Technical Reports Retrieval by Computer at the U. S. Naval Postgraduate School Library

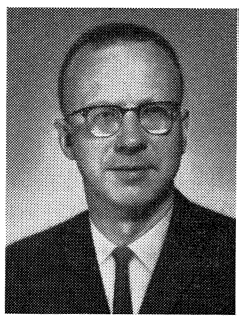
電子計算機による技術報告の検索

——米国海軍大学院における——

Edgar R. Larson

エドガー・アール・ラーソン

要　　旨



筆者の意図は，図書館員および利用者の立場から米国海軍大学院における，技術報告の検索に応用された電子計算機利用の発端と展開を紹介することにある。

ここで用いられている方式は SABIRS (Semi-Automatic Bibliographic Information Retrieval System) と呼ばれているが，この方式が採用されるに至った動機は，整理に非常な困難を感じさせる技術報告の数が急速に増加したことにある。最初は，これらの技術報告は未整理のまま放置されていたが，Prof. Luckett が館長に就任するに及んで，通常の件名標目による主題検索の方法が考えられた(1958)。しかしながら，この方法は時間と費用（1点当り約4ドル）の点で，3ヶ月試用の後廃止されるに至った。その代り，当時機械化に最も適合すると思われていた，ユニタームによる検索方式が考慮の対象として考えられた。

しかしながら，Kruse 女史の言うように，Coordinate-indexing は，われわれのコレクションのように多様性を持ち，また数も多い場合には，電子計算機の助けを借りなければ利用し難いことが明かになった。当時(1960)技術報告取扱い職員の数は5名であり，図書館に配属され，独自の収集・整理および参考業務を遂行していた。コレクションは約16万点に達し，内約6万点は秘扱いで，年間増加点数は5,000点であった。また，利用者は軍人，教授および将校学生に亘っていた。

ユニターム採用試験期においては，約2万点を抽出して実験を行ったに拘わらず，1点当りに与えられるターム数は12から15に達し，時間的に到底実用化の見こみが立たなくなった。その上，ユニターム使用の際の方法そのものにより，多大な努力を費して得られる結果は単なる資料の受入番号のリストに過ぎず，書誌的データを得るためには，現物に当らざるを得ないという状態であった。

オートメーションによる合理化は，既に1959年に考慮されていたが，この状態を体験して，館長は大学院附属の計算機センター長である Prof. Stewart と急拠策を練り，学生の1人である Wildberger 大尉に依頼し，論文に代えて，報告書管理の機械化の実現方を計るに至った。

大尉は，計算機に関する知識と共に問題点に対する深い理解も持ち，満足と思われる機械化方策の条件を考え，その第1に正確さと迅速さを置いたが，同時に研究資料としての技術報告の利用も考え，フ

Edgar R. Larson, Chief, Readers Service Department, U. S. Naval Postgraduate School Library. 1951-52 Visiting Professor, Japan Library School. エドガー・アール・ラーソン：米国海軍大学院附属図書館奉仕部長；1951-52 年度図書館学科訪問教授.

ァイルを各人の立場で点検する自由も保留するように計画した。利用者の要求事項を主題件名に変換し，その主題に合致する報告書を抽出する方式を考え，その為に先ず数字的モデルの設計が試みられた。この間において，図書館員と具体的な打合わせが数次に亘って行われ，望ましい基準が設けられた。

その中の若干を列記すれば，1) 処理さるべき点数，2) ファイルの増大率，3) 質問の種類，4) 主題領域，5) 取扱われる概念の種類と数，6) 分析精度，7) 人事，8) 予算，8) 結果の評価などに関する事項である。さらに，検索関連事項としては，1) 団体著者，2) 主題内容に対応するディスクリプター（ユニターム），3) 報告書作成年月，などに考慮が払われることになった。

かくして，使用さるべきユニタームが改訂増補され，8 チャンネル・コードに変換された。その際タームの年間増加率は約15%と見込まれた。

1961年5月には，SABIRS は試験期に入り，報告書の処理が始まった。各報告書に関しては，1) 受入番号，2) 団体著者名，3) 報告書番号，4) 標題および著者名，5) 年月日，6) ディスクリプターが付与され，ペーパー・テープから磁気テープに変換されて保存される方式を採った。

