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July 18, 2022

Michelle Hammond
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11545 Rockville Pike
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RE: TRUGLO Inc. Exempt Distribution License Renewal Application License No. 42-23889-01E

Dear Ms. Hammond:

Enclosed are our responses to your questions contained in your emailed dated July 7, 2022. For your convenience we have listed your questions with our response:

In accordance with 10 CFR 32.22 (a)(2)(vi) and (xiii), Please submit additional information on the items below:

1. **Maximum external radiation levels at 5 and 25 centimeters from any external surface of the product, averaged over an area not to exceed 10 square centimeters, and the method of measurement.**

As per the previously submitted document, the maximum radiation dose rate at 5, 30, cm from any external surface of the product, as averaged over 10 square centimeters is at background levels. Tritium (H-3) emits beta particles with a maximum energy of 18.6 Kev (source: Health Physics and Radiological Handbook, 4th edition). Due to the low energy of the beta particles, these values cannot be measured with any standard type of survey meter, thus these are calculated values. The NRC traditionally accepts calculated values when field surveys are not practical.

The beta particles emitted by tritium have insufficient energy to penetrate the borosilicate glass of the Gaseous Tritium Light Source (GTLS), nor do they have energy to penetrate the source housing. In addition, the beta particles have insufficient energy to penetrate the dead layer of human skin. Thus, the external dose to the user is at background levels.

2. **Please provide dose assessment addressing all of the appropriate scenarios to demonstrate that the device meets the safety criteria in 10 CFR 32.23. [Please see the attached Appendix E of NUREG 1556 Volume 8].**

(a) In normal use and disposal of a single exempt unit, it is unlikely that the external radiation dose in any one year, or the dose commitment resulting from the intake of radioactive material in any one year, to a suitable sample of the group of individuals expected to be most highly exposed to radiation or radioactive material from the product will exceed the dose to the appropriate organ as specified in Column I of the table in § 32.24 of this part.

The following dose assessment is made to determine the expected dose from the routine use and disposal of the TRUGLO gun sight to ensure that doses are below the limits given in Column I of the table in 10 CFR 32.24.

Routine Use Scenarios Considered

NUREG 1717 lists two scenarios to indicate potential doses from routine use: 1) typical use by a police officer, and 2) typical use by a private gun owner storing the gun at home. The NUREG 1717 assumptions for leakage rates, number of sights distributed, contact times, ventilation rates, breathing rates, etc. are appropriate for the dose assessment for the TRUGLO gun sights with one exception: The basis for the NUREG 1717 dose calculations is an activity of 50 mCi per set, whereas the TRUGLO sights contain 90 mCi per set. Therefore, the NUREG 1717 dose calculations, for purposes of this response to NRC, will be increased by the ratio 90/50 = 1.8.

Scenario 1, police officer
For the police officer, the annual EDE is estimated to be 0.006 mrem in the first year according to NUREG 1717 2.14.5.3. Since the TRUGLO gun sight may contain up to 1.8 times the activity of the source assumed by NUREG 1717 calculations, this quantity is multiplied by 1.8. The annual EDE is estimated to be:

0.006 mrem x 1.8 = 0.011 mrem in the first year.

For an assumed average of three other family members, the initial annual EDEs are estimated to be:

Less than 0.001 mrem x 1.8 = less than 0.002 mrem

Scenario 2, private gun owner
For the private gun owner storing the gun at home, the annual EDE is estimated to be less than 0.001 mrem for the gun owner and three other family members according to NUREG 1717 2.14.5.3. Since the TRUGLO gun sight may contain up to 1.8 times the activity of the source assumed by NUREG 1717 calculations, this quantity is multiplied by 1.8. The annual EDE is estimated to be:

Less than 0.001 mrem x 1.8 = less than 0.002 mrem

The collective EDE from the routine use of 100,000 gun sights used for 10 years is estimated by NUREG 1717 to be 4 person-rem. For the TRUGLO gun sights, the collective EDE is calculated as:

4 person-rem x 1.8 = 7.2 person-rem

Disposal Scenarios Considered

To estimate the potential radiation doses due to the disposal of gun sights containing H-3, NUREG 1717 2.14.5.4 is referenced. The assumption is made that most of the GTLSs remain intact during waste collection and landfill disposal. Since the TRUGLO gun sight may contain up to 1.8 times the activity of the source assumed by NUREG 1717 calculations, the potential dose is multiplied by 1.8.

