INIS: The International Nuclear Information System

by Ivan S. Zheludev and Hans W. Groenewegen

It is estimated that during 1977 the store of information relating to the peaceful uses of nuclear energy published around the world increased by some 80 000 documents. Of these some 38% dealt with aspects of nuclear physics; 25% with chemistry, materials and the earth sciences; 18% with engineering, technology, particularly reactor technology, and waste processing; 12% with the life sciences and the remaining 7% with other aspects of nuclear science, including nuclear law, safeguards and economics.

If one considers that this annual growth rate of 80 000 documents has been sustained for the last decade or more, the question must arise: how does a scientist, wishing to keep abreast with the latest developments in his field, manage to do so without having to scan through intolerably large quantities of irrelevant information? Or again, how does he, if he wants to conduct an in-depth survey of the current state of the art in a certain subject as described in the literature, manage to locate all the important documents that would help him to put the picture together?

INIS and Information

The answer is that more and more scientists are now taking advantage of various products of the IAEA's International Nuclear Information System (INIS). For example, the scientist wanting to keep abreast of new publications in his field makes a point of scanning regularly the relevant subject section of *INIS Atomindex,* a semi-monthly abstracting journal. There he will find the titles and summaries of the contents of new documents that have been published around the world. There is also a description of the document, precise enough to enable a librarian to obtain it for him, should he wish to read it. In many countries the scientist is freed even from the work of scanning through the pages of *INIS Atomindex.* Instead he receives a computer printed list of new publications that match his subject interest "profile" This list will have been prepared in a national information centre in his country from the INIS computer tapes, which are now being distributed to some 35 countries around the world.

The scientist wanting to search back through the literature to compile as complete a list as possible of publications on a particular topic, can again use *INIS Atomindex* to do so. Each issue has an alphabetical subject index, which is cumulated every six months.

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Using these indexes, it is comparatively easy to locate the information required. But here again, the work can be much reduced by using the fast data processing powers of the computer. In many countries the possibility already exists of asking a national information centre to carry out a computer search through the accumulated INIS tapes for information on specific topics.