実用化の段階に入ったのは同年7月であり，1960年11月以降の報告書がすべて機械検索の対象となることが決定された。アウトプットとして得られるものは，やはり受入番号だけであったので，1963年4月に至り，図書館からの要求により，簡略な書誌的事項（上記6項目）を打ち出すプログラムの作成を依頼し，それが1964年早々 Mrs. Haworth により完成され，SABIR 2 と称せられることになった。

第1段階のプログラムに於ては，最初の6ケ月に150の検索が行われたが，翌年には2,000に増加し，第2段階が実現するに至ってさらに3,500に達し，翌年度は5,000に及ぶものと予期されている。SABIR 2によれば，50件の検索が同時に可能であるが，機械の有効利用のため，質問に対する答は通常 24 時間後に与えられることになっている。

現在まで，この方式は満足感を以て受け取られており，さらに将来の発展が期待されている。(M. F.)

Much has been written in the past decade about the use of computers for information storage and retrieval in libraries—too much if we are to judge by the current confused thinking in this area of library endeavor or by the fear and trembling with which many librarians of the traditional school contemplate this area of information control. It is with some reluctance, then, that the writer, a mere librarian of the traditional school, has agreed to add yet another paper on this fearsome subject, and then only upon the urging of Dr. Takahisa Sawamoto and in order that he may in his small way contribute to the honor being accorded Professor Takashi Hashimoto, Director of the Japan Library School, Keio University, on the occasion of his "Koki." Indeed, it is with great pleasure and the happiest of memories that the writer, one of the first group of visiting faculty at the Japan Library School during its infancy in 1951 and 1952, accepts this opportunity to pay respect and tribute to the present Director of the School and in a sense to the School itself.

In this paper it is the writer's intention to present a report of the inception and development of the use of a computer for information storage and retrieval in the Technical Reports Section of the U.S. Naval Postgraduate School Library from the point of view of the librarian and user, not the information nor the computer specialist. For those who are more interested in the latter aspect of this situation there are two already published highly-specialized documents that give much more than the writer could possible expect to expound, to which the more sophisticated reader may be referred.[1)2)] The first reference is significant in that it is the document that, in effect, instituted computer retrieval of technical reports in the USNPGS Library and in its second part gives

a full and highly sophisticated explanation of this system of information control which locally has come to be known as SABIRS (Semi-Automatic Bibliographic Information Retrieval System). The second reference, an equally sophisticated report, gives a very comprehensive and technical elucidation of the second stage of the SABIR system, that of full bibliographic citation by computer.

As has so often been the case, this highly refined and exceedingly efficient system has its beginnings in an unwanted and neglected collection of technical reports that "just growed" rather like Topsy soon after the Library of the USNPGS was established in 1947.[3] After several years of rather complete neglect, a serious effort to organize the collection, which now had come to include approximately 8,000 unclassified and a like number of classified technical reports, was made under the direction of the new librarian, Professor George R. Luckett (who has continued as head librarian to the present time).

In 1958 an attempt was made to bring the growing and unwieldy collection under more rigid subject control by the use of conventional subject headings,[4] which over the years has worked well for books but has proved somewhat less than satisfactory for technical reports. This proved to be the case at the USNPGS, too, where, partly because of the time element and partly because of the expense involved (the cost of processing each item averaging approximately $4.00), this form of subject control was abandoned after a trial period of three months. In its place the Uniterm System of Coordinate Indexing was adopted, partly because of the prevailing belief that this system was ideally suited to possible future mechanization.

This system of indexing has been otherwise variously characterized by various people. A full discussion of its many advantages and disadvantages is neither feasible nor proper in this paper. However, one such comment pertinent to the purposes of this paper may be in order. In her paper on the use of electronic computers for information retrieval at the Naval Ordnance Test Station, China Lake, California, Carolyn J. Kruse says, "Coordinate indexing does not appear to be applicable to a collection as heterogeneous and as large as ours without resorting to the use of computers to perform the manual operations."[5]

The experience at USNPGS was not much different *in this respect* from that at NOTS, China Lake, and it became apparent before too long that some alternative to the manual coordination of uniterm cards was required.

