2.0 ROUTINE AIRBORNE EMISSIONS OF RADIOACTIVE MATERIALS

The Rocky Flats Plant has engaged in manufacturing efforts related to the production and recycling of components for nuclear weapons since beginning operation in 1952. These efforts include various chemical processing, metalworking and machining, and assembly operations that result in the release of radioactive materials via normal ventilation exhaust from plant buildings. Although the ventilation exhaust systems have included multistage Chemical Warfare Service and, in more recent years, high efficiency particulate air (HEPA) filters to remove the bulk of the radioactive material, some material was continually released to the environment even when these filtering systems were working as intended. The integrity and efficiency of the filtration systems has been the subject of study and debate for many years, and many plant operational documents (e.g., Hornbacher, 1975-1982; and Dow, 1972) identify various problems associated with the operation of these filtration systems.

Previous project investigations (ChemRisk 1991a, 1991b, 1992) identified five elements with various radioactive isotopes as potentially being associated with routine releases from the Rocky Flats Plant. The radioactive elements and their isotopes that have been the subject of detailed investigation for the purposes of quantifying historical releases at the plant are as follows:

- Americium-241
- Plutonium-238, plutonium-239, plutonium-240, plutonium-241, and plutonium-242
- Thorium-232
- Tritium (H-3)
- Uranium-233, uranium-234, uranium-235, and uranium-238

Source term development methods for this study have relied heavily on the use of effluent monitoring data. While other emissions estimating methods that do not rely on the effluent monitoring data (e.g., mass balance and engineering calculations) could be employed for some limited emission reconstructions for some specific operations based on available inventory or engineering information, such approaches would not be successful in estimating facility-wide emissions since the needed historical information for all processes is not available to perform the necessary calculations. Any mass balance or engineering calculations that were performed would be subject to significant uncertainties as a result of the need to estimate a variety of process losses, including losses in ventilation ducts and the need to address the historical efficiency of the HEPA filtration systems.

Project investigations have therefore focused on the evaluation of the effluent monitoring data for use in estimating routine radionuclide emissions from the facility.

One of the primary advantages of the monitoring record is that it not only records releases resulting from normal process operations, but it also reflects releases resulting from upset conditions within a building where the monitoring system continued to operate. In addition, a monitoring system measures contaminants in the airstream after, or downstream of, the HEPA filtration systems, eliminating the need to address filter system efficiency in quantifying emissions.

The monitoring record begins in 1953 and documents the fact that some form of airborne radioactive effluent monitoring was conducted historically whenever processing activities involving radioactive substances were initiated in one of the plant buildings. However, the sampling and analytic methods employed and the type of record vary over time.

The review of the airborne effluent monitoring data record at the plant for the purposes of dose reconstruction included the following activities to identify biases in the sampling and analytic programs that needed to be considered as sources of error or uncertainty:

- Characterization of the basic properties of the radionuclides released from Rocky Flats influencing effluent sampling and environmental transport (i.e., particle size, tritium chemical form, and plutonium and uranium compound solubility),

- Characterization of the radiological effluent sampling and analytic systems and practices that have historically been in place at the plant and the appropriateness of the methods, and

- Characterization of the available monitoring records and the accuracy of data reduction and reporting practices based on the review of raw data and summary-level data reporting documents.

The extensive volume of effluent monitoring data collected by the plant represents one of the best sources of information for quantifying airborne radioactive emissions of the primary production-related radionuclides: plutonium and uranium. Effluent monitoring for tritium covers a somewhat limited time period, but still offers the best source of information for quantifying airborne tritium effluents from the plant. Since americium was specifically quantified in effluent samples to only a limited extent and thorium was not routinely quantified, other emissions estimating approaches must be used to develop source term estimates for these materials.