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Approach to MOC
Follow. On
Planning

Main Briefing
+
Back-up material

WH5-071-2

APPROACH TO MOL FOLLOW-ON PLANNING

BRIEFING PURPOSE

- OBJECTIVES & RATIONALE FOR MOL FOLLOW-ON PLANNING
- PRELIMINARY "BASELINE" FOLLOW-ON PLANNING FRAMEWORK
- ACTIONS REQUIRED FOR IMPLEMENTATION OF THE PLANNING POSTURE
- PLANNING TASK PRIORITIES AND SCHEDULES
- FY'68 FUNDING ITEM IDENTIFICATION

POSSIBLE MOL PROGRAM FOLLOW-ON OPTION

(ESTIMATED COSTS)

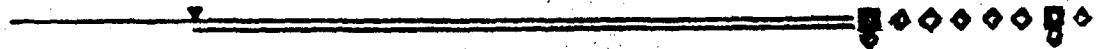
MOL DEVELOPMENT (OPTION 6)



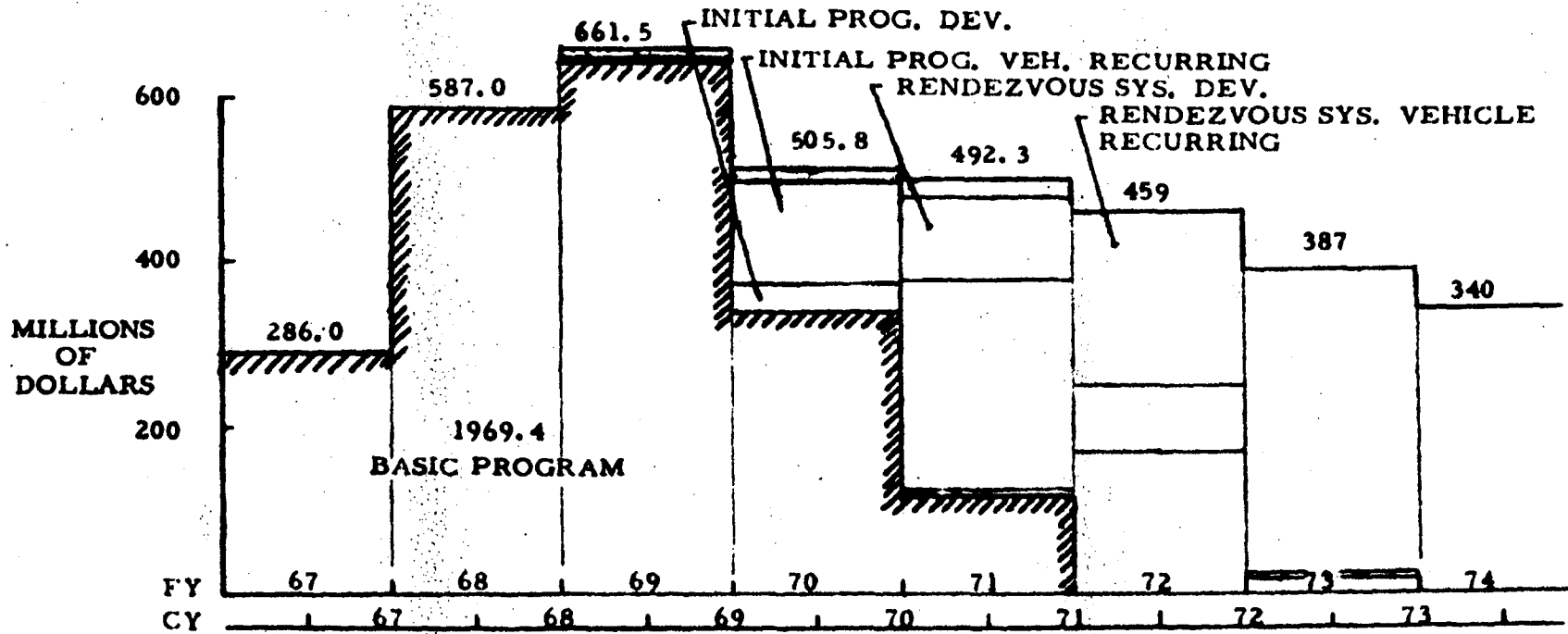
INITIAL FOLLOW-ON



RESUPPLY SYSTEM



CY 67 68 69 70 71 72 73 74



(ESTIMATED TOTAL PROGRAM COST (UP TO CY 1976) ~ 3.40 BS)

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MOL GROWTH OBJECTIVES




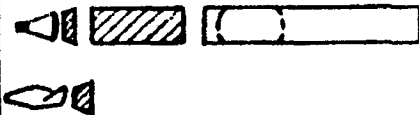



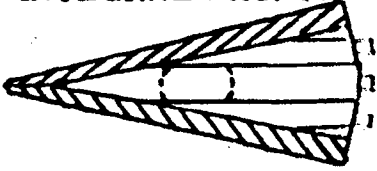
- IMPROVED SYSTEM ECONOMICS
 - ✓ INCREASED MISSION DURATION
 - ✓ EXTENDED UTILIZATION OF SYSTEM SEGMENTS

