KRISS USA, INC
912 Corporate Lane
Chesapeake, VA 23320

March 11, 2015

Device registration amendment request

Exempt distribution license number: 45-23855-01E
Device registration number: NR-1368-D-101-E

Dear Dr. Herrera,

KRISS USA, Inc. is requesting an amendment to our device registration to include 8 additional devices to the current exempt distribution license and device registration referenced above.

The 8 additional devices share the following traits as the approved devices NR1 Front Sight and the NR1 Rear Sight (Registration number: NR-1368-D-101-E).

- The source type used is the mb-microtec Model 400/1.
- Quantity of sources used for each device is identical. 1 source for each front sight and 2 sources for each rear sight.
- The dose level calculation will be identical.
- The working life of the source is identical, by virtue of using the same source.
- We propose that the NRC maintain the existing marking convention governing device number NR-1368-D-101-E by identifying the additional devices accordingly, as specified in the engineer drawings accompanying this request.
- Manufacturing process uses the same tools and components.
- Conforms to NUREG 1556 Volume 3 Chapter 10 as the original device registration.

While the 8 additional devices differ aesthetically, the fundamental design concept is similar to the registered devices. The 8 additional devices have the following HALO model designations.

- NR2 Front Sight
- NR2 Rear Sight
- NR3 Front Sight
- NR3 Rear Sight
- NR4 Front Sight
- NR4 Rear Sight
- NR5 Front Sight
- NR6 Front Sight

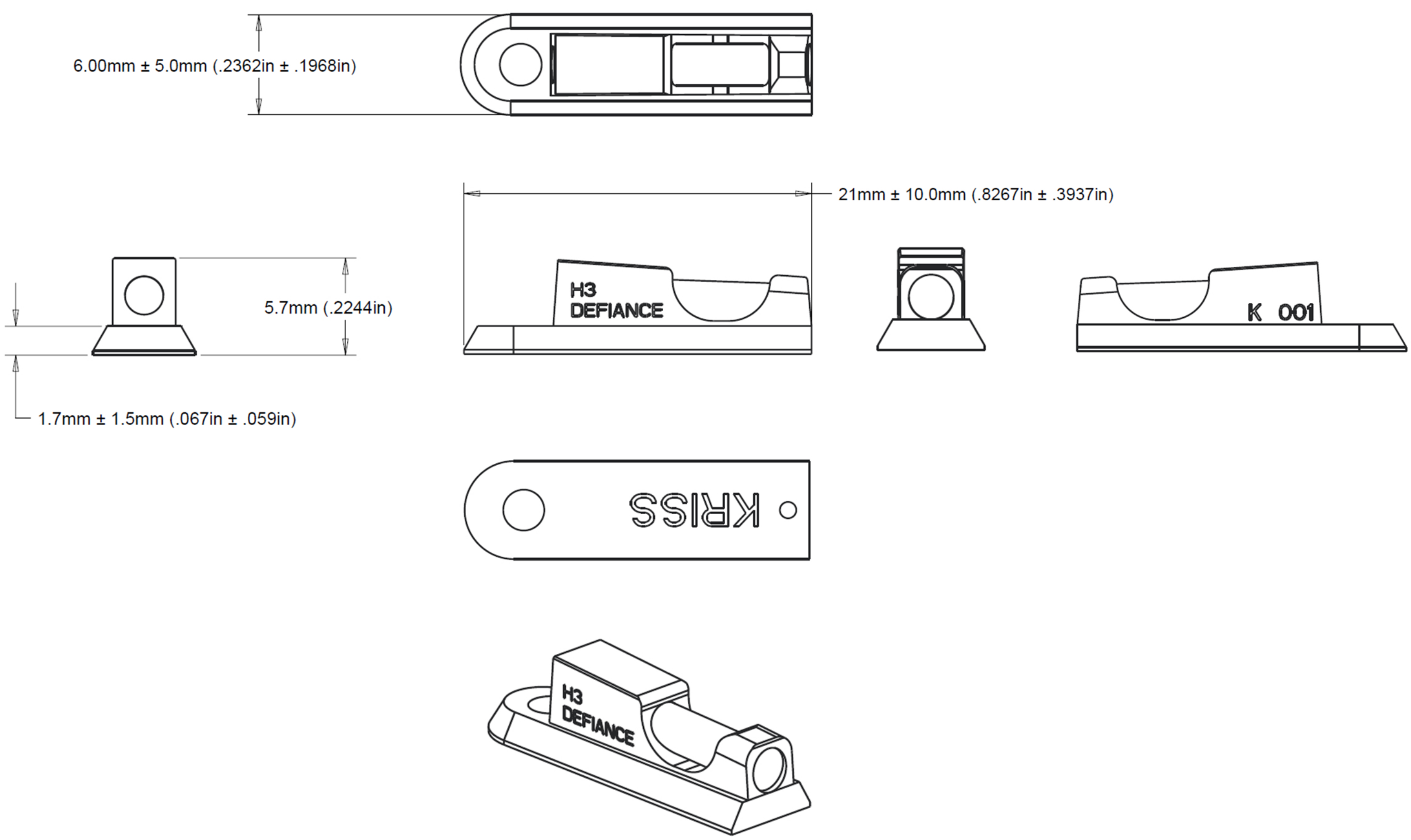
The engineer drawings of the aforementioned models are provided in the proceeding pages. Please contact Hikaru Okamura by phone (951) 310-8259 or by E-mail, H.OKAMURA@KRISS-USA.COM regarding this correspondence.

Sincerely,

HIKARU OKAMURA
Compliance Manager, KRISS USA, Inc.