Scenario 1, Landfill Disposal
For waste collectors the annual individual EDE according to NUREG 1717 is less than 0.001 mrem. For the TRUGLO gun sights, the individual EDE to waste collectors at landfills is:

Less than 0.001 mrem x 1.8 = less than 0.002 mrem

The annual individual doses to workers at landfills, off-site members of the public, and future on-site residents would be less than the above dose, 0.002 mrem.
The total collective EDE according to NUREG 1717 is 0.3 person-rem. For the TRUGLO gun sights, the collective EDE is:

0.3 person-rem x 1.8 = 0.54 person-rem

Scenario 2, Incinerator Disposal
For waste collectors the annual individual EDE according to NUREG 1717 is 0.004 mrem. For the TRUGLO gun sights, the individual EDE to waste collectors at incinerators is:

0.004 mrem x 1.8 = 0.0072 mrem

The annual individual doses to workers at landfills, off-site members of the public, and future on-site residents would be less than the above dose, 0.0072 mrem.
The total collective EDE according to NUREG 1717 is 0.4 person-rem. For the TRUGLO gun sights, the collective EDE is:

0.4 person-rem x 1.8 = 0.72 person-rem

The above values are below the limits stated in Column I of 10 CFR 32.24 for individual EDE in routine use and disposal scenarios.

(b) In normal handling and storage of the quantities of exempt units likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, it is unlikely that the external radiation dose in any one year, or the dose commitment resulting from the intake of radioactive material in any one year, to a suitable sample of the group of individuals expected to be most highly exposed to radiation or radioactive material from the product will exceed the dose to the appropriate organ as specified in Column II of the table in § 32.24.

The following dose assessment is made to determine the expected dose from the distribution, transport, and installation of the TRUGLO gun sight to ensure that doses are below the limits given in Column II of the table in 10 CFR 32.24.

Distribution, Transport, and Installation Scenarios Considered

To estimate the potential radiation doses due to the distribution, transport, and installation of gun sights containing H-3, NUREG 1717 2.14.5.1 is referenced. NUREG 1717 lists two scenarios to indicate potential doses from distribution, transport, and installation: 1) transport by local parcel-delivery drivers in large trucks that pick up the self-luminous gun sights from suppliers and take them to a local terminal, where they are shipped by semi-truck to other local terminals for delivery to gunsmiths or manufacturers, and 2) a gun sight installer in a gun repair shop. Since the TRUGLO gun sight may contain up to 1.8 times the activity of the source assumed by NUREG 1717 calculations, the potential dose is multiplied by 1.8.

Scenario 1, local parcel delivery driver
For the local parcel delivery driver, the annual EDE is estimated to be 0.1 mrem according to NUREG 1717 2.14.5.1. Since the TRUGLO gun sight may contain up to 1.8 times the activity of the source assumed by NUREG 1717 calculations, this quantity is multiplied by 1.8. The individual EDE is estimated to be:

0.1 mrem x 1.8 = 0.18 mrem

The individual doses to other truck drivers, terminal works, and members of the public would be less than the above dose, 0.18 mrem.