At this point it may be well to describe the situation as it prevailed in the Technical Reports Section of USNPGS at this time (1960). Personnel-wise the Section was made up of five staff members (two professional and three clerical workers). It was (and is) a self-contained unit within the structure of the Library, maintaining its own aquisitions, cataloging and reference services. It maintained a collection at that time of approximately 150,000 technical reports, 60,000 of which were classified Confidential or Secret, and the average yearly accession rate was about 5,000 reports. The principal patrons of the Section included the military staff, civilian faculty, and officer students of the USNPGS.

With respect to the situation at that time so far as coordinate indexing was concerned, despite the fact that only 20,000 documents were controlled by the Uniterm System, many of the more common terms embraced from 12 to 15 cards. In many instances the time consumed in coordinating (that is, comparing) such cards manually in order to arrive at the accession numbers of the technical reports in this collection on a reasonably well-defined subject often became prohibitive. This time-consuming factor discouraged the use of the Coordinate Index by many Library patrons who were thus confronted with a deluge of uniterm cards with literally thousands of accession numbers to coordinate. Under the manual system then in use, the *future* looked even gloomier, for the greater the number of reports controlled by the Coordinate Index, the more Herculean would be the task of retrieval by manual coordination.

To compound the difficulty, another disadvantage was that the final product of every coordination was simply a list of accession numbers

which then had to be found in the shelflist in order to obtain full bibliographic information about the reports (that is, source of report, report number, title, personal authors, and date) from which a determination could be made as to the value of the report to the patron.

In the face of this dilemma it was fortuitous that a student should appear on the scene who, in the course of his career at the USNPGS, would help to bring some order out of this chaos.

But to set the scene for his appearance it is necessary to go back in time to late 1959. At that time it was already realized that automation alone could provide the only feasible answer to problems that were bound to become increasingly acute with the passing of every month. And so Professor Luckett discussed with Professor Elmo J. Stewart, Directior of the School's Computer Center, the possibilities of converting to machine information storage and retrieval.

As a result of this study Professor Stewart assigned the previously-mentioned student, Lt. August Wildberger of the Department of Mathematics and Mechanics, the problem of eliminating the manual process of coordination as a project for his master of science thesis.

The Library was fortunate indeed to obtain the services of Lt. Wildberger for he began this project with a sympathetic understanding of the problems involved as well as an extensive knowledge of the Control Data Corporation 1604 high speed digital computer, its potentialities and limitations.

Lt. Wildberger has delineated his approach to the problem as follows: "Before proceeding to discuss possible approaches to such a theory [of information retrieval], we would first like to consider what one should expect from a satisfactory information retrieval system. The [person] who will use an automated information retrieval system by asking questions and receiving reports will be primarily interested in accuracy and speed. But he would also prefer a system which will make few demands on him as far as learning new techniques is concerned, and he would somehow like to reserve the privilege of browsing through the file if it were possible, since one function of a collection of documents is to stimulate new and unexpected approaches to his problem.

"From the librarian's or documentalist's viewpoint the daily routine activities necessary to operate the system must be performed with the utmost of convenience. Therefore, the manner in which the searching and file maintenance entries are prepared must be as simple and direct as possible.

"A customer desiring to use an information retrieval system activates it by presenting a 'prescription' for the information that he wants. The retrieval system responds to this prescription by indicating to the customer a set of documents from the collection which presumably will furnish the information he desires. In other words, an information retrieval system translates or transforms the customer's prescription into a set of documents.

"From the operational point of view we shall begin the construction of a mathematical model for the information retrieval problem." [1)]

As Wildberger proceeded he held frequent conferences with the librarians in the Technical Reports Section. As Professor Luckett has pointed out, the following criteria were set forth by the librarians concerned:

1. Size of file to be covered
2. Rate of growth of file and system
3. Range of inquiries to be serviced, or the purposes to be served
4. Range of subject matter to be covered
5. Kinds of concepts to be represented
6. Specificity and type of analysis
7. A specified limit on personnel required to the analysis
8. The availability of funds that could be allocated to processing information and conducting searches
9. A statement of desired reliability of results, or probability of retrieval
10. A general idea of what we hoped to accomplish

Likewise the following three retrieval approaches were desired:

1. The corporate author
2. The various descriptors (uniterms) that

defined the subject content

3. Control by date of report[3]

A concomitant project completed by the technical report librarians was a revision of the "Glossary of Uniterms and Descriptors" for the Coordinate Index. The glossary was converted from a typewritten list to a set of IBM punched cards for all uniterms and descriptors. Also all uniterms and descriptors were assigned octal codes for computer purposes. Supplements of the glossary could now be printed on the IBM 402 (later replaced by the IBM 1401) Accounting Machine, and an annual revision of the glossary could be produced in 15% of the time formerly required for typing.[4]

By May 1961 the SABIRS program was in an experimental stage. Documents were assigned descriptors and coded. The coded data were recorded on papar tape using the Remington Rand Synchrotape Machine. The synchrotapes thus produced were taken to the Computer Center where the contents were read into the CDC 1604 core memory using the Ferranti Photoelectric Reader and subsequently written onto the magnetic tape current file of records.

As a part of the program for SABIRS, an updating program was developed which deletes documents from the appropriate tape files when documents are discarded from the collection and adds documents to the files when items are added to the Library's collection.

An example of catalog information transcribed to coded format may be helpful in understanding what is involved:

	Item	Catalog Card Data & Assigned Descriptors	Coded Data
1.	Accession number	U-57 896	U0057896
2.	Corporate author	National Aeronautics and Space Administration	00100012
3.	Report number	TN-R-107	
4.	Title and author	Burnout during rocket reentry, by H.L. Sears	
5.	Date	August 1960	00006008
6.	Descriptors (uniterms)	Rocket (missile)	00001630
		Atmosphere	00000336
		Reentry	00002206
		Burnout	00000650

The SABIRS program became operational in July 1961 and all technical reports added to the collection since November 1960 have been entered into the system. No material has as yet been added retroactively.

The primary achievement of SABIRS was the elimination of manual coordination of uniterms. It also provided for a selection of documents on the basis of issuing agency (or agencies) and on a limitation by date if so desired by the requestor.

The most serious disadvantage of the system was that the computer output (printout) consisted solely of a listing of accession numbers for the reports that complied with the requestor's "prescription" (that is, his selection of "descriptors" plus issuing agencies and limiting dates if any). Thus, it was still necessary for him to go to the shelflist to determine the exact bibliographic designation of the selected documents, or in the case of unclassified documents, the even more tedious task of finding all the documents themselves on the shelves by accession number if this method were preferred.

For this reason in April 1963 the Library requested the Computer Center to provide a new programming that would add abstracts or bibliographic information (that is, corporate authors, titles, personal authors, dates, and in some instances, abstracts).

This program, known as SABIR 2, was completed by Mrs. Haworth early in 1964 and has been in operation since. For those interested a flow chart for the SABIR 2 system is included as Appendix I.

During the first six months of operation of original SABIRS program a total of 150 searches were made. This increased during the following year to 2,000. With the introduction of SABIR 2 the total yearly searches increased to 3,500, and it is anticipated that within the next year this total will grow to 5,000 annually.

Using the SABIR 2 program, fifty searches may be run simultaneously in a matter of minutes. However, because of the demand for time on the computer, which is used for many other USNPGS programs, there is at present an average delay of 24 hours from the time

a request is submitted to the Technical Reports Section until the answer is received by the requestor.

A typical example of a search request may serve to illustrate more clearly how the system works from the point of view of the user. A user may approach the Technical Reports Section looking for all available technical reports dealing with "boundary-layer and sound." If his request is presented in vaguer terms, the glossary is used to define his requirement in terms that the computer will understand. He then fills out a request form (see Appendix II).

The Library staff then translates his request (this actually may be several requests as shown in Appendix II) into computer-readable code at the bottom of the request form. The form is then sent to the Library's Processing Department, where the requests are converted to synchrotape. These tapes are transmitted to the Computer Center where they are read into the computer. As has already been mentioned, the computer will take as many as 50 searches at one time. The computer search results in printed output as shown in Appendix III and Appendix IV. The former is simply a reiteration of all the searches by name and number of request that have on this run been read into the computer. Appendix IV on the other hand is the complete bibliographic printout of the answer to one of the requests, namely Pitter 1 (boundary-layer sound).

