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DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/G 13/10  
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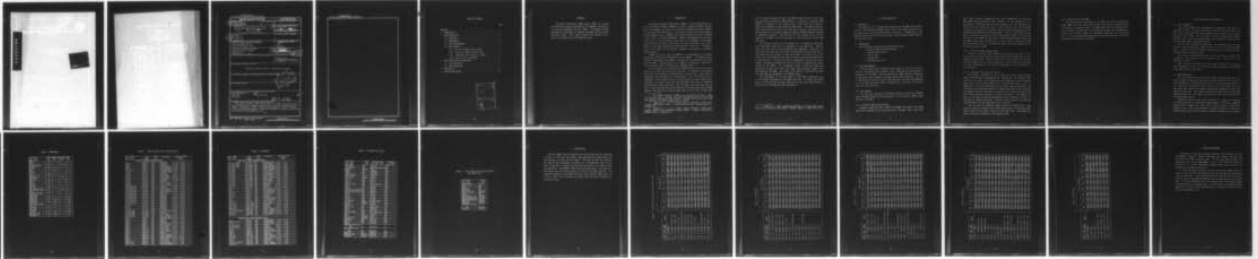
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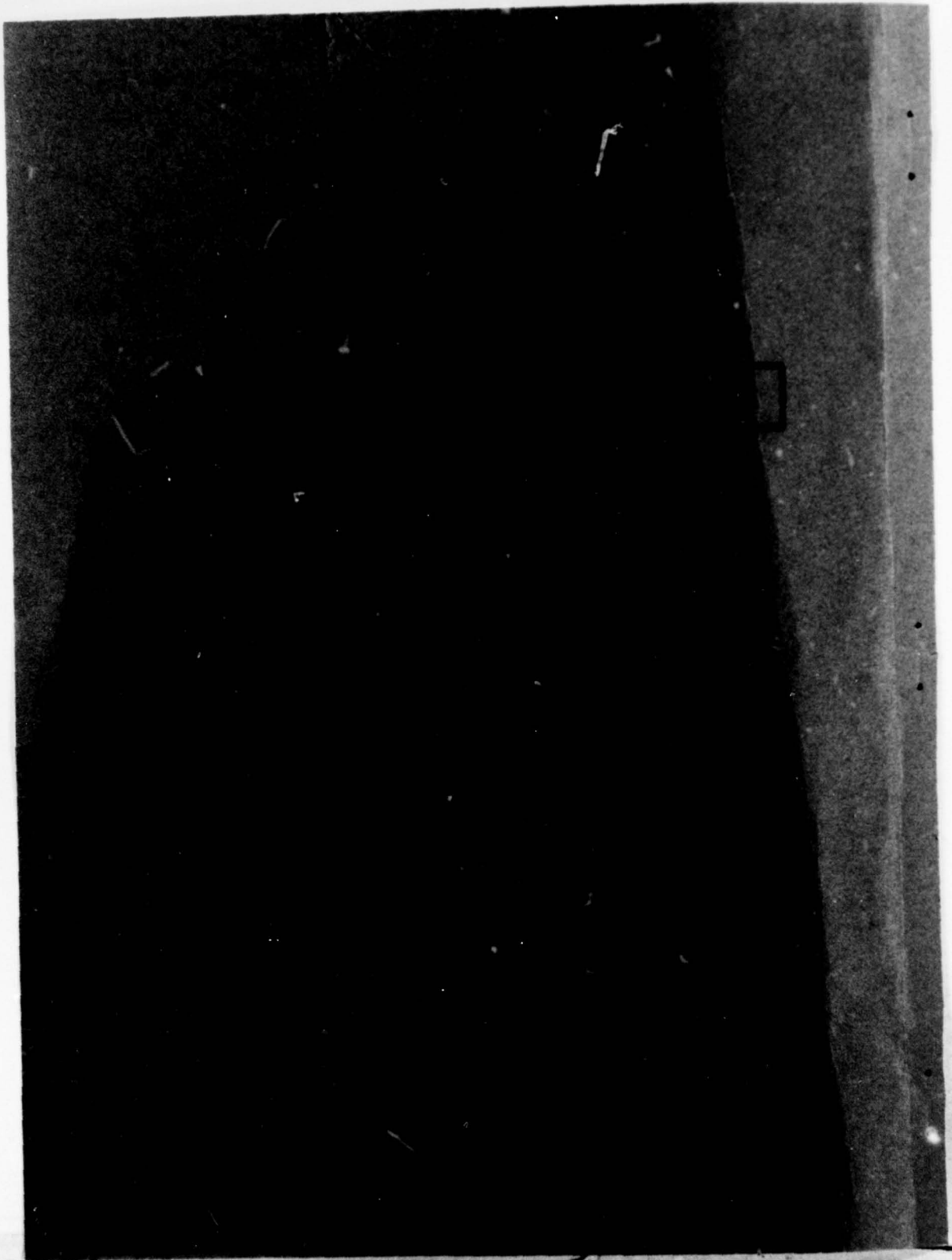
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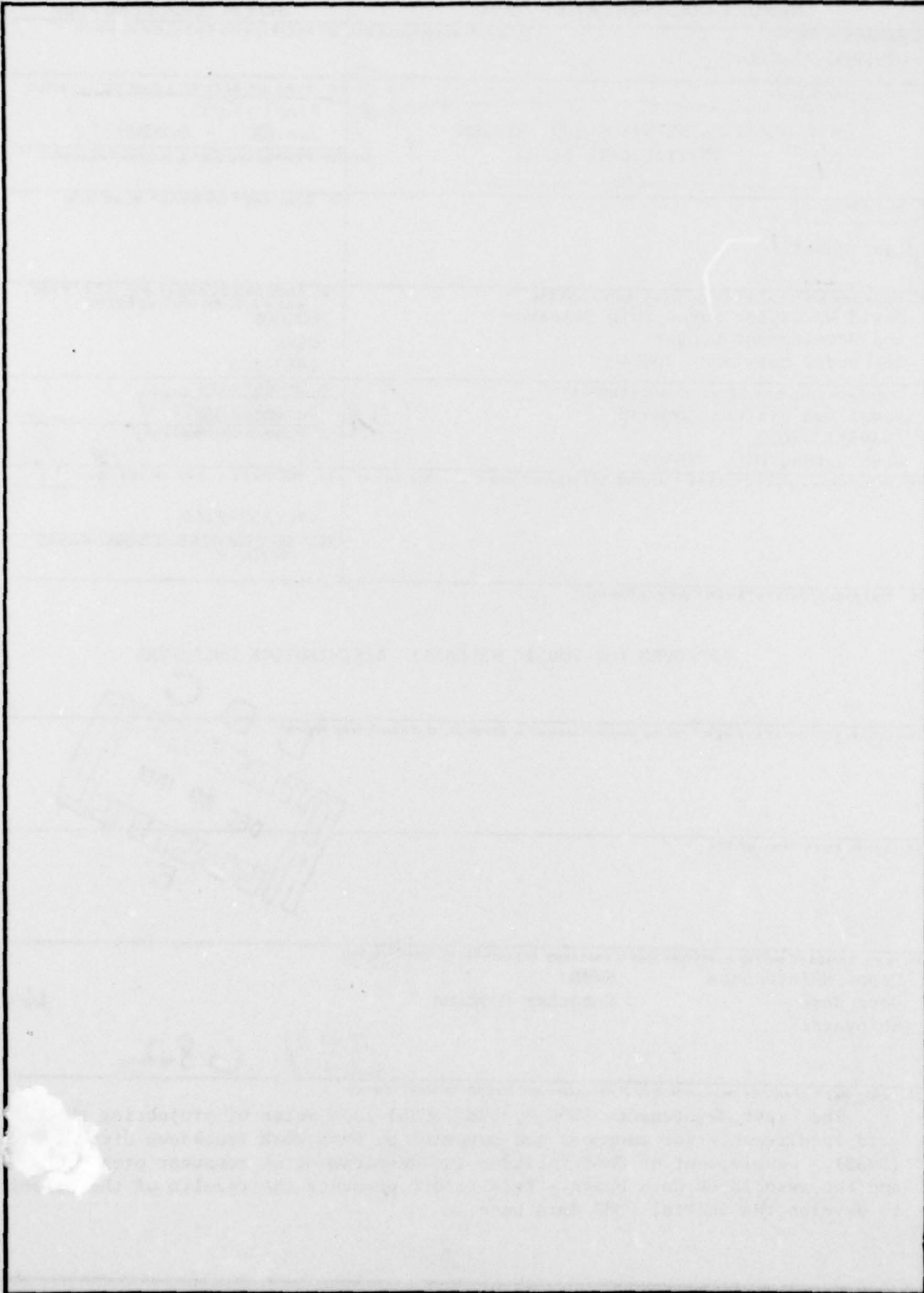
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## ABSTRACT

