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First results with INVAP STAX monitor

Fernandez Baldis, F.[1]; Di Tada, M.[2,3]; Nuñez, M.[1]; Pino, R.[1]; Zapata, A.[1]; Nassif, E.[1]; Sagarzazu, R.[1]; Boccoli, H.[1]; Carranza, E.[4]

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POSTER

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ABSTRACT

A general description of INVAP STAX monitor final status is shown, including calibration and software/hardware configuration. The equipment is mainly focused to low flow rate and high activity concentration emissions.

In the near future the INVAP STAX monitor will be installed and measuring in a real Noble Gas emission environment, at Ezeiza Atomic Center, CNEA, Buenos Aires, Argentina.

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INTRODUCTION

About INVAP

- 40 years of experience in Nuclear Industry
- More than 10 Research Reactors (RR) and Medical Isotope Production Facilities (MIPF) built around the world
- Nuclear Instrumentation and Radiation Monitoring Systems (RMS)
- Equipment oriented to measure gaseous releases

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INTRODUCTION

INVAP's integration facilities

Integration of the STAX monitor

Integration of radars

Integration of air effluent monitors

Integration of satellites

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INTRODUCTION

INVAP's MIPF projects

- Radioisotope Production Facility at Inshas, Egypt
  Associated with the ETRR II (Egyptian Test & Research Reactor supplied in 1998)
  200 Ci Mo-99 batch (six days pre-calibrated)
  Delivered 2013
- Retrofit with a new process existing infrastructure of operating Hot-Cells by ANSTO Australia 2006
- Radioisotope Production Facility at Mumbai, India
  300 Ci Mo-99 batch (six days pre-calibrated)
  Delivered 2019
- RMB RR (Brazil) for CNEN (30 MW, Open Pool) - In Progress
  Up to 3000 Ci (Mo-99) per irradiation position at the end of irradiation
- RA-10 RR (Argentina) for CNEA (30 MW Open Pool) - In Progress
  Up to 4000 Ci (Mo-99) per irradiation position at end of irradiation

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INTRODUCTION

INVAP's noble gas measurement heritage

NURR Algeria (1991)
Aerosols: gross β
Iodine: ^{131}I
Noble Gases: gross β

ETRR 2 Egypt (1998)
Aerosols: gross γ
Iodine: ^{131}I
Noble Gases: gross γ

OPAL Australia (2006)
Aerosols: gross β/γ
Iodine: ^{131}I
Noble Gases: gross β/γ and ^{41}Ar

RPF Egypt (2013)
Aerosols: off-line
Iodine: off-line
Noble Gases: NaI(Tl), ^{133}Xe and ^{135}Xe

RPF India (2018)
Aerosols: off-line
Iodine: off-line
Noble Gases: NaI(Tl) and CdTe
γ spectrometry

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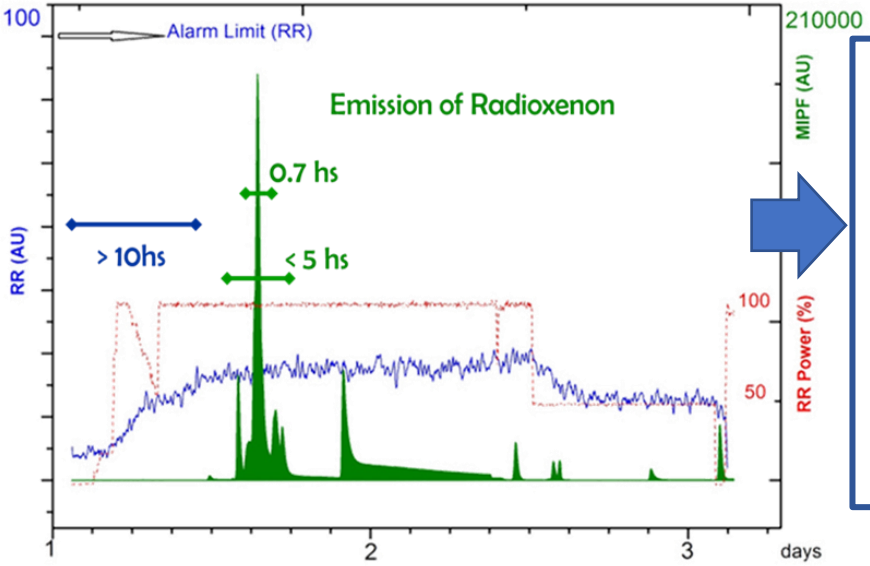
METHODS

