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CONVERSION OF THE AN/PDR-T1B RADIAC TO A REMOTE AREA MONITOR

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ADMINISTRATIVE INFORMATION

The work reported was part of a project sponsored by the Office of Civil Defense and by Defense Atomic Support Agency. The project is described in USNRDL Technical Program Summary for Fiscal Years 1963, 1964, and 1965, 1 November 1962, where it is designated Program A-1, Problem 11.

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ABSTRACT

A reliable remote-area monitor was devised from two AN/PDR-T1B gamma survey meters by coupling the electronics of one unit, located at the readout position, with the ion chamber from a second instrument located at the remote monitoring position. Cable lengths up to 50 ft were used with no appreciable signal degradation. The instrument is useful in fields up to 500 r/hr, and it has produced measurements agreeing with a standard NRDL Model 103 gamma intensity vs time recorder (GITR) to within ± 20 %.

SUMMARY

Problem

In a recent weapon effects test it was necessary for personnel in underground manned stations to know the exterior gamma dose rate at all times. No suitable instrument was available for this purpose.

Findings

A reliable instrument satisfying the requirement was devised from two interconnected AN/PDR-T1B survey meters. One served as the control and readout unit, the other as the remote detector. Separations up to 50 ft were employed without appreciable signal degradation.

INTRODUCTION

The development of radiological countermeasures and the evaluation of the effectiveness of radiological countermeasure systems requires information and data on radioactive fallout produced by nuclear explosions. During a recent weapon effects test, personnel in underground manned stations measured, during fallout, the radiation and deposition dynamics of the event. To assess the progress of the fallout event, personnel in the manned stations required an instrument to record continuously the exterior gamma dose rate.

The two major requirements for the instrument were: an immediate and continuous readout capability, and a radiation intensity range extending to an upper limit of 50 r/hr, or 500 r/hr as specified. The standard NRDL GITR (Gamma Intensity vs Time Recorder)** easily covered the intensity range desired, but this device requires laboratory processing of the magnetic tape record for readout. A low-level self-recording GITR developed at NRDL* offered immediate readout, but was limited to a maximum intensity of .10 r/hr. It was, therefore, necessary to develop an instrument satisfying the above requirements. The required six units were designed, tested and fabricated within three months.

DESCRIPTION OF INSTRUMENT

The radiac training set AN/PDR-T1B was modified to meet the requirements for remote gamma radiation monitoring. Two instruments were required for each installation. One instrument was located in the control or readout position within the manned station and the ion chamber from a second instrument was placed in the remote monitoring locations. A light-tight, moisture-proof and dust-proof container was provided for the remote detector by using the original case of the second instrument.

METHOD OF MODIFICATION

The remote feature was achieved by substituting the remote ion chamber for the chamber of the control radiac. This was accomplished by disconnecting the cathode of the internal chamber of the control radiac at point "A", shown in the circuit diagram reproduced in Fig. 1, and connecting the cathode of the remote detector to the electrometer circuit in the control unit. RG/59U Co-ax cable was used for this connection,

*P. A. Covey, A Low-Range Gamma Intensity Time Recorder, Technical Report in preparation.

**M. M. Bigger, H. R. Rinnert, H. A. Zagorites. Operation Hardtack, Proj. 2.1. WT-1619, January 1960 (CONFIDENTIAL).

in lengths up to 50 ft, with no degradation of signal or appreciable change in time constant. The high voltage lead was disconnected from the internal chamber at point "C" (Fig. 1) and connected through a length of wire (alpha 1553, MIL-W-76A) to the high voltage terminal of the remote chamber.

The remote wiring was installed in conduit to provide electrical and mechanical protection and to prevent movement of the signal cable. Any movement of this cable would have generated some noise voltage which would have indicated on the readout meter, when the more sensitive ranges were being used.

EXTENDED RANGE MODIFICATIONS

Where specified the range of this instrument was extended to 500 r/hr in the following way: Referring to Fig. 1, the range resistor R1 was removed and resistors R2, R3, R4 and R5 were moved one position to the left on the range switch, so that R2 would now occupy position R1, etc. This left a blank terminal at the 50K mr/hr position, R5. A 2.0 megohm, 5 % carbon resistor was installed between this terminal and the range resistor common terminal.

