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TRACOR INC AUSTIN TEX  
MOBILE SONAR TECHNOLOGY INFORMATION BANK.(U)  
APR 72 J L BARDIN  
T72-AU-9579-U

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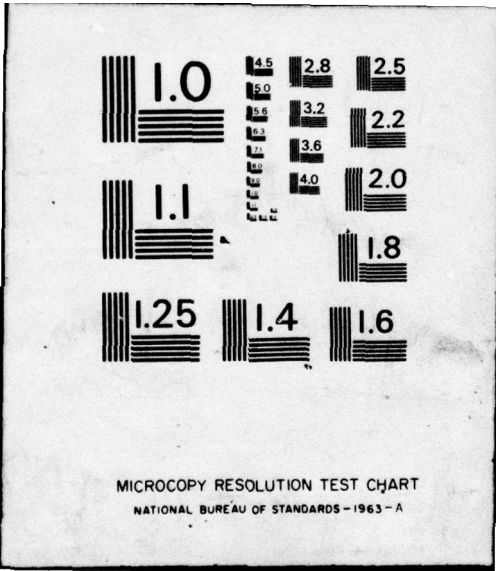


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**TRACOR**

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MOST Project *1*

FG

Contract No. *15* N00024-71-C-1132  
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Task 12851  
TRACOR Project 037 001 01  
Document No. *14* T72-AU-9579-U

*9*  
FOURTH QUARTERLY PROGRESS REPORT. no. *4*

*6*  
MOBILE SONAR TECHNOLOGY INFORMATION BANK.

*10*  
by  
J. L. Bardin

Submitted to

Commander  
Naval Ship Systems Command  
Department of the Navy  
Washington, D. C. 20360

Attention: Mr. C. Smith  
Code 901B

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NOV 11 1976  
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*11*  
12 Apr 1972

Approved:

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*12* 27p.

Submitted:

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Distribution Unlimited

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ACCESSION BY

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DDC	Not Section	<input type="checkbox"/>
ORAI		<input type="checkbox"/>
JUST		<input type="checkbox"/>

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1.0

INTRODUCTION

This report describes progress on the subject contract during the fourth quarter of the contract period. The major accomplishment during this period was the construction and implementation of a test to determine the adequacy of the file structure which has been developed under this contract and previously reported. (See Refs. 1, 2, and 3.) The testing of adequacy was with respect to demonstrating the feasibility of the system (structure) developed as the basis for an information bank and retrieval system.

A discussion follows which describes the test construction and implementation *are described.*



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## 2.0 DISCUSSION

As pointed out earlier, the purpose of the work performed during this reporting period was to design and conduct a test to determine the adequacy of the file structure which has been developed. The test was designed by the origination of sixteen questions which reflect the needs of potential users of the storage and retrieval system. The test was conducted by translating the questions into "descriptive words" and "key words," searching the sample file [Ref. 3], and listing the document titles which contain the information appropriate to determining the answers to the test questions.

The testing and the results are discussed below.

### 2.1 Testing

The testing of the file structure was accomplished by taking a four step approach--(1) developing the questions which would be typical of questions appropriate for an information storage and retrieval system, (2) translating the questions into the language of the system (viz, descriptive words and key words), (3) searching the sample file for titles of appropriate documents and (4) selection of the document titles and information extraction sheets for later evaluation of test results.

The view taken in the development of the test questions was that there are two basic groups of potential users of the system--managers (including sponsors of the exploratory development effort) and researchers. Accordingly, two groups of questions were constructed to reflect the interests peculiar to both groups. The questions were designed using some existing needs as bases.



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It should be noted at this point that the questions were constructed by people with several years of experience in industry and government in mobile sonar technology.

The questions based on managers' needs are referred to below as Type I. Those reflecting needs of researchers are denoted Type II. In the discussion which follows, descriptions of the needs are presented with the questions which were formulated based on such needs.

