Radiation Protection Instrumentation at the Hot Cells of Forschungszentrum Juelich – The New Digital Data Acquisition and Visualisation System

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Abstract

The radiation protection instrumentation of the Hot Cells of the Forschungszentrum Juelich consists of stationary devices for measurement of dose rate at different locations of operation and of mobile supervising devices for the detection of radioactive aerosols in the room air. To minimize the impact of the environment, the release of α–, β–aerosols, rare gases, iodine and tritium is also monitored at the control room of the Hot Cells. A new system of acquiring, displaying and registration of data and alarms was implemented shortly. It uses standard hardware components and a new software visualisation system for displaying and archiving of data.

Keywords: Hot Cells

1. Introduction

In nuclear facilities and radioactive laboratories radiation protection is an important task. An extensive instrumentation is necessary to monitor the radiation levels and limits at the different locations and to record the acquired data for supervising and archiving. In the past, different systems were used starting with analogue measuring instruments and plotting devices and ending with digital instruments and printers.

Since the beginning of the '80s, at the control room of the Hot Cells of the Forschungszentrum Juelich analogue display instruments (bar graph displays), plotting devices and a digital process computer system were used for the acquisition and documentation of the signals from the different radiation measuring devices.

1.1. Radiation Protection Areas and Instrument Locations

The radiation protection instrumentation of the Hot Cells consists of 22 supervising stations in the operational areas, where the dose rate is measured and limit exceedings are signalised by alarms. The room air is supervised at 10 mobile stations, where α-, β-aerosol or rare gas activities are measured and alarms are monitored. The exhaust air from the cells, from different service areas and the outlet of the ventilation system (chimney) is measured at 10 stations. Aerosols (α,β), rare gases, iodine and tritium activities are registered and limit exceedings are signalised by alarms too. All data and alarms are displayed and recorded at the control room of the Hot Cells. In addition, there are still 10 radiation level monitors to measure the dose rate in the cells. If the radiation level is above a certain limit, the cell doors are interlocked.

In the past, a digital process computer system was used for the acquisition and documentation of the signals from the different radiation measuring devices. But the hardware became obsolete, and support was no longer available for hard- and software of the process computer system. In the middle of the '90s, the supervising authorities demanded a recording and storage of the data for 30 years. It was decided to install a new data acquisition and documentation system, which meets the demand of the supervising authorities and fulfils additional wishes for an advanced system.

1.2. The New Registration and Documentation System

First of all the new system should use standard components. The plotting devices and instruments with bar graph display should be replaced by new visualizing techniques. During the installation of the new system the operation of the hot cells should not be interrupted longer than one day. Together with SIEMENS company a combination of SIEMATIC S7 data acquisition system and the MEVIS data processing and visualisation software, developed by UMAD GmbH Berlin for BERTHOLD company, was chosen.

1.2.1. Hardware Components

For each of the three radiation protection fields (operational zones, room air and exhaust air) a separate programmable logic controller (PLC) SIEMATC S7-300 with own power supply has been installed. The analogue input lines acquire the data signals (0... 20 mA) of the measuring devices. Alarms generated from the measuring devices are registered by the digital inputs. By means of the digital outputs, the alarms are signalised on the display board of the control room. The data are sent from three communication controllers with own memory (each for one PCL) to a standard PC and in addition, they are kept in memory for at least 10 hours. The PC with monitor, keyboard and mouse is connected to the LAN. An event printer prints system status and messages about the measuring device status. The protocol or system printer is also connected to the PC for the printout of the daily mean and max-values of all stations or for graphical diagrams generated by the user. The system is supervised by a watch-dog timer (USEW) triggered at certain time steps by the running software. A CD-writer is installed in the PC for data archiving and backup. Fig. 1 shows a schematic drawing of the components.

1.2.2. Software features

The PLC's acquire the measured values of the radiation instruments in time steps of one second. These data are averaged over one minute and are sent to the communication controller together with the max-, min-values and the alarms. The MEVIS data processing and visualisation software is running on the PC under the operating system software Windows NT4. It offers a lot of useful features to record, analyse and display the measurement data.