MIPF's stack release monitoring…a specific challenge

Special requirements in terms of sensitivity and dynamic range, together with energy discrimination capabilities on Xenon isotopes



Comparison of stack releases between RR and MIPF

- ❑ Discontinuous Regime
- ❑ Pulsed Batch Emissions
- ❑ Short Follow-up Periods required
- ❑ Customized Sampling Systems
- ❑ Very High Noble Gas Activity Concentrations

This is particularly demanding in case of Radioisotope production plants with low dilution (low stack flow rates = 10^2 to 5×10^3 m^3/h)

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METHODS

MIPF´s Xenon Releases…some figures

MIPF´s emission objective : < 5 x 10^9 Bq/day

Research Reactors:

^{133}Xe + ^{135}Xe ~ 10^9 Bq/day
^{41}Ar ~ 10^{10} Bq/day

Nuclear power plants (normal operation) ~ 10^{12} Bq/day

Target to RXe´s high activity concentrations MIPF plants releases*:

***Low dilution emission facilities (~10^2 to 5 x 10^3 m^3/h):**

…above 10^{10} Bq/day…(^{133}Xe ~ > 5 x 10^{11} Bq/day)

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METHODS

The STAX monitor by INVAP

Main features

- Compact ("all in one" rack)
- Ergonomically simple (easy maintenance & transport)
- Oriented to low flow rate stack and high activity concentration emission Plants

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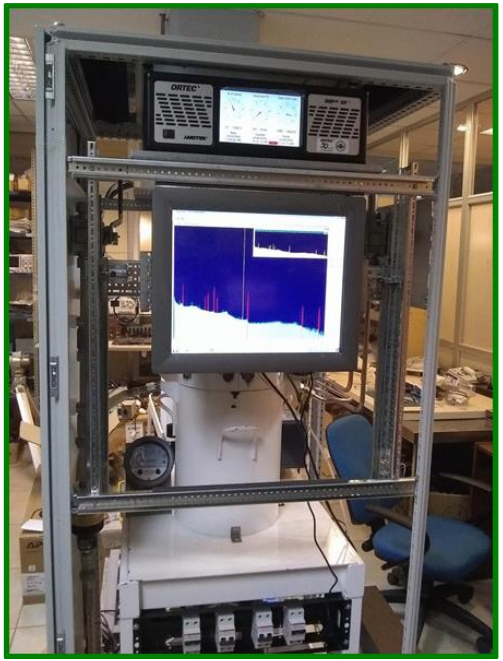
METHODS

The STAX monitor by INVAP

Main features

- Panel PC with touch screen
- Screen lift system for more comfortable operation & mantainance



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The STAX monitor by INVAP

Main features

- Tilting electrical panel for an easier and safer maintenance
- Quick filter replacement procedure

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METHODS

The STAX monitor by INVAP

Main features

- Top opening low background shield with easy access to Noble Gases measurement chamber
- Integrated cooling system LN_2-free for HPGe detector