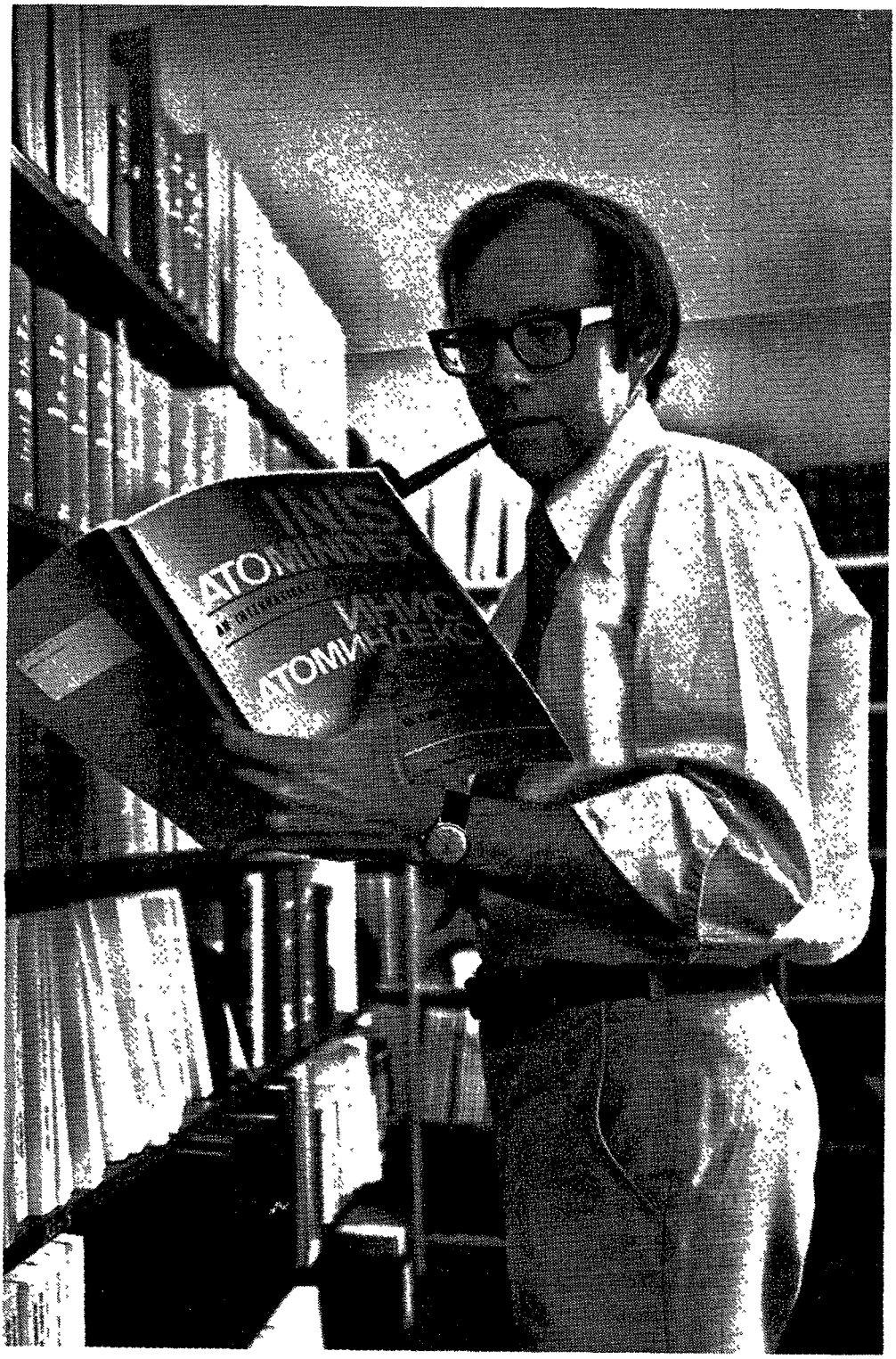
In some countries this process has been made inter-active, the user or an information specialist sits at a computer terminal and conducts a computer search in a manner that resembles a "conversation" with the computer. For example, he will enter a command requesting the computer to search the files for documents on radiation-induced disease resistance in various cereals. The computer will respond almost instantaneously with an answer "There are 1344 documents in the file which meet your request." Depending on the number of documents found, the searcher can then delimit his request further, e.g. by asking for documents published in a certain language or after a certain date only. Or he can request a display of the abstract and description of some or all of the documents found. Should the result of his first attempt not meet his requirements entirely, then he can continue to refine and amend his request until he ends up with a collection of highly relevant document references. These are then printed by the computer and the resultant list can be given to a librarian who will obtain the full text copies of the document on his behalf.

A system such as that described above is now becoming available in a growing number of countries, due to the initiative of the IAEA, which, in 1977, announced the commencement of an experiment in on-line information retrieval. The response from the Member States was immediate and enthusiastic. During the first half of 1978 almost each new month saw the addition of one or more countries to the list of those participating. Austria in January was the first to connect. It was followed by the Netherlands in March, the United Kingdom and the Scandinavian countries in April, France in May, Czechoslovakia in June and Hungary in July, with the USSR due to follow later in 1978. Within each of the countries, computer terminals, installed in various centres, are used by information scientists to request computer searches of the INIS files. The answers are returned directly to the terminal or printed at the IAEA computer and forwarded by airmail to the centres concerned.

As yet, this project is experimental and subject to review early in 1979. Given a positive evaluation, however, it is hoped to expand it further and to make it available also to countries outside Europe, in particular, the developing countries. The IAEA is also co-operating with the Space Documentation System of the European Space Agency, and the International Institute for Applied Systems Analysis (IIASA) in exploring ways of further improving and developing the service.

