RADIATION PROTECTION ASPECTS OF THE DECOMMISSIONING OF THE LINAC-ADONE STORAGE RING

M. Chiti and A. Esposito [1]
[1]INFN-LNF, 00044 Frascati, Italy

Introduction

An e^+ e^- collider, christened DAΦNE (Double Anular Φ factory for Nice Experiments), optimized for operation at a total energy of 1020 MeV, is under construction at the Frascati National Laboratories (LNF) of the National Institute of Nuclear Physics (INFN). The new machine will be placed into the existing buildings which in the past housed the Linac-Adone complex, which definitively ceased operation April 26th 1993 and was at once decommissioned.

The Linac-Adone complex has operated without stopping up to the 26th of April 1993 except for the ordinary maintenance periods.

It was composed by a Linac, capable of accelerating 100 mA of e^- beam peak current to 400 MeV and 1 mA of e^+ beam peak current to 365 MeV, in operation since 1964, and by an e^+ e^- storage ring capable of storing $2x10^{11}$ particles per beam at 1500 MeV, in operation since 1967.

Radiation safety standard and criteria for unrestricted release adopted at LNF

The objectives of radiation safety for the Linac-Adone decommissioning were:

- limitation of personal doses;
- control of radioactive materials either for reuse or for disposal;
- prevention of dispersion of radioactive material during handling and transportation to the final destination.

The limits for personal doses and radioactive material were taken from the recommendations of the Italian National Agency of Environment Protection (1) and from the law in force on the safety and health protection for workers and population against the danger of ionizing radiation field (2), as follows:

- the reference dose for people working in decommissioning areas was 15 mSv/y;
- a limit for unrestricted release for β–γ emitters was set at 1 kBq/m^2 for surface contamination and 1 kBq/kg for mass activity.

Preliminary measurements

Following the shut down of the Linac-Adone complex, the Health Physics Service carried out many measurements to find out the amount of dose rate along e^+e^- beam lines, the specific activity in dust, in cooling water and in metallic components of the machine, in order to obtain useful information for planning the decommissioning itself.

Gamma dose rates, using CaF_2 TLD dosimeters (bulb dosimeter mod. 4040 by Harshaw) and a Victoreen ionization chamber mod. 450 P, were measured along e^+e^- beam lines at the distance of about 30 cm from the machine. The results obtained, shown in Figure 1 stress that the dose rate values are higher than the background only near the positron converter and the final part of the e^- beam line before beam dump.

Liquid samples, collected from the primary cooling circuit of the machine supplied with aqueduct water and from the secondary circuit supplied with distilled or demineralized water show (Table I) an appreciable concentration of H-3, as expected, in cooling water of beam dumps.

Tab. I - Measured specific activity in water of Linac-Adone-Leale cooling circuits

Radionuclides	Co-58	Co-60	H-3
Cooling circuits	(Bq/l)	(Bq/l)	(Bq/l)
Linac-Adone primary cooling circuit			3.1±1.3
Linac secondary cooling circuit (5350 l)		1.47±0.07	21.9±1.6
Wiggler secondary cooling circuit (5500 l)		2.00±0.08	21.7±1.6
Adone secondary cooling circuit (5900 l)			20.8±1.6
Leale primary cooling circuit			18.8±1.7
Leale secondary cooling circuit S2 (1500 l)			30.8±1.8
Leale secondary cooling circuit S3 (1000 l)			7.4±1.6
Linac beam dump 1 cooling circuit (2000 l)		0.27±0.03	3.5E04±43
Linac beam dump 2 cooling circuit (6000 l)		1.38±0.06	3.4E04±42