The Depot Maintenance SWBS System (DMSS) is a means of projecting shipyard requirements for manpower and material by Ship Work Breakdown Structure (SWBS). Development of DMSS included the development of computer programs and the associated data bases. This report presents the results of the effort to develop the initial DMSS data base.

## 1. INTRODUCTION

The Depot Maintenance SWBS System (DMSS) is being developed by the Naval Sea Systems Command (NAVSEA) to report projected shipyard requirements for manpower and material by Ship Work Breakdown Structure (SWBS)\* as required by DOD INST 4151.15. The David W. Taylor Naval Ship Research and Development Center (DTNSRDC) has provided technical support to NAVSEA in the areas of systems development, computer programming, and data base construction. The performing organization within DTNSRDC is the Operations Research Division (Code 186), and the responsible code within NAVSEA is the Depot Maintenance Planning Branch (Code 0713). Documentation of the system and the computer programs is contained in a separate DTNSRDC report.<sup>1</sup>

DTNSRDC previously supported NAVSEA in the development of the Depot Maintenance Planning and Programming System (DMPPS). The DMPPS projects shipyard requirements for manpower and material by production shop category and SWBS. Documentation of the computer programs and a description of the overall system is contained in a DTNSRDC report.<sup>2</sup>

The development of the data bases for DMPPS was divided into separate efforts for repair and alterations type work. A large part of the repair portion of an availability (scheduled ship overhaul) for a given ship is repeatable from availability to availability. Since the repair work is repeatable, future repair work can be projected from past repair work. Therefore, the repair data base was developed from data on completed availabilities (historical data). This data base consists of two types of data - repair profiles which break down the total ship repair work by SWBS category, and shop vectors which break down the work within a SWBS cate-

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\* The primary division of SWBS is at the one-digit level. There are nine such groups. However, each one-digit SWBS is further sub-divided into numerous three-digit SWBS elements. NAVSHIP NOTICE 4790 of 18 July 1973 describes the SWBS categorization in detail.

1. Lamatrice, L., J. St. Laurent and M. Lamatrice, "Depot Maintenance SWBS System (DMSS) - System Description", DTNSRDC report in preparation.

2. Lamatrice, L., J. St. Laurent and M. Lamatrice, "Depot Maintenance Planning and Programming System (DMPPS) - System Description", DTNSRDC report in preparation.

gory by shipyard production shop. The SWBS categories used in both cases are groupings of three-digit SWBS elements. In addition, a one-digit SWBS summary is available for the repair profiles which gives the fraction of repair work expended in each one-digit SWBS group. The repair profiles, constructed along ship class lines (and type of work), were derived from data extracted from shipyard departure reports (NAVSHIPS Report FA-905A) on completed overhauls. The profiles not only formed one of the key inputs to the DMPPS, but were also useful in constructing the initial DMSS data base.

The alteration portion of an availability is composed of many separate alterations which are not repeatable on the same ship. However, within the same class of ship alterations are repeatable. Therefore, the ship alteration data base for DMPPS was developed by collecting data on individual ship alterations for each ship class. The total of the individual ship alterations was then used to project the alteration portion of an availability. The Ship Alteration Management Information System (SAMIS), developed by NAVSEA 042, was the source of scheduled ship alterations for the DMPPS. The information listed in SAMIS for each ship alteration includes ship type, ship class, ship alteration number, man-days required, and SWBS. The results of the effort to develop the alteration data base are documented in a DTNSRDC report.<sup>3</sup>

The development of the data base for the DMSS incorporated many of the features developed for the DMPPS data base. The ideas, and actual data, of features such as repair profiles and the use of SAMIS played an active role in the DMSS data base development.