Meanwhile, however, the question that arises is: how is the information, made available by the methods described above, collected in the first place? The answer is through a remarkable example of international cooperation.

Two times per month a new issue of *INIS Atomindex* is published. Each issue brings an average of 2500-3000 new publications in the nuclear field to the notice of scientists around the world. ▶



The Development of INIS

Exactly 10 years ago a small international team of experts worked together for a period of three months at IAEA headquarters to develop a final design for an international nuclear information system. Their work was the culmination of an intensive period of preparation that had started some two or three years earlier. It was prompted by the recognition that the amount of published information in nuclear science was increasing rapidly and that the IAEA, under Article VIII of its statute, has a responsibility to assemble this information and make it available in an accessible form to all its Member States.

The approach taken by the team was based on an international "network" concept for the collection and dissemination of nuclear information. Under this concept, each country that wanted to participate would undertake to scan through the literature published within its boundaries and select from it those documents that fall within the agreed subject scope. The countries would prepare a detailed description of each item selected and send it, in some cases together with a copy of the document, to the IAEA in Vienna. Here the incoming information would be checked and eventually combined with the input from other countries into a single computer-readable file. The information would then be redistributed back to the participating countries in certain agreed forms (including machine-readable tapes and as a printed journal). This concept was first suggested in 1965 by two consultants, one from the USSR and one from the USA, who advised the IAEA on an outline plan for an international nuclear information system.

The concept was adopted in principle by an international meeting of experts in 1966. It was developed in detail by the INIS study team in 1968 and was ultimately approved by the IAEA's Board of Governors in February 1969. The world's first truly international computerized information system was born.

In April 1970 the initial output of the new International Nuclear Information System was distributed. In the first two or three years the amount of information collected and redistributed was relatively small. The national centres responsible for preparing the input were still being organized and the IAEA Secretariat was still setting up its procedures for handling the information contributed.

Gradually, however, the system's organization on an international basis took shape and in 1973 the number of items processed amounted to 56 700, about twice a many as had been processed in total during the three previous years. From 1974 on INIS reached steady operation, processing annually 60 000 to 70 000 documents. Starting at the end of 1975, instead of the reference system, a new abstract service was introduced on an experimental basis, with abstracts published in English, French and Russian. As of 1 January 1976, INIS became the world's comprehensive abstracting and indexing service in the field of atomic energy. The total amount of information that has been collected in the eight years that INIS has been operating now consists of almost 400 000 items, and continues to grow.

National Participation in INIS

An even more spectacular growth has taken place in the participation by IAEA Member States. In 1970, at the commencement of the system, 38 countries had indicated their willingness to participate by contributing information. Now, in the middle of 1978, the number of countries has grown to 59. As part of their participation many of the countries

have established highly developed national information collection procedures. For example, in the Soviet Union, which each year contributes approximately 18% of the total information distributed by INIS, the work of collecting the information is assigned to some 18 centres, which are located in the Ministries of Electric Power Development & Electrification, Geology, Public Health and Agriculture and in the Academies of Science in 14 of the Socialist Republics. The activities of these centres are coordinated by Atominform Central Research Institute in Moscow. Atominform itself is responsible for covering the material from the Russian Soviet Federated Socialist Republic. It is also responsible for controlling the quality of the input collected by the other centres, for translating it into English (the carrier language of INIS) and for converting the input to machine-readable form.

Like the USSR, most of the countries that have a large quantity of information to report, convert it to machine-readable form (paper-tape, magnetic tape or pages suitable for processing by optical character recognition (OCR) equipment) before sending it to Vienna, thus lightening the burden of the central processing unit at the IAEA. Indeed, well over 90% of the input is already in a form that permits the IAEA to process it immediately by machine, without any further manual interference. This has enabled the system to achieve a rapid turn-around. a large proportion of the information, ranging from 85–95%, is redistributed back to the Member States within 15 days of being received. It has also helped keep the central processing cost relatively low: the average cost of processing one item is estimated at US $21.50.