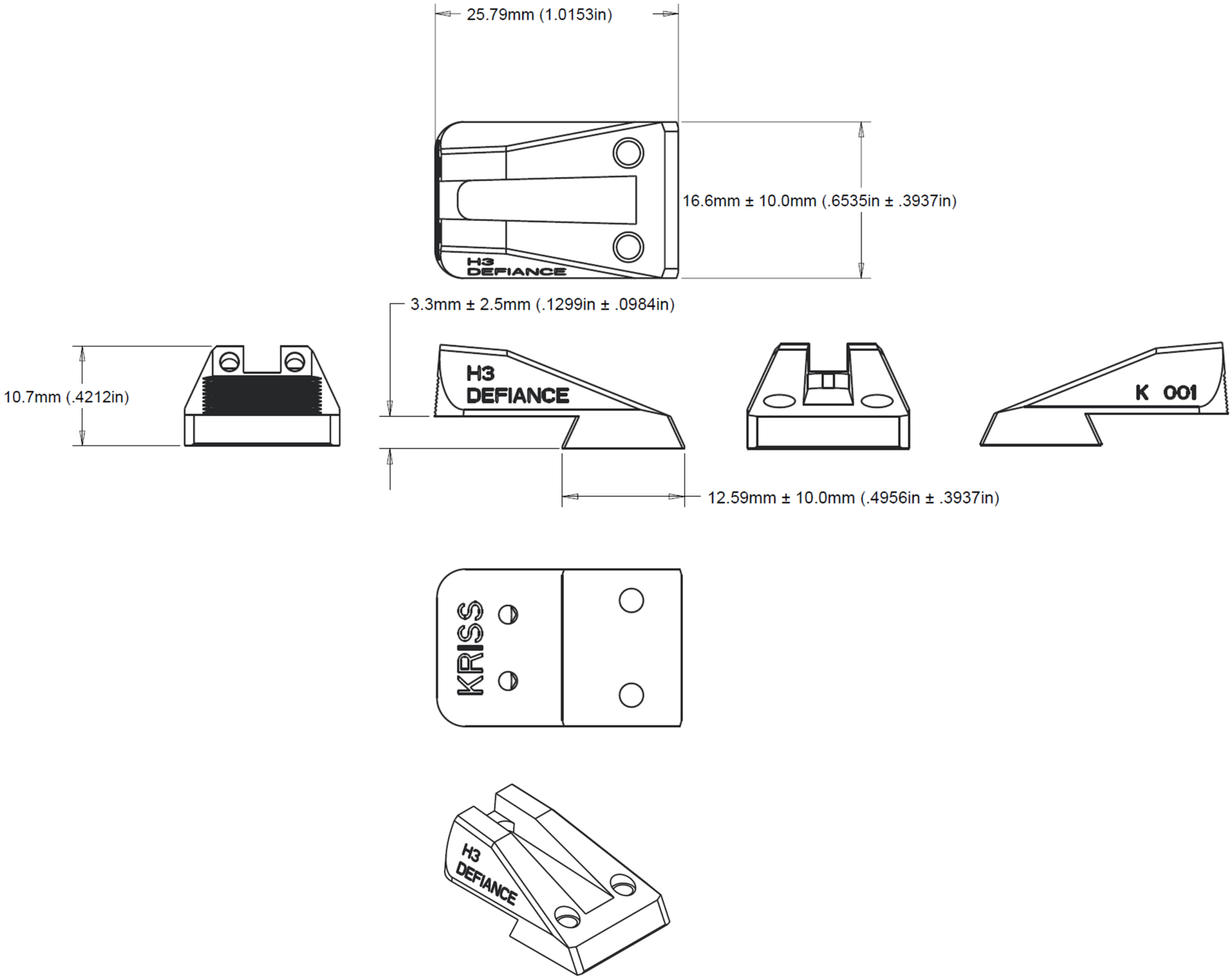
NO.: PENDING REVIEW DATE: PENDING REVIEW ATTACHMENT 1 of 8

DEVICE TYPE: Gun Sights



HALO Model:
NR2 Front Sight
KRISS USA, Inc.

