

Development of Radioxenon Forensics Laboratory

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Radioxenon

Noble gasses have advantages for forensic measurements because:

- They are more likely to leak from a reactor or underground test than other elements.
- Minimal chemical reactions in environment to perturb forensic signature.
- Creation at source can be relatively high.

Georgia Tech is developing a laboratory to support studies on radioxenon and other noble gasses.

Radioxenons of Interest

	^{131m} Xe	^{133m} Xe	¹³³ Xe	¹³⁵ Xe
Half-Life	11.9 days	2.19 days	5.24 days	9.09 hours
²³⁵U Fission Yield Per 100 Fissions				
Direct (%) – Thermal	3.48 x 10 ⁻⁷	1.89 x 10 ⁻³	6.66 x 10 ⁻⁴	7.85 x 10 ⁻²
Direct (%) – Fast	2.41 x 10 ⁻⁷	4.23 x 10 ⁻³	1.45 x 10 ⁻³	1.20 x 10 ⁻¹
Cumulative (%) – Thermal	4.05 x 10 ⁻²	1.95 x 10 ⁻¹	6.70	6.54
Cumulative (%) - Fast	4.51 x 10 ⁻²	6.72	1.98 x 10 ⁻¹	6.60

Sources of Radioxenon to Environment

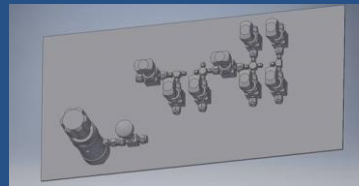
Type of Release	Order of Magnitude Radioxenon Released
Hospitals	~ 10 ⁶ Bq/day/facility
Nuclear Power Plants	~ 10 ⁹ Bq/day/facility
Radiopharmaceutical Facilities	~ 10 ¹¹ to 10 ¹³ Bq/day/facility
Nuclear explosion underground	~ 0 to 10 ¹⁵ Bq/kton
Nuclear explosion atmospheric	~ 10 ¹⁶ Bq/kton

Production



- Starfire nGen-800 neutron generator produces 5x10⁹ neutron with energies on the order of 2.5 MeV/neutron.
- Modular constructions allow reactions chambers to be built around the generator head to collimate and moderate neutrons

Transfer



- Gas manifold for controlling radioxenon sent to isolation cell for detection.
- Includes vacuum pump, inlet ports for different noble gases, and a comprehensive series of valves for full control of gas flow.

Counting

- Purpose to identify and separately count the four radioxenon isotopes of interest.
- System consists of two NaI(Tl) scintillation detectors with a Canberra PIPSbox passivated implanted beta cell detector for beta-gamma spectroscopy.
- Data acquisition system bins counts based on incident radiation energy.