International Atomic Energy Agency

INDC(CCP)-249/L

INDC

INTERNATIONAL NUCLEAR DATA COMMITTEE

UPDATING AND USING THE INTERNATIONAL NON-NEUTRON EXPERIMENTAL NUCLEAR DATA BASE IN "GENERALIZED EXFOR" FORMAT

G.M. Zhuravleva and F.E. Chukreev

(Translated from Nuclear Constants 2(56) 1984, pp. 3,
Russian Original distributed as INDC(CCP)-232/G)

Translated by the IAEA

October 1985

IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA

INDC(CCP)-249/L

UPDATING AND USING THE INTERNATIONAL NON-NEUTRON EXPERIMENTAL NUCLEAR DATA BASE IN "GENERALIZED EXFOR" FORMAT

G.M. Zhuravleva and F.E. Chukreev

(Translated from Nuclear Constants 2(56) 1984, pp. 3,
Russian Original distributed as INDC(CCP)-232/G)

Translated by the IAEA

October 1985

Reproduced by the IAEA in Austria
October 1985

85-04961

Translated from Russian INDC(CCP)-249/L

UDC 681.3.06-142.2:539.170

UPDATING AND USING THE INTERNATIONAL NON-NEUTRON EXPERIMENTAL NUCLEAR DATA BASE IN "GENERALIZED EXFOR" FORMAT

G.M. Zhuravleva, F.E. Chukreev

ABSTRACT

A software system for the automatic preparation of non-formalized textual information for the international exchange of nuclear data in the "Generalized Exchange Format (EXFOR)" is described. The "Generalized EXFOR" format is briefly outlined and data are given on the size of the international non-neutron experimental data base in this format.

The continual increase in the cost of experiments in all branches of science due to the need to investigate different phenomena has made it appear desirable to collect and organize the available information and to extract reliable data from it for use in the various spheres of science and technology[1].

The process whereby communication takes place between people involved in the processing of quantitative information can be seen as having four consecutive stages:

- Obtaining and publication of data by the research worker himself;

- Collection, analysis and comparison of scientific information obtained by different methods and compilation of the necessary tabular, evaluated and standard reference data;

- Dissemination of these data in a form convenient for the user;

- Use of the tabular, evaluated and standard reference data.

It would be excessively impractical and expensive for each research worker or even for each laboratory to compile their own set of data themselves. A link thus needs to be established between those who originally obtain the data and those who use them, by setting up a system for the review, evaluation and compilation of data tables by qualified experts. To achieve these aims for the field of nuclear physics an international network of centres was set up in 1964 on the initiative of the Nuclear Data Section of the International Atomic Energy Agency (IAEA) [2]. The main tasks of the centres are to collect experimental information, to evaluate the data obtained in experiments and to disseminate these data. The centres are now regularly exchanging nuclear data bases by means of magnetic tapes. The data are recorded on tape in accordance with international standards governing the flagging and structure of magnetic tapes. The standards also lay down rules for structuring data blocks in various formats. The standardization of data in terms of entry formats facilitates the elimination of linguistic difficulties in data exchange and also makes it relatively easy for centres with different data processing equipment to convert and interpret the data they receive and to use them to solve various problems. When data bases are transferred on magnetic tape from one country to another, this constitutes an exchange of scientific or technical information on an international scale which enhances the scientific and technical potential of the countries involved in the international network of centres. In addition, this type of exchange makes possible various different types of information retrieval and automatic updating of the centre's data base; as a result, the efforts expended are many times less, since totally formalized data are used.

This paper considers questions relating to the updating of the international non-neutron experimental nuclear data base in "Generalized EXFOR" format (the EXFOR data base) with non-formalized primary information and discusses the way this is done at the Centre for Nuclear Structure and Reaction Data (CAJaD) of the USSR State Committee on the Utilization of Atomic Energy [3]. However, the authors believe that it is worthwhile first to provide some basic information on the international format called "Generalized EXFOR" (GE). This format is an artificial information retrieval language designed for "factographic" description of physics experiments with subsequent retrieval and processing of data for the synthesis of new information (this being a typical characteristic of logical information systems). GE can be described as a format which provides a compact means of recording numerical experimental values and physics information (needed for understanding the experiment and interpreting the data) and which is well suited to be used on computers for the international exchange of experimental nuclear data.

The GE format is now widely used because it is flexible and relatively easy to adapt for the description of results from any type of nuclear physics experiment. Many years of experience with it have shown that, by modifying the dictionaries, this format can be used to describe practically all experiments involving dependences of the continuous type, such as infra-red spectra, characteristics of radioactive transformations, product yields of chemical interactions in binary reactions, etc. The structure of the GE format has been made such that the range of data compiled in it can be extended. Historically, the development of the format began with the compilation of information on neutron-induced reactions [4]. Later, as a result of the accumulation of experience and the expansion of international co-operation, data from experiments on nuclear reactions induced by charged particles, and subsequently also by photons, were increasingly compiled as well [5]. Recently the GE format has been applied to atomic and molecular data, and the Institute of Physics and Energy (FEhI) in Obninsk has adapted it for thermal physics data.

The EXFOR data base on charged particle reactions is being disseminated by the following major centres (which are responsible for the selection, compilation and dissemination of nuclear data information in a defined service area):

- CAJaD, which services the USSR;

- The United States National Nuclear Data Centre at the Brookhaven National Laboratory, which services the United States and Canada;

- The IAEA Nuclear Data Section (Austria), which services centres in Eastern Europe, Asia, South and Central America, Australia and New Zealand;

- The Centre for Nuclear Energy Documentation, which services the Federal Republic of Germany[*];

- The data bank of the Nuclear Energy Agency (NEA) in Saclay (France), which disseminates data to all member countries of the Organisation for Economic Co-operation and Development (OECD) apart from the United States and Canada.

Each centre can compile data measured outside the area which it services but may transmit to other centres only data from its own area. Thus, each of the centres is building up an international library of experimental nuclear data in machine-readable form. In compiling new experimental works for inclusion in the data base, preference is given (due account being taken of the requirements of each particular centre) to those containing data on the most important elements and reactions. The activities of the German centre and of CAJaD mainly relate to the compilation of works on integral nuclear data on charged particles used for activation analysis and isotope production. The United States and IAEA centres are concerned with the compilation of charged particle nuclear data on the basis of reactions of interest as neutron sources.

---

[*] The Karlsruhe Charged Particle Nuclear Data Group (KACHAPAG), which officially belonged to this centre and was concerned with the compilation of cross-section data for charged particles, ceased to exist on 1 January 1982. However, a data base consisting of 200 works compiled by the Group was included in the international data base on charged particle reactions.

As has already been mentioned, the exchange of data between centres makes it necessary for the content of the information to be standardized. In the GE format this is achieved by means of keywords, i.e. system and information identifiers and specially developed codes (Annex 1). The keywords and codes render the information "comprehensible" to the computer and ensure that the entry is sufficiently compact when the information is transmitted. At the same time the GE format can also be used to record any free text which describes important aspects of the experiment that need to be pointed out but which is unsuitable for encoding by accepted methods. Obviously, the requirement that the format should be flexible conflicts with the requirement of compactness. However, the strict rules for the GE format ensure that data can relatively easily be transformed from GE into fixed but compact entries which may be required for input into specially prepared formats for subsequent computations [6].

The requirement of compactness for data entry in GE format has led to the development of a set of dictionaries for describing various aspects of the results and of the conditions in which experiments are performed and also for giving additional (e.g. bibliographical) information about them. This set of dictionaries is used to compile data, to verify the codes employed in syntactic and semantic checking programs and also to reconstruct and extend free text in such a way that the compiled text can easily be read by human beings. The IAEA's Nuclear Data Section is responsible for the co-ordination and feasibility of including new codes in the format dictionaries and also for their consistency with codes agreed earlier. The Section regularly sends out additional and/or updated dictionaries to the other centres.

Reference [7] contains the currently agreed set of definitions, conventions and rules for coding and international exchange of data in GE format. This manual has two parts. Part One ("EXFOR Systems Manual") is devoted to the description of the format and its structure, to the rules for the coding of nuclear data and to international links for the exchange of information in GE format. This part provides basic material both for pysicists compiling nuclear data and for programmers preparing software for processing information recorded in GE format (for the EXFOR system). Part Two ("LEXFOR") contains information of specific relevance for physicists. Here, the coding rules and code definitions, the physical meaning of the codes and their areas of application are spelled out. The GE format is continually being developed in such a way that a maximum of standardization to facilitate automated computer processing of data is combined with the possibility of including new types of data and a wide variety of information on experiments. The format is being developed in two main directions: (1) improvement of the coding rules to make their interpretation unambiguous, which is particularly important when the format is used for different applications (compilation of data on neutron, non-neutron and photonuclear reactions); and (2) extension of the GE format dictionary sets and their codes (as a consequence of the first type of development).

