RAPID DEPLOYMENT FORCE (RDF)

SURFACE EFFECT SHIP

DRAFT

COST ESTIMATE
(CLASS F)
15 JULY 1981

SURFACE EFFECT SHIP ACQUISITION PROJECT
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C.

LSES COST ESTIMATE

Introduction

Table 1 presents the summary highlights of Basic Construction Cost of the lead LSES. This format is supported be the estimating detail presented in pages 3 through 8 of this package and by Table 2. These figures are preliminary in nature and are subject to change pending reviews. Escalation to FY 82 $ is accomplished via the OSD inflation factors of July 1981. Specifically, the 50/50 Labor/Material Composite factor is applied

BASIC CONSTRUCTION COST
LEAD LSES

	DIRECT LABOR HRS,000's	DIRECT LABOR $,000's	Overhead $000's	Material $,000's	TOTAL COST
100 Hull	2,082.8	23,640	26,004	14,449	64,093
200 Propulsion	302.4	3,432	3,775	58,815	66,022
300 Electric	234.4	2,660	2,926	12,050	17,636
400 Comm/Surv	171.2	1,943	2,137		4,080
500 Auxiliaries	547.4	6,213	6,834	20,159	33,206
600 O&F	498.9	5,663	6,229	5,358	17,250
700 Armament	51.9	589	648		1,237
SWBS 100-700	3,889.0	44,140	48,553	110,831	203,524
Margins	388.9	4,414	4,855	11,083	20,352
Spares	—	—	—	500	500
SUBTOTAL	4,277.9	48,554	53,408	122,414	224,376
800 DES/NTE	2,139.0	27,978	30,776	3,029	61,783
900 Assembly	1,497.3	16,994	18,693	3,672	39,359
TOTAL, 100-900	7,914.2	93,526	102,877	129,115	325,518
Profit, 15 %					48,828
Platform Cost, FY 82 $					374,346
FY 84 $ (1.138)					426,006

DRAFT

TABLE 1

ESTIMATING DETAIL

SWBS 100 (exc 119) Hull Structure

a) Labor Hours

	WT, LT		Hrs/lb, Hrs/LT	Hours
HY 100	3,314.0	(92.1%)	.240, 538	1,781,600
5456 Al	286.0	(7.9%)	.442, 990	283,100
				2,064,700

b) Material Cost (FY 82 $)

	WT, LT	Scrap	$/lb (FY82)	Est'd $
HY 100	3,314.0	20%	.865 X 1.086	8,368,100
5456 Al	286.0	20%	1.730 X 1.086	1,444,300
				$ 9,812,400

SWBS 119 (Flexible seals & skirts)

a) Labor Hours

	Wt, lbs	WT, LT	Hrs/LT	Hours
Bow Seal	51,370	22.9	438	10,000
Stern Seal	41,450	18.5	438	8,100
				18,100

b) Material Cost (FY 82 $)

	Wt, lbs	$/lb. (FY82)	Est'd $
Bow Seal	51,370	46 x 1.086	2,566,200
Stern Seal	41,450	46 x 1.086	2,070,700
			$ 4,636,900

DRAFT

SWBS 200 (except 233,248) Propulsion

a) Labor Hours

100 men/month x 18 months x 168 hrs/mo x 60%

≅ 181,400

b). Material Cost (FY 82 $)

1. Specific Equipment

			$ FY82 (000's)
234	Gas Turbines	(LM 5000, 1.086)	17,376
241	Reduction Gearing	(CINTI, 1.172)	12,798
242	Clutches & Couplings	(B-J, 1.086)	9,448
243	Shafting (4 lines)		
244	Bearings		
245	CP Props (4)		
252	Propulsion Control	(in 234)	—
			$39,622

2. Non-Specific Equipment

			FY82 $ (000's)
251	Combustion Air	(417,000 x 1.172)	489
259	Exhaust	(393,000 x 1.172)	461
261	Fuel Oil	((234 + 241) x .05)	1,509
262	Lube Oil		
298	Operating Fluids	(in w/260)	—
299	Spares	(not est'd here)	—
			$2,459

Specific + Non Specific Equipment $42,081

DRAFT

SWBS 233, 248 Lift System

a. Labor hours

100 men/month x 18 mo. x 168 hrs/mo. x 40%

$\cong$ 121,000

b. Material Cost (FY 82 $)

1. Specific Equipment

		FY 82 $ (000's)
233	SACM 240 diesels (6) (Donnelly, 1.172)	10,556
248	Aerophysics DWDI fans (6) (1.172)	5,469
		$16,025

2. Non Specific Equipment

		FY 82 $ (000's)
248	Sub-bases (.865 x 1.086 x 22.3 LT)	47
248	Air Dist. (.865 x 1.086 x 10.5 LT)	22
248	Dsl. Spt. (SWBS 250 CER x 9.8LT)	239
248	Lube/Fuel oil ((233+248) x .025)	401
		$709

Specific + Non Specific Lift Equipment $16,734

DRAFT

SWBS 300 Electric

a. Labor Hours

	WT, LT	Hrs/LT (LSD-41)	Hours
Electric Plant	306	766	234,400

b. Material Cost (FY 82 $)

	WT, LT	$/lb. (LSD-41)	Est'd $
Electric Plant	306	17.58	12,050,000

SWBS 400 Communication and Surveillance

a. Labor Hours

	WT, LT	Hrs/LT (LHA-1)	Hours
SWBS 400	174.7	980	171,200

b. Material Cost (FY 82 $)

All GFE ϕ

SWBS 500 Auxiliary Systems

a. Labor Hours

	WT, LT	Hrs/LT (LSD-41)	Hours
SWBS 500	1,017.5	538	547,400

b. Material Cost (FY 82 $)

	WT, LT	$/LT (LSD-41)	Est'd $
SWBS 500	1,017.5	19,812	20,158,700

DRAFT

SWBS 600 Outfit and Furnishing

a. Labor Hours

	WT, LT	Hrs/LT	Hours
SWBS 600	907	550	498,900

b. Material Cost (FY 82 $)

	WT, LT	$/LT (1,172)	Est'd $
SWBS 600	907	5,907	5,357,600

SWBS 700 Armament

a. Labor Hours

	WT, LT	Hrs/LT	Hours
SWBS 700	207.6	250	51,900

b Material Cost (FY 82 $)

None, all GFE ϕ

Margins

a. Labor Hours

	Labor Hours, SWBS 100-700	Margins, % LS Weight	Hours
Margins	3,889,000	10	388.9

b. Material Cost (FY 82 $)

	Material Cost SWBS 100-700	Margins, % LS Weight	Est'd $
Margins	110,831,000	10	11,083,100

DRAFT

Spares (Shipborne)

a. Labor Hours

Not applicable — Ø

b. Material Cost (FY 82 $)

	$
Repair parts	500,000

SWBS 800 Design and Integration

a. Labor Hours

	Labor Hours, 100-700, Margins, Spares	%	Hours
SWBS 800	4,277,900	50	2,139,000

b. Material Cost (FY 82 $)

	SWBS 800 hours	$/hr	Est'd $
SWBS 800	2,139,000	1.416	3,028,800

SWBS 900 Assembly and Support Services

a. Labor Hours

	Labor Hrs, SWBS 100-700, Margins, Spares	%	Hours
SWBS 900	4,277,900	35	1,497,300

b. Material Cost (FY 82 $)

	Material Cost, SWBS 100-700, Margins, Spares	%	Est'd $
SWBS 900	122,414,000	3	3,672,400

PRODUCTION LABOR & OH COST ($000, FY82)

	D.L. HRS.	D.L. Cost	Overhead
100	2,082.8	23,640	26,004
200	302.4	3,432	3,775
300	234.4	2,660	2,926
400	171.2	1,943	2,137
500	547.4	6,213	6,834
600	498.9	5,663	6,229
700	51.9	589	648
100-700	3,889.0	44,140	48,553
Margins (10%)	388.9	4,414	4,855
Spares	—	—	—
TOTAL	4,277.9	48,554	53,408
900	1,497.3	16,994	18,693
		65,548	72,101

D.L. Cost = Hours x (10.45 x 1.086)
Overhead = Hours x ((10.45 x 1.086) x 110%)

ENGINEERING LABOR & OH COST ($000's, FY 82)

	D.L HOURS	D.L. Cost	Overhead
800 DES/NTE	2,139.0	27,978	30,776

D.L. Cost = Hours x (12.04 x 1.086)
Overhead = Hours x ((12.04 x 1.086) x 110%)

DRAFT

TABLE 2

TABLE OF CONTENTS

1. INTRODUCTION

Estimating Ground Rules

The estimate which follows addresses all elements of program cost for a 14 ship build of the Rapid Deployment Force (RDF) Surface Effect Ship (SES). These elements of cost include (1) Basic Construction Cost expressed in FY 81 $ (with profit), (2) inflation anticipated between now and the time of contract award, (3) program support costs, and (4) escalation from contract award to ship delivery. In order to estimate both inflation and escalation, the OSD approved factors as of 4/80 are utilized. Overall, the estimate quality is consistent with that required of a Class F estimate (defined by NAVSEAINST 7300.14 of 3 June 1980 as an estimate based on technical feasibility studies and/or extrapolated from higher quality estimates of similar items).