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3. Hubai, P., "Depot Maintenance Planning and Programming System Major Ship Alteration Data Base", DTNSRDC Report 77-0063, June 1977.

## 2. TASK DESCRIPTION

### 2.1 OBJECTIVE

The objective was to develop the data base for the DMSS. Each availability is described by two SWBS ratios, one for the repair portion of the work and one for the alteration portion of the work. A SWBS ratio is the decimal fraction of the work done in each of the one-digit SWBS groups to the total work done.

### 2.2 METHODOLOGY

The methodology consisted of the following steps:

- o Determine DMSS data requirements
- o Identify data sources
- o Collect data
- o Process data
- o Establish data file

### 2.3 DATA REQUIREMENTS

The Depot Maintenance Assignment File<sup>2</sup> (DMAF) is the list of availabilities (scheduled ship overhauls) which determines the data base requirements for the DMSS. For each availability, DMAF contains information on type work, dates, shipyard, man-days, and percent alteration. The list of availabilities and the type of work determine the data requirements; i.e., the data base must contain information on each type of work performed on each ship class.

### 2.4 DATA SOURCES

The data were gathered from sources already available at DTNSRDC. These included historical data provided by the shipyards, DMPPS repair profiles, and SAMIS.

#### 2.4.1 One-Digit SWBS Shipyard Tapes

Magnetic tapes were sent monthly to DTNSRDC from each of the eight major Navy shipyards during the period from September 1974 to July 1976.

These tapes contained expenditures for each availability, by one-digit SWBS group and by production shop category. At the completion of an availability, SWBS/shop matrices were generated for the availabilities repair work and alterations work. These matrices give the breakdown (in terms of fractions) of the total repair or alteration man-days by both one-digit SWBS and production shop category. That is, each element of the matrix indicates the fraction of the availabilities repair or alterations work done in each SWBS and each shop. These matrices therefore contained the SWBS ratios needed by DMSS for each type of work. Matching the DMSS data requirements with the available one-digit matrices provided much of the data required by DMSS.

#### 2.4.2 Three-Digit SWBS Shipyard Tapes

Beginning in October 1976, DTNSRDC received quarterly from the shipyards a tape containing production shop and three-digit SWBS data for each completed availability. Matrices generated from these tapes also included one-digit SWBS ratios for each availability. These ratios were used with the ratios developed from the one-digit SWBS tapes in the construction of the data base.

#### 2.4.3 Comparable Ship Types and Classes

Ship groups, consisting of one or more ship classes having similar repair and alteration requirements, were identified. The available SWBS ratios for the ships in the group were then combined to form an average SWBS ratio for the ship group and for a particular type of work. A comparison of the data available with the data required indicated that there were still many ship classes (or types) and types of work for which no shipyard data were available. In some of these cases, data from other ship groups could be used for the initial data base. For example, the LHA is a new type of ship just entering service; therefore, no data are available on completed overhauls. The LHA is most similar to the LPH type ship; therefore, the LPH data were used for the LHA.

Also, if data for different types of work are required for a ship type, but data are available for only one type of work, the available data can be used for all types of work for that ship type. This method was used to extend the coverage of the available data.

#### 2.4.4 Repair Profile and SAMIS

The repair profile data base of the DMPPS was used to develop the repair SWBS ratios for availabilities that could not be covered by shipyard tapes or by similar ships. The SWBS ratios for the alteration portion of these availabilities were developed by adding the scheduled alterations as listed in SAMIS by single-digit SWBS and then forming the ratio. All data requirements that could not be covered by the first three sources were covered by this method.

### 3. DATA COLLECTION AND PROCESSING

#### 3.1 DATA COLLECTION

The initial DMSS data requirements as determined from DMAF are presented in Table 1 for each ship type and class and for each type work. The initial ship type and class groupings were as setup for the repair profiles of the DMPPS. The only types of work considered were regular overhauls (RO), restricted availabilities (RA), overhauls to Naval Reserve training ships (NRT), and Refuelings (RF).

With the data requirements established, the precedence for collecting data was first from shipyard tapes, either the one- or three-digit SWBS tapes. Table 2 lists the completed availabilities from which data were collected from the shipyard tapes.

The similar ships method was then used to extend the shipyard tape coverage to other classes and other types of work. These results are presented in Table 3.

Repair profiles and SAMIS were then used to fulfill the remaining data requirements. Table 4 lists the ship types whose data was developed using repair profiles and SAMIS.

#### 3.2 DATA PROCESSING

The data obtained from the one-digit SWBS shipyard tapes were processed through a computer program which changed the format for input to a later program and re-normalized the ratios to insure that they summed to 1.0. The input included an identification card which listed ship type and class, data source (hull number) and man-days expended for repair and alteration type work. The repair and alteration SWBS ratios followed the identification card. The output included the identification card and the reformatted SWBS ratios.

Frequently data for more than one ship in a class were obtained from either the one- or three-digit shipyard tapes. Therefore, a computer program which combined the single ship ratios was used to produce an average ratio. The input included a category definition card which identified the type and hull numbers covered by the data to be averaged,

and the single ship SWBS ratios such as were output from the preceding program. The program multiplies the SWBS ratio by the man-day figure to produce a SWBS spread. It then sums the mandays for each one-digit SWBS and the total, and divides to produce a combined ships average SWBS ratio. The resultant SWBS ratio is then normalized to 1.0. This process is done for both repair work and alteration work. The output consists of punched cards which contain the category definition data, the repair and alteration mandays, and repair and alteration SWBS ratios.

The data produced from the similar ships method were duplicated from the averaged ratios: data developed from repair profiles and SAMIS was produced in the format of this average ratio. However, all data were processed through the averaging program to insure that the ratios sum to 1.0.