Practically any data on the experimental device, on the measurement method and on the processing of the measurements not only can but also should be recorded in GE format, since the data may not be used immediately after publication or may be applied to reach conclusions which had not even occurred to the author as a possibility. The space in the average journal article is limited, so not all details of an experiment can be described. In this case the magnetic tape serves as a supplement to the journal article, storing for subsequent analysis details which might appear superfluous to an editor or referee. But all these "insignificant" details are known only to the author of the publication. They will appear on an exchange tape if the entry is prepared not by the compiling physicist working at the centre but by the author himself. In addition, the format is intended for the compilation of data not only on published experimental work but also on preliminary results

The principles for coding the results of experimental research are as follows: if an experimental work (publication) is coded in accordance with GE formatting rules, it will be recorded on an international exchange tape which will usually contain a number of compiled works (entries). Within an entry, sub-entries are identified in such a way that each of them contains information relating, for example, to the same type of reaction for a given nuclide. The first sub-entry of the compiled work always contains information which is common to all subsequent sub-entries (cf. Annex 1). Each sub-entry apart from the first can have up to three sections: bibliographical information (BIB), common data and data table. The structure of the exchange tape is shown in Fig. 1.

For experimenters, evaluators, developers and other users the following are of the greatest interest (cf. Annex 1):

- The results of measurements and calculations represented in tabular form with columns for independent variables, errors, and so on (recorded in the DATA section);

- Numerical data which are common to the whole table of a given sub-entry (recorded in the COMMON section);

- Numerical information which is common throughout the given entry (always recorded in the COMMON section of the first sub-entry).

The tables of experimental numerical data cannot be interpreted and used meaningfully without accompanying textual information on the data, bibliographical references, error analyisis, normalization and so on. This information is recorded in the BIB section. Each piece of descriptive information is identified using information identifiers such as TITLE, MONITOR or REACTION. Any information identifier is described by an object-characteristic structure [8,9] in which its name determines the designation of an object whose properties appear in the form of a whole finite set of characteristics (Table 1). In accordance with the formatting rules the characteristics are entered in a certain sequence with appropriate syntax. The values of the characteristics are represented by codes or numerical values. For example, the information identifier DETECTOR is associated with codes such as (GELI) and (SCIN) and the METHOD keyword with codes such as (TOF) and (COINC), meaning that measurements were made with a germanium-lithium or a scintillation detector using the time-of-flight or the coincidence method. In addition, any coded information can be supplemented by free text.

All numerical data are shown under data headings (for example, DATA, EN) and in data units (such as EV, MB). Some data tables can have a more complex structure and there may be several of them for different reactions in one sub-entry. In this case each reaction is linked with the corresponding column of the data table (the DATA section) by means of a pointer (cf. Annex 1) which is used for linking information from different sections.

The logical division of information on an exchange tape into entries, sub-entries and sections is performed by means of system identifiers (Fig. 2), each of which defines a data unit on the exchange tape (Table 2). In combinations with the prefixes NO and END, the system identifiers indicate:

- The beginning of a data unit (by the system identifier entry alone);

- The end of a data unit (by the prefix END preceding the system identifier);

- The omission of a data unit (by the prefix NO preceding the system identifier).

The length of a record on the tape is 80 characters, and each record has its own individual number, the record identifier (cf. Annex 1). This is entered in columns 67-80 and consists of five fields:

- 67: the centre identifier, showing the individual code of the centre transmitting the information to the network of centres;

- 68-71: the numerical identifier of the work, showing the accession number of the compiled publication;

- 72-74: the numerical identifier of the sub-entry, showing the accession number of the sub-entry in the entry;

- 75-79: the numerical identifier of sequential record numbering within a sub-entry;

- 80: the alter flag, indicating that records have been altered since the tape was last transmitted.

Use of the record identifier ensures that each record on the tape will have a unique reference which can readily be found. The structure of the record is such that it is easy to perform any data processing operation: retrieval, updating, input, deletion of records and so on.

One of the most important characteristics of the EXFOR data base is continual updating with new works. However, when new data are received it is necessary to check their reliability; otherwise users may lose confidence that there are no contradictions or errors. Only after evaluation for reliability can the updated data base be further used. At CAJaD this task is performed in two stages. The first consists in having the authors of the experiment prepare or check the text which is recorded in GE format and reflects not only the basic characteristics but also the details of the experiment. This measure is not merely desirable but essential, since errors may arise in the compilation of an article, especially in the preparation of data tables when the compiling physicist takes the data from figures. Moreover, the experiment must be described in such a way as to be reproducible, so the publication, and thus also the coded "factographic" description, must contain all the necessary information. The second stage for ensuring that data are reliable consists in making a computer identify syntactic and semantic errors which may have occurred in coding the publication and entering the "factographic" description into the computer. The development of computerized means of monitoring data is important, especially as an additional guarantee of reliability, since manual checking is somewhat laborious.

The structure of the GE format is such that many data processing operations can be automated and automation is being successfully introduced at the international centres. Such systems are generally developed on large computers with certain functions being partially entrusted to powerful minicomputers [10]. In certain cases it is desirable not to use large computer systems but small computers, for example in relatively small laboratories or in order to protect the confidentiality of work.

Each regional centre has particular computer system capabilities and user requirements and its own data transmission and storage system optimized for its own needs and capabilities [10-12]. The retrieval system of CAJaD for data processing operations is based on a small 1010B computer [13]. The principles of organization of the software are determined not only by the nature of the problems to be solved and by the design of the system components, but also in large measure by the configuration of the computer itself. Characteristic features of the 1010B are the small size of its internal memory (32 kilobytes) and direct-access memory (two 800 kilobyte minidisks) and its standardized software, which make it practically impossible to transfer the software of the EXFOR system developed at other international centres.

The development of a set of programs for the EXFOR system at CAJaD has been based on the principles and structure of the software for an information retrieval system developed at CAJaD to control large data files on magnetic tape in internal storage format. At the same time the operating system of the 1010B computer is interactive. This means that the EXFOR data base can be prepared and processed in interactive mode [14]. The computer is made to perform data "assembly" (coding) functions, functions for identifying the most frequently encountered errors and information storage operations at all stages of processing.

The set of programs for the EXFOR system developed and produced at CAJaD can be used on a small computer, within the limits of its capacity, to produce, maintain, store and exchange large data files recorded in the international GE format. The approach followed in developing the EXFOR computer programs was to reduce the proportion of manual work at all stages of the data preparation and processing cycle (Fig. 3). To achieve this, the data preparation software must perform information input, monitoring, editing and updating functions which take the form of independent programs for the tasks to be performed at each stage of processing. The parameters prepared or stored by the programs of the previous processing stage for those of the following stage are transmitted under automatic control of the sequence in which the stages are performed in the computer. If necessary, this sequence can be interrupted. The operator can perform any stage in the sequence independently, but this significantly increases the amount of manual operations, thereby lowering the speed and quality of data processing.

The procedure established at CAJaD for adding to the EXFOR data base begins with the stage of preliminary analytical processing. This includes the review of Soviet and foreign publications on the subject in question, the identification of publications of interest for the data base and the preparation of a "factographic" description of the publication in the form of a secondary information document (SID). The special feature of this stage is the fact that it requires an "intellectual" conversion of primary, non-formalized information. The role of human beings in this stage is very important since it consists in extracting the semantic information (meaning) contained in the primary information document (PID). This work can be done only by a highly qualified person with a profound knowledge of the kind of information which needs to be stored in the experimental data base. This stage, which is also called the stage of pre-machine data processing (semantic and technical), is the most laborious one. The stage of preliminary analytical processing ends with the production of an SID, which is a manuscript version of the work coded in GE format. Some centres use pre-formatted entry of the SID on special forms, which ensures rigorous standardization in its composition. The form is completed in full conformity with the formatting rules. The manuscript version used at CAJaD, however, provides for the entry of semantic information only, but in such a way that its form will be comprehensible to the operator for input into the computer.

Any data input process involves the conversion of data to a form which can be accepted by the computer. The stage of SID input into the computer is one of the basic process components in the whole data preparation cycle. Input is through a visual display unit (VDU) screen using a special program. The strictness of the format is such that the process of data input can be automated and data can even be entered piecemeal in accordance with GE formatting rules. If data input is done not by the operator but by the staff concerned with the preliminary analytical processing, i.e. by the compiling physicist directly from the PID, the need for a manuscript version of the SID does not arise.

