Alternative *on-line* cyclotron beam-intensity and exposure-rate levels operative monitoring

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INTRODUCTION

Present contribution describe efforts at the Cyclotron Sections, La Reina Nuclear Center, Chilean Nuclear Energy Commission (CCHEN), to take advantage from data being produced during target irradiation to monitor other well behaved cyclotron's parameters. Cyclotron operators considers as advantageous and always necessary to have an alternative and indirect ways to track irradiations parameters such beam intensity on target.

In this work, we show a simple method to provide additional, instantaneous exposure-rate data to be interpreted as an indirect beam-on-target probe, and viceversa. The exposure-rate data monitoring allow you to obtain an inside vault irradiation radiological-profile during target irradiation.

Sure enough, you wonder, why you would want to consider vault readings when operationally exposed personnel never are present, inside the vault, during an irradiation. We have found the most reliable exposure-rate detector and corresponding target intensity relationship to occur when esposure-rate detector is located inside vault. Other exposure-rate readings outside vault are affected by the presence of natural barriers most importants being high-density walls, additional shielding and distance. A reliable correlation between beam-on-target intensity and exposure-rate measured at areas such as accelerator Control Room is currently under progress.

M E T H O D

An inside cyclotron vault gamma-detector probe (Ludlum Survey Meter Area Monitor, LSMAM) at a selected angular position, 1.5 m over floor and 1.8 m distance from enriched water aqueous Fluoride-18 producing target, has been installed to monitor exposure-rate during irradiation. Several trials were performed to achieve best exposure-rate data detector-target geometry

The gamma-detector probe is operated through a new Remote Radiological Area Monitoring System (SMARR) resulting on instantly and continuos *on-line* radiological variables providing necessary support as required for radiological safety. For cyclotron operations, data from LSMAM are sent via RS-232 communication network and thus collected through SMARR on a PC running LabView program which depict, under real time mode, the inside vault generated signals graphically on-screen. The collected data is automatically stored on a server being available for later-on statistics and other data reduction and can be remotely accessed form any Red Lan PC terminal.

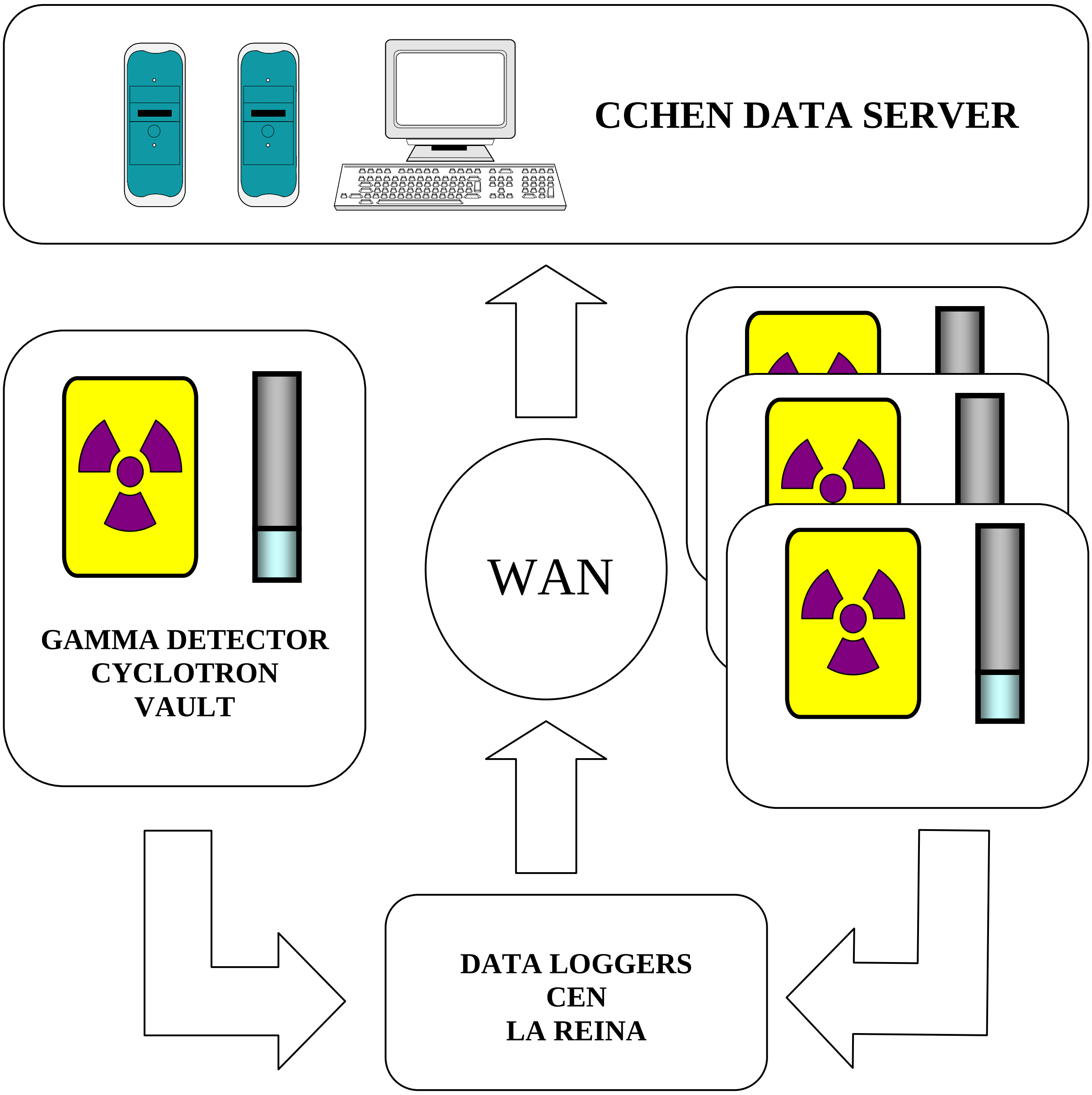

Figure 1.- The intranet network created for SMARR applications at CCHEN CEN La Reina used on this work