The Basic Construction Cost is estimated through two primary approaches. First, wherever ship system definition permits, vendor quotes are solicited for the material involved. Second, where system definition is not sufficient to support the solicitation of a vendor quote, material costs and labor hours are estimated using CERs. The CERs employed to estimate labor hours and material cost for the RDF have not been developed in a mathematically rigorous manner. Rather, the estimating relationships used by PMS 304 are those exhibited by various shiptypes for which data is available. The particular CER chosen from the available data reflects the judgment and experience of PMS 304-10 (Plans and Programs) and is selected through consultation with other Navy estimating activities, members of PMS 304's technical staff, and shipyards, among others. The result of this approach is an improved understanding of the relationships which exist between the RDF's ship systems and the estimated cost of those systems. In the case of the RDF, due to systems similarity, the CERs applied most frequently reflect LSD-41 cost data. Within the area of platform cost, as in other related areas, the general estimating philosophy has been one of conservatism, which serves to minimize the effects of unknowns that arise as ship design definition improves.

The acquisition will be administered by NAVSEA, PMS 304, using in-place cost control management systems, with the lead ship procured on a cost plus basis and the 13 follow production ship contracts awarded on a fixed price basis. The program will be executed in a single shipyard, which will be responsible for contract design, detail design, ship construction, test, and delivery of each RDF. The RDF will be built to a PMS 304 generated Surface Effect Ship spec blending commercial and military standards of design, construction, and management. Consequently, the Basic Construction cost estimate reflects this synthesis of commercial and military practice.

Labor hours required to perform detail design and to construct the lead RDF are estimated through the use of appropriate CERs. For follow ships, labor hours for SWBS 100-700, Margins, and SWBS 900 follow a 90% learning curve. SWBS 800 hours follow a 64.9% curve. In order to estimate labor related costs, the estimated labor hours are extended by hourly labor and labor overhead rates which have been coordinated with NAVSEA 017. These labor rates, which are given below, include all elements of overhead expense, including G&A. Profit is not included.

Direct Labor:	Manufacturing	$10.42/hr.	
	Engineering	$12.24/hr.	
Labor Overhead:	Manufacturing	$11.46/hr.	(110%)
	Engineering	$13.46/hr.	(110%)
Loaded Labor Rates:	Manufacturing	$21.88/hr.	
	Engineering	$25.70/hr.	

The RDF program assumes a contract award in the 1st quarter of FY 84 with delivery of the lead RDF to occur 42 months later. Long lead procurement is the Navy's responsibility and commences prior to contract award. Some of the systems/components to be ordered by the Navy as long lead items include gas turbine engines, CP props, lift fans, bearings, and castings. In this estimate, such material is treated as CFE and is reflected in the RDF's Basic Construction and Platform Cost.

2. RDF END COST SUMMARY

This section presents some of the RDF program cost highlights. The figures below are supported by the detailed estimating rationale which is presented in subsequent sections of this cost report. The lead RDF and the 13 follow ships are all costed in this report; the program cost highlights below therefore relate to both individual ships and to cumulative averages derived from the multiple ship acquisition program.

		$000's
1.	Basic Construction Cost, Lead RDF (FY 81 $)	257,438
2.	Profit, 15% (FY 81 $)	38,616
3.	Lead Ship Platform Cost (FY 81 $)	296,054
4.	Lead Ship Platform Cost (FY 84 $)	374,804
5.	Program Support Costs (Lead RDF)	65,591
6.	Escalation to Delivery	70,561
7.	End Cost (Lead RDF, FY 84 Program $)	510,956
8.	1st Production Ship Platform Cost (FY 84 $)	331,767
9.	Program Support Costs	44,789
10.	Escalation to Delivery	72,268
11.	End Cost (1st Production, FY 84 Program $)	448,824
12.	Average Platform Cost (FY 84 $)	295,409
13.	Average Support Costs per ship	40,951
14.	Average Escalation per ship	98,700
15.	Cumulative Avg. End Cost, FY 84 Program $	435,059
16.	Total End Cost, FY 84 Program $	6,090,832

3. RDF BASIC CONSTRUCTION AND SUPPORT COST DETAILS

This section presents a more detailed summary of both the RDF's Platform Cost and the potential end cost (FY 84 Program $) of a 14 ship RDF acquisition.

Table 3-i summarizes the results of the lead RDF estimating rationale presented in detail in Section 4.1. Profit of 15% is added to the cost of SWBS 100-900 to derive the total for Platform Cost. This percentage of profit is consistent with NAVSEA 017 estimating guidance. The Basic Construction Cost in FY 81 $ is then restated to FY 84$ through application of the OSD approved (4/80) composite inflation factor of 1.266. This factor addresses the expected increase in cost from the current time period to that of contract award (1st quarter, FY 84).

Unlike prior PMS 304 estimates, the cost of the Lift System is not presented as a separate line item. Following the guidance laid down in NAVSEA's Ship Work Breakdown Structure, the estimated costs of the various Lift System components are presented in their proper SWBS "home"; SWBS 200 for the diesel engines (233), lift fans (248), and the air distribution system (248) and SWBS 100 for the flexible skirts and seals (119). Although the costs for this equipment and the labor hours relating to its fabrication/installation are not presented as a separate element of the RDF's estimated cost, they were costed separately in Section 4 for the sake of visibility. See SWBS 119, 223, and 248 for details.

The estimated cost of the first production ship is shown in Table 3-ii. It takes the Lead RDF cost estimate as a base and makes certain adjustments to it to derive an estimated cost . See Section 4.2 for the underlying rationale.

In addition to Basic Construction Cost, the RDF estimate addresses elements of program cost required to support the ship construction effort. As a result of consultation with SEA 017, the following elements of cost (expressed as percentages of Platform Cost) are included in the RDF end cost estimate.

	Lead Ship	1st Production
A. Change Orders	12.0%	8.0%
B. Government Support Services	2.5%	2.5%
C. Hull/Mechanical/Elect Equip	3.0%	3.0%
	17.5%	13.5%

Post delivery corrections and outfitting material are sometimes included as support costs (for example, in the ANVCE model, Vol. III, p. 2-8, they are estimated at 5.0% and 4.0% respectively). However, since they are established by the project manager at the time of budget preparation for the contemplated program, and since these costs are authorized and funded separately from program end cost as defined by SEA 017, they are not included as elements of program support cost for the RDF. SEA 017 uses 1.0 to 1.5% H/M/E costs, but 3.0% is adopted here for the sake of conservatism.

To account for inflation from the time of contract award to ship delivery, an allowance for escalation is required. Expressed as a percentage, it does not apply to profit or to support costs. The percentage applied is a simple average of the labor and material factors approved by OSD as of 4/80. Three separate factors are applied, one for the lead ship (RDF 1), one for the 1st production ship (RDF 2), and one for the remaining production ships (RDF 3 through RDF 14).

Assuming a contract award in the 1st quarter of FY 84 of the entire 14 ship RDF program to one yard, the escalation factors are as follow:

	Award-Deliv.	(Labor + Mat'l) ÷ 2	Escalation Factor
Lead RDF	42 mo.	(26.5 + 16.8)/2	21.65%
1st Prod. RDF	51 mo.	(30.4 + 19.7)/2	25.05%
Follow RDFs	88 mo.	(49.2 + 33.9)/2	41.55%

Table 3-iii presents the potential end cost of the 14 ship RDF program, including estimated support costs and escalation. Both the support costs and escalation are based on the estimated platform costs of RDFs 1 through 14. See Sections 4.1, 4.2, and 4.3 for the rationale underlying the estimated costs shown in Table 3-iii.

LEAD SHIP BASIC CONSTRUCTION COST

	DIRECT LABOR		OVERHEAD	MATERIAL	TOTAL
	HRS,000s	$,000s	COST	COST	COST
100 HULL	2,021.6	21,065	23,168	13,325	57,558
200 PROPULSION	302.5	3,152	3,467	55,175	61,794
300 ELECTRIC	234.4	2,442	2,686	12,050	17,178
400 COMM/SURV	23.0	240	264	4,250	4,754
500 AUXILIARIES	519.2	5,410	5,950	19,119	30,479
600 O & F	429.0	4,470	4,916	4,359	13,745
700 ARMAMENT	--	--	--	--	--
100-700 TOTAL	3,529.7	36,779	40,450	108,279	185,508
MARGINS (10%)	353.0	3,678	4,045	10,828	18,551
SPARES	--			500	500
SUBTOTAL	3,882.7	40,457	44,495	119,607	204,559
800 DES/NTE	1,108.8	13,572	14,924	1,496	29,992
900 ASSEMBLY	882.0	9,190	10,108	3,588	22,886
TOTAL (EXC. 800)	4,764.7	49,648	54,603	123,195	227,446
TOTAL (100-900)	5,873.5	63,220	69,527	124,691	257,438
PROFIT (15%)					38,616
PLATFORM COST		FY 81 $			296,054
		FY 84$ (1.266)			374,804

TABLE 3-i

1st PRODUCTION SHIP BASIC CONSTRUCTION COST

	DIRECT LABOR		OVERHEAD	MATERIAL	TOTAL
	HRS,000s	$,000s	COST	COST	COST
100 HULL	1,819.4	18,959	20,851	13,059	52,869
200 PROPULSION	272.3	2,837	3,120	51,493	57,450
300 ELECTRIC	211.0	2,198	2,417	11,809	16,424
400 COMM/SURV	20.7	216	238	4,165	4,619
500 AUXILIARIES	467.3	4,869	5,355	18,737	28,961
600 O & F	386.1	4,023	4,424	4,272	12,719
700 ARMAMENT	--	--	--	--	--
100-700 TOTAL	3,176.7	33,101	36,405	103,535	173,041
MARGINS (10%)	317.7	3,310	3,641	10,354	17,305
SPARES	--			490	490
SUBTOTAL	3,494.4	36,411	40,046	114,379	190,836
800 DES/NTE	719.6	8,808	9,686	733	19,227
900 ASSEMBLY	733.8	7,646	8,409	1,758	17,813
TOTAL (EXC. 800)	4,228.2	44,058	48,455	116,137	208,650
TOTAL (100-900)	4,947.8	52,866	58,141	116,870	227,877
PROFIT (15%)					34,182
PLATFORM COST		FY 81 $			262,059
		FY 84$ (1.266)			331,767

