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NUCLEAR SCIENCE ABSTRACTS: A 21-YEAR PERSPECTIVE

Robert L. Shannon, *Extension Manager*

Division of Technical Information Extension
U. S. Atomic Energy Commission, P. O. Box 62
Oak Ridge, Tennessee 37830

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Nuclear Science Abstracts is now well into its twenty-second year of publication. Although it is not senior in age to such respected abstract journals as *Physics Abstracts* or *Chemical Abstracts*, *NSA* nevertheless has grown and matured concurrently with the very science it represents. It is my belief that *NSA* is not surpassed by any abstract journal in vigor, vitality, and effectiveness. The number of abstracts published annually has increased from 2500 in 1948 to 54,000 in 1968. The year just ended reflected a 20-fold increase over the first year of issuance. Furthermore, during its 21-year existence, I doubt that there has been any appreciable amount of serious literature on nuclear science that has not been covered in the more than one-half million abstracts that have appeared in *NSA*. In terms of total numbers of abstracts published, the first decade produced fewer than 100,000 and the last 11 years more than 450,000. I have a personal interest in statistics such as these because, although I have been in some measure associated with *NSA* during its entire life's history, its publication for the last 11 years has been among my general responsibilities and one of my chief interests. It is for this reason that I am pleased to have this opportunity to tell you something about *Nuclear Science Abstracts*, which I consider to be the U. S. Atomic Energy Commission's most important scientific publication.

NSA was begun to fill a need. This need was initially expressed by the AEC's major laboratories and contractors. It was from them that we received the first encouragement to explore the possibilities of establishing an announcement journal that would regularly report the publication of research results in the field of nuclear science.

Abstracting and indexing services in the United States, such as *Chemical Abstracts*, had served established disciplines for many years, but there was no comparable service for nuclear science information, and it appeared unlikely that any private group would attempt such an undertaking. Thus, as is pointed out by Seaborg and Wilkes in the book *Education and the*

Atom,[1] the AEC began publishing *NSA* after a brief experiment with limited-purpose abstract journals.

NSA at first covered only the technical report literature, but its coverage was soon enlarged to include journal literature as well, and still later to encompass virtually every publication on nuclear science regardless of language, format, or origin.

Let me assure you that there would be no success story to tell if our international friends had not very quickly given their support and cooperation in full measure. Since its inception, *NSA* has always been international in coverage, in use, and in the support it receives. It is interesting to note that 73 different countries contributed literature to Volume 23, just completed. We have long had arrangements with the major scientific information producing countries of the world to provide nonconventional literature items that fall within our scope of interest, and we have hundreds of agreements whereby we exchange *NSA* subscriptions for subscriptions to primary journals. Both publishers and individual authors generously provide preprints, books, and other materials for announcement to the world's scientific community through *NSA*.[2] In fact, a difficult processing problem is to choose only those items which we feel are properly within *NSA*'s scope. In this selection process we examine at least a half-million items annually; of these, only one-tenth are chosen. I would emphasize that selecting the one item in ten that is within our scope of interest from the hundreds of thousands of scientific reports and articles appearing annually requires a great deal of technical knowledge, if not a fair amount of temerity, on the part of *NSA*'s evaluators and editors.

It was not long after *NSA* began publication that we realized there must be a guiding principle in the selection of materials to be included. In short, *NSA* required a subject scope. We assumed the task of filtering out from all the disciplines of science only those areas which constituted the new field of nuclear science and technology. We early defined nuclear science as the study of the production, properties, and phenomena of atomic nuclei, subatomic particles, gamma rays, and X rays. We also defined nuclear technology as the application of nuclear science to other sciences and engineering, and, conversely, the application of other sciences and engineering to the problems of nuclear science.

These general definitions are deceptive in their simplicity because they provide only the first sorting. In fact, the currently published subject scope notes[3] define 10 major subject areas and some 65 subareas as well as the exact extent of our interest in each of the chemical elements. These notes show the exact range and limits of interest for the subject matter to be abstracted and indexed.

Our regularly published subject scope gives the user precise information about the subject matter he will find in *NSA*. Similarly, we publish a list of the scientific journals we scan. This practice of publishing the subject scope and literature coverage, in my opinion, forms the backbone of *NSA*'s systems integrity because we believe that we must define the subject matter and identify the literature being covered so that any user of *NSA* knows what to expect. After that, he can rely on our stated intent.

It has been our objective, therefore, that *NSA* would serve the nuclear scientist as the most optimum means of keeping him aware of the current literature that is included in the definitions as well as the limitations of nuclear science.

In the early volumes, the abstract arrangement was rather heterogeneous with some 35 sections. Beginning with Volume 3, abstracts were arranged into broad scientific disciplines of chemistry, engineering, instrumentation, life sciences, metallurgy, physics, and reactor technology. Various areas of these disciplines have received considerable attention and review

during the intervening years, and the *NSA* tables of contents have reflected these changes of emphases. Even so, the primary arrangement today is still much the same as it was in Volume 3.

