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Source Term
Analysis of Xenon

Project Update

June 2022

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

History of STAX

- STAX was developed through discussions at WOSMIP
  - Stack data with ATM can improve nuclear explosion monitoring
  - HPGe stack detection systems could provide useful info for production facilities
  - STAX project guidelines came from NDC discussions

wosmip
WORKSHOP ON SIGNATURES OF MAN-MADE ISOTOPE PRODUCTION

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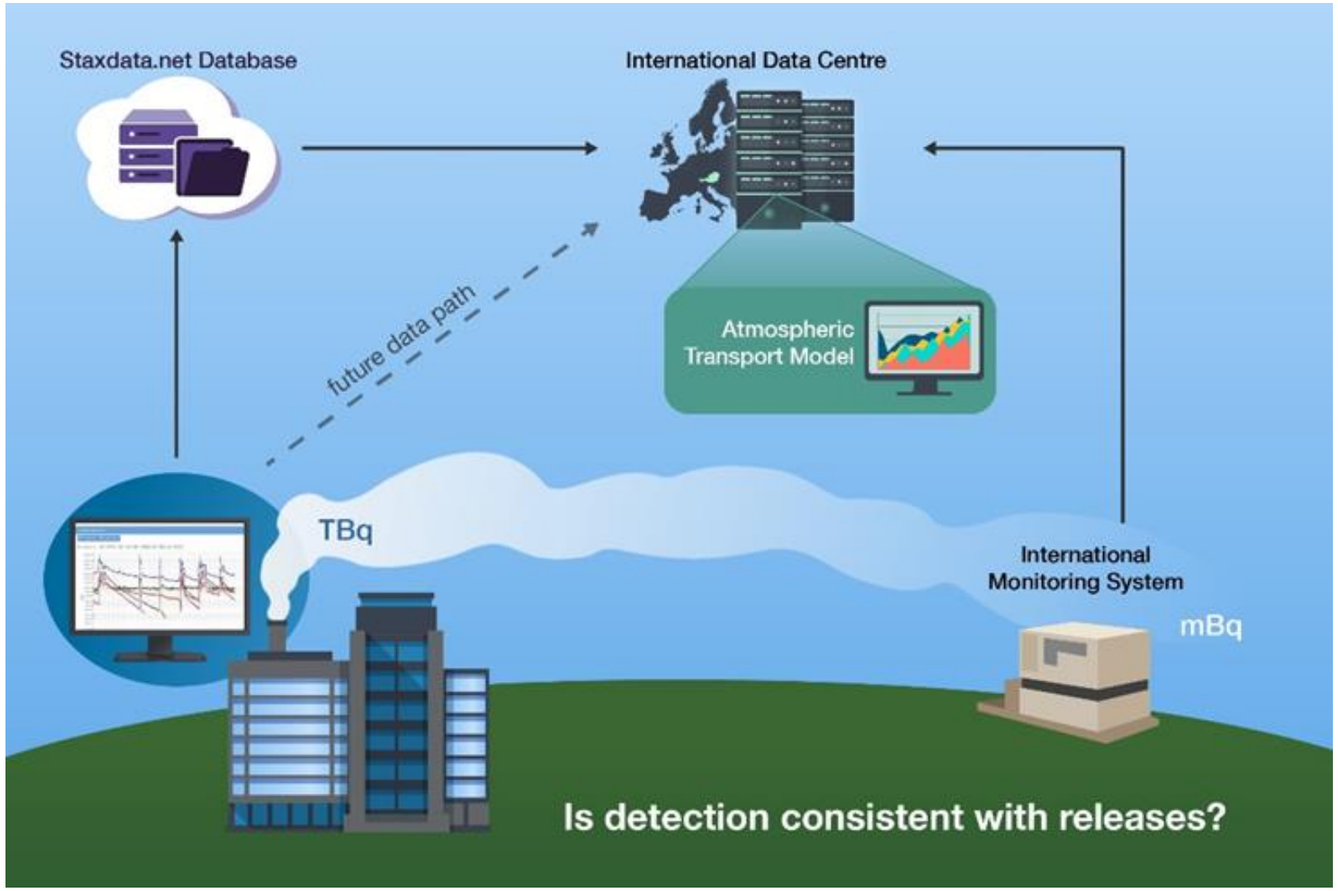
The STAX project is…