- IMPROVED OPERATIONAL FLEXIBILITY
 - ✓ RECALL/REPEATER CAPABILITY
 - ✓ CREW NUMBER INCREASE
 - ✓ ORBITAL ASSEMBLY
 - ✓ ORBITAL STORAGE
 - ✓ VULNERABILITY COUNTERMEASURES

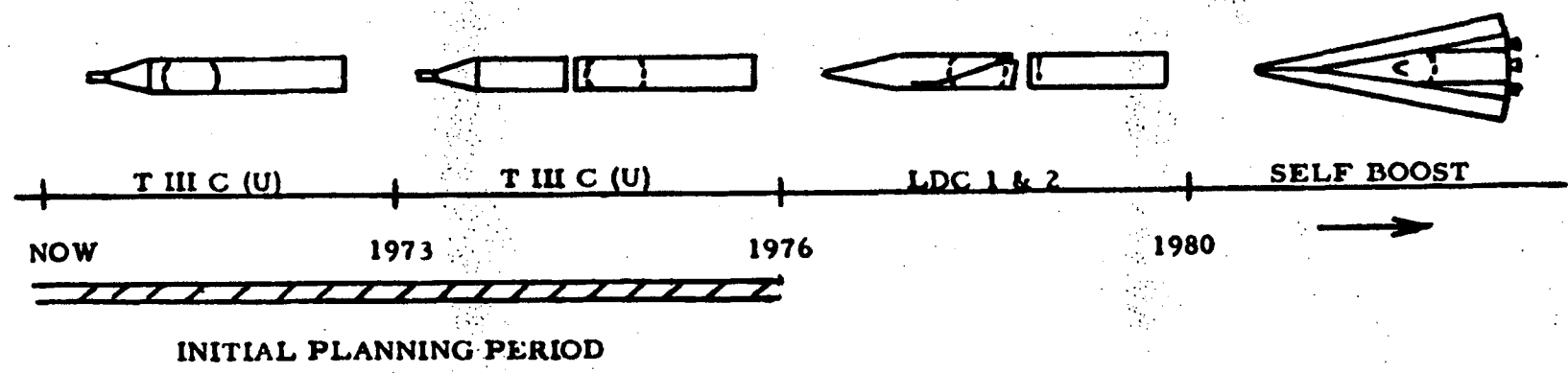
- IMPROVED MISSION PERFORMANCE
 - ✓ BASELINE P/L CAPABILITY
 - ✓ HIGHER RESOLUTION P/L
 - ✓ ADDITIONAL/COMPLIMENTARY P/L ELEMENTS
 - ✓ DATA RECOVERY TECHNIQUES

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POTENTIAL VEHICLE SYSTEM CONCEPTS