Type I (Limited user; viz, NAVSHIPS 901)

1. Program Construction

Presently, there is no real summary of the state-of-technology in each area of interest to 901 as represented by the technical reports in the library. The primary guidance to 901, then, comes through (1) tradition, (2) strong salesmen, and (3) known deficiencies in systems technology. An additional path for overall program review should be provided by a summary output of the files. This could be useable as summaries for specific fields of interest as well--for example, a review of documentation on "Man-Machine Interaction" would serve as excellent background for making funding decisions in that area (with respect to total budget considerations).

NEED: Program Construction

OUTPUT: Summary listings of specific fields of interest

QUESTION: What reports describe the state-of-technology in sonar displays with respect to the human engineering involved?



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## 2. Background for Presentations and Panel Work

The people in Exploratory Development are asked by the head of the sonar codes (SHIPS 901) to make presentations on states of development technology in all the various subject areas concerning sonar systems. These generally are desired by the Captain before he entertains programs proposed by the systems development codes. Such presentations allow him to more directly address and scrutinize problem areas as well as ensure that the developers are taking advantage of all applicable technological progress.

Besides the presentations, 901 people are consulted by problem solvers inside and outside of the sonar codes to give information on possible solutions (or nonsolutions) to specific developmental problems. For example, the advanced development code might seek information from 901 on data-rate-reduction techniques for use in solving technological problems existing in potential systems.

A well organized and complete set of files would aid the memory of the engineers associated with each subject/ problem area.

NEED: Background Information

OUTPUT: State of technology in narrow areas

QUESTION: What are the limiting information (or data) processing rates for sonar operators; and, what data-rate-reduction techniques exist?



### 3. Duplication/Related Effort Check

Many people approach the Exploratory Development code with proposals and proposal ideas. In some instances, the ideas and concepts proposed are very similar to or are related to effort which has been proposed in the past and rejected or possibly funded. A valuable aid to the engineers in 901 would be a file system which could be used to identify past proposals or work which relates to or duplicates that which is being proposed. This information would contribute to the prevention of undesirable duplication of effort; also, it would provide possible enhancement to new effort that might never have been taken advantage of otherwise.

NEED: Duplication/Related Check

OUTPUT: List of documents relating to specific concepts

QUESTION: Are there reports available on the elimination of sonar self-noise lines which show up on submarine passive sonar Bearing-Time Recorders?

### 4. Project Monitoring Reference

The project engineers in 901 are under a difficult burden in the monitoring of their projects. They are managing (and making important reviews and decisions) work by leading researchers in Navy labs, industry, and university labs in many subjects. It is impractical in the atmosphere in which they work to expect the Navy's project engineers to stay as technically sharp as is required to give sufficient guidance to the researchers which they manage. Therefore, a project engineer has need of reference material as one source of information which will enable him to independently review and evaluate the technical adequacy of the work which he is managing.



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The report files afford the engineer such a source of information. Assuming the files are organized to assist in evaluating and guiding their sponsored research and development.

NEED: Project Monitor Reference

OUTPUT: Lists of reference-type reports

QUESTION: What are the characteristics of ambient noise which influence submarine sonar performance?

#### 5. General Education

The engineers in 901 are extremely busy and consequently do not have time enough to spend some of it casually reading in all the areas of systems development to keep up-to-date. Therefore, the general education which the engineers should be getting because of all the reports coming into their offices is in fact not taking place. If a system were working which could produce summarized information available to the engineers on a routine basis, they could keep up a general education process which could make them aware of a broad view of exploratory development and related activities.

NEED: General Education

OUTPUT: Surveys of areas

QUESTION: Are data available on the spectral characteristics of submarine radiated noise signatures?



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### Type II Questions

Though there are many researchers' needs which arise which call for summary data, by far the greatest need is to ascertain which documents contain specific technological area data so that they may be acquired. Therefore, the questions listed below relate to specific information assumed to be in the documents listed in the sample file.

### Questions Relating to Information in Documents

1. What reports are available on the baffling and mounting techniques used on the SQS-26-type bow array?
2. What measurements have been made on the dome-array element interaction (acoustic) on hull mounted sonars for surface ships?
3. What data are available on the reflection of broad band acoustic energy from the ocean bottom?
4. What are the directional characteristics with respect to ocean depth of ambient sea noise?
5. What are the major highlights which can be detected in sonar echoes off U. S. submarines?
6. What are the characteristics of an optimal temporal processor for active sonar detection?
7. What is the difference between performance estimates for a broad band passive sonar when



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using a center-frequency Directivity Index and when using a beamformer model?