During all the years *NSA* has been published, the subject scope has been influenced by the Atomic Energy Commission's Technical Information Panel, one of the oldest advisory groups of the AEC, and by feedback from users. Exhaustive reviews of the subject scope are made periodically. The last such review, made before the publication of Volume 20, included studies not only by our own staff but also by operating divisions of the AEC, our national laboratories and major contractors, the American Nuclear Society, and the nations with which we have bilateral agreements for technical cooperation. Such reviews assure that *NSA* covers the essential subject matter of nuclear science. *NSA* coverage continues to exclude popular literature and commercial news items on the basis that such material should not be included in a journal that reports exclusively on pure science. It has also been a long-standing policy to exclude repetitious radiation therapy and isotopic tracer studies. Only new techniques or applications involving these topics are covered.

Three major user studies have been made in the last eight years relating to the effectiveness of *NSA* as a current awareness tool. These were made in 1962 by Herner and Company, in 1965 by the Biological Sciences Communication Project at George Washington University, and in 1966 by the American Nuclear Society. All three studies showed that *NSA* was consistently used for both current awareness and retrospective searching.

The second important use of *Nuclear Science Abstracts* is for the retrospective location of information. For this purpose the indexes are essential. There can be no use of *NSA* for retrospective searching without the indexes. The indexes are used, of course, in connection with *NSA*'s function as a current awareness tool, but here they play a secondary role.

The form and types of indexes in *NSA* have varied over the years as we tried to satisfy the needs of our users and as our capabilities for producing indexes improved. However, we have always recognized the importance of the subject and author indexes and very early in the history of *NSA* ensured their inclusion in each issue. Preparation of the author indexes has seldom been a serious problem; however, the intellectual challenge of subject indexing has always been stimulating, as have the problems of mechanical production.

I think most of you are familiar with the various kinds of indexing systems prevailing today; some examples are classification schemes, conventional subject indexes, uniterms, keywords, and the like. Most of you also understand the differences, intended applications, and natural limitations of the various systems. For this reason, I shall not dwell on indexing.

The subject indexes of the first volumes of *NSA* were produced without a subject heading authority, but, as we realized the retrospective search potential of the indexes, we also realized the need for an authority. We began by using the authority developed for preparation of a card catalog[4] and, as the relative importance of *NSA* indexes over catalog cards became apparent, the subject authority was modified accordingly. We were fortunate in that, when we started, the amount of material to be indexed was small, and we were able to use a small thesaurus. Our thesaurus was able to grow with nuclear science itself, and we have never had to make a special project of thesaurus building. Many times we have had to index a subject before it had a generally accepted name. At those times we have had to make an educated guess as to which name would be accepted. We think that sometimes our choice has influenced the adoption of the terminology by the scientific community; other times we have made a bad choice and have had to retreat and reindex. One of the consequences of being early in the field is that our

thesaurus has been a principal base, or perhaps a target, for any other thesaurus touching on nuclear science.

Mechanical aids have been used from the beginning for producing *NSA* indexes. Indexes in the early volumes were compiled with electronic accounting equipment, which was the only practical way to produce indexes for each issue without delay and to cumulate without repetitious work. After Volume 4, the content of the subject indexes was changed to provide more information to the user, but then, as a price paid for improvement, the subject indexes had to be dropped from the issues because the changes had made them too complicated to handle with the sorting equipment then available.

We were able to include subject indexes in each issue again when we began using a sequential camera combined with conventional punched card sorting equipment and special Vari-Typer machines as an index production method.[5] It is important to note that in 1959, without the aid of computers, *NSA* became the first abstract journal to include four indexes in each abstract issue. We converted to a computer system for producing the indexes in time to begin Volume 21. Shortly thereafter, the bibliographic data and subject indexing became available for mechanical retrieval and for the automatic production of bibliographies.[6]

The steps leading to the production of *NSA* begin with acquisition of material. This material is evaluated, and only those items are chosen which are within our subject scope, are at the proper technical level, and are scientifically valid.

The next step is descriptive cataloging. We are quite proud of our descriptive cataloging, which is limited to only one keyboarding operation. That operation at once provides a processing form used in subsequent functions, provides the hard copy for the citation that appears above each abstract, and provides tape from which three *NSA* indexes, corporate author, personal author, and report number, are prepared.

The next step is preparation of abstracts and subject indexes. We have 32 professional staff members working full time and 6 part-time professional women who normally work half time. Each is a college graduate in the physical or life sciences, and many have masters and doctors degrees. Five nonprofessional personnel support the professional staff. The Science and Technology Branch, which is responsible for abstracting and indexing, is organized into seven sections, each responsible for a scientific discipline paralleling an *NSA* section; thus, each professional staff member works with the literature in his field. This organizational concept at times results in uneven backlogs but increases the quality of our information products. It also provides an opportunity for each staff member to be professionally aligned to his preferred scientific discipline. Many of our professional staff members come to us directly from college, having little or no experience. Training is on the job, and a year is usually required before all duties, i.e., indexing, abstracting, selecting, and searching, can be accomplished without close review.