TABLE 1 - DMSS INITIAL DATA REQUIREMENTS

Ship Type And Class	TYPE WORK REQUIRING DATA			
	RO	RA	NRT	RF
AD-14, 26	X			
AD-37	X			
AE-21, 23	X			
AE-26	X			
AFS-1	X			
AG-153	X			
AG-520	X			
AGDS-2	X	X		
AGF-3	X			
AGFF-1	X			
AGSS-555	X			
AGSS-563	X			
AO-51, 143	X	X		
ACE-1	X			
AOK-1	X	X		
AK-5, 28	X			
ARS-6, 38	X			
AS-11	X	X		
AS-19	X			
AS-31, 33, 36	X	X		
ASR-7, 21	X			
ATF-81, 96, 148	X		X	
ATS-1	X			
AVM-1	X			
CG-4, 10	X			
CG-16	X	X		
CG-26	X	X		
CGN-9	X			
CGN-25	X	X		
CGN-35	X	X		
CGN-36, 37, 38	X	X		
CV-19, 41, 59	X	X		
CV-63	X	X		
CV-67	X	X		
CVN-65	X	X		
CVN-68	X	X		
CVT-16	X	X		
DD-710, 825			X	
DD-931, 945	X		X	
DD-963	X	X		
DDG-2	X			
DDG-31	X			
DDG-35	X			
DDG-37, 38	X	X		

TABLE 1 (CONTINUED)

Ship Type And Class	TYPE WORK REQUIRING DATA			
	RO	RA	NRT	RF
DSRV-1	X			
DSV-1	X			
FF-1037,1040	X		X	
FF-1052	X	X		
FFG-1	X			
FFG-7		X		
LCC-19	X			
LHA-1	X	X		
LKA-112,113	X		X	
LPA-248			X	
LPD-1,4	X			
LPH-2	X			
LSD-28	X			
LSD-36	X			
LST-1179	X	X		
MSO-442,428,508	X		X	
PHM-1	X			
SS-563,572,580	X			
SSBN-598				X
SSBN-608	X			
SSBN-616	X	X		X
SSBN-627	X	X		X
SSBN-640	X	X		X
SSN-571,575,578		X		X
SSN-585	X			
SSN-594	X	X		X
SSN-597				X
SSN-637	X	X		X
SSN-671,685	X	X		X
SSN-688	X	X		

TABLE 2 - DATA GATHERED FROM SHIPYARD TAPES

SHIP TYPE AND CLASS	HULL NUMBER	TYPE WORK	SHIPYARD	AVAILABILITY DATES
ONE-DIGIT SWES SHIPYARD TAPES				
AD-37	AD-38	RO	NORFOLK	5/75 - 9/75
AOE-1	AOE-3	RO	NORFOLK	7/74 - 2/75
AOR-1	AOR-1	RO	LONG BEACH	6/74 - 2/75
AOR-1	AOR-2	RO	PHILADELPHIA	2/75 - 9/75
CG-4, 10	CG-10	RO	PHILADELPHIA	7/73 - 5/74
CG-16	CG-17	RO	PHILADELPHIA	4/74 - 4/75
CG-26	CG-27	RO	NORFOLK	7/73 - 7/74
CG-26	CG-29	RO	LONG BEACH	4/75 - 2/76
CG-26	CG-31	RO	LONG BEACH	2/74 - 12/74
CG-26	CG-33	RO	LONG BEACH	12/74 - 10/74
CG-26	CG-26	RA	NORFOLK	1/75 - 3/75
CGN-9	CGN-9	RA	PUGET SOUND	2/76 - 6/76
CGN-35	CGN-35	RO	PUGET SOUND	3/74 - 7/75
CV-19, 41, 59	CV-60	RO	NORFOLK	3/74 - 4/75
CV-19, 41, 59	CV-34	RA	LONG BEACH	8/74 - 3/75
CV-19, 41, 59	CV-42	RA	PHILADELPHIA	5/74 - 8/74
CV-19, 41, 59	CV-43	RA	LONG BEACH	8/75 - 5/76
CV-19, 41, 59	CV-59	RA	NORFOLK	9/75 - 2/76
CV-19, 41, 59	CV-59	RA	NORFOLK	8/73 - 11/73
CV-19, 41, 59	CV-59	RA	NORFOLK	9/74 - 12/74
CV-19, 41, 59	CV-62	RA	NORFOLK	2/74 - 4/74
CV-19, 41, 59	CV-62	RA	NORFOLK	6/74 - 7/74
CV-19, 41, 59	CV-62	RA	NORFOLK	3/75 - 6/75
CV-63	CV-66	RO	NORFOLK	12/74 - 10/75
CV-67	CV-67	RO	NORFOLK	3/74 - 11/74
CV-67	CV-67	RA	NORFOLK	2/76 - 5/76
DD-710, 825	DD-820	NRT	PHILADELPHIA	6/74 - 6/75
DD-931, 945	DD-941	RO	NORFOLK	4/75 - 1/76
DD-931, 945	DD-945	RO	LONG BEACH	4/74 - 4/75
DD-931, 945	DD-948	RO	PEARL HARBOR	6/75 - 2/76
DDG-2	DDG-2	RO	PHILADELPHIA	2/75 - 1/76
DDG-2	DDG-3	RO	NORFOLK	5/75 - 3/76
DDG-2	DDG-5	RO	NORFOLK	4/74 - 12/74
DDG-2	DDG-6	RO	PHILADELPHIA	4/74 - 2/75
DDG-2	DDG-7	RO	LONG BEACH	10/73 - 7/74
DDG-2	DDG-9	RO	LONG BEACH	6/73 - 6/74
DDG-2	DDG-14	RO	LONG BEACH	2/75 - 1/76
DDG-2	DDG-16	RO	PUGET SOUND	7/74 - 6/75
DDG-2	DDG-17	RO	NORFOLK	10/74 - 9/75
DDG-2	DDG-20	RO	PEARL HARBOR	3/74 - 3/75
DDG-2	DDG-24	RO	PEARL HARBOR	10/73 - 10/74
DDG-2	DDG-24	RO	LONG BEACH	1/75 - 12/75
DDG-31	DDG-31	RO	LONG BEACH	4/75 - 2/76
DDG-37, 38	DDG-37	RO	PHILADELPHIA	11/75 - 1/75
DDG-37, 38	DDG-46	RO	PEARL HARBOR	6/74 - 4/75

TABLE 2 (CONTINUED)