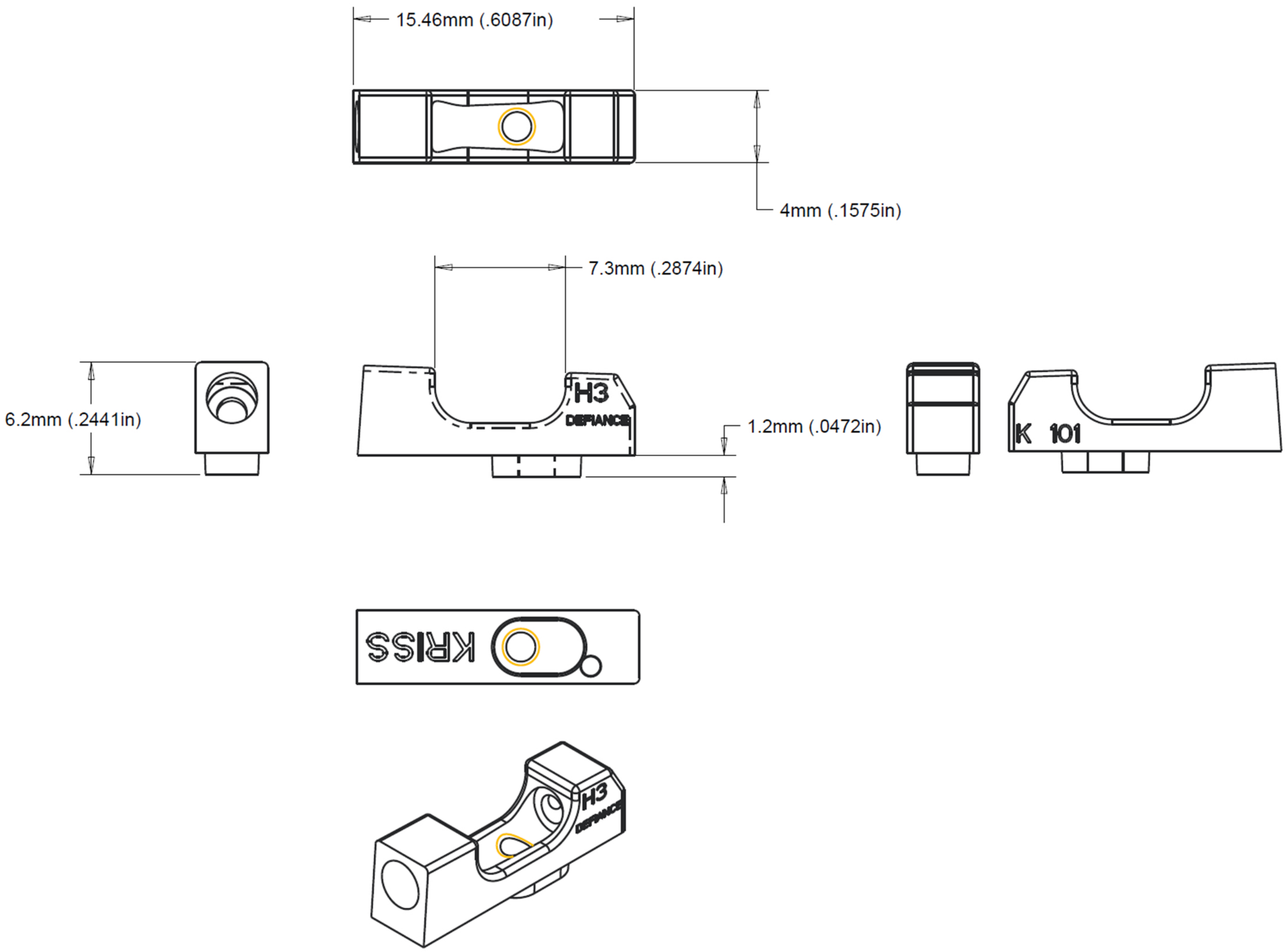
DEVICE TYPE: Gun Sights



HALO Model:
NR2 Rear Sight
KRISS USA, Inc.

NO.: PENDING REVIEW DATE: PENDING REVIEW ATTACHMENT 3 of 8

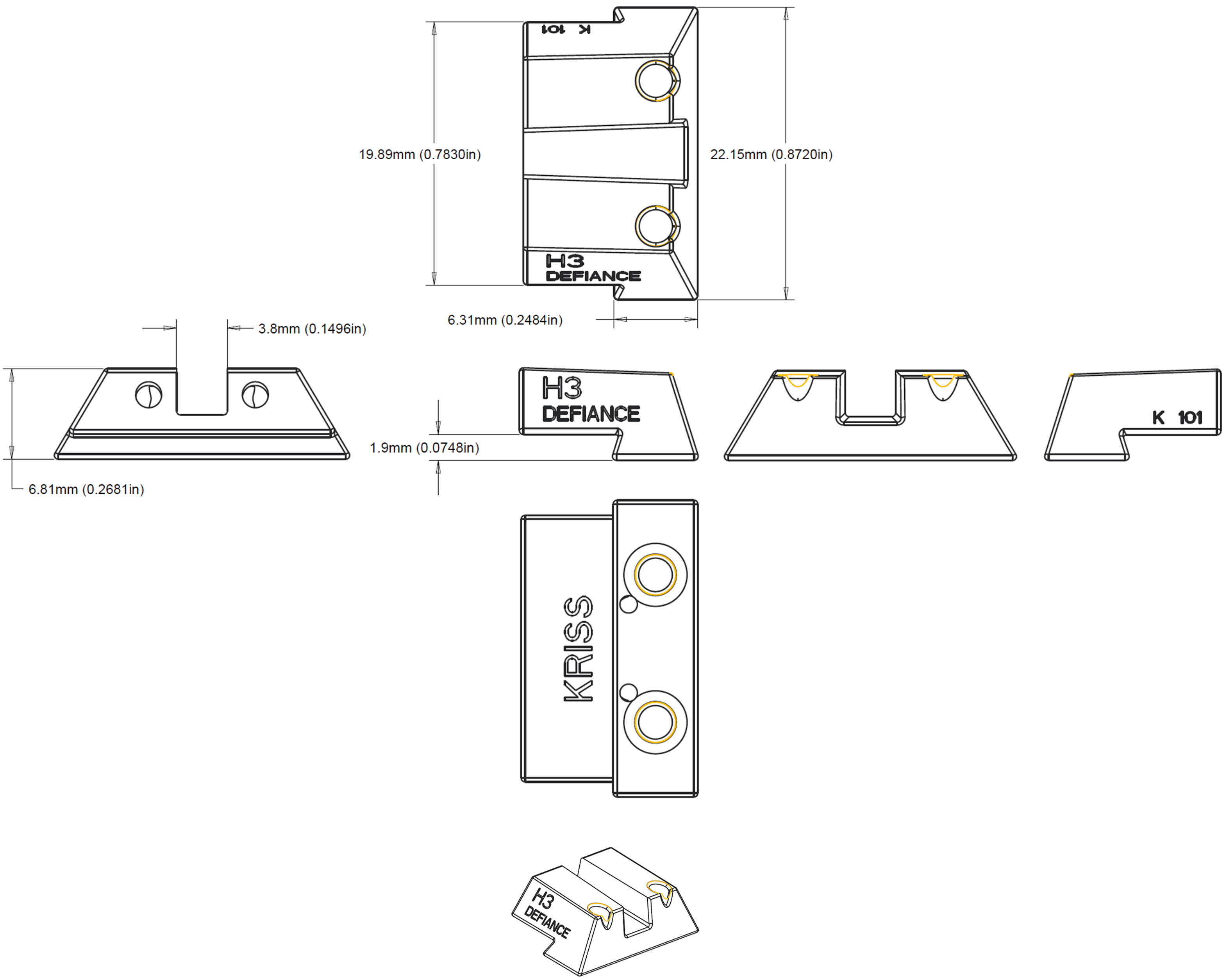
DEVICE TYPE: Gun Sights



HALO Model:
NR3 Front Sight
KRISS USA, Inc.