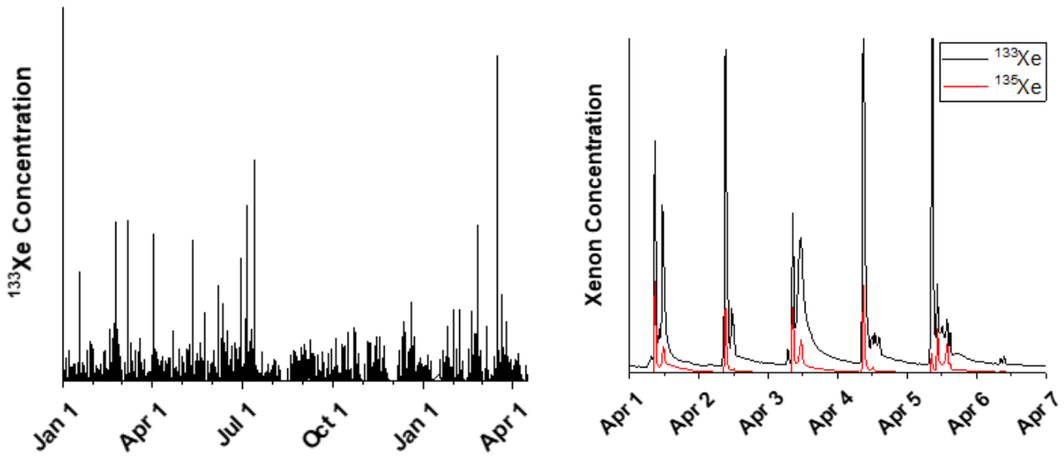
- Establishing voluntary partnerships with facilities
- Purchasing and installing slightly modified commercially available stack monitoring systems in facilities
- Maintaining and optimizing system performance
- Developing data sharing agreements with facilities and NDCs to control access to data
- Developing tools to view, access, and use the data



Update in Belgium

- A Mirion built system was installed in IRE in December 2017
- Radioxenon emission data collected every 15 min is automatically transmitted to www.staxdata.net via encryption
- Some equipment maintenance has been required
- Data sharing ongoing with NDCs
  - Belgium, Canada, France, Germany, U.S., UK, Palau
- Recent and upcoming publications in the Journal of Environmental Radioactivity
  - Analysis of Environmental Radioxenon Detections in the UK, M. A. Goodwin, A. V. Davies, R. Britton, AWE, UK
  - Use of STAX data in global-scale simulation of ^{133}Xe atmospheric background, S. Generoso, P. Achim, M. Morin, P. Gross and G. Douysset, CEA, France
  - Trends, events and potential sources of Xe-detections in the German radioxenon network A. Bollhöfer, S. Brander, R. Krais, S. Schmid, O. Ross, C. Schlosser, BfS, Germany