The methods and equipment used by the IAEA for the processing of INIS input are amongst the most modern available. They include optical character recognition, on-line data entry through computer terminals, and computerized photo-composition. The IAEA computer, an IBM 370/158 which INIS shares with a number of other IAEA divisions, is one of the most powerful on the market.

Aided by this advanced equipment, central processing is very prompt. However, the original identification of the relevant literature, its acquisition and its cataloguing and indexing can take time. The national INIS centres in the participating countries have a responsibility to ensure that the time taken in reporting new information to the system is not excessive. Simultaneously they must make certain that the literature produced in their countries is collected comprehensively and that the input is prepared accurately and consistently with the system's rules. The cost of performing this work is not trivial. It is estimated that the preparation in a national centre of one item of input for INIS can cost as much as $40 to $70, depending on local economic conditions, whether translation is involved, etc.

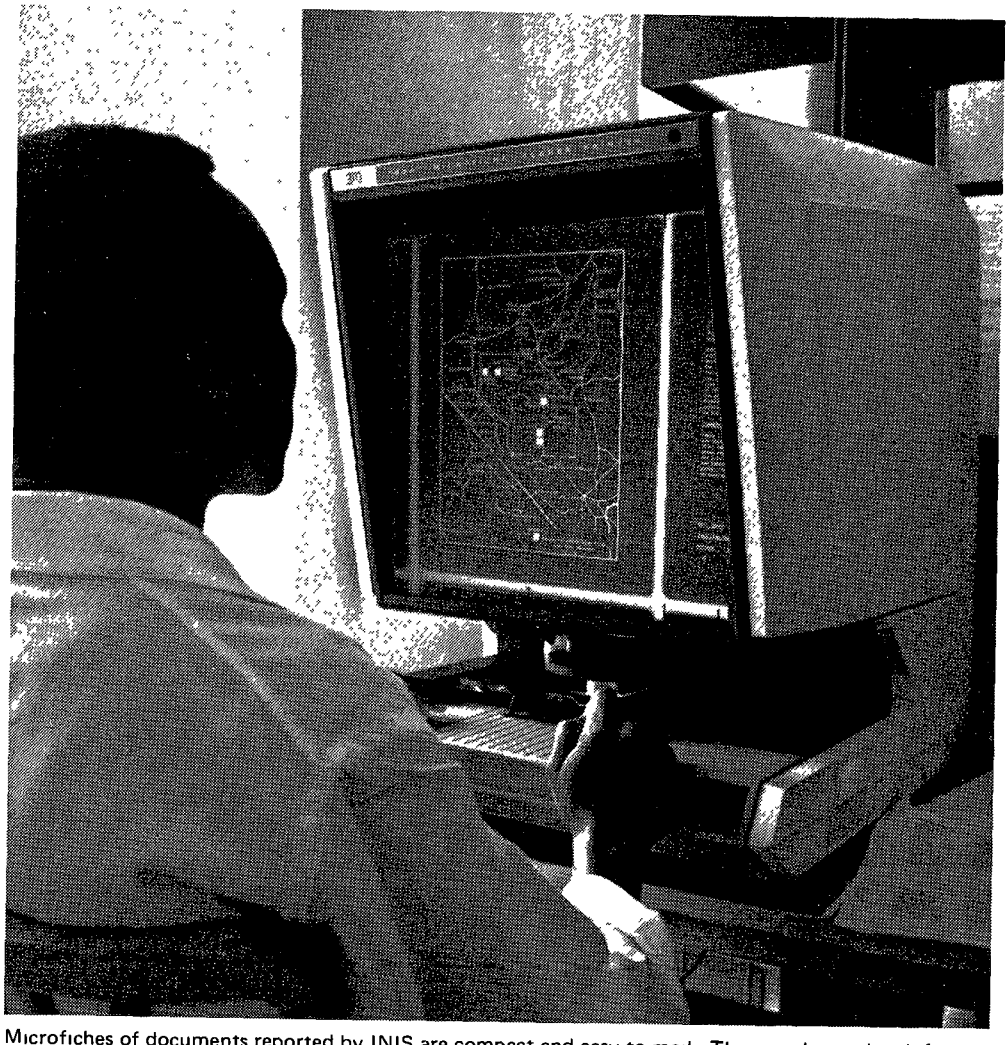
Some Member States have taken advantage of the existence of other information systems to help them in the preparation of input for INIS For example a number of countries, including the United Kingdom, the Netherlands, some Scandinavian countries, Switzerland and Austria have some of their input prepared on their behalf by INSPEC, the information system for physics, electrical engineering and computer science of the Institution of Electrical Engineers of Great Britain. Such an arrangement eliminates wasteful duplication of effort and ensures consistent input of high standard.

