THE RADIATION SHIELDING INFORMATION CENTER (RSIC)
A UNIFYING FORCE IN THE INTERNATIONAL SHIELDING COMMUNITY

B. F. Maskewitz, D. K. Trubey, R. W. Roussin, F. H. Clark
Radiation Shielding Information Center
Oak Ridge National Laboratory
Oak Ridge, Tennessee, USA

ABSTRACT

THE RADIATION SHIELDING INFORMATION CENTER (RSIC)
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The Radiation Shielding Information Center is a technical institute serving the international shielding community. It acquires, selects, stores, retrieves, evaluates, analyzes, synthesizes and disseminates information on shielding and ionizing radiation transport. Computer codes and computer-readable nuclear data are treated as an integral part of this work. Problems which hinder code exchange are alleviated by scientists making new development available and therefore open to scrutiny and improvement. Through free and open exchange of shielding information the entire international shielding community can progress rapidly as a unit to advance the state of the art.

RESUMÉ

Le Centre d'Information pour la Protection contre les Radiations est un institut technique desservant la communauté internationale. Il acquiert, sélectionne, classifie, recherche, évalue, analyse, synthétise et dissémine l'information concernant la protection et le transport des radiations ionisantes. Les programmes de calcul et les données nucléaires sont une partie intégrale de ce travail. Les problèmes qui limitent l'échange des programmes de calcul sont atténués par les chercheurs qui font part de leur nouveaux travaux qui sont par conséquent examinés critiquement d'une manière ouverte. Par l'Intermédiaire de l'échange libre et ouvert des informations concernant la protection, la communauté internationale peut progresser plus rapidement et faire avancer leur science.

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MASTER

We live in a complex technological society. In order to do his job, a modern man must increasingly base his action on the findings of others. The technical man must keep up to date in his methods, whether he is involved in engineering design, trying to optimize the effectiveness of a reactor shield, or in research, attempting to forge ahead into new realms of knowledge. He must be continuously aware of what his colleagues are doing and what results they have obtained. Without such information, he will duplicate work already performed by others which is wasted effort, involving large, unnecessary expenditures.

The acquisition of such knowledge is hampered by an information explosion. The number of scientists continues to increase. Laboratories pour out results in many different languages. We no longer rely mainly on personal contacts or the correspondence that formerly bound scholars together. While jet travel and the telephone make direct communication easier, the output of printing presses builds new barriers. It is imperative that we increase the efficiency of the information transmission process. Although a number of people are working to increase this efficiency, scientists, themselves, shoulder the major obligation toward developing new ways to let the scientific right hand know what the scientific left hand is doing.

THE INFORMATION ANALYSIS CENTER CONCEPT

The information analysis center concept was articulated by a select body of scientists called together by the President of the United States in 1962. Chaired by A. M. Weinberg, Oak Ridge National Laboratory (ORNL), the committee reported¹ that "science must undergo a social reorganization to enable it to remain unified even though it continues to grow...The beginnings and the shape of this reorganization can be discerned in the emergence of scientists who are primarily handlers of information - who sift, retrieve, and analyze the information created by others and who, in so doing, synthesize new information based upon the individual findings of others."

In the report to the President the panel states: "We believe information is part of research; that the links in the information transfer chain are welded together, and that in this age of information crisis, the creator of information must assume as much responsibility as possible for subsequent dissemination and retrieval of the information he creates."

The report observed: "We shall cope with the information explosion, in the long-run, only if some scientists and engineers are prepared to commit themselves deeply to the job of sifting, reviewing, and synthesizing information; i.e. to handling information with sophistication and meaning, not merely mechanically.

"Such scientists must create new science, not just shuffle documents; their activities of reviewing, writing books, criticizing, and synthesizing are as much a part of science as is traditional research. We urge the technical community to accord such individuals the esteem that matches the importance of their job, and to reward them well for their efforts."

