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Analysis of air discharges from a radiopharmaceutical production center based on a cyclotron

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1. INTRODUCTION

Inside a PET (Positron Emission Tomography) center provided with cyclotron is usually made an automatic control of air concentrations to assess dose to workers and population. Samplings are performed at the outlet of the chimney, inside the cyclotron vault during and after the irradiation, on hot cells release, inside a radioactive waste storage, and so on.

The frequency of sampling can be set as continuous with respect to the chimney discharge and cyclic for other areas (e.g. 1 minute every 8 minutes). The gamma-ray spectrometric measurement are generally made on-line and for a short time (1 min.) by using a Marinelli beaker filled with sampled air and a shielded NaI(Tl) 2"x2" scintillator (Fig. 1).

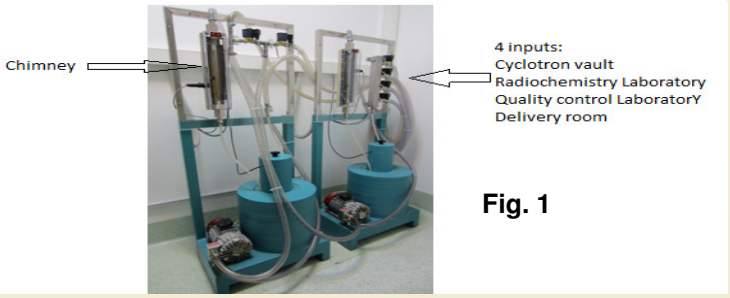

Fig. 1

An automatic analysis based on counting values in specific ROIs (one Region Of Interest for the photopeak, two ROIs for background) allows to determine a concentration value to be compared with limit values in order to generate suitable alarms. Fig. 2 shows a schematic diagram of an air monitoring system used iinside an operative Nuclear Medicine Center (NMC).

2. METHODS

The concentration values are very numerous (720 per day for the chimney) and a software analysis is needed. An average value per day was computed with the use of an home-made software, written in VISUAL BASIC language. The analysis of data allowed us to verify the compliance with potential dose constraints but also some criticalities of the system have been highlighted. For example, Fig. 3 shows an anomalous release from the hot cells during the synthesis procedure.

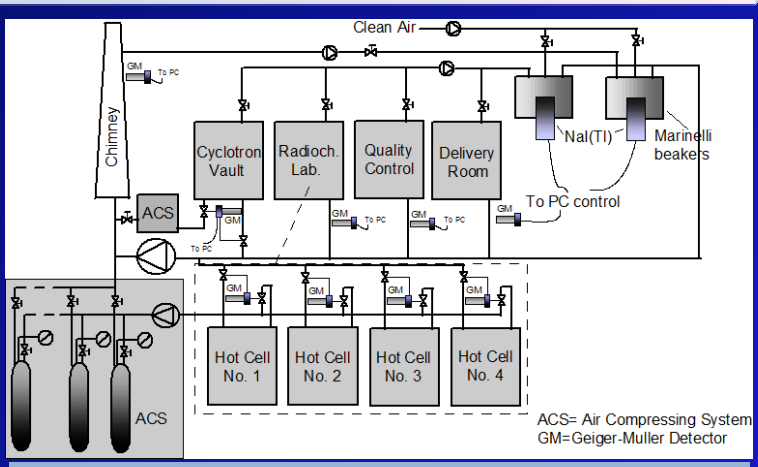

Fig. 2 – *Schematic of the air monitoring system and the proposed ACS improvements.*

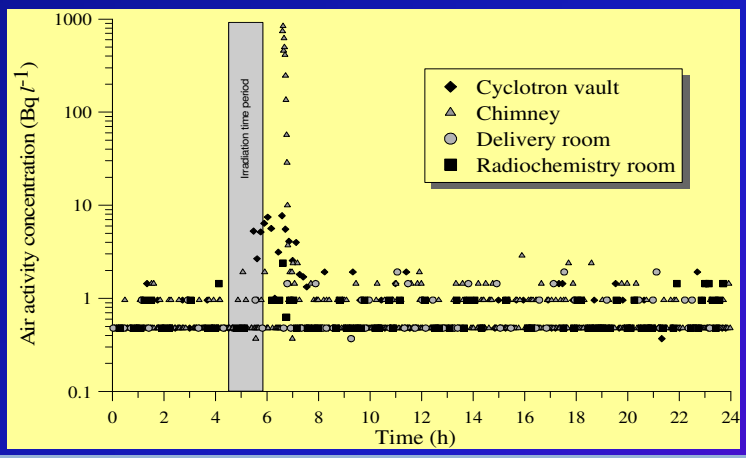

Fig. 3 – Time dependence of air activity concentration values.

3. RESULTS AND CONCLUSIONS

At the end of the study, the analysis of the anomalies suggests some possible improvements either on operative procedures of air monitoring system or on additional devices and precisely (with reference to the previous NMC center, see Fig. 2) :

- **Air Compressing Stations (ACS) for both Hot cells and Cyclotron vault release.**
- **A block of air recirculation inside the cyclotron vault for at least 4 hours after the end of irradiation.**
- **A delay line (a pipe long enough to delay the release of contaminated air from the chimney of at least 4-6 h).**

In this way is ensured, for all examined scenarios, the respect of a potential dose limit value to the surrounding population.