

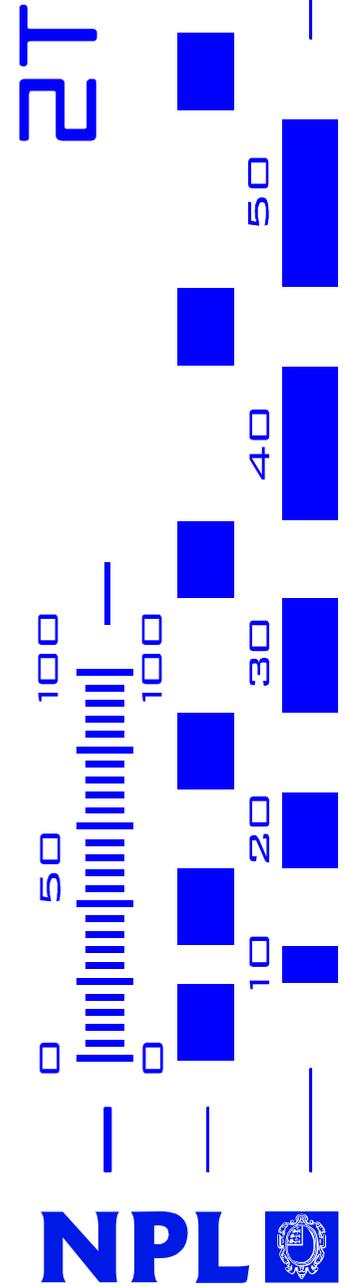
Environmental Radioactivity Comparison
Exercise 2002 - Workshop

Selection of radionuclides/
source preparation and
validation

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Date: Thursday 8th May 2003



Overview

- ◆ Details of User Survey from 2002 Workshop
- ◆ Target specifications of comparison mixtures
- ◆ Source preparation and validation

User survey at 2002 Workshop

- ◆ Carried out to give NPL feedback on which radionuclides/radionuclide types, activity levels and sample matrices users would like to analyse in future comparisons
- ◆ Suggested:
 - categories of β/γ -emitters
 - α - and α/γ -emitters
 - β -emitters
- ◆ Participants asked to allocate 'priority ratings' (high, medium or low) to any nuclides/activity levels/matrices of interest

Suggested categories for β/γ -emitters

- ◆ Those exhibiting cascade summing
 - ◆ Low-energy emitters (< approx. 200 keV)
 - ◆ Groups of radionuclides with overlapping emissions
 - ◆ Positron emitters
 - ◆ Other categories?
-
- ◆ Activities down to approximately 1 Bq kg⁻¹

Suggested matrices for β/γ -emitters

- ◆ Aqueous
 - ◆ Reconstituted Milk
 - ◆ Kaolin
 - ◆ Concrete
 - ◆ Calcium sulphate
 - ◆ Others?
-
- ◆ Lead-time may be long

Suggested α - and α/γ -emitters

- ◆ Polonium-210
 - ◆ Radium-226
 - ◆ Thorium-232
 - ◆ Uranium
 - ◆ Neptunium-237
 - ◆ Plutonium-238
 - ◆ Plutonium-239
 - ◆ Americium-241
 - ◆ Curium-244
 - ◆ Others?
-
- ◆ Activity concentrations down to approximately 1 Bq kg⁻¹

Suggested β -emitters

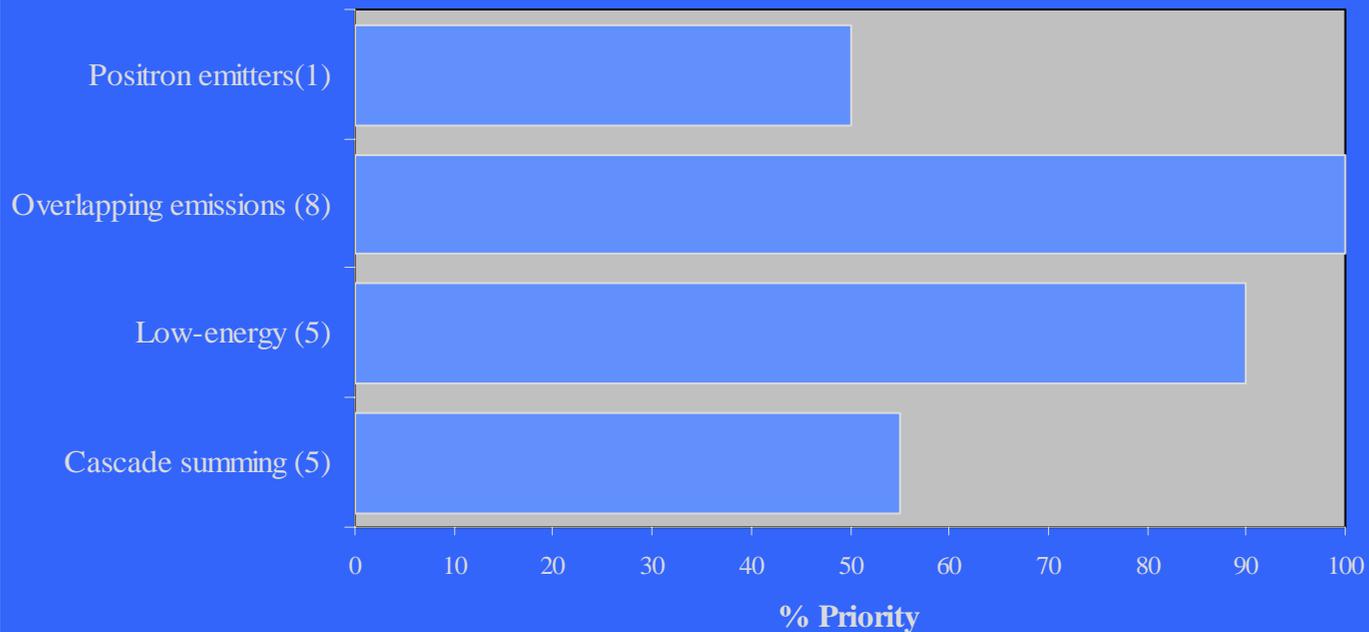
- ◆ Tritium
 - ◆ Carbon-14
 - ◆ Phosphorous-32
 - ◆ Sulphur-35
 - ◆ Calcium-45
 - ◆ Iron-55
 - ◆ Nickel-63
 - ◆ Strontium-89
 - ◆ Strontium-90
 - ◆ Technetium-99
 - ◆ Lead-210
 - ◆ Promethium-147
 - ◆ Others?
- ◆ Activity concentrations down to order of 1 Bq kg⁻¹

User Survey

Environmental Radioactivity Comparison Exercise 2001 - Workshop at NPL, 09/01/02.

