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XENAH: Xenon Environmental Nuclide Analysis at Hartlepool

Brian Milbrath[1], Ashley Davies[2], Matthew Goodwin[2], Mark Arnold[3], Craig Dohring[3], Andrew Petts[3], Michael Warren[3], Anders Ringbom[4], Theodore Bowyer[1], Jonathan Burnett[1], Judah Friese[1], Jim Hayes[1], Lori Metz[1]

[1]Pacific Northwest National Laboratory, [2]Atomic Weapons Establishment,
[3]Electricite de France (EDF Energy), [4]Totalförsvarets forskningsinstitut (FOI)

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POSTER

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XENAH: Xenon Environmental Nuclide Analysis at Hartlepool

Scientists from the U.K., U.S., and Sweden are performing measurements involving a suite of radionuclide monitoring techniques in order to better understand radionuclide emissions from a nuclear power reactor and how those might affect the International Monitoring System. The Xenon Environmental Nuclide Analysis at Hartlepool (XENAH) collaboration will perform these measurements utilizing the Hartlepool Power Reactor in northeast England with cooperation of the reactor operator, EDF Energy

Hartlepool Nuclear Power Station

- A seaside location in County Durham (NE England)
- Owner/Operator: EDF Energy
- Two advanced gas-cooled reactors (AGRs) (gas is CO_2)
- Total power generation: 1.3 GW
- Total thermal power: 3.1 GW
- Commissioned in 1983
- Currently licensed until 2024
- Hartlepool estimates its radioxenon emissions: 11.7 GBq/release during ~12 hr releases 5x/yr

Hartlepool Power Station

XENAH's Three Radionuclide Monitoring Techniques

- Reactor stack monitoring for radioxenon
  - ✓ Measurement at the source

- Stand-off measurements of radioxenon after several km of atmospheric transport and dispersion
  - ✓ Measurements using several sensitive atmospheric radioxenon sampler/analyzers

- Radionuclide measurement of environmental and regulatory samples taken at or near the power station
  - ✓ Measurements performed at two ultra-low background gamma spectrometry facilities

Reactor Stack Monitoring for Radioxenon Emissions

- Same type of monitor the STAX (Source Term Analysis of Xenon) project has placed at medical isotope production facilities
- Air extracted from stack flows through Marinelli beaker around HPGe at 3.5 L/min. Measured concentration adjusted by total stack flow.
- Monitor is currently at Hartlepool, but COVID-19 has delayed installation

Example Stack Monitor (different facility)

Stand-off measurements of radioxenon after several km of atmospheric transport and dispersion

- Measurements done with Scienta's SAUNA Q_B, designed to be more portable for field measurements
- Size – 72 x 108 x 108 cm
- Sample time – 12 hours
- MDC – Xe-133 < 0.4 mBq/m^3, Xe-131m < 0.3 mBq/m^3, Xe-133m < 0.3 mBq/m^3, Xe-135 < 1.3 mBq/m^3
- Measurements should begin later this summer and run for a year