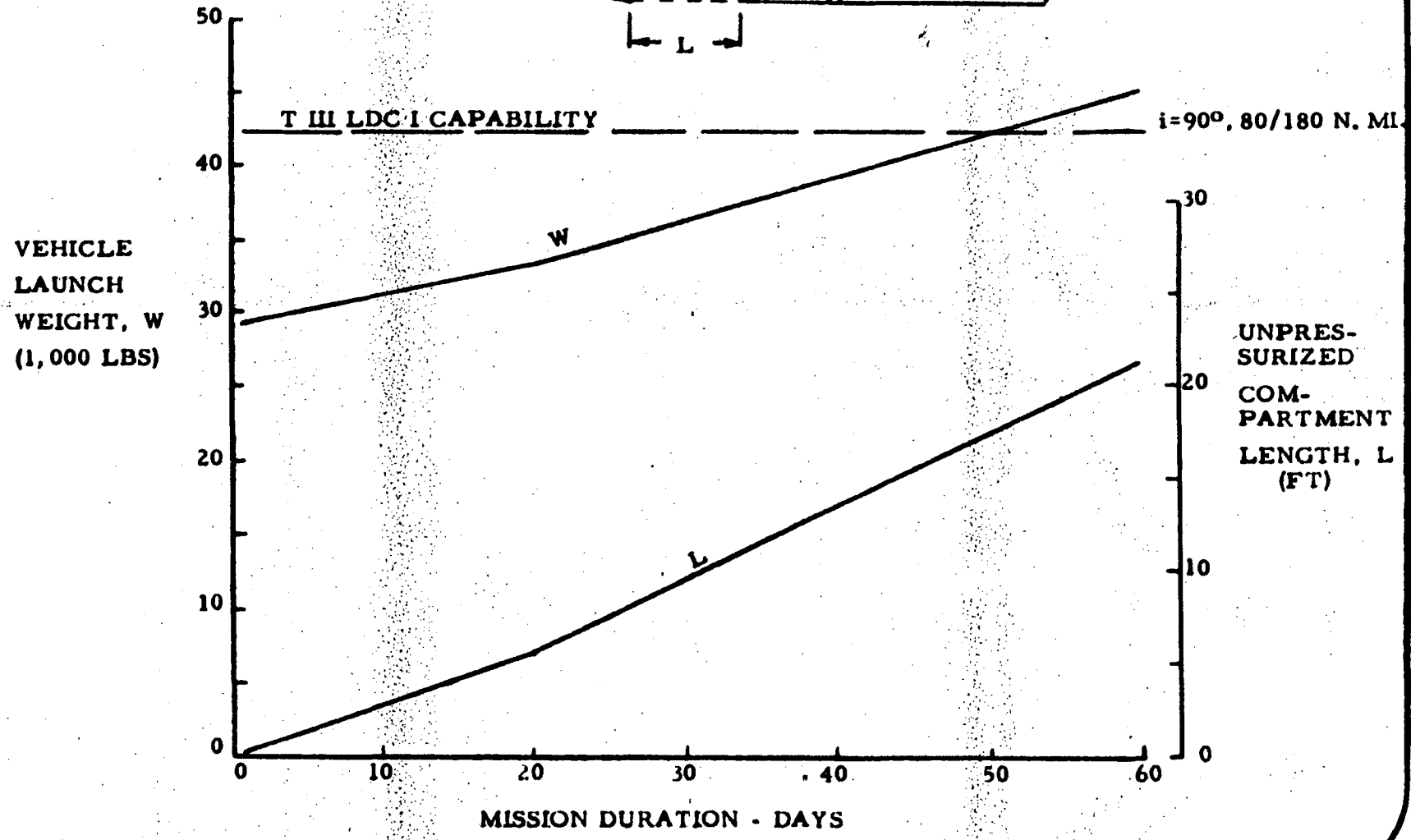
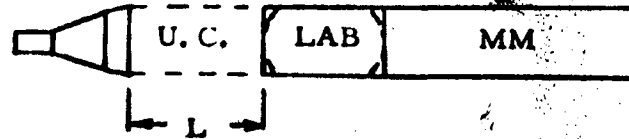
<p>I</p> <p>INTEGRAL LAUNCH</p>  <p>Dispose all Segments each Mission.</p>	<p>II</p> <p>INTEGRAL LAUNCH</p>  <p>Retrieve/Reuse R. E. V. each Mission - Dispose all other Segments.</p>	<p>III</p> <p>RENDEZVOUS/RESUPPLY</p>  <p>Dispose R. E. V. + Supply Module (RRV) each Resupply Mission - Revisit/Reuse Orbiting Vehicle for ~ 1 year cycle.</p>	<p>IV</p> <p>RENDEZVOUS/RESUPPLY</p>  <p>Dispose Supply Module each Resupply Mission - Retrieve/Reuse R. E. V. - Revisit/Reuse Orbiting Vehicle for ~ 1 year cycle.</p>
<p>V</p> <p>RENDEZVOUS/RESUPPLY</p>  <p>Retrieve/Reuse R. E. V. + Supply Module (RRV) each Resupply Mission - Revisit/Reuse Orbiting Vehicle for ~ 1 year cycle.</p>	<p>VI</p> <p>RENDEZVOUS/RESUPPLY</p>  <p>Retrieve/Reuse Integrated R. E. V. + Supply Module + Lab - Revisit/Reuse Mission Module Lab ~ 1 year cycle</p>	<p>VII</p> <p>INTEGRAL LAUNCH</p>  <p>Retrieve/Reuse fully Integrated R. E. V. + Lab + Supply Module + Mission Module. Dispose conventional booster only.</p>	<p>VIII</p> <p>INTEGRAL LAUNCH</p>  <p>Retrieve/Reuse fully Integrated R. E. V. + Lab + Supply Module + Mission Module + Propulsion Sys. Dispose propellant tanks and pressurization system only.</p>

POSSIBLE MOL GROWTH PERSPECTIVE



WHS-071-6

EXTENDED DURATION INTEGRAL LAUNCH (T III LDC-1)



