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# A rapid determination of high concentration Pu in safeguards samples at the on-site laboratory in the Rokkasho Reprocessing Plant using a combined TIMS-HRGS method

K-edge densitometry (KED) is used as a priority method for timely analysis of numerous inspection samples at the On-site laboratory (OSL) in the Rokkasho Reprocessing Plant (RRP), because the KED can quickly measure Pu and U concentrations in the samples non-destructively with a reasonable uncertainty. However, if the KED is not available due to sudden equipment failure, all samples that are supposed to be measured with the KED would have to be measured using isotope dilution mass spectrometry (IDMS). It may be difficult to achieve the timeliness requirements for nuclear material inventory verification, because the IDMS always requires chemical separation of U and Pu that is cumbersome and time-consuming to avoid isobaric interference caused by 238U and 241Am on the masses of 238Pu and 241Pu in the thermal ionization mass spectrometry (TIMS), although it is the most precise method. For this reason, as a backup method of the KED a combined method of thermal ionization mass spectrometry and high resolution gamma spectrometry (TIMS-HRGS) has been developed for rapid Pu concentration assay by the IDMS in high concentration Pu samples without chemical separation of U and Pu by merging the 238Pu/239Pu and 241Pu/239Pu ratios from HRGS and 240Pu/239Pu and 242Pu/239Pu ratios from the TIMS. The combined method was applied to 182 pure Pu samples and 74 U/Pu mixed samples with the U/Pu ratios ranging from ⊠1 to ⊠2, which were collected at the RRP between 2010 and 2017. The relative biases of Pu assay results by the combined TIMS-HRGS method with isotopic codes to that of the conventional IDMS were within 0.15% and 0.10% in the pure Pu samples and the U/Pu mixed samples, respectively. Since no chemical separation is required, the combined TIMS-HRGS method reduces analysis complexity and improves timeliness analysis for safeguards verification without compromising accuracy of the results. It is expected that the combined method will be used efficiently for Pu concentration assay in routine safeguards samples and especially in case of emergency situation where the KED is not available.

## Which "Key Question" does your Abstract address?

SGI4.4

## Which alternative "Key Question" does your Abstract address? (if any)

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## Topics

SGI4

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