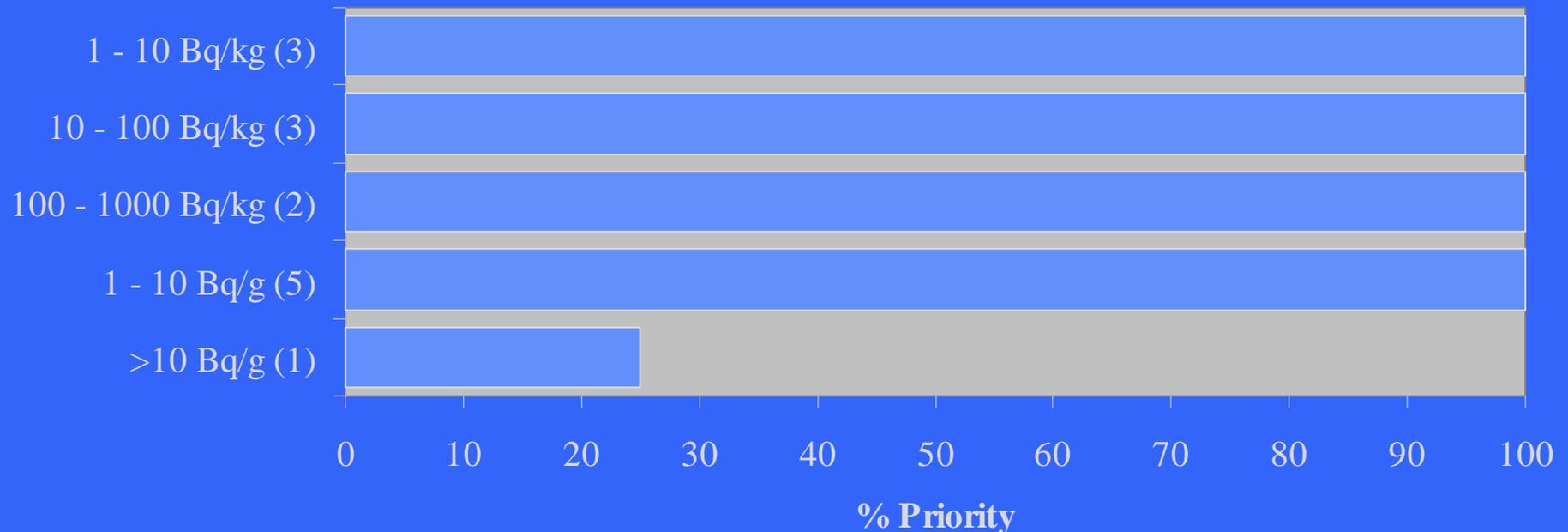
Results of survey of user needs

Beta/Gamma - emitting samples: nuclide categories



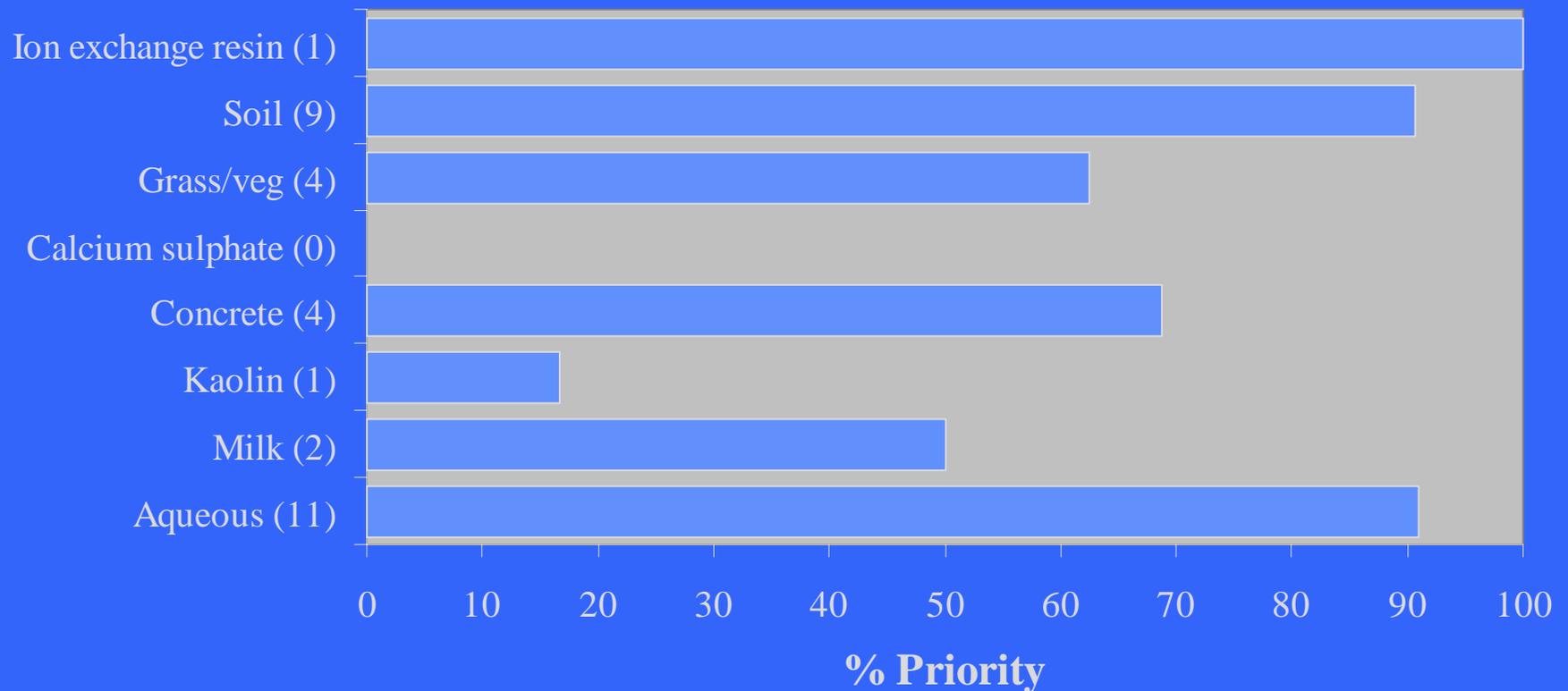
User Survey

Environmental Radioactivity Comparison Exercise 2001 - Workshop at NPL,
09/01/02. Results of survey of user needs.
Beta/Gamma - emitting samples: activity concentrations