NO.: PENDING REVIEW DATE: PENDING REVIEW ATTACHMENT 4 of 8

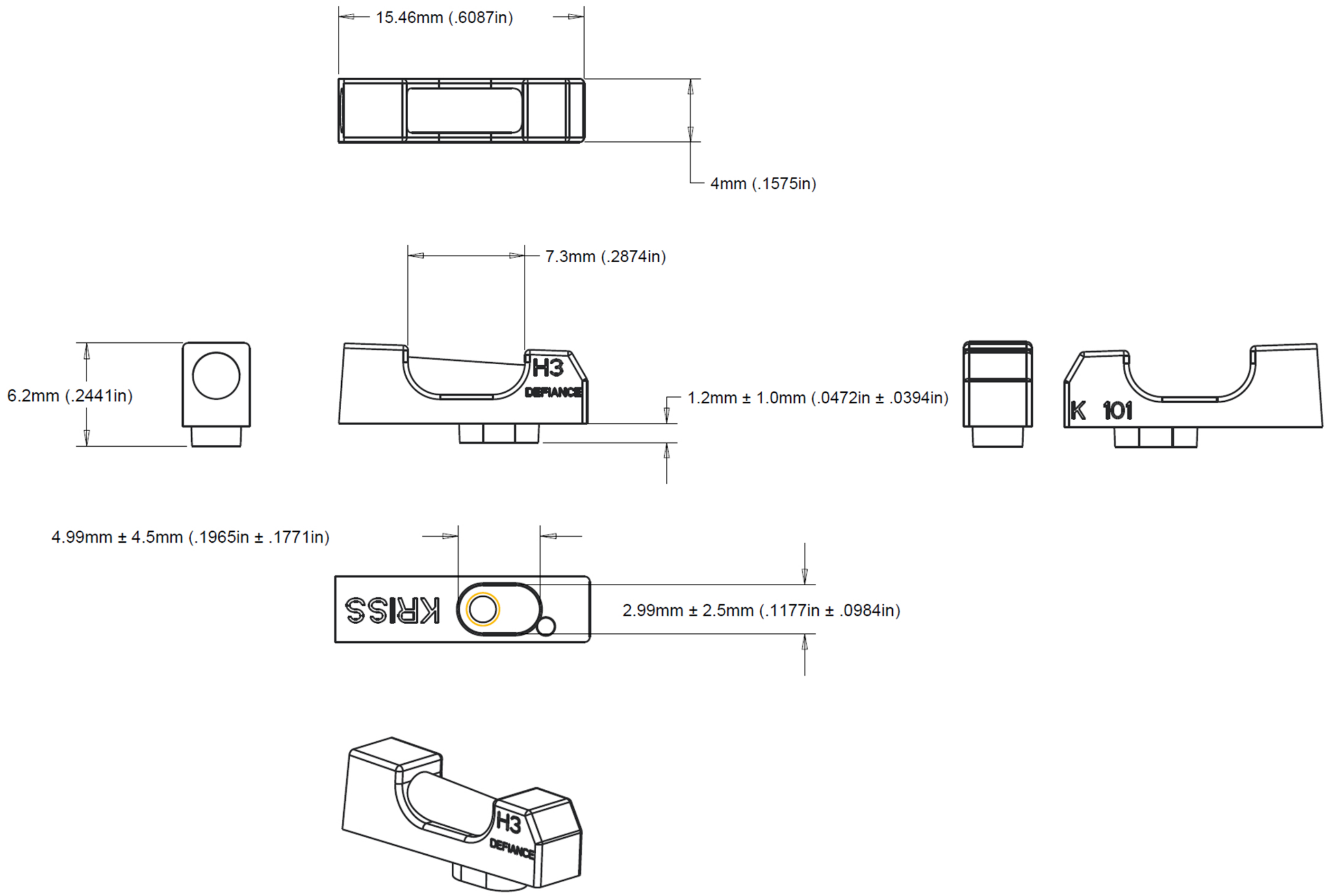
DEVICE TYPE: Gun Sights



HALO Model:
NR3 Rear Sight
KRISS USA, Inc.