8. What is the expected improvement in active sonar performance in using color coded displays?
9. Are data available on the expected patrol degradation of transducer calibration for surface ship sonars?
10. How much validation data exist for Figure of Merit performance prediction models?
11. Are survey type data available on acoustic energy bottom loss values for the North Atlantic?

After the development of the questions, the straightforward task of translating the questions and searching the sample file was accomplished. The following discussion is presented in order to illustrate the translation process. To understand the translation step however, it is necessary that a brief review of the concept of filing and retrieving developed under this contract be presented. It is covered thoroughly in References 1, 2, and 3.

The logic structure for mobile sonar technology developed under this contract calls for the description (and hence the accession) of a document to consist of a "descriptive word" rather than the more common set of key words. On the following page, number 9, is an example of the information extracted from each of 329 file documents contained in NAVSHIPS 901's library. In a storage and retrieval system operation, this would be a worksheet for indexing the documents. In our case, we used the



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302.4 File No. 000 015  
 Originating Orgzn. General Electric Co., Heavy Military  
Elec. Sys.  
 Originating Orgzn. Location Syracuse, New York  
 Title A Design for a Digital Phase and  
Delay Beamformer for Planar Array  
Sonar  
 Personal Author Dickey, Jr., F. R.  
 Publication Date Sept. 67 No. of Pages 108  
 Doc. No. Origin. Orgzn. R67EMH31  
 U.S. Rpt. Series No. \_\_\_\_\_  
 Contract No. \_\_\_\_\_  
     Project Serial No. \_\_\_\_\_  
     Task \_\_\_\_\_  
 Document Type Proposal  
 Security Class. Confidential Group 4  
 Distribution Limitations \_\_\_\_\_  
 Note \_\_\_\_\_

DESCRIPTIVE WORD ELEMENTS:

Sonar Function 09  
 General Theory Prin. 05  
 Orientation 01  
 Sonar System X  
 Subject Category 0101 0102

Key words Beam formers Conformal Arrays  
Phase shifting, Planar Arrays  
filtering, analog to digital conversion

Prepared by: FS      Date: 8/3/71      Reviewed by:      Date:



sheets for document identification and for generating the descriptive words. The sheets themselves constituted the sample file.

Emphasis was placed on the descriptive word elements in the information extraction, since this is the key to the adequacy of the system proposed. The sheet on page 9 shows the descriptive word for the particular document described to be the following:

01	0102	(...)	09	01	X
Subject Category	Sub-Cat.	Key Words	Sonar Function	Orienta- tion	Sonar System

Note: See Appendix for code to descriptive word elements entries.

Now it becomes obvious that the translation of the test questions amounted to the generation of descriptive words by looking at the questions. An example of such a translation appears below.

Question: What reports are available on the baffling and mounting techniques used on the SQS-26 type bow array?

Descriptive Word: [04, 0402, (...), X, 10-12, 61-62-63-64]

In order to provide a way to measure the adequacy of the descriptive word system beyond that of evaluation of the retrieval list, the test included translating the questions also into key words and searching the sample file on a key word basis; thus, making a comparison possible.



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It should be noted here that the actual tester had virtually no experience in the area of sonar. He would qualify as a reasonably able indexer. The tester took the list of questions, translated them, searched the sample file for matches, and tabulated the matches by question.

The search of the sample file using the questions translated into descriptive words and key words was conducted manually. As noted earlier, the sample file consisted of the kind of sheet shown on page 9 of this report. Therefore, the "search" amounted to taking the descriptive words and key words and comparing them with each information sheet and recording the matches. The results of the searches were indicated by lists of identifying document file numbers according to question. These results are presented and discussed below.

## 2.2

### Results

The results of the system feasibility test described in this report are shown in terms of retrieval performance in the table on page 12. As indicated by the table, the following ratios were tabulated:

1. Relevant/Total--where

Relevant  $\equiv$  the number of documents  
relevant to the question and retrieved;

Total  $\equiv$  the number of documents retrieved.