It will be seen that nine documents were found, all unclassified, three of which do not have full bibliographic information because they were entered into the collection before the implementation of SABIR 2. For these items recourse would have to be made to the technical reports shelflist to determine the exact nature of the report. The reports, of course, can be obtained directly from the shelf by using the accession number.

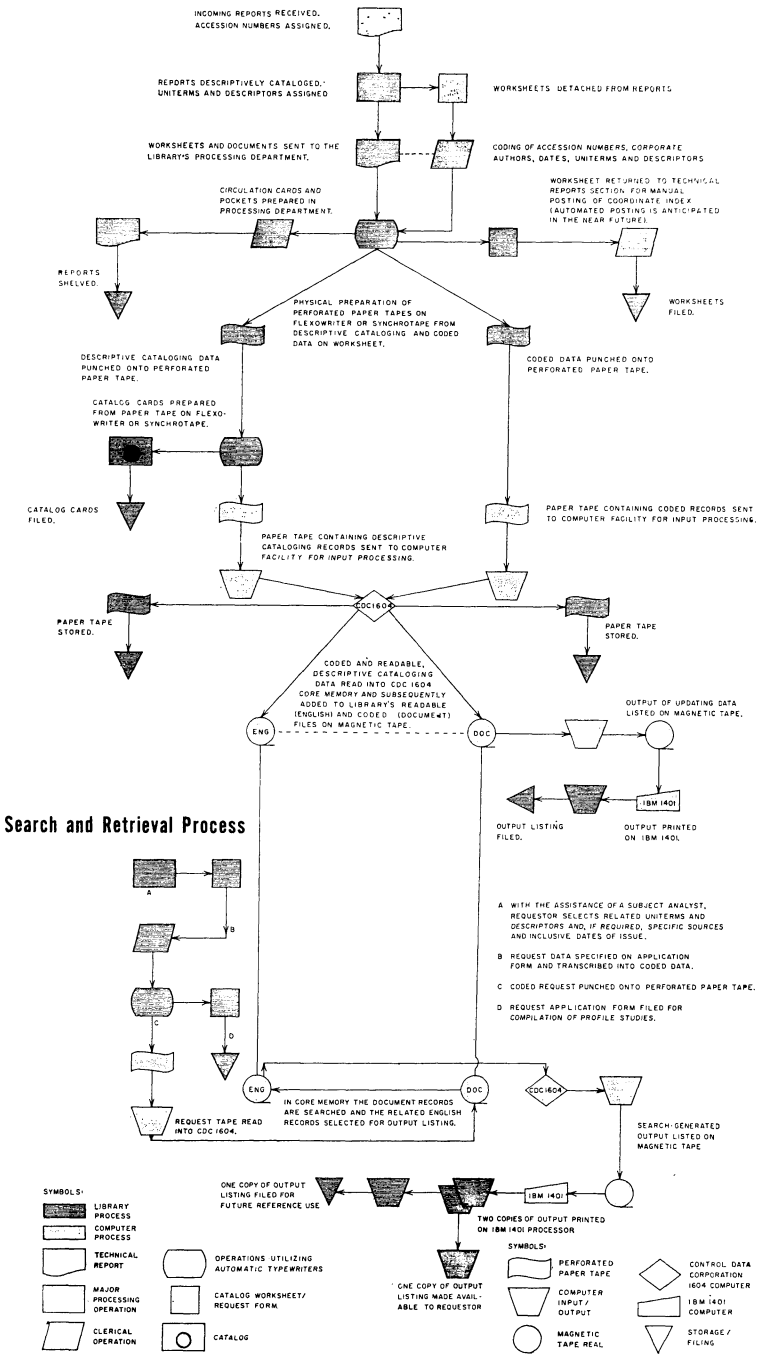
So far the computer system of information retrieval at USNPGS has resulted in a great deal of satisfaction not only to the users of the Library but also to the librarians who service the technical reports collection. For the most part the Library is pleased with past developments and is looking forward to even greater refinements in this area of service to its users.