TABLE 3-ii

PROGRAM END COST SUMMARY,$000'S

RDF	LABOR HRS (000'S)	FY1981 $000 LOADED LABOR $	MATERIAL $	BASIC CONST.	PROFIT	PLATFORM COSTS FY81	PLATFORM COSTS FY84	FY1984 $000 SUPPORT COSTS	ESCALATION	END
1	5873.5	132747	124691	257438	38616	296054	374804	65591	70561	510956
2	4947.8	111007	116870	227877	34182	262059	331767	44789	72267	448823
3	4534.3	101345	115497	216842	32526	249368	315700	42619	114064	472383
4	4272.4	95264	114533	209797	31470	241267	305444	41235	110358	457037
5	4084.8	90928	113790	204718	30708	235426	298049	40237	107686	445972
6	3940.6	87606	113187	200793	30119	230912	292335	39465	105622	437422
7	3824.5	84938	112680	197618	29643	227261	287712	38841	103951	430504
8	3727.9	82725	112242	194967	29245	224212	283852	38320	102557	424729
9	3645.7	80844	111857	192701	28905	221606	280553	37875	101365	419793
10	3574.3	79214	111514	190728	28609	219337	277681	37487	100327	415495
11	3511.5	77781	111205	188986	28348	217334	275145	37145	99411	411701
12	3455.5	76506	110923	187429	28114	215543	272877	36838	98592	408307
13	3405.1	75359	110665	186024	27904	213928	270833	36562	97853	405248
14	3359.4	74319	110426	184745	27712	212457	268971	36311	97180	402462

TOTAL END COSTS = 6090832

NOTES: FY81 PLATFORM COST IS RESTATED TO FY 84 $ THROUGH APPLICATION OF THE DOD APPROVED INFLATION FACTOR OF 1.266 (APPROVED 4/80)

LABOR HOURS FOR 100-700, MARGINS, AND 900 FOLLOW A 90% LEARNING CURVE. SWBS 800 HOURS FOLLOW A 64.9% CURVE. LABOR HOURS(000'S) FOR THE TOTAL PROGRAM AMOUNT TO 56157.3 .

TABLE 3-iii

4. BASIC CONSTRUCTION COST ESTIMATING RATIONALE

This section presents the rationale for the lead ship, 1st production ship, and 12 follow ships (Sections 4.1, 4.2, and 4.3 respectively).

4.1 GROUND RULES, ASSUMPTIONS, & ESTIMATING RATIONALE: LEAD SHIP

SWBS 100 HULL (except SWBS 119)

A. Labor Hours

The same labor hour CERs used in the MPS are applied to the weight of the RDF's hull structure. Since a detailed weight estimate is not available, the weight of the aluminum superstructure on the RDF is assumed to represent the same proportion of total hull weight as the superstructure of the MPS (6.8%). The weight distribution between aluminum and HY100 and the estimated labor hours are as follows:

		WT,LT	Hrs/Lb, Hrs/LT	Hours
HY 100	(93.6%)	3,396.1	.240,538	1,825,700
5456 Alum	(6.8%)	247.9	.320,717	177,700
	100.0%	3,644.0	.245,550	2,003,400

Assuming that hull fabrication and erection proceeds over a 30 month period (from month 11 to 40, for example), the labor hour estimate provides for an average manloading of 398 people (at 168 manhours per month).

B. Material Cost

Recently supplied vendor quotes are applied to steel and aluminum to estimate material cost. The finished weight of each hull material is increased by 20% to allow for cut off of bad ends, cutouts, scrap, spoilage, etc. The total estimated hull material cost is therefore:

		WT, LT	$/lb.	$
HY 100	3,396.1 x 1.20 =	4,075.3	.865[1/]	7,896,300
5456 Alum	247.9 x 1.20 =	297.5	1.730[2/]	1,152,900
		4,372.8		9,049,200

1/ Average price for HY 100 according to U.S. Steel letter, 6/25/81.
2/ Per telephone quote from ALCOA.

SWBS 119 (SEALS)

A. Labor Hours

NAVSEA's SWBS guidance does not encourage SES lift systems to be estimated as a separate aggregations of cost. Rather, seals are treated as part of the hull structure (SWBS 119) and the remainder of the lift system is reported in SWBS 200 (SWBS 230 and 240, primarily). This estimate adopts this guidance at a summary level, but the components of the lift system are estimated separately for the sake of visibility. On the RDF, the labor hours required to install the seals (they are assumed to be purchased fully fabricated) are estimated through application of the most recently used labor hour CER, 438 hrs/LT from the MDC. This yields the following labor hour estimate:

	WT,LT	Hrs/LT	Labor Hours
SWBS 119 Seals	41.5	438	18,200

This labor hour CER results in an average manloading of over 27 men for a period of 4 months (168 manhours/month).

B. Material Cost

The seals are assumed to be purchased fully fabricated at $46/lb., which is consistent with the range currently experienced in the construction of the Bell-Halter 110. The estimated material cost is therefore:

		WT,LT[1/]	$/lb.	Mat'l $
SWBS 119	Bow Seal	23.0	46.00	2,369,900
	Stern Seal	18.5	46.00	1,906,200
		41.5		4,276,100

1/ Weights are assumed to be the same as for the MPS and LSES bow and stern seals.

SWBS 200 PROPULSION

A. Labor Hours (except 233, 248)

The labor hours required to install the conventional portion of the RDF propulsion system are assumed to be a share of the hours estimated for the entire propulsion group. SWBS 200 includes the lift system in addition to the gas turbines, gearboxes, shaftlines, props, and related support equipment which comprise the more typical configuration. The total estimated labor hours are allocated between the conventional and lift system components based on their proportionate weight (356 LT and 238.5 LT respectively, approximately a 60/40 ratio). The total manhours for SWBS 200 are estimated by assuming an average monthly manloading of 100 people over an 18 month period, from month 18 through 35 for example. This yields a total manhour estimate of about

302,500 hours at 168 manhours/month, of which 60% is associated with the installation of the more conventional propulsion components.

	Labor Hours
SWBS 200 (esc. 233, 248)	181,500

On a weight basis, this yields a CER of about 509 hrs/LT or .227 hrs/lb.

B. Material Cost (except 233, 248)

Design definition within SWBS 200 is characteristically good and is sufficient to support the solicitation of vendor quotes. Vendor quotes for some items have been requested and received for earlier ship design cost estimates and may be expressed in pre FY 81 $. In such cases, the OSD approved composite inflation factors (of April 1980) are applied to such quotes to restate them to FY 81 $. Equipment comprising the conventional propulsion system for which vendor quotes are available includes:

		WT, LT[1/]	%	$,000's
234	Gas Turbines (4)	67	18.8	16,000[2/]
241	Reduction Gearing	152	42.7	12,110[3/]
242	Clutches & Couplings			
243	Shafting (4 lines)	84	23.6	8,700[4/]
244	Bearings			
245	CP Props (4)			
252	Propulsion Control	1	.3	--[5/]
		304	85.4	36,810

1/ Since the total weight of the RDF is the same as given in the LSES technical report, the weight of individual components in each ship is assumed to be identical.

2/ (4) GE LM 5000's @ $4,000K each. Includes the cost of local propulsion control and monitoring equipment.

3/ Uprated version of CINTI gearboxes quoted for the MPS, which weighed 120 LT. The $/lb CER implicit in that quote for recurring cost ($6,748K, FY 80) is restated to FY 81 $ (multiplied by 1.109) and applied to the weight of the RDF gearboxes. Nonrecurring costs ($2,372K, FY 80) are restated to FY 81 $ (using the same factor) and added to the total computed for recurring costs.

$6,748 x 1.109 x (152/120) = $ 9,479K
$2,372 x 1.109 = $ 2,631K
$12,110K

4/ Per Dennis Corrado of Bird-Johnson, licensee for KAMEWA, $8,200K + 500K for testing.

5/ Local controls and monitoring equipment are included in the cost of the engine.

Propulsion support equipment for which vendor quotes are unavailable includes:

		WT, LT
251	Combustion Air System	24
259	Exhaust System	15
261	Fuel Service	1
262	Lube Oil Service	7
298	Operating Fluids	4
299	Repair Parts	1

Since the weight for SWBS 251 and 259 is the same as for the MPS, it is assumed that the systems are similar enough so that the MPS estimate can serve as the basis for the RDF estimate. Only the material portion of the MPS estimate for intake and exhaust cost is restated; however, since the SWBS 200 labor hour CER already provides for the hours necessary to fabricate the systems. The material costs from the MPS, restated to FY 81 $, are used to estimate the cost of the RDF systems and results in the following:

251	Combustion Air	417,000 x 1.109 = 462,000
259	Exhaust System	393,000 x 1.109 = 436,000
		898,000

For SWBS 260, a simple percentage is applied to the cost of the engines (excluding the lift diesels) and gearboxes. For the sake of conservatism, 5% of the cost of SWBS 234 and 241 is provided to cover the cost of SWBS 260 equipment. This yields a total of about $1,406K for SWBS 260 as it relates to the more conventional portion of the propulsion system.