In addition to these changes the voltage supplied to the ion chamber by batteries BT1 and BT6 was increased to 300 volts to insure adequate saturation current at high radiation rates (500 r/hr). A Burgess type U-200, 300 volt battery was convenient for this purpose. The original batteries BT1 and BT6 were disconnected at point Y (Fig. 1), and the U-200 negative terminal was connected to this point with the positive side connected to the remote chamber. This battery did not fit in the space occupied by BT1 and BT6. It was convenient in the manned station application to put this battery adjacent to the control unit.

OPERATION AND CALIBRATION

These modifications necessitated instrument recalibration. The procedure described in the instruction manual TM11-5514 was followed for all ranges except the 500 r/hr. After calibration of the lower ranges was accomplished it was necessary to check the instrument output on the high range, in order to determine whether the new range resistor R5 was the correct value. Tests of several of these systems showed that the value of this resistor varied between 1.8 and 2.2 megohms. This difference cannot be compensated for by readjusting the calibrate pot,

R17, since this would cause maladjustment on all lower ranges. Therefore where necessary, adjustment of the value of R5 was done in the following way: A gamma radiation field equal to 4/5 of full scale (400 r/hr) was established at the remote detector. The meter in the control unit was then read. If the reading was higher than + 20 % of 400 r/hr, R5 was changed to 1.8 meg; if lower, R5 was changed to 2.2 meg. A miniature 2.5 megohm potentiometer might have been used for R5 to facilitate calibration, but this was not done since one of the stated three fixed resistor values adequately adjusted the system to within ± 20 % of the true gamma dose rate on this range. The zero-set, battery check and range controls were operated in the normal manner, except that with the 500 r/hr modification an X10 Scale Multiplier was applied to the meter readings on all ranges. Every precaution was taken when the electrometer compartment or any part of the signal circuitry was being worked on to avoid any contamination (e.g., fingerprints, dust, or moisture).

RESULTS AND CONCLUSIONS

Six remote reading radiacs were modified as described and installed in manned stations for use in a recent weapon effects test. The performance of all six instruments was excellent. A typical result is shown in Fig. 2 for the remote radiac detector mounted 3 ft above the level of the soil backfill over the manned station, with one from a nearby standard GITR. The points representing individual readings obtained manually with the remote radiac are compared with the GITR record. It can be seen that except in regions where the intensity is changing rapidly the readings agree within ± 20 %. It is concluded that the novel modifications described led to an accurate and reliable remote gamma monitoring device.

