AN INTELLIGENT ENVIRONMENTAL NEUTRON AND γ MONITORING SYSTEM

Li Jianping, Tang Yueli, Shao Beibei, Liu Shudong,
Zhang Zhengang, Qu Guoying
Institute of High Energy Physics Academia Sinica, Beijing
Presented by Shao Beibei

Introduction

The first high energy accelerator of the People's Republic of China, the BEPC electron - positron collider, is at present, under construction in Beijing and should become operational in 1988. According to the national law an environmental monitoring programme must be set up for such an installation and preoperational measurements should start some years before the accelerator comes into operation. Therefore an intelligent environmental neutron and gamma monitoring system was developped, which is in operation since the end of 1985. Similar systems have been provided for the Heavy Ion Accelerator in Lanzhou and the Synchrotron Radiation Facility in Hefei. Another system will be installed around a nuclear power station in the south of China soon.

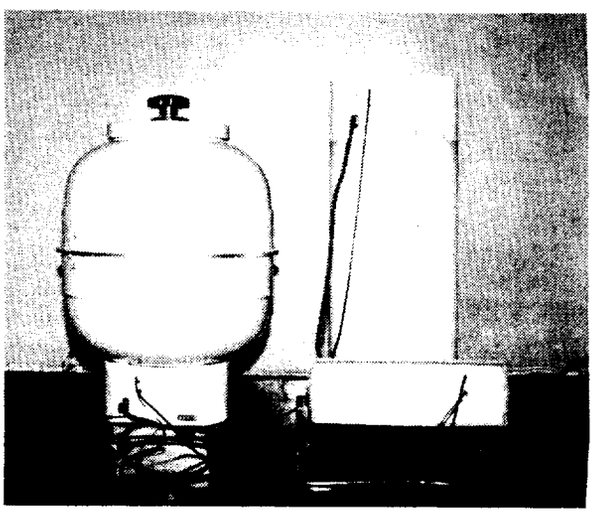
1. The monitors

The neutron detector consists of a 50mm Ø, 350mm long BF_3 proportional counter housed in a 130mm Ø polyethylene moderating cylinder. Its sensitivity is 17.0 ± 0.3 cps/n/cm^2.

The γ detector is a spherical stainless steel ionization chamber (260 mm Ø, wall thickness 2.5mm) filled with Argon at 25 bar. Its sensitivity is $2.65.10^{-14}$ A/μR/h. A charge digitizer is as used current to frequency converter giving 20 pulses per minute for a current of 1 pA. Pulses from both detectors are suitably amplified and shaped (1 msec.), isolated by optocouplers and then transmitted to a local data logger.

Fig. 1

Photograph of both detectors

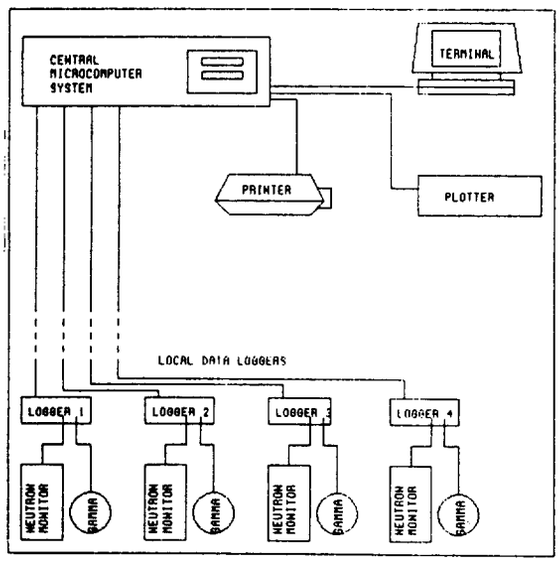


2. The Data Acquisition System

The originality of the acquisition system lies in the fact that local intelligence has been provided at each monitor station, which comprises one gamma and one neutron detector, and the local data logger as shown in Figure 2 below.

Fig. 2

Block diagram of the system

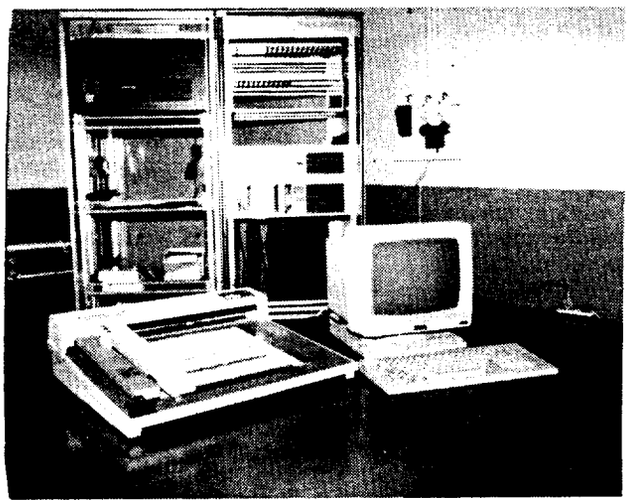


The local data logger is a high speed, low power, low cost computer entirely composed of CMOS circuitry which accepts the pulses from each of the two detectors and stores them until requested by the central computer unit. It is based upon a Motorola MC 146805E2 single chip microcomputer which comprises a CPU, memory, timer and I/O ports on a single integrated circuit. 2 KBYTE EPROM and 4 KBYTE static RAM are used for program and data storage. The I/O ports are used to input pulses from the monitors, drive two alarm relays and provide a parallel output for a local printer when required. Additionally a liquid crystal display provides a local indication of date, time and other status conditions. Communication with the central computer unit is via an asynchronous port through which commands are received and data is sent. The use of 20 mA current loop transmission makes it possible to have a distance of up to 3 km between the central computer system and each monitor. Total power consumption for a station is less than 0.1 W and rechargable batteries guarantee continued operation in the event of mains power failure.

The central computer unit, which is shown in Fig. 3 is based upon a Motorola MC 6809 microcomputer running the flex operating system.

Fig. 3

Photograph of the data acquisition system



Data is normally transferred from the data loggers once per week, but they can be interrogated at any time on request from the central computer. Long term storage is on floppy disk and a plotter is used to provide a hard copy the acquired data.

3. Operation

The system worked well since 1985. A test for the sensitivity of the system was, that a 2.5% increase of the radiation level in the Beijing area due to the nuclear accident in Chernobyl could be detected. Fig. 4 shows the record of neutron and gamma dose rates as measured during the month of June 1986. Later on the system will be connected to the BEPC computer control centre.

4. Acknowledgement

We would like to express our gratitude to the CERN Radiation Protection Group, and especially to Mr. B. Moy, for their advice and continuous support.

Fig. 4

Gamma and neutron dose rates as measured in June 1986