The cost of operating fluids (SWBS 298) is included within the estimated cost of SWBS 260 above. The estimated cost of SWBS 200 spares (SWBS 299) is included in the total of $500,000 provided in the general element of cost, SPARES.

Therefore, the total estimated material cost for the non-lift portion of the propulsion system is:

		$,K
234	Gas Turbines	16,000
241	Reduction Gearing	12,110
242	Clutches & Couplings	
243	Shafting	8,700
244	Bearings	
245	CP Props	
250	Propulsion Support	898
260	Fuel, Lube Oil	1,406
SWBS 200 (exc. 233, 248)		39,114

A. Labor Hours (SWBS 233, 248)

The labor hours required to install the lift system portion of the RDF propulsion system are assumed to be a share of the hours estimated for the

entire propulsion group. In addition to the gas turbines, gearboxes, shaftlines, props, and related support equipment which comprise the more typical propulsion system configuration, SWBS 200 in the RDF estimate includes all of the lift system components except seals. The total estimated labor hours are allocated between the conventional and lift system components based on their proportionate weight (356 LT and 238.5 LT respectively, approximately a 60/40 ratio). Labor hours for SWBS 200 are estimated by assuming an average monthly manloading of 100 people over an 18 month period, from month 18 through 35, for example. This yields a total manhour estimate of about 302,500 hours at 168 manhours/month, of which 40% is associated with the installation of the lift system components.

	Labor Hours
SWBS 238, 248	121,000

On a weight basis, this yields a CER of about 509 hrs/LT or .227 hrs/lb.

B. Material Cost, SWBS 233, 248

Material costs associated with the lift portion of the propulsion system are estimated here. Excluding the weight of the seals (41.5 LT), the lift system weight distribution is as follows:

		WT, LT
233	SACM 240 V20 RVR (6) diesels with accessories	162.0
248	Acrophysics DWDI fans (6), with accessories	35.4
	Sub-bases Air distribution system Combustion support Lube/fuel oil systems	41.1
		238.5

Vendor quotes have been previously solicited for the engines and lift fans. They are as follows:

233	(6) SACM 240 V20 RVRs	9,977[1/]
248	(6) Aerophysics fans	5,175[2/]

1/ F. W. Donnelly's quote of $1,484,400 (FY 80 $, French Franc @ $.24) restated to FY 81 $ (multiplied by 1.109) with an additional $100,000 provided for 2 extra clutches for the CODOG diesels and a dynamic analysis for the aft fan engines. Includes reduction gearboxes.

2/ Aerophysics quote of $777.8K (FY 80 K) per fan restated to FY 81 (multiplied by 1.109). Ship set of 6.

The weight of the remaining lift system equipment (41.1 LT) is assumed to be distributed among the systems listed below in the same proportion as calculated for each out of the MPS and LSES Technical Reports. This rational results in the following distribution of weight.

		WT,LT
248	Sub-bases	19.9
	Air distribution/control	14.9
	Combustion support	3.6
	Fuel/Lube oil	2.7
		41.1

It is assumed that these sub bases will be fabricated out of HY 100 steel, so the same $/lb. CER as used in the hull is applied to the weight of the sub bases ($.865/lb.). This results in an estimated cost of about $39,000 for sub base material (labor hours to fabricate these sub bases are estimated elsewhere).

The air distribution and control system is assumed to be fabricated out of thin gauge mild steel. For the sake of conservatism, the same $/lb. CER is applied to the mild steel as to the HY 100. This results in a material cost estimate of about $29,000 for the air distribution system (labor hours to fabricate and install the system have already been estimated).

To estimate the material cost related to combustion support systems, the $/lb. CER calculated for SWBS 250 ($10.28/lb.) is applied to the weight of such systems in SWBS 248. The resultant material cost estimate is about $83,000.

The material cost for fuel and lube oil systems is estimated according to the same rationale as applied to other propulsion equipment, i.e. a % is applied to the cost of the equipment it supports, in this case, diesel engines, fans, and reduction gearboxes. The same factor of 5% is applied to a total cost of $15,152K, yielding a total estimated cost of about $758,000.

The total estimated material cost for the lift portion of the propulsion system is thus:

233	Diesel engines	9,977
248	Fans	5,175
	Sub-bases	39
	Air distribution	29
	Combustion support	83
	Fuel/lube oil support	758
		16,061

The total for SWBS 200 is therefore:

SWBS 200, exc. 233, 248	39,114
SWBS 233, 248	16,061
	55,175

SWBS 300 ELECTRIC PLANT

A. Labor Hours

Since the LSD-41 and the RDF have the same electric plants, are similar in size and mission, and provide about the same level service, the weight based CER calculated out of available LSD-41 data, 766 hrs/LT (232,500 hrs ÷ 303.6 LT), is applied to the weight of the RDF's system. The labor hour estimate is thus:

	WT,LT	Hrs/LT	Labor Hours
300 Electric Plant	306	766	234,400

Assuming this activity takes place over 16 months between months 25-40, an average manloading (at 168 manhours per month) of about 87 men is provided.

B. Material Cost

Since the LSD-41 and RDF plants are nearly identical, the cost of the RDF plant is estimated by applying the weight based CER calculted for the LSD-41 ($17.58/lb.) to the weight of the RDF electric plant. Estimated material cost is therefore:

	WT,LT	$/lb.	Mat'l $
300 Electric Plant	306	17.58	12,050,000

SWBS 400 COMMUNICATION AND SURVEILLANCE

A. Labor Hours

Like the MPS, the RDF communication suite is basically a commercial system upgraded only in those areas where the ship's military mission requires it. The similarity betwen the MPS and RDF systems is further confirmed by their respective weight statements, 22.9 LT for the MPS vs 23.0 for the RDF. Thus, the appropriate estimating rationale should, like the MPS's, draw extensively on available data relating to ships whose communications gear is similar in concept. Ships fitting this description for which labor hour data is available include the LSD-41 and the 3 commercial oiler (T-AO) cost estimates funded by the Navy. From this data, the selection of a labor hour CER of 1000 hrs/LT seems reasonable. The resulting labor hour estimate is:

	WT,LT	Hrs/LT	Labor Hours
400 Comm & Surv	23.0	1,000	23,000

Assuming installation of the communications and surveillance gear occurs over an 11 month period (between months 30-40), an average manloading of over 12 men per month is provided (168 manhours/month).

B. Material Cost

Since the MPS and RDF systems are so similar in terms of weight, the system are assumed to be essentially the same. To estimate the material cost of the RDF's system, the cost of the one estimated for the MPS is adopted, having been restated to FY 81 $ (multiply the MPS estimate by 1.109).

	Material $
SWBS 400 Comm & Surv	4,250,400

The above estimated cost includes approximately $2,911,100 for the Integrated Ship Control System (SWBS 438).

SWBS 500 AUXILIARY SYSTEMS

A. Labor Hours

Since the RDF and LSD-41 are quite similar in terms of mission and accommodations, the weight based labor hour CER derived from the LSD-41 (538 hrs/LT) is applied to the weight of the RDF's auxiliary systems. This rationale yields the following estimate:

	WT,LT	Hrs/LT	Labor Hours
SWBS 500 Auxiliaries	965	538	519,200

Assuming this activity occurs over a period of 21 months, between months 20 and 40, an average manloading of over 147 men per month is provided (168 manhours/month).

B. Material Cost

For the same reasons as detailed above, the weight based CER calculated from LSD-41 data ($19,812/LT) is applied to the weight of the RDF's auxiliary systems, yielding an estimate of:

	WT,LT	$/lb.	Mat'l $
SWBS 500 Auxiliaries	965	19,812	19,119,000

SWBS 600 OUTFIT AND FURNISHING

A. Labor Hours

Although the RDF and LSD-41 are very similar in accommodations, overall size, and mission, some characteristics peculiar to the RDF design (an SES with an aluminum superstructure) require caution when selecting a CER for this group. In view of labor hour CERs available for LSD-41, LHA-1, MPS, 3KSES, T-AO, and

AO-177 ship types, a labor hour CER of 550 hrs/LT seems reasonable. This results in a labor hour estimate of:

	WT,LT	Hrs/LT	Labor Hours
SWBS 600 O & F	780	550	429,000

Assuming that performance occurs over a 21 month period between months 20 and 40, an average manloading of nearly 122 equivalent men per month is provided for (168 manhours/month).

B. Material Cost

The CER of $5040/LT used to estimate the cost of material on the MPS is well supported by data which became available later, so this same CER (restated to FY 81 $) is used to estimate the cost of SWBS 600 material on the RDF.

	WT,LT	$/lb.	Mat'l $
SWBS 600 O & F	780	5,589	4,359,400

SWBS 700 ARMAMENT

No such equipment is planned for the RDF; thus there are no labor hours or material to be estimated for this group.

MARGINS

The margins for labor hours and dollars and for material dollars are computed at 10% of the SWBS 100-700 totals, as is the weight margin. This procedure is equivalent to assuming that weight growth would tend to be distributed over the various weight groups and subgroups in the same proportions as contained in the SWBS 100-700 estimates. Average manloading is not calculated.

SPARES

The cost of onboard spares is estimated at $500,000 and is reflected in the material cost of the lead RDF and all follow ships. Shore based spares are considered part of the general ship support costs (SCN category 533).