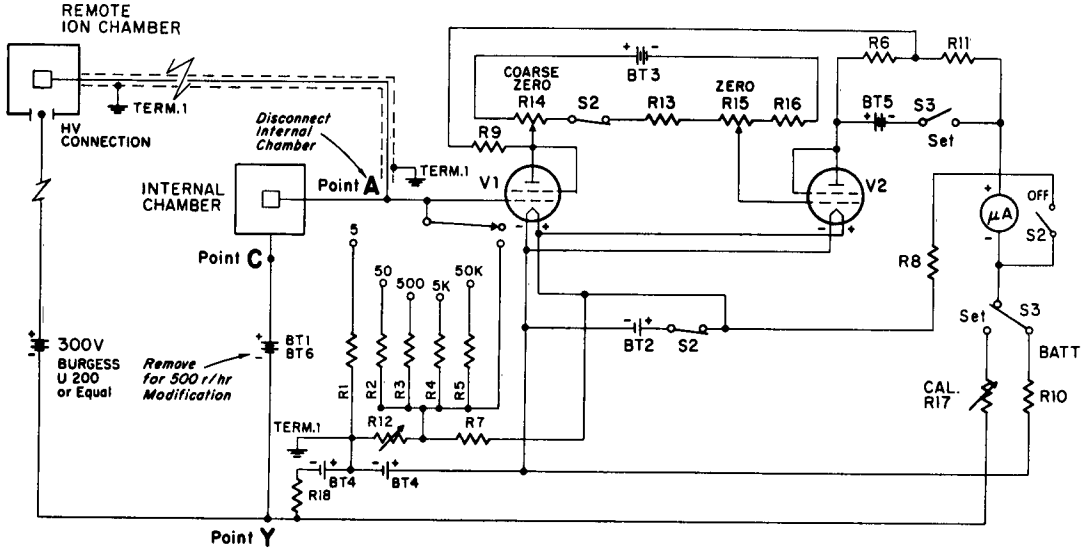

Fig. 1 Schematic Diagram

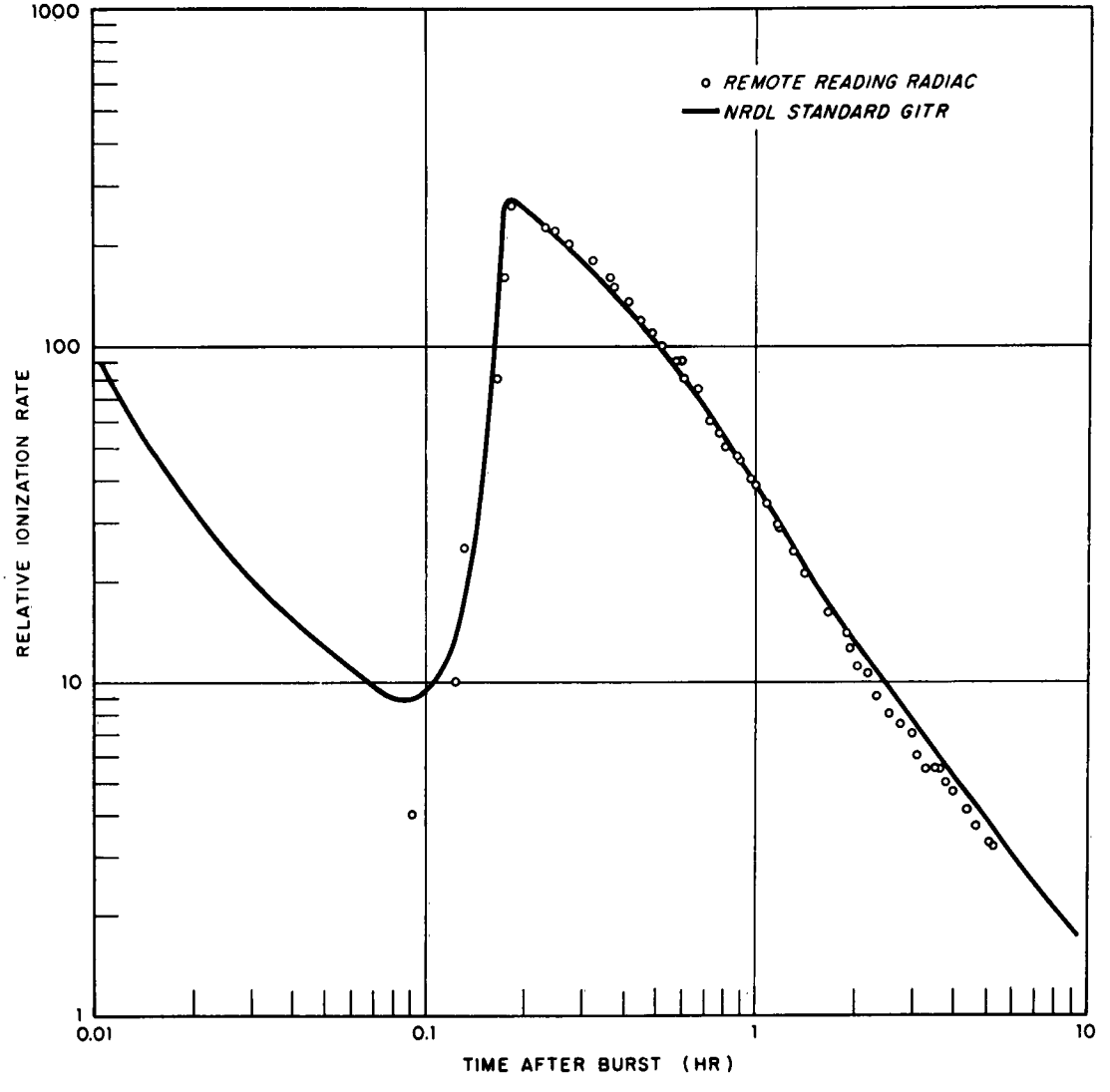

Fig. 2 Readout Comparison

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2. Ionization chambers.
3. Gamma radiation.

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