SHIP TYPE AND CLASS	HULL NUMBER	TYPE WORK	SHIPYARD	AVAILABILITY DATES
ONE-DIGIT SWBS SHIPYARD TAPES				
FF-1037,1040	FF-1038	RO	PHILADELPHIA	3/75 - 9/75
FF-1037,1040	FF-1041	RO	LONG BEACH	6/75 - 6/76
FF-1037,1040	FF-1048	RO	PEARL HARBOR	8/74 - 5/75
FF-1052	FF-1056	RO	PHILADELPHIA	11/73 - 6/74
FF-1052	FF-1057	RC	PEARL HARBOR	9/73 - 4/74
FF-1052	FF-1058	RO	LONG BEACH	10/73 - 7/74
FF-1052	FF-1059	RO	PHILADELPHIA	6/75 - 3/76
FF-1052	FF-1060	RO	LONG BEACH	7/73 - 3/74
FF-1052	FF-1062	RO	PEARL HARBOR	8/75 - 4/76
FF-1052	FF-1066	RO	LONG BEACH	7/74 - 2/75
FF-1052	FF-1067	RO	LONG BEACH	7/74 - 3/75
FF-1052	FF-1077	RC	LONG BEACH	9/74 - 5/75
FF-1052	FF-1056	RA	NORFOLK	11/74 - 3/75
FF-1052	FF-1082	RA	NORFOLK	7/75 - 11/75
FFG-1	FFG-2	RO	LONG BEACH	10/73 - 7/74
FFG-1	FFG-5	RC	PHILADELPHIA	4/75 - 1/76
LCC-19	LCC-20	RO	PHILADELPHIA	7/74 - 2/75
LPD-1,4	LPD-8	RO	LONG BEACH	2/74 - 7/74
LPD-1,4	LPD-13	RO	NORFOLK	1/74 - 6/74
LPH-2	LPH-7	RO	PHILADELPHIA	9/74 - 4/75
LPH-2	LPH-9	RO	PHILADELPHIA	7/75 - 3/76
LSD-28	LSD-28	RO	LONG BEACH	2/74 - 7/74
LST-1179	LST-1186	RC	LONG BEACH	1/75 - 6/75
LST-1179	LST-1180	RA	NORFOLK	5/75 - 6/75
LST-1179	LST-1181	RA	NORFOLK	8/75 - 9/75
SSEN-608	SSEN-611	RF	MARE ISLAND	11/74 - 5/76
SSN-571,575,578	SSN-583	RF	PEARL HARBOR	9/73 - 4/75
SSN-585	SSN-592	RF	MARE ISLAND	12/73 - 5/75
SSN-597	SSN-597	RF	PORTSMOUTH	3/73 - 8/74
THREE-DIGIT SWBS SHIPYARD TAPES				
AS-11	AS-11	RC	CHARLESTON	4/76 - 10/76
AS-31,33,36	AS-34	RO	CHARLESTON	1/76 - 8/76
CG-16	CG-22	RO	PUGET SOUND	9/75 - 9/76
CV-19,41,59	CV-60	RA	NORFOLK	8/76 - 11/76
CV-19,41,59	CV-62	RA	NORFOLK	5/76 - 9/76
DDG-2	DDG-8	RO	LONG BEACH	9/75 - 7/76
DDG-2	DDG-22	RO	PEARL HARBOR	10/75 - 8/76
DDG-2	DDG-23	RO	NORFOLK	9/75 - 6/76
DDG-31	DDG-32	RO	LONG BEACH	1/76 - 11/76
FF-1052	FF-1052	RO	PEARL HARBOR	2/76 - 10/76
LCC-19	LCC-19	RO	LONG BEACH	11/75 - 7/76
LPH-2	LPH-12	RO	NORFOLK	4/76 - 2/77
SS-563,572,580	SS-572	RO	MARE ISLAND	7/75 - 8/76
SSN-637	SSN-647	RO	PEARL HARBOR	8/75 - 8/76

TABLE 3 - SIMILAR SHIP TYPES

SHIP TYPE AND CLASS	TYPE WORK	SIMILAR SHIP TYPE AND CLASS	SIMILAR TYPE WORK
AD-14, 26	RO	AD-37	RO
AG-153, 520	RO	MSO-422, 428, 508	RO
AGDS-2	RO, RA	AD-37	RO
AGF-3	RO	LSD-28	RO
AGFF-1	RO	FF-1037	RO
AGSS-555, 563	RO	SSN-637	RO
AO-51, 143	RO, RA	AOE-1	RO
AR-5, 28	RO	AD-37	RO
AS-11	RA	AS-11	RO
AS-19	RO	AS-11	RO
AS-31, 33, 36	RA	AS-31, 33, 36	RO
AVM-1	RO	LCC-19	RO
CG-16	RA	CG-16	RO
CGN-25, 35, 36, 37, 38	RA	CGN-9	RA
CGN-9, 25, 36, 37, 38	RO	CGN-35	RO
CV-63	RA	CV-67	RA
CV-63	RO	CV-67	RO
CVT-16	RO	CV-59	RO
CVI-16	RA	CV-59	RA
DD-931, 945	NRT	DD-931, 945	RO
DD-963	RO, RA	CG-26	RO
DDG-35	RO	DDG-31	RO
DDG-37, 38	RA	DDG-37, 38	RO
DSRV-1	RO	SSN-637	RO
DSV-1	RO	SSN-637	RO
FF-1037, 1040	NRT	FF-1037, 1040	RO
FFG-7	RA	FF-1052	RA
LHA	RO, RA	LPH-2	RO
LKA-112, 113	RO, NRT	LPD-1, 4	RO
LPA-248	NRT	LPD-1, 4	RO
LSD-36	RO	LSD-28	RO
PHM-1	RO	FF-1052	RO
SSBN-598, 616, 627, 640	RF	SSBN-608	RF
SSN-594, 637, 671, 685	RF	SSN-597	RF
SSN-637	RA	SSN-637	RO
SSN-671, 685	RO, RA	SSN-637	RO
SSN-688	RO, RA	SSN-637	RO

TABLE 4 - SHIP TYPES USING REPAIR PROFILE  
AND SAMIS DATA

SHIP TYPE AND CLASS	TYPE WORK
AE-21, 23, 26	RO
AFS-1	RO
ARS-6, 38	RO
ASR-7, 21	RO
ATF-81, 96, 148	RO, NRT
ATS-1	RO
CVN-65, 68	RO, RA
MSO-422, 428, 508	RO, NRT
SSBN-598, 608, 616	RO, RA
SSBN-627	RO, RA
SSBN-640	RO, RA
SSN-571, 575, 578, 585	RO, RA
SSN-594	RO, RA

#### 4. SWBS RATIOS

The final SWBS ratios included in the initial data base are presented in Table 5. The first two columns, ship type and hull range, define the ship category to which the data apply. The third column, TW, specifies the type of work as defined in Section 3.1. An additional type of work, OTW, is used here to denote that the data are used for all types of work that may occur. The comment column gives the data source if the data were developed from the similar ships or profile and SAMIS methods. The remaining columns list the SWBS ratios for each one-digit SWBS group. At the far right, the R denotes the repair ratio and the A denotes the alteration ratio.

