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## IAEA Safeguards and GUM-based Measurement Uncertainty Estimation –a Reconciliation

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In response to its specific need to assess the statistical significance of declared and observed nuclear material accounting differences shipper-receiver difference (SRD), material unaccounted for (MUF), operator-inspector difference (D), inspector's estimate of MUF (IMUF), the safeguards community in the 1970s and 1980s developed a methodology to estimate measurement error variances. This has been applied by the IAEA to date and is currently undergoing review and enhancement. The terminology associated with this approach attributes observed variances to sources of error.

Since the first publication in 1995 of the 'Guide to the Expression of Uncertainty in Measurement' (GUM), safeguards laboratories are converging in their treatment of measurement results towards this international metrological standard. GUM models the analytical process from the ground up via cause-and-effect and accounts for and propagates uncertainties at each point of the process up to the measurand via the law of error propagation. In contrast, the safeguards methodology estimates uncertainties from the top down by applying estimation routines to paired measurement data and attributing the resulting variance to operator/inspector and random/short-term systematic components. Differences in both approach and terminology complicate communication between communities in need of close co-operation: IAEA safeguards data evaluators and safeguards laboratory analysts.

The authors wish to reconcile the IAEA methodology with the GUM-based uncertainty estimation. In a first step, the features of both approaches are introduced and compared. After resolution of purely terminological differences, the divergences in approach caused by differences in the underlying problems to be solved become clearly visible. We do not expect the approaches to become unified because the deliverable of a laboratory is a measurement result whereas the deliverable of material balance evaluation is an assessment of the statistical significance of observed balance statistics, but we identify potential benefits and recommend specific steps towards convergence in areas of overlap.

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IAEA

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