For purposes of comparison, interested readers may be referred to three other computerized systems of information storage and retrieval in Navy libraries, namely those of Naval Ordnance Test Station, China Lake, California,[5] Naval Ordnance Laboratory, White Oak, Maryland,[6] and Bureau of Ships, Department of the Navy, Washington, D.C.[7][8]

1) Wildberger, August Martin. Information retrieval. Thesis. U.S. Naval Postgraduate School, 1961.
2) Haworth, Carol S. Documentation of SABIR 2 (Semi-Automatic Bibliographic Information Retrieval, 2d version). Parts 1 and 2. U.S. Naval Postgraduate School, 1964. (Research Paper no. 44)
3) Luckett, George R. "The U.S. Naval Postgraduate School SABIRS program utilizing the CDC 1604 and the IBM 1401," *in* Proceedings of the 7th Military Librarians' Workshop. U.S. Naval Ordnance Laboratory, 1964. (NOLTR 64-98) p. 74-82.
4) Spinks, Paul. Machine information storage and retrieval: Its potential role in the U.S. Naval Postgraduate School. U.S. Naval Postgraduate School, 1961.
5) Kruse, Carolyn J. "The use of electronic computers for information retrieval at the Naval Ordnance Test Station," *in* Special Libraries, 54(2): 90-93, February 1963.
6) Liberman, Eva. "Information retrieval—library code for IBM 704," *in* [Proceedings of the] Third Military Librarians' Workshop. U.S. Naval Postgraduate School [1959] 7 p. (unnumbered)
7) Nicolaus, John J. The automated approach to technical information retrieval library applications. U.S. Bureau of Ships, Department of the Navy, 1964. (NAVSHIPS 250-210-2)
8) Johanningsmeier, Walter F. and F. Wilfrid Lancaster. Project SHARP (SHips Analysis and Retrieval Project). Information storage and retrieval system: Evaluation of indexing procedures and retrieval effectiveness. U.S. Bureau of Ships, Department of the Navy, 1964. (NAVSHIPS 250-210-3)

APPENDIX I

U.S. Naval Postgraduate School Library, Monterey, California
SABIR 2 - Machine Information Storage And Retrieval System
Utilized By The Technical Reports Section



APPENDIX II

MACHINE INFORMATION RETRIEVAL APPLICATION
TECHNICAL REPORTS and CLASSIFIED MATERIALS SECTION
I2ND PGS 73 (I-65)

United States Naval Postgraduate School
MONTEREY, CALIFORNIA

The Library's Retrieval System is available for literature search of documents received by this department since NOVEMBER 1960.

NAME	SCHOOL OR DEPT.	DATE
PITTER, E G	ORD. ENG	2/16/65
☐ FACULTY ☐ STAFF	☑ STUDENT ☐ OTHER	ROUTING OR BOX NO. 1492

☐ I wish to have the printed output sent to me. ☑ Retain output pending my collection.

AREA of SEARCHES REQUIRED. Please specify the subject field(s) in which you are interested by using the terms established in the Glossary of Descriptors and Uniterms. For more detailed instructions in the completion of this section, please request the assistance of the staff. Up to six searches may be requested on this form.

1. BOUNDARY-LAYER and SOUND
2. SUBSONIC FLOW and SOUND
3. SUBSONIC PIPE FLOW
4. SOUND FLOW INTERACTION
5. STABILITY PIPE FLOW
6.

SOURCE or SOURCES (If you wish to have these searches restricted to a particular source or sources (Example: NOTS, China Lake, General Electric, etc.) please specify below).

a.	c.
b.	d.

DATE or INCLUSIVE DATES of ISSUE (If you wish to have these searches restricted to documents issued on a particular date (month and year), prior to a particular date, after a particular date, or between two inclusive dates, please specify.)

a.	c.
b.	d

To be completed by Library Staff

TO Processing Department

NAME OF REQUESTER

```
PITTE/1/00000603/00000031/BOUNDARY/LAYER/SOUND///..
PITTE/2/00003474/00001615/00000031/SUBSONI/C/FLOW/SOUND///..
PITTE/3/00003474/00004370/00001615/SUBSONI/C/PIPE/FLOW////..
PITTE/4/00000031/00001615/00002157/SOUND/FLOW/INTERACTION/..
PITTE/5/00001706/00004370/00001615/STABILI/TY/PIPE/FLOW////..
```

1. Please prepare synchrotape exactly as prescribed above.
2. Allow a minimum of 10 to 12 inches of tape feed prior to punching.
3. After all data have been punched on a tape, punch at least three seventh level holes (non-print keys on the Synchrotape or stop-code on the Flexowriter).

