A NEW AEREA MONITORING SYSTEM AT THE TRIGA-REACTOR VIENNA

J. HAMMER

Atominstitut, Vienna, Austria

ABSTRACT

The paper gives a survey of the data processing in an area monitoring system at a small research reactor. Eighteen instruments (ionisation chambers, geiger mueller counters, and scintillation counters as well as neutron monitors) are installed in the reactor hall and in some other parts of the instituts building which produce analog and digital signals at the central unit in the control room. If a preset alarm level is reached,optical and accoustical signals are triggered.

A microprocessor controlled data logging system as a back-up system compares the analog signals with preset programmed alarm levels and prints the relevant datas when certain criterias are fulfilled. For documentation the system scans the radiation levels continiously and prints a protocol several times a day which is available for reactor responsibles and authorities.

1. INTRODUCTION

The primary task of the new area monitoring system at the TRIGA-reactor Vienna is the on-line information of the reactor operator about the radiation levels in the reactor hall. A periodic scan prints every hour a protocol with date, time and radiation levels of the 18 monitors. This data documentation is necessary for the Austrian authorities and is a helpful aid for reactor responsibles as well as for the healths physics section.

The system guarantees a safe recognition of dangerous radiation levels and assures immediate counteraction of the reactor operator.

2. DESCRIPTION

The monitoring system is a moduled construction as shown in fig. 1. The local monitors - numbered between 1 to 18 - are commercial instruments (Hartmann & Braun, type TKU 154), connected either to a high pressure ionization chamber, to a scintillator, to GM-tubes or to neutron detectors. Their output signals are connected to the central unit at the control room, using screened, ten lead cables. These monitors deliver both analog 20 mA current loops and potential-free limit contacts.

2.1. ANALOG SECTION

The analog signal of each radiation monitor is indicated by a meter at the instrument. Using an isolation amplifier a parallel meter at the control room shows the radiation level for the reactor operator. In case of breakdown of the central unit this readings stays correct. This 20 mA loops send their signals to the Datalogger for further processing, too.

2.2. DIGITAL SECTION

The monitor limit contacts are wired with TTL levels for easy connecting to integrated circuit gates. For logical combination the following signals are available:

1 - The lower limit is activated only when no signal at all is indicated (i.e. cable damage, power failure).
2 - The first upper limit contact is so positioned, that it is activated slightly above the radiation value when the reactor is in full power operation.
3 - The main alarm (second upper limit) is activated in case that the radiation level exceeds significantly the normal operation value.

This concept has been successfully proofed during the last 20 years [1]. The digital signals are correlated in the central unit to obtain a maximum of information and safety which is represented by the following three alarms:

1st the failure alarm

It has only signal character. In case of a multiple lower level failure alarm it is intended to install an additional alarm, because the lower level failure indication is only activated during the failure period. If the instruments operate normally again no lower level failure indication is signalized except the summary failure indication SF in fig.3 flashes until the next reset activation.

2nd the warning

The warning (pre-alarm, first upper limit) is locally characterized by a LED, a bright red lamp and an acoustic signal which can be turned off by the health physics responsible with a 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 reactor building (see fig.3). Therefore it is easy for the operator to localize the area of high dose rate. If the duration of the alarm exceeds one second, an acoustic alarm in the control room is activated and the summary-warning-LED (SW in fig.3) flashes.

3rd the 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 through a logic circuit as shown in fig.2, if:

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

The time delay prevents spurious alarms produced by spikes or cable induced effects. If such a recognized main-alarm duration exceeds one second, the information is also indicated outside the reactor hall at the entrance guard which is staffed round the clock. Especially during night and weekend the entrance guard contacts the personell in charge in case of an alarm.

Both warning and main alarm is stored until the next reset action. Short radiation excursions (e.g. reactor pulses) can be detected by this design.

The reset of acoustic signals in the control room is possible anytime, if the radiation level is below the alarm level. The reset of optical indications of warning and main alarm is only possible with a key. This reset action is countered electromechanically for documentation.

3. DATA LOGGER

The data logger is a microprocessor-controlled calculating data acquisition system with statement programming. This design is made for industrial and scientific application [2].

The analog outputs of the radiation monitors are connected to the input modules and are scanned every ten seconds by a reed multiplexer and a self-calibrating digital voltmeter.

The 20 mA loops representing a radiation dose rate in logarithmic scale are converted into a digital readout in mR/h units using mathematical software. This digitalized radiation levels are shown at the CRT-screen which is part of the data logger and at some external CRT-monitors (control room, reactor hall). On the other hand a printer prints every hour this radiation values for documentation. In the future this output shall be stored at a magnetic cassette type to send it discontinually to the main computer pdp 11/45 for further statistic processing [3].