Scenario 2, gun sight installer
For the gun sight installer, the annual EDE is estimated to be 0.3 mrem according to NUREG 1717 2.14.5.2. Since the TRUGLO gun sight may contain up to 1.8 times the activity of the source assumed by NUREG 1717 calculations, this quantity is multiplied by 1.8. The individual EDE is estimated to be:

0.3 mrem x 1.8 = 0.54 mrem

The annual dose equivalent to the skin according to NUREG 1717 could be 30 mrem over a skin area of 3 cm^2 in contact with the gun sights. This quantity is multiplied by 1.8. The annual dose equivalent to the skin is estimated to be:

30 mrem × 1.8 = 54 mrem over a skin area of 3 cm^2

The collective EDE to all gun installers from 1 year's distribution of 100,000 gun sights is estimated to be 0.007 mrem according to NUREG 1717. This quantity is multiplied by 1.8:

0.007 mrem x 1.8 = 0.0126 mrem

The above values are below the limits stated in Column II of 10 CFR 32.24 for individual EDE in distribution, transport, and installation scenarios.

c) It is unlikely that there will be a significant reduction in the effectiveness of the containment, shielding, or other safety features of the product from wear and abuse likely to occur in normal handling and use of the product during its useful life.

There is no change in the product regarding the effectiveness of containment and shielding over its anticipated useful life. While some studies by investigators have indicated that gaseous tritium may diffuse through the borosilicate glass over time, the manufacturer maintains that this is not possible (source: MB Microtec, personal communication).

The tubes containing the H-3 gas are made of borosilicate glass. Borosilicate glass (called Pyrex® in commercial applications) is resistant to extreme temperatures and to chemical corrosion. It can handle both extreme heat and cold, making it very popular for laboratory glassware and other scientific instruments. It also has a reduced rate of thermal expansion, and its softening point is 1,510°F (820°C). All these attributes make it very robust when used in this application.

d) In use and disposal of a single exempt unit, or in handling and storage of the quantities of exempt units likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, the probability is low that the containment, shielding, or other safety features of the product would fail under such circumstances that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column III of the table in § 32.24, and the probability is negligible that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column IV of the table in § 32.24.

For the routine user of a single exempt unit, the probability is low that the containment could be compromised as described in question c). The following dose assessment is made to determine the expected dose from the routine use of the TRUGLO gun sight to ensure that doses are below the limits given in Columns III and IV of the table in 10 CFR 32.24. The potential dose from the particle radiation and the photon radiation components of H-3 decay are examined.

<u>Particle Radiation</u>
Tritium decays to stable Helium-3 (He-3) by emitting a negative beta particle. No direct photon (gamma) radiation occurs during this transformation. The E_{max} energy of this beta particle is 0.0186 MeV (18.6 keV) and the E_{avg} energy is 0.005685 MeV (5.69 keV) (Kocher, David C. "Radioactive Decay Data Tables." U.S. Department of Energy, DOE/TIC-11026). The yield of this transformation is 1.0. Inspection of the Beta Particle Range-Energy Curve from the Health Physics and Radiological Health Handbook shows that a H-3 beta particle, even at the maximum particle energy (with a yield approaching zero) will not penetrate a density-thickness of 7 mg/cm2 (the nominal density-thickness of the upper layer of the epidermis (the stratum corneum or dead skin cell layer). Therefore, as an external hazard, there would be no shallow dose (SDE), no eye (lens) dose (LDE), and no deep dose (DDE) delivered to any person from the H-3 particle emissions.

<u>Photon Radiation</u>
Bremsstrahlung photon emissions from an intact device will be negligible. This is confirmed in NUREG-17173 on page A.4-10, Table A.4.2 footnote b, which states that for H-3 the "Dose due to

bremsstrahlung is assumed to be zero (0), because the energies of the bremsstrahlung photons are very low and pathways of internal exposure also are assumed to occur."