ORNL led in the pioneering effort to make the envisioned concept come alive.² The Radiation Shielding Information Center (RSIC) is a viable example of this effort.³

To fully understand the RSIC style, it is necessary to define the information analysis center concept. Panel No. 6 (Information Analysis and Data Centers) of COSATI (Committee on Scientific and Technical Information of the Federal Council for Science and Technology) has adopted the following definition.⁴

"An Information Analysis Center is a formally structured organizational unit specifically (but not necessarily exclusively) established for the purpose of acquiring, selecting, storing, retrieving, evaluating, analyzing, and synthesizing a body of information in a clearly defined specialized field or pertaining to a specified mission with the intent of compiling, digesting, repackaging, or otherwise organizing and presenting pertinent information in a form most authoritative, timely, and useful to a society of peers and management."

The overall idea of the information analysis center was strongly endorsed in the Weinberg Report,¹ which emphasizes

"...knowledgeable scientific interpreters who can collect relevant data, review a field, and distill information in a manner that goes to the heart of a technical situation are more help to the overburdened specialist than is a mere pile of relevant documents. Such knowledgeable scientific middlemen who themselves contribute to science are the backbone of the information center; they make an information center a technical institute rather than a technical library. The essence of a good technical information center is that it be operated by highly competent working scientists and engineers - people who see in the operation of the center an opportunity to advance and deepen their own personal contact with their science and technology."

It may be noted that each definition implies critical examination - the material collected by the Center is filtered through the human brain, analyzed, and placed in context. The answer to a question addressed to the Center is a composite of the literature and the expert's judgement, based on an analysis of the questioner's needs. Therefore, it is essential to the technical institute concept that the information analysis center focus on a specialized area, that it be placed in a large multi-purpose laboratory where active work in the field is going on, and be manned by a technical staff suited to the role of scientific middleman.

RSIC OBJECTIVES AND SCOPE

The Radiation Shielding Information Center (RSIC) functions within the Neutron Physics Division (NPD), Oak Ridge National Laboratory, which has long been engaged in shielding and radiation transport research. It is a technical institute serving, since early 1963, the international scientific community engaged in research and development for the design of shields which provide protection from biological and physical damage due to ionizing radiation. Such radiation emanates from nuclear reactors, radioisotopes, nuclear weapons, and accelerators, and is also present in space. The Center personnel collect, organize, evaluate, package, and disseminate shielding information to anyone whose work requires such information. In general, all information concerned with the transport of ionizing radiation is covered, with partial coverage of the areas of radiation instrumentation and neutron thermalization.

RSIC material is distributed currently to more than 1400 persons,⁵ of whom about 20% are located in countries other than the United States. The RSIC Newsletter is mailed to individuals in 39 different nations of the world. In return, we ask for shielding information and the cooperation of the international shielding scientist in making of the information analysis center an efficient technical institute, able to give a useful service to the community we serve.

Shielding research and design require the use of large high-speed computers and complex computer codes^{6,7} and associated data libraries.⁸ RSIC treats this kind of information as an inseparable part of shielding information.^{9,10,11,12} The effort made to understand it, to use it to analyze other shielding information, and to use it as a means of technology transfer has made RSIC an effective information analysis center.¹³ Computer code and data exchange has had a tremendous impact on shielding technology.¹⁴

RSIC'S ROLE IN UNIFICATION OF THE FIELD OF SHIELDING

By the nature of its functions and the manner in which it implements them, RSIC contributes substantially to the unification of the community engaged in the various areas of radiation transport and shielding. The dissemination of information to otherwise unrelated users is in itself a unifying activity. RSIC, however, promotes a closer relationship between Center and user. Communication channels between the Center and the worker in the field are kept open and extensively used. Many RSIC projects have benefitted by the active participation of the Center's users. Seminar-workshops, topical meetings, policy advisory committees, review articles, and data collection and management activities point to an industry-wide cooperative enterprise. The RSIC forum is both an information exchange medium and a focal point for the initiation and organization of new activities and the identification of new leadership in the field.

Early voluntary informal efforts at providing guidelines for good documentation of computer programs, and for programming practices to facilitate exchange has evolved into a formal standards effort under the auspices of the American Nuclear Society (ANS). Two standards have been published,^{15,16} a third is now underway.¹⁷ An RSIC staff member has been a motivating force behind and a participating member in the effort since the beginning.