TABLE 5 - DMSS REPAIR AND ALTERATION SWBS RATIOS

SHIP TYPE	HULL RANGE	TYPE WORK	COMMENT	SINGLE DIGIT SWBS RATIOS										R/A
				SWBS 1	SWBS 2	SWBS 3	SWBS 4	SWBS 5	SWBS 6	SWBS 7	SWBS 8	SWBS 9		
AD	8-9999	RO		.015700 .175000	.087300 0.000000	.099300 .021200	.043700 .081500	.344600 .656600	.231000 .045200	.000500 0.000000	.005400 .019600	.262700 R 0.000000 A		
AE	8-9999	RO	PROFILE + SAMIS	.070700 .012600	.094300 0.000000	.030900 .006400	.366100 .213400	.495700 .566700	.104400 .190700	.054500 0.000000	.039400 0.000000	.040300 R 0.000000 A		
AFS	8-9999	RO	PROFILE + SAMIS	.047400 0.000000	.132900 0.000000	.056300 .014800	.071500 .235500	.451300 .610000	.136600 .140100	.013700 .030100	.039900 0.000000	.052400 R 0.000000 A		
AG	8-9999	RO	USE MSD RO	.320300 .112900	.050500 0.000000	.026000 .000000	.085700 .534000	.152700 .215600	.140400 .133500	.010200 0.000000	.011600 0.000000	.100600 R 0.000000 A		
AGDS	8-9999	JTM	USE AD RO FOR RORA	.015700 .175000	.087300 0.000000	.099300 .021200	.043700 .081500	.344600 .656600	.231000 .045200	.000500 0.000000	.005400 .019600	.262700 R 0.000000 A		
AGF	8-9999	RO	USE LSD 28 RO	.043000 0.000000	.122800 0.000000	.044000 0.000000	.040400 .080600	.232700 .493400	.371100 .346100	.040500 0.000000	.036600 .019600	.096100 R 0.000000 A		
AGFF	8-9999	RO	USE FF 1037 RO	.044000 .036500	.321300 .074900	.044700 0.000000	.146400 .454000	.183500 .290000	.071500 .027700	.031700 .027400	.039600 .045200	.110400 R .030070 A		
AGSS	8-9999	RO	USE SSM 637 RO	.043300 .100300	.179900 .193100	.040100 0.000000	.069700 .455600	.279000 .042000	.040000 .093000	.020400 0.000000	.187300 .074000	.171800 R .123700 A		
AO	8-9999	BTM	USE AOE RO	.134100 0.000000	.299600 0.000000	.036000 0.000000	.031000 .190500	.210100 .730300	.091300 .079200	.182000 0.000000	.081400 0.000000	.094400 R 0.000000 A		
AOE	8-9999	RO		.134100 0.000000	.299600 0.000000	.036000 0.000000	.031000 .190500	.210100 .730300	.091300 .079200	.182000 0.000000	.081400 0.000000	.094400 R 0.000000 A		
AOR	8-9999	BTM	RA USES RO RATIO	.044900 .406500	.138600 0.000000	.041000 0.000000	.033900 .113000	.369000 .371100	.155200 .010100	.021100 .074400	.045900 .009500	.100400 R .024600 A		
AR	8-9999	RO	USE AD RO	.015700 .175000	.087300 0.000000	.099300 .021200	.043700 .081500	.344600 .656600	.231000 .045200	.000500 0.000000	.005400 .019600	.262700 R 0.000000 A		
ARS	8-9999	RO	PROFILE + SAMIS	.025000 .010300	.263400 0.000000	.100900 .050100	.076900 .124300	.353200 .505600	.073000 .309500	.010500 0.000000	.004700 0.000000	.091600 R 0.000000 A		

TABLE 5 (CONTINUED)