The sequence in which system and information identifiers are "assembled" (generated) is monitored by the input program and results from a dialogue between the operator and the computer. In one way or another, this involves specifying the sequence of execution of computer operations by means of "transactions" [*]. With this approach, SID input can commence practically without a detailed study of the instructions. The operator's answers will take the form of indications what the computer should do at any given moment. This makes it possible to avoid errors, thereby obviating the need for the operator to remember the data sequence. The operator must enter only the substantive part of the SID which is not determined unambiguously by the formatting rules.

During the operator/computer dialogue each line of formalized ENTRY text is displayed on the screen so that the operator can identify and, where necessary, correct errors in the line being assembled. This constitutes an

[*] Transmitted messages which initiate a particular type of operation in the computer.

important difference from systems using punched-card input, where the whole card has to be replaced when a symbol is entered incorrectly.

The program for SID input into the computer performs the following functions:

- It structures the data;
- It assembles information for maintaining the integrity of the record in international exchange;
- It checks that the input symbol is consistent with the format alphabet;
- It shows, in the appropriate part of the screen, errors committed by the operator;
- It stores the formalized ENTRY text on magnetic tape in the working library;
- It assigns to the ENTRY text the appropriate name in the catalogue of coded works;
- It instructs the alphanumeric printer to print out a sheet containing the formalized ENTRY text.

The operator/computer dialogue at the SID input stage begins with selection of the input mode, which determines the subsequent computer operations.

There are two SID input modes:

- Input of a new coded work;

- Addition of information from an SID to an ENTRY, the beginning of which has been stored in the working library under the appropriate name.

In this case, the input program ensures that the correct structure is maintained in the whole ENTRY when adding the new information and storing it in the working library.

In assembling the bibliographical section (BIB), automatic input of a text in the working library is possible from any position on the line. The operator must introduce into the line being assembled a special transaction enabling the program to call the name of this text. After receiving the correct name the program will "erase" the dialogue on the screen and perform the transaction specified, transferring the text in sequence from the working library to the ENTRY text, while complying with the transfer rules and recording all the necessary service routines. Text transfer can also end at any position on the line. The operator must either complete a line that has been begun or proceed to assemble a new line.

In assembling the COMMON and DATA sections the recording of numerical data is strictly standardized. Eleven characters are assigned to one value, i.e. there cannot be more than six columns in a line (80 characters). If the number of columns, which is determined by the number of data headings is greater, special formatting rules provide for the transfer of the values to the next line. For this reason the values entered by the operator must occupy particular positions in the line of a table. This depends not only on the structure of the data table but also on the format in which the data are recorded. Two formats are used: a decimal one when a decimal point is obligatory in the entry of the variable, and the so-called "E format" (analogous to that used in FORTRAN) when the variable must be placed in the right-hand spaces of the column. The program ensures that the GE formatting rules listed above are complied with, i.e. it checks the input values and their transcription in the appropriate positions and displays the correctly assembled line of the numerical data table on the screen.

The process of entering coded text can end either when the whole SID has been entered (in this case the code for ending the input process is a line with the system identifier ENDENTRY) or after the next sub-entry has been entered (the ending code being the system identifier ENDSUBENT). In either case the text entered is stored in the working memory and assigned the appropriate name.

The ending codes for the input process determine the subsequent operating mode of the system. During input, codes for exceptional situations preventing the normal termination of the process may appear. In this case some response from the operator will be required. Procedures for handling exceptional situations are used only when the corresponding code has been found and the specific exceptional situation has been reported. The procedures can be followed either with or without a return to the program. In the latter case the operator changes to off-line sequential mode.

When the input process ends normally and the whole SID has been entered, the next stage, that of checking the data entered for correctness of the structure and for reliability, begins automatically. However, it is not possible to perform a strict check of the coded information without being sure that its structure is correct. In addition, the checking process is sequential in nature and requires a fairly large main memory and time for preparation of the checking program. For a complete reliability data check, therefore, it has been necessary to write special programs [16] with limited checking of the extent to which the formalized text is consistent with GE formatting rules and its codes.

Particular emphasis is placed on checking information for which coding is most complicated and for which demonstration of consistency with GE formatting rules by visual checking is laborious. Practical experience with checking programs at various centres has made it possible to identify the most frequent errors made in coding (Annex 2). The programs make a particularly careful check of those places in the ENTRY text where such errors are most likely.

Checking the ENTRY text for correctness of structure and reliability means identifying errors and ambiguities in both the external and the internal structure of the formalized text. Checking the external structure involves verifying its correct division into sub-entries and sections by analysing each such part in accordance with the necessary system identifier, the service routines for it, the numerical identification of lines, etc. The internal structure is checked by finding a given information identifier and following its coding rules (presence of obligatory components, appropriate syntax, consistency of brackets, checking of mnemonic codes) and also by fulfilling the requirements for the entry of numerical tables and quantities, verifying consistency of information between sections, and so on. Thus, syntactic and lexical analysis of the formalized ENTRY text is used to check the correctness of its structure and the reliability of the information in it.

For checking the reliability of data it is sufficient to ensure that the code used is in the relevant dictionary. The use of dictionary code files (without decoding them) is thus a sufficient condition for the operation of the checking program. The dictionary conversion program reads off the whole set of GE format dictionaries from the magnetic tape, files the dictionaries in accordance with the specified structure and, in a certain sector of the disk, enters a catalogue of dictionaries, taking as the address the beginning of the codes of each dictionary on the disk. The special arrangement of dictionary codes ensures economy of utilization of machine memory and - in the case of checking programs - reduces the code retrieval time to some extent by allowing direct access to a given dictionary and use of the method of key comparison for code retrieval.

The result of the operation of checking codes is a hard-copy log produced by an alphanumeric printer and containing information about the nature of the errors found and their locations. If an error has been found in the semantic part the author (the physicist who compiled the particular text) will be needed to correct it. An error of this type can either be corrected immediately by the compiling physicist of the centre or else the author of the publication must be consulted, in which case a printout of the formalized ENTRY text with notes for further information is sent to the authors. Only after the authors have replied with their corrections and additions is the formalized ENTRY text corrected and edited. If an error which does not require in-depth elucidation is found, the operator corrects it, editing the ENTRY text with the help of an editing program. By means of this program, texts can conveniently be corrected from the VDU terminal keyboard: characters and lines can be deleted or introduced in the text, and various separate pieces of text can be joined together or sections of text split up.

During manual editing it is possible that the structure of the information record in the ENTRY text will be disturbed and that the entry will cease to be in conformity with GE formatting rules. The most common errors of this type are inconsistencies in line identification, in correct service routines for system identifiers and errors in the alphabet of characters entered during manual editing. The next stage is therefore performed by the automatic editing program, which corrects all errors committed in the manual editing of the formalized text in accordance with formatting rules.

The automatic editing program, after printing out the edited ENTRY text on the alphanumeric printer, performs the following functions:

- It replaces characters which are not consistent with the GE format alphabet by the sign ? (lines with such symbols are specially noted);

- It adds to the text a line with the information identifier HISTORY and automatically enters the date of editing in this line (the purpose of this operation is to indicate the "history" of preparation of the ENTRY text);

- It stores the formalized text in the working library, deleting its old name and assigning it the corresponding new one in the catalogue of coded works;

- It prints out the working library catalogue; and

- When the automatic editing process has finished, the syntactic and lexical analysis stage begins, i.e. the programs for checking the structure and reliability of the formalized ENTRY text are put into operation once again.

The stages of correction, editing (manual and automatic) and rechecking can be repeated until the formalized text no longer contains any errors violating the GE formatting rules. Only then is the ENTRY text recorded on the international exchange tape and in the EXFOR data base. The experimental non-neutron nuclear data base in GE format is at present available at CAJaD on six magnetic tapes - the same as the number of centres adding to it (Table 3).

This data base is being added to continually. The structure of entries of textual and numerical information is such that not only the process of data base maintenance but also that of information retrieval can be automated. The EXFOR data base is versatile. It is used by all centres for retrospective information retrieval and subsequent issue in both generalized form and without generalizations. It is also used directly for printed publications. For example, in 1979 the KACHAPAG group began to issue a multi-volume publication within the Physik Daten/Physics Data series containing data on the formation of radioactive isotopes in charged-particle reactions. These data were taken directly from the international exchange tape. The publication contains both bibliographic and "factographic" material which is updated as data are corrected and new measurement results appear. The United States National Nuclear Data Centre uses the EXFOR international data base when preparing annual collections of bibliographical data [17]. In the IAEA Nuclear Data Section, a program is being tried out which converts formatted data from the EXFOR data base into so-called "experimental data computation format" [6]. Taking data on cross-sections and angular and energy distributions, the program converts them into graphic form for comparison with the corresponding evaluated data from the ENDF/B data base [18]. The intention is that in the future the "experimental data computation format" should be used to demonstrate the reliability of data submitted by authors of publications and also for evaluation purposes. At CAJaD the data base in GE format is used mainly for retrospective information retrieval to respond to individual requests by users. The search program is organized to meet requests for data on nuclear reaction cross-sections. It can search for reactions producing a particular isotope, reactions involving a particular target or reactions induced by particular particles (heavy ions). Responses to requests can take the form either of alphanumeric printout or of a file assembled on an output tape.

