

**IPNDV Working Group 3: Technical Challenges and Solutions
High Explosives (HE) in a container - Monitoring Technologies Matrix**

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Technology	Information detected/determined	Key Limitations (Shielding issues, possible size restraints, etc.)	Approximate Measurement Time Scales	Equip Availability (TRL) / for Simple Scenario (TRL)	IB Needed (TRL?)	Comments	Related Technology Paper
Raman Explosive Identification System	Spectroscopic technique to observe vibrational, rotational and other low frequency modes of a molecular system; when compared to known spectra can be used to confirm presence and identification of HE	Dependent on HE stored in a semi-transparent container; would not likely work with a sturdy wooden container	15 minutes	Readily in use today (9) / For Dismantlement (5)	Yes (1)	Works for both bulk and trace detection	HE4 - Raman Explosive Identification System
Fast Neutron Interrogation System	Measures gamma emissions in response to excitation by neutron bombardment; resulting spectra observed can be used to confirm presence and identification of HE; also can be used to image material	need compositional information ahead of time; container composition dependent	10 minutes	Readily in use today (9) / For Dismantlement (5)	Yes (1)	Operator needs to be shielded from the neutron source.	HE2 - Fast neutron interrogation system for HE identification
Compton Backscattering Cameras	Active x-ray technique to determine shape and number of components	Battery operated; cannot be used with thick metal containers.	Seconds to minutes	Commercially available (9) / For Dismantlement (7)	Yes (1)	Minor health and safety issues (x-ray source)	HE5 - X-ray backscattering imaging
NQR-explosive Identification System	Spectroscopic technique where select nuclei are excited using radio waves, where the response is observed; when compared to known spectra can be used to confirm presence and identification of HE	Likely works with a variety of containers but not metal	1 hour	Readily in use today (8) / For Dismantlement (3)	Yes (1)	Works best for bulk detection	HE3 - NQR explosive identification system
X-Ray Diffraction	X-ray technique that can be used to confirm presence/absence and identification of HE	Requires material library Difficult to penetrate high-density materials	5 minutes	Commercially available (9) / Portable for Dismantlement (4)	Yes (1)	X-ray source is a radiation safety concern. Can only be used on disassembled components due to problems with high-density materials.	HE6 - X-ray Diffraction
Nuclear Resonance Fluorescence	Gamma-ray spectrum, isotope information, C/N and C/O ratios for explosives determination, potential for SNM mass determination.	Hydrogen is the only element that can't be detected. In the transmission configuration, the measurement is aided by a 'witness or detection' foil that consists of the isotope of interest.	10 minutes	Commercially available (9) / For Dismantlement (7)	Yes (1)	There will be a radiation safety concern. Relatively large physical footprint	HENM1 - Nuclear Resonance Fluorescence
X-ray Computed Tomography	3D volumetric information, shape, location, effective atomic number, density, mass, material type. The technology can identify objects that are surrounded (hidden) by other objects.	Will not penetrate through materials with a high density thickness	seconds to 10 minutes	Commercially available (9) / For Dismantlement (7)	Yes (1)	Designed to be used within a concrete bunker and do pose a radiation hazard if used outside of these conditions	HE1 - X-ray Computed Tomography
Swipe Sampling	Detects trace amounts of explosive	Dismantlement facilities will have trace amounts of HE all over the facility and in empty containers		Commercially available (9)		NOT RECOMMENDED	N/A