NO.: PENDING REVIEW   DATE: PENDING REVIEW   ATTACHMENT 5 of 8

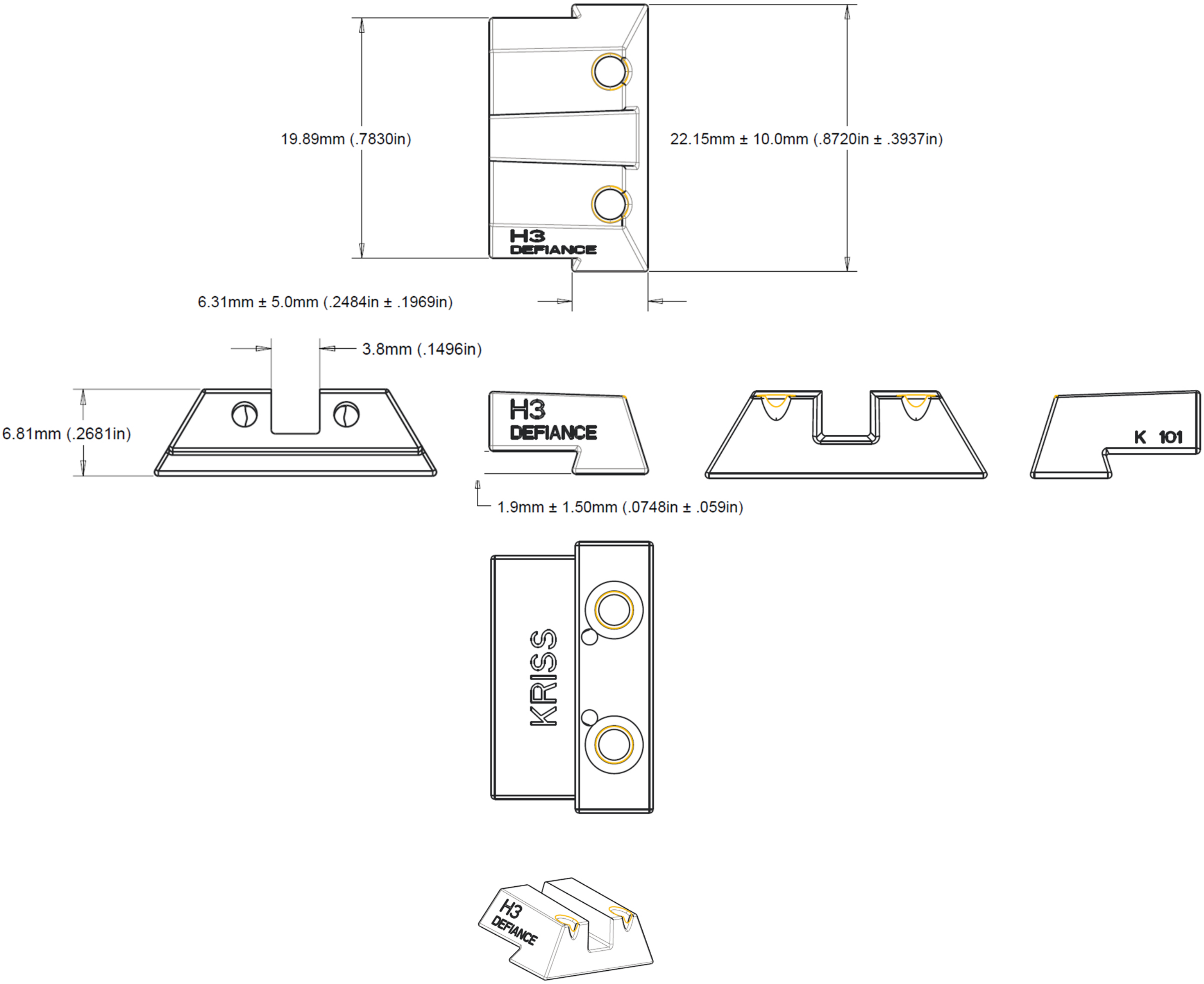
DEVICE TYPE: Gun Sights



HALO Model:
NR4 Front Sight
KRISS USA, Inc.