Thus, this set of computer programs, working on the principle of once-only full processing of primary information provides a basis for an integrated information system.

REFERENCES

I. Horen D.J., Weinberg A.M. Criteria of choice for compilations of nuclear data. - In: Nuclear data in science and technology. V. 1, Vienna, 1973, p.3-11.

2. Summary report specialists' meeting on nuclear data for applications. Vienna, 1974. INDC(NDS)-060/W+Special.

3. Chukreev F.E. Centre for collection, evaluation and dissemination of non-neutron nuclear data.- In: [1], v.2, p.319-323, IAEA-SM-170/24.

4. BYCHKOV, V.I., MANOKHIN, V.N., SURGUTANOV, V.V. An automated experimental neutron data library, Voprosy atomnoj i tekhniki. Ser. Yadernye konstanty. 19 (1975) 181-198 [in Russian]

5. Summary report on the consultants'meeting on charged particle and photonuclear reaction data. Vienna, 1974, INDC(NDS)-59/W+Special.

6. Report on the sixth IAEA consultants' meeting of Nuclear reaction data centers. Vienna, 1982. INDC(NDS)-141.

7. NDS EXFOR MANUAL. Documentation series of the IAEA Nuclear data section. Vienna: IAEA, IAEA-NDS-3 (Rev.79/6).

8. KRINIISKIJ, N.A., MIRONOV, G.A., FROLOV, G.D., Avtomatizirovannye informatisionnye sistemy (Computerized information systems), Nauka, Moscow (1982).

9. SOKOLOV, A.V., Informatsionno-poiskovye sistemy: Uchebnoe posobie dlya vuzov (Information retrieval systems: A teaching manual for higher educational establishments), Radio i svyaz'. Moscow (1981).

IO. Generalized data management systems and scientific information. - Report of a specialist study. Paris, OECD Nuclear Energy Agency, NEA Working Group on Nuclear Energy Information. 1978.

II. CINDU Catalogue of numerical nuclear data available from the IAEA Nuclear data section. Vienna, 1976, CINDU-11.

I2. Report on the fifth IAEA consultants' meeting of Nuclear reaction data centers. Vienna, 1980, INDC(NDS)-125.

13. Vychislitel'naya mashina 1010B: Spravochnik (The 1010B computer: A handbook), Videoton, Budapest (1973).

14. ZHURAVLEVA, G.M., "Nuclear data base preparation in interactive mode" in Problems of Computing for Fundamental and Applied Scientific Research in the Light of Decisions by the XXVIth Congress of the CPSU (Proc. All-Union Conf., Zvenigorod, 4-6 May 1982, Part 2 Moscow (1982) 190 [in Russian].

15. MARTIN, J., Organizatsiya baz dannykh v vychislitel'nykh sistemakh (The organization of data bases in computer systems), Mir, Moscow (1978).

16. ZHURAVLEVA, G.M., Ensuring the reliability of data recorded in EXFOR format on a small computer, Preprint IAEh-3649/15, Moscow (1982) [in Russian].

I7. Burrows T.W., Dempsey P. The bibliography of integral charged particle nuclear data. Information analysis center report, March 1980, BNL-NCS-50640.

I8. Garber D., Dunford C., Pearlstein S. Data formats and procedures for the evaluated nuclear data file, ENDF. USA, BNL, Oct.1975. BNL-NCS-50496.

Manuscript [Russian version] submitted to Editors: 19 December 1983

Table 1

STRUCTURE OF THE INFORMATION IDENTIFIER

Information identifier	Meaning of information identifier	Field No.	Fields included and their codes
ADD-RES	Information about additional results in the paper but not included in data table	-	Code from dictionary 20
ANALYSIS	Description of the analysis method used for obtaining values (parameters) from experimental points or instrument spectra	-	Code from dictionary 23
ASSUMED	Information about reference values used in the process of data analysis	1	Code of column heading in data table
		2	Description of nuclear reaction for which parameters are given
AUTHOR	Initials and family names of all authors of the work	-	
COMMENT	Comments on the work. Additional information which cannot logically be entered under another keyword	-	Free text
CORRECTION	Information about corrections made to the experimental data by the authors	-	Free text
COVARIANCE	Information provided by the experimenter about correlations within the data table	-	Free text
CRITIQUE	The opinion of the compiler or evaluator about the quality of the data presented in the data table	-	Free text

Information identifier	Meaning of information identifier	Field No.	Fields included and their codes
DECAY-DATA	Decay data for nuclides for which cross-sections are calculated	1	"Decay flag" linking entry to DATA table
		2	The decaying nuclide, in the format Z-S-A-X
		3	Half-life showing data units (code from dictionary 25)
		4	Radiation type (code from dictionary 13)
		5	Particle energy (in kilovolts)
		6	Abundance of particles per decay (fields 4-6 may be repeated as often as necessary)
DECAY-MON	Decay data for nuclides used in the publication on the monitor reaction	-	Coding as for DECAY-DATA
DETECTOR	Type of detector used in measurements	-	Code from dictionary 22
EN-SEC	Shows headings under which data on secondary particle energies are given	1	Code of column heading in data table
		2	Code of particle (from dictionary 13) or nuclide (coded in format Z-S-A-X)
ERR-ANALYS	Shows types and sources of uncertainties given in data tables	1	Code of column heading in data table
		2	Free text
EXP-YEAR	Year in which experiment was performed if differs significantly from year of publication	-	
FACILITY	Main apparatus used in the experiment	1	Code from dictionary 18
		2	Institute or laboratory code (from dictionary 3) may be shown

Information identifier	Meaning of information identifier	Field No.	Fields included and their codes
FLAG	Fixed point number and explanation. Used for identifying experimental data differing from other points in the data table (e.g. in method of production, processing, etc.)	1 2	Flag for data table Free text
HALF-LIFE	Data on the half-life of the nuclide	1 2	Code of column heading in data table Code of the nuclide (coded in format Z-S-A-X)
HISTORY	Used to document handling of the data set (entry or sub-entry)	1 2	Date Code denoting action taken in respect of data set (from dictionary 15)
INC-SPECT	Information on certain characteristics of the particle beam of importance for evaluating data quality (resolution, spectrum shape, etc.)	-	Free text
INSTITUTE	Laboratory, institute or university at which the experiment was performed	-	Code from dictionary 3
METHOD	Description of the experimental method	-	Code from dictionary 21
MISC-COL	Used for any data given in the paper for which no special headings (from dictionary 24) are foreseen in the table	1 2	Code of column heading in data table Free text
MONITOR	Gives the monitor reaction where used as standard reference for experimental data	-	Coding as for information identifier REACTION

Information identifier	Meaning of information identifier	Field No.	Fields included and their codes
MONITOR-REF	Gives the reference from which the monitor data used were taken	1	Sub-accession number of an entry coded in GE format
		2	First author of publication on monitor reaction
		3	Reference to publication (coding as for keyword REFERENCE)
N-SOURCE	Source of beam particles	-	Code from dictionary 19
PART-DET	Prompt reaction products detected	-	Radiation type (code from dictionary 13) or particle code in Z-S-A-X format
RAD-DET	Data on type of radiation of radio-active products	1	Decay flag linking to data table where values are given
		2	Unstable nuclide (coded in Z-S-A-X format)
		3	Radiation type (code from dictionary 13)
REACTION	Description of the nuclear reaction studied	1	Target nucleus (coding in Z-S-A-X format)
		2	Incident particle (code from dictionary 33 or coding in Z-S-A-X format)
		3	Process (code from dictionary 30) or set of emitted particles (code from dictionary 33)
		4	Product nucleus (coding in Z-S-A-X format)
		5	Information on reaction branch (code from dictionary 31)
		6	Information on measured parameter (code from dictionary 32)
		7	Indication (when this is not obvious) of reaction products detected to measure the parameter of field 6 (code from dictionary 31)

Information identifier	Meaning of information identifier	Field No.	Fields included and their codes
		8	Additional information on data presentation, e.g. line position coefficients, etc. (code from dictionary 34)
		9	Data type: experimental, theoretical, evaluated (code from dictionary 35)
REFERENCE	Reference to publication	1	Type of publication (code from dictionary 4)
		2	Reference code (codes from dictionaries 5-7)
		3	Volume (issue)
		4	Page
		5	Date of publication
REL-REF	References related to the work	1	Reason for citing the reference (code from dictionary 17)
		2	First author of the publication
		3	Reference to publication (coding as for keyword REFERENCE)
SAMPLE	Characteristics of the sample (composition, structure)	-	Free text
STATUS	Information on the status of the data given	1	Code from dictionary 16
		2	Reference to data set (entry or sub-entry) coded in GE format
TITLE	Full title of the publication	-	-