WHS-071-7

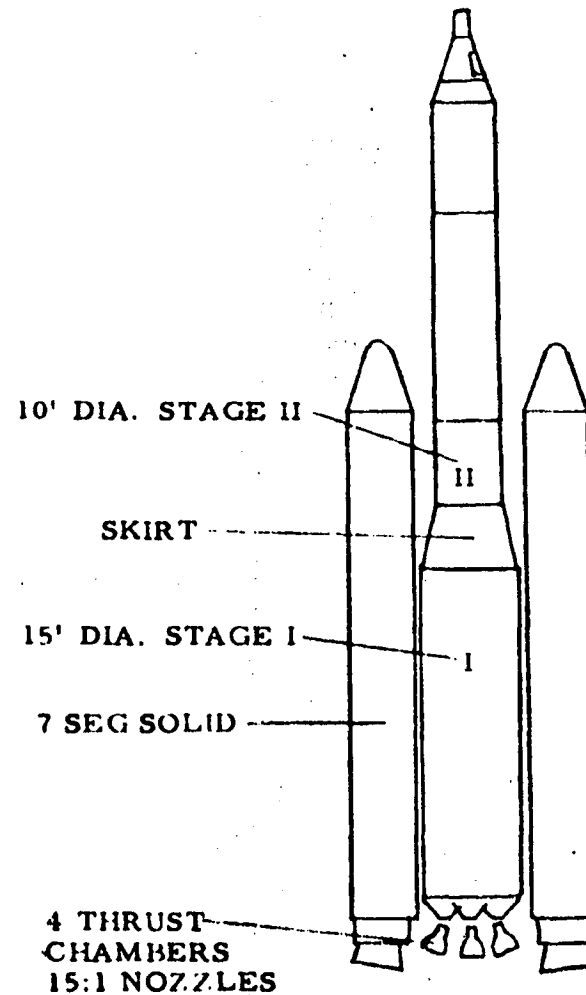


LARGE CORE TITAN III
STAGE I

- PAYLOADS ($i = 80^\circ$; 80/130 ORBIT)
 - .. LDC 1/7 SEG. -- 44,000 LBS.

- THIC (U) DEVELOPMENT PROVIDES
 - .. 15:1 NOZZLES
 - .. 7 SEGMENT SOLIDS

- LDC 1 CHANGES
 - .. STRUCTURES
 - .. PROPULSION SYSTEM
 - .. CONTROL SYSTEM



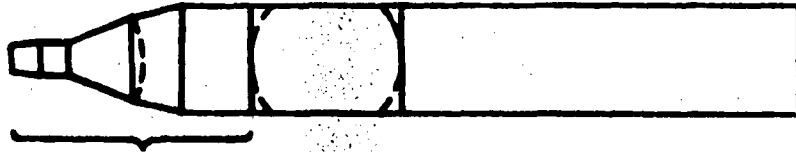
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RESUPPLY VEHICLE DERIVATION FROM MOL HARDWARE