SHIP TYPE	HULL RANGE	TYPE WORK	COMMENT	SINGLE DIGIT SWBS RATIOS											R/A
				SWBS 1	SWBS 2	SWBS 3	SWBS 4	SWBS 5	SWBS 6	SWBS 7	SWBS 8	SWBS 9			
AS	11- 19 3TW		RA USES RO RATIO	.148303 0.000000	.046549 0.000000	.058189 0.000000	.016230 0.349497	.403967 0.319328	.173702 0.203196	.005867 0.000000	.044435 0.000000	.100750 R 0.127979 A			
AS	31- 37 3TW		RA USES RO RATIO	.013312 0.000000	.147708 0.000000	.058490 0.000000	.016647 0.107998	.406370 0.573398	.080022 0.317266	.056360 0.001538	.002530 0.000000	.130181 R 0.000000 A			
ASR	0-9999 RO		PROFILE + SAMIS	.030800 0.000000	.142200 0.000000	.059800 0.000000	.059100 0.210720	.419900 0.775923	.130200 0.300000	.000000 0.000000	.022400 0.000000	.128400 R 0.000000 A			
ATF	0-9999 JTW		PROFILE + SAMIS	.061800 0.000000	.218100 0.000000	.162100 0.000000	.027900 0.587647	.367800 0.263408	.092400 0.109266	.001300 0.000000	.027400 0.000000	.045800 R 0.000000 A			
ATS	0-9999 RO		PROFILE + SAMIS	.061803 0.000000	.218106 0.000000	.162100 0.000000	.027900 0.587647	.367800 0.263408	.092400 0.109266	.001300 0.000000	.027400 0.000000	.045800 R 0.000000 A			
AVH	0-9999 RO		USE LCC RJ	.033968 0.000000	.152700 0.000000	.051277 0.000000	.163145 0.598755	.195625 0.322387	.222321 0.081733	.000036 0.000000	.062744 0.051901	.113384 R 0.051114 A			
CG	4- 15 RO			.152400 0.000000	.224300 0.000000	.027800 0.000000	.210700 0.465000	.179800 0.453000	.057300 0.003400	.025600 0.076600	.016900 0.009600	.185200 R 0.024000 A			
CG	16- 25 3TW		RA USES RO RATIO	.040781 0.000000	.336597 0.000000	.033807 0.000000	.094672 0.437835	.160421 0.283280	.081616 0.088628	.045897 0.001443	.063139 0.007820	.135873 R 0.066322 A			
CG	26- 34 RO			.028321 0.000000	.385152 0.453345	.040486 0.020645	.122497 0.462463	.160966 0.171566	.157536 0.170391	.013789 0.037936	.044382 0.051838	.119331 R 0.033438 A			
CG	26- 34 RA			.049495 0.000000	.006599 0.000000	.117208 0.000000	.111689 0.089800	.039796 0.000000	.066793 0.021900	.003282 0.000000	.681842 0.004500	.021123 R 0.003000 A			
CGM	9- 48 RO		ALTS USE RA DATA	.008100 0.000000	.344736 0.000000	.008591 0.000000	.123288 0.131613	.345865 0.337134	.061394 0.097210	.073693 0.303238	.218879 0.016402	.051394 A 0.001300 A			
CGM	9- 43 RA			.035734 0.000100	.243325 0.448796	.066307 0.008591	.067637 0.123288	.133413 0.345865	.158916 0.061394	.022802 0.073693	.109811 0.218879	.158715 R 0.051394 A			
CV	19- 62 RO			.133100 0.000000	.326500 0.000000	.039500 0.000000	.094900 0.131613	.285500 0.337134	.103000 0.097210	.000000 0.303238	.001800 0.016402	.079100 R 0.001300 A			
CV	19- 62 RA			.003157 0.028043	.275537 0.081362	.050582 0.337600	.060054 0.282838	.296461 0.342183	.079911 0.234408	.030573 0.303238	.018309 0.211153	.185416 R 0.020625 A			
CV	63- 67 RO			.073790 0.038662	.253343 0.284663	.029768 0.128883	.091842 0.144373	.315922 0.397369	.078596 0.297545	.001715 0.009195	.005776 0.016910	.064448 R 0.004000 A			
CV	63- 67 RA			.026597 0.003000	.108789 0.012200	.045795 0.000000	.085991 0.474500	.403560 0.339400	.075392 0.145700	.133687 0.009500	.005399 0.019400	.116793 R 0.000000 A			

TABLE 5 (CONTINUED)

SHIP TYPE	HULL RANGE	TYPE WORK	COMMENT	SINGLE DIGIT SWBS RATIOS											SWBS 9	R/A
				SWBS 1	SWBS 2	SWBS 3	SWBS 4	SWBS 5	SWBS 6	SWBS 7	SWBS 8	SWBS 9				
CWN	0-9999 RO		PROFILE + SAMIS	.051130 3.000000	.336130 0.000000	.011730 0.011405	.051130 3.46007	.211300 -111439	.050300 0.000000	.020700 -261369	.136900 0.000000	.134200 0.000000	R			
CWN	0-9999 RA		PROFILE + SAMIS	.029120 .310249	.151420 .069750	.333200 .111820	.191500 -308377	.201300 -374105	.100000 .055611	.160000 0.000000	.000000 0.300000	.110400 0.000000	R			
CWT	3-9999 RO		USE CV 59 RO	.133100 0.000000	.235500 .032703	.039500 0.000000	.094900 .131613	.205500 -337134	.103300 0.997210	.020300 -303230	.000100 -0.164402	.079100 -0.013300	R			
CWT	3-9999 RA		USE CV 59 RA	.083157 .024043	.275537 .081362	.050502 .037630	.060054 -232030	.296461 -342103	.379911 -0.37021	.030573 -0.1153	.010309 -0.20625	.105416 -0.02625	R			
DD	714- 093 NRT			.136614 .143200	.239300 .339300	.031703 -0.27000	.093109 -113500	.243024 -301033	.000100 -0.13000	.020102 -0.666000	.055502 -1.25200	.079000 0.000000	R			
DD	931- 951 01M		NRT USES RO RATIO	.054323 .021960	.303340 .992223	.040841 -0.06614	.302750 -154350	.172923 -0.45879	.009456 -1.26592	.016000 -1.59959	.022702 -0.82132	.129400 -0.10203	R			
DD	963- 992 01M		USE CG 26 RO FOR RORA	.020321 .006300	.305152 .045345	.040606 -0.27645	.122497 -0.62463	.160966 -1.71566	.157336 -1.70391	.033739 -0.37934	.044302 -0.51030	.119301 -0.33430	R			
DDG	2- 24 RO			.040360 .006092	.336721 .044452	.033170 -0.05467	.137305 -0.14237	.162014 -216031	.076634 -0.90000	.039513 -0.72204	.032677 -0.37373	.132710 -0.24007	R			
DDG	31- 36 RO			.043595 .306529	.365243 .373756	.063224 0.000000	.000310 -0.10723	.200079 -0.80079	.050462 -0.25569	.016142 -0.43874	.060355 -1.13609	.136402 -0.39072	R			
DDG	37- 46 01M		RA USES RO RATIO	.021673 .020754	.304015 .170771	.031395 0.000000	.091026 -307050	.177902 -202025	.110945 -1.16520	.024125 -0.60710	.029203 -0.32649	.200916 -0.12713	R			
DSRV	0-9999 RO		USE SSM 637 RO	.003310 .100399	.179303 .193160	.043160 0.000000	.069790 -0.55696	.279000 -0.42033	.040046 -0.09320	.020400 0.000000	.107301 -0.74007	.171300 -1.23700	R			
OSV	0-9999 RO		USE SSM 637 RO	.003313 .100399	.179903 .193160	.043160 0.000000	.069790 -0.55696	.279000 -0.42033	.040046 -0.09320	.020400 0.000000	.107301 -0.74007	.171000 -1.23700	R			
FF	1037-1051 01M		NRT USES RO RATIO	.044013 .336593	.321153 .074392	.046702 0.000000	.146433 -0.54069	.103530 -298006	.071515 -0.32707	.031721 -0.27610	.039604 -0.05265	.116469 -0.30070	R			
FF	1052-1097 RO			.037702 .364619	.267127 .023374	.040499 -0.01667	.126552 -241432	.192966 -0.229703	.095467 -0.02903	.042710 -0.10060	.037594 -0.21300	.159295 -0.35574	R			
FF	1152-1197 RA			.100220 .201660	.317103 .074065	.001229 -0.05000	.090337 -364001	.194109 -109907	.004776 -0.96540	.000000 -0.17554	.000000 -0.315799	.125222 -0.50010	R			
FFG	1- 5 RO			.020074 .180774	.250223 .035712	.030906 0.000000	.147310 -329755	.125506 -292154	.150303 -0.06040	.033719 -0.43627	.060524 -0.30627	.165407 -0.25299	R			
FFG	7- 99 RA		USE FF 1052 RA	.130220 .231660	.317103 .074065	.001229 -0.05000	.090337 -364001	.194109 -119907	.004776 -0.96540	.000000 -0.17554	.000000 -0.315799	.125222 -0.50010	R			