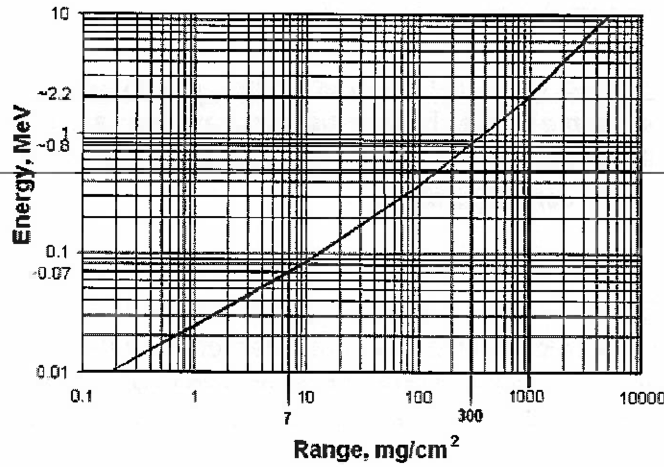

Figure 1. Beta particle range-energy curve showing threshold energies for shallow (7 g/cm^2), lens or eye (300 mg/cm^2) and deep (1000 mg/cm^2) dose equivalents

With regards to routine use, external radiation dose to all exposed individuals and groups is zero. Internal doses, at a leak rate of 10 ppb/h, should be negligible and certainly less than 1 mrem per year for an individual and less than 10 mrem per year to handlers and distributors of these devices. This fulfills the requirements of 10 CFR 32.23 and 10 CFR 32.24 for external whole-body dosed, extremities and skin. Therefore, in normal use of a single exempt unit, it is unlikely that the external radiation dose in any one year, or the dose commitment resulting from the intake of radioactive material in any one year, to a suitable sample of the group of individuals expected to be most highly exposed to radiation or radioactive material from the product will exceed 1 mrem.

The following dose assessment is made to determine the expected dose from the routine use of the TRUGLO gun sight to ensure that doses are below the limits given in Columns III and IV of the table in 10 CFR 32.24. For the disposal of a single exempt unit, the generic disposal methodology described in NUREG 1717 A.2 is used to calculate the EDE to a group of exposed individuals using the relationship,

$$H_{ij} = DSR_{ij} \times A_i$$

where H_{ij} = EDE from exposure to radionuclide i for exposure pathway j
DSR = dose-to-source ratio for the particular radionuclide and exposure pathway
A_i = assumed activity of the particular radionuclide disposed for the assumed option.

Two waste disposal scenarios are addressed: disposal in landfills and EDE to waste collectors, landfill workers, off-site members of the public, and future on-site residents, and disposal in incinerators and EDE to waste collectors, incinerator workers, and off-site members of the public. In both cases, the DSRs for external exposure from H-3 for both individual and collective dose are 0, and the external exposure contribution to dose is expected to be 0.

Scenario 1, Landfill Disposal

WHEN BRIGHTNESS COUNTS

The assumptions made for the calculations of annual individual and collective EDEs are: the DSRs for all exposure pathways are reduced by a factor of 0.8 to take into account the fraction of disposed activity sent to landfills (about four times the amount sent to incinerators); the DSRs for inhalation and ingestion are reduced by a factor of 10 because the H-3 within the TRUGLO gun sight is considerably less dispersible than loose trash but nonetheless could be dispersed to some extent. The total DSR is the sum of the DSRs for inhalation and ingestion because the external exposure contribution is 0.