User Survey

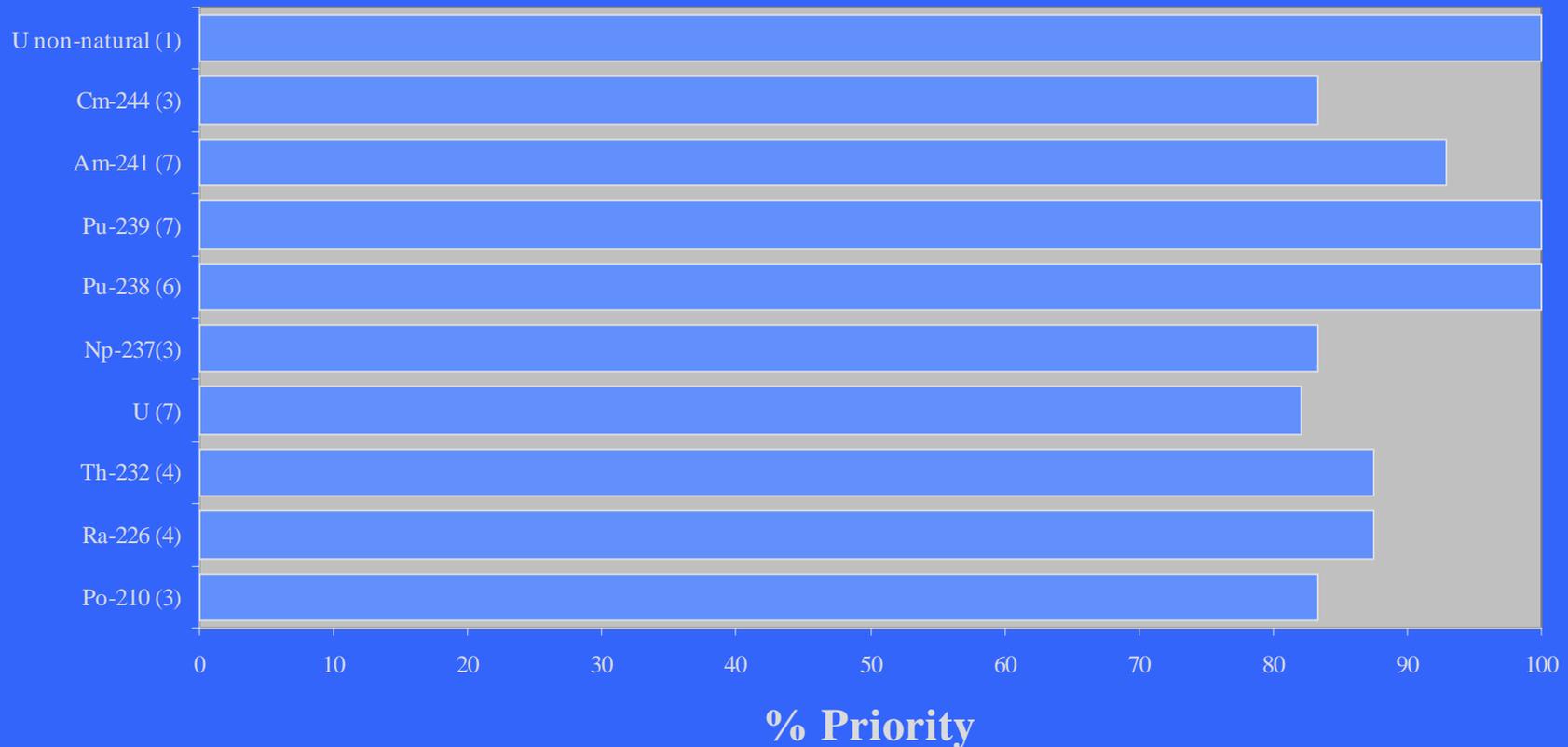
**Environmental Radioactivity Comparison Exercise 2001 -
Workshop at NPL, 09/01/02. Results of survey of user needs.
Beta/Gamma - emitting sample matrices**



User Survey

Environmental Radioactivity Comparison Exercise 2001 - Workshop at NPL, 09/01/02. Results of survey of user needs.

