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COMPUTER CONTROLLED AREA SURVEILLANCE SYSTEM FOR THE TRIGA MARK II REACTOR VIENNA

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In a nuclear facility a round-the clock surveillance of the radiation levels in selected areas is necessary and usually required by the national regulatory institutions. In addition the instrument readings have to be recorded automatically and stored for a longer period, typically 10 years. One problem with such systems is the accumulation of a large amount of radiation data which are very difficult to review and store. Usually only a small fraction of data (i.e. when exceeding preset alarm levels) are of interest while the rest of the data are more or less unnecessary although their storage is required for continuous documentation.

As a compromise between storage of all data but immediate information on important data (i.e. alarms) an area surveillance system has been designed and installed at the TRIGA reactor Vienna using a data logger and a personal computer as a storage facility. In total 16 radiation monitor signals are permanently scanned by a multiplexer for deviation from normal operation values. These data are printed out every full hour while in case of an excess radiation level alarm is triggered optically and acoustically and the relevant monitors are listed together with the radiation levels. All the data are transferred to the institute's central computer (VAX 11/750) where they are available for further processing in a proper file structure.

Introduction

Since 1980 a computer controlled area monitoring system is installed at the TRIGA Mark II reactor in Vienna. The primary task of this system is the information of the reactor operator about the radiation levels in the reactor hall and in associated parts of the building. The second aim is the hourly printed protocol with date, time, radiation levels of 16 monitors and related data. This hard copy protocol is important for the reactor manager as well as for the health physics staff. Nevertheless collected data are also stored on the disk drives of the institute's central computer VAX 11/750. To assure lossfree data transmission, a small personal computer is programmed as intermediate memory which can store the data records up to 3 days.

Description

The monitoring system is a commercial moduled construction as shown in Fig. 1. The individual monitors are equipped either with high pressure ionization chambers (reactor hall, control room) with NaJ-scintillators (primary and secondary cooling system) or with endwindow GM-tubes (ventilation system). Their output signals are connected to the central unit as well as to the datalogger, both in the control room. The analog signal (0... 20 mA current loop) of each monitor is indicated by a meter at the local instrument

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and at the central unit. The monitor limit contacts are wired to the following logical combinations:

Failure alarm

It has signal character and is only activated during the failure period. If the instruments operate normally again, the alarm is cancelled and only the summary failure indication flashes until the next reset action.

Pre-alarm

The pre-alarm or warning (first upper limit) is locally characterized by a bright red lamp and a loud acoustic signal which can be turned off by the health physics staff using a special key. In the control room this warning is indicated optically near the specific meter representing the activated monitor and in a map which shows the location of the monitor in the building. For the reactor operator it is therefore easy to localize the area of a deviated radiation level. In addition an acoustic alarm in the control room is activated and the summary-warning LED flashes.

Main alarm

It is signalized at the monitor only by an additional red LED, because at warning stage the information about increasing radiation level is fully given. In the control room the alarm is recognized if:

- the duration exceeds one second
- it is accompanied by a warning
- no failure is detected.

If such a recognized main-alarm duration exceeds one second, the information is then indicated outside the reactor hall at the entrance guard which is staffed round the clock.

Both warnings and main alarm are stored until the next reset action is performed which is only possible with a key. Each reset action is counted electro-mechanically for documentation purposes.

Data logger

The data logger is a commercial data acquisition system with statement programming and calculation software. The analog outputs of the radiation monitors are connected to the input modules of the data logger and are scanned every ten seconds by a reed multiplexer and a self-calibrating digital voltmeter. The logarithmic input is thereby converted in a digital readout and is shown at the CRT-screen which is part of the data logger.

Parallel to the limit comparator in each monitor the data acquisition system has programmable alarm limits. They are used in such a way, that they produce immediately a printout with date time and label statements so that a documentation of all these alarms is given.

When the main power breaks down program and data are saved by batteries. The process starts automatically after such a power break down.