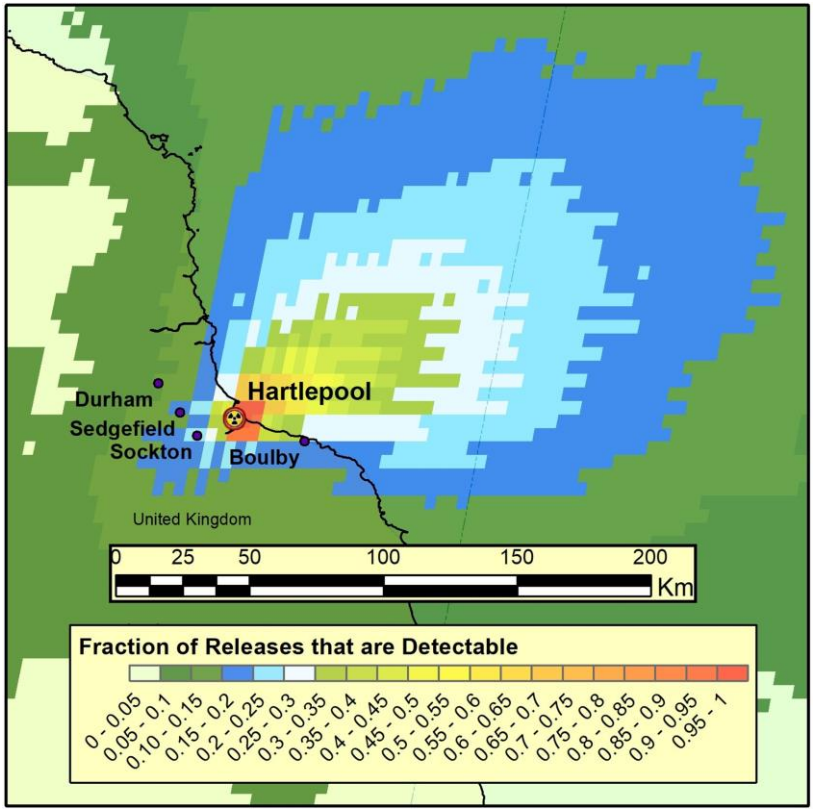
SAUNA Q_B radioxenon sampler/analyzer

Stand-off measurements of radioxenon after several km of atmospheric transport and dispersion

- 3 detectors (1 each from U.K., U.S., and Sweden) at different locations a few 10's of km around Hartlepool
- Comparisons of the stand-off measurements with predictions based on atmospheric transport of stack monitor results are a key measurement goal of the project
- Evaluate advantages of an array network over single station and how this could improve the IMS

Hartlepool Power Station

Atmospheric Transport from Hartlepool

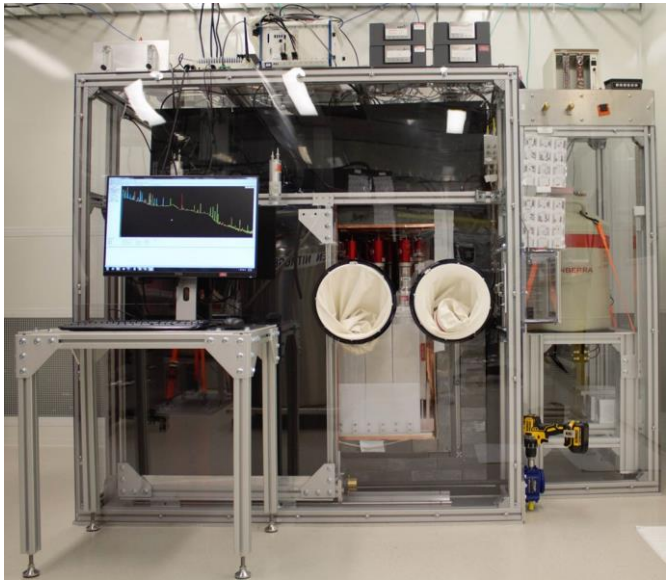


- Hysplit simulations using one year of metrological data archived on a 25 km, 3 hr basis
- 11 GBq 12 hr release of radioxenon
- 0.4 mBq/m^3 MDC for 12 hr collection
- XENAH plans to deploy detectors at Boulby, Sedgefield/Durham, and a 3rd location further away

Radionuclide measurement of environmental and regulatory samples taken at or near the power station

- First samples were EDF regulatory filters and charcoal
- Short-lived isotopes will have to come from samples collected for purpose
- AWE has a low-background detector system at nearby Boulby Mine facility; PNNL has a low background detector system at its Shallow Underground Laboratory

* See J. Burnett poster P2.4-308 for details



Low-Background Detector System in PNNL's Shallow Underground Laboratory

Current Timeline

		Jan-Mar	Apr-June	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
		2021				2022			
SAUNA QB	AWE								
	PNNL								
	FOI								
Env Sampling	AWE								
	PNNL								
stack monitor	PNNL								

Equipment Arrives

Equipment to Hartlepool

Measurements

Watch for our results after measurements complete in 2022!

Questions?

Contact: Brian.Milbrath@pnnl.gov

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