

Table 4b
Plutonium Mass Fraction Measurements (DA)

Method	Material	Uncertainty Component (% rel. , k=1)		ITV (% rel. , k=1)	Notes
		u(r)	u(s)		
GRAV	Pu Oxide	0.05	0.05	0.07	<u>1/</u>
TITR	Pu Oxide and Nitrate	0.15	0.15	0.21	<u>2/</u>
	U/Pu Oxide and Nitrate	0.2	0.2	0.28	
COUL	Pu (pure compounds)	0.1	0.1	0.14	<u>3/</u>
IDMS ^{11/}	Hot Cell Conditions	0.2	0.2	0.28	<u>4/ 5/</u>
		0.3	0.3	0.42	<u>4/ 6/</u>
	Glove Box Conditions	0.15	0.1	0.18	<u>4/ 5/</u>
		0.2	0.2	0.28	<u>4/ 6/</u>
KEDG	Pu and U/Pu Solution	0.3	0.3	0.42	<u>7/</u>
HKED	Spent Fuel Solution	0.8	0.5	0.94	<u>8/</u>
XRF	Pu Solution (low conc.)	2	2	2.8	<u>9/</u>
PUSP	Process Solutions	2	2	2.8	<u>10/</u>
ALPH	Waste Solution (low conc.)	7	7	10	

1/ Materials containing non-volatile impurities at less than 1000 µg/g.

2/ Techniques such as the MacDonald and Savage and the AgO titration methods.

3/ Recommended Pu mass range for aliquots is 4 mg to 15 mg; for samples containing Fe/Pu mass fraction greater than 25 µg/g, an iron correction or a chemical separation is required to minimize uncertainty; uranium is not an interference when the U/Pu mass fraction is 100 or less.

4/ For all materials typically encountered in the nuclear fuel cycle.

5/ Using gravimetrically prepared and/or using commercially available non-diluted spikes (such as Large Size Dried Spikes), spiking non-diluted samples.

6/ Using samples and/or spikes after dilution, using artificial spikes or high abundant spikes with variable spike to sample amount ratios.

7/ Pu concentration above 40 g/L with a U/Pu mass ratio below 0.1 and measurement times in the range of 3 x (1000-3000) s.

8/ U concentration of 150 g/L to 250 g/L with a U/Pu mass ratio of 80 to 150 and measurement times in the range of 3 x (1000-3000) s.

9/ Uncertainties related to XRF performance and for samples in solution in the range of Pu concentrations from 1 g/L to 50 g/L; counting precision greater than > 1 % if Pu concentration less than 1 g/L (HKED system)

10/ Pu concentration of greater than 0.1 g/L.

11/ Refers to ID-TIMS and ID-MC ICPMS.