High-purity germanium (HPGe) detector installed in IRE

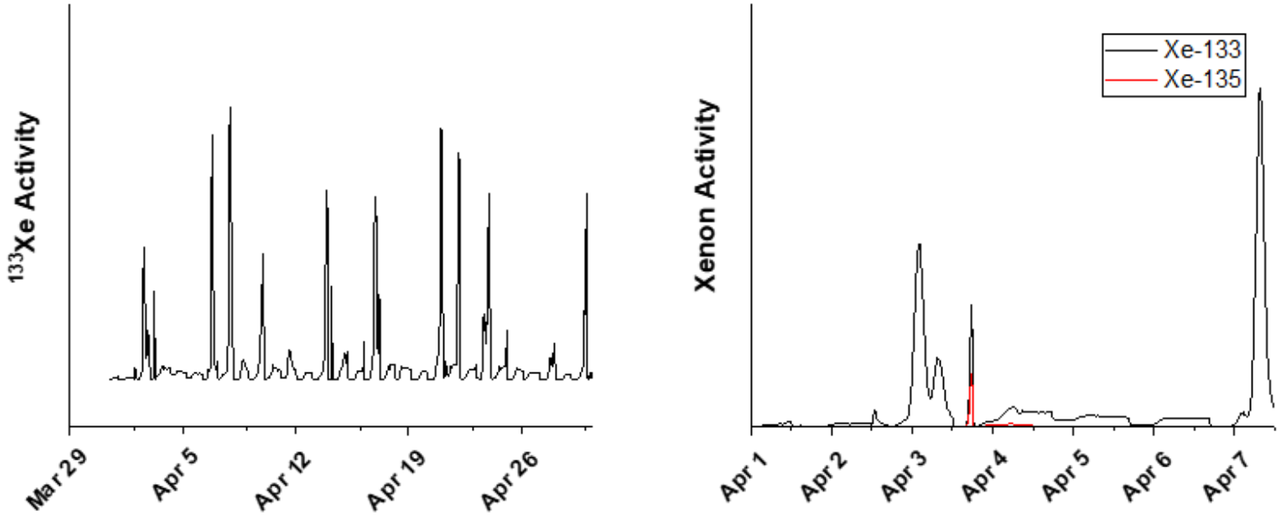


Left: 133Xe concentration for 2019. Right: 133Xe and 135Xe concentration for April 1-7

Update in Australia

- A Mirion built system was installed in ANSTO in October 2018
- System operating well
- 15 min data automatically transmitted to www.staxdata.net via encryption
- Working to edit data sharing agreement to allow access by NDCs

High-purity germanium (HPGe) nuclear detector installed in ANSTO

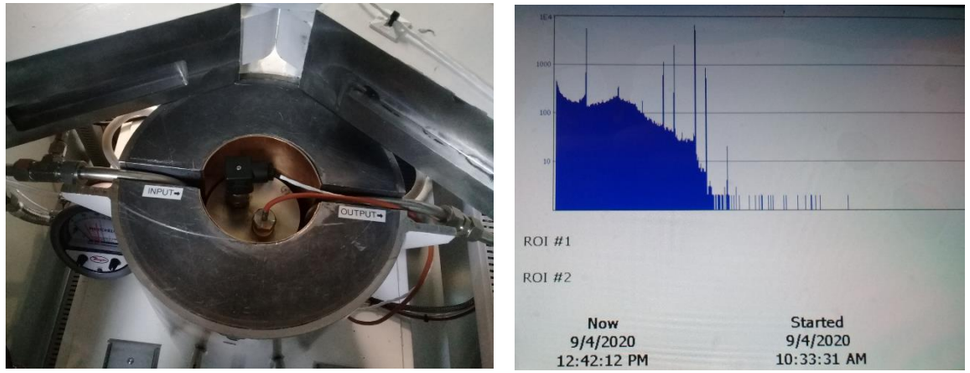


Left: 133Xe Activity for April 2019. Right: 133Xe and 135Xe activity for April 1-7

Update in Argentina

- In September 2018, INVAP initiated the designing and building of the detector system
- In August 2021, the system was installed in CNEA facility for testing
- This year the details of a formal collaboration with CNEA are being developed

High-purity germanium (HPGe) detector installed in CNEA



Close-up view of the STAX HPGe system and examples of first data collected by the system

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Update in the U.S.

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- Mirion built system installed at Niowave in March 2021
- VF Nuclear built system installed in SHINE in June 2022
- Data being automatically transmitted to database
- Data sharing agreements will be established when activities ramp up at the facilities

Mirion High-purity germanium (HPGe) detector installed in Niowave

VF Nuclear High-purity germanium (HPGe) detector installed in SHINE

Data from Nuclear Power Plants

- STAX system temporarily installed at Hartlepool NPP in the UK in September 2021 as part of XENAH
  - Data is manually transmitted to www.staxdata.net via encryption
- Forsmark NPP started sharing data with STAX in March 2021

- Data comparison of MIP and NPP
  - NPPs are not constant on a large time scale
  - NPPs release much less than 1E9 Bq/day but can release more when doing something other than power production