NO.: PENDING REVIEW   DATE: PENDING REVIEW   ATTACHMENT 6 of 8

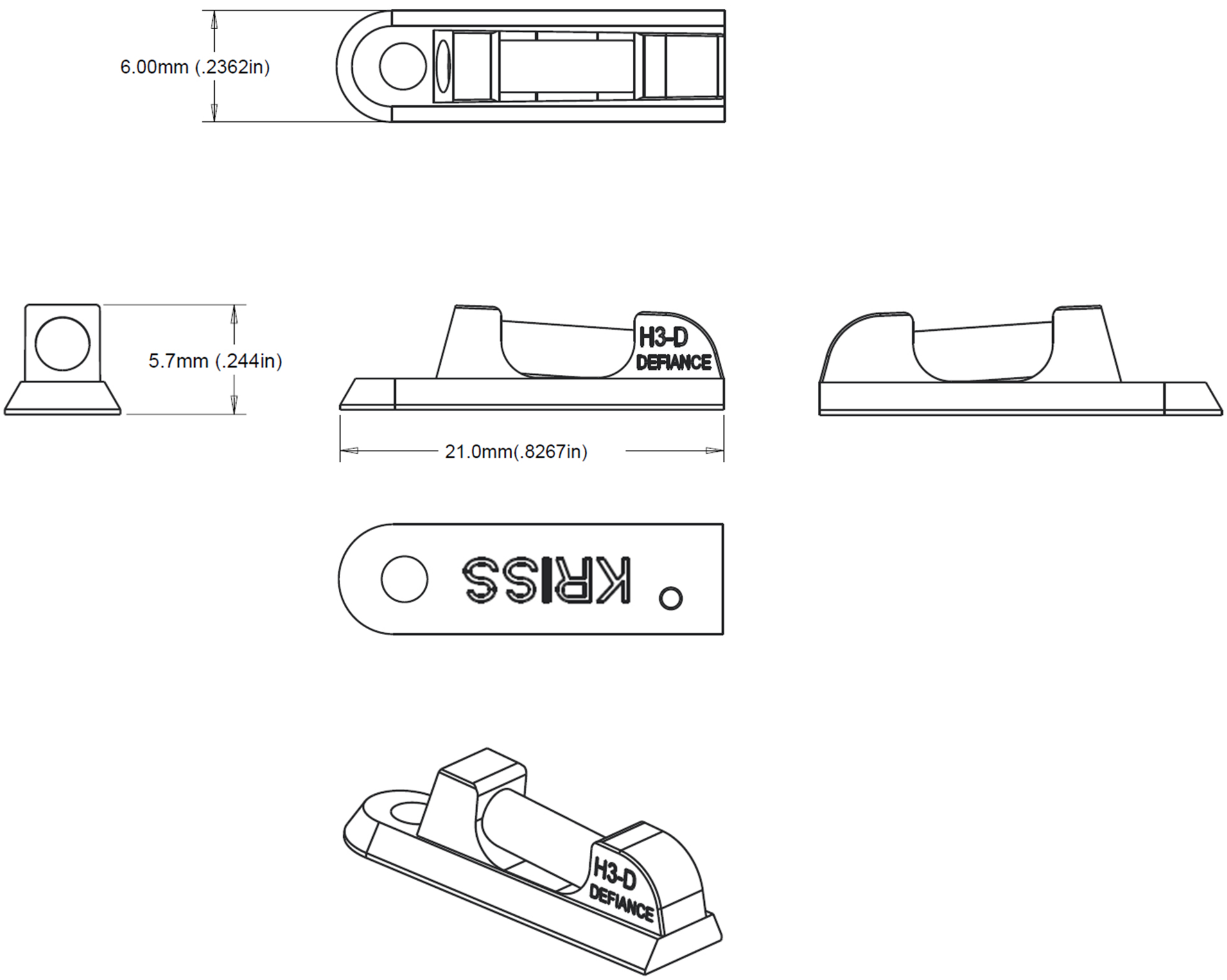
DEVICE TYPE: Gun Sights



HALO Model:
NR4 Rear Sight
KRISS USA, Inc.

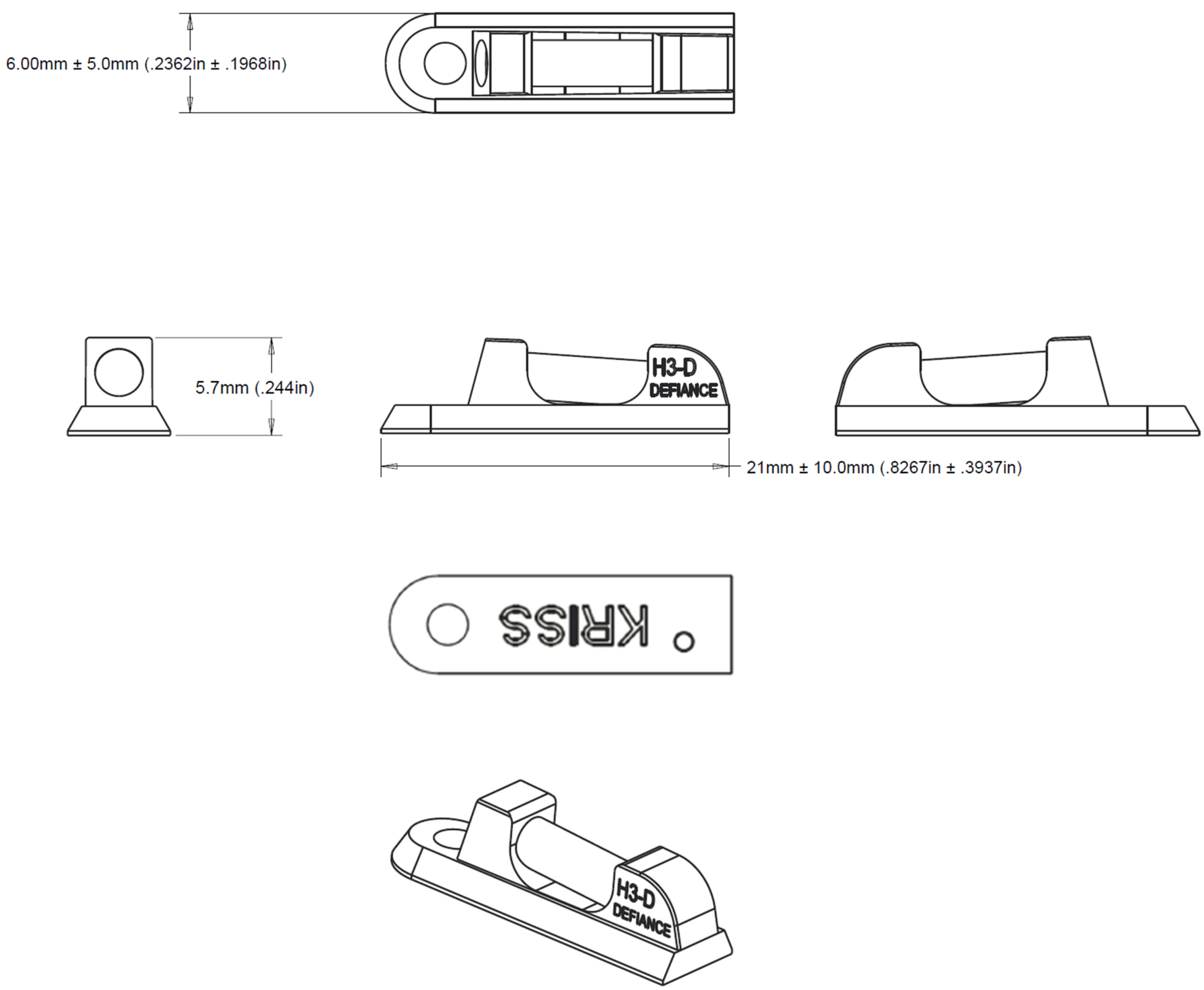
NO.: PENDING REVIEW   DATE: PENDING REVIEW   ATTACHMENT 7 of 8

DEVICE TYPE: Gun Sights



HALO Model:
NR5 Front Sight
KRISS USA, Inc.

DEVICE TYPE: Gun Sights



HALO Model:
NR6 Front Sight
KRISS USA, Inc.

International Radiation Safety Consulting, Inc.