Parallel to the limit comperator in each monitor, the data logger has programmable alarm limits too. They are so programmed to produce an alarm if the radiation limits are reached or if a failure is detected. A printout with date, time and label statements is produced in addition in case of such an alarm.

When the main power breakes down the program and the internal clock is protected by a battery backup system. The data processor starts automatically and operates in its normal function, if the power is again available.

4. POWER SUPPLIES

The whole system is supplied by an AC-DC-AC converter with 220 V 50 Hz output. Using a 110 V buffer battery the function is assured during a main line brake down for one hour. Diversity and multiple safety devices in the network construction give reliable function in case of local overload.

5. CONCLUSION

The presented new area monitoring system has been successfully in operation in the last six months; the concept proofed to be reliable and efficient for extended period. The used data logging system works now successfully after some minor problems at the beginning.

With the future installation of a cassette tape recorder and a software package at the pdp 11 a statistical view over a long operation period will be possible.

REFERENCES

[1] H.WEISS E und M Vol. 78 (19) Oct 1961 p 595

[2] ACUREX Autodata TEN/10 Technical Manual 1980

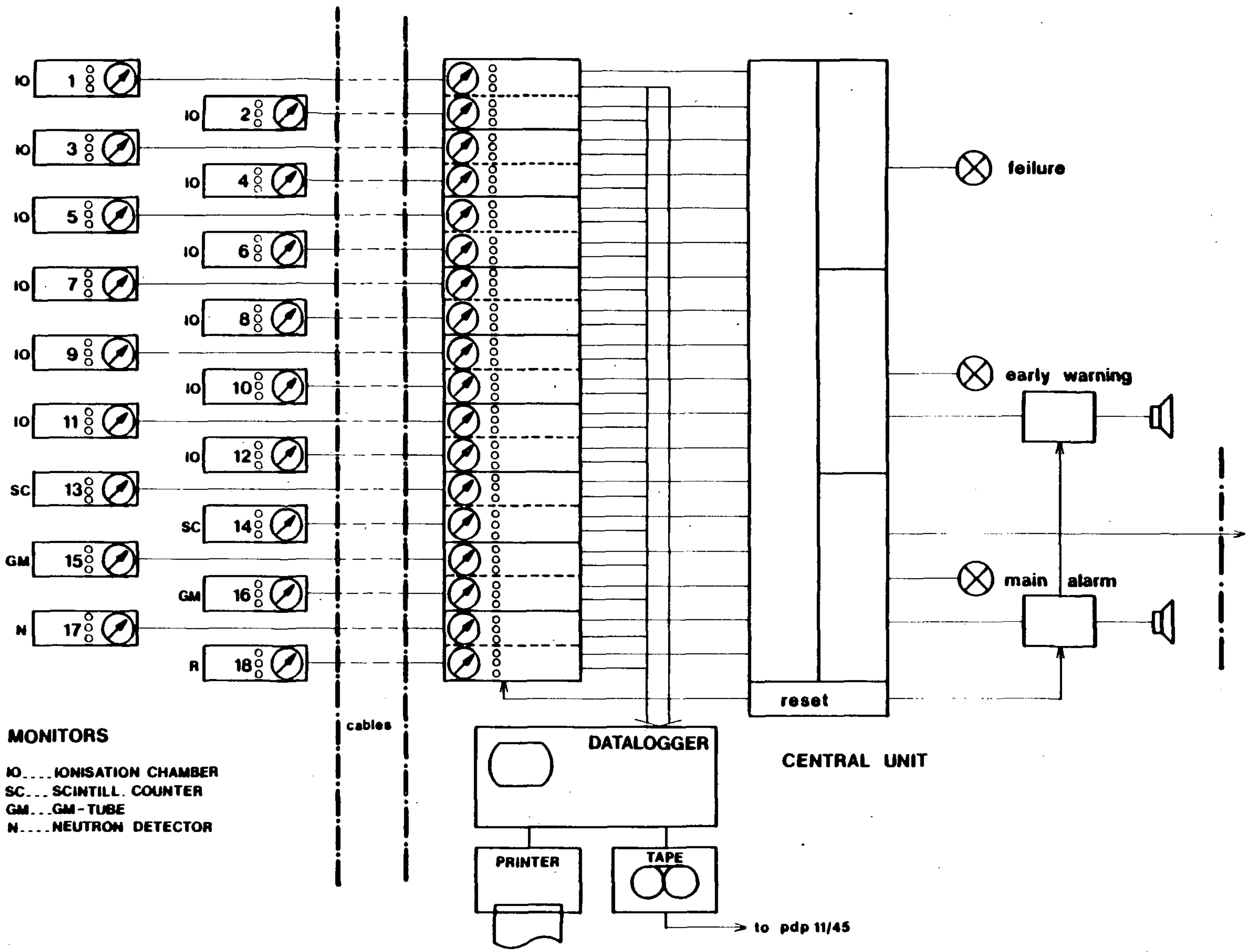
[3] H.BÖCK 5.European TRIGA Users Conf., Portoroz, Jugoslavia, September 4 - 6, 1978