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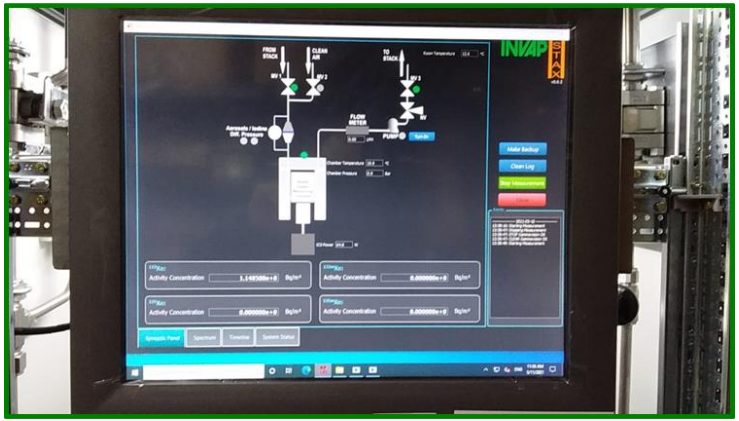
METHODS

The STAX monitor by INVAP

Main features

- Proprietary software for control, monitoring and communication
- User friendly HMI
- Relational database for relevant data storage



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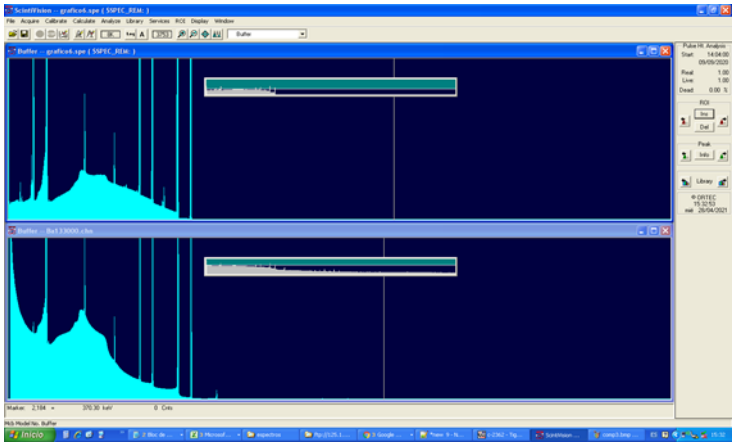
The STAX monitor by INVAP: First Results & Performance

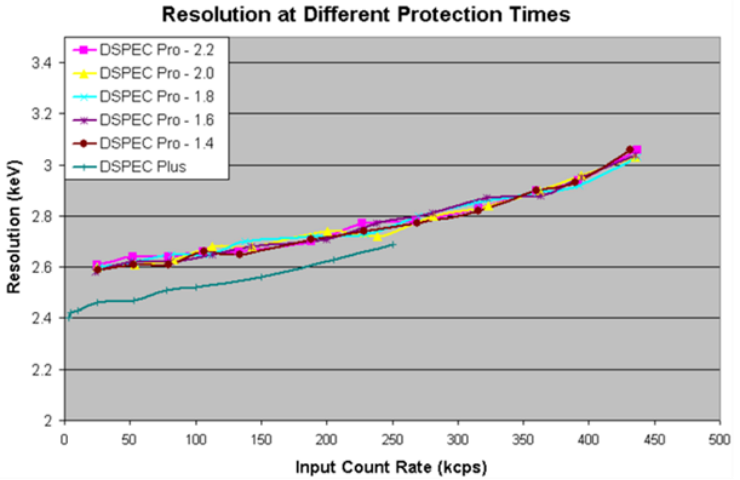
RESULTS

***NOTE**: The results being presented here correspond to STAX monitor lab test performed at INVAP facilities with "gas like" radioactive calibration sources (^{133}Ba & ^{152}Eu).*

Due to delay caused by Pandemic transport & circulation restrictions in Argentina, the measurement campaign at CAE/Ezeiza Fission Production Facility (CNEA), is currently delayed. Nevertheless, it is foreseen that the monitor can be finally installed at this facility during August 2021.

