Modification of a Geiger-Muller Survey Meter for Continuous Usage

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Four Geiger-Muller (G-M) type survey meters were modified for continuous use in routine clinical monitoring and emergency preparedness situations. The meters were modified using readily available components from a local electronics store at minimum cost and labor. Simple wiring of each meter enabled them to operate on standard AC line voltage using a small DC transformer to supply adequate voltage to the unit and its nickel-cadmium (Ni-Cd) batteries. All units can be removed from the transformer and operated on the Ni-Cd batteries for routine monitoring. Most survey meters will operate continuously for over 48 hr before the Ni-Cd batteries need to be recharged. Pre- and post-modification meter calibrations indicate no change in instrument response. After 6 mo of testing the systems to determine reliability and constancy, all were found to be in good working order.

The survey meter is a main component of the radiation safety program of any nuclear medicine department, however, it is sometimes the most often neglected piece of equipment. One of the most common problems encountered by a health physicist or regulatory official during a routine inspection of a nuclear medicine laboratory is the malfunction of the laboratory's portable radiation survey meter due to dead batteries. Normally, these general survey instruments are routinely employed to monitor the laboratory and personnel for radionuclide contamination and penetrating radiation exposure hazards. Technicians, technologists and physicians are trained to properly operate and maintain such instruments, however, occasionally the instruments are accidentally left on overnight or for several days, resulting in the loss of available battery power. The survey meter is useless in the event of an emergency.

On-line AC powered area monitors used for measuring personal contamination and exposure levels are frequently employed in nuclear medicine "hot labs." The use of such equipment allows constant monitoring without the worry of expending batteries. However, these instruments are usually not designed for portability and, if so, are expensive to purchase. These can also be used for emergency monitoring of areas outside the department, provided AC outlets and suitable extension cords are readily available.

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A simple modification can be made to a standard battery operated G-M type survey meter to incorporate the use of Ni-Cd batteries and an appropriate recharger to allow continuous operation of the meter. The advantages to such a system are: (a) continuous area monitoring, (b) meters are readily available for surveying at full battery power when disconnected from the charging unit, (c) no routine battery replacement is required and (d) no safety violations pertaining to a nonfunctioning meter due to dead batteries will occur. All components can be purchased at the local electronics shop or supplied by the hospital's biomedical engineering section and can be installed with minimum labor and tools.

MATERIALS AND METHODS

Four survey meters representing different manufacturers, age of manufacture and battery supplies were selected to be modified for this project*. The modification of each unit consisted of installing a miniature phone jack on the instrument's control panel which was connected in parallel to the battery terminals of the survey meter (Fig. 1). The miniature jack acts as the junction point for the battery charger and the survey meter and, as such, allows for easy connection or disconnection of the recharger for routine portable survey meter applications. This simple arrangement permits contin-

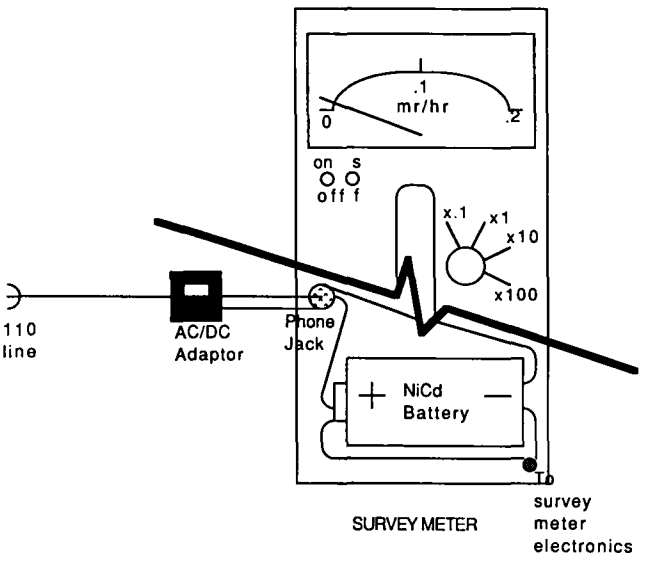

FIG. 1. Diagram for NiCd battery modification.