Dose Calculations: Gaseous Tritium Light Sources for Gun Sights

Doses to Various Critical Groups, Supplement 1
Based on NUREG-1556, Volume 8 Methodology

Kriss U.S.A., Inc.
P.O. Box 8928
Virginia Beach, VA 23450

June 16, 2014

Prepared by:
Radiation Safety Associates, Inc.
19 Pendleton Drive/PO Box 107
Hebron, CT 06248

Introduction

In a letter dated May 21, 2014, Dr. Rodriguez-Luccioni of the USNRC requested some additional information in order to proceed with the Kriss USA, Inc. application. The information provided below is in response to his request.

Response to question 2. a.

Adapted from NUREG 1556, Volume 8, Appendix O. The adjustments made to the NUREG calculations were: the actual total activity of this set of Kriss sights (125 mCi/set) was used.

A. Normal conditions

1. Normal use

No radiation dose commitment is anticipated during normal use of the gunsight systems. External radiation dose rate at 25 cm is estimated to be less than 0.001 mrem/hr. The tritium gas is sealed in borosilicate glass, therefore no inhalation or ingestion of the radioactive material is expected in normal use.[1]

2. Storage

Distilled water immersion tests on the sights indicated a leakage rate no greater than 1E-5 µCi/sight in 24 hours. Assuming that 8000 units containing five[2] tritium sources each and 2000 units containing one source each [(8000 × 5) + 2000 = 42,000] are stored in a 14 ft x 10 ft room (10 ft high) in a 65,000 sq ft warehouse with an air exchange rate of 1 air change per hour, the calculated equilibrium concentrated of tritium is as follows:

$$C = \frac{I}{\lambda V}$$

where:

I = rate of influx of H-3 gas

V = volume of the room (1400 ft^3)

λ = air exchange rate (1 ach/h)

C = equilibrium H-3 gas concentration

I = 42,000 sights x 1 E-5 /Ci/sight -24 hr = 4.2 E-1 µCi/hr

V = 1400 cubic ft x 2.83 E4 cc/cubic foot = 3.96 E+7 cc

$$C = \frac{4.2\,E-1\,uCi/hr}{1\frac{ach}{hr}\times 3.96\,E+7cc} = 1\text{ E} - 8\ \mu\text{Ci/cc}$$ *(Also, C = 1E -5 mCi/m^3)*

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[1] NUREG 1556, Volume 8, Appendix O, Attachment 1, p. O-7.
[2] The Kriss gunsight array under consideration has 5 sources per assembly, not 3 as in the NUREG assumption..

The concentration limit set in 10 CFR Part 20, Appendix B, Table 2, Column 1 for H-3 in air is 2 E-7 µCi/ml. The calculated equilibrium concentration in the storage area (1 E-8 µCi/cc ÷ 2E-7 µCi/cc = 0.05) is only 5% of the 10 CFR 20 concentration limit for a controlled area.

The annual dose commitment to a warehouse worker, working in the area for 1 hour/day, 250 days/year is as follows:

Assume:

- All H-3 gas is converted to tritiated water
- Total rate of absorption of tritiated water into body fluids (mCi/minute) from inhalation and skin absorption is 3 E-2 C where C is the concentration of tritiated water in air in mCi/cubic meter (ICRP 30)
- Committed dose equivalent per unit intake of tritiated water is 1.7E -11 Sv/Bq (6.3 E-2 rem/mCi)
- Annual committed dose:

  H = 1 E-5 mCi/cubic meter x 3 E-2 mCi-cubic meter/mCi-minute x 60 minute/hour x 250 hr/yr x 6.3 E-2 rem/mCi = 2.8 E-4 rem/year

  H = 0.28 mrem/year.

3. Transportation

Assume a truck driver transports all sights to be stored in the warehouse in a single truckload and spends a total of two hours in the trailer loading and unloading.

V = 2.9 E+7 cc (NUREG/CR-0215)

I = 4.2 E-1 µCi/hr

λ = 1 ach/hr

$$C = \frac{4.2\ E-1\ uCi/hr}{1\frac{ach}{hr}\times 2.9\ E+7cc} = 1.4\text{ E } - 8\ \mu\text{Ci/cc}$$

Dose commitment:

H = 3.8 E-7 mCi/cubic meter x 3 E-2 mCi-cubic meters/mCi-minute x 2 hours x 60 minutes/hour x 6.3E-2 rem/mCi

H = 3.2E-6 rem = 3.2 E-3 mrem.

4. All other situations during normal use, storage, and transportation involve smaller quantities of H-3 and/or shorter exposure times thus would result in negligible dose commitment.[3]

5. Disposal

The gunsights are relatively expensive items and are unlikely to be inadvertently removed from the firearm and disposed of. The disposal of an intact firearm to normal trash is unlikely. Instructions accompanying the sights request return of damaged or defective sights to the distributor. Therefore, improper or careless disposal of the sights is unlikely to cause any significant radiation dose.

NUREG/CR-0215 estimates the dose commitment to the maximally exposed individual for burial of 500,000 tritium lighted wristwatches per year in landfills (20,000 in a single location) to be 0.1 mrem/yr. If the sources are burned a potential maximum dose commitment of 17 mrem/yr was estimated.

The total number of gunsights potentially disposed of in a single year would be much lower and the H-3 activity per unit also lower by a factor of seven than that postulated for watches containing H-3. Therefore, disposal of gunsights will not present a radiation hazard to the general public.[4]

[3] NUREG 1556, Volume 8, Appendix O, Attachment 1, p. O-9.
[4] Ibid.

Response to question 2. b.

Adapted from NUREG 1556, Volume 8, Appendix O. Adjustments made to the NUREG calculations were using the actual total activity of this set of Kriss sights (125 mCi/set), actual activity in the rear sight (100 mCi), and actual distance from the rear sight to the shooter's nose (18 inches or 46 cm).

