

April 5, 1991

## Standardization for Radiation Monitoring Equipment

R. May *R. May*

Several inquiries have been made regarding the process by which certain radiation monitoring instruments were selected for use at CEBAF. This note was written to provide information on the scope of the investigation which resulted in the selection of the Victoreen 471 (RF) air ionization chamber and the Bicon Microrem meter for routine use by the Radiation Control Group, Assigned Radiation Monitors and others designated by the Radiation Control Group.

The operational environment in which prompt radiation measurements are made at CEBAF is characterized by radio-frequency radiation and strong magnetic fields. In addition the prompt radiation is pulsed and, as a result, a loss in apparent sensitivity can occur. This loss is approximately proportional to the intensity of the radiation divided by the accelerator duty cycle. In an attempt to minimize these effects and still obtain a radiation measurement instrument sensitive enough to the radiation being measured, the Radiation Control Group undertook a review of commercially available equipment.

In general, equipment using geiger-mueller detectors was avoided. These are subject to severe dead time losses in pulsed radiation fields. Air ionization chambers for prompt photon radiation measurements, moderated BF-3 neutron detectors for prompt neutron measurements and scintillation detectors for the release of activated material were considered to be the functional basis for selection. The air ionization chamber should be insensitive to radio-frequency radiation up to approximately 10 mW per square centimeter and should have a 0 to 1 milliRoentgen per hour low scale. The neutron detector response should be tissue equivalent and a(n) optional or built-in scaler should be included. The scintillation detector should have a tissue equivalent response and a 0 to 20 microrem per hour low range.

The following manufacturers and associated model numbers were considered:

<u>Manufacturer</u>	<u>Instrument Model</u>	<u>Detector</u>	<u>Note</u>
Eberline Instruments	RO-2(A)	ionization	1,2,3
	RO-3(C,D)	ionization	1,3
	PIC-6B	ionization	1,3
	SPA-3 probe	scintillation	4
	SPA-6 probe	scintillation	
	ESP-1,2/NRD	neutron	

<u>Manufacturer</u>	<u>Instrument Model</u>	<u>Detector</u>	<u>Note</u>
Ludlum Measurements	12S, 19	scintillation	4
	12-4	neutron	
	9, 17	ionization	1,3
	44-2, 10 probe	scintillation	4
Bicron	Microrem	scintillation	
	RSO-5, 50, 500	ionization	1,2,3
	Micro analyst	scintillation	4
	G1,2,3	scintillation	4
Victoreen	471(RF)	ionization	
	440 RF/C	ionization	
	450	ionization	1,3
	470	ionization	1,3
	740	ionization	1,3
	478	neutron	
Nuclear Research Corp.	SM-200	ionization	1,3
	SM-400	ionization	1,3
	CP-10	ionization	1,3
	NP-2	neutron	
	NG-2	neutron	

**Notes:** (1) sensitive to radio-frequency coupling in counting circuit, (2) sensitive to magnetic fields due to magnetic range changing switches, (3) high range of first scale range greater than 1 milliRoentgen per hour, (4) energy dependence of detector unacceptable. No note implies that the instrument specifications are basically acceptable and may be selected for use after careful examination of features and the cost versus benefit of using one instrument over another.

It should be noted that many different types of instruments were already in use at CEBAF, having been procured by various groups and used beyond their calibration due date (or never calibrated at all). The Radiation Control Group has taken custody of these instruments, had them calibrated, and in some cases returned them to use with the appropriate calibration and training for the user. There are, therefore, several types of instruments in use or in our custody besides the Victoreen 471(RF) or the Bicron Microrem meter. Standard equipment for neutron monitoring will be selected after procurement and final evaluation of the neutron (channel) detectors to be used in the area monitors. The Radiation Control Group may evaluate additional instrumentation beyond the ones identified above for technical applicability to CEBAF specific needs as the lab grows in technical complexity.

Further inquiries should be directed to Robert May, Operational Health Physicist at 7632.