TÜRKİYE ATOM ENERJİSİ KURUMU

THE EARLY WARNING ENVIRONMENTAL RADIATION MONITORING SYSTEM IN TURKEY
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THE EARLY WARNING ENVIRONMENTAL RADIATION MONITORING SYSTEM IN TURKEY

I. INTRODUCTION

Recent events have caused a growing demand for a method for the rapid determination of increases in background radiation levels over large expanses. Essentially, the Chernobyl accident that had occurred on 26th of April 1986, and its subsequent effects over Turkey has dictated the necessity of establishing an Early Warning Environmental Radiation Monitoring System (EWERMS). The essential task of the EWERMS is to monitor atmospheric radiation level continuously and rapidly alert personnel in the case of elevated levels.

For this purpose, Turkish Atomic Energy Authority (TAEA) selected 42 different spots all over the country to be used for radiation monitoring. In this selection, the locations of existing power plants in the neighboring countries and meteorological conditions were taken into consideration. At these places a Remote Monitoring Station (RMS), that is going to be described in detail, has been established in the buildings of State Meteorological Organization (SMO). In each of these buildings an officer is in charge for 24 hours and at least a public telephone line is available for long distance communication. Some SMO buildings have better communication infrastructure like fax, telex, or HHF/SSB.

The first RMS had been established in September 1987, at the moment 27 RMSs are in operation, total number will be 30 by the end of 1992. The 27 RMS in Turkey and their yearly average background readings for the year 1992 are shown in Fig.1.
The RMSs that are on-line connected to Ankara

The RMSs that will be included in the on-line network in the Year 1993

Fig. 1. The RMSs in Turkey and Their Average Background Readings (µR/h) for the Year 1992
I. REMOTE MONITORING STATION, STRUCTURE AND OPERATION

The RMS of Turkish EWERMS is basically comprised of four sub-units and shown in Fig.2. The sub-units are:

* The microcomputer based intelligent radiation monitor (Eberline ESP-2)
* GM detector (Eberline HP-270)
* Printer (Citizen D-120)
* Battery charger and alarm unit (designed and realized in the Electronics Division of Ankara Nuclear Research and Training Center (ANRTC)).

II.1 THE RADIATION MONITOR

Technical specifications of the Eberline's portable radiation monitor is given in Appendix I. As it can be seen from the specifications, the ESP-2 is a flexible, programmable instrument to be used as a radiation monitor. It has various operating modes and sub-modes; like ratemeter, peak-trap ratemeter, average rate, fixed-precision and integrating scaler modes. In the EWERMS, ESP-2 is used in "Fixed-precision scaler, auto recycle, auto log" mode. In this mode, the instrument integrates the detector pulses for whatever time is required for the selected precision and displays the average rate. At the completion of each cycle, the results are logged into the internal RAM of the instrument and also to the printer through the RS-232 serial communication port, the cycle then restarts.
FIG. 2. DIAGRAM OF THE EARLY WARNING ENVIRONMENTAL RADIATION MONITORING SYSTEM
II.2 THE GM DETECTOR

Eberline HP-270 is a general purpose GM probe with energy compensation and beta shield. It permits reliable exposure rate measurement from background to 3000 mR/h. It is placed in a cylindrical non-metallic weather-proof housing.

II.3 THE PRINTER

The hard-copy unit is Citizen D-120, 80 column dot-matrix printer and receives and prints the measured data of ESP-2.

II.4 THE ALARM AND CHARGER UNIT

Some minor modifications were made in the ESP-2 in order to integrate it to the EWERMS. The six standard carbon-zinc batteries are replaced with a maintenance-free lead-acid chargeable battery for continuous field operation. An additional 9-pin D-sub connector is installed into the instrument to interconnect ESP-2 with alarm and charger unit.

This unit charges the battery when the terminal voltage drops below a specified level. It has also an 2W audio amplifier which amplifies an internally generated warning signal according to the state of the alarm level coming from ESP-2. This signal is active when the environmental background radiation level exceeds the alarm level which is presetted at the stage of installation.
II.5 OPERATION

The radiation monitor ESP-2 measures the ambient background radiation level in the specific mode as described above and dumps each measurement data to the printer. Fig.3 is an example of printer output data format. The officer in charge in the SMO building tears out the printer paper at the end of each month and mails it to the Radiation Protection Department (RPD) in TAEA. These data belonging to each RMS is loaded into the database computer in RPD for further evaluation.

If the ambient radiation level exceeds the presetted threshold, the alarm unit gives an audible alarm and immediately the officer makes a telephone call to the RPD revealing the existence of an alarm condition. This basic off-line operation of the EWERMS is shown in Fig.4.

III. THE ON-LINE NETWORK CONSTRUCTION OF THE EWERMS

In 1989 TAEA decided to improve the operation of the EWERMS by establishing a real-time on-line communication network. The aim was to enable the RPD to reach the data of each RMS directly from Ankara and to receive a direct alarm warning in the case of over threshold measurements. This network development approach was supported by IAEA within the framework of the TC project TUR/9/010 and a collaboration between Seibersdorf laboratory and the Electronics Division of ANRTC was initiated.

The network feasibility study which was realized with the consultancy from IAEA resulted in selecting the public telephone network which has the widest distribution and lowest management cost in Turkey. The principal topology of the decided network which has a star structure is shown in Fig.5.