SWBS 800 DESIGN & INTEGRATION (DES/NTE)

A. Labor Hours

Engineering and engineering support hours are provided for in this group to permit the accomplishment of tasks in areas such as:

(1) contract design
(2) detail design drawings and specifications
(3) engineering calculations, test, and evaluation
(4) production engineering
(5) quality assurance planning and implementation
(6) ILS engineering
(7) project management - contractor

For the RDF, the total labor hours estimated in SWBS 800 (all engineering) are the sum of two different average manloading profiles assumed as a result of consultation with PMS 304 technical staff members. For the first 24 months of the program, an average manloading of 200 men per month is assumed (at 168 manhours/month). For the remaining 18 months of the program, average manloading is assumed to be 100 men per month. This rationale yields a total manhour estimate of 1,108,800 hours for SWBS 800, approximately 28.5% of 100-700 plus Margins.

B. Material Cost

The cost of SWBS 800 material is estimated by applying a $/hr. CER to the estimated labor hours for this group (1,108,800). From the 10/12/76 B & F proposal for the 3KSES (Part II) submitted by Rohr Marine, Inc., about $1.00 of material cost (in FY 78 $, on the average) was provided for every hour of labor in SWBS 800. The 12/15/78 Change Proposal amended the 10/12/76 B & F and revealed a CER of about $.60/hour of SWBS 800 labor. For the sake of conservatism the 10/12/76 CER of $1.00/hr is selected. It is restated to FY 81 $ through application of the OSD approved composite inflation factor of 1.349. This yields an estimate of $1,495,800 for SWBS 800 material. This estimate covers the cost of design related materials and subcontract services.

SWBS 900 ASSEMBLY & SUPPORT SERVICES

A. Labor Hours

Tasks performed under this SWBS group include:

(1) Module and sub-assembly construction and erection. Hours are often accumulated against these modules and sub-assemblies as a monitoring device and are subsequently prorated to their appropriate SWBS elements.

(2) Contract and production supprt services including trials, test and inspection, and data administration.

(3) Construction support services, including material handling services and non-recurring costs associated with jigs, fixtures, and special tooling.

For the RDF, an average manloading of 125 men is assumed over the 42 month period from contract award to ship delivery. This yields a labor hour estimate of 882,000 hours for SWBS 900 tasks, approximately 22.7% of the total hours in SWBS 100-700 and Margins. The resultant percentage is somewhat lower

than NAVSEA experience indicates, but the RDF's hull labor hour CERs were chosen so as to estimate all hull fabrication hours in SWBS 100.

B. Material Cost

A CER of 3% of the material cost in SWBS 100-700 plus Margins and Spares is selected to provide for the cost of purchased parts and raw material relating to tooling expenses.

	SWBS 100-700 + Margins & Spares	x 3%
900 Assembly and Support	$119,607,000	$3,588,200

PROFIT

The RDF will be procurred under a Cost Plus Fixed Fee (CPFF) contract administered by NAVSEA. Therefore, a fee (or profit) of 15% is added to the sum of 100-900 costs. This profit rate is consistent with NAVSEA estimating guidance.

4.2 GROUND RULES, ASSUMPTIONS, AND ESTIMATING RATIONALE: FIRST PRODUCTION SHIP (RDF 2)

Taking the cost of the lead RDF as a base, the following adjustments are made to estimate the cost of the 1st production ship:

1. CINTI's nonrecurring costs relating to gearbox design and tooling are deleted from SWBS 200. Cost reduction, $2,631,000.

2. The remaining material cost in SWBS 100-700 is reduced by 2% to account for cost savings expected from learning. Cost reduction, $2,113,000.

3. Margin costs (material) are computed at 10% of SWBS 100-700 costs. Since the 1st production ship's SWBS 100-700 estimated material costs are $4,744,000 less than those for the lead ship, the material cost margin is $474,400 less.

4. 50% of the cost of material in SWBS 800 is deleted since it represents a nonrecurring cost associatd with converting the contract design to a detailed ship design. Cost reduction, $748,000.

5. 50% of the original material cost estimated for jigs, fixtures, etc. (SWBS 900) is deleted. Cost reduction, $1,794,000.

6. The remaining estimated material costs in Spares, SWBS 800, and SWBS 900 are reduced by 2% to reflect cost reductions expected as a result of learning. Cost reduction, $60,800.

7. A 90% learning curve is applied to SWBS 100-700 and Margins labor hours. Therefore, the lead ship labor hour estimate is reduced by 388,300 hours. Cost reduction, $8,496,000.

8. Appendix F, pg. F-23 of the AMSHIP Study (Center for Naval Analysis, April 1980), indicated that SWBS 800 labor hours follow a 64.9% learning curve. Therefore, 35.1% of the Lead RDF's hours are dropped. This represents a reduction of 389,200 labor hours and a cost reduction of approximately $10,002,400.

9. Labor hours for SWBS 900 are estimated at 21% of those within SWBS groups 100-700 plus Margins. This results in a reduction of 148,200 hours. Cost reduction, $3,242,600.

4.3 GROUND RULES, ASSUMPTIONS, & ESTIMATING RATIONALE: FOLLOW SHIPS

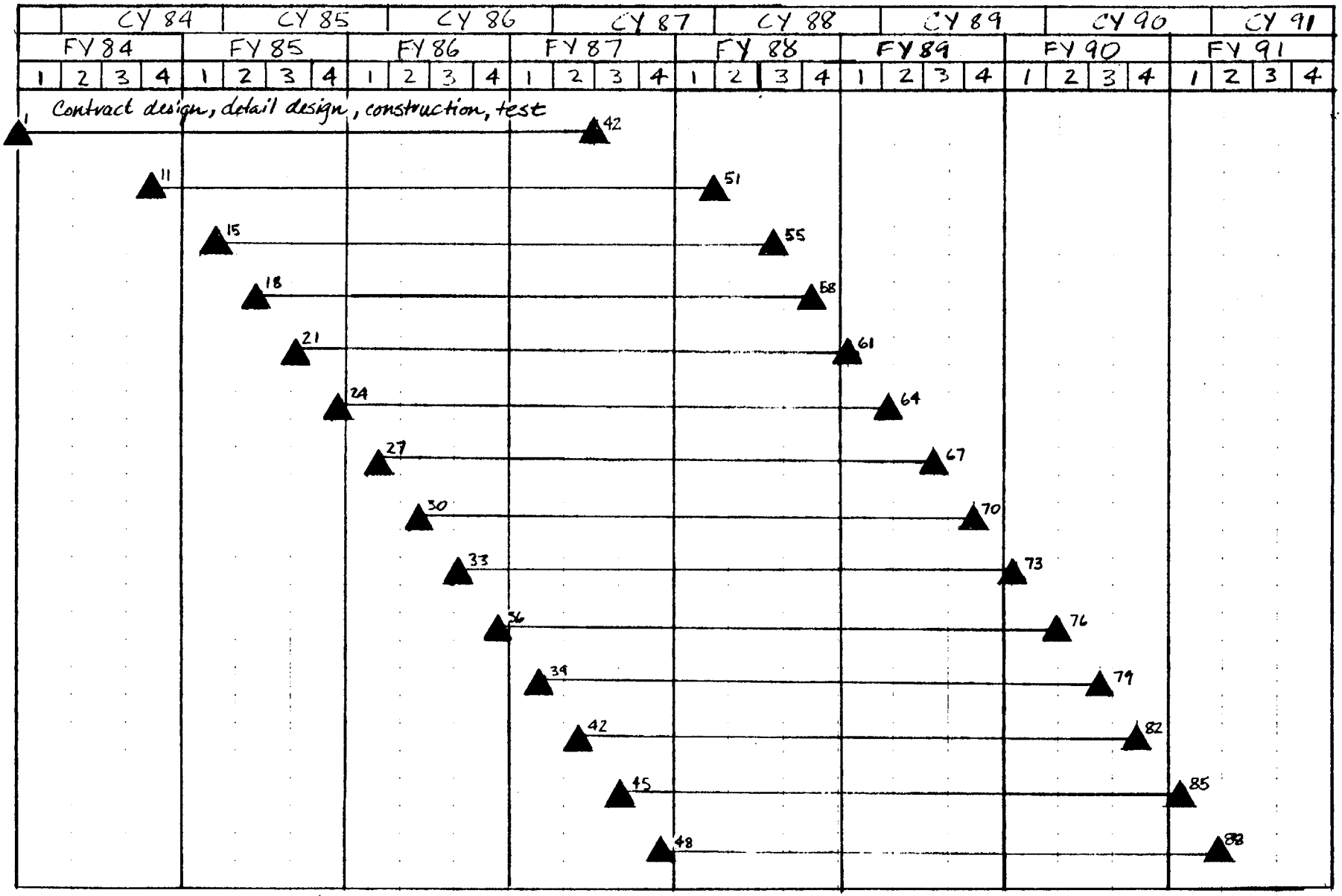
All adjustments made to the lead RDF that are reflected in the cost estimate for the 1st production ship apply to follow production ships. However, labor hours relating to SWBS 100-700, Margins, and SWBS 900 for these ships are further reduced based on a 90% learning curve (unit type) beginning with the lead ship. SWBS 800 hours continue to be reduced along the 64.9% unit learning curve discussed in Section 4.2.

Material costs are reduced along a 98% learning curve and are added to the labor and overhead cost calculated for each follow ship to derive the cost (before profit) of each ship. As in the case of the lead ship and the 1st production ship, profit on each follow ship is assumed to be equal to 15% of the labor, overhead, and material cost of each ship.

5. SCHEDULE

Figure 5-1, page 5-2, presents the RDF production schedule. The acquisition will be administered by NAVSEA with the lead ship procured on a cost plus basis and the 13 follow production ship contracts awarded on a fixed price basis. The program will be executed in a single shipyard, which will be responsible for contract design, detail design, ship construction, test, and delivery of each RDF. The lead ship is scheduled for delivery 42 months after contract award. Each follow production ship is built over a 41 month build cycle with construction beginning on the first follow production ship 10 months after contract award. The first production ship is thus delivered 9 months after the lead ship with subsequent deliveries at 3 month intervals (except for RDF 3, which is delivered 4 months after RDF 2).

