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THE USE OF COMPUTERS IN THE ENVIRONMENTAL DOSERATE MONITORING NETWORK OF BADEN-WÜRTTEMBERG (Germany, F.R.)

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Environmental Gamma doserates are monitored continuously, by a government-operated network, at altogether 111 points in the vincinity of 5 nuclear power stations. Three of them are located in the German Federal State of Baden-Württemberg, and two in the neighbouring countries France and Switzerland.

The local measuring stations are equipped with microprocessors for data evaluation, storage, and transfer through postal datex lines to a central main computer. This main computer, located at Karlsruhe, includes meteorologic and source-related data of the German power plants and is able to calculate and predict, in case of any radioactive release from one of those plants, the development of the situation and the radiological impact on the environment and the population. This computer again is linked to a terminal in the Ministry of Agriculture and Environment in the state capital of Stuttgart.

Additionally, those 24 stations monitoring the doserate in the vincinity of the foreign power plants are transmitting their data to two satellite computers located at Freiburg, a regional sub-capital in the southwestern part of the country. The satellite computers are providing printouts of the real-time dosimetric data for the regional public safety authorities.

The overall structure of the network

The legal prerequisites of the network

In 1979, the German Ministry of Internal Affairs issued general guidelines for monitoring radioactive releases from nuclear power plants [1], followed in 1980 by a more specified recommendation for remote monitoring networks as operated by the individual federal states [2]. Part of such networks is the real-time measurement of doserates in the environment, in order to enable the responsible authorities to recognize automatically and instantly any significant increase in dose to the population caused by the radioactive effluents of a power plant.

Such high demands can only be met by the extensive use of advanced microprocessors and computers.

The geographical structure of the network

Baden-Württemberg is hosting the nuclear power plants of Obrigheim (328 MWel) on the Neckar, Neckarwestheim (810 MWel operating, 1230 MWel under construction) on the Neckar, and Philippsburg (864 and 1268 MWel) on the Rhine. Each plant is surrounded by about 30 doserate measuring stations in a 10 km distance circle area, concentrated however according to main wind direction and population density.

The two foreign power plants of Fessenheim (2 x 880 MWel) and Leibstadt (942 MWel), both on the Rhine river, are monitored by 12 stations each on the German side of the Rhine.

The main computer is located at Karlsruhe, with extensions to the capital of Stuttgart. Two independent satellite computers linked with the Fessenheim and Leibstadt stations, are installed at Freiburg.

The Local Stations

The local measuring stations as well as the satellite computers have been designed, built and delivered by Labor Prof. Dr. Berthold. The radiological performance of the LB 1025 radiation monitoring units, as well as the considerations that have determined the selection of the detectors used have already been described elsewhere [3, 4]. We, therefore, will restrict our following explanations to the computer part of the system.

Two independent Motorola 6809 microprocessors are used, together with an 8 K RAM and a 32 K EPROM each. One of them is handling the measurement, basically sequencing the process, converting countrates to doserates and storing the results. The other one is controlling interfacing and data transfer. The system is backed-up for mains failure for 24 hours by a trickle-charged battery. Standard averaging times are 1 h at normal, and 10 min at elevated background values. These times are switched over either automatically according to the actual measurements, or remote-controlled by the satellite or main computers.

At any time, the latest 72 1-hour values and 12 10-min values are kept in the memory. They may be called-off by any one of the superior computers, either entirely or partly. In normal operation, call-off is initiated each day at midnight by the central computer. In case of elevated background, probe failure, system failure, or mains failure, the station is sending the

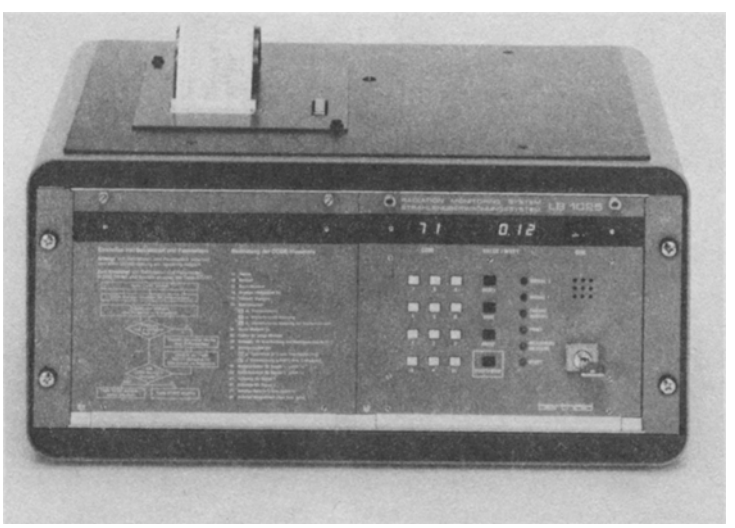

Fig. 1 The LB 1025 Radiation Monitoring Computer System

appropriate signal to the superior computers, awaiting further commands. Such commands may be an automatic call-off of the stored values, a switching to the shorter measuring time, etc. The clocks in the LB 1025 systems are synchronized in regular intervals by the main computer. A special system status "service mode" is also provided for on-site repairs, set-ups and calibration. In this mode, no alarm or failure signals are generated, and no data stored. On initiating the service mode by a turnkey-switch on the LB 1025, a status signal is also sent to the main computer.

