AUTOMATIC DATA PROCESSING FOR A NATIONAL FILM DOSIMETRY SERVICE

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Abstract—The operation of a national film dosimetry service involves a considerable amount of documentation, including regular badge dispatch lists, a dosage information bulletin sent to each organization, and full records of individuals and organizations using the service. The smooth operation of the dosimetry service depends on the regular flow of this documentation.

Automatic data processing has been introduced to handle all the documentation of the Soreq Dosimetry Service, which acts as a national scheme for all industrial and medical applications of radiation. This results in a fully flexible system, capable of meeting increased demands without a corresponding increase in the personnel required for documentation. The use of an electronic computer results in considerable saving in manpower and a reduction in errors, and permits convenient storage of all the recorded dosage statistics on magnetic tape.

AUTOMATIC data processing has been applied to the operation of the Soreq Dosimetry Service, to handle all the documentation and data storage. The system is fully flexible and capable of meeting increased demands in documentation, without a corresponding increase in the number of personnel. The use of the electronic computer results in a considerable saving in manpower, a reduction in errors, and convenient storage of all the recorded dosage statistics on magnetic tape.

ORGANIZATION OF THE DOSIMETRY SERVICE

The Soreq Dosimetry Service is a national service covering all personnel working in industrial or medical applications of radiation throughout the country. Interested organizations wishing to join the scheme fill in a special order form giving the personal information required for each worker, i.e. full name, name of father, date of birth, sex, national identity card number, and type or types of film badge required. Each organization is designated by a serial number given by the film service, and this number is used for all operations involving that organization. In addition, each badge wearer is given a personal identification number (not connected with the national registration number). Individuals working for two or more different organizations receive a different identification number in each organization.

The film service at present offers five categories of film badge. Type A, usually worn on the chest, is for measuring the total body dose of beta, gamma, X-rays and thermal neutrons. Types B, C and D are similar to type A, but are worn for measuring hand, foot and head dosage respectively. Type N is used for fast neutron dosage, and is usually worn on the chest. Each badge wearer receives the same personal identity number for all types of badges worn within a given organization.

The badges are usually changed every two weeks (hereafter called the "period"). However, for cases where the film wearer is not regularly in contact with radiation, the change is every six weeks. Badges for new members are delivered at the very first regular dispatch after the order form is received, an improvement in service which has only become possible since the introduction of the computer system. After assembly of the film badges in the film service laboratory, they are sent to the different organizations accompanied by a dispatch list. This list includes the personal identity number

and full name of the badge wearer and the film serial number for that period. A duplicate list is kept as a work list in the laboratory. At the end of the period the badges are returned to the laboratory, where the films are developed under standard conditions and the radiation dose evaluated using film dosimetry techniques. The dose of each film is entered on the work list, which is then used to prepare the input for the computer. The computer prints period dose reports for each organization, and keeps a personal dose record stored on magnetic tape for each badge wearer. Before the introduction of the computer, this documentation was done semi-automatically using business machines.

PREPARATION OF INITIAL DATA FOR THE COMPUTER

For preparing a new service from the start, a full list of organizations and badge wearers is drawn up, using a suitable code to represent the Hebrew letters. Within each organization, the list is ordered according to increasing personal number. One of the main problems in arranging such a list is to keep a continuous check on alterations which occur, even during the preparation of the list. Up-to-date information on changes is therefore added before finally using the programme. Numerical codes are used to describe the badge category, radiation type (X-ray, gamma, beta, thermal neutron or fast neutron), special remarks, and radiation dosage. This saves space in the computer memory. For efficient operation, the organizations are divided into five different groups, each having a separate "run" and using a separate section of the storage magnetic tapes. To minimize errors, several checks are made on the input data, including a check on the correct ordering of personal numbers, a search for faulty numbers, etc. These checks would not of course correct any errors in the actual dosage as recorded by the film laboratory technician.

USE OF THE COMPUTER FOR ROUTINE OPERATION

The full list of badge wearers organizations and addresses, the codes, and other required parameters (including period dates) are recorded on magnetic tape and transferred to the computer memory, one "run" at a time. All changes within this run, including cancellations and additions of new badge wearers, are now brought up to date using IBM cards. For additions, the organization identity number is required. For cancellations only the personal number and a single digit designating cancellation are required. Full details of the input information are shown in Appendix A. It should be emphasized that the present system of adding new badge wearers is considerably simpler than the earlier method, which involved ordering a special address plate with a three weeks delivery time.