2. Recall Ratio  $\equiv$  the number of documents relevant  
and retrieved divided by the number  
of documents in the sample file  
relevant to the question.



## RESULTS

Questions	Retrieval Performance		
	Descriptive Words		Key Words
	Relevant/Total	Recall Ratio	Relevant/Total
Type I			
1	12/15	12/12	1/15
2	4/13	4/4	0/13
3	0/3	0/0	0/3
4	14/19	14/16	0/19
5	0/1	0/1	0/1
Type II			
1	0/0	0/0	0/0
2	3/3	3/4	0/3
3	22/37	22/23	1/37
4	6/7	6/6	0/7
5	0/2	0/1	1/2
6	29/37	29/30	0/37
7	4/8	4/4	0/8
8	0/20	0/0	0/20
9	2/3	2/2	0/3
10	18/29	18/18	0/29
11	10/11	10/10	0/11
	Ave. = 5/9 = 55%	Ave. = 6/7 = 85%	Ave. = 1/93 = 1%



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Judgments of relevancy were made by the author. The translation of the questions were checked and corrected before searches were made; and, each of the retrievals was checked for relevancy. Determination of sample file content relevant to each question was made by the author.

It can be seen from the results of the test that, clearly, the descriptive word approach to information storage and retrieval offers much improvement over the key word approach.

It is concluded that, based on these results, the implementation of a descriptive word system be pursued by NAVSHIPS and TRACOR.



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3.0

REFERENCES

1. J. L. Bardin, "First Quarterly Progress Report, Mobile Sonar Technology Information Bank," TRACOR Document No. T71-AU-9557-U, 24 May 1971.
2. J. L. Bardin, "Second Quarterly Progress Report, Mobile Sonar Technology Information Bank," TRACOR Document No. T71-RV-5517-U, 7 July 1971.
3. J. L. Bardin, "Third Quarterly Progress Report, Mobile Sonar Technology Information Bank," TRACOR Document No. T71-RV-5519-U, 7 October 1971.



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APPENDIX

DESCRIPTIVE WORD ELEMENTS



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This appendix contains listings which identify the possible entries in the descriptive words referred to in the main body of this report. The elements of the descriptive word are covered here in the same order as they appear in a word; namely, Subject Category, Sub-Category, Key Words, Sonar Function, Orientation, and Sonar System Nomenclature.



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SUBJECT CATEGORY INDEX  
(Including Sub-Categories)

- 01 Acoustic Signal Transformation
  - 0101 Signal generation and control
  - 0102 Array configurations
  - 0103 High power transducers
  - 0104 Hydrophones
  - 0105 Measurements
  - 0106 Materials
  - 0107 Design constraints
  - 0108 Design aids
  - 0109 Reliability
- 02 Domes
  - 0201 Physical properties
  - 0202 Acoustical properties
- 03 Acoustics and Oceanography
  - 0301 Oceanographic factors
  - 0302 Scattered field
  - 0303 Noise field
  - 0304 Target characteristics
  - 0305 Acoustic propagation theory
  - 0306 Signal field
- 04 Noise
  - 0401 Ambient noise
  - 0402 Self-noise
- 05 Target Characteristics
  - 0501 Radiated noise
  - 0502 Reflection properties
- 06 Signal Processing
  - 0601 Spatial processing
  - 0602 Temporal processing



SUBJECT CATEGORY INDEX--Continued

- 07 Man-Machine Interface
  - 0701 Displays
  - 0702 Human factors engineering
  - 0703 Phychoacoustics
  - 0704 Measurements
  - 0705 Training
  - 0706 Design characteristics
  - 0707 Console
  - 0708 Controls
  
- 08 Sonar and Transducer Testing
  - 0801 Transducer calibration
  - 0802 Facilities
  - 0803 Equipment
  - 0804 Techniques
  
- 09 System Operation/Description
  - 0901 Performance prediction
  - 0902 ASW effectiveness
  - 0903 Reliability
  - 0904 Maintainability
  - 0905 Measured performance
  - 0906 Utilization
  
- 10 Comprehensive Texts
  - 1001 Texts
  - 1002 Manuals
  - 1003 Surveys



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#### KEY WORDS

NOTE: Due to the length of the key word list, it is not reproduced here. A partial list may be found in Reference 2 of the main report; the final list will be an appendix to a future report of work performed under this contract.