RSIC is also involved in work on shielding standards.⁵ A staff member is chairman of the ANS Standards Subcommittee on shielding, ANS-6, whose goals are to establish standards in connection with radiation shields, to provide shielding information to other standards groups, and to prepare recommended sets of shielding data and test problems.

We can claim some credit for the advancement of the state-of-the-art in shielding calculations. Our insistence on documenting code development and our assistance given to the code developer while he is documenting his work is well known. Our encouragement for the use of higher-level programming languages to facilitate exchange, and for the use of standards in programming practices, is also well known. We are quick to refute the claiming of proprietary interests which would withhold programming efforts from free exchange. In shielding, this trend has been kept to a minimum. You will find interesting code development from the private sector in the RSIC collection.

In addition to providing a Center with the total information spectrum, RSIC handling of computer codes as an essential part of shielding

information has additional benefits. We can be of greater assistance to the shielding research man. We supply the bibliography with abstracts for his prior study; we suggest calculational methods to solve his particular problem which requires the use of the computer; we help him select the computer program best suited to his problem and to his computer environment, and we give him assistance in making it operable at his installation. We spend a great deal of time trouble-shooting while a customer is seeking a solution to his problem. And, when we review the report of his research at a later time, we have more insight as to how he got his results.

A brief example:

A distinguished university professor, well-known in the shielding industry, took a one-semester sabbatical leave from his university to do a study of the effect of material composition on neutron penetration of concrete slabs for the U.S. National Bureau of Standards. He spent a week at RSIC using the information store and conferring with staff members. RSIC supplied a code (ANISN), a data library for concrete (DLC-9); gave help in the details of weighting and collapsing the cross sections; helped in the details of running the adjoint calculations and in interpreting the results. The professor was able to complete his work in the brief allotted period, including documentation. His generous acknowledgement cited his partnership with RSIC.

We also make a difference to the code developer.

If his work is of interest to a large number of people, we save him time, effort, and expense. He prepares his code material once for us, gives us a workshop, and we then handle the requests. He "freezes" his work at a given level to place it in the public domain and goes full speed ahead exploiting and developing his own work; when he reaches a new plateau, he "freezes" again and updates the current code package. Many times, contributors have requested that we send to them their code packages of a certain level, because in their own advance code development they took a bad turn and want to begin again from the earlier point.

Close relations with the American Nuclear Society (ANS) has also been a means of unifying and serving the shielding community. Active participation and leadership in the ANS Shielding and Dosimetry Division by members of the RSIC staff has served to increase the usefulness of both the Center and the Society.

We have previously stated that the Center's cooperative activities have not been limited to the United States. Shielding information travels in all directions across the oceans. Various exchange agreements exist between nations. The United States Atomic Energy Commission (USAEC) and the Organization for Economic Cooperation and Development (OECD) Nuclear Energy Agency (NEA) have exchanged computer programs and cross section data since 1963. Their agreement has been extended to third parties under defined circumstances. The Fourth International Conference on Reactor Shielding is expected to provide new impetus to fruitful exchange and to further unite the shielding community across all national boundaries. We are pleased to welcome EURATOM's European Shielding Information Service (ESIS) as a collaborator in such international information exchange.

Our title refers to RSIC as a "unifying force in the international shielding community." We have always worked toward such unification, believing it to be in the best interests of technological progress in our field. We now call your attention to some obstacles to progress towards

a greater unity.

SOME PROBLEMS IN CODES EXCHANGE

Computer code exchange has always been a major RSIC function. There are abroad in the world some impressions about computer programs and their exchange with which we do not agree.

One can still hear in some quarters the old bromide that it is easier to write a program than to use someone else's work. You do not hear that any more in shielding.

At the opposite extreme, there is an impression that codes can be centrally warehoused with documentation provided by their authors and distributed with no further processing. Then, there is the notion that a major program should be completely and permanently developed at a single site and that subsequent use of the program be confined to that site or that other sites simply learn input and output procedures. When sufficient investment has been made on such a program, it tends to acquire an authority not necessarily fully supported by the laws of nature.