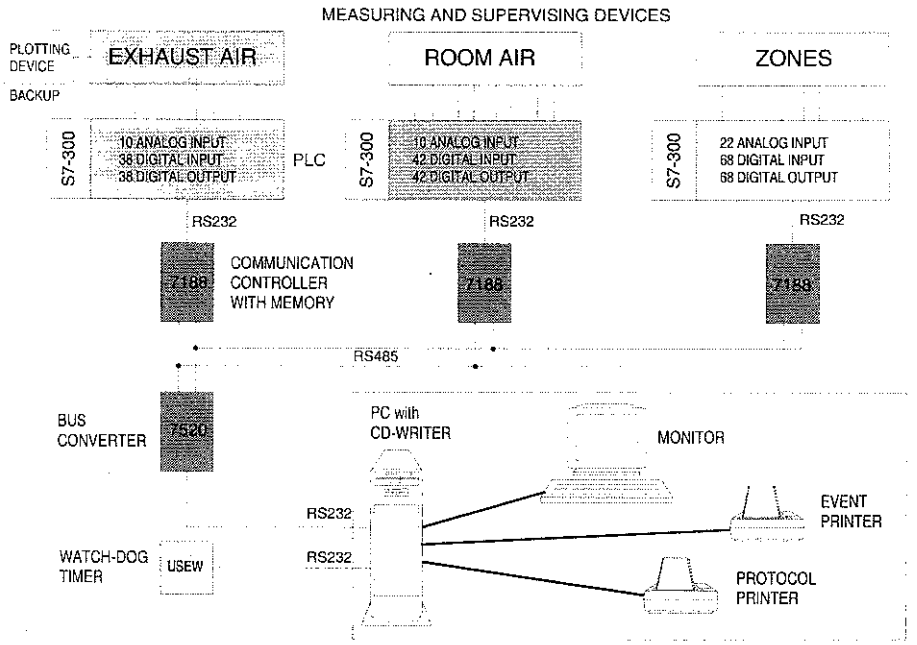

Figure 1 Hardware components of the new registration and documentation system (schematic)

The one minute-, min/max-values and alarms are registered continuously, checked against the limit values and stored on the hard disk of the computer. In case of alarms and exceeding of limits, the location number and actual values are printed out in addition to signalisation on the display board of the control room. Limits are not only defined by absolute values but also by the signals slope (trend recognition). Exceeding of limits can be predicted at a very early state. A printout of the mean and max-values during 24 hours of all measuring locations is triggered automatically (Fig 2). The history of interesting data can be displayed graphically on the monitor with different time scales and scaling possibilities (Fig.3). All data are stored for about two month in the data base of the computer hard disk as ASCII-text files and than archived on CD-ROM. Since the computer is connected to the local area network, registered users have access to the stored data for displaying and analysing locations of interest.

2. Conclusions

The new system could be installed with only a short interruption of operation of the hot cells. It has very flexible visualisation possibilities and fulfils all the demands and wishes for an advanced system. Since the beginning of this year (2001), the new system has been in operation and shows good results of performance and availability.

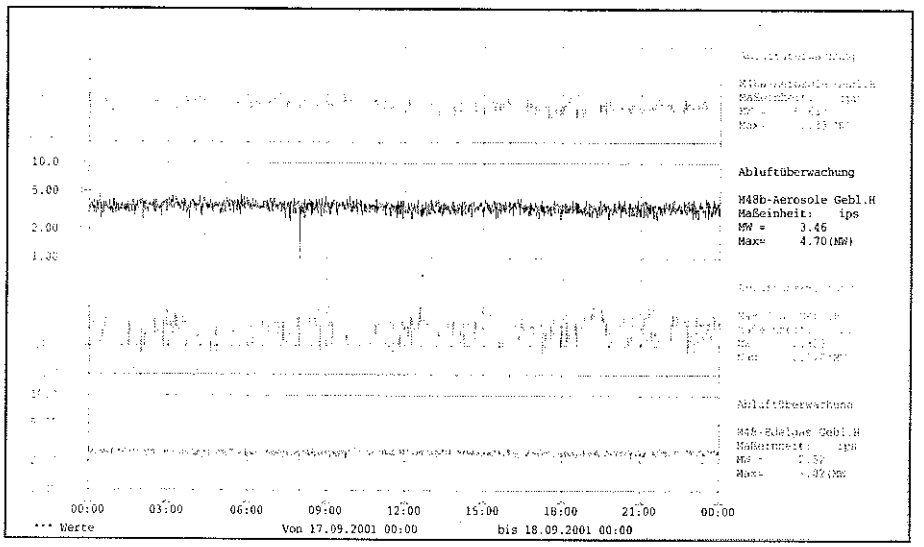

Figure 2 Release of α-, β-aerosol, iodine and rare gas activities out of the chimney (exhaust air supervising) as an example of the daily graphical printout

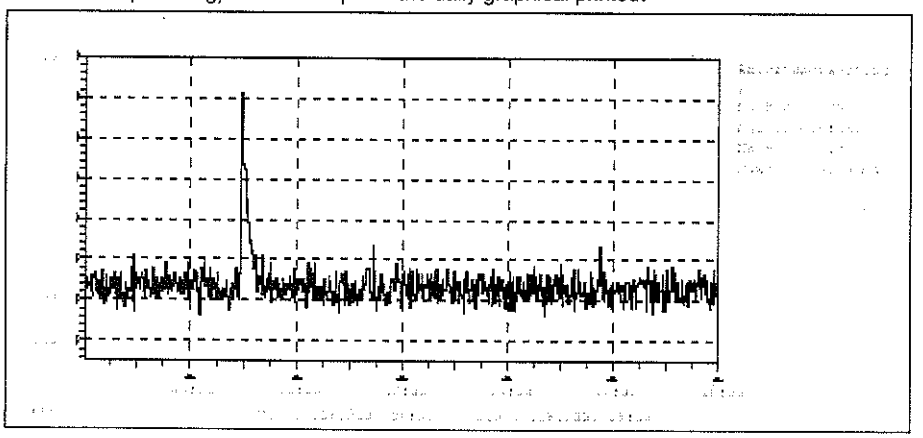

Figure 3 Release of rare gases during opening of a small storage container with HTR graphite fuel elements (changing of the sealing)