RDF ACQUISITION SCHEDULE



All start dates are from the 1st of the month noted
All delivery dates are on the last day of the month indicated

FIGURE 5-1

6. MANPOWER DISTRIBUTION OVER TIME

Monthly manpower requirements are estimated for the lead ship, the first production ship, and the 14 ship program. In order to convert the total manning estimate to a time-phased plan, a 50/25/25 manning profile was used. It was applied in turn to the lead ship, the 1st production ship, and the 14 ship series. The resultant manpower spreads are shown graphically in Figures 6-1, 6-2, 6-3, and are presented in tabular fashion in Tables 6-i, 6-ii, and 6-iii. The manning profile selected (50/25/25) is a modified version of the manufacturing profile used by NAVSEA 0713, Shipwork Industry Capacity and Capability Branch.

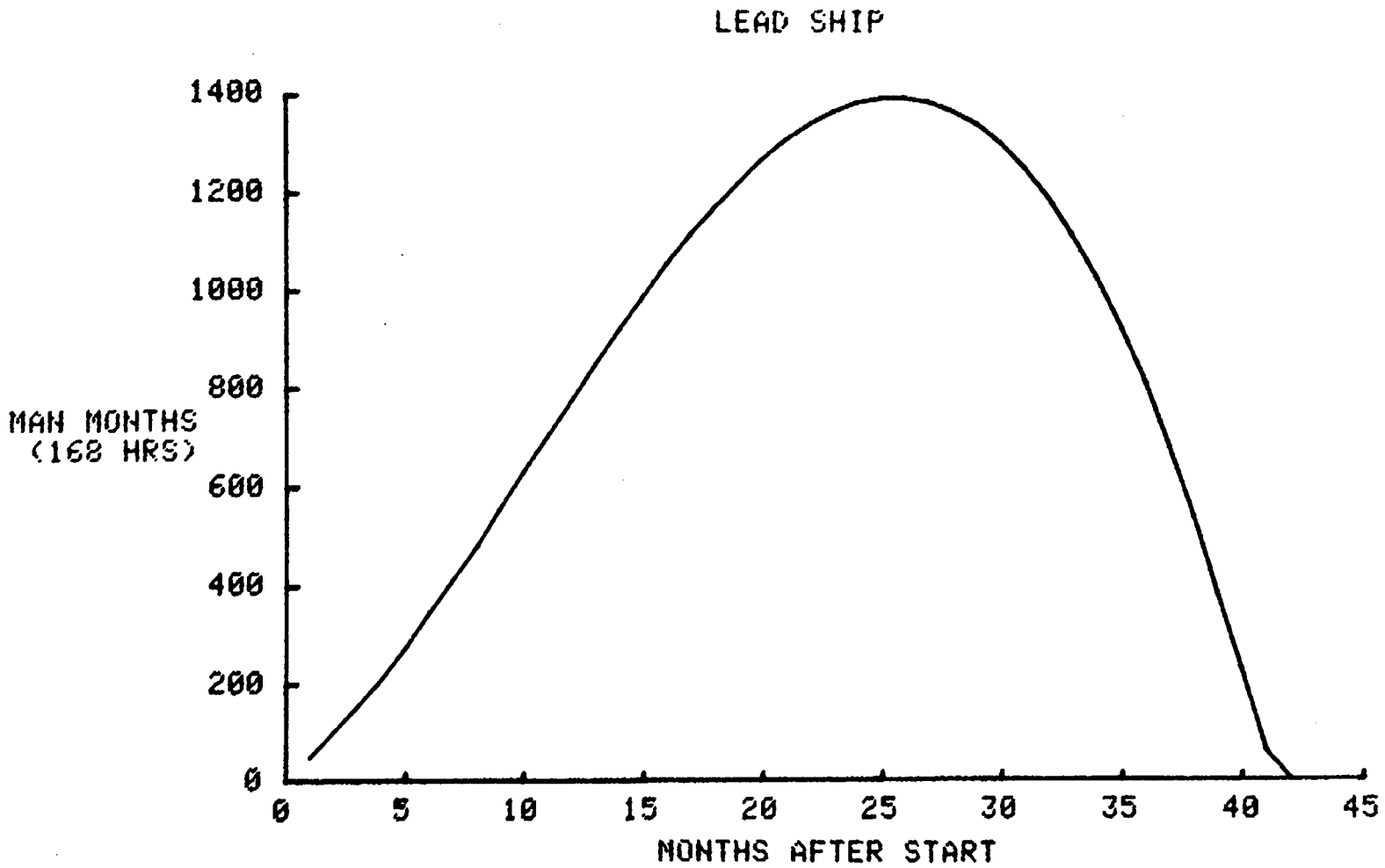

LEAD SHIP
1400
1200
1000
800
600
400
200
0
MAN MONTHS
(168 HRS)
0
5
10
15
20
25
30
35
40
45
MONTHS AFTER START

FIGURE 6-1

	MONTHLY M/P	CUM M/P
1	50.42	50.42
2	99.74	150.16
3	154.42	304.58
4	213.80	518.37
5	277.21	795.59
6	344.01	1,139.60
7	413.52	1,553.12
8	485.09	2,038.20
9	558.05	2,596.25
10	631.74	3,227.99
11	705.50	3,933.49
12	778.67	4,712.16
13	850.59	5,562.75
14	920.60	6,483.35
15	988.03	7,471.37
16	1,052.22	8,523.60
17	1,112.47	9,636.07
18	1,168.24	10,804.31
19	1,218.95	12,023.26
20	1,264.08	13,287.34
21	1,303.10	14,590.44
22	1,335.51	15,925.95
23	1,360.77	17,286.72
24	1,378.38	18,665.10
25	1,387.81	20,052.90
26	1,388.54	21,441.44
27	1,380.06	22,821.50
28	1,361.84	24,183.33
29	1,333.37	25,516.70
30	1,294.12	26,810.83
31	1,243.59	28,054.42
32	1,181.24	29,235.66
33	1,106.57	30,342.23
34	1,019.05	31,361.28
35	918.16	32,279.43
36	803.46	33,082.89
37	675.53	33,758.42
38	535.63	34,294.05
39	385.02	34,679.07
40	224.97	34,904.04
41	56.76	34,960.80
42	0.00	34,960.80

TABLE 6-i

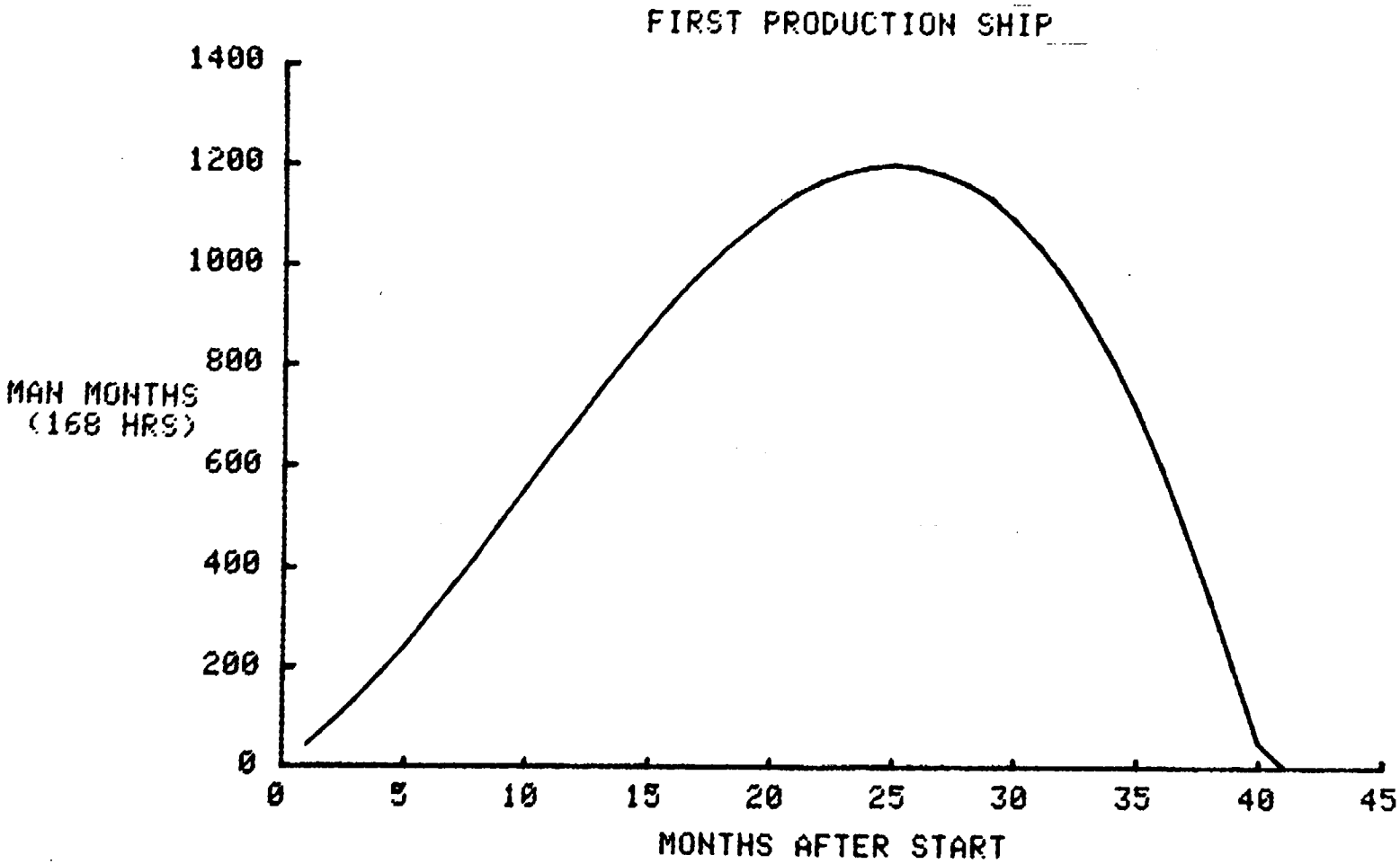

FIRST PRODUCTION SHIP
1400
1200
1000
800
600
400
200
0
MAN MONTHS
(168 HRS)
0
5
10
15
20
25
30
35
40
45
MONTHS AFTER START