Again, in the USA, which contributes the largest quantity of information to INIS (over 26% in 1977) the input is prepared as a by-product of the national energy information system by the Department of Energy's Technical Information Centre. This centre was for years responsible for the compilation and production of *Nuclear Science Abstracts*. The separate

Through computer terminals like this, an increasing number of centres in various countries are able to obtain direct access to the latest nuclear information stored on the IAEA computer

publication of *Nuclear Science Abstracts* was discontinued by the United States Government in July 1976 on the grounds that INIS was by that time providing virtually identical coverage and thus the separate publication of a nuclear abstracting journal in the USA was no longer necessary Now, in the USA, the nuclear information contained in the INIS files is added to information collected from other sources to make up the national energy data base. This base is made available to scientists around the country through a highly developed on-line computer network.

Generally, in the developing countries less nuclear information is published. This is partly because these countries do not have a highly developed scientific journal publication programme. Thus their scientists frequently publish research results in international and foreign journals where they can obtain wider exposure. The preparation of input to INIS for this material then becomes the responsibility of the country in which the journal is published.



Microfiches of documents reported by INIS are compact and easy to mail. They can be read and if necessary reproduced in full size on a reader such as this.

This is the reason why the Netherlands is one of the largest contributors to INIS (about 10% in 1977). The Netherlands is traditionally a world centre of scientific publishing and many major international journals are published there. Nevertheless, many developing countries have established national INIS centres and are contributing input to INIS. In this way they build up their own facilities for information processing on modern lines and of course, it gives them access to the combined output of the system.

The INIS Liaison Officers

Although the national organizations for participation in INIS vary they have one thing in common. In almost all countries the heads of the national centres that take the responsibility for preparing the input and for distributing the output have been appointed as INIS Liaison Officers by their national Governments. Thus a "network" of Liaison Officers has been

established. Jointly with the IAEA Secretariat they are responsible for the day-to-day management and smooth running of the system. Each year the INIS Liaison Officers come together at a 2–3 day consultative meeting convened by the IAEA when they review the progress achieved by INIS during the previous 12 months and make recommendations for its future development.

This form of "participatory government" has benefited the system tremendously. It ensures that INIS keeps in close touch with the real information needs of the participating countries. Secondly, it means that proposals for the development of INIS are more likely to be based on a realistic assessment of the resources available in the Member States to implement them. Finally it means that any problems in the running of the system can be reviewed collectively so that solutions acceptable to all participants can be found.

