

ALARA Analysis Worksheet

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|--|--------------------------------------|--------------------------------------|----------------------|--|
| Survey Area: <u>SVC-01</u> Survey Unit: <u>18</u> | | | | |
| A. Estimation of Total Cost (Cost_T) | | | | |
| 1. Cost of performing remediation work (Cost _R) (assume 3-staff crew for 1 day@average \$60 per hour; cost for heavy equipment not included) | \$ 1800 | | | |
| 2. Cost of waste disposal (Cost _{WD}) = (2.a) · (2.b) a. estimated waste volume: 1 m ³ b. cost of waste disposal: \$670/m ³ | \$ 670 | | | |
| 3. Cost of workplace accident (Cost _{ACC}) = \$3,000,000 person ⁻¹ · 4.2x10 ⁻⁸ h ⁻¹ · (3.a) a. time to perform remediation action: 30 person-hours | \$ 3.78 | | | |
| 4. Cost of traffic fatality (Cost _{TF}) = {\$3,000,000 · 3.8x10 ⁻⁸ km ⁻¹ · (2.a) · (4.a)}/(4.b) a. total distance traveled per shipment: 4100 km b. waste volume per shipment: 13.6 m ³ , if unknown, use 13.6m ³ as a default value | \$ 34.37 | | | |
| 5. Cost of worker dose (Cost _{WDose}) = \$2,000 per person-rem · (5.a) · (5.b) a. worker TEDE: _____ rem/h b. remediation exposure time _____ person-hour | \$ 0 | | | |
| Cost _T | \$ 2508 | | | |
| B. Survey Unit Radiological Information | | | | |
| <u>Radionuclide</u> | <u>Average Concentration</u> | <u>Relative Fraction^a</u> | <u>Half-Life (y)</u> | <u>Decay Constant^b (y⁻¹)</u> |
| 1. <u>Co-60</u> | a. <u>6622 dpm/100cm²</u> | b. <u>1</u> | c. <u>5.271</u> | d. <u>0.13</u> |
| 2. _____ | a. _____ | b. _____ | c. _____ | d. _____ |
| 3. _____ | a. _____ | b. _____ | c. _____ | d. _____ |
| 4. _____ | a. _____ | b. _____ | c. _____ | d. _____ |
| 5. _____ | a. _____ | b. _____ | c. _____ | d. _____ |
| 6. _____ | a. _____ | b. _____ | c. _____ | d. _____ |
| 7. _____ | a. _____ | b. _____ | c. _____ | d. _____ |
| 8. _____ | a. _____ | b. _____ | c. _____ | d. _____ |
| Total Concentration: _____ | | | | |
| ^a Relative fraction = average concentration divided by the total concentration. ^b Decay constant = 0.693 divided by half-life. | | | | |

C. Calculation of ALARA Action Level (AL)

1. Removable fraction for remediation action being evaluated: 1.0
2. Monetary discount rate: 0.03 y⁻¹
3. Number of years over which the collective dose is calculated: 1000 y
4. Population density for the critical group: 0.0004 people/m²
5. Area being evaluated: 100 m²

6. AL for each radionuclide-of-interest:

- a. $AL = \{Cost_T / (\$2000 \cdot C.4 \cdot 0.025 \cdot C.1 \cdot C.5)\} \cdot \{(C.2 + B.1.d) / (1 - e^{-(C.2+B.1.d) \cdot C.3})\} \cdot \{B.1.b\} = \underline{1356}$
- b. $AL = \{Cost_T / (\$2000 \cdot C.4 \cdot 0.025 \cdot C.1 \cdot C.5)\} \cdot \{(C.2 + B.2.d) / (1 - e^{-(C.2+B.2.d) \cdot C.3})\} \cdot \{B.2.b\} = \underline{\hspace{2cm}}$
- c. $AL = \{Cost_T / (\$2000 \cdot C.4 \cdot 0.025 \cdot C.1 \cdot C.5)\} \cdot \{(C.2 + B.3.d) / (1 - e^{-(C.2+B.3.d) \cdot C.3})\} \cdot \{B.3.b\} = \underline{\hspace{2cm}}$
- d. $AL = \{Cost_T / (\$2000 \cdot C.4 \cdot 0.025 \cdot C.1 \cdot C.5)\} \cdot \{(C.2 + B.4.d) / (1 - e^{-(C.2+B.4.d) \cdot C.3})\} \cdot \{B.4.b\} = \underline{\hspace{2cm}}$
- e. $AL = \{Cost_T / (\$2000 \cdot C.4 \cdot 0.025 \cdot C.1 \cdot C.5)\} \cdot \{(C.2 + B.5.d) / (1 - e^{-(C.2+B.5.d) \cdot C.3})\} \cdot \{B.5.b\} = \underline{\hspace{2cm}}$
- f. $AL = \{Cost_T / (\$2000 \cdot C.4 \cdot 0.025 \cdot C.1 \cdot C.5)\} \cdot \{(C.2 + B.6.d) / (1 - e^{-(C.2+B.6.d) \cdot C.3})\} \cdot \{B.6.b\} = \underline{\hspace{2cm}}$
- g. $AL = \{Cost_T / (\$2000 \cdot C.4 \cdot 0.025 \cdot C.1 \cdot C.5)\} \cdot \{(C.2 + B.7.d) / (1 - e^{-(C.2+B.7.d) \cdot C.3})\} \cdot \{B.7.b\} = \underline{\hspace{2cm}}$
- h. $AL = \{Cost_T / (\$2000 \cdot C.4 \cdot 0.025 \cdot C.1 \cdot C.5)\} \cdot \{(C.2 + B.8.d) / (1 - e^{-(C.2+B.8.d) \cdot C.3})\} \cdot \{B.8.b\} = \underline{\hspace{2cm}}$

7..... Sum of ALs (= ALARA AL) = 1356

D. ALARA Evaluation

| <u>Radionuclide</u> | <u>DCGL</u> | <u>DCGL Fraction^a</u> |
|--------------------------------|-------------------------------------|--|
| 1. <u>Co-60</u> | a <u>6622 dpm/100cm²</u> | b. (B.1.a)/(D.1.a) = <u>1.0</u> |
| 2. <u> </u> | a. <u> </u> | b. (B.2.a)/(D.3.a) = <u> </u> |
| 3. <u> </u> | a. <u> </u> | b. (B.3.a)/(D.4.a) = <u> </u> |
| 4. <u> </u> | a. <u> </u> | b. (B.4.a)/(D.5.a) = <u> </u> |
| 5. <u> </u> | a. <u> </u> | b. (B.5.a)/(D.6.a) = <u> </u> |
| 6. <u> </u> | a. <u> </u> | b. (B.7.a)/(D.7.a) = <u> </u> |
| 7. <u> </u> | a. <u> </u> | b. (B.8.a)/(D.8.a) = <u> </u> |
| 8. <u> </u> | a. <u> </u> | b. (B.9.a)/(D.9.a) = <u> </u> |
| 9..... | Sum of DCGL Fractions = <u>1.0</u> | |

^a DCGL fraction = average residual concentration in survey unit (from Section B) divided by the DCGL.

10. Comparison of the sum of the DCGL fractions (D.9) to ALARA AL (C.7):

Check one: Sum of the DCGL Fractions < ALARA AL ☒ Sum of the DCGL Fractions > ALARA AL ☐

12. **Decision Criteria:** If the sum of the DCGL fractions < AL, then additional remediation is not cost beneficial. If the sum of the DCGL fractions > AL, then additional remediation is cost beneficial.

Check one: Additional remediation **IS NOT** cost beneficial ☒

Additional remediation **IS** cost beneficial ☐

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