WORKPLACE MONITORING AT ACCELERATOR FACILITIES USING THERMOLUMINESCENT DOSIMETERS

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ABSTRACT

The increasing use of high energy and intense particle accelerators in the development of industrial processes for reticulation, polymerization and sterilization of wires and cables has brought the importance of detection and workplace monitoring at accelerators facilities into the Instituto de Pesquisas Energéticas e Nucleares - Comissão Nacional de Energia Nuclear, IPEN-CNEN/SP. According previous measurements carried out by technicians in a routine monitoring, the radiation dose in beam tube and room accelerator door is high enough to demand a routine program of workplace monitoring of the facility. For this reason, fifteen thermoluminescent dosimeters (TLD) were located at various points of the plant where the dose should be measured, for a period of 3 months and then readout at the same time of the control dosimeter which was maintained in a shielded containment. The monitor consisted of a small double layer containing three TLD $CaSO_4$: Dy pellets inside an outer holder adopted in routine personal dosimetry normally. The obtained results show that the radiological protection program must be implemented in order to improve safety procedures and to ensure the health physics design of the workers.

INTRODUCTION:

Departamento de Aplicações na Engenharia e Indústria (TE) do Instituto de Pesquisas Energéticas e Nucleares – Comissão Nacional de Energia Nuclear, IPEN-CNEN/SP has two linear electrons accelerators from Radiation Dynamics, Inc. (RDI) used for wire and cable insulation crosslinking, vulcanization of rubber, sterilization and disinfection of medical disposable and foodstuffs. The first is a Dynamitron Job 188 (1,5 MeV, 25 mA) that came into operation in 1978. The second, a Dynamitron Job 307 (1,5 MeV, 65 mA), commenced operation in 1996. Since 1978 operational requirements of radiological protection has been carried out which include the observation of high radiation levels, shielding studies, facility design, personnel access control, radiation dosimetry etc. However, the increasing use of high energy and intense particle accelerators in the development of industrial processes to Brazilian community had brought the importance of detection and workplace monitoring in the accelerator facilities. The purpose of this investigation was to evaluate the exposure level for electromagnetic radiation in different places of the plant in order to optimize radiation protection program.

MATERIAL AND METHODS:

Fifteen (15) thermoluminescent dosimeters (TLD) were located in different points of accelerator facilities in order to obtain useful information in the evaluation of exposure level for electromagnetic radiation. Figure 1 shows the location of the measurement places.

The dosimeters were located in:

A- Exhauster
B- Air inlet
C- Air outlet
D- Inlet and outlet of cables (accelerator 1)
E- Inlet and outlet of cables (accelerator 2)
F- Beam tube 1
G- Beam tube 2
H- Staircase (accelerator 1)
I- Staircase (accelerator 2)
J- Behind oscillator unit (accelerator 1)
K- Behind oscillator unit (accelerator 2)

L- Vault opening (accelerator 1)
M- Vault opening (accelerator 2)
N- Between the accelerators
O- Gallery