Table 2

CORRESPONDENCE BETWEEN DATA UNITS AND GE FORMAT SYSTEM IDENTIFIERS

Data	System identifier
Exchange tape	TRANS
Entry (coded work)	ENTRY
Sub-entry	SUBENT
BIB section	BIB
COMMON section	COMMON
Data table section	DATA

Table 3

INTERNATIONAL NON-NEUTRON EXPERIMENTAL NUCLEAR DATA BASE IN GE FORMAT (AS OF DECEMBER 1982)

Supplying Centre	No. of coded works	No. of records on magnetic tape
CAJaD	I30	32393
US National Nuclear Data Centre (NNDC), Brookhaven National Laboratory	5I	I056I
IAEA Nuclear Data Section (NDS), Austria	23	8323
Charged Particle Nuclear Data Group (KACHAPAG), FRG	200	5568I
Centre for Data on Photonuclear Experiments, Moscow State University, USSR	45	27993
US National Nuclear Data Centre (NNDC), Lawrence Livermore National Laboratory	35	24882

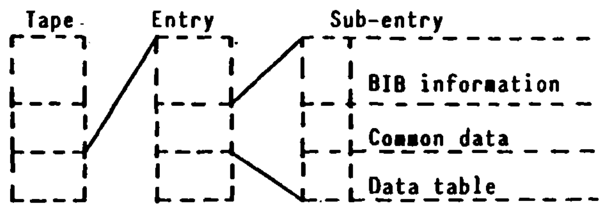


Fig. 1. General Structure of exchange tape

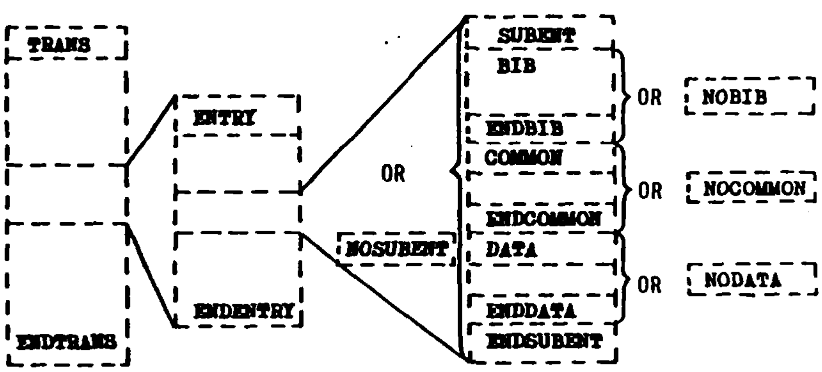


Fig. 2. Structure of the exchange tape using system identifiers

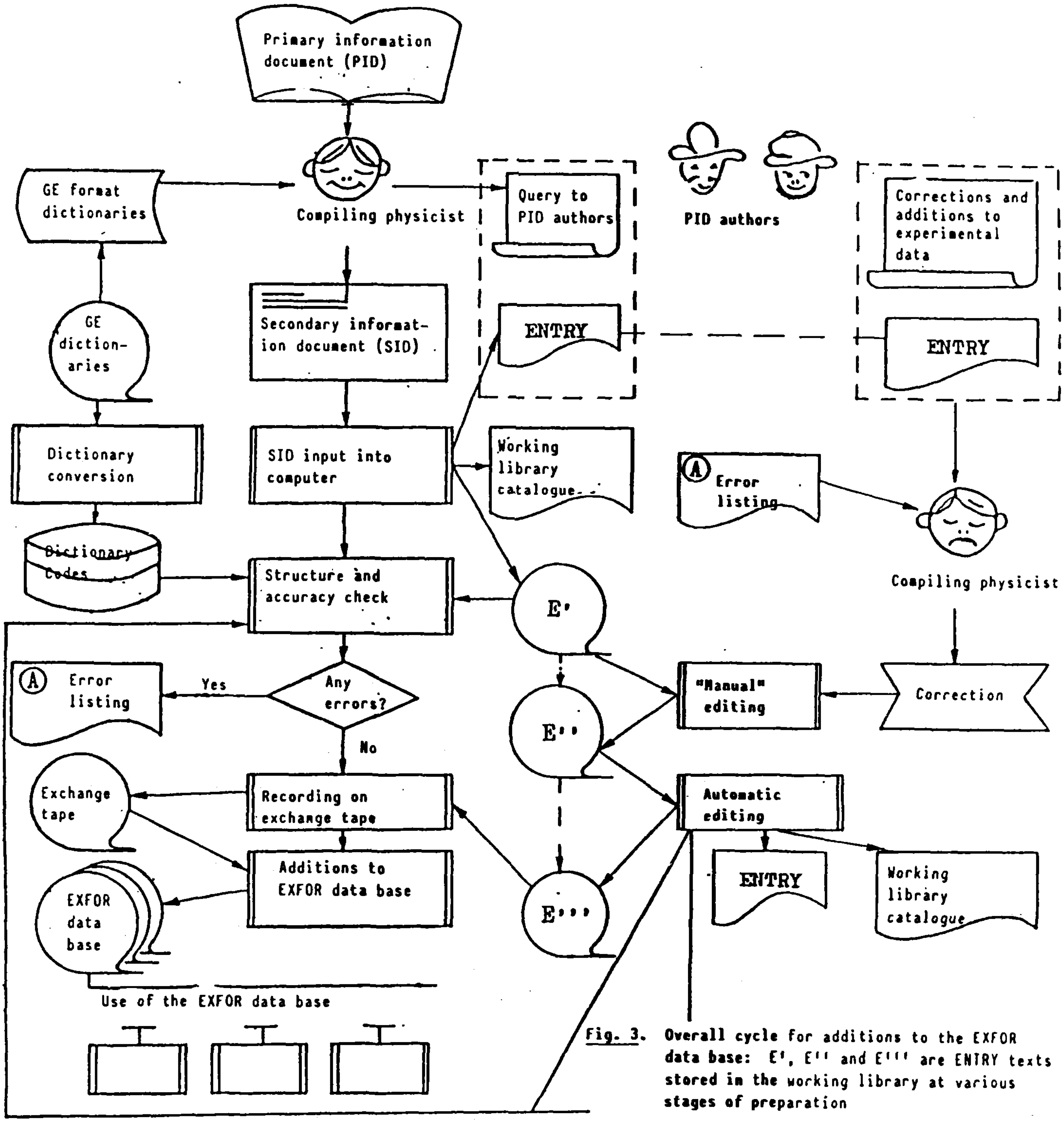


Fig. 3. **Overall cycle for additions to the EXFOR data base: E', E'' and E''' are ENTRY texts stored in the working library at various stages of preparation**

FIRST SUB-ENTRY OF ENTRY A0154.001

```
ENTRY            A0154       830405                              A015400000001
SUBENT        A0154001       830405                              A015400100001
BIB                 18           31                              A015400100002
TITLE      EXCITATION FUNCTIONS FOR 3-HE-PARTICLE INDUCED        A015400100003
           NUCLEAR REACTIONS ON 76-SE,77-SE AND NAT-SE.          A015400100004
           POSSIBILITIES OF PRODUCTION OF 77-KR.                 A015400100005
AUTHOR     (MF YOUFENG, S.M.QAIM, G.STOCKLIN)                    A015400100006
REFERENCE  (J,ARI,33,13,82)                                      A015400100007
INSTITUTE  (2GERJUL)                                             A015400100008
FACILITY   (CYCLO,2GERJUL),COMPACT CYCLOTRON CV28.               A015400100009
SAMPLE     AL-SE-AL SANDWICH. THICKNESS OF AL WAS EQUAL 20MU.    A015400100010
           THICKNESS OF SE WAS EQUAL 3-8 MU (WEIGHT 1.5 -2.      A015400100011
           MILIGRAMM/CM**2, APPROXIMATELY).                      A015400100012
HISTORY    (821106C)                                             A015400100013
           (830405U)                                             A015400100014
           (821220U)                                             A015400100015
METHOD     (STTA,EXTB,ACTIV).                                    A015400100016
           EACH STACK HAD 6-8 AL-SE-AL SANDWICHS.                A015400100017
MONITOR    (22-TI-0(HE3,X)23-V-48,IND,SIG,,,EXP)                 A015400100018
COMMENT    /BY AUTHORS/. SEVERAL HIGH PURITY TITANIUM(99.6 PER   A015400100019
           CENT) AND ALUMINIUM(99.99 PER CENT) FOILS WERE INSERT A015400100020
           AT SEVERAL PLACES IN THE STACKS TO ALLOW BEAM CURRENT A015400100021
           MONITORING AND THE REQUIRED ENERGY DEGRADATION.       A015400100022
DECAY-MON  (23-V-48,16.1D,DG,983.,1.,                            A015400100023
                         DG,1312.,0.98)                          A015400100024
MONIT-REF  (A0169009,R.WEINREICH+,J,ARI,31,223,80)               A015400100025
DETECTOR   (GELI). VOLUME=12 CM**3.                              A015400100026
ANALYSIS   (AREA)                                                A015400100027
ERR-ANALYS (EN-ERR), UNCERTAINTIES OF DIGITIZATION.              A015400100028
ADD-RES    (TTY-C).                                              A015400100029
           THE METHOD OF TARGET PREPARATION.                     A015400100030
STATUS     (CURVE). BY CAJAD.                                    A015400100031
REL-REF    (R,,C.F.WILLIAMSON+,R,CEA-R-3042,66),STOPPING POWER   A015400100032
           TABLES.                                               A015400100033
ENDBIB              31                                           A015400100034
COMMON               1            3                              A015400100035
EN-ERR                                                           A015400100037
MEV                                                              A015400100037
      0.31                                                       A015400100038
ENDCOMMON            3                                           A015400100039
ENDSUBENT           38                                           A015400199999
```

