A COMPUTER-AID SYSTEM FOR OFF-SITE NUCLEAR EMERGENCY SITUATIONS MANAGEMENT

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INTRODUCTION

In order to better deal with nuclear accidents and the following emergency situations at its five nuclear centres, the ENEA (the italian nuclear research board) has developed a computer-aid emergency system the main feature of which is the link amoung five computers each sited at one of the nuclear centres, and a sixth devoted to control and monitor all the communications amoung them. The whole system is designed in such a way as to assure the maximum degree of reliability and a sufficient flexibility to fit the specific needs of each centre and to face with possible extensions and changes in procedures and basic data.

The system is aimed at calculating and predicting the atmospheric transport, dispersion and radiologic impact of radioactivity accidentally released by ENEA nuclear plants starting from meteorological and inventory data which are acquired in real time by the system itself. The exchange of communications, informations and data between the Centres and the ENEA H.Q. is also assured. Since the beginning the system has been mainly conceived as a tool higly useful to decision-makers during emergency situations.

It should be stressed that the system has a sufficient flexibility to allow also the analysis of the routine releases from the Centres and to provide useful data in case of emergency situations coming from both national and extra-boundaries accidents. In addition, in the near future, it will run all the radiation protection related codes under development at the ENEA, including a personnel dose record-keeping program concerning about 2000 radiation Workers.

GENERAL SYSTEM ARCHITECTURE

The whole system is mainly composed of a network system, the on-site subsystems and a coordination central system.

The first one links the various computers, each of which is located in the on-site emergency room, to the central emergency room of the ENEA H.Q. and to the computer of the control board (nuclear safety and radiation protection directorate), as shown in fig. 1.

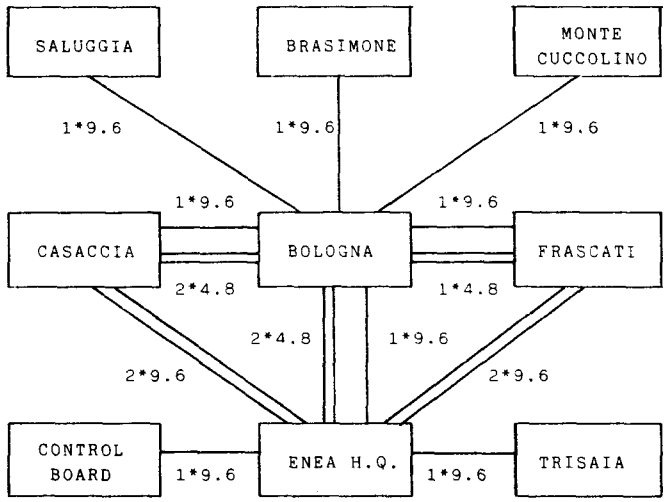

Fig. 1 - The ENEA DEC network system (kbaud).

Each on-site subsystem carries out the following tasks:

- real-time data acquisition from the meteorological tower, the stack monitors, the remote field radiation monitors, the in-plant area radiation monitors;
- data reduction, if any, validation and update;
- data formatting and preparation for their transfer;
- evaluation of the radiological situation by the simple diffusion and transport code SPADE (bidimensional, no orography);
- receiving the results of more complex codes run at either the main central computer or the control board computer.

The emergency coordination centre system has the following tasks:

- to receive the on-site radiological and meteorological data;
- to update the main data-base;
- to evaluate the radiological impact on the environment and on the population by running complex diffusion and transport codes;
- to replace the local computer, as for the accident consequences analysis, in case of the latter's failure.

HARDWARE FEATURES

The application programs and the simulation codes which run or will run on the various computers of the emergency management system need a fair large memory as they shall be managed at various

priority levels by a multi-user and a multi-tasking operating system. So 16-bit computers of the uVAX family have been chosen.

SOFTWARE FEATURES

The software is composed of indipendent modules, so that it attains a high flexibility, has a hierarchical tree based menu driven structure and works in an interactive way. Its gross structure is sketched in fig. 2 and comprises five main packages:

- on-line data acquisition;
- data filing;
- environmental data analysis;
- communication and its monitoring;
- accidental analysis.

One of its main features is that the various functions and inputs are fully automated; however, of course, request functions and manual inputs are allowed at many stages and levels.

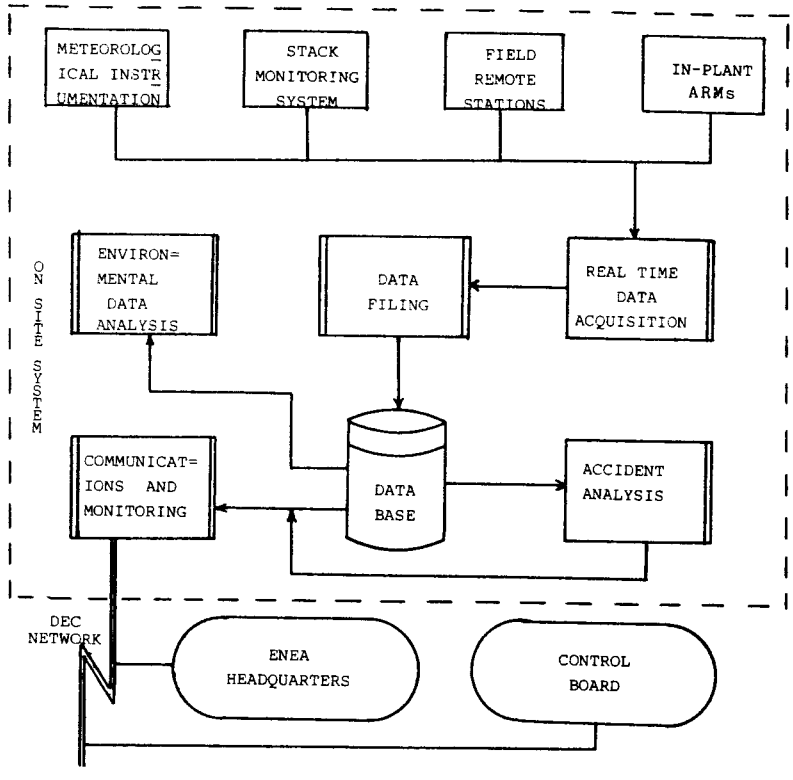

Fig. 3 - Main System Structure

The communication and monitoring module must coordinate, manage and monitor all the communication-related actions between, among and within the centres (local and coordination). Its main function is the monitored data transfer (automatic function), which comprises the environmental data reading, the data validation, the data packing and transfer and their back-up on an overlapping circular 48-hour memory. In addition request functions, such like start-up request in case of drills, test and pre-alarm conditions and requests to receive the results of codes run on the other computers, can be performed.

In addition to the above mentioned tasks, the described module performs the task of monitoring and filing all the communications, informations and functions and continuously checking the status of the lines pointing out the malfunctions, if any. These tasks are usefull not only during the emergency phase itself but also on the occasion of drills, when an "a posteriori" check is needed in order to ascertain the whole emergency machinery.

The accident analysis package is mainly based upon the SPADE code (Sequential Puff Atmospheric Diffusion Evaluation), a simple gaussian code which uses a variable trajectory advection atmospheric dispersion model and calculates dispersion factors inside a 10 km radius. This figure is based on Design Based Accident evaluations, whilst major severe accident consequences will be treated in the future.

REFERENCES

1) Documento del gruppo di lavoro "Automazione della gestione delle emergenze nucleari", ENEA, private communication, 1984.
2) F. Desiato and G. Tonini, "SPADE un modello a sequenza di puff per la valutazione della diffusione atmosferica", ENEA, RT/DISP/84/6, 1984.