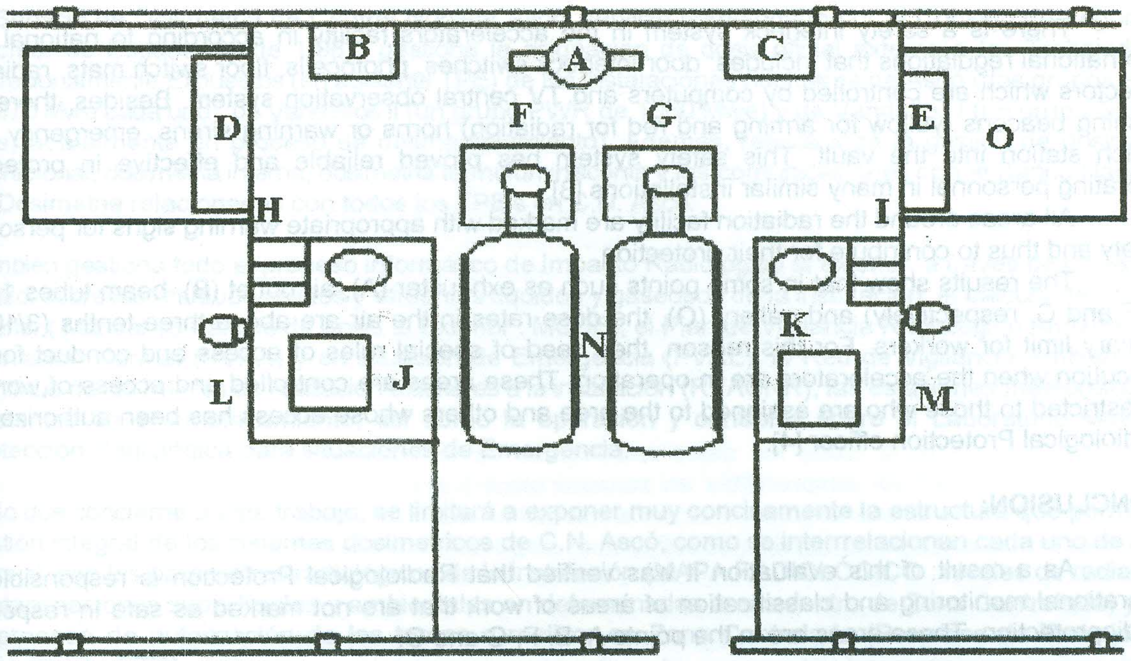

Figure 1: Accelerator facilities and measurement places

TLDs were placed in the field, at the point where the dose must be measured for a period of 3 months and then readout at the same time of the reference dosimeter that was maintained in a shielded containment. Each dosimeter consists of a small double layer of polyethylene containing three pellets of $CaSO_4$: Dy with a diameter of 6 mm and thickness of 0,8 mm. Different metallic filters are used for radiation attenuation [1]. $CaSO_4$: Dy pellets are preferred as dosimetrical detector because of its high sensibility, low cost and its ability to be easily manufactured [2]. Besides, it presents high-energy dependence response due to its high atomic number. At last, the polyethylene badge is placed in an outer holder normally used in routine personal dosimetry inside a transparent plastic bag to protect the dosimeters against humidity. The TL response was determined using a Harshaw model 5500.

RESULTS:

Measurement Place	Dose Rate (μGy/h)
Exhauster (A)	8,6
Air outlet (B)	11,2
Air inlet (C)	5,0
Outlet and inlet of cables 1 (D)	1,6
Outlet and inlet of cables 2 (E)	1,8
Beam tube 1 (F)	8,7
Beam tube 2 (G)	10,6
Staircase accelerator 1 (H)	0,97
Staircase accelerator 2 (I)	3,1
Behind oscillator unit 1 (J)	0,82
Behind oscillator unit 2 (K)	1,1
Vault opening1 (L)	1,5
Vault opening 2 (M)	3,0
Between the accelerators (N)	1,0
Gallery (O)	190

All sites are classified as areas of restricted access under Radioprotection point of view, because they show dose rates above one fiftieth (1/50) of maximum limit for workers.

DISCUSSION:

There is a safety interlock system in the accelerators facility in according to national and international regulations that includes: door interlock switches, photocells, floor switch mats, radiation detectors which are controlled by computers and TV central observation system. Besides, there are flashing beacons (yellow for arming and red for radiation) horns or warning sirens, emergency stop switch station into the vault. This safety system has proved reliable and effective in protecting operating personnel in many similar installations [3].

All areas around the radiation facility are marked with appropriate warning signs for personnel safety and thus to contribute for their protection.

The results show that in some points such as exhauster (A), air outlet (B), beam tubes 1 and 2 (F and G, respectively) and gallery (O), the dose rates in the air are above three-tenths (3/10) of primary limit for workers. For this reason, they need of special rules of access and conduct for job execution when the accelerators are in operation. These areas are controlled and access of workers is restricted to those who are assigned to the area and others whose access has been authorized by Radiological Protection officer [4].

CONCLUSION:

As a result of this evaluation it was verified that Radiological Protection is responsible by operational monitoring and classification of areas of work that are not marked as safe in respect to Radioprotection. These areas are in the points A, B, F, G and O.

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