Analysis of spent nuclear fuel has important applications to nuclear forensics, since measurement of the composition of spent fuel can indicate reactor conditions and the possibility of diversion. An ever relevant question is how to improve the accuracy of forensics based on measuring isotopic ratios. Resonance Ionization Mass Spectrometry (RIMS) can help improve spent fuel analysis by increasing the precision of isotopic ratio measurements and measuring multiple isotopes of interest simultaneously. RIMS is particularly advantageous in situations when there are very small quantities of the isotope of interest and they cannot be reliably separated by chemical purification, and for which other conventional spectroscopy methods (e.g. gamma) exhibit reduced efficiency. This is the case with several isotopes of interest to nuclear forensics, including Ba-132, 134, 135, 136, 138, and 140; Cs-133 and 135; Rb-85 and 87; and Sr-84, 86, 88, and 90. A time-of-flight detector used in coordination with a laser ionization setup with a time delay between two elements can reliably distinguish a host of isotopes between two different elements, obviating the need for chemical purification of small sample sizes. We aim to utilize the increased accuracy of RIMS measurements for the stated isotopes to increase the accuracy of predictions about the processing and reactor history of spent nuclear fuels.