Information identifiers

Codes

Experimental data were taken at CAJaD from figures given in the publication

Constant parameters common to all sub-entries of entry A0154

Contains information common to all sub-entries of the entry

Work was published in journal (J) Int. J. Appl. Radiat. Isot. (ARI) 33 (1982) 13

The experiment was performed on cyclotron (CYCLO) at institute Kernforschungsanlage Jülich in the FRG (2 GERJUL)

The experiment was performed in an external beam (EXTB) by the activation method (ACTIV) using a stack (STTA)

Standard reference for relative measurements was provided by the reaction shown

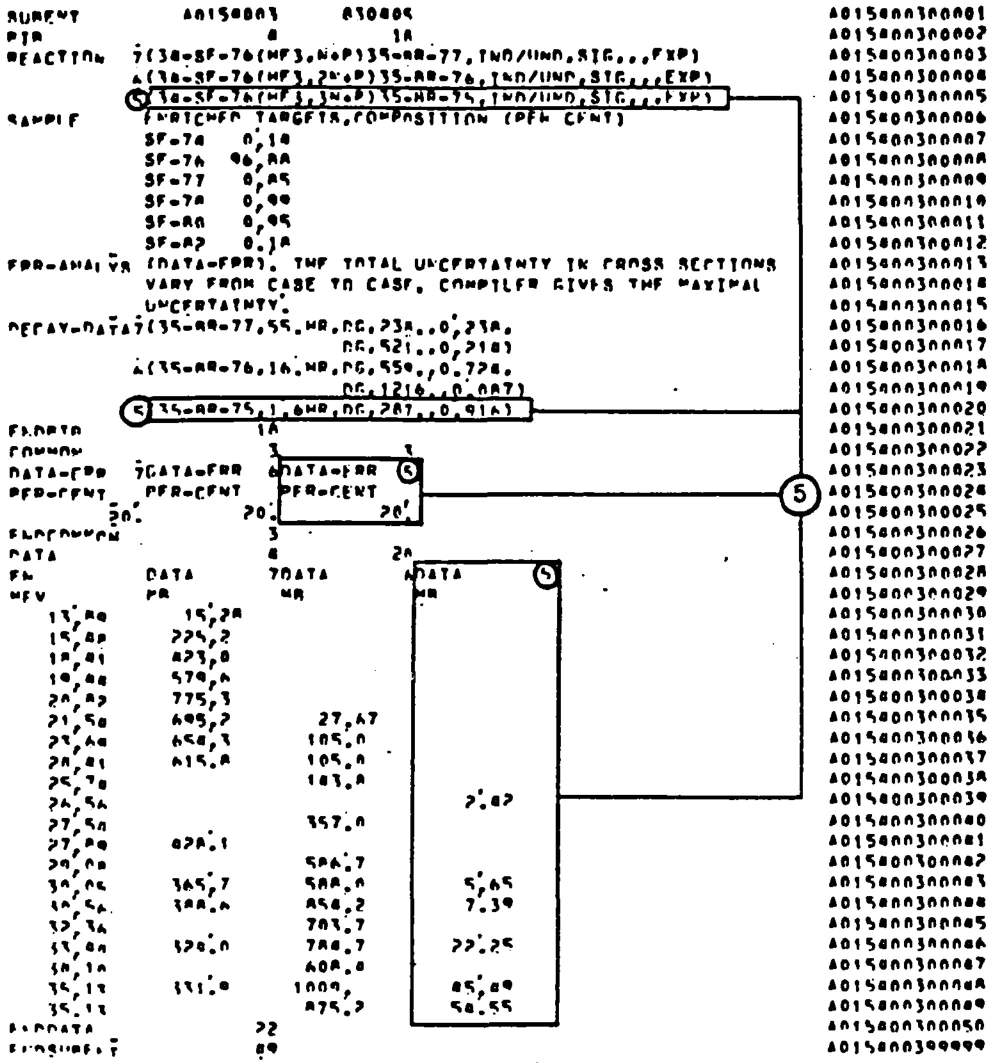
Description of the monitor reaction was taken from the paper by R. Weinrech et al. published in the journal (J) Int. J. Appl. Radiat. Isot. (ARI) 31 (1980) 223 and coded in GE format in sub-entry A0169.009

```
SUBENT        A0154002       810605                              A015400200001
BIB                   8          16                              A015400200002
REACTION   2(34-SE-76(HE3,2N)36-KR-77,IND,SIG,,,EXP)             A015400200003
           6(34-SE-76(HE3,N)36-KR-78,IND,SIG,,,EXP)              A015400200004
SAMPLE     ENRICHED TARGETS, COMPOSITION(PER CENT)               A015400200005
           SE-74    0.19                                         A015400200006
           SE-76   96.88                                         A015400200007
           SE-77    0.85                                         A015400200008
           SE-78    0.99                                         A015400200009
           SE-80    0.95                                         A015400200010
           SE-82    0.18                                         A015400200011
ERR-ANALYS (DATA-ERR). THE TOTAL UNCERTAINTY I   CROSS SECTIONS  A015400200012
           VARY FROM CASE TO CASE. COMPILER GIV   THE MAXIMAL    A015400200013
           UNCERTAINTY.                                          A015400200014
DECAY-DATA2(36-KR-77,1.24HR,DG,130.,0.873,                       A015400200015
                           DG,147.,0.089)                        A015400200016
          6(36-KR-79,18.6HR,DG,270./272.,0.267,                  A015400200017
                           DG,316.,0.401)                        A015400200018
ENDBIB               16                                          A015400200019
COMMON                2          3                               A015400200020
DATA-ERR   DATA-ERR   2                                          A015400200021
PER-CENT   PER-CENT                                              A015400200022
   15.        12.                                                A015400200023
ENDCOMMON             3                                          A015400200024
DATA                  3         21                               A015400200025
EN         DATA      2DATA       6                               A015400200026
MEV        MB         MB                                         A015400200027
   13.19      26.56                                              A015400200028
   13.97      10.79                                              A015400200029
   16.15     179.8                                               A015400200030
   17.10     222.8                                               A015400200031
   18.68     327.1                                               A015400200032
   19.31     311.6                                               A015400200033
   21.10     416.0                                               A015400200034
   21.68     354.9         5.06                                  A015400200035
   23.63     360.1        20.60                                  A015400200036
   24.80                  38.55                                  A015400200037
   25.79     296.7        45.62                                  A015400200038
   27.84     202.5        66.20                                  A015400200039
   28.89                 148.0                                   A015400200040
   29.58     113.7                                               A015400200041
   30.05                  99.60                                  A015400200042
   30.89                 136.1                                   A015400200043
   31.21     105.8                                               A015400200044
   32.63      90.47      167.                                    A015400200045
   33.68                 123.6                                   A015400200046
   34.32      66.20      186.3                                   A015400200047
   35.05      60.13      159.4                                   A015400200048
ENDDATA              23                                          A015400200049
ENDSUBENT            48                                          A015400299999
```

SECOND SUB-ENTRY OF ENTRY A0154.002

Reactions can be entered under the same information identifier if measurements were made on one target

Record identifier



THIRD SUB-ENTRY OF ENTRY A01547003 [sic]