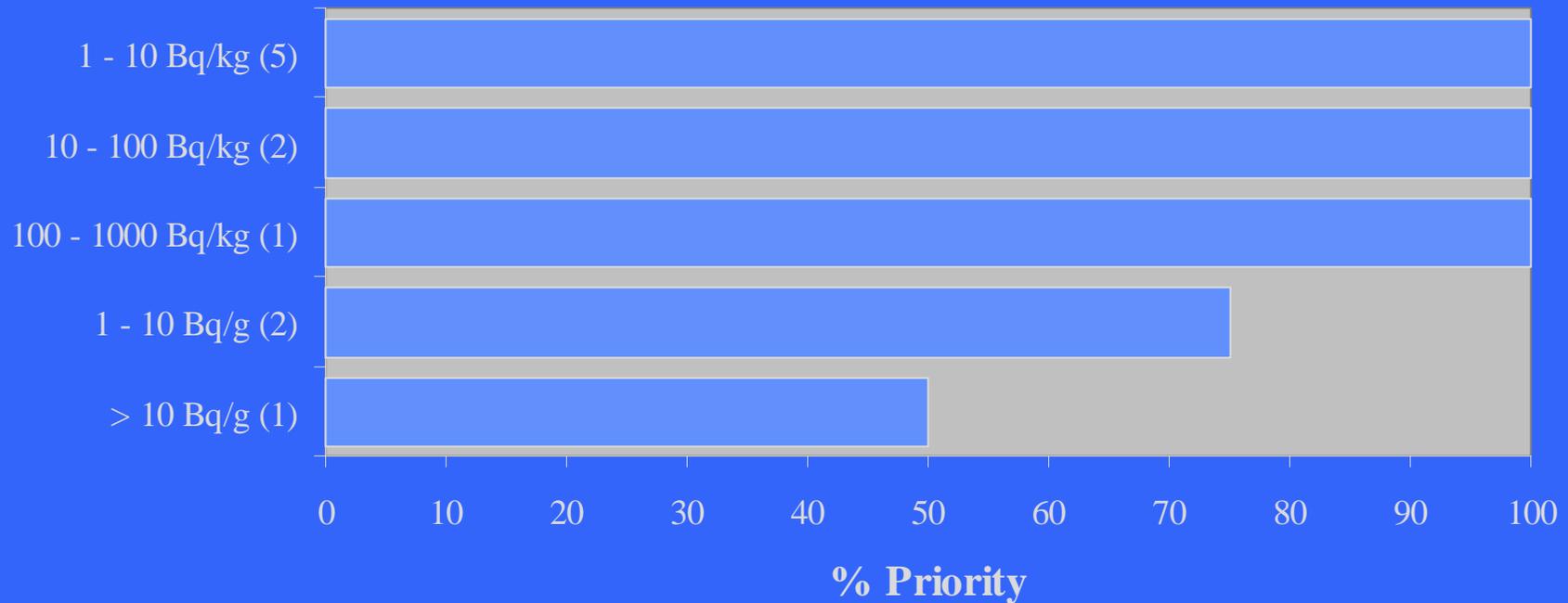
Alpha or alpha/gamma - emitting samples: nuclides



User Survey

Environmental Radioactivity Comparison Exercise 2001 - Workshop
at NPL, 09/01/02. Results of survey of user needs.

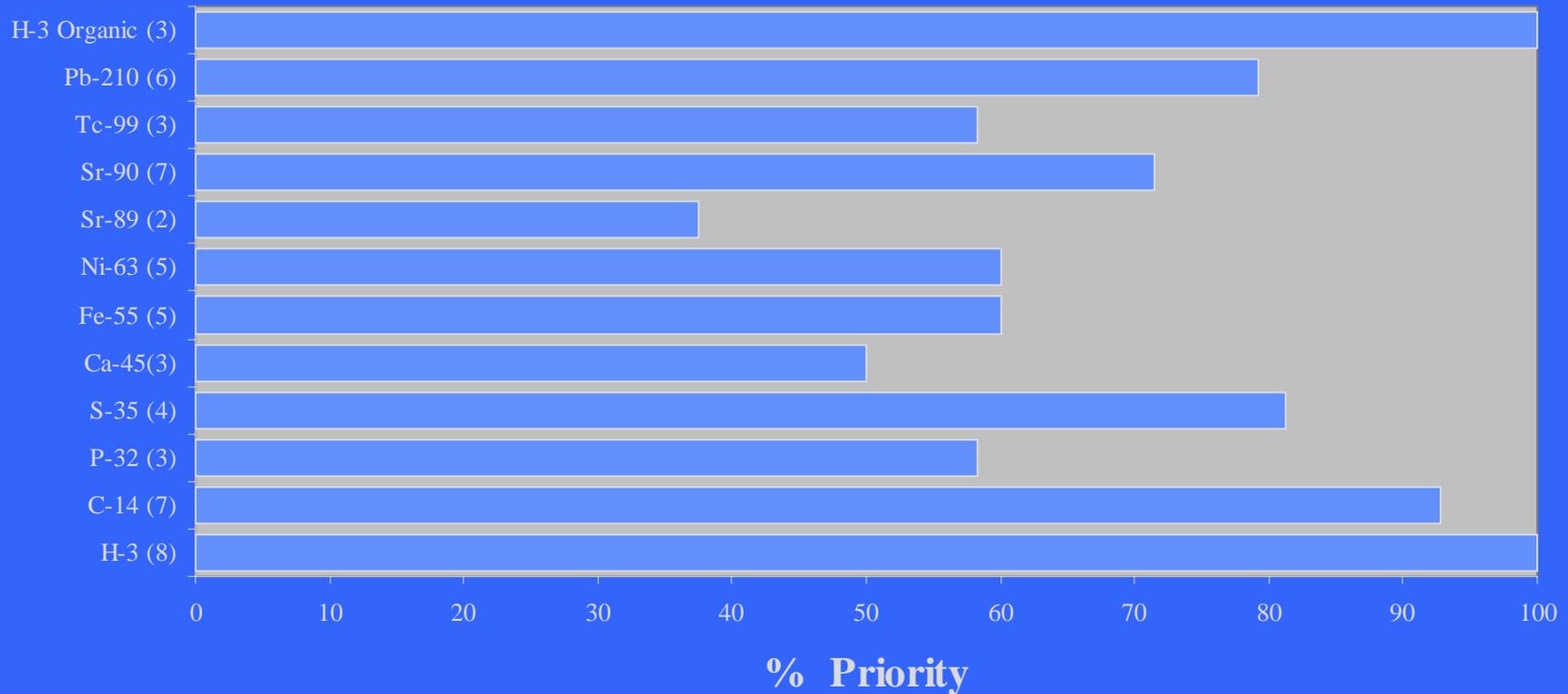
Alpha or alpha/gamma - emitting samples: activity concentrations