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## SONAR FUNCTION

- 01 **ACTIVE DETECTION:** The process of determining that a possible target (submarine, mine, torpedo, swimmer) is present in which an active sonar system transmits energy, and it is observed that the received echo contains the effects of having reflected off of a target.
- 02 **PASSIVE DETECTION:** The process of determining that a possible target is present in which acoustic information is received by a passive sonar system; and, it is observed to contain the effects of energy radiated from a target.
- 03 **ACTIVE CLASSIFICATION:** A decision process in which received echoes in an active sonar system are analyzed and sorted into target and non-target categories. In general, the detection process will have been completed before classification is performed.
- 04 **PASSIVE CLASSIFICATION:** A decision process in which the acoustic information received by a passive sonar system is analyzed (usually involving narrowband frequency analysis), and identification is made of target generated noise.
- 05 **LOCALIZATION:** A process in which a determination is made, using a sonar system, of the range to a target under surveillance and the relative azimuthal position of the target with respect to own-ship (viz, bearing). Processing equipment in addition to that used for detection and classification is generally required.



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- 06 TRACKING: A function which is performed by a sonar system in which contact with a target is maintained for an unspecified amount of time. The contact maintenance is accomplished using the detection/classification and localization portions of the system.
- 07 COMMUNICATIONS (ACOUSTIC): A function performed by an underwater acoustic system whereby information is passed from one party to another (e.g., submarine to surface ship).
- 08 NAVIGATION: A process in which geographical location is determined by any of a set of acoustic systems, radar systems, and visual systems.
- 09 GENERAL APPLICABILITY: An indication that the subject document addresses three or more of the above listed functions.



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## ORIENTATION

- 01 LABORATORY MEASUREMENTS: Any measurements at facilities such as contractor plants, Navy labs, etc.
- 02 FIELD-TEST MEASUREMENTS: Those made at sites away from the plant or laboratory--such as, for example, lake stations, or at-sea but without the use of Fleet assistance.
- 03 RANGE MEASUREMENTS: Those made at operational ranges such as TOTO, FORACS, etc.
- 04 OPERATIONAL MEASUREMENTS: Those made at sea using Fleet vessels and carried out under operational conditions.
- 05 GENERAL THEORETICAL PRINCIPLES: Applicable to documents which deal with basic concepts of the field of Sonar Technology--physics, acoustics, oceanography, underwater acoustic propagation theory, mathematics, signal detection theory, decision theory, filter theory, stress-strain relations in transducer material, etc. These documents deal with subjects which are completely general, and the sonar applications are to be deduced.
- 06 IMPLEMENTATION OF THEORY: This phrase is used to identify those documents which describe equipments (not systems) of the breadboard variety which are implementations of theoretical developments.
- 07 MODEL: An analytical (meaning mathematical) or physical image, or copy, of a process, a system which can be used to represent that process or system.



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- 08 SIMULATION: A mathematical or physical process or device which is a counterfeit process or device which is built to yield the same results when operated as some other process or device.
- 09 SURVEY: An attempt to describe a process, a parameter, or a phenomenon in general, so as to yield a reference volume for all specific applications--examples are AMOS, MGS, FASOR.
- 10 COMPARISON (EVALUATION): An activity in which measurements are made to test the sufficiency and proficiency of theoretical concepts.
- 11 STANDARDS: Sets of values for specific parameters which serve as expected values (anticipated and/or required). These could be measurements or theoretically determined characteristics. Examples: FORACS reports, specifications.
- 12 TECHNIQUES: a) Generally accepted or required procedures for testing;  
b) Applications of theoretical developments which do not uniquely imply sonar usage--e.g., signal processing techniques.
- 13 EQUIPMENT DESCRIPTION: Such documents which mainly enumerate and characterize the essential aspects of equipment--e.g., a Technical Operating Manual.