Training and Education

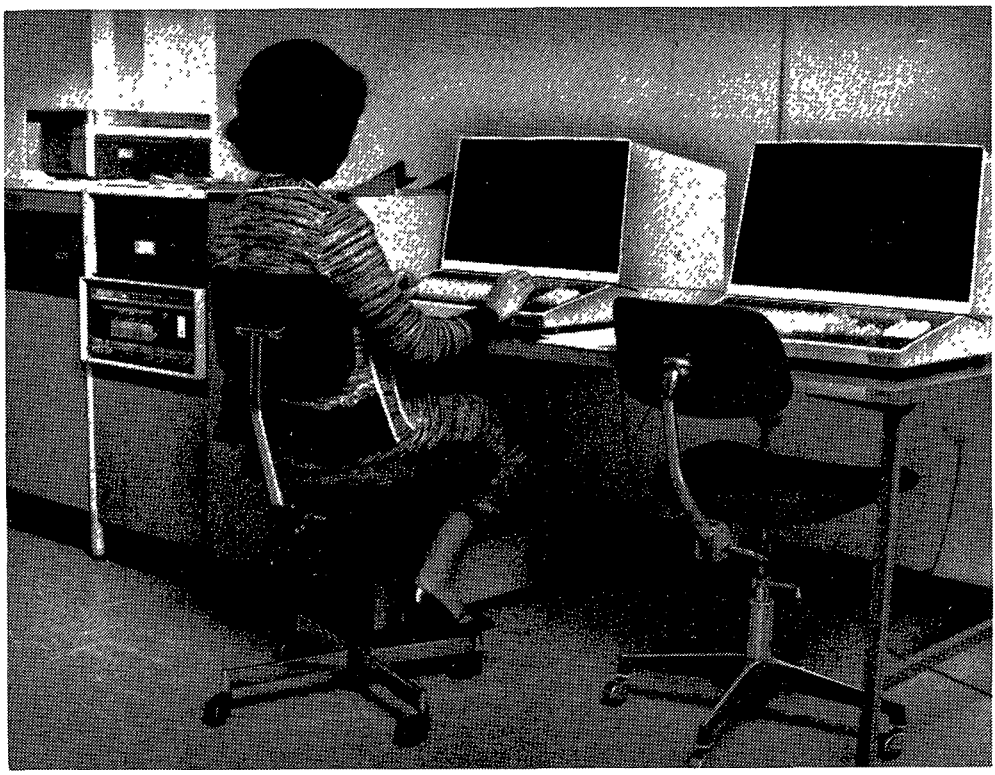
The decentralized, cooperative nature of INIS makes it essential that the staffs of the various national centres are thoroughly familiar with the rules for the preparation of input to the system and that they know how to utilize the output to the greatest effect. In fact, one of the major potential advantages of decentralization is that it tends to stimulate the establishment and improvement of national information facilities and services.

In order to assist the Member States in building up their information processing capabilities, INIS established a continuous training programme. This comprises seminars which are usually held annually, workshops, a fellowship training scheme and advisory services to national centres. The emphasis in the programme has gradually shifted from input procedures (such as cataloguing and indexing) to a concentration on teaching participants how to make the best use of the INIS output. For example, during the current year INIS is conducting a series of 2 to 3 day workshops for the staffs of information centres in countries having direct access to the INIS files. The intention is to give as much practical experience as possible in the techniques and skills required to search the INIS data base. Participants are taught the computer commands required to conduct a search session on the terminal. They also learn about the contents and structure of the files that are being searched.

A follow-up and extension of the training given in the introductory workshops is to be included in the programme of the large-scale INIS Training Seminar at the end of the year. Like its recent predecessors, this seminar is expected to attract well over 100 participants. It will provide courses in input preparation, aimed particularly at representatives from developing countries and countries which have only recently begun to participate in INIS. An additional course which is expected to be of general interest will relate to the flagging of data in the INIS files, a new and potentially far-reaching development of the system.

Data Flagging and Tagging

It should be clear from the discussion so far that up to now INIS has only been concerned with the storage and retrieval of information regarding *literature* available in the nuclear field. In other words, the information provided by INIS is a series of document references, a list of available publications dealing with a particular subject. For example a physicist who wants to have experimental values for the energy-dependent differential cross sections for elastic scattering of neutrons by Carbon-12 nuclei can learn from INIS the details of various publications which will give him those values. However, he still needs to obtain the publications themselves before he can learn what these values are.



An optical character recognition (OCR) machine like that above is an example of the modern equipment used in the processing of INIS data. INIS has pioneered OCR as a method for the conversion to machine-readable form of data in both the Latin and Cyrillic alphabets.