User Survey

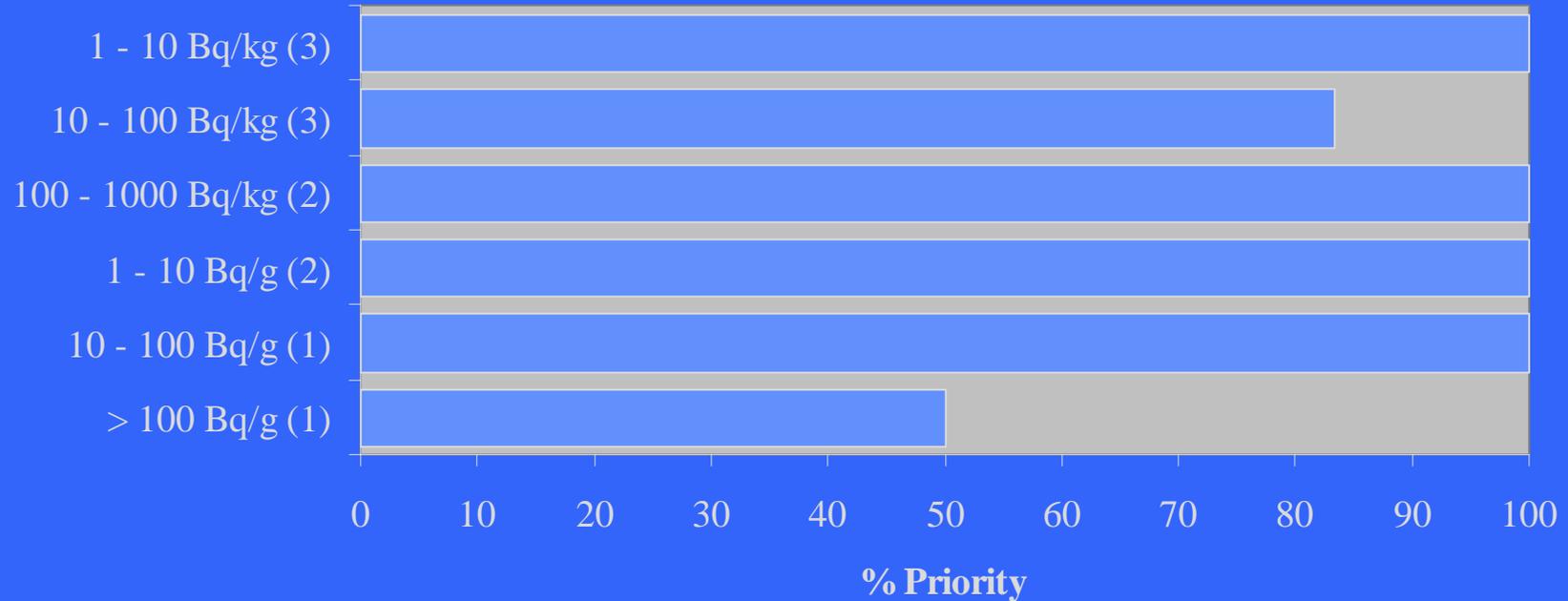
Environmental Radioactivity Comparison Exercise 2001 - Workshop at NPL, 09/01/02. Results of survey of user needs.

Beta - emitting samples: nuclides



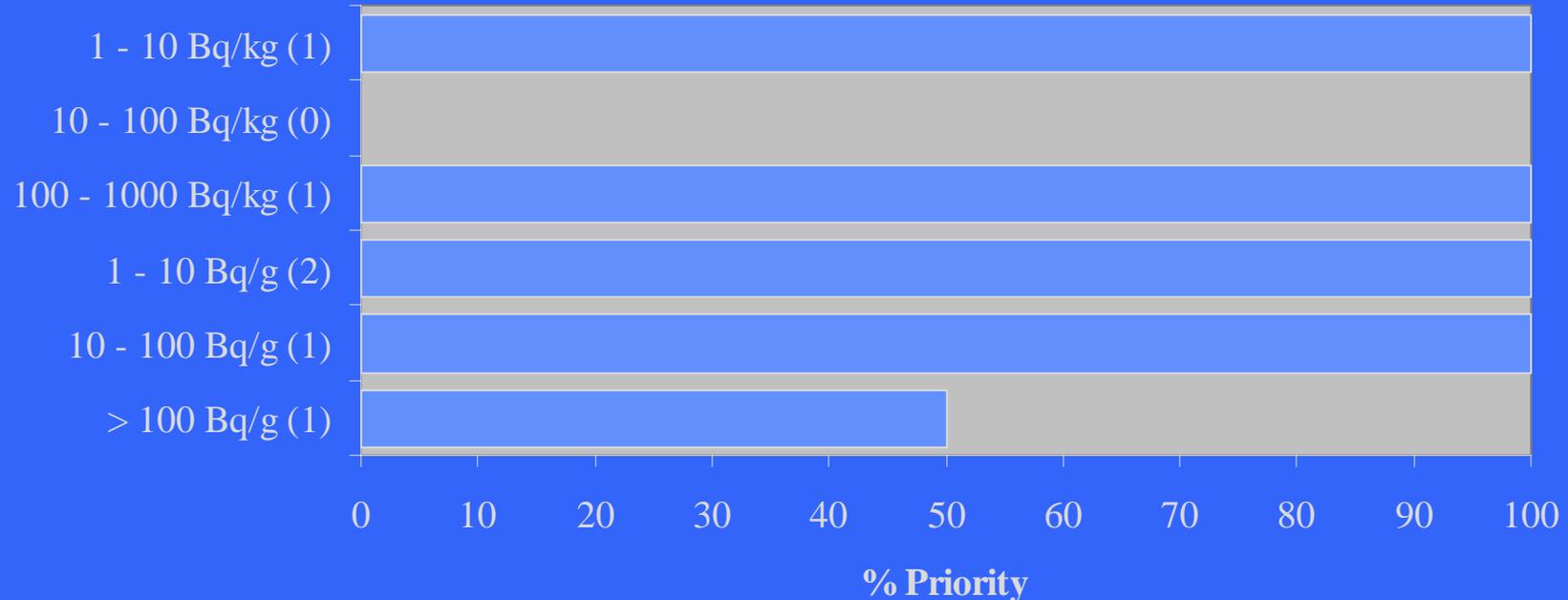
User Survey

Environmental Radioactivity Comparison Exercise 2001 - Workshop at NPL,
09/01/02. Results of survey of user needs. Beta - emitting samples: activity
concentrations for H-3