The total activity of a single exempt unit for one set of TRUGLO gun sights is 90mCi or 90000μCi.
For waste collectors at landfills (DSRs from NUREG 1717 Table A.2.1 and Table A.2.2),
Annual individual dose = (90000μCi) [(0.1)(2.6×10^{-17} rem/μCi) + (0.1)(3.3×10^{-15} rem/μCi)](0.8) = 2.4×10^{-11} rem
Annual collective dose = (90000μCi) [(0.1)(9.2×10^{-14} person-rem/μCi) + (0.1)(1.2×10^{-11} person-rem/μCi)](0.8) = 8.7×10^{-8} person-rem
For workers at landfills (DSRs from NUREG 1717 Table A.2.3 and Table A.2.4),
Annual individual dose = (90000μCi) [(0.1)(3.0×10^{-18} rem/μCi) + (0.1)(7.0×10^{-16} rem/μCi)](0.8) = 5.1×10^{-12} rem
Annual collective dose = (90000μCi) [(0.1)(5.2×10^{-14} person-rem/μCi) + (0.1)(1.2×10^{-11} person-rem/μCi)](0.8) = 8.7×10^{-8} person-rem
For off-site residents at landfills due to airborne releases (DSRs from NUREG 1717 Table A.2.5),
Annual individual dose = (90000μCi) [(0.1)(1.1×10^{-17} rem/μCi))](0.8) = 7.9×10^{-14} rem
Annual collective dose = (90000μCi) [(0.1)(3.3×10^{-12} person-rem/μCi))](0.8) = 2.4×10^{-8} person-rem
For off-site residents at landfills due to releases to groundwater (DSRs from NUREG 1717 Table A.2.7),
Annual individual dose = (90000μCi) [(0.1)(1.2×10^{-15} rem/μCi))](0.8) = 8.6×10^{-12} rem
Annual collective dose = (90000μCi) [(0.1)(1.0×10^{-9} person-rem/μCi))](0.8) = 7.2×10^{-6} person-rem
For future on-site residents at landfills (DSRs from NUREG 1717 Table A.2.8 and Table A.2.9),
Annual individual dose = (90000μCi) [(0.1)(4.2×10^{-20} rem/μCi) + (0.1)(1.2×10^{-18} rem/μCi)](0.8) = 8.9×10^{-15} rem
Annual collective dose = (90000μCi) [(0.1)(1.8×10^{-15} person-rem/μCi) + (0.1)(5.1×10^{-14} person-rem/μCi)](0.8) = 3.8×10^{-10} person-rem

Thus, based on the generic disposal methodology, the highest annual individual EDEs for landfill disposal would be 2.4×10^{-11} rem to waste collectors at landfills. The collective EDE from 1 year's distribution of the exempt item from all landfill pathways would be 7.4×10^{-6} person-rem. These values are below the limits stated in Columns III and IV of 10 CFR 32.24.

Scenario 2, Incinerator Disposal
The assumptions made for the calculations of annual individual and collective EDEs are: the DSRs for all exposure pathways are reduced by a factor of 0.2 to take into account the fraction of disposed activity sent to incinerators (about one-fourth of the amount sent to incinerators); the DSRs for inhalation and ingestion are reduced by a factor of 10 because the H-3 within the TRUGLO gun sight is considerably less dispersible than loose trash but nonetheless could be dispersed to some extent. The total DSR is the sum of the DSRs for inhalation and ingestion because the external exposure contribution is 0.

The total activity of a single exempt unit for one set of TRUGLO gun sights is 90mCi or 90000μCi.
For waste collectors at incinerators (DSRs from NUREG 1717 Table A.2.10 and Table A.2.11),
Annual individual dose = (90000μCi) [(0.1)(6.1×10^{-16} rem/μCi) + (0.1)(7.8×10^{-14} rem/μCi)](0.2) = 1.4×10^{-10} rem
Annual collective dose = (90000μCi) [(0.1)(9.2×10^{-14} person-rem/μCi) + (0.1)(1.2×10^{-11} person-rem/μCi)](0.2) = 2.2×10^{-8} person-rem
For workers at incinerators (DSRs from NUREG 1717 Table A.2.12 and Table A.2.13),
Annual individual dose = (90000μCi) [(0.1)(1.7×10^{-18} rem/μCi) + (0.1)(2.1×10^{-17} rem/μCi)](0.2) = 4.1×10^{-14} rem
Annual collective dose = (90000μCi) [(0.1)(5.2×10^{-16} person-rem/μCi) + (0.1)(6.4×10^{-15} person-rem/μCi)](0.2) = 1.2×10^{-11} person-rem
For off-site residents at incinerators due to airborne releases (DSRs from NUREG 1717 Table A.2.14),
Annual individual dose = (90000μCi) [(0.1)(1.0×10^{-16} rem/μCi))](0.2) = 1.8×10^{-13} rem
Annual collective dose = (90000μCi) [(0.1)(5.6×10^{-10} person-rem/μCi))](0.2) = 1×10^{-6} person-rem