TABLE 5 (CONTINUED)

SINGLE DIGIT SWBS RATIOS													
SHIP TYPE	HULL RANGE	TYPE WORK	COMMENT	SWBS 1	SWBS 2	SWBS 3	SWBS 4	SWBS 5	SWBS 6	SWBS 7	SWBS 8	SWBS 9	R/A
LCC	19- 20 RO			.033968 3.000000	.152700 0.000000	.051277 0.000000	.163145 .598755	.195625 -.302307	-.222321 .001733	-.044036 .000000	-.362744 .051901	-.113304 .045114	R A
LMA	8-9999 01M		USE LPM RO	.037278 .054429	.158517 .001298	.033061 .005818	.105731 .191562	.338038 .401932	.174053 .267934	.022951 .021293	.338967 .023127	-.087462 .032615	R A
LCA	8-9999 01M		USE LPD RO	.062368 .081175	.156552 0.000000	.056391 0.000000	.117730 .147209	.165727 .693024	.307300 .097278	-.012507 0.000000	.020105 .012594	-.093262 .048720	R A
LPA	8-9999 01M		USE LPD RO	.062368 .081175	.156552 0.000000	.056391 0.000000	.117730 .147209	.165727 .693024	.307300 .097278	-.012507 0.000000	.020105 .012594	-.093262 .048720	R A
LPD	1- 15 RO			.062368 .081175	.156552 0.000000	.056391 0.000000	.117730 .147209	.165727 .693024	.307300 .097278	-.012507 0.000000	.020105 .012594	-.093262 .048720	R A
LPM	2- 12 RO			.037278 .054429	.158517 .001298	.033061 .005818	.105731 .191562	.338038 .401932	.174053 .267934	.022951 .021293	.338967 .023127	-.087462 .032615	R A
LSD	28- 43 RO			.043096 0.000000	.122000 0.000000	.044096 0.000000	.040496 .060603	.202700 .493433	.371163 .346100	.040596 0.000000	.038696 .019403	-.096109 .005503	R A
LST	1179-1198 RO			.184100 .028997	.277400 .018998	.075100 0.000000	.023700 .056194	.219600 .678032	.131100 .097490	-.082900 0.000000	.057200 .046097	-.108900 .004592	R A
LST	1179-1198 RA			.076585 .788903	.309018 0.300300	.000667 0.000000	.010251 0.000000	.172265 0.070000	.281124 .291100	0.000000 0.000000	.000661 .030000	-.150019 0.000000	R A
MSO	8-9999 RO		PROFILE + SAMIS	.328300 .112904	.050500 0.03124	.026000 0.000000	.085700 .534306	.152700 .215602	.148400 .133527	.016200 0.000000	.011600 0.000000	-.108600 0.000000	R A
MSO	8-9999 01M		PROFILE + SAMIS	.328300 .047423	.050500 0.000000	.026000 0.000000	.085700 .326598	.152700 .278677	.148400 .344138	.016200 0.000000	.011600 0.000000	-.108600 0.000000	R A
PHM	8-9999 RO		USE FF 1052 RO	.037782 .344619	.257127 .023974	.040499 0.01667	.126552 .241432	.192966 .229783	.095467 .002943	.042710 .018640	.037594 .021368	-.159295 .035574	R A
SS	563- 582 RO			.118039 .122542	.163158 0.000000	.043395 0.000000	.089746 0.08911	.210000 .714626	.021048 0.000000	.046256 0.000000	.111761 .110759	-.203925 .024962	R A
SSBN	598- 659 RF		USE SSBN 611 RF	.054705 .022398	.198628 .328068	.044334 0.000000	.308438 .152485	.229923 .117108	.058686 .023380	.095518 .123387	0.000000 0.000000	-.237924 .263174	R A
SSBN	598- 626 01M		PROFILE + SAMIS	.052100 0.000000	.132400 0.000000	.033900 0.000000	.066200 .503134	.177900 .141337	.047500 .021049	.092980 .128267	.170200 0.000000	-.226900 .000000	R A
SSBN	627- 636 01M		PROFILE + SAMIS	.047284 0.000000	.051310 0.000000	.000398 0.000000	.394366 0.000000	.400095 0.000000	.048038 0.000000	.366489 0.000000	.030000 0.000000	-.000000 0.000000	R A
SSBN	648- 659 01M		PROFILE + SAMIS	.052100 .059286	.132400 .115895	.033900 .011643	.066200 .413155	.177900 .251974	.047500 .331196	.092980 .125071	.170200 0.000000	-.226900 0.000000	R A



## 5. UPDATING PROCEDURES

Updating the data base becomes necessary either because the data requirements change or because additional data become available from the three-digit SWBS shipyard tapes. If the requirements change, the methodology used in the development of the initial data base should be repeated (i.e., define requirement, identify data source, collect and process data, include in data file).

If new data become available from the three-digit SWBS tapes, the source of the existing data determines how the new data are incorporated into the data base. If the previous data were developed from the similar ships or profile and SAMIS methodology, the new data replace the previous data. If the previous data were from shipyard tapes, the new data should be combined with the previous data. In either case the averaging program should be run, even if only one SWBS ratio is available, so that the final data are normalized to 1.0.

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