T2.4-P4

Experience as a significant tool for the design of gaseous effluents stack monitors

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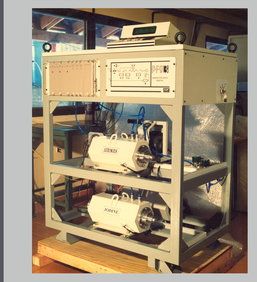
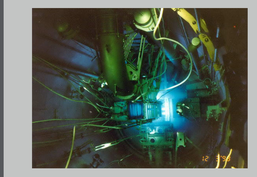
Abstract

INVAP has a 25 year experience in the design, construction and start-up of stack gaseous effluent monitoring systems. The hands-on knowledge acquired during these years has allowed to reach a modular, versatile and multipurpose product, that can be installed either in RPF, Nuclear Research Reactors or any other nuclear facility. The stack gaseous effluent monitor has been optimized for the real-time measurement the radioxenon releases to the atmosphere. Characterization of emissions from RPFs is of great interest for CTBT, given its need to know the atmospheric background because the fact that RPFs are the responsible of most of the produced background. This poster presents the evolution of the **INVAP** stack monitor. The main features taken into account in the optimization of the design are described following the historical evolution of the monitoring system.

First Generation of AEM for Research Reactor





- First generation of gaseous effluent monitors installed in the **NUR reactor in Algeria** (1989) and **ETTR-2 reactor in Egypt** (1998).
- The monitor included three dedicated measurement channels:
  - **Iodine:** 1.5″x2″ NaI detector with a SCA for analysis of ^{131}I.
  - **Aerosols:** Plastic Scintillator for gross β.
  - **Noble Gases:** Plastic Scintillator for gross β.
- All channels worked continuously and on-line
- The monitor was controlled by a microcontroller-based CPU which was developed by **INVAP**.
- These were the first experiences of **INVAP** in the development of stack gaseous effluent monitoring systems.

Second Generation of AEM for Research Reactor

- Second generation of AEM installed in the research reactor **OPAL in Australia** (2007).

- The monitor included three dedicated measurement channels:
  - **Iodine:** NaI detector.
  - **Aerosol:** NaI detector for gross γ and Plastic Scintillator for gross β.
  - **Nobel Gases:**NaI detector with particular interest in the measurement of ^{41}Ar and Plastic Scintillator for gross β
- All channels worked continuously and on-line.
- The monitor was controlled with a single board computer.
- This monitor featured an improvement in the automation of the process of opening and closing the electrovalves, increasing the safety of the operator in the filter replacement process.

First Generation of AEM for Radiosotope Plant Prodution

- First generation of AEM designed exclusively for use in Radioisotope Production Plants.
- This monitor is operating in the **RPF facility in Egypt** (2007)
- It was optimized to cover the characteristic emission rates, produced by fission radioisotopes production facilities..
- This monitor includes an on-line and continuous noble gas measuring channel that uses a 3″x3″ NaI detector.
- Aerosols and Iodine are collected continuously in a two redundant lines system with corresponding filters.
- This was the first experience of **INVAP** in the design, construction and commissioning of stack gaseous effluent monitoring systems dedicated to Radioisotope Production Plants.

Second Generation of AEM for Radiosotope Plant Prodution

Figure 1: Measurement rack

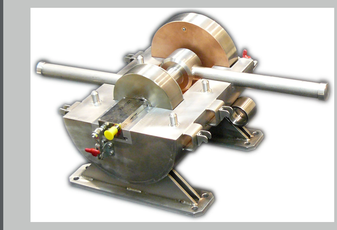


Figure 2: CdTe noble gas chamber

Figure 3: New Software

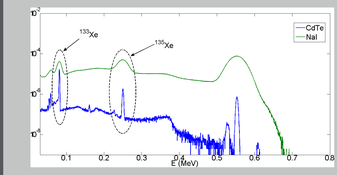
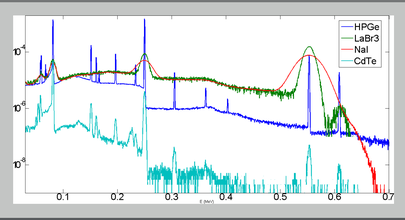


Figure 4: Monte Carlo simulation with real emission inventory

- Experience gained with previous gaseous effluent monitors has been used as a base for the development of the second generation monitors for radioisotopes production facilities.
- After the start-up of the stack gaseous effluent monitor in the RPF of Egypt, the need to increase detection limits became evident. This is due to the batch-like emissions of these plants, which can have high rates of discharges in short time periods.
- In the new design, noble gases chambers have been optimized to cover all the discharge range. It also includes redundant sampling lines for Aerosols and Iodine with corresponding filters.
- The noble gas channel uses a $3''x3''$ NaI detector and a semiconductor detector of CdTe.
- NaI detector is used to measure at low activity concentration in the range of $1 \cdot 10^7$ to $5 \cdot 10^{10}$ Bq/m^3 in the stack.
- CdTe detector has higher resolution and allows detection limits between $5 \cdot 10^{10}$ to $1 \cdot 10^14$ Bq/m^3 in the stack.
- Monte Carlo simulations have been performed in order to optimize the noble gas chambers geometries to get better quality measurements.
- The processing of the signals of the detectors is performed by digital electronics.
- An industrial PC, with a new version for the software allows the semi-automatic operation of the monitor.
- All the monitor-realted operations are performed in a touch-screen.

Third Generation of AEM



- Work is under progress in order to add a new monitor based on high resolution gamma detection systems to the family of intelligent gaseous effluent monitor.

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