B. Accident conditions

1. Use

The maximum credible accident involving the use of the gunsight system is rupture of the source and instantaneous release of the gas during firing. Only the rear sight is of consequence since it is much closer to the breathing zone of the user than the front sight.

Assume:

- Rear sight contains a total of 100 mCi of H-3 gas
- Rear sight is 46 cm from the user's face (measured using the firearm under consideration)
- Breathing zone can be represented by a cone with apex at the source, and the base being a 10cm diameter circle (r = 5 cm) at the user's face
- All H-3 is converted to tritiated water instantly
- Effective half-time[5] for tritiated water = 10 days
- Total absorption of inhaled tritium in body fluids
- Mass of soft tissue = 63,000 g (ICRP 30).

Fraction of gas (F) released in the direction of the breathing zone:

$$F = \frac{\pi\, r \times r}{4\,\pi\, R\ \times R}$$

where

r = radius of the base of the cone

R = distance from source to nose (rifle = 46 cm)

$F = \frac{\pi\ 5\times 5\ cm^2}{4\ \pi\ 46\ \times 46\ cm^2}$ = 0.003

Maximum estimated dose commitment to user assuming all H-3 gas is converted to tritiated water

H = 100 mCi × 0.003 × 6.3 E-2 rem/mCi = 0.019 rem = **19 mrem**

[5] The product ÷ the sum of biological and radiological half-times.

For such an accidental instantaneous release, most of the gas would remain as elemental H-3, at least until it was outside the shooter's breathing zone. The dose commitment from H-3 gas would be approximately 1000 times less (i.e., the total estimated dose commitment would be 2% of the calculated value since up to 2% of the gas originally in the glass capsule could be in the form of tritiated water.

2. Storage

The maximum credible accident involving storage of the units would involve a fire in the storage area which ruptures some of the borosilicate glass capsules. (A massive fire which would rupture all sources would be likely to result in immediate dispersion of the H-3 gas and dilution with outside air, thus reducing the concentrations of H-3 gas in the storage area. on information from KRISS, at any one time, up to 3,000 sets (375 Ci) might be located in a warehouse

Assume:

- 50% of the sources ruptured
- Immediate dispersion of the gas within the storage area
- Conversion of all H-3 gas to tritiated water

Total rate of absorption of tritiated water into body fluids (mCi/minute) from inhalation and skin absorption is 3 E-2 C where C is the concentration of tritiated water in air in mCi/cubic meter (ICRP 30). From above,

$$C = \frac{I}{\lambda V}$$

Where

λ = air exchange rate (1 ach/h)

V = 1400 cubic ft x 2.83 E4 cc/cubic foot = 3.96 E+7 cc

$$C = \frac{375\ Ci\ \times 0.50}{3.96\ E + 7\ cc} = 4.7E - 6\ Ci/cc$$

$$= 4.7\text{E+3 mCi/m}^3$$

Dose commitment:

$$H = \frac{4.7\text{E} + 3\text{ mCi}}{m^3} \times \frac{3\text{ E} - 2\text{ mCi} - m^3}{\text{mCi} - \text{min}} \times \frac{6.3\text{ E} - 2\text{ rem}}{\text{mCi}}$$

H = 8.9 rem/minute

Dose commitment to fireman remaining in enclosed area without respiratory protection for 2 minutes for purpose of rescue = 17.8 rem.

This calculation greatly overestimates the true dose commitments in this situation. Air currents would disperse the gas very rapidly in the case of a fire, particularly one of such severity as to rupture 50% of the sources instantaneously. In addition, only a small fraction of the H-3 gas is likely to be converted to tritiated water before venting to the outside.

A more reasonable estimate of the dose commitment would be obtained using the maximum fraction of tritiated water in the source, 0.02. If this value is used the dose commitments become 178 mrem for the occupant and 356 mrem for the fireman.

3. Ingestion or inhalation of the entire H-3 content of the front sight (100 mCi).

H = 100 mCi × 6.3 E-2 rem/mCi = **6.3 rem**

The calculation assumes the entire 100 mCi H-3 gas is converted to tritiated water. H-3 gas is not absorbed readily in body fluids thus produces negligible dose. This postulated accident would require that an individual remove the source from the sight without damaging it, swallow it, and have the source rupture while in the digestive tract. Each of these conditions is highly improbable. The combination of all three occurring is nearly impossible.[6]

[6] NUREG 1556, Volume 8, Appendix O, Attachment 1, p. O-11.

Compliance with 10 CFR 32.23 and 32.24

A. Normal use and storage

No radiation dose commitment is expected in normal use of the gunsight system. This satisfies the dose limit in Column 1, § 32.24.

The maximum expected dose commitment to workers in the storage area is less than 1 mrem/year. This satisfies the dose limit in Column 2, § 32.24.

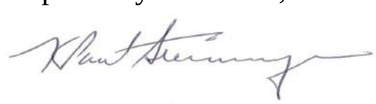
B. Accident conditions

Under maximum credible conditions of use of the equipment, the dose commitment to an individual would not exceed 19 mrem. This is within the limits set in Column III, § 32.24.

In the highly improbable case where an individual ingested the contents of an entire source, the estimated dose commitment is 6.3 rem. This is within the limits set in Column IV, § 32.24.

Under extreme fire conditions in the storage area, the estimated maximum dose commitment to an occupant of the area is 8.9 rem; to a fireman in the process of rescue, 17.8 rem. More reasonable values based on 2% of the H-3 gas being oxidized and remaining in the storage room are 178 mrem and 356 mrem respectively. Once this allowance for reasonableness is taken into account, the §32.24 Column IV test is met.

Respectfully submitted,



K. Paul Steinmeyer, RRPT
Senior Health Physicist