Operation Tomadachi: Evaluation of Water Supplies with Potential Radiological Contamination

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PURPOSE. To provide Department of Defense (DOD) personnel information and guidance on the evaluation of water supplies during Operation Tomadachi with potential radiological contamination related to the Japan Nuclear Facility events.

BACKGROUND.

a. Brief Overview. Radionuclides generally enter drinking water through erosion of naturally occurring mineral deposits, but may also be the result of manmade activities. Industrial or accidental releases of radioactive material may enter the water system directly, may precipitate from airborne contamination, or enter when water travels through contaminated soil.

b. Field Sampling and Analysis. Samples should target natural waters used as sources for drinking water production or to which personnel may be exposed. Additional samples should represent the treated water in the distribution system. Each sample should consist of 2 one-gallon collections using provided plastic cubitainers. Samples should be chilled to 4 °Celsius. Due to the nature of the current operation, all samples collected will be subject to comprehensive analysis. Analysis will include gross alpha, beta, and gamma emitting radionuclides. Testing for additional specific radionuclides will be added, as warranted.

c. Health Criteria. Fixed activities of the U.S. DOD in Japan are regulated by the Japan Environmental Governing Standards (JEGS) which consider long-term exposures and are equivalent to U.S. Environmental Protection Agency (USEPA) standards. Water contamination which exceeds the JEGS may lead to long-term chronic disease if consumed for a lifetime. However, short-term exposure to higher concentrations, but below the short-term or emergency guidelines expressed in the Table 1 below, present a low risk.

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Table 1. Guidelines for Radionuclides in Drinking Water

Contaminant	JEGS	Short Term < 30 days	Emergency < 7 days
Gross Alpha Particles	15 pCi/L (0.56 Bq/L)	50,000 pCi/L (1800 Bq/L)	3,000,000 pCi/L (110,000 Bq/L)
Beta Particles/photon emitters	4 mrem/yr (0.04 mSv/y)[a]	[b]	[b]

[a] This cumulative annual dose considers a total of 179 individual beta particle and photon emitters. The concentrations of the most likely radionuclide contaminants which would yield this dose are listed in table 2.
[b] Short term and emergency guidance is based on total radioactivity.
Conversion factors: 1 curie (Ci)=3.7 x10^{10} becquerels (Bq)=1 disintegration per second
1 roentgen equivalent man (rem)= 0.01 sievert (Sv)

d. Contaminants of Concern (COC). While there are many radionuclides associated with atomic energy production, the focus isotopes include iodine-131 (I-131), strontium-90 (Sr-90), cesium-134 (Cs-134), cesium-137 (Cs-137), tritium (H-3), and total uranium (U-238) and the U-235/U-238 isotopic ratio.

Table 2. Concentrations of COCs Equivalent to 4 mrem/y (0.04 mSv/y

Isotope	Equivalent Concentration	
Iodine-131 (I-131)	3 pCi/L	0.1 Bq/L
Strontium-90 (Sr-90)	8 pCi/L	0.3 Bq/L
Cesium-134 (Cs-134)	80 pCi/L	3 Bq/L
Cesium-137 (Cs-137)	200 pCi/L	7 Bq/L
Tritium (H-3)	20,000 pCi/L	700 Bq/L

TREATMENT.

Best available technologies for treatment of radioactive materials in water include ion exchange, reverse osmosis (RO), lime softening, and enhanced coagulation/filtration. However, the technology that the military has readily available to treat for radionuclides is RO. The RO technology can reduce alpha and beta emitting radioactive material concentrations in water by at least 99 percent. Military RO water purification systems also have available ion exchange and activated carbon filters for post RO treatment. For instance, the Marine Corps Lightweight Water Purification System (LWPS) should be capable of reducing 99.99 percent of alpha and beta radioactive material concentrations in water when employing high pressure RO and post filters according to paper-studies conducted by the USAPHC (Prov). Post filter capacity is very limited with a life span of 100 hours or less.

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