FIGURE 6-2

	MONTHLY M/P	CUM M/P
1	44.04	44.04
2	87.81	131.85
3	136.42	268.27
4	189.26	457.53
5	245.72	703.25
6	305.16	1,008.41
7	366.99	1,375.40
8	430.59	1,805.99
9	495.33	2,301.33
10	560.62	2,861.95
11	625.82	3,487.77
12	690.34	4,178.10
13	753.54	4,931.64
14	814.82	5,746.46
15	873.56	6,620.03
16	929.15	7,549.18
17	980.93	8,530.11
18	1,028.44	9,558.55
19	1,071.16	10,629.71
20	1,108.58	11,738.29
21	1,140.25	12,878.54
22	1,165.67	14,044.21
23	1,184.36	15,228.57
24	1,195.83	16,424.40
25	1,199.61	17,624.01
26	1,195.22	18,819.23
27	1,182.16	20,001.39
28	1,159.96	21,161.35
29	1,128.14	22,289.49
30	1,086.20	23,375.69
31	1,033.68	24,409.38
32	970.09	25,379.46
33	894.93	26,274.40
34	807.74	27,082.14
35	708.07	27,790.21
36	596.25	28,386.46
37	473.45	28,859.91
38	340.82	29,200.73
39	199.57	29,400.30
40	50.87	29,451.17
41	0.00	29,451.17

TABLE 6-ii

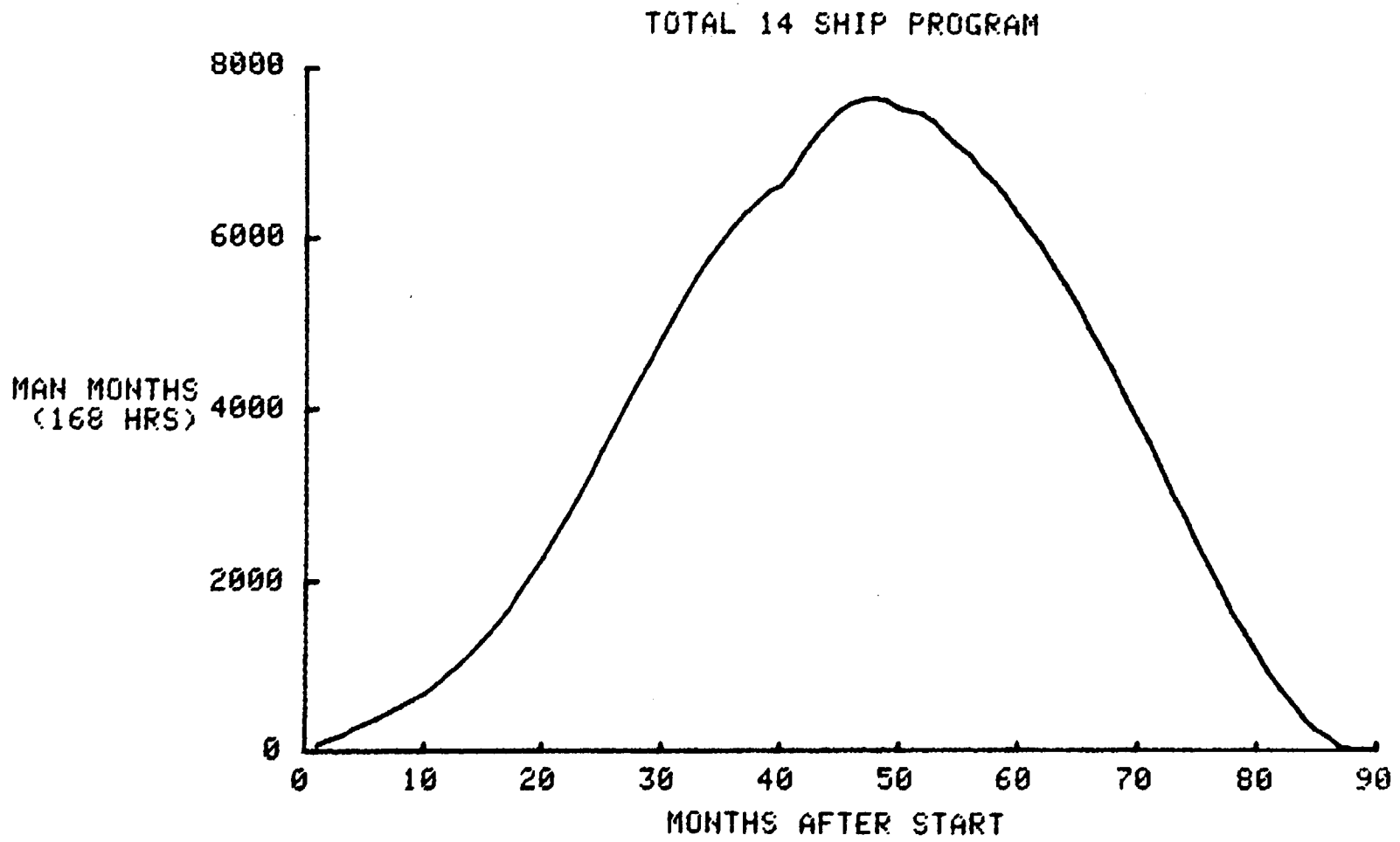

TOTAL 14 SHIP PROGRAM
MAN MONTHS
(168 HRS)
8000
6000
4000
2000
0
0
10
20
30
40
50
60
70
80
90
MONTHS AFTER START

FIGURE 6-3

	MONTHLY M/P	CUM M/P
1	52.28	52.28
2	104.24	156.51
3	161.95	318.46
4	224.67	543.14
5	291.69	834.82
6	362.26	1,197.08
7	435.65	1,632.73
8	511.15	2,143.88
9	588.01	2,731.89
10	665.51	3,397.40
11	786.95	4,184.34
12	907.30	5,091.65
13	1,030.95	6,122.59
14	1,156.53	7,279.12
15	1,323.07	8,602.19
16	1,488.62	10,090.82
17	1,656.47	11,747.29
18	1,862.92	13,610.21
19	2,067.90	15,678.11
20	2,274.07	17,952.18
21	2,515.51	20,467.69
22	2,753.36	23,221.05
23	2,989.55	26,210.60
24	3,256.37	29,466.97
25	3,515.74	32,982.71
26	3,768.93	36,751.65
27	4,046.68	40,798.32
28	4,311.60	45,109.92
29	4,564.45	49,674.37
30	4,834.78	54,509.15
31	5,085.56	59,594.71
32	5,317.16	64,911.87
33	5,558.00	70,469.87
34	5,771.46	76,241.33
35	5,957.49	82,198.82
36	6,144.56	88,343.38
37	6,298.26	94,641.64
38	6,420.07	101,061.71
39	6,538.54	107,600.25
40	6,619.53	114,219.77
41	6,787.72	121,007.49
42	7,013.66	128,021.15
43	7,201.61	135,222.76
44	7,350.84	142,573.60
45	7,486.95	150,060.55
46	7,575.52	157,636.07
47	7,617.08	165,253.15
48	7,638.11	172,891.26
49	7,605.15	180,496.41
50	7,519.16	188,015.57
51	7,482.00	195,497.58
52	7,443.34	202,940.92
53	7,349.78	210,290.70
54	7,199.42	217,490.12
55	7,085.84	224,575.96
56	6,963.89	231,539.85
57	6,785.44	238,325.29
58	6,638.94	244,964.23
59	6,482.14	251,446.37
60	6,270.01	257,716.37
61	6,087.45	263,803.82
62	5,894.41	269,698.23
63	5,648.19	275,346.41
64	5,431.06	280,777.47
65	5,204.76	285,982.24
66	4,928.48	290,910.71
67	4,682.47	295,593.18
68	4,429.88	300,023.06
69	4,131.44	304,154.50
70	3,865.69	308,020.20

TABLE 6-iii

	MONTHLY M/P	CUM M/P
71	3,597.02	311,617.22
72	3,287.46	314,904.68
73	3,014.13	317,918.81
74	2,742.53	320,661.34
75	2,435.83	323,097.16
76	2,169.97	325,267.14
77	1,911.44	327,178.58
78	1,624.47	328,803.05
79	1,383.97	330,187.03
80	1,157.35	331,344.38
81	909.78	332,254.15
82	715.31	332,969.46
83	542.18	333,511.64
84	356.46	333,868.09
85	231.41	334,099.50
86	135.50	334,235.00
87	34.54	334,269.53
88	0.00	334,269.53

TABLE 6-iii (cont.)