BASELINE M/AM VEHICLE



GEMINI B
+
LABORATORY
UNPRESSURIZED
COMPARTMENT

BASELINE AM VEHICLE



DRV &
FILM HANDLING
SYSTEM

+
BASELINE SUBSYSTEM
COMPONENTS



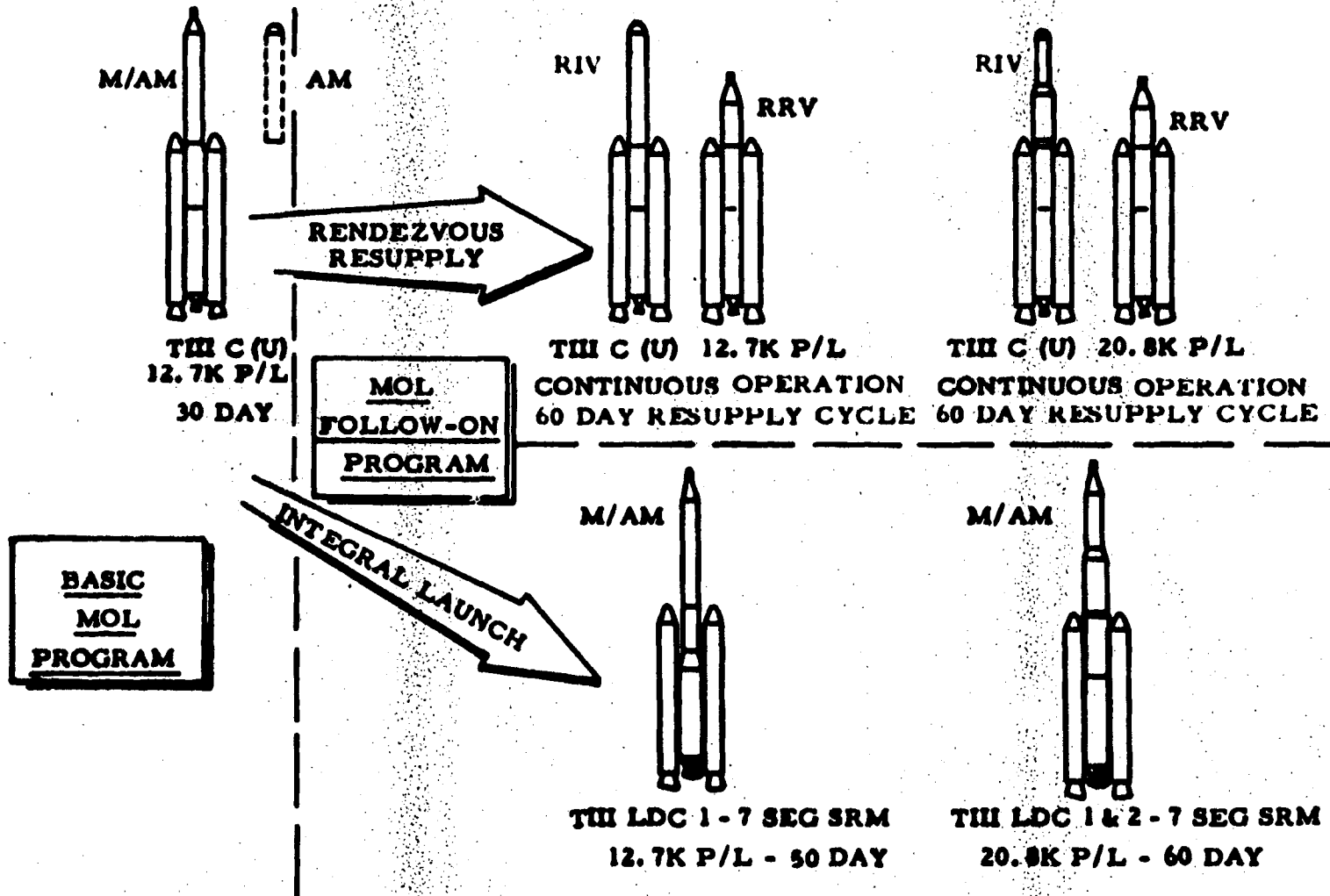
RENDEZVOUS RESUPPLY VEHICLE

GEMINI B +
LAB U.C. | EXTENDED
DURATION
MODULE

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GROWTH AVENUES

WHS-671-9



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COMPARISON OF ALTERNATIVE SYSTEM CAPABILITIES
FOR T I DATA RETURN

	<u>6 BASELINE M/AM FLIGHTS</u>	<u>6 LDC 1/50 DAY M/AM FLIGHTS</u>	<u>1 RIV* + 6 RRV FLIGHTS</u>
● TOTAL NUMBER OF CLEAR PHOTOGRAPHS/YEAR	13,308	24,400	29,200
● TOTAL NUMBER OF CLEAR, SPECIAL PHOTOGRAPHS/YEAR	1,344	2,110	2,540
● ANNUAL COST - M\$	<u>520.8</u>	<u>552.0</u>	<u>374.0</u>
● RELATIVE COST, PER C.S.P.	2.6	1.8	1.0
● RELATIVE COST, PER C.P.	3.1	1.8	1.0

RECURRING COST EST.
(M\$)

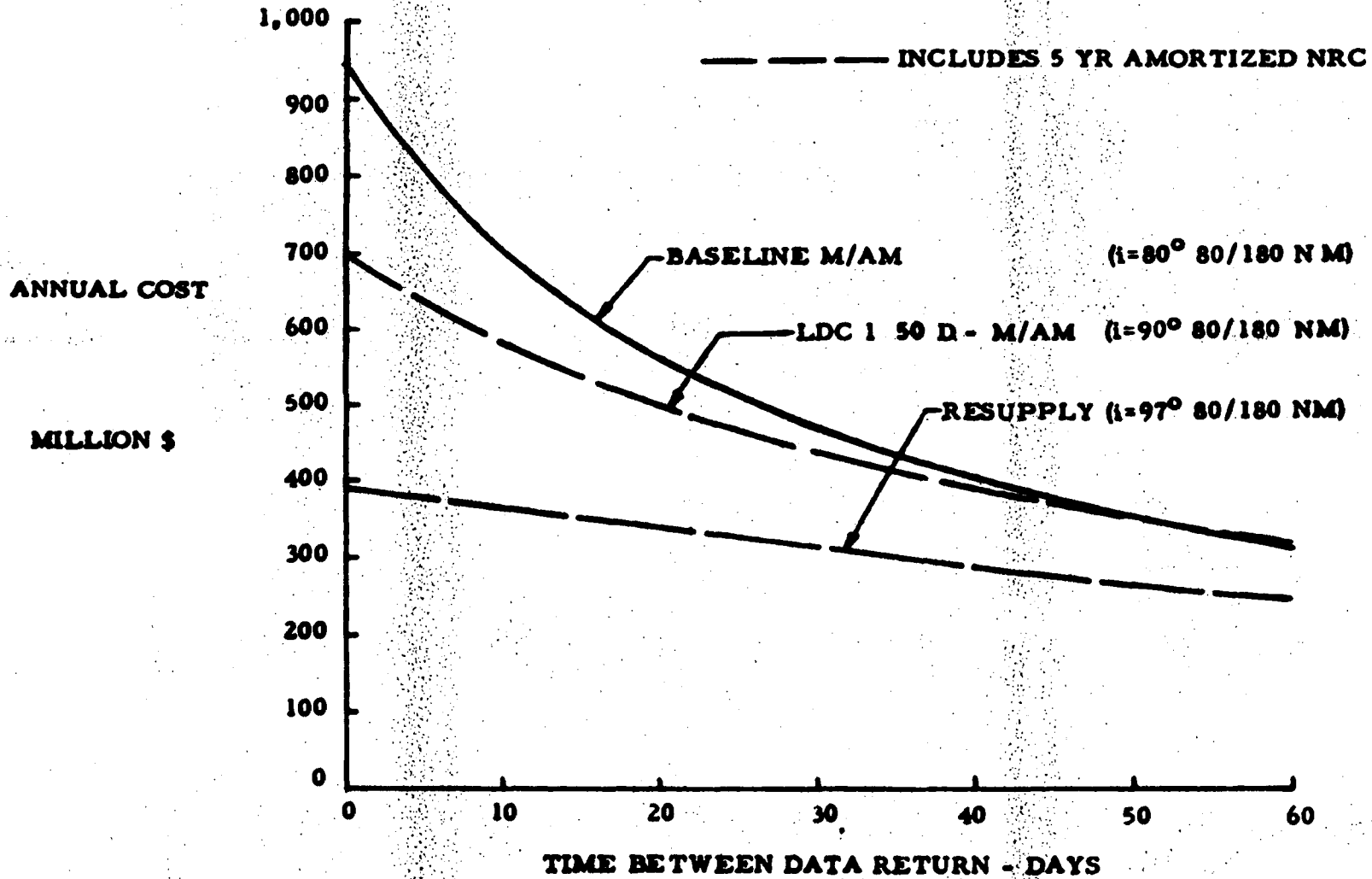
<u>MAM</u>	<u>LDC 1/50 DAY M/AM</u>	<u>RAM</u>	<u>RRV</u>
87	91.7	74.8	43.8