Since the period dose report for a particular period is prepared several weeks after its corresponding dispatch list, and meanwhile new dispatch lists have to be prepared which may include changes, two separate magnetic tapes are kept, one for the dispatch and work lists, and one for the period dose reports. The same input data cards are used to introduce changes in both tapes, but with a delay to take into account the extra time needed for the latter tape.

The preparation of dispatch lists and work lists requires input data giving any changes in the badge wearer list for that "run", the period number, the "run", and the serial number of the first film in the whole run. The computer prints this serial number for the whole print out.

The input data required for the period dose reports are entered on IBM cards, according to the organization, keeping strictly to the order of increasing personal number. The code for the particular period and the organization number are given first, then the dose details of badges found to have received a measurable radiation dose. If a badge is not returned, or a special remark is required for the dose report, then this is added here. No entry is required for a badge returned in its proper period and showing no measurable dose; the computer takes the absence of a given personal number as meaning zero dosage. This permits considerable reduction in the input data. In addition, a special code is used for whole groups or subgroups of badges which do not arrive in time for the period development, to permit rapid addition to the input data. The accumulated doses for previous periods are stored on the

period dose storage tape, permitting totals and sub-totals to be given in the dose reports.

The personal dose records are stored for one year on magnetic tape. The dose record of any individual badge wearer can be furnished immediately just by giving his personal identity number and the required periods. Normally such a report is printed every 3 months and sent to the parent organization. The doses received by individuals in more than one organization are printed on separate cards.

The scheme has been running efficiently for over six months and has proved itself excellently over this period. At present the service is operating for several thousand badge wearers in over two hundred organizations. The use of the electronic computer has permitted the documentary staff to be reduced by 2 members (a cut of 50%), with a big reduction in errors. In addition, the very rapid documentation possible with the computer gives a great deal of flexibility to the operation of the whole badge service not possible with semi-automatic documentation, which required many days of preparation. Previously, any backlog in documentation caused by illness or any other reason, could lead to considerable disruption of the whole service. The monthly cost in computer time is only IL.450 ($150), quite insignificant compared with the other costs of the service.

APPENDIX A

I. *Input Data for Dispatch and Work Lists*

This input includes an IBM card giving the period number, the "run" number indicating the organizations included and the serial number of the first film. The main volume of input data here is information on new users, transfer of users from one organization to another, and cancellation of users from the service.

(*a*) *Addition of new badge wearers.* The information on each new user occupies a single IBM card. The following items are included (the number of bits allocated to accommodate each item is shown in brackets): personal identity number (6), full name (16), national registration number (8), date of birth (5), badge type (1), organization identity number (3).

(*b*) *Transfer of badge wearers from one organization to another.* The transfer of badge wearers requires the addition of a card of the type described in (*a*) above, including the former personal identity number and the new organization number. In addition, to permit transfer of partial radiation totals and cancel the position in the former organizations, the following information is required: personal identity number (6), badge type (2), transfer signal (2), radiation dose totals (16). The data for three individuals can be entered in a single IBM card.

(*c*) *Cancellations.* A typical cancellation card contains the following information: personal identity number (6), badge type (2), and cancellation signal (2).

All the above data are entered in order of personal identity number, within each organization.

II. *Input Data for Period Dose Reports and Personal Dose Records*

Each card contains the following information for five badge wearers: badge type (1), personal identity number (5), period (2), radiation type (1)—dose (2) (twice), remarks (2). This permits dose information to be entered about two types of radiation. A film badge returned during the correct period, but not showing any measureable dose, is not included in the input data—its absence being taken to mean zero dose. This considerably reduces the volume of input data. Where a badge has not been returned in the normal period, this is indicated in the "remarks" position and the individual is not included in the period dose report. For a badge returned late from an earlier period, a remark is added to this effect. In addition, a separate card is added for all late films, giving the serial number of the film and the appropriate period number. If a whole group or sub-group is returned late, it is added to the input data with indication of the first and last members of the group and a special remark.

Owing to the extreme importance of accuracy in the dose input data, all the information is double checked against the work lists, by two different operators.