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### SONAR SYSTEM NOMENCLATURE

- |                       |                       |
|-----------------------|-----------------------|
| 1. AN/AQA-5           | 31. AN/BQS-12         |
| 2. AN/AQS-10          | 32. AN/BQS-13         |
| 3. AN/BQA-7B          | 33. AN/BQS-13 DNA     |
| 4. AN/BQG-1           | 34. AN/BQS-15         |
| 5. AN/BQG-2A          | 35. AN/FQQ-1          |
| 6. AN/BQH-1           | 36. AN/FQR-1          |
| 7. AN/BQH-1A          | 37. AN/FQS-4          |
| 8. AN/BQH-2D          | 38. AN/FQS-13         |
| 9. AN/BQQ-1           | 39. AN/PQC-1          |
| 10. AN/BQQ-2          | 40. AN/POS-1          |
| 11. AN/BQQ-3          | 41. AN/SOA-10         |
| 12. AN/BQR-2B         | 42. AN/SOA-10/29      |
| 13. AN/BQR-2C         | 43. AN/SOA-11         |
| 14. AN/BQR-2( ) DIMUS | 44. AN/SOA-13/35      |
| 15. AN/BQR-4          | 45. AN/SOA-17         |
| 16. AN/BQR-4A         | 46. AN/SON-( ) (XN-2) |
| 17. AN/BQR-7          | 47. AN/SOQ-3          |
| 18. AN/BQR-7 DIMUS    | 48. AN/SOQ-5 thru 8   |
| 19. AN/BQR-7B         | 49. AN/SOQ-14         |
| 20. AN/BQR-15         | 50. AN/SOQ-16         |
| 21. AN/BQR-16         | 51. AN/SOQ-18A        |
| 22. AN/BQR-19         | 52. AN/SOQ-23 PAIR    |
| 23. AN/BQS-2          | 53. AN/SOQ-36 (XN-2)  |
| 24. AN/BQS-4          | 54. AN/SQR-13         |
| 25. AN/BQS-5          | 55. AN/SQS-4          |
| 26. AN/BQS-6          | 56. AN/SQS-10         |
| 27. AN/BQS-6A         | 57. AN/SQS-11         |
| 28. AN/BQS-6B         | 58. AN/SQS-13         |
| 29. AN/BQS-8          | 59. AN/SQS-17         |
| 30. AN/BQS-11         | 60. AN/SQS-18         |



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SONAR SYSTEM NOMENCLATURE--Continued

- |                       |                     |
|-----------------------|---------------------|
| 61. AN/SQS-19         | 91. AN/WQC-2        |
| 62. AN/SQS-21         | 92. AN/WOM-2 (XN-1) |
| 63. AN/SOS-21 (XN-1)  | 93. AN/WQR-1        |
| 64. AN/SQS-23         | 94. BRASS           |
| 65. AN/SQS-23A        | 95. BRASS II        |
| 66. AN/SQS-23 TRAM    | 96. BRASS III       |
| 67. AN/SQS-26         | 97. ULMS            |
| 68. AN/SQS-26AX       | 98. MID-70          |
| 69. AN/SQS-26BX       | 99. NGSS            |
| 70. AN/SQS-26CX       | 100. LORAD          |
| 71. AN/SQS-26 (XN-2)  | 101. PADLOC         |
| 72. AN/SQS-29 thru 32 | 102. AN/BQA-8       |
| 73. AN/SQS-35         |                     |
| 74. AN/SQS-38         |                     |
| 75. AN/SQS-503A       |                     |
| 76. AN/SQS-505        |                     |
| 77. AN/SQS-507        |                     |
| 78. AN/SSQ-30         |                     |
| 79. AN/SSQ-41         |                     |
| 80. AN/SSQ-47         |                     |
| 81. AN/SWS-10         |                     |
| 82. AN/SYA-4          |                     |
| 83. AN/UQN-1          |                     |
| 84. AN/UQX-3          |                     |
| 85. AN/USQ-20         |                     |
| 86. AN/UQS-1          |                     |
| 87. AN/UQS-1B         |                     |
| 88. AN/UQS-2          |                     |
| 89. AN/UQS-3          |                     |
| 90. AN/WQC-1          |                     |

