

Is Tritium over-regulated by DOE? Should the TFG support NA-1 SD G 1027 tritium values? (LA-UR-13-22542)

Tritium Focus Group

Mike Rogers

April, 2013



**NOT MEASUREMENT
SENSITIVE**

DOE-STD-1027-82
December 1992

CHANGE NOTICE NO.1
September 1997

DOE STANDARD

**HAZARD CATEGORIZATION AND
ACCIDENT ANALYSIS TECHNIQUES FOR
COMPLIANCE WITH DOE ORDER 5480.23,
NUCLEAR SAFETY ANALYSIS REPORTS**



**U.S. Department of Energy
Washington, D.C. 20585**

AREA SAFT

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

DOE-STD-1027-92 defines Nuclear Facility Categories and therefore the graded regulatory approach for facilities.

- **Category 1 Potential for significant off-site consequence**
- **Category 2 Potential for significant on-site consequence
(1 rem @ 100 meters with very conservative meteorological conditions)**
- **Category 3 Potential for only significant localized consequences
(10 rem @30 meters with 24 hr. exposure)**
- **Radiological (less than Category 3 consequences)**

SUPPLEMENTAL GUIDANCE

NA-1 SD G 1027

Approved: 11-28-11

**GUIDANCE ON USING RELEASE FRACTION AND
MODERN DOSIMETRIC INFORMATION
CONSISTENTLY WITH DOE STD 1027-92,
*HAZARD CATEGORIZATION AND ACCIDENT
ANALYSIS TECHNIQUES FOR COMPLIANCE
WITH DOE ORDER 5480.23, NUCLEAR SAFETY
ANALYSIS REPORTS, CHANGE NOTICE NO. 1***



**U.S. DEPARTMENT OF ENERGY
NATIONAL NUCLEAR SECURITY ADMINISTRATION**

AVAILABLE ONLINE AT:
<http://www.nnsa.energy.gov>

INITIATED BY:
Office of the Chief of Defense Nuclear Safety

Comparison of Tritium Threshold Values

DOE-STD-1027-92	Category 3 threshold	Category 2 threshold
	1.6 grams*	30 grams

****“At the recommendation of the Tritium Focus Group the Category 3 threshold value has been increased from 1.0 E+3 and 1.0E-01 grams to 1.6E+4 Ci and 1.6E+00 grams consistent with the methodology of EPA used for the other nuclides.”**

NA-1 SD G 1027	Category 3 threshold	Category 2 threshold
	0.87 grams**	62.4 grams **

** Calculated but not implemented.

NA-1 SD G 1027 calculated, but did not change, tritium values pending Tritium Focus Group input.

“The position of the TFG [Tritium Focus Group] is to retain the existing DOE-STD-1027 thresholds for tritium Category 2 and 3 nuclear facilities as is. The next meeting of the TFG is tentatively scheduled for the spring at SRS [Savannah River Site] and signed correspondence by all participants of that meeting can be obtained at that time if desired.”

“Accordingly, the radionuclide threshold values for tritium in Table 1 of this guidance default to the values in DOE-STD-1027-92 (30 grams for Hazard Category 2 and 1.6 grams for Hazard Category 3).”

The most significant difference for Cat 2 threshold calculations is the assumed tritium release fraction.

	NRC	1027-92	NA-1 SD G 1027
Gases (Noble)	1.0	1.0	1.0
Highly Volatile/ Combustible	0.5	0.5	0.5
Semi Volatile	0.01	0.01	0.01
Solid/Powder/Liquid	0.001	0.001	0.001

Tritium

Is change to Tritium release fraction justified?

- Tritium is a gas but not a Noble gas.
- Tritium is better described as “Highly Volatile/Combustible”.
- The oxide form is assumed in all dose models, which at least implies that the release was combustible.
- NA -1 SD G 1027 calculations are consistent with NRC and EPA models.

NA-1 SD G 1027 used the latest ICRP dose conversion factors and breathing rates.

- ICRP 72 dose factors to the public for the Category 2 threshold
- ICRP 68 dose factors to the worker for the Category 3 threshold

- Breathing rate of 3.3×10^{-4} m³/sec (public and workers)
(DOE-1027-92 used 3.5×10^{-4} public and 2.66×10^{-4} worker)
- Dose conversion factor of 66.7 Rem/ Ci for Tritium


- $X/Q = 1 \times 10^{-4}$ sec/m³ was used for the Category 2 calculation
- $X/Q = 7.2 \times 10^{-2}$ sec/m³ was used for the Category 3 calculation

Why did tritium category three threshold decrease from 1.6 grams to 0.87?



I propose that the TFG accept the NA-1 SD G 1027 methodology for tritium and recommend that the calculated Category 2 threshold be 62.4 grams.

- **Consistent with other isotopes and NRC/EPA models**
- **Uses latest ICRP dose model recommendations**
- **No known negative impact to existing facilities**
- **Potential reduction of requirements/controls for some existing facilities**



Should the TFG also adopt the calculated Category 3 threshold?

- **Consistent with other isotopes and NRC/EPA models**
- **Uses latest ICRP dose model recommendations**
- **Could have negative impact to existing facilities!**
- **Are there NNSA/DOE tritium facilities with greater than 0.87 grams but less than 1.6 grams of tritium?**

If not, the TFG should also adopt 0.87 as the Cat 3 threshold!

Does NA-1 SD G 1027 go far enough? Comparison to Pu-239

	H-3	Pu-239	ratio Pu/T
■ Cat 3	0.87g	38.6 g	44.4
■ Cat 2	62.4g	2610g	41.8
■ Rem/g	6.42 E5	1.56 E8*	240
■ Rem/C2	4 .0 E7	4.1 E11	1 E4
■ 1 um particle	0.00017 Rem	0.2 Rem*	12000

* Pu-239 Injection dose conversion factor = 2.5 E9 CEDE/Ci

Additional Opportunities

$$ST = MAR \times DR \times \text{ARF} \times RF \times LPF$$

Consider :

- tritium stored as a metal hydride
- tritium oxide stored on molecular sieve

Category 3 non-reactor nuclear facilities require significantly less regulation.

- No off-site or significant on-site consequences.
- Potential for only significant localized consequences/ worker dose.
- DSA requires hazard analysis but not accident analysis.
- No Safety Class SSCs and fewer (if any) Safety Significant SSCs.
(Would require significantly less “Conduct of Engineering”.)
- “TSRs may consist solely of an inventory limit to maintain Hazard Category 3 classification and provide appropriate commitments to safety programs in the administrative controls section of the TSR.” (DOE-STD-3009-94)