TABLE 1. Components for Meter Modification

Instrument	NiCd Batteries		Connector			
	Type	Qty	Recharger	Plug	Jack	Misc.
S-E International M-4	9VT (23-126)	1	8.1V-8 mA (23-131A)	1/8" (3.5 mm) (274-286A)	1/8" (3.5 mm) (274-251)	9V battery clip (270-325)
Eberline E-120	D	2	3V-200 mA (273-1435A)	1/8" (3.5 mm) (274-286A)	1/8" (3.5 mm) (274-251)	
Ludlum Model 2	D (23-123)	2	3V-200 mA (273-1435A)	1/8" (3.5 mm) (274-286A)	1/8" (3.5 mm) (274-251)	
Civil Defense Meter CDV-700	D	4	6V-300 mA (273-1650)	1/8" (3.5 mm) (274-286A)	1/8" (3.5 mm) (274-251)	

Note: Part numbers in parentheses refer to Radio Shack stock numbers. Radio Shack, Tandy Corp., Fort Worth, TX.†

uous operation of the survey meter while maintaining the Ni-Cd batteries in a fully charged state for use without the charger. Keeping the survey meter on will also prevent overcharging the batteries. All parts were readily obtainable through local electronic shops.

RESULTS

The goal of this project was to provide nuclear medicine and basic research laboratories with a continuous operating survey meter, always capable of responding to emergency conditions at a minimum of cost to the user. The current cost for the basic hardware to configure a survey meter ranges from $18.00 to $30.00 with less than 1 hr of labor required to install the components (Table 1).

All meters were inspected and calibrated prior to and after modification to assure that there were no changes in response, sensitivity and linearity in the instruments. The modification had no effect on the instruments' calibration. Tests conducted to determine maximum Ni-Cd battery life during continuous operation without the charger indicate a useful operating life to 72 hr for most units (Fig. 2). The instruments were reconnected to their charging units and were capable of measuring radiation (while on the charger) immediately.

DISCUSSION

Of particular interest was the conversion of older "Civil Defense" type meters which are readily available and are the usual mainstay of many local clinics and laboratories. These instruments can be modified but at a slightly higher cost due to the increased number of batteries and the larger DC recharger required to operate them. The Ni-Cd battery life (before recharging) was shorter on our Civil Defense meter compared to the other meters modified thus far. However, this does not seem to be a problem since the meter can be readily recharged or left connected to the DC power supply until needed for portable survey use. Conversion of the Civil Defense G-M type survey meters may be useful for hospital emergency preparedness programs where radiologic monitoring devices are required to be operating properly at a moment's notice.

NOTES

* Instruments modified: Victoreen Civil Defense Meter Model 6B, Cleveland, OH; Eberline Model E-120 Geiger Counter, Eberline Instrument Corp., Santa Fe, NM; Ludlum Model 2 Geiger Counter, Sweetwater, TX; SE International Monitor—4, Summertown, TN

† Radio Shack, Tandy Corporation, Fort Worth, TX

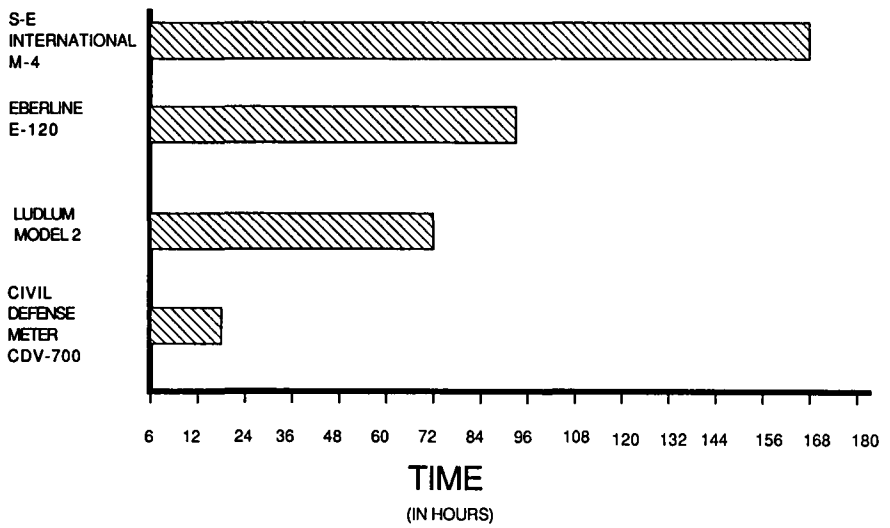

FIG. 2. Useful operating life of NiCd batteries in modified meters.