As it is shown in Fig. 5, each RMS has a PC/XT that will function as a Local Controller Unit (LCU). In the network, the serial communication port of
Date: 11/18/92 1839

Instruments:

- **INSTRUMENT #**: 000000
- **USER I.D. #**: 000000000

Detector Info:

- **DETECTOR INFO**: #1 HP-270-SN-216

Operating Mode:

- **OPERATING MODE**: SCALER, 5% PRECISION (AUTO RECYCLE/LOG)
- **CALIB. CONSTANT**: 7.53E+07
- **DEAD TIME (SEC)**: 1.15E-04
- **HIGH VOLTAGE**: 8.97E+02

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Fig. 3. ESP-2 Printer Heading and Data Format
Fig. 4: BASIC OFF-LINE OPERATION OF TURKISH EWERMS
CONTROL STATION
(RADIATION PROTECTION
DEPARTMENT OF TAEA)

REMOTE MONITORING
STATION
(RMS)

HARDWARE
1. IBM PC/AT
   * 1MB RAM
   * 20MB Hard Disk
   * 1.2MB fdd 5 1/4
   * 1.44MB fdd 3 1/2
2. Graphics Printer
3. Racal-Vadic Auto-Dial Modem
   * 2400 Baud
   * AT Hayes Compatible
   * MNP Class 5 Error Control

HARDWARE
1. IBM PC/XT
   * 640KB RAM
   * 2*360KB 5 1/4 FDD
   * Discovery 2400
     Plug-in Modem
     * Monocrom Monitor
2. Matrix Printer
3. ESP-2 Radiation Monitor

Fig. 5. The Network Topology of EWERMS
ESP-2 which is normally connected to the printer as shown in Fig. 2, is connected to the serial port of PC/XT. This way, at the end of each measurement, the measurement data of ESP-2 is sent to LCU and stored in a temporary data file. A plug-in card type modem is installed into the PC/XT and uses the second serial communication port of the computer.

The hardware of the Control Station (CS) is basically comprised of a PC/AT, a modem and a graphics printer. The AT system has a high capacity hard disk to accommodate data of all RMSs.

Two different software packages are developed to be executed at the computers of CS and RMSs. The functions of each program will be described in the next section in detail. The operating philosophy of the network software can be summarized as follows:

In normal operation of the network where an alarm condition does not exist, the CS acts as the "Master" and the RMSs are "Slaves" in turn. The CS polls each RMS sequentially at user-defined time intervals in a day and pulls the available data to Ankara. After a successful communication and data transfer, the data file in each RMS is deleted to allow the accumulation of data belonging to forecoming measurements. The polling time is set to predetermined times where a low telephone traffic exists in the public telephone network.

If the radiation level rise to and above the alarm threshold, the CS has to be alerted in the quickest possible way. This, of course can be accomplished only by random access. Therefore, for these situations the RMS, that reports an alarm condition, becomes "Master" in the network and immediately calls CS. In such a case CS reacts to incoming alarm call and logs all relevant measurement data dictated by the alarm pending RMS. CS also alerts an Officer In Charge (OIC) of the EWERMS to allow for further guided actions by the authority.
III.1 CENTRAL STATION SOFTWARE

The Central Station software has two distinct features related to the requirements:

A) Tasks related to on-line communication:
   * Establishing an on-line communication channel with the RMSs and achieving successful transfer of data to Ankara,
   * Acknowledging the service request of alarm signaling RMS and processing the data produced by the event,
   * Immediately calling OIC by using the dialing capability of modem,
   * Remote calibration of working parameters of the radiation monitor ESP-2; like, operating mode, high voltage, alarm threshold etc.

B) Tasks related to off-line data analysis:
   * Display of country map and the location of RMSs,
   * Proper manipulation and organization of raw data for further analysis in the radiation measurements data base,
   * Graphic presentation of data for making inter comparison among the data belonging to different RMSs,
   * Graphic presentation of time history of an RMS,
   * File management.

III.2 REMOTE MONITORING STATION SOFTWARE

The RMS software package runs in the LCU and it fulfills the following tasks:

A) Tasks related to on-line communication:
* It continuously monitors the serial communication port COM2 to detect a polling request from CS, and if it detects such a request, transfers the data on the diskette to CS and deletes the transmitted file,

* In the case of an over threshold measurement immediately calls CS and reports the alarm status.

B) Tasks related to off-line data collection:

* It continuously monitors the serial communication port COM1 to which ESP-2 is connected and if there is data available, stores it onto the floppy disk,

* Checks the measurement data against the preset alarm level.

Both of the software programs were developed in Electronics Division of Ankara Nuclear Research and Training Center. Programs were written in Turbo C language because of portability as well as execution speed.

IV. CURRENT STATUS OF THE TURKISH EWERMS

The expansion of the EWERMS will continue in 1993 year and the installation of 12 more RMSs will be completed.

Concerning the on-line network, June 1992, the first RMS is put into network in Çekmece Nuclear Research Center/Istanbul. By this connection, real time tests are being executed to test the developed CS and RMS software programs. Such tests allowed the appearance of practical problems so that, they are being recovered in the developed software programs. Recently, RMS in Edirne/Thrace was included in the network. Software modification and upgrading studies as well as network expansion will continue in 1993. The 12 RMSs indicated in Figure 1., the hardware of which have been obtained from IAEA under the TC project TUR/9/010, will be included in the network.