It is worthwhile to note, however, that the LB 1025 may be operated completely as a stand-alone system, then outputting the data on a strip printer. This is also a last resort for data conservation in case of a complete fail of the transmission lines, or of the superior computers.

The local operation and parameter setting is effected in a code-no.-system by means of a pocket-calculator type keyboard (Fig. 1). The operational sequence instructions and the meaning of the code-nos. are figured on the front panel, making it easy even from untrained personnel to handle the system, -provided they have the key to unlock the device.

The Central Computer

The central computer is located at the government-operated Institute for Environmental Protection (Landesanstalt für Umweltschutz) at Karlsruhe. It consists of two VAX 11/730 units from Digital Equipment, programmed and delivered by Dornier. One of the units is handling and processing the incoming data, whereas the other is managing the data files, saving the data, and calculating the geographic activity or dose distributions to be expected. All functions may be interchanged at any time.

Accepting the doserate values from the environmental survey stations is only a small part of the entire duties of the central computer. It also receives the monitoring values of more than 30 parameters from each of the 3 power plants, like stack-emitted activity and air flow, reactor operational data, and meteorological quantities. High-resolution multicolor graphics allow the display of the momentary radiological situation as well as its backdated development and predicted course taking.

Data are coming in through the datex lines via two Henschel FEP 8011 Front-End-Processors. The plant data are called off hourly, the doserate data once daily. In case of any threshold exceeding or failure signals coming up, transmission is initiated immediately by the station itself.

Reports of unusual events are transmitted again to the Authorities at the Ministry for Agriculture and Environment at the state capital of Stuttgart.

It may be quite fascinating to note that the messages are given in clear language. The computer composes the spoken text according to the context to be conveyed, out of a stock of several hundred sentences, spoken previously on tape by a presumably very charming actress.

There are, however, some barrings built in to cross-check first in case

of an alarm signal with further stations or parameters, before the message is forwarded.

The system has been installed at the beginning of 1985, and is still running in a test phase. It will be fully operational at the end of this year.

The Satellite Computers

The 24 local measuring stations operating on the German side of the Rhine river opposite the foreign power plants of Fessenheim and Leibstadt are linked not only to the main computer but also, at the same time, to 2 satellite stations of the type LB 1029, located at Freiburg which is the subcapital of the region. It is apparent, however, that these computers are not receiving source data from the foreign power plants. They do process doserate values only. The same microprocessors are used as in the LB 1025, and the same functions are valid as far as data transfer and status signalling is concerned. Up to 48 LB 1025 stations may be handled by one LB 1029.

The LB 1029 versions used in the Baden-Württemberg network are rather simple ROM versions with the only task of receiving, listing, group-selecting, formatting and outputting the data. They are operated via a teletype keyboard. There exists, however, a floppy disk version (Fig. 2) with a video screen display, data storage on disk, and a calculation program to give averaged doserate or accumulate dose values for days, weeks, months or any other desired period of time. This version is used in a similar network in the State of Luxembourg.

Fig.2. The LB 1029 Satellite Computer, disk version, with printer and video terminal. Values of up to 48 local stations can be processed and displayed in 4 groups to 12 stations each.

References

1. Richtlinie zur Emissions-und Immissionsüberwachung kerntechnischer Anlagen, gemeinsames Ministerialblatt Ausgabe A, Nr. 32, vom 26.11.79, S. 668-683.
2. Rahmenempfehlung für die Fernüberwachung von Kernkraftwerken vom 11.9.80, BMI RS II 4-515 607/3.
3. R. Maushart und J. Eppler, Dosisleistungsmessung zur Immissionsüberwachung in der Umgebung von Kernkraftwerken, Nuclex International Fair Conference, Session E Paper No. 5, Basel, 1981.
4. R. Maushart, Kriterien zur Auswahl von Detektoren für Dosisleistungmeßsysteme zur Umgebungsüberwachung kerntechnischer Anlagen, in Atomenergie-Kerntechnik, Vol. 43 no. 2, 1983, p. 91-94.