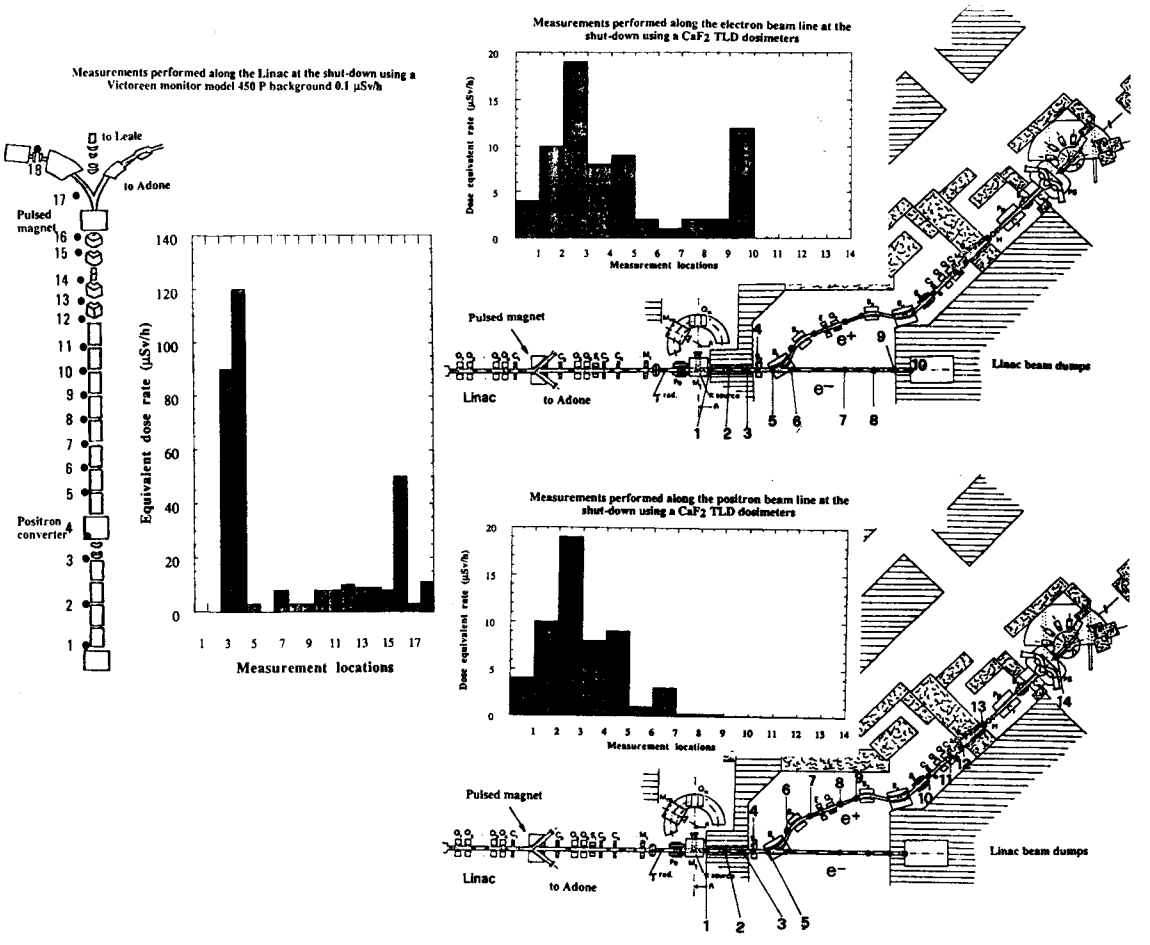

Figure 1 Dose equivalent rate from residual radioactivity

Dismantling of the machine elements and final cleaning

On the basis of the results of the preliminary measurements the decommissioning program, the handling and transportation of materials began and were completed in 3 months without particular protections for people involved except the use of personal dosimeters and disposable dresses used in dusty operations.

During the dismantling the following instruments were used for in the field measurements:

- two portable HpGe EG&G spectrometric systems;
- two environmental Reuter Stokes ionization chambers;
- a Victoreen 450 P ionization chamber;
- a Victoreen Frisker connected with a pancake probe;
- other useful monitors.

Two HpGe spectrometric systems in network with a 486 IBM PC were used for the quantitative analysis of samples.

Materials coming from Linac, including the 12 accelerator sections, the magnetic structures, the vacuum pipe line, the Linac-Adone transfer lines and 43 baskets, filled with remaining materials, were transported to the storage area without any quantitative measurements.

On the basis of the γ rate measurements it was clear that the most part of the materials had a concentration values higher than the clearance levels while the remaining ones not voluminous but very numerous, would have paralized uselessly all Health Physics Service γ ray spectrometric systems. More accurate measurements are foreseen for the future.