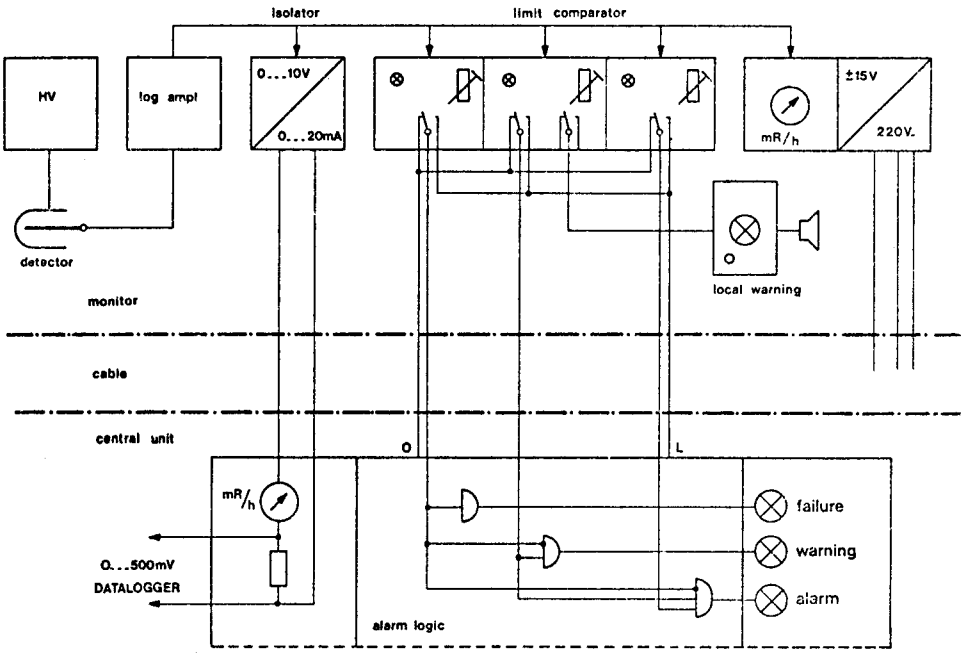

Fig. 1. Radiation monitor and its related part in the central unit

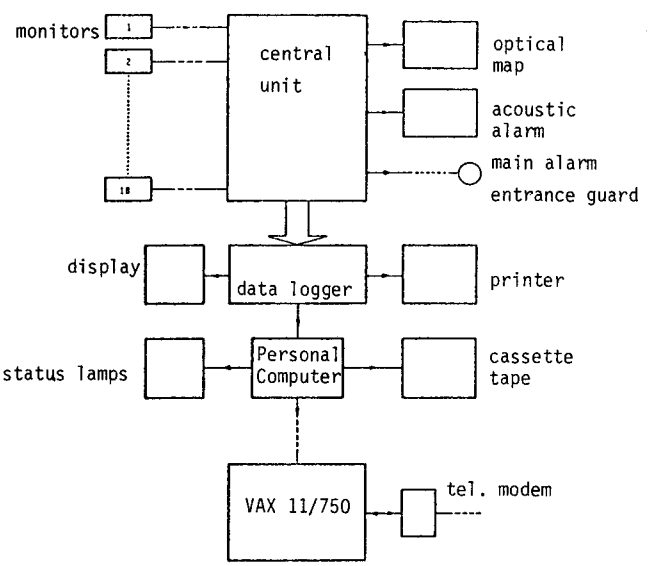

Fig. 2. Block diagram of the area monitoring system at the TRIGA Mark II reactor Vienna

Intermediate memory and data transfer

To assure effective data handling a data transfer to a comfortable host computer has been installed. The hardware of this system consists of a commercial personal computer (PC) with 32 K bytes of available memory, micro cassette tape and standardized communication ports (see Fig. 2). The memory is partly used as a ring buffer to accumulate radiation levels from the data acquisition system. This accumulation procedure has the highest priority because of the data logger specifications. The host computer (VAX 11/750) starts under normal conditions every ten minutes a request to get data from the PC. It creates for each day an individual file which is then available for further software procedures like the calculation of the monthly Ar-41 production or the mean dose rate at a certain point in the reactor hall. The data transfer uses a full duplex repetitive protocol for correct data transmission. If the connection to the host computer is interrupted for service or other reasons, the PC stores all data coming from the data acquisition system in its ring buffer until the memory is full. Then the PC starts recording at the integrated tape while a status lamp indicates this exceptional situation. The system can operate approximately 3 days data loss free without changing of cassettes. As soon as the VAX 11/750 connection is reinstalled all data will be stored in sequential files at the mass storage medium while special sorting software generates a chronological installation of all this files.

Power supplies

The whole system (monitors, central unit, data logger and PC) is supplied by an AC-DC-AC converter with 220 V 50 Hz 5 kW output. Using a 110 V buffer battery the function is assured during a line break down for one hour. Diversity and multiple safety devices in the whole network construction give reliable function in all cases of overload.

The main power supply was interrupted only for the annual services on the converter and for some additional installation in the system. Totally less then 10 hours in the last five years.

Summary and conclusions

The described area monitoring system fulfills all requirements for a reliable and safe data collection and retrieval system as required for nuclear reactors. The monitoring- and data logging system worked without any safety related failure during the last five years, while the intermediate memory and the data transfer system is presently under installation. As all components are commercially available parts a similar excellent performance is also expected for these systems.