Visitors to our *NSA* offices in Oak Ridge usually show as much interest in the mechanical aspects of *NSA* as in the intellectual processes because we have kept abreast of the latest technological advances in photography, electronics, and computers so that these advances can be used to their fullest in handling the increasing program demands. I should like to speak briefly about the mechanics of *NSA* preparation and about future plans.

In the present system, data for all the indexes are keyed on Flexowriters. A paper tape for all except the subject indexes is generated as a by-product of the descriptive cataloging function. This paper tape is converted to magnetic tape on our IBM 360/Mod 20 computer and then processed on an IBM 7090 computer to perform an edit of the data. The resultant edited and

proof tapes are printed on our IBM 360/Mod 20, which uses a specially designed 120-character chain printer. The printouts are proofread and marked, the corrections are keyboarded on the Flexowriter, and the resulting paper tape is used to initiate a second cycle.

The number of cycles depends on the number of input errors, the number of additions and deletions made by the proofreaders, and the acceptance of data by the computer. It is not unusual for each complete cycle to take from four to six working days.

A paper tape system of the kind I have described has many good features such as easy keyboarding, excellent hard copy production, and good operator control. Such a system does not provide for keyboarding directly onto magnetic tape, and consequently offers no possibilities for reducing either time or effort in the correction routines.

Therefore, in April 1968, when we decided to add abstracts to the computer data base, it was necessary that we select a completely new input system. Extensive study of the problem was made during the next several months, and, in November 1968, a modular input system was designed. This system is characterized by direct input to magnetic tape via a typewriter keyboard but using a cathode-ray tube for visually displaying to the operators the characters being input. The system permits on-line corrections of errors.

Essentially, an on-line, time-sharing system was projected. Three data streams, i.e., abstracts, subject indexing, and descriptive cataloging, were examined. We estimated that each stream would require approximately eight on-line cathode-ray tubes and keyboard terminals to handle the workload that had been calculated. These would also employ a character set of 120 characters that can be expanded according to the needs of the system.

Since the implementation of this system depended upon the proper staffing and budgeting of equipment and required an orderly phasing in, a three-year implementation plan was selected. Each data stream would be implemented separately and would serve as the building block for the following stream. Equipment thus would be added each year to accommodate the next new phase of operations. The first phase is now under way and is being tested. Equipment for the second phase has been ordered.

The end product of the new system will be a correct data tape for each issue of *NSA* which can be stored for searching in an on-line or batch mode. In addition, we will be able to use the stored data to produce complete regular and cumulative *NSA* issues. Photocomposition or character-generating equipment, which we do not have at present, will be required ultimately for this objective.

The successful publication of *NSA* for more than two decades has not been the accidental result of routine shopkeeping, nor has it been altogether the result of its management's good intentions. Rather, it is the result of a system carefully constructed over many years which has required the best efforts of many people. It is the result of a demand for information that knows no national boundaries, and it is the result of its own faithfulness in discharging its stated mission. It is also the result of good will substantially enriched by international support.

Principally, *NSA* is the result of the efforts of the people who are directly responsible for its publication and who wear the service badges for time invested as well as some scars incurred along the way. These people have shaped its policies, regulated its course, rebutted its critics, and profited by its mistakes. These people, to their everlasting credit, have labored for its journalistic integrity and scientific excellence.

But, beyond this, they believe that *NSA* is an essential instrument for users of nuclear science and technology. Most of us realize that computerized information management and retrieval is not available to, or indeed needed by, vast numbers of organizations and

individuals. But we do believe that both systems are needed if we are to serve the needs of little science as well as big science.

The college professor, researcher, and small industrial user, who do not have access to computer-assisted retrieval, must have access to some kind of manual system. In my opinion, they always will. On the other hand, in ensuring that we not deprive the small user of what he is able to use, we must not deprive the big user at the expense of serving the other. Therefore we intend to maximize the use of the data we have in computer storage with the hope that soon we will have effective cross-linked real-time access to this treasury of nuclear information.

At the same time we intend to continue publishing *NSA* in its printed form because we believe it is essential to countless hundreds of small libraries, laboratories, and individuals. As my colleagues at Euratom expressed it, *NSA* must continue to form the information base for nuclear science and technology.

In closing, I bring to this distinguished conference greetings from Dr. Glenn T. Seaborg, Chairman of the United States Atomic Energy Commission. Dr. Seaborg has asked that I relay to you a brief message which I quote as follows:

> *Nuclear Science Abstracts* has been of exceptional value to the nuclear energy community in the United States and abroad since its inception more than 20 years ago. As a multidisciplinary abstract journal, it has proved to be the best single source of reference material on nuclear science and technology which is available on a prompt reporting schedule and at reasonable cost.
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> I take pride in the fact that the U. S. Atomic Energy Commission has sponsored the publication of *Nuclear Science Abstracts* and that it has been used so effectively on an international scale, and I trust that it will continue to serve science equally as well in the years ahead.
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> The interest of the International Atomic Energy Agency and its member nations in *Nuclear Science Abstracts* is most welcome. This latest exchange of views on how best to disseminate the voluminous technical literature of nuclear energy should lead to more effective, efficient, and economical methods for ensuring that every nuclear scientist has the latest research information at his disposal.

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*Available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.