Thus, based on the generic disposal methodology, the highest annual individual EDEs for incinerator disposal would be 1.4×10^{-10} rem to waste collectors at incinerators. The collective EDE from 1 year's distribution of the exempt item from all incinerator pathways would be 1×10^{-6} person-rem. These values are below the limits stated in Columns III and IV of 10 CFR 32.24.

For the handling and storage of the quantities of exempt units likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, three scenarios are considered: dose to a warehouse worker and to a firefighter extinguishing a fire in a manufacturer's warehouse, dose to firefighters extinguishing a tractor trailer fire, and dose to firefighters extinguishing a fire in an end use facility, assumed to be a military or law enforcement armory.

Assumptions are made that at any one time, up to 3,000 sets containing 90mCi each (270,000 mCi) might be located in a warehouse, 200 devices (18,000 mCi) might be in transit to sellers in a single tractor-trailer vehicle, and up to 50 sets (4,500 mCi) might be in the assembly process. The remainder of the H-3 is either on order or is somewhere in the manufacturing process. It is also reasonable to estimate that a typical end user (military or law enforcement) might have as many as one hundred (100) gun sight sets (9,000 mCi) in an armory at one time.

For purposes of these calculations, the following assumptions are made in each scenario.
1. Dose to a warehouse worker and to a firefighter extinguishing a fire in a manufacturer's warehouse containing 3,000 sets (270 Ci). This scenario assumes that 1% (30) of the sets are destroyed in the fire, releasing 2.7 Ci or 2.7×10^6 μCi = A;
2. Dose to firefighters extinguishing a tractor trailer fire containing 200 sets (18 Ci). This scenario assumes that 1% (2) of these sets are destroyed in the fire, releasing 0.18 Ci or 1.8×10^5 μCi = A;
3. Dose to firefighters extinguishing a fire in an end use facility, assumed to be a military or law enforcement armory (analogous for these calculations to the size of a private residence) and containing 100 gun sight sets (9 Ci). One per cent or one gun sight sets are assumed to be destroyed in the fire releasing 0.09 Ci or 0.9E x 10^5 μCi = A.

Internal Dose Potential

WHEN BRIGHTNESS COUNTS

For Instantaneous Airborne Concentration (C) in an Accidental Release (NUREG 1717 A.1.2 equation 1):

$$C = Q/Vkt\,(1 - e^{-kt})$$

Where, from above:

Structure	A (µCi)
Warehouse	2.7×10^{6}
Tractor Trailer	1.8×10^{5}
Armory	0.9×10^{5}

Calculate Quantity Released (Q) (NUREG 1717 A.1.3 equation 3):

$$Q = RF \times A$$

Where:
Q = quantity (µCi) released
RF = fraction of radioactive material released as respirable size particles (100% for gaseous sources)
A = total amount of radioactive material involved in a fire

Structure	Q (µCi)
Warehouse	2.7×10^{6}
Tractor Trailer	1.8×10^{5}
Armory	0.9×10^{5}

Calculate Instantaneous Airborne Concentration (C)

$$C = Q/Vkt\,(1 - e^{-kt})$$

Where:
Q = released quantity (µCi)
V = volume (m^3) into which activity is released (see table 1 below)
k = ventilation rate (see Table 1 below)
t = time over which C is averaged. A time of 1 hour is used for this calculation.