*COST BASED ON 1.5
RIV'S/YR

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**EFFECT OF NON-OPERATING INTERVAL ON ANNUAL COST
OF ALTERNATIVE SYSTEMS**



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WH 5-971-12

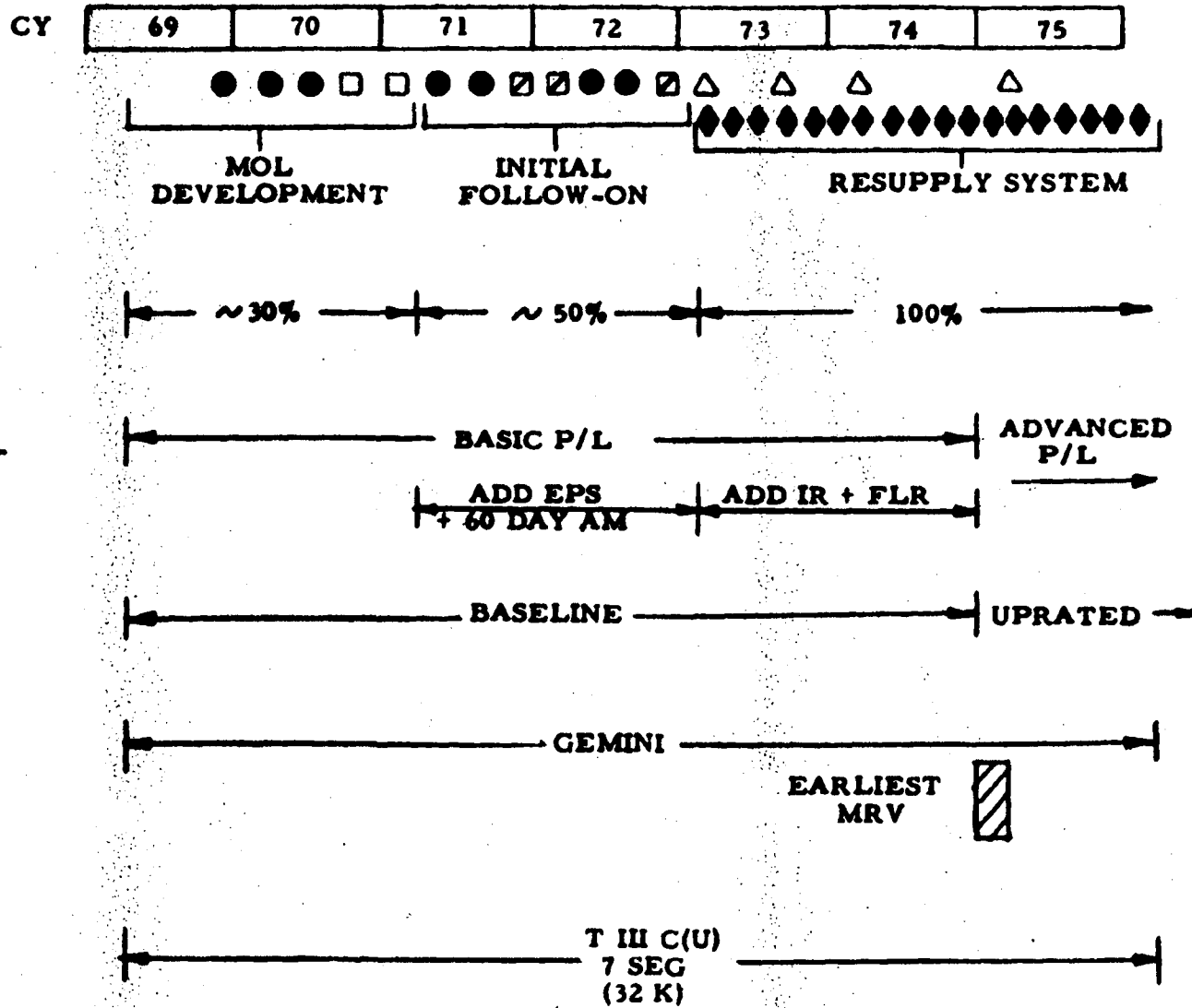
COMPARISON OF ALTERNATIVE SYSTEM CAPABILITY TO MEET
OVERALL MOL GROWTH OBJECTIVES