Scientists are becoming more and more dissatisfied with this two-stage process for obtaining information. They would like to see the expansion of the present document-oriented ("bibliographic") information system into a data-oriented, fact-retrieval system. However this transition would increase the cost and complexity of the system by several orders of magnitude so perhaps is only feasible on a step by step basis. It is generally agreed that the first transitionary step should be the "flagging" or labelling of the bibliographic records in the files of the information system to indicate which of the records relate to publications that contain data. The labelling system adopted could also be designed to indicate the kind of data the publications contain (e.g. experimental data, evaluated data, theoretical data) and the form in which the data are presented (e.g. in the form of tables, graphs, etc.). INIS is one of the first information systems in the world to decide on taking the initial step towards eventual conversion into a data retrieval system by including data flagging from the beginning of 1979.

Document services

Many of the frustrations and delays involved could be reduced if the information system made provision for a system of document "back-up", i.e. if the user could have ready and assured access to all the documents that are listed in the information files.

Right from its beginning INIS established a method of ensuring the availability of that literature which is perhaps the most difficult to obtain. the documents that are not distributed through commercial outlets, but which are published, usually only in a small number of copies, by universities, research institutions and other such organizations. INIS calls this literature "non-conventional" to differentiate it from that published through traditional channels, such as journal publishers and the book trade. It comprises technical reports, patents, standards, university dissertations and conference preprints.

To increase availability of this material the IAEA established the INIS Clearinghouse which makes and supplies micro-copies of the non-conventional literature contributed by the participating countries. In other words the INIS Clearinghouse functions as a "library" and copies of any of its documents can be requested at nominal cost. This library now consists of almost 100 000 documents. It supplies only microcopies of these documents. However, as the copies are prepared in conformity with accepted standards they can be read and, if necessary, reproduced in full size on equipment which is relatively inexpensive and available almost everywhere in the world.

This system goes a considerable way towards resolving the difficulty of obtaining full texts of the documents listed in the INIS files. However, it still does not produce a solution for scientists wishing to see copies of journal articles or commercially published books which may not be readily accessible in their laboratories or even in their countries. Accordingly the IAEA is now negotiating with a number of large lending libraries in various countries to secure guaranteed access to literature that is not available from the INIS Clearinghouse. A number of INIS Liaison Officers have also offered to make copies of nuclear documents published in their countries available. The details of the services offered by them are printed in each issue of *INIS Atomindex*.

Conclusion

Thus eight years after INIS operations commenced, the system is still developing and expanding. It has become a model for other international information systems notably AGRIS, the International Information System for the Agricultural Sciences and Technology, established by FAO. INIS performs the central processing operations for AGRIS on a cost-reimbursable basis. This is possible because from its beginning AGRIS took over the standards, and procedures of INIS. AGRIS has therefore been able to take advantage of the INIS experience and techniques, even to the extent of utilizing the same computer software.

Indeed, through its adoption and development of international information processing standards INIS has contributed significantly towards improved compatibility and inter-connection between information systems. This is one of the main objectives of UNISIST, the inter-governmental programme sponsored by UNESCO which aims at co-operation in the field of information.

Although the quantity of information collected by INIS in the last few years has remained relatively stable, the methods by which it is being made available have been constantly improved. The most recent and most exciting development in this direction is surely the establishment of the experimental Direct Access project. This places the combined store of information of 59 countries within easy reach of the scientist or documentalist seated at the console of a computer terminal in his laboratory or library. Within minutes he can have a detailed and comprehensive list of the existing information sources on any one of a large

range of topics related to the peaceful uses of atomic energy. This facility is a further logical extension of the system first conceived over 12 years ago with the express aim of accelerating and enlarging the contribution of atomic energy to peace, health and prosperity throughout the world through the exchange and dissemination of information.

References

The following will be of interest to those wishing to learn more about the history, development and technical aspects of the International Nuclear Information System

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