E.g., for the warehouse:

$$C = (2.7 \times 10^{6} / (2739)(1)(1))\,(1 - e^{-(1)(1)})$$

$$C = 621.0\ uCi/m^3$$

Type of Enclosure	Q (µCi)	L x W x H (m)	Floor area (m^2)	Volume (m^3)	Ventilation Rate (volume/h)	Instantaneous air conc (µCi/m^3)
Warehouse 30 units broken	2.7×10^{6}	24.4 x 24.4 x 4.6	5.95	2,739	1	621.0
Tractor trailer 2 units broken	1.8×10^{5}	13.7 x 2.35 x 2.7	32	87	1	1303.4

Residence 1 unit broken	0.9×10^5	186 m^2 x 2.44	32	450	1	126

Table 1. Assumed attributes of relevant transport, storage and use enclosures; instantaneous airborne concentrations

<u>Inhalation Intake and Dose</u>

During a fire, an individual's intake from inhalation of airborne radioactive material (µCi) is given by

$$I_{Inh.} = C \times BR \times t,$$

Where:
t = time of exposure (h),
BR = breathing rate (m^3/h) = 1.2 m^3/h
C = average concentration of airborne radioactive material (µCi/m^3) over time, t.

Type of Enclosure	Avg. Conc. (µCi/m^3)	Breathing Rate (m^3 /h)	Inh. Intake (µCi) t = 0.083 hour (5 min) Worker (Resident)	Intake (µCi) t = 2 hour Firefighter	Intake (µCi) t = 0.5 hour Firefighter	Intake (µCi) t = 1 hour Firefighter
Warehouse	621.0	1.2	61.9	1490.4 (496.8)	-	-
Tractor trailer	1303.4	1.2	129.8	-	782.0 (260.7)	-
Residence	126	1.2	12.5	-	-	151.2 (50.4)

Table 2. Calculated intakes due to fires for the various enclosure types, for workers as well as firefighters. Firefighter intakes in parenthesis account for SCBA use and are the intake of record. Firefighters are presumed to be wearing self-contained breathing apparatus (SCBA) that provides an assigned protection factor of 3 against tritium. Refer to 10 CFR 20 Appendix A footnote f.

Internal dose is calculated by comparing the calculated intake to the stochastic ALI for tritium in Appendix B to 10 CFR 20. This ALI is 8×10^4 µCi. Using proportionalities, e.g.,

$$5000 \text{ mrem}/8 \times 10^4 \text{ µCi} = (x \text{ mrem})/61.9 \text{ µCi}$$
$$x = (61.9 \text{ µCi})(5000 \text{ mrem})/8 \times 10^4 \text{ µCi} = 3.9 \text{ mrem}$$

Type of Enclosure	Inh. Intake (µCi) t = 0.083 hour (5 min) Worker (Resident)	Worker (Resident) Dose
Warehouse	61.9	3.9
Tractor trailer	129.8	8.1
Residence	12.5	0.8

Table 3. Calculated internal doses to workers (residents) due to a 5-minute inhalation

Type of Enclosure	Intake (µCi) t = 2 hours	Dose (mrem) t = 2 hours	Intake (µCi) t = 0.5 hour Firefighter	Dose (mrem) t = 0.5 hour	Intake (µCi) t = 1 hour Firefighter	Dose (mrem) t = 1 hours
Warehouse	(496.8)	31.0	-	-	-	-
Tractor trailer	-	-	(260.7)	16.3	-	-
Residence	-	-	-	-	(50.4)	3.2

Table 4. Calculated internal doses to fire fighters for various exposure times due to inhalation. Intakes in parentheses indicate that the APF for SCBAs has already been accounted for.

As above, e.g.,

$5000 \text{ mrem}/8 \times 10^4 \text{ µCi} = (x \text{ mrem})/496.8 \text{ µCi}$

$x = (496.8 \text{ µCi})(5000 \text{ mrem})/8 \times 10^4 \text{ µCi} = 31.0 \text{ mrem}$

Ingestion Intakes and Doses

Released gaseous H-3 is quickly bound into airborne water vapor as T_2O (^3H_2O). A portion of this might be absorbed through the skin and is considered to be an ingestion. Ingestion intake is calculated as follows:

$I_{Ing.} = A \times 10^{-4}$

Where:

A = total amount of available material at risk during the accident.

