exposure, if film badge data are partially available but cannot be used statistically for calculations, special activities are indicated for specific individuals, or if other types of radiation exposures are indicated. In dose reconstruction, the conditions of exposure are reconstructed analytically to arrive at a radiation dose. Such reconstruction is not a new concept; it is standard scientific practice used by health physicists when the circumstances of a radiation exposure require investigation. The underlying method is in each case the same. The radiation environment is characterized in time and space, as are the activities and geometrical position of the individual. Thus, the rate at which radiation is accrued is determined throughout the time of exposure, from which the total dose is integrated. An uncertainty analysis of the reconstruction provides a calculated mean dose with confidence limits. The specific method used in a dose reconstruction depends on what type of data are available to provide the required characterizations as well as the nature of the radiation environment. The radiation environment is not limited to the gamma radiation that would have been measured by a film badge, but also includes neutron radiation for personnel sufficiently close to a nuclear detonation, as well as beta and alpha radiation (internally) for personnel whose activities indicate the possibility of inhalation or ingestion of radioactive particles.

§ 218.2 General procedures.

The following procedures govern the approach taken in dose determination:

(a) Use individual film badge data where available and complete, for determining the external gamma dose.

(b) Identify group activities and locations for period(s) of possible exposure.

(c) Qualitatively assess the radiation environment in order to delineate contaminated areas. If no activities occurred in these areas, and if no other potential for exposure exists, a no dose received estimate is made.

(d) If partial film badge data are available, define group(s) of personnel with common activities and relationships to radiation environment.

(e) Using standard statistical methods, verify from the distribution of film badge readings whether the badged sample adequately represents the intended group.

(f) Calculate the mean external gamma dose, with variance and confidence limits, for each unbadged population. Assign a dose equal to 95% probability that actual exposure did not exceed the assigned dose.

(g) If badge data is not available for a statistical calculation, conduct a dose reconstruction.

(h) For dose reconstruction, define radiation environment through use of all available scientific data, e.g., measurements of radiation intensity, decay, radioisotopic composition.

(i) Quantitatively relate activities shielding, position, and other factors to radiation environment as a function of time. Integrate dose throughout period of exposure.

(j) Where possible, calculate mean dose with confidence limits; otherwise calculate best estimate dose or, if data are too sparse, upper limit dose.

(k) Compare calculations with available film badge records to verify the calculated doses. Whether or not film badge data is available, calculate initial and internal doses where identified as a meaningful contribution to the total dose.

§ 218.3 Dose reconstruction methodology.

(a) *Concept.* The specific methodology consists of the characterization of the radiation environments to which participants through all relevant activities, were exposed. The environments, both initial and residual radiation are corrected with the activities of participants to determine accrued doses due to initial radiation, residual radiation and/or inhaled/ingested radioactive material, as warranted by the radiation environment and the specific personnel activities. Due to the range of activities, times, geometries, shielding, and weapon characteristics, as well as the normal spread in the available data pertaining to the radiation environment, an uncertainty analysis is performed. This analysis quantifies the uncertainties due to time/space variations, group size, and available data.