Other acelerator operational data such as stripper current and target pressure, can also be used if available and necessary. The beam-on-target and exposure-rate related pair seems to be an obvious choice, however.

RESULTS

Resulting exposure-rate curve as a function of irradiation time is converted to a graphical monitor screen output and compared with Real Time Display curve from Cyclotron General Layout screen under IBA's Cyclone 18/9 operation platform software (INTOUCH) see Figure 2.

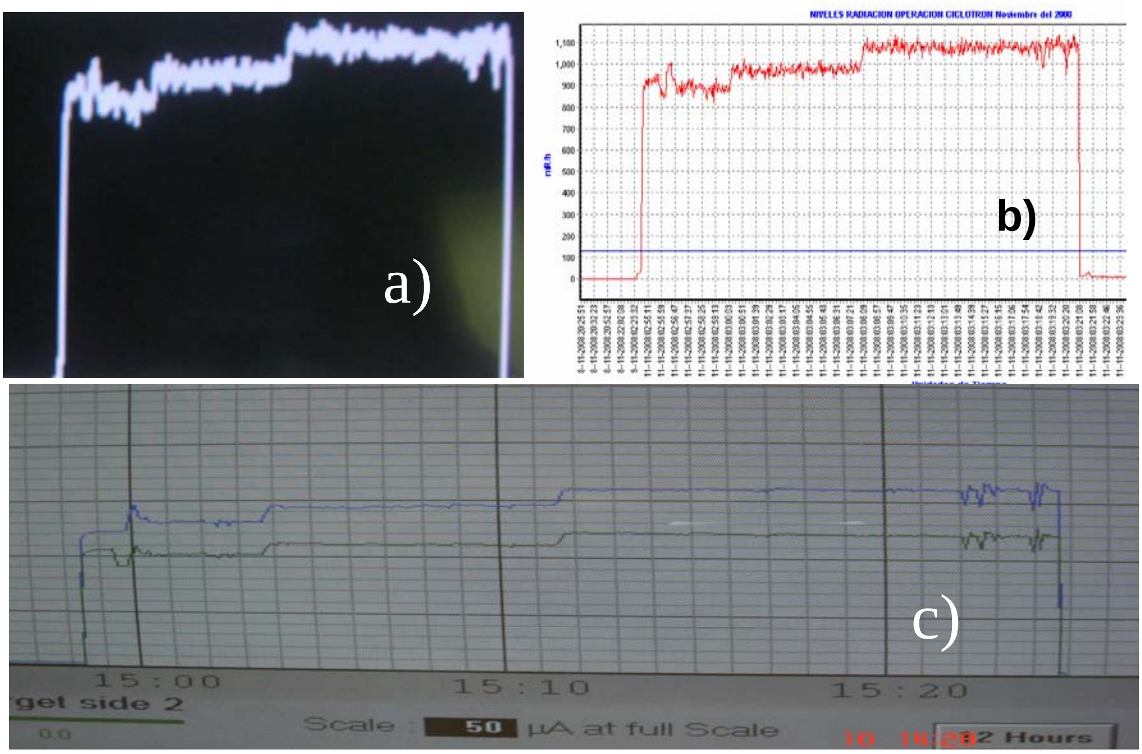

Figure 2.- a) Instantaneous and continuous exposure-rate monitoring, as displated on PC screen, from inside cyclotron's vault data during target irradiation. b) LabView plot display for collected data from LSMAM through SMARR network. c) Time dependent, both beam-on-target and stripper, intensities as a function of irradiation time as seen on IBA's INTOUCH screen.

Empirical data is used to estimate a proportionality digital coefficient to estimate from registered exposure rate an average value for beam intensity impinging on target and vice versa. A linear correlation for beam intensity on target (as related to FDG production demand) and measured exposure rate yields: $E_{rate} = 83.9I_o + 53.7$ Where E_{rate} = exposure rate (mR/h), I_o = beam intensity (µA) and $R^2 = 0.999$. The resulting reverse relationship is $I_o = 0.0119\ E_{rate} – 0.63$

C O N C LU S I O N

An easy to interpret, on-screen visually-catching and as well as an efficient indirect way to monitor both radiological parameters and beam intensity during irradiation as been tested and validated as fast and reliable alternative tool to help accelerator operators to make decisions.

These *on-line* beam-on-target monitoring results can be used as reference levels of radiation protection on low to medium energy accelerators facilities if no exposure detector are available at any given time during irradiation.

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R E F E R E N C E S

M. J. Avila Sobarzo, **Indirect, Although Redundant, But Still Useful Operational Data**. 6th IBA 18/9 and 10/5 PET Cyclone Users Meeting. 7th – 10th September, 2007. Seville, Spain.