In these three scenarios, A = Q from the calculations above.

Warehouse $A = 2.7 \times 10^6 \times 10^{-4} = 270$ µCi

Tractor Trailer $A = 1.8 \times 10^5 \times 10^{-4} = 18$ µCi

Armory $A = 0.9 \times 10^5 \times 10^{-4} = 9$ µCi

Activity on skin is absorbed and is considered another ingestion component, added to the inhalation quantity. For a firefighter in full turnout gear, assume a dose reduction of 33%.

Type of Enclosure	Available Material (A) (µCi)	Dose Worker (Resident) (mrem)	Available Material Firefighter (µCi)	Dose Firefighter (mrem)
Warehouse	270	16.9	90	5.6
Tractor trailer	18	1.1	6	0.4
Residence	9	0.6	3	0.2

Table 5. Calculated internal doses to firefighters due to ingestion.

Internal dose is calculated by comparing the intake to the stochastic ALI for tritium in Appendix B to 10 CFR 20. This ALI is 8×10^4 µCi. Using proportionalities and the Warehouse Worker scenario, e.g.,

$5000 \text{ mrem}/8 \times 10^4 \text{ µCi} = (x \text{ mrem})/270 \text{ µCi}$

$x = (270\ \mu Ci)(5000\ mrem) / 8 \times 10^4\ \mu Ci = 16.9\ mrem$

NOTE: NUREG-1717 gives an ingestion dose conversion factor for H-3 of 6.4×10^{-5} rem/µCi. Use of this factor results in essentially the same doses as are calculated above using ALIs.

Total Effective Dose Equivalent (TEDE) Estimate

TEDE = ∑DDE + CEDE

In the case of tritium, deep dose equivalent (DDE) is zero as described above.

Committed effective dose equivalent (CEDE) has two components that are additive. A summary table is provided below.

Type of Enclosure	Ingestion Dose (mrem) Worker (Resident)	Inhalation Dose (mrem) Worker (Resident)	TEDE Worker (Resident) (mrem)
Warehouse	16.9	3.9	20.8
Tractor trailer	1.1	8.1	9.2
Residence	0.6	0.8	1.4

Table 6. Total effective dose equivalent (TEDE) to workers (residents) in the postulated accident scenarios.

Type of Enclosure	Ingestion Dose Firefighter	Inhalation Dose Firefighter	TEDE Firefighter (mrem)
Warehouse	5.6	31.0	36.6
Tractor trailer	0.4	16.3	16.7
Residence	0.2	3.2	3.4

Table 7. Total effective dose equivalent (TEDE) to firefighters in the postulated accident scenarios

These values are below the limits stated in Columns III and IV of 10 CFR 32.24. In use and disposal of a single exempt unit, or in handling and storage of the quantities of exempt units likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, the probability is low that the containment, shielding, or other safety features of the product would fail under such circumstances that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column III of the table in 10 CFR 32.24, and the probability is negligible that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column IV of the table in 10 CFR 32.24.

Please note: NUREG 1556 Vol 8 states: "The NRC has approved the distribution for use under 10 CFR 30.19 of gun sights not already installed on a gun; however, in such a case, it should be clear that *the product is designed for attachment to a gun and that the scenarios of use can be adequately anticipated in order to develop an adequate dose assessment. It is also important in this situation that the required label be visible even after the sight is installed on a gun."*

The gunsights sold by Truglo are designed and marketed as attachments for guns. The scenarios for use per model are described in the currently approved sealed source and device registration, and in the packaging the supplied with the gunsight.

Labeling on our gunsights models is either at the top of the product or on the side. For both labeling methods, this labeling is not obscured after the gunsight has been mounted on a gun. Enclosed are some Images which confirm the labeling is still visible post-installation.

If you have any questions, please call me at (214) 934-9621.

Sincerely,

Charles Lanman
Radiation Safety Officer

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