User Survey

Environmental Radioactivity Comparison Exercise 2001 - Workshop at NPL,
09/01/02. Results of survey of user needs. Beta - emitting samples: activity
concentration for other nuclides



Chosen radionuclide mixtures and target concentrations

- ◆ All aqueous
- ◆ Sr-90, Pb-210, Ra-226, Pu-238, Pu-239 and Am-241 at two activity levels:
 - 2 Bq g⁻¹ per nuclide (except Sr-90 which will be 20 Bq g⁻¹)
 - 2.5 Bq kg⁻¹ per nuclide (except Sr-90 which will be 25 Bq kg⁻¹)

Chosen radionuclide mixtures and target concentrations (continued)

◆ H-3, C-14 and S-35 at two activity levels:

- 20 Bq g⁻¹ per nuclide
- 25 Bq kg⁻¹ per nuclide

◆ Na-22, Co-57, Co-60, Zr-95, Ru-106, Cs-134, Cs-137, Eu-154 and Eu-155 at two activity levels:

- 2 Bq g⁻¹ per nuclide
- 2.5 Bq kg⁻¹ per nuclide

Source preparation scheme for individual β/γ -emitters

Individual radionuclide
stock solution

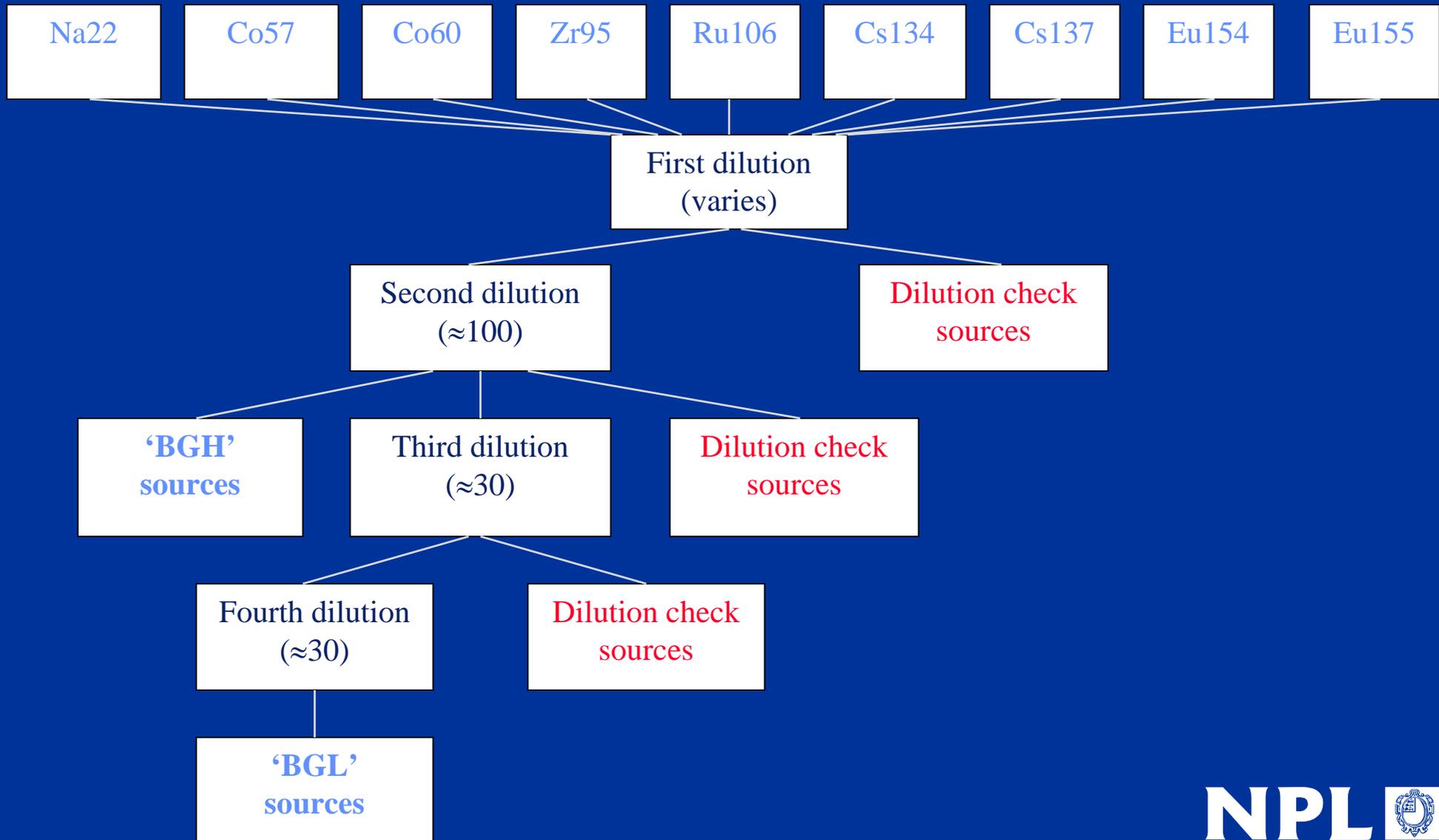
Ampoules for
ion-chamber
assay and
subsequent mixing