FIGURE CAPTIONS

Figure 1 Area monitoring system at the TRIGA reactor Wien block diagram

Figure 2 Connections between a local radiation monitor and the central unit

Figure 3 Map of the reactor building with alarm indications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DATALOGGER
CENTRAL UNIT
PRINTER
TAPE
to pdp 11/45
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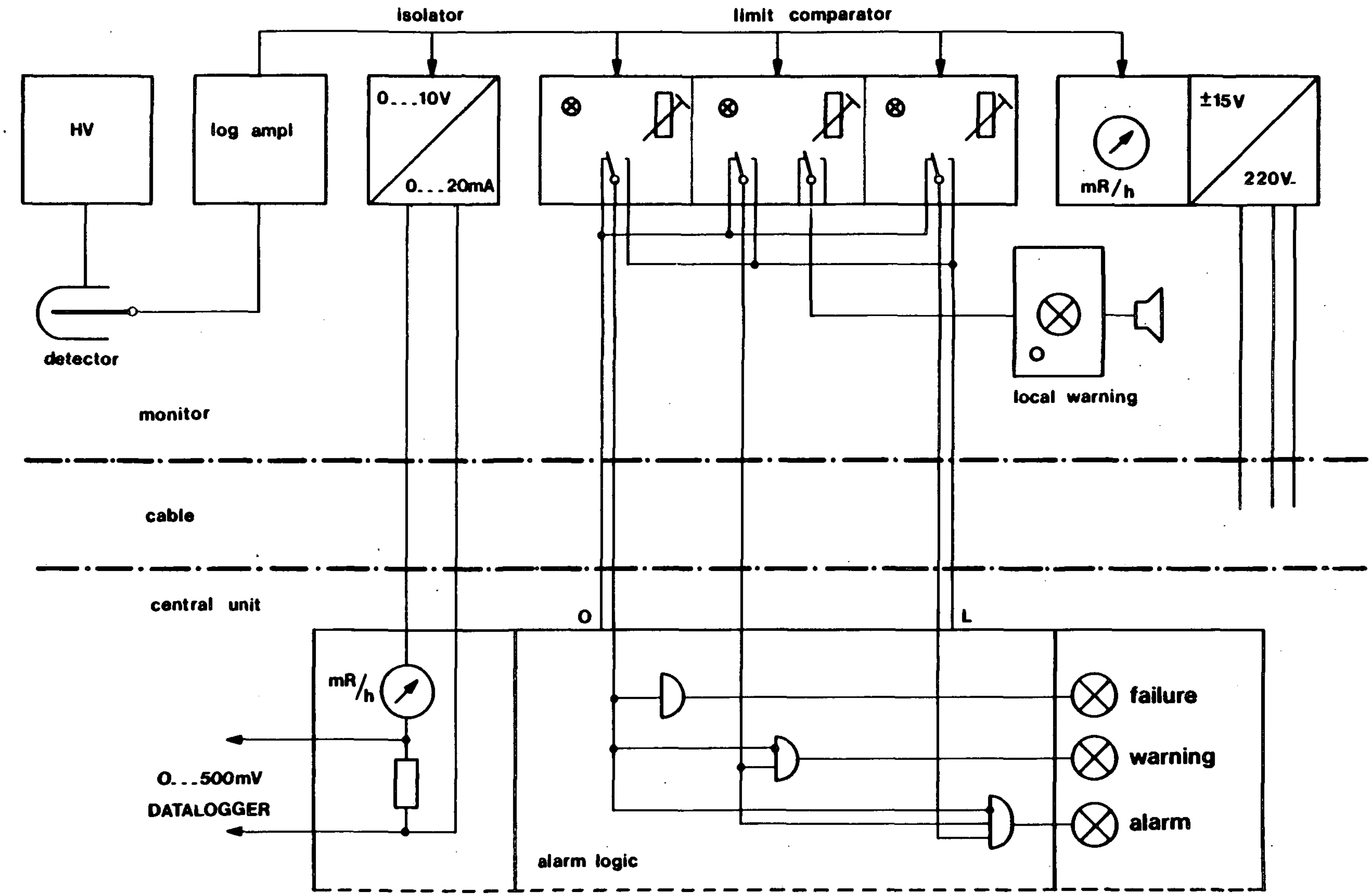
SC...SCINTILL. COUNTER
GM...GM-TUBE
N....NEUTRON DETECTOR