APPENDIX III

REQUESTS FOR 02/17/65

OCONN/1/00001122000002166/WAR/GAME//////

OCONN/2/00002003000002166/INDUSTRIAL/GAME NEGATIVE

OCONN/3/00001672/SIMULATION/////

OCONN/4/00002166/GAME///

→ PITTE/1/0000060300000031/BOUNDARY/LAYER/SOUND///

PITTE/2/0000547400001615000000031/SUBSONIC/FLOW/SOUND////

PITTE/3/0000547400004370000001615/SUBSONIC/PIPE/FLOW///// NEGATIVE

PITTE/4/0000003100001615000021 57/SOUND/FLOW/INTERACTION/ NEGATIVE

PITTE/5/0000170600004370000001615/STABILITY/PIPE/FLOW////

CUNNI/1/00001700000005164/SONAR/SEARCH///

CUNNI/2/00001700000001425/SONAR/DETECTION

CUNNI/3/00001652000005164/RADAR/SEARCH///

CUNNI/4/00001652000001425/RADAR/DETECTION

KINN//1/00001700000017 17/SONAR/WAVE/////

KEIL//1/00003615/MARTENSITE/////

KEIL//2/00001262/CRYSTAL

SHUTE/1/0000161500004122/FLOW/NONUNIFORM

SHUTE/2/0000161500005220/FLOW/SHEAR/////

SHUTE/3/0000161500006137/FLOW/VISCOUS///

SHUTE/4/0000161500001631/FLOW/FORCE/////

SHUTE/5/0000060300001631/BOUNDARY/LAYER/FORCE///

SHUTE/6/0000060300005220/BOUNDARY/LAYER/SHEAR///

HOWE//1/00012312/WEIBULL

CARRE/1/00003571/MARK/46/TORPEDO

ROBER/1/0000472300002064/RELIABILITY/SHIP///////

ROBER/2/0000472300002104/RELIABILITY/SUBMARINE//

ROBER/3/0000472300005103/RELIABILITY/NUCLEAR/SUBMARINE// NEGATIVE

APPENDIX IV

PITTE/1/

U0062640

U0064741

U0066067
AERONAUTICAL RESEARCH LABORATORY ARL 148, PART III A COMPARISON OF THE INFLUENCE OF MECHANICAL AND ACOUSTICAL VIBRATIONS ON FREE CONVECTION FROM A HORI- ZONTAL CYLINDER, BY R. M. FAND AND E. M. PEEBLES. DECEMBER 1961. 25 P. MASSACHUSETTS INSTITUTE OF TECHNOLOGY ARL 148, PART II

U0066440
INSTITUTE OF AEROPHYSICS, UNIVERSITY OF TORONTO, CANADA UTIA REPORT 81 INVESTIGATIONS OF AERODYNAMICALLY GENERATED SOUND, BY H. S. RIBNER. JANUARY 1962. 5 p.

U0067198
AERONAUTICAL RESEARCH LABORATORIES ARL 62-362 EFFECT OF LOCALIZED ACCOUSTIC EXCITATION ON THE STABILITY OF A LAMINAR BOUNDARY LAYER, BY FRANCIS J. JACKSON AND MANFRED A. HECKL. JUNE 1962. 56 P. BOLT BERANEK AND NEWMAN ARL 62-362

U0072050
INSTITUTE OF AEROPHYSICS, UNIVERSITY OF TORONTO CANADA. UTIA REPORT 87. AN EXPERIMENTAL INVESTIGATION OF THE SOUND GENERATED BY THIN STEEL PANELS EXCITED BY TURBULENT FLOW (BOUNDARY LAYER NOISE), BY G. R. LUDWIG. NOVEMBER 1962. 42 p.

U0075259
BOLT, BERANEK AND NEWMAN, INC. REPORT 1054. THE SOUND RADIATED FROM TURBULENT FLOWS NEAR FLEXIBLE BOUNDARIES, BY J. E. FFOWCS WILLIAMS AND R. H. LYON. 15 AUGUST 1963. 52 p.

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