Ampoule for
contaminant
checks

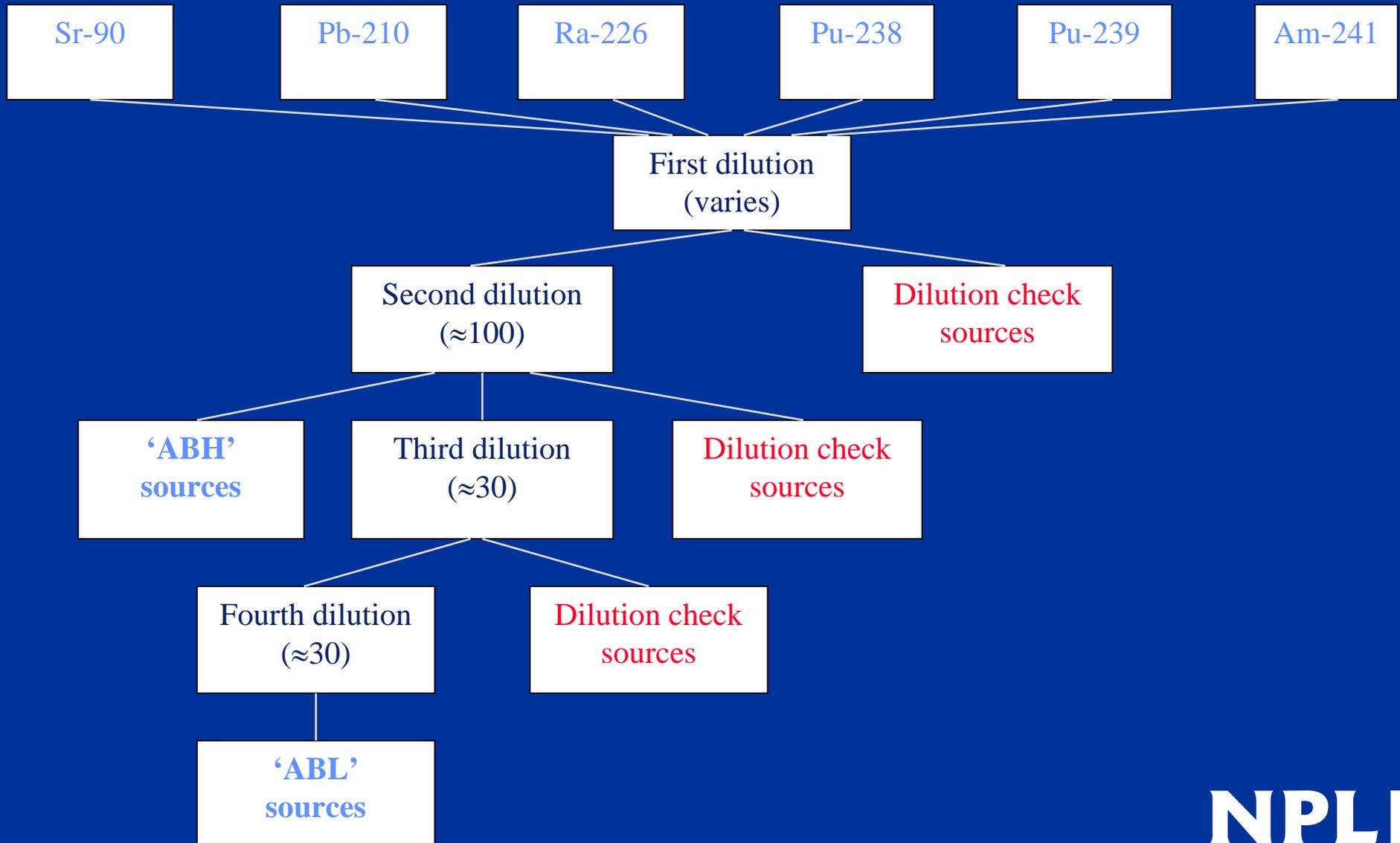
Bottles for
QA checks

Dilution check
sources

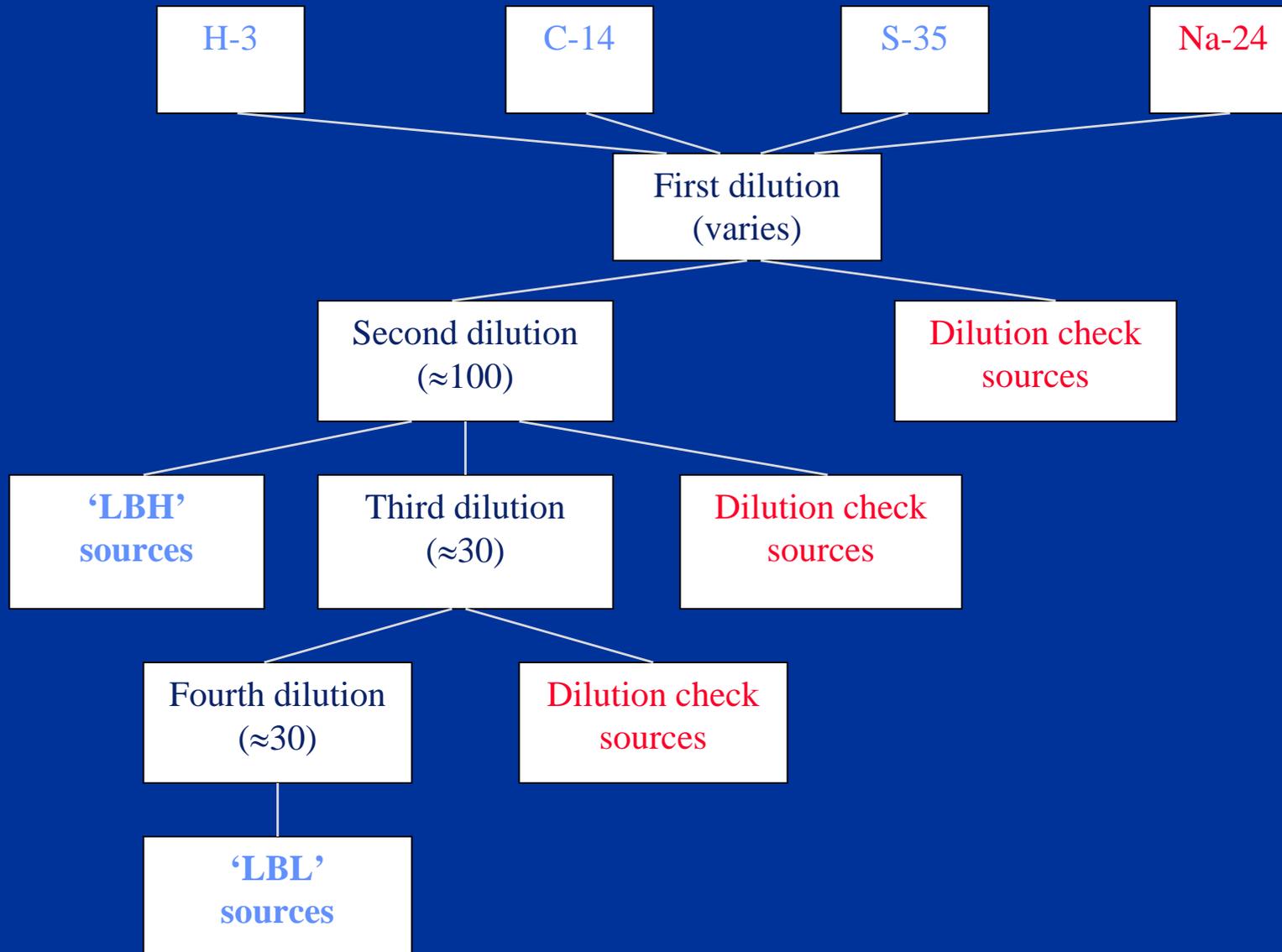
Source preparation scheme for β/γ mixture