The pointers link numerical and textual information within one sub-entry. In this example, descriptions of nuclear reactions (REACTION) and information on the radioactive decay of reaction products (DECAY-DATA) are linked with the corresponding numerical data from measurements.

```
SUBENT        A0154004     830405                                           A015400400001
BIB                  4          19                                          A015400400002
REACTION   9(34-SE-77(HE3,N)36-KR-79,IND,SIG,,,EXP)                         A015400400003
           7(34-SE-77(HE3,3N)36-KR-77,IND,SIG,,,EXP)                        A015400400004
           6(34-SE-77(HE3,4N)36-KR-76,IND,SIG,,,EXP)                        A015400400005
SAMPLE      ENRICHED TARGETS,COMPOSITION(PER CENT)                          A015400400006
            SE-74     0.06                                                  A015400400007
            SE-76     0.66                                                  A015400400008
            SE-77    94.38                                                  A015400400009
            SE-78     3.02                                                  A015400400010
            SE-80     1.61                                                  A015400400011
            SE-82     0.27                                                  A015400400012
ERR-ANALYS (DATA-ERR).THE TOTAL UNCERTAINTY IN CROSS SECTIONS               A015400400013
            VARY FROM CASE.COMPILER GIVES THE MAXIMAL UNCERTAINTY.          A015400400014
DECAY-DATA9(36-KR-79,35.HR,DG,261.,0.127,                                   A015400400015
                            DG,397.,0.095,                                  A015400400016
                            DG,606.,0.081)                                  A015400400017
           7(36-KR-77,1.2HR,DG,130.,0.873,                                  A015400400018
                            DG,147.,0.409)                                  A015400400019
           6(36-KR-76,14.6HR,DG,270./272.,0.267,                            A015400400020
                             DG,316.,0.400)                                 A015400400021
ENDBIB                 19                                                   A015400400022
COMMON                  3          3                                        A015400400023
DATA-ERR   9DATA-ERR  7DATA-ERR  6                                          A015400400024
PER-CENT    PER-CENT   PER-CENT                                             A015400400025
   15.         12.        15.                                               A015400400026
ENDCOMMON               3                                                   A015400400027
DATA                    4         12                                        A015400400028
EN          DATA       9DATA      7DATA      6                              A015400400029
MEV         MB          MB         MB                                       A015400400030
   14.86       8.74                                                         A015400400031
   18.06      25.5        1.36                                              A015400400032
   20.05      40.15      12.97                                              A015400400033
   22.32      40.28      82.86                                              A015400400034
   23.80                179.                                                A015400400035
   25.58      18.24     261.                                                A015400400036
   27.38      10.1      273.          1.31                                  A015400400037
   29.33       8.73     313.                                                A015400400038
   31.03       6.53     356.6         5.44                                  A015400400039
   32.57       9.60     304.9        11.8                                   A015400400040
   34.44       5.82     290.         18.7                                   A015400400041
   35.72       7.6      287.         36.6                                   A015400400042
ENDDATA                14                                                   A015400400043
ENDSUBENT              42                                                   A015400499999
```

```
SUBENT        A0154005      830405                                       A015400500001
BIB                 4           18                                       A015400500002
REACTION  A(34-SE-77(HE3,N+P)35-BR-78,IND/UND,SIG,,,EXP)                 A015400500003
          7(34-SE-77(HE3,2N+P)35-BR-77,IND/UND,SIG,,,EXP)                A015400500004
          6(34-SE-77(HE3,3N+P)35-BR-76,IND/UND,SIG,,,EXP)                A015400500005
SAMPLE     ENRICHED   TARGETS.COMPOSITION(PER CENT)                      A015400500006
           SE-74        0.06                                             A015400500007
           SE-76        0.66                                             A015400500008
           SE-77       94.38                                             A015400500009
           SE-78        3.02                                             A015400500010
           SE-80        1.61                                             A015400500011
           SE-82        0.27                                             A015400500012
ERR-ANALYS (DATA-ERR).THE TOTAL UNCERTAINTY IN CROSS SECTIONS            A015400500013
           VARY FROM CASE TO CASE.COMPILER GIVES THE MAXIMAL             A015400500014
           UNCERTAINTY.                                                  A015400500015
DECAY-DATA8(35-BR-78,6.4MIN,DG,614.,0.136)                               A015400500016
          7(35-BR-77,56.HR,DG,238.,0.238,                                A015400500017
                           DG,521.,0.214)                                A015400500018
          6(35-BR-76,16.HR,DG,559.,0.724,                                A015400500019
                           DG,1216.,0.087)                               A015400500020
ENDBIB              18                                                   A015400500021
COMMON               3           3                                       A015400500022
DATA-ERR   8DATA-ERR  7DATA-ERR  6                                       A015400500023
PER-CENT   PER-CENT   PER-CENT                                           A015400500024
  20.        20.        20.                                              A015400500025
ENDCOMMON            3                                                   A015400500026
DATA                 4           17                                      A015400500027
EN         DATA      8DATA       7DATA       6                           A015400500028
MEV        MB         MB          MB                                     A015400500029
   10.44      72.09                                                      A015400500030
   13.61     349.                                                        A015400500031
   14.70                  3.63                                           A015400500032
   16.49     547.8                                                       A015400500033
   17.64                 22.02                                           A015400500034
   19.19     675.3                                                       A015400500035
   20.06                101.3                                            A015400500036
   21.56     562.3                                                       A015400500037
   22.48                430.8                                            A015400500038
   23.86     432.9                                                       A015400500039
   25.48     493.4      743.7                                            A015400500040
   27.67     346.6      810.2         4.38                               A015400500041
   29.17     348.1      949.                                             A015400500042
   31.07     328.9      961.5         9.49                               A015400500043
   32.62     263.3      912.5        28.11                               A015400500044
   34.24     296.2     1040.         76.97                               A015400500045
   35.36               1201.        112.5                                A015400500046
ENDDATA             19                                                   A015400500047
ENDSUBENT           46                                                   A015400599999
```

SIXTH SUB-ENTRY OF ENTRY A0154.006

```
SUBENT        A0154006       821220                            A015400600001
BIB                  4           14                            A015400600002
REACTION     (34-SE-77(N,X)...,N+A)34-SE-75,IND/UND,SIG,,,EXP)  A015400600003
SAMPLE       ENRICHED TARGETS,COMPOSITION(PER CENT)            A015400600004
             SE-74        0.06                                 A015400600005
             SE-76        0.66                                 A015400600006
             SE-77       94.30                                 A015400600007
             SE-78        3.02                                 A015400600008
             SE-78        3.02                                 A015400600009
             SE-82        0.27                                 A015400600010
ERR-ANALYS   (DATA-ERR),THE TOTAL UNCERTAINTY IN CROSS SECTIONS A015400600011
             VARY FROM CASE TO CASE,COMPILER GIVES THE MAXIMAL  A015400600012
             UNCERTAINTY.                                      A015400600013
DECAY-DATA   (34-SE-75,120.D,DG,136.,0.58,                     A015400600014
                              DG,265.,0.58,                    A015400600015
                              DG,280.,0.249)                   A015400600016
ENDBIB               14                                        A015400600017
COMMON                1           3                            A015400600018
DATA-ERR                                                       A015400600019
PER-CENT                                                       A015400600020
   15.                                                         A015400600021
ENDCOMMON             3                                        A015400600022
DATA                  2          11                            A015400600023
EN           DATA                                              A015400600024
MEV          MB                                                A015400600025
   14.96       7.10                                            A015400600026
   17.96      26.45                                            A015400600027
   20.37      50.53                                            A015400600028
   22.65      48.90                                            A015400600029
   25.17      40.16                                            A015400600030
   27.34      63.65                                            A015400600031
   29.22      60.27                                            A015400600032
   30.95      49.03                                            A015400600033
   32.37      47.25                                            A015400600034
   34.22      35.88                                            A015400600035
   35.80      42.89                                            A015400600036
ENDDATA              13                                        A015400600037
ENDSUBENT            36                                        A015400699999
```