We deplore the rising shadow of proprietary interests and commercialism with consequent threat to freedom of scientific information exchange. The reasons underlying such attitudes may be cost control, desire for commercial gain, or protection of national political interests. We believe that, whatever the justification, such policies can and do generate serious inadequacies in computer programs and the findings based on them.

Let us classify codes as open or closed. We define open codes as those which, at some stage of their development, become well-documented, closely scrutinized in their internals by members of the industry at large, widely used, and frequently modified by the users. (Note that these are characteristics which we commonly expect to find in any piece of valid science.) We shall define a code as closed if either of the following conditions are for any reason met: (1) it is not well documented, or (2) has not been scrutinized in its internals by the profession at large. It is very likely to be closed if any of the following conditions are met: (1) it is not widely used, or (2) has never been modified by any but its authors, or (3) is used only at the site where developed, or if used at other sites, is used at them only as a "black box," i.e. a converter of input into output.

The proprietary and commercial policies itemized above tend to have the effect of producing closed codes. In fact, all proprietary codes are closed.

RSIC has evolved, not always with prior intention, different ways of preparing programs for exchange which we feel lead to substantially greater return on the investment.

RSIC specifies procedures to be followed by authors in preparing their codes for submission. A necessary requirement for the inclusion of any code on our distribution list is that it be successfully operated under RSIC auspices. If the code has been properly prepared by the author, the cost of this test is small. If it has been improperly prepared, the test is obviously essential to avoid duplicating the effort at each installation to which the code is sent.

Some few programs in the mainstream of shielding are very complex, carry a heavy investment in their development, and have generated very wide interest. Such programs often receive special attention. We may place more than ordinary effort in preparing them for distribution, and often they become the subject of a seminar-workshop, an in-depth teaching session.

We believe that the teaching session is to benefit the code more than to benefit the attendees. By helping bring the code into the area of critically examined, used, adapted, and modified information it elevates the code to the level of genuine technical information. A closed code can never command respect as a legitimate element of technology. An open code does not readily become obsolete, but tends to develop with the developing technology and be maintained current and correct.

We consider the open code to be a part of living technology. A code which is, by reason of classification, proprietary considerations, or other policy, confined to the examination of a small group, is moribund. These moribund codes do not have the benefit of constructive contributions from the entire field; nor can they ever carry the authority which comes only from widespread critical examination and acceptance by professionals. This is, after all, the final and only measure of technical validity of any kind of information.

An RSIC seminar-workshop^{18,19,20} is a teaching session extending over several days and centered about one or more related computer programs and the technical problem treated. The workshop's format includes sessions dealing with the general nature of the problem under study, papers detailing the approaches to solutions employed in the codes under study, input-output sessions, and actual problems placed on the computer by the participants.

Some people, it is true, come only to learn input-output procedures; but there are always some who come to study the problem as well and who go away with the beginnings of a complete understanding of the program and its approach to the problem. These people, in the course of using the program, soon begin to find previously undisclosed or unforeseen defects; they often improve the algorithms, make improved approximations to the natural phenomena; adapt the program to their own problems, and in so doing, enlarge its capabilities. All such changes and improvements are reflected into the distribution through RSIC. Such developments can cumulatively be very substantial but their cost is generally widely distributed and borne as a normal part of applications cost with no further charge to initial development.

We commend the OECD NEA Computer Programme Library for arranging to follow this Conference with such a teaching session on shielding codes.

A final problem is that of reciprocity in codes and other information exchange.

It is not necessary that such exchanges be made on a strictly *quid pro quo* basis for this to be of substantial benefit to both parties. However, it is important that this not be a one-way exchange. It is extremely difficult, since RSIC is financially supported by government agencies, for us to explain to our sponsors why we have no major contributions in the RSIC information store from countries in which it is known that there is considerable interest in shielding. It is even more difficult in such

cases when RSIC continues to honor requests for information.

It is our hope that discussions at this Conference, both formal and informal, will lead to a new era in which free exchange of reactor shielding information will flourish.

While striving to alleviate the problems cited, we feel that the ideal of the free and open flow of information is realized to a greater extent in shielding than in most technical areas. RSIC claims some share of the credit for this.

