed elsewhere)*		
TO:	RIS	

SECTION A (Continued)	MATERIAL ACCOUNTABILITY	
		A. ELEMENT WEIGHT
54. SHIPMENTS – MISC		
58. DONATED MATERIAL – TO U.S. GOVT BY OTHERS		
59. DONATED MATERIAL – TO OTHERS BY U.S. GOVT		
65. ROUNDING BIAS		0.01
71. DEGRADATION TO OTHER MATERIALS	a. ICT	
	b. ICT	
72. DECAY		
73. FISSION AND TRANSMUTATION		
74. NORMAL OPERATIONAL LOSSES/MEASURED DISCARDS		
75. ACCIDENTAL LOSSES		
76. APPROVED WRITE-OFFS		
77. INVENTORY DIFFERENCE		
80. ENDING INVENTORY – U.S. GOVT OWNED		5342.05
81. ENDING INVENTORY – NOT U.S. GOVT OWNED		
82. TOTAL *(lines 41-81)*		
83. BIAS ADJUSTMENT		
SECTION B	FOREIGN OBLIGATIONS	

Physical Inventory Listing

vs.

MBR

```
101312007DZA 89079 0000000001000000000000500E
101312007DZA 89080 0000000001900000000000001000E
101312007DZA 10899 0000000149100            0
101312007DZA 20899 0000000311500000000000068500
101312007DZA 40899 0000000121800000000000072400
101312007DZA 44899 0000000027550000000000055200
101312007DZA 45899 0000000027550000000000055000
101312007DZA 46899 0000000055150000000000110300
101312007DZA 48899                0000000114700
101312007DZA 50899 0000000036910000000000132700
101312007DZA 60899 0000000054760000000000337400
101312007DZA 70899 0000000006170000000000010900
101312007DZA 81899 0000000016000
101312007DZA 82899 0000000549900
101312007DZA 83899 0000000059490000000000029710
101312007DZA 86899 0000000547970000000000547970
101312007DZA 87899 0000000534205
101312007DZA 88899 0000000548300
101312007DZA 89899 0000000009500000000000004900
```

MBR Line 80 + 81 = PIL Line 899

Values are fictitious for example only

Basic Rounding Example

	LANMAS	NMMSS
Beginning Inventory	300.3612	300.36
+ Reported Receipts	100.5447	100.54
	100.2322	100.23
- Reported Removals	100.0795	100.08
Ending Inventory	401.0586	401.05
-Ending Baseline Inventory		401.06
Rounding Transaction (TIC 65 Removal)		-0.01

Tritium Reported to hundredths

Values are fictitious for example only

Types of Internal Transactions

Change 1.2322 grams from DMT 22 to DMT21

Not reportable to NMMSS

```
A M102                                                    01312007
A M20122                    EFG303030320078  G
A M501                     00000000100     00806600000000000
A M20271                    EFG303030320078  G
A M502                     00000000100     04000000000000000
```

Changes Physical Inventory Listing balances

even though no increase or decrease in total site holdings

Values are fictitious for example only

Rounding Example

		LANMAS	733	NMMSS
Beginning Inventory	MT 21	5339.3612	5339	5339
	MT 22	423.31	423	423
Total			5762	5762

Move 1.2322 grams of Uranium DMT 22 to DMT 21

Ending Inventory	MT 21	5340.5934	5341	5339
	MT 22	422.0778	422	423
Total			5763	5762

Subtract Baseline Inventory (733)		5763
Rounding Transactions (TIC 65 Removal)		-1

*(*Looking at Element Only/One Project Number)*

Values are fictitious for example only

Reconciliation (i.e. Rounding)

Rounding transactions performed around differences in 3 criteria

- Summary Material Type
- Project Number
- Owner code

Summary

- LANMAS Decay Calculations
  - Decays using Half-Life in Days
  - SQL ln2
  - Decay Start Date and Decay Start Weight
  - In-growth Americium
- Rounding Calculations
  - Reported Transactions
  - Changes in DMT

Questions?

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