Constant parameters valid only for sub-entry A0154.006

Table of data determined under information identifier "REACTION"

```
SUBENT        A0154007     821220                                            A015400700001
BIB                  4          13                                           A015400700002
REACTION     (34-SE-76(HE3,A)34-SE-75,IND/UND,SIG,,,EXP)                     A015400700003
SAMPLE       ENRICHED   TARGETS.   COMPOSITION(PER CENT)                     A015400700004
             SE-74        0.14                                               A015400700005
             SE-76       96.88                                               A015400700006
             SE-77        0.85                                               A015400700007
             SE-78        0.99                                               A015400700008
             SE-80        0.95                                               A015400700009
             SE-82        0.18                                               A015400700010
ERR-ANALYS   (+DATA-ERR) AUTHOR'S UNCERTAINTIES.                             A015400700011
             (-DATA-ERR) AUTHOR'S UNCERTAINTIES.                             A015400700012
DECAY-DATA   (34-SE-75,120.D,DG,136.,0.54,                                   A015400700013
                               DG,265.,0.58,                                 A015400700014
                               DG,280.,0.249)                                A015400700015
ENDBIB              13                                                       A015400700016
NOCOMMON                                                                     A015400700017
DATA                 4          12                                           A015400700018
EN           DATA        -DATA-ERR    +DATA-ERR                              A015400700019
MEV          MB          MB           MB                                     A015400700020
   10.17        3.55        0.67         0.83                                A015400700021
   15.53       11.84        2.84         3.74                                A015400700022
   18.71       16.78        3.89         4.61                                A015400700023
   20.66       11.59        2.60         3.82                                A015400700024
   21.61       25.06        5.81         5.24                                A015400700025
   23.97       29.68        7.12         5.84                                A015400700026
   24.70       25.06        4.77         4.93                                A015400700027
   27.92       24.54        5.29         5.77                                A015400700028
   30.60       28.15        7.20         8.12                                A015400700029
   33.23       47.24       10.96        14.93                                A015400700030
   34.60       75.96       14.47        17.87                                A015400700031
   35.10       88.09                    18.44                                A015400700032
ENDDATA             14                                                       A015400700033
ENDSUBENT           32                                                       A015400799999
```

```
SUBENT        A0154008     830805                             A015400800001
BIB                  4          14                            A015400800002
REACTION    (34-SE-0(HE3,X)36-KR-79,IND,SIG,,,EXP)            A015400800003
SAMPLE      ISOTOPE     COMPOSITION(PER CENT)                 A015400800004
            74-SE              0.87                           A015400800005
            76-SE              9.02                           A015400800006
            77-SE              7.58                           A015400800007
            78-SE             23.52                           A015400800008
            80-SE             49.82                           A015400800009
            82-SE              9.19                           A015400800010
ERR-ANALYS  (DATA-ERR).THE TOTAL UNCERTAINTY IN CROSS SECTIONS A015400800011
            VARY FROM CASE TO CASE, COMPILER GIVES THE MAXIMAL A015400800012
            UNCERTAINTY.                                      A015400800013
DECAY-DATA  (36-KR-79,35.,HR,DG,261.,0.127,                   A015400800014
                                DG,397.,0.095,                A015400800015
                                DG,606.,0.081)                A015400800016
ENDBIB              14                                        A015400800017
COMMON               1          3                             A015400800018
DATA-ERR                                                      A015400800019
PER-CENT                                                      A015400800020
   15.                                                        A015400800021
ENDCOMMON            3                                        A015400800022
DATA                 2          17                            A015400800023
EN          DATA                                              A015400800024
MEV         MB                                                A015400800025
   14.81       2.46                                           A015400800026
   15.98      49.94                                           A015400800027
   17.33      58.50                                           A015400800028
   18.90     115.9                                            A015400800029
   19.77     111.7                                            A015400800030
   20.92     183.                                             A015400800031
   21.64     163.9                                            A015400800032
   23.33     136.8                                            A015400800033
   23.75     131.                                             A015400800034
   25.66      68.37                                           A015400800035
   27.23      62.50                                           A015400800036
   28.59      53.10                                           A015400800037
   30.55      88.95                                           A015400800038
   31.77     149.7                                            A015400800039
   33.66     189.3                                            A015400800040
   34.54     219.3                                            A015400800041
   36.05     204.2                                            A015400800042
ENDDATA             19                                        A015400800043
ENDSUBENT           42                                        A015400899999
```

```
SUBENT        A0154009      830405                    A015400900001
BIB                  4          13                    A015400900002
REACTION  (34-SE-0(HE3,X)36-KR-77,IND,SIG,,,EXP)      A015400900003
SAMPLE    ISOTOPE     COMPOSITION(PER CENT)           A015400900004
          74-SE         0.87                          A015400900005
          76-SE         9.02                          A015400900006
          77-SE         7.58                          A015400900007
          78-SE        23.52                          A015400900008
          80-SE        49.82                          A015400900009
          82-SE         9.19                          A015400900010
ERR-ANALYS (DATA-ERR).THE TOTAL UNCERTAINTY IN CROSS  A015400900011
          SECTIONS VARY FROM CASE TO CASE.            A015400900012
          COMPILER GIVES THE MAXIMAL UNCERTAINTY.     A015400900013
DECAY-DATA (36-KR-77,1.2HR,DG,130.,0.873,             A015400900014
                     DG,147.,0.409)                   A015400900015
ENDBIB              13                                A015400900016
COMMON               1           3                    A015400900017
DATA-ERR                                              A015400900018
PER-CENT                                              A015400900019
   12.                                                A015400900020
ENDCOMMON            3                                A015400900021
DATA                 2          17                    A015400900022
EN        DATA                                        A015400900023
MEV       MB                                          A015400900024
  14.25     0.15                                      A015400900025
  15.91     0.89                                      A015400900026
  16.77     9.38                                      A015400900027
  18.30    20.43                                      A015400900028
  19.07    21.16                                      A015400900029
  20.32    40.43                                      A015400900030
  21.32    35.68                                      A015400900031
  23.22    44.28                                      A015400900032
  23.68    49.34                                      A015400900033
  25.50    32.45                                      A015400900034
  26.90    32.08                                      A015400900035
  28.70    29.64                                      A015400900036
  30.30    26.88                                      A015400900037
  31.77    27.90                                      A015400900038
  33.66    27.40                                      A015400900039
  34.78    27.74                                      A015400900040
  36.20    28.78                                      A015400900041
ENDDATA             19                                A015400900042
ENDSUBENT           41                                A015400999999
```

```
SUBENT        A0154010      830405                                          A015401000001
BIB                  4          13                                          A015401000002
REACTION    (34-SE-0(HE3,X)36-KR-76,IND,SIG,,,EXP)                          A015401000003
SAMPLE      ISOTOPE  COMPOSITION(PER CENT)                                  A015401000004
            74-SE       0.87                                                A015401000005
            76-SE       9.02                                                A015401000006
            77-SE       7.58                                                A015401000007
            78-SE      23.52                                                A015401000008
            80-SE      49.82                                                A015401000009
            82-SE       9.19                                                A015401000010
ERR-ANALYS  (DATA-ERR).THE TOTAL UNCERTAINTY IN CROSS                       A015401000011
            SECTIONS VARY FROM CASE TO CASE.                                A015401000012
            COMPILER GIVES THE MAXIMAL UNCERTAINTY.                         A015401000013
DECAY-DATA  (36-KR-76,14.6HR,DG,270./272.,0.267,                            A015401000014
                       DG,316.,0.400)                                       A015401000015
ENDBIB              13                                                      A015401000016
COMMON               1           3                                          A015401000017
DATA-ERR                                                                    A015401000018
PER-CENT                                                                    A015401000019
  15.                                                                       A015401000020
ENDCOMMON            3                                                      A015401000021
DATA                 2           9                                          A015401000022
EN          DATA                                                            A015401000023
MEV         MB                                                              A015401000024
  23.25       0.88                                                          A015401000025
  23.47       1.66                                                          A015401000026
  25.23       4.76                                                          A015401000027
  26.84       7.03                                                          A015401000028
  28.85       8.61                                                          A015401000029
  30.61       8.86                                                          A015401000030
  31.98      13.19                                                          A015401000031
  33.45      13.93                                                          A015401000032
  35.07      13.29                                                          A015401000033
ENDDATA             11                                                      A015401000034
ENDSUBENT           33                                                      A015401099999
ENDENTRY            10                                                      A015499999999
```

ANNEX 2

List of the errors most frequently committed in coding data in GE format[*]

1. Coding of nuclei and reaction products.

2. Use of new codes (laboratories, conferences, publications, etc.) which have not yet been included in the format dictionaries.

3. Use of symbols forbidden by the formatting rules (%, :, ;).

4. Use of a bracket in the 12th position of a line when free text is used (i.e. for information identifiers such as COMMON, TITLE, INC-SPECT).

5. Use of the MISC heading in the COMMON section.

6 Omission, in coding information for the DECAY-DATA keyword, of the decimal point in a numerical value, of the data unit code or of the data type code.

7. Use of the -G extension for the ground state when no metastable state is known or of the -M extension for nuclear states which are not generally considered metastable.

8. Use of blanks instead of zeros in line identifiers.

9. In data tables: omission of decimal points in numerical values; entry of headings and data units other than were required by the format; omission of data values; wrong characters or blanks in numerical values; use of incorrect headings (e.g. ELEM instead of ELEMENT).

10. Incorrect field numbers N1 and N2 for system identifiers BIB and Data

---

[*] Information taken from document "NDS Checking of Incoming TRANS Tapes" provided by the IAEA Nuclear Data Section.