VF Nuclear High-purity germanium (HPGe) detector installed at Hartlepool

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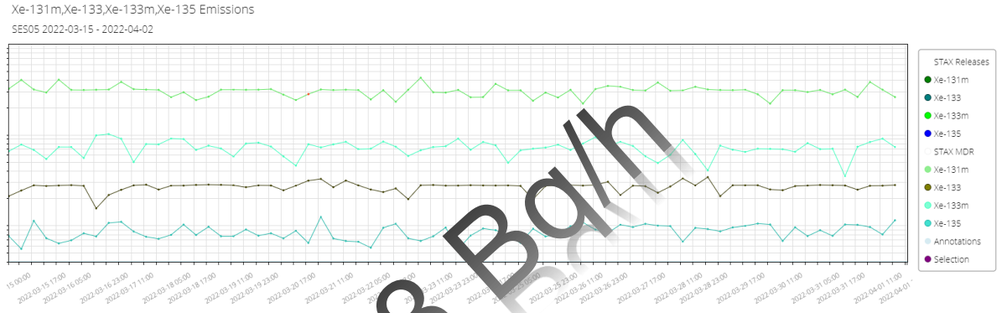
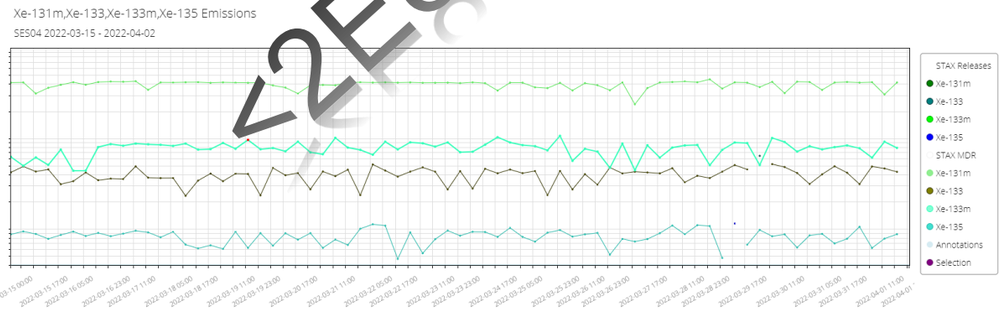
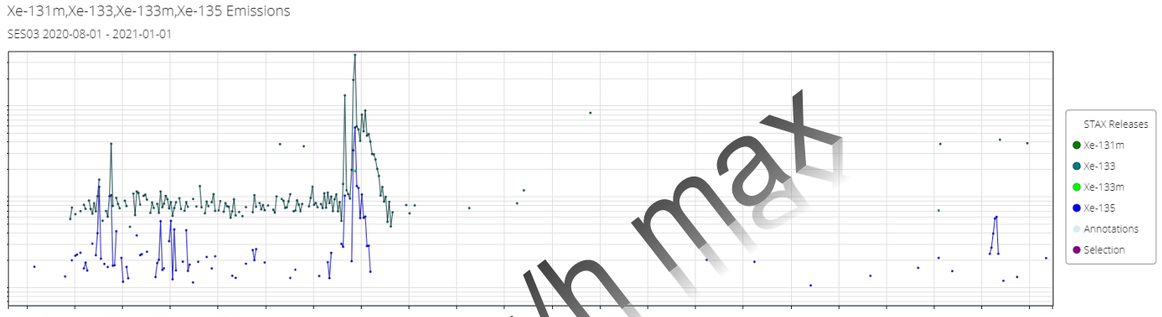
Hartlepool, UK

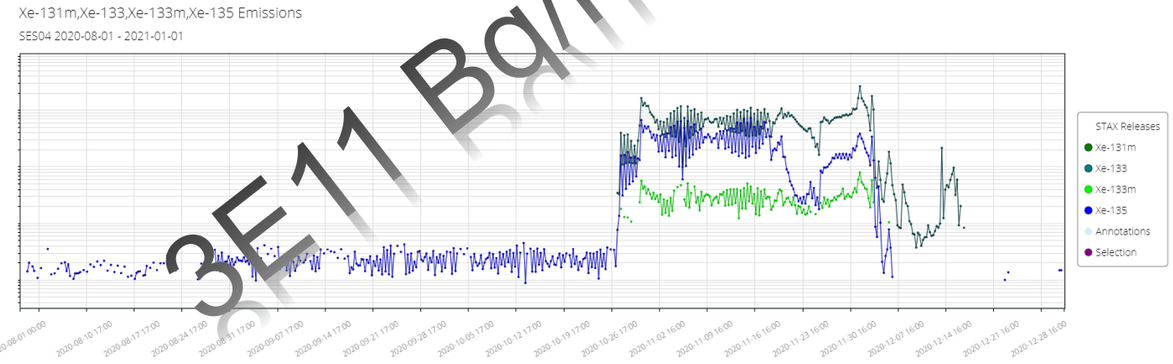
- NPP releases not constant 1E9 Bq/d
  - Nothing released (<2E8 Bq) under typical operations
- Periodic (few times a year) releases will be roughly 10% of MIPF