<u>GROWTH OBJECTIVE</u>	<u>INTEGRAL LAUNCH SYSTEM</u>	<u>RESUPPLY SYSTEM</u>
● IMPROVED SYSTEM ECONOMICS:		
✓ REDUCTION IN HRO P/L LAUNCHES	GOOD	BEST
✓ UTILIZATION OF BASELINE DEVELOPED HARDWARE	GOOD	GOOD
✓ IMPACT OF SENSOR AVAILABILITY	POOR	BEST
✓ SYSTEM FIRST COST	BEST	GOOD
✓ COST PER C.S. P.	GOOD	BEST
● IMPROVED MISSION PERFORMANCE:		
✓ ACQUISITION & AVAILABILITY OF C.S. P. S	GOOD	GOOD
✓ ON CALL RECYCLE	GOOD	BEST
✓ ADDITIONAL P/L ELEMENTS	GOOD	BEST
✓ ADVANCED SENSOR DEVELOPMENT FLIGHTS	POOR	GOOD
● IMPROVED OPERATIONAL POTENTIAL:		
✓ ORBITAL STORAGE	---	BEST
✓ ORBITAL ASSEMBLY	POOR	BEST
✓ CREW NUMBER INCREASE	---	BEST
✓ TECHNIQUES FOR LONG LIFE SYSTEMS	GOOD	BEST
✓ VULNERABILITY COUNTERMEASURES	POOR	BEST
✓ EXTENDED BIOASTRONAUTICS	POOR	BEST

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POSSIBLE PLANNING FRAMEWORK

WHS-171-13



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WHS-171-15

STUDY MATRIX - MOL FOLLOW-ON SYSTEM

<u>STUDY ITEM</u>	<u>DESCRIPTION/PURPOSE</u>	<u>PRIORITY GROUP</u>	<u>START DATE</u>
<u>SYSTEM LEVEL STUDIES</u>			
INITIAL FOLLOW-ON MIX	PERFORMANCE/COST/SCHED/ EFFECTIVENESS	1	JAN'67
EXTENDED DURATION INTEGRAL LAUNCH(EDIL)	PERFORMANCE/COST/SCHED/ CONFIGURATION ANALYSIS	2	FEB'67
EXTENDED DURATION AUTO-MODE TEST REQ'MT	SUBSYS. TEST REQM'TS. OPS PLANNING	1	JUL'67
RESUPPLY MISSION & HDWE (RRV/RIV)	PERFORMANCE/COST/SCHED/ CONFIGURATION ANALYSIS	2	FEB'67
ADVANCED P/L DEFIN/CONFIG.	PARAMETERS/PERFORMANCE DEFIN/REQM'TS	1	JAN'67
VULNERABILITY/ESCAPE SYS. GEM B APPLIC & REFURB (GBLLS)	THREAT/REQM'TS/TRADES/CONFIG COST/OPS. IMPACT (PH 0 STUDY)	4	MAR'67
LIFT BODY APPLIC (LBREV)	DEFINE SPECIFIC REQM'TS	4	JUL'67
MAN-IN-MOL EXPERIENCE PARAMETERS	COMPARISON PARAMETERS MAN-UM	4	JUN'67
		1	JAN'67
<u>MISSION-P/L ENHANCEMENT STUDIES</u>			
ELECTR. POINTING SYS. (EPS)	(DEFERRED BASELINE ITEM?)	-	---
RADAR ACQ./TRACK (FLR)	REQUIREMENTS STUDY	3	AUG'67
INFRA-RED IMAGING (IR)	REQUIREMENTS STUDY	3	AUG'67
<u>ORBITING VEHICLE SUBSYSTEM TECHNOLOGY STUDIES</u>			
DATA RECOVERY (DRV & WB)	REQM'TS/OPS MODES/TRADES	2	SEP'67
POWER SYSTEMS APPLIC.	TYPES/TRADES/SIZING/INTEG.	3	JUN'67
PROPULSION SYSTEMS	TYPES/TRADES/SIZING/INTEG.	3	OCT'67
RESUPPLY DOCKING SYSTEMS	REQM'TS/TRADES/DESIGN LAYOUTS	2	MAR'67
SUBSYSTEM LIFE EXTENSION	ON-ORBIT LIFE EXTENSION, MAINTENANCE, EFFECTIVENESS	2	FEB'67