7. AREAS OF POTENTIAL PROGRAM COST REDUCTION

One of PMS 304's general estimating philosophies is that of conservatism. Therefore, some reasonable assumptions were rejected on the basis of their exhibiting a degree of optimism too high to be reconciled with the preference for a conservative approach. Nonetheless, the following items represent elements of cost reduction that are believed by PMS 304 to be reasonably attainable.

(1) Optimization of the hull structure may result in material cost and labor hour savings.

(2) The availability of laser welding technology would have a significant impact on labor hours required to fabricate the hull.

(3) A steeper learning curve than 90% may be attainable due to the RDF's hull form being suitable for automated production.

(4) The RDF program could be pursued in 2 shipyards, thus saving escalation costs.

(5) The program office maintains some control over the cost of change orders and would anticipate something like 5% for the lead and all follow RDFs, rather than the 12% and 8% used.

(6) PMS 304 would probably negotiate a fee of less than 15%.

(7) Escalation may be lower than currently estimated.

8. APPENDICES

APPENDIX A. RDF-SES PRINCIPLE CHARACTERISTICS

CONSTRUCTION

Structure	Welded High Strength Steel
Seals	Two Dimensional Bag and Fingers
Electrical	Four 1500 KW 60 Hz Diesel Generators
Steering	Electrical/Hydraulic

POWER PLANTS

Propulsion Engines (CODOG)	Four LM2500 Turbines and Two SACM Diesels
Lift Engines	Six SACM Diesel Engines (including CODOG)
Lift Fans	Six Mixed Flow Fans

DIMENSIONS

Length Overall (LOA) (ft)	686
Beam Overall (BOA) (ft)	105
Wet Deck Height (ft)	29
Cushion Pressure (psf)	600
Effective Cushion Length (L_C) (ft)	639
Effective Cushion Beam (B_C) (ft)	75
L_C/B_C	8.52
Cushion Area (ft^2)	42,925
Main Deck Height Above Keel (ft)	53

DRAFT

On Cushion (ft)	9
Off Cushion (ft)	18

CARGO SPACE

Cargo Deck Area (Gross) (636 x 105) ft^2	66,570

CREW AND TROOP ACCOMMODATIONS

Crew	100
Troop Max/Ship	895

APPENDIX A. RDF-SES PRINCIPAL CHARACTERISTICS (continued)

LSES WEIGHT ESTIMATES

SWBS Group	Description	Weight (LT)
100	Structures	3,644
200	Propulsion	356
300	Electric Plant	306
400	Comm & Surveillance	23
500	Auxiliary	965
600	Outfit & Furnishings	780
700	Armament	0
	SUBTOTAL	6,354
Design & Builder's Margin		635
Growth Margin		0
Light Ship		6,989
F 10 Crew & Personal Effects		12
F 15 Marines		96
F 30 Stores		47
F 40 Ships Fuel		2,900
F 50 Potable Water		27
F 60 Cargo		4,929
Total Variable Load		8,011
	TOTAL (FLD)	15,000

APPENDIX B. VENDOR QUOTES

PROGRAM END COST SENSITIVITY

Labor Cost, Lead RDF

1. Labor Cost, 100-700	$1.00
2. Margins	.10
3. 100-700, Spaces, Margins	1.10
4. SWBS 800	—
5. SWBS 900	—
6. Basic Construction Cost, FY81 $	1.10
7. Profit (.15 x 1.10)	.165
8. Platform Cost, FY81 $	1.265
9. Platform Cost, FY84 $	1.601
10. Support Cost (.175 x 1.601)	.280
11. Escalation (.2165 x 1.392)	.301
12. END COST, FY84 Program $	2.182

For every labor dollar saved in Groups 100-700, an additional $1.182 is saved in program end cost. At an average loaded labor cost of about $22.60, every labor hour saved in SWBS 100-700 on the lead ship results in an overall end cost reduction of $49.31.

7/16/81

PROGRAM END COST SENSITIVITY
Material Cost, Lead RDF

1. Material Cost, 100-700	$1.00
2. Margins (.10 x 1.00)	.10
3. 100-700, Spares, Margins	1.10
4. SWBS 800	—
5. SWBS 900 (.03 x 1.10)	.033
6. Basic Construction Cost, FY 81 $	1.133
7. Profit (.15 x 1.133)	.17
8. Platform Cost, FY 81 $	1.303
9. Platform Cost, FY 84 $	1.65
10. Support Cost (.175 x 1.65)	.289
11. Escalation (.2165 x 1.435)	.311
12. END COST, FY 84 Program $	2.250

For every material dollar saved in Groups 100-700, an additional $1.25 is saved in program end cost.

D 1/1 | 7/16/81

OPTIMISTIC PROGRAM END COST ESTIMATE: LEAD RDF

	000's			
	Labor Hours	Labor Cost	Material Cost	TOTAL COST
SWBS 100 Hull [1]	1010.8	22116	11,515	33,361
100-700 Total	2518.9	55,113	106,469	161,582
Margins (10%)	251.9	5,511	10,647	16,158
Spares			500	500
SUB TOTAL	2770.8	60,624	117,616	178,240
SWBS 800	1,108.8	28,496	1,496	29,992
SWBS 900	882.0	19,298	3,528	22,826
Total, exc. 800	3,652.8	79,922	121,144	201,066
Total, 100-900	4,761.6	108,418	122,640	231,058
Profit, 8% [2]				18,485
Platform Cost, FY 81 $				249,543
Platform Cost, FY 84 $				315,921
Support Cost (10.5%) [3]				33,172
Escalation (21.65%)				63,330
END COST, FY 84 Program $				412,423

[1] Laser welding saves 50% of labor hours, hull material (steel and aluminum) reduced by 20%

[2] Profit negotiated at 8%.

[3] Change orders held to 5%

CUMULATIVE COST COMPARISON[1]

1 yard vs 2 yard Program

	$000,000	
	1 YARD	2 YARDS
1. Loaded Labor $	919.8	1,081.8
2. Material $	1,562.8	1,594.8
3. Basic Construction Cost	2,482.6	2,676.6
4. Profit	198.6	214.1
5. Platform Cost, FY81	2,681.2	2,890.7
6. Platform Cost, FY84	3,394.4	3,659.6
7. Support Costs	356.4	384.3
8. Escalation	1,205.1	963.8
9. End Cost, FY84 Program $	4,955.9	5,007.7

[1] Cumulative costs reflect the optimistic program cost assumptions. See following pages for details

OPTIMISTIC ASSUMPTIONS: 1 YARD PROGRAM

PROGRAM END COST SUMMARY,$000'S

	FY1981 $000						FY1984 $000		
RDF	LOADED LABOR $	MATERIAL $	BASIC CONST.	PROFIT	PLATFORM COSTS FY81	PLATFORM COSTS FY84	SUPPORT COSTS	ESCA-LATION	END
1	108418	122640	231058	18485	249543	315921	33172	63330	412423
2	89180	114858	204038	16323	220361	278977	29293	64707	372977
3	78637	113509	192146	15372	207518	262718	27585	101073	391376
4	72086	112561	184647	14772	199419	252464	26509	97129	376102
5	67464	111831	179295	14344	193639	245147	25740	94313	365200
6	63955	111238	175193	14015	189208	239537	25151	92155	356843
7	61161	110740	171901	13752	185653	235037	24679	90424	350140
8	58860	110310	169170	13534	182704	231303	24287	88987	344577
9	56918	109932	166850	13348	180198	228131	23954	87767	339852
10	55245	109595	164840	13187	178027	225382	23665	86709	335756
11	53783	109290	163073	13046	176119	222967	23412	85780	332159
12	52488	109014	161502	12920	174422	220818	23186	84954	328958
13	51330	108760	160090	12807	172897	218888	22983	84211	326082
14	50285	108525	158810	12705	171515	217138	22799	83538	323475

TOTAL END COSTS = 4955920

NOTES: FY81 PLATFORM COST IS RESTATED TO FY 84 $ THROUGH APPLICATION OF THE DOD APPROVED INFLATION FACTOR OF 1.266 (APPROVED 4/80)

LABOR HOURS FOR 100-700, MARGINS, AND 900 FOLLOW A 85% LEARNING CURVE. SWBS 800 HOURS FOLLOW A 64.9% CURVE.

OPTIMISTIC ASSUMPTIONS: 2 YARD PROGRAM

PROGRAM END COST SUMMARY,$000'S

RDF	FY1981 $000 LOADED LABOR $	MATERIAL $	BASIC CONST.	PROFIT	PLATFORM COSTS FY81	PLATFORM COSTS FY84	FY1984 $000 SUPPORT COSTS	ESCA-LATION	END
1	108418	122640	231058	18485	249543	315921	33172	63330	412423
2	89180	114858	204038	16323	220361	278977	29293	64707	372977
3	78637	113509	192146	15372	207518	262718	27585	75288	365591
4	72086	112561	184647	14772	199419	252464	26509	72350	351323
5	67464	111831	179295	14344	193639	245147	25740	70252	341139
6	63955	111238	175193	14015	189208	239537	25151	68645	333333
7	61161	110740	171901	13752	185653	235037	24679	67356	327072

TOTAL END COSTS = 2503858

NOTES: FY81 PLATFORM COST IS RESTATED TO FY 84 $ THROUGH APPLICATION OF THE DOD APPROVED INFLATION FACTOR OF 1.266 (APPROVED 4/80)

LABOR HOURS FOR 100-700, MARGINS, AND 900 FOLLOW A 85% LEARNING CURVE. SWBS 800 HOURS FOLLOW A 64.9% CURVE.