MCNP simulation for STAX geometry with ^{133}Ba calibration source, compared to Spectra





DSPEC 50A improved throughput and energy resolution by ORTEC's Enhanced Throughput Mode

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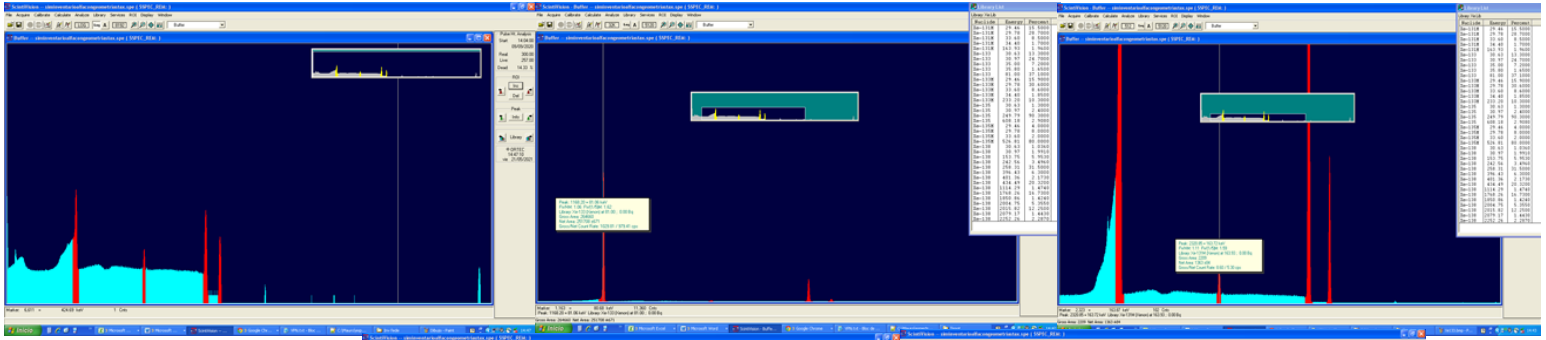
The STAX monitor by INVAP: First Results & Performance

RESULTS



Real Stack inventory
MCNP simulation -
4 RXe's detection
with STAX geometry

- Range (^{133}Xe) ~ 10^4 - 10^{11} Bq/m^3 (estimated)
- Sensitivity (^{133}Xe) ~ 5.5 x 10^{-3} cts/Bq (approx.)

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CONCLUSIONS

The STAX monitor by INVAP

Next steps

- Installation at Ezeiza Atomic Center's MIPF (CNEA)
- Commissioning and calibration
- RXe's release measurement in a real environment
- Automatic data transmission

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Background at WOSMIP and SnT conferences

- WOSMIP 2012, Italy
  "Optimization of a Gaseous Effluent Stack Monitor to measure RPF´s emissions"
- WOSMIP 2013, Austria
  "Stack Monitor for IPF´s emissions"
- WOSMIP 2015, Belgium
  "Stack Monitoring System for Gaseous Emissions in Radioisotopes Production Facilities"
- SnT 2015, Austria
  "Measuring Radioactive Emissions in Gaseous Effluents at Medical Isotope Production Facilities"
- WOSMIP 2016, Argentina. Hosted by INVAP at Bariloche.
  "Stack Air Effluent Monitor: present and future"
- INGE 2017, United Kingdome
  "Results of measurements of the CdTe and NaI(Tl) detectors of the new AEM in a real stack environment"
- SnT 2017, Austria
  "Start-up and calibration of INVAP stack air effluent monitor"
  "Experience as a significant tool for the design of gaseous effluents stack monitors"
- WOSMIP 2018, Australia
  "Tailored designed stack monitor for STAX project"
  " IPF Gaseous Effluent Stack Monitor Calibration With Customized Detection Geometries and Tailored Gas-like Sources"
- SnT 2019, Austria
  "Status of the stack monitor for the STAX project"
  "Data processing modular software for real-time stack monitor"
- WOSMIP 2020, remote
  "INVAP's Progress with the STAX System"
  "INVAP Virtual Tour"