Source preparation scheme for α/β mixture



Source preparation scheme for pure β mixture



Final compositions of α/β mixtures (RT 1200 GMT 01/10/02)

Radionuclide	Activity concentration in ABH**/02 (Bq g ⁻¹)	Uncertainty (k=1) (Bq g ⁻¹)	Activity concentration in ABL**/02 (Bq kg ⁻¹)	Uncertainty (k=1) (Bq kg ⁻¹)
Sr-90	19.980	0.160	24.69	0.55
Pb-210	3.420	0.160	4.230	0.210
Ra-226	1.979	0.030	2.445	0.063
Pu-238	2.000	0.016	2.471	0.055
Pu-239	1.991	0.023	2.460	0.058
Am-241	1.996	0.018	2.466	0.056

Impurities in α/β mixtures (RT 1200 GMT 01/10/02)

Radionuclide	Activity concentration in ABH**/02 (Bq g ⁻¹)	Uncertainty (k=1) (Bq g ⁻¹)	Activity concentration in ABL**/02 (Bq kg ⁻¹)	Uncertainty (k=1) (Bq kg ⁻¹)
²⁴¹ Pu	0.02	-	0.025	-
unspecified α -emitters	< 0.001	-	< 0.001	-

Final composition of higher-level β/γ mixture

(RT 1200 GMT 01/10/02)

Radionuclide	Activity conc'n (Bq g ⁻¹)	Uncertainty (k=1) (Bq g ⁻¹)	Radionuclide	Activity conc'n (Bq g ⁻¹)	Uncertainty (k=1) (Bq g ⁻¹)
²² Na	2.024	0.010	¹³⁴ Cs	2.025	0.016
⁵⁷ Co	2.008	0.020	¹³⁷ Cs	2.015	0.015
⁶⁰ Co	2.009	0.008	¹⁵⁴ Eu	2.081	0.017
⁹⁵ Zr	1.943	0.032	¹⁵⁵ Eu	2.041	0.024
¹⁰⁶ Ru	2.012	0.011			

Final composition of lower-level β/γ mixture

(RT 1200 GMT 01/10/02)

Radionuclide	Activity conc'n (Bq kg ⁻¹)	Uncertainty (k=1) (Bq kg ⁻¹)	Radionuclide	Activity conc'n (Bq kg ⁻¹)	Uncertainty (k=1) (Bq kg ⁻¹)
²² Na	2.670	0.054	¹³⁴ Cs	2.672	0.056
⁵⁷ Co	2.649	0.058	¹³⁷ Cs	2.659	0.056
⁶⁰ Co	2.651	0.053	¹⁵⁴ Eu	2.745	0.058
⁹⁵ Zr	2.564	0.066	¹⁵⁵ Eu	2.693	0.062
¹⁰⁶ Ru	2.654	0.054			

Impurity in β/γ mixtures (RT 1200 GMT 01/10/02)

Radionuclide	Activity concentration in BGH**/02 (Bq g ⁻¹)	Uncertainty (k=1) (Bq g ⁻¹)	Activity concentration in BGL**/02 (Bq kg ⁻¹)	Uncertainty (k=1) (Bq kg ⁻¹)
¹⁵² Eu	0.044	0.010	0.058	0.013

Final compositions of low-energy β mixtures

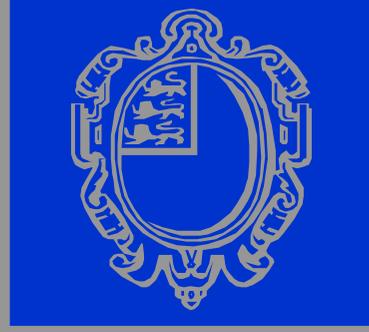
(RT 1200 GMT 01/10/02)

Radionuclide	Activity concentration in LBH**/02 (Bq g ⁻¹)	Uncertainty (k=1) (Bq g ⁻¹)	Activity concentration in LBL**/02 (Bq kg ⁻¹)	Uncertainty (k=1) (Bq kg ⁻¹)
³ H	20.04	0.18	25.13	0.56
¹⁴ C	19.46	0.12	24.41	0.53
³⁵ S	20.22	0.14	25.36	0.55

Impurity in low-energy β mixtures (RT 1200 GMT 01/10/02)

Radionuclide	Activity concentration in LBH**/02 (Bq g ⁻¹)	Uncertainty (k=1) (Bq g ⁻¹)	Activity concentration in LBL**/02 (Bq kg ⁻¹)	Uncertainty (k=1) (Bq kg ⁻¹)
³⁶ Cl	0.0022	0.00055	0.0028	0.0007

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