INFORMATION FOR A CHANGING SOCIETY

For society's purposes, technical information must be credible, interpreted, and appropriately packaged. International cooperation as a means for using the store of human knowledge more effectively should be increasingly relied upon and strengthened. No nation, regardless of size or wealth, can afford to be self-sufficient in its generation and use of technical information. Focusing on a highly specialized scientific area, RSIC is a force for the unification of the international shielding community. Its experience in international cooperation provides an example that can be followed in other specialized scientific areas. The information explosion calls for more vigorous development of the information analysis center concept, relying upon such centers to collect the relevant literature from the entire world's output, index, store, evaluate, and condense it into reports on the state of the art, critical reviews, and compilations of data.

A report prepared under OECD auspices entitled *Information for a Changing Society*²¹ is an outgrowth of OECD concern with national and international policy relating to information systems in science and technology.

In 1969 OECD Secretary General Emile Van Lennep appointed the *Ad Hoc* Group on Scientific and Technical Information²² to examine the information program of his organization and to advise OECD member states on information policy. The ad hoc group decided in its earliest deliberations that policy for information in science and technology could not be considered separately from policy for science and technology, which in turn could not be separated from policy for economic growth and other social goals. The task of the group thus became an examination of the information needs of the changing society that constitutes our global village.

Brady and Branscomb²³ have summarized the conclusions in the following manner. "Scientific and technological information has not been used as effectively in the past as it might have been, perhaps partly because it has often been considered an administrative or mechanical matter, treated separately from research and development (R&D) strategy. Full effectiveness of information for public policy demands a proper mixture of scientific and technological information with social, economic, and political information - in a system specifically designed for the purpose, rather than the discipline-oriented information systems designed by specialists for other specialists. More attention should be paid to the development of systems for industrial technology. Greater emphasis on quality control of both input and output is required; since information systems are evolving rapidly now, the need for quality control should be kept in mind constantly during their evolution."

The last two recommendations of the OECD *ad hoc* group deal with international cooperation. They urge increased and strengthened international cooperation, pointing out that reliance upon national self-sufficiency has never been a realistic policy.

The report concludes²¹ "The situation calls for more vigorous development of the information analysis center concept, relying upon such centers to collect relevant literature from the entire world's output, index it, store, evaluate, and condense it into reports on the state of the art, critical reviews, and compilations of data. The smaller nations, especially those whose mother tongue is not a major world language, must take special care to ensure that they have access to that portion of the world's information that they need, taking into account the importance of concentrating their R&D programs on a limited number of technical areas in which they can hope to make a contribution."

Clearly seen in the report is the expanding role and need for international cooperative efforts. In addition to the traditional camaraderie of individual scientists, international problem-solving is seen as a new source of cooperation among nations, particularly in meeting environmental, health, and energy problems common to all.

Several efforts are underway to attack the technological problems of information exchange. The format for exchange of nuclear data between the USAEC (NNCSC), the OECD NEA (CCDN), the IAEA (NDC), and the USSR (INDC) is an example.²⁴ The IAEA-coordinated International Nuclear Information System (INIS)²⁵ for the world-wide exchange of scientific and technical information in the field of nuclear science and technology is becoming well-known. UNISIST, the Intergovernmental Conference for the Establishment of a World Information System²⁶ is UNESCO's plan for exchanging scientific and technical information in all languages between all nations of the world.

While urging you to support efforts to aid in scientific information exchange, we note that no matter what the motivation, international scientific cooperation is only as good as the science put into it; and it can be successful only if all sides are keenly interested in making it work.

RSIC will continue to vigorously pursue its mission within the context of flourishing international cooperation. We value highly the deepening understanding between nations engaged in common research as being beneficial to all society.

In conclusion, we share with you the most extravagant compliment we have received to date.

Written across a published copy of our annual statistics in bright red ink, came this message from an RSIC user, "And all of this you have done with charm and with human concern, always leaving with us the growing realization that protection from harmful radiation was more than a national effort - a common bridge to betterment among the peoples of this earth."

We would like to think so.

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