Appendix C
Equations

Minimum Detectable Concentration (MDC)

MDC is equal to the mean of a distribution such that 95 percent of the measurements of the distribution will produce analytical results that have the activity above that of a blank. It is possible to achieve a very low level of detection by analyzing a large sample size and counting for a very long time.

The laboratory used the following equation for calculating the MDCs for each radionuclide in various sample matrices:

$$MDC = \frac{4.65 \quad S_b}{K \; T} + \frac{3}{K \; T}$$

Where:

S_b	=	Standard deviation of the background
K	=	A correction factor that includes items such as unit conversions, sample volume/weight, decay correction, detector efficiency, chemical recovery and abundance correction, etc.
T	=	Counting time

For further evaluation of MDC, refer to HPS N13.30-1996, *Performance Criteria for Bioassay*.

Total Propagated Uncertainty (TPU)

Total propagated uncertainty for each data point must be reported at 2σ level. The TPU was calculated by using the following equation:

$$TPU_{1\sigma} = \sigma_{ACT} = \frac{\sqrt{\sigma_{NCR}{}^2 + (NCR)^2 * (RE^2_{EFF} + RE^2_{ALI} + RE^2_R + \Sigma\, RE^2_{CF})}}{2.22 * EFF * ALI * R * ABN_S * e^{-\lambda t} * CF}$$

Where:

EFF	=	Detector Efficiency
ALI	=	Sample Aliquot Volume or Mass
R	=	Sample Tracer/Carrier Recovery
ABN_s	=	Abundance Fraction of the Emissions Used for Identification/Quantification
σ^2_{NCR}	=	Variance of the Net Sample Count Rate
NCR	=	Net Sample Count Rate

RE^2_{EFF}	=	Square of the Relative Error of the Efficiency Term
RE^2_{ALI}	=	Square of the Relative Error of the Aliquot
RE^2_{R}	=	Square of the Relative Error of the Sample Recovery
RE^2_{CF}	=	Square of the Relative Error of Other Correction Factors
λ	=	Analyte Decay Constant = ln 2/(half-life) [Same units as the half-life used to compute λ]
t	=	Time from Sample Collection to Radionuclide Separation or Mid-Point of Count Time (Same units as half-life)
CF	=	Other Correction Factors as Appropriate (i.e., Ingrowth factor, self-absorption factor, etc.).

Relative Error Ratio (RER)

The Relative Error Ratio is a method, similar to a t-test, with which to compare duplicate results (see Chapters 4 and 8; WP 02–EM 3004).

$$RER = \frac{|\, x_A - x_B \,|}{\sqrt{(2\sigma_A)^2 + (2\sigma_B)^2}}$$

Where:

X_A	=	Mean Activity of Population A
X_B	=	Mean Activity of Population B
σ_A	=	Standard Deviation of Population A
σ_B	=	Standard Deviation of Population B.

Percent Bias (% Bias)

A measure of the accuracy of radiochemical separation methods and counting instruments; that is, a measure of how reliable the results of analyses are when compared to the actual values.

$$\%\ BIAS = \left[\frac{A_m - A_k}{A_k}\right] * 100$$

Where:

% BIAS	=	Percent Bias
A_m	=	Measured Sample Activity
A_k	=	Known Sample Activity.