**Environmental Radiation Surveillance Site Readings** 

## **Sample Collection and Analysis**

This document is intended to provide information for researchers who wish to know more about the sample collection and laboratory analysis process used to obtain the data reported here. The information is of a technical nature and understanding of the terms is not necessary for a member of the public to be able to use the data set.

The reporting units used in this report are stated in picocurie (pCi) per unit volume or mass (e.g., for liquid samples – pCi/liter or pCi/L, for air samples – pCi/1000meter<sup>3</sup> or pCi/1000m<sup>3</sup>, for solid samples – pCi/kilogram or pCi/kg, and for fallout samples – pCi/meter<sup>2</sup>-day or pCi/m<sup>2</sup>-day).

## 1.1 Types of Samples Collected

Various types of samples (different media) were collected to measure the concentration of select radionuclides in the environment. Air, water, milk, sediment, vegetation, animal and fish samples were obtained, although not all types of samples were collected at each site. Please refer to the limitations in the "About" section to learn more about the limitations in the types of samples collected.

### 1.2 Sample Collection and Analysis

New York State Department of Health (NYSDOH) personnel, local health units and, in some cases, the site operator, collect samples. The New York State Department of Health's Wadsworth Center (WC) then analyzes these samples using a variety of equipment, following appropriate methods for the specific sample type and radionuclides of interest. For some samples, the analysis requires radiochemical procedures and techniques that extract and concentrate the radionuclide of interest. A brief description of how samples are collected and analyzed is given below.

#### 1.2.1 Air

Continuous air samplers are used to draw approximately one cubic foot of air per minute through the sampling media described below. Samplers normally run one to two weeks to allow a sufficient air volume to pass through the sampling medium/media.

### 1.2.1.1 Particulate Filters

Paper filters are used to measure the activity of particulates in the air. Gross beta activity is measured as a screening procedure. For selected sites composited samples are analyzed using gamma spectroscopy (i.e., 4 weekly samples will be counted together to serve as a monthly sample).

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## 1.2.1.2 Activated Charcoal Cartridges

The NYSDOH uses activated charcoal to collect the isotopes of radioiodine. Analysis for Iodine-131 is by gamma spectroscopy or by radiochemical separation followed by beta/gamma coincidence counting. Chemical extraction of Iodine-129 and Iodine-125 precedes counting analysis through use of an intrinsic-germanium detector.

### 1.2.1.3 Silica Gel Columns

Airborne tritium (H-3 as titrated water vapor or HTO) is collected by passing air through a silica gel column. The absorbed water vapor is removed from the column and the tritium is measured using liquid scintillation counting.

#### 1.2.2 Milk

Based on dairy farm availability, two-liter samples of milk are collected near facilities that may release fission products such as Iodine-131, Cesium-137 or Strontium-90. Using a historically derived protocol, analyses may include gamma spectroscopy and isotope-specific measurements for beta emitters such as Sr-90 and tritium. Standard radiochemical methods are used in the analyses for Sr-90 and radioiodines.

#### **1.2.3 Water**

Two-liter samples are obtained as grab samples or aliquots of continuously collected samples. For selected sites, composite samples are made by mixing equal portions of grab samples collected over a calendar quarter. Samples are analyzed for gross alpha, gross beta, isotopic gamma (several radionuclides), Strontium-90 and tritium activity (as HTO). When gross alpha activity exceeds a certain level, gamma spectral analysis is performed to identify the radionuclides present in the sample. These water samples are generally collected from non-potable water sources and are not included in the State's Safe Drinking Water Program. A separate sampling program for drinking water has been established to enable the State to demonstrate compliance with the levels of radionuclides specified in the US EPA's Safe Drinking Water Act.

#### 1.2.4 Fallout

Fallout samples are collected in plastic buckets that are exposed to atmospheric precipitation and dust.

#### 1.2.5 Soil and Sediment

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Soil or sediment samples are collected from areas where the long-term deposition of radionuclides has occurred or where federal government facilities and/or industrial operations are using radioactive materials with potential discharges to the environment. Analysis is usually done by gamma spectroscopy.

## 1.2.6 Food or Vegetation

Samples of local food crops are collected near sites of interest to monitor the radionuclide concentrations in edible material and animal feed stock. Analysis is usually done by gamma spectroscopy.

#### 1.2.7 Animals and Fish

Tissue and/or bone samples are used to monitor radionuclide concentrations in fish and/or animals (usually deer) near sites of interest. For deer samples, radionuclide concentrations of various fission products including tritium, Cesium-137, Strontium-90, Pu-238/239 and Iodine-129 are measured in flesh, thyroid and lung tissue. Fish samples are analyzed as whole fish (flesh plus bones, minus the head, tail and fins) or as flesh and bone components, which are then analyzed individually for fission products of interest and naturally-occurring radionuclides.

### 1.3 Types of Sampling Sites

Sample sites are categorized as background sites, scheduled or routine sites near nuclear power plants, industrial users of radioactive material, and other pre-determined locations across the State, and non-routine sites.

#### 1.3.1 Background Sites

These are sites which are not affected by the operations of facilities that release radionuclides to the environment (within the provisions of a New York State Department of Environmental Conservation (NYSDEC) permit or as allowed by NYS DEC regulations). Samples taken at these locations show consistent, expected concentrations of naturally-occurring radionuclides, plus ubiquitous contributions from weapons testing (fallout) and other man-made radiation sources including consumer products, industrial and nuclear fuel cycle operations. Results from these sites are used to compare to results from routine and non-routine sites.

#### 1.3.2 Routine Nuclear Sites

These sites are used to measure the influence of specific facilities on radioactivity in the environment. A paired site may be chosen as a background location for the site of interest, e.g., a sampling site upstream from a facility's point of release to the stream may serve as a "background" sampling location for comparison with downstream values to determine if a facility's operation have resulted in increased levels of radioactivity in the environment.

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#### 1.3.3 Non-routine Sites

These locations are selected for a specific purpose, such as a site restoration project, the start-up operation of an industrial or commercial operation using radioactive materials or an environmental emergency situation. Their inclusion or elimination in later years will depend on circumstances associated with the particular location.

## 1.4 Reporting of Sample Analysis Results

Sample results are reported in one of three ways. The following is an example for Strontium (Sr):

- 1. Sr-90 20  $\pm$  5
- 2. Sr-90 < 8
- 3. Sr-90 Not Reportable (NR), No Sample (NS), "---" or other footnote

In the first example, a concentration value is given with the associated "two standard deviations" uncertainty limit. This limit means that the actual concentration value has a 95 percent probability of being within the interval 15 to 25 pCi/L.

In the second example, the concentration is reported as less than (< ) the minimum detectable level of 8 pCi/L.

In the third example, the scheduled analysis could not be performed due to sample loss, damage or degradation, incorrect collection procedure, missing/incomplete sample collection information, or the specific analysis is not required.

All three types can be seen in the dataset for various chemicals using the same format as shown in the example above.