Fig. 1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mR/h
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monitor
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O...500mV
DATALOGGER
failure
warning
alarm
alarm logic

Fig. 2

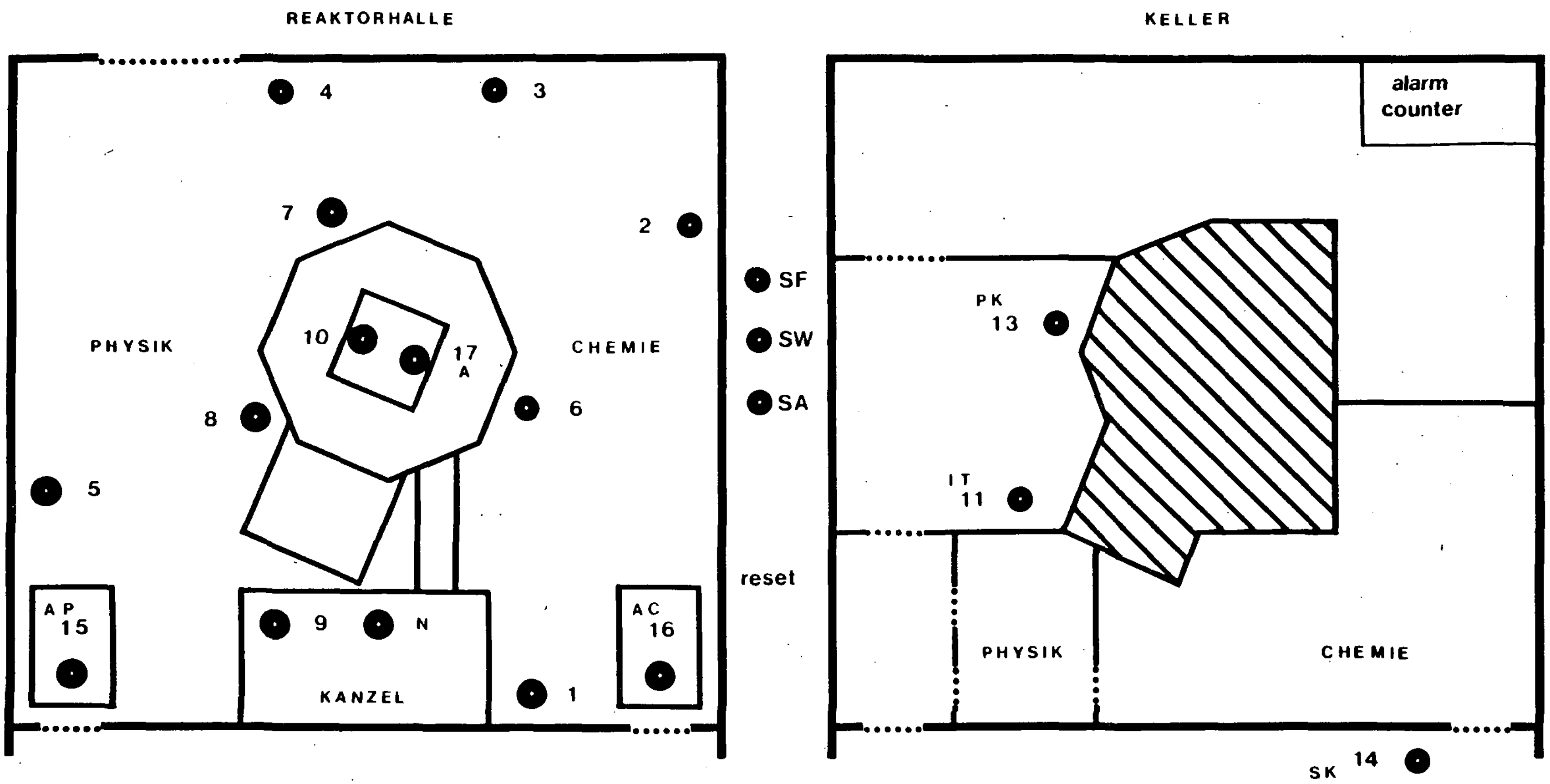
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Fig. 3