Forsmark, Sweden



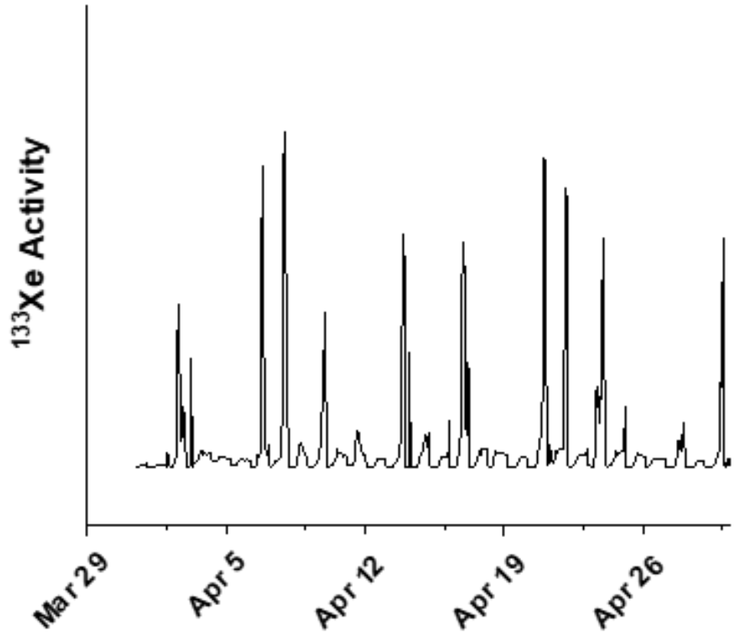


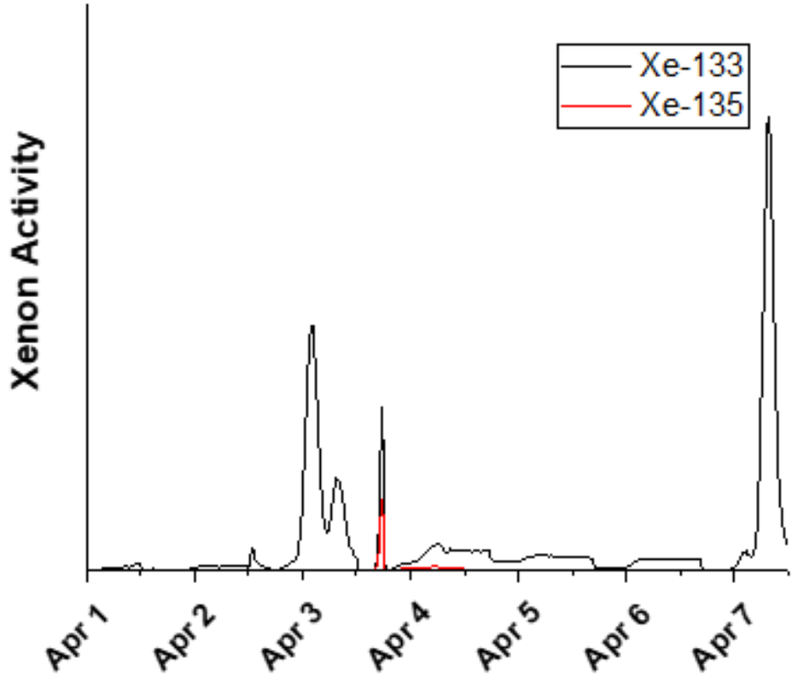




Contrast to MIP

- MIPF range from 5E11 to 7E12 Bq/h peak releases daily
- For ATM…
  - For NPP, wind direction AND release amount matter
  - For MIPF, only wind direction matters as release are enough to be detected every day.





Next Steps

- Remaining STAX Phase 1 activities (ending September 2023)
  - Additional installs
    - System being purchased for CCHEN in Chile
    - Ongoing discussions with additional facilities
  - Continued data review and system maintenance
  - Continued data sharing
  - Development of tools to help streamline data use

- Planning is underway for STAX Phase 2
  - Focused on continued system maintenance and data sharing

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Thank you