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CONTRACTOR STUDIES, SCHEDULE & COST ESTIMATES

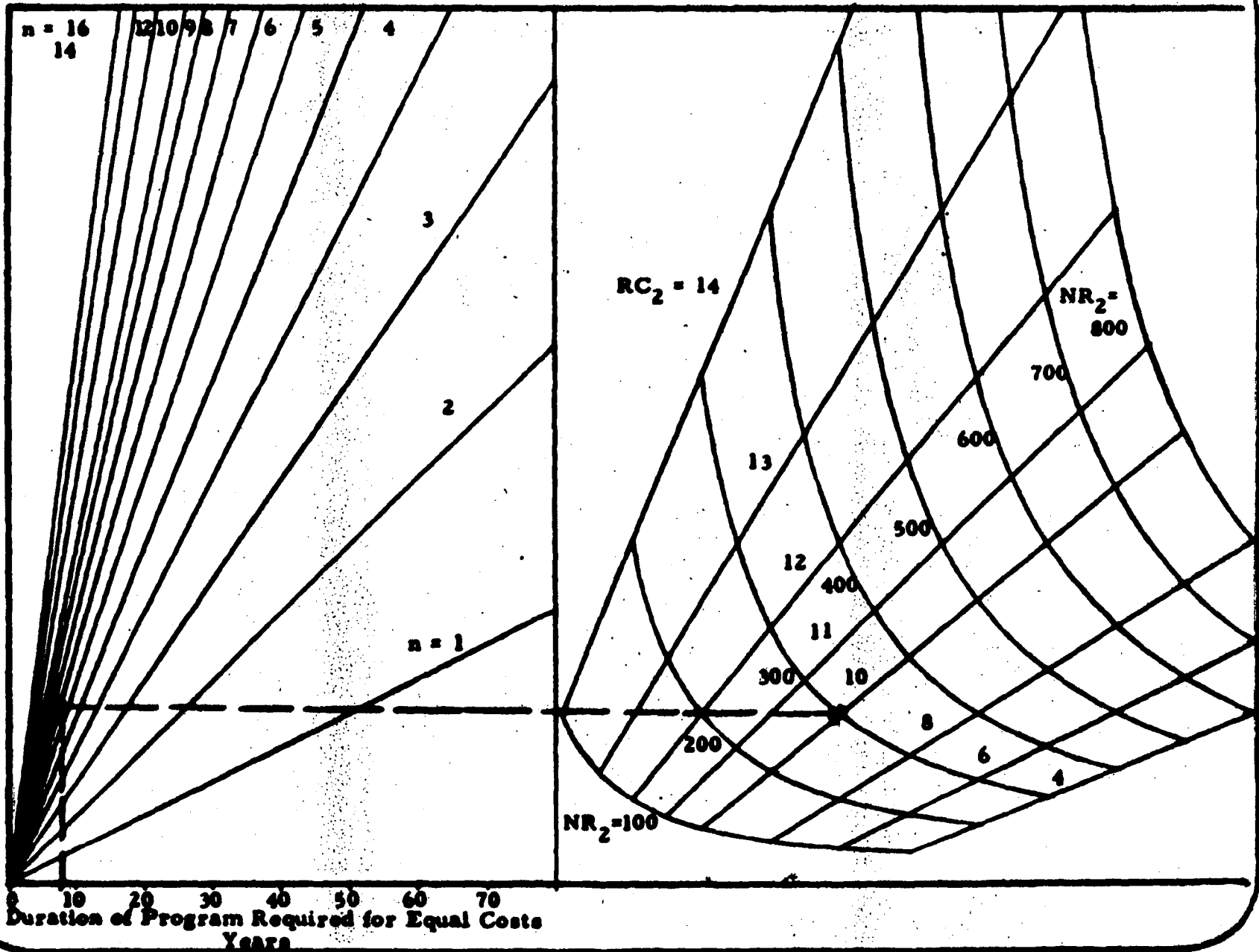
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STUDY ITEM	FY 68	FY 69	FY 70	FY 71	FY '68 ROM COST ESTIM THOUSAND \$
	DY 67	CY 68	CY 69	CY 70	
● EXTENDED DURATION AM TEST REQ'M'T STUDY		████████████████████			350
● ADVANCED PAYLOAD (AVAILABLE 1975)	████████████████████			████████████████████	2,600 (73 PROG)
			████████████████████		3,900 (73 PROG)
● RESUPPLY MISSION & HDWE (ADV. P/L 1975)	████████████████████				600 (73 PROG)
			████████████████████		1,800 (73 PROG)
● SUBSYSTEM LIFE EXTENSION	████████████████████				425
● EXTENDED DURATION INTEGRAL LAUNCH SYSTEM	████████████████████				350
● GEM B LAND LANDING SYS. & REFURBISHMENT	████████████████████				120
● LIFTING RE-ENTRY BODY APPLICATIONS	████████████████████				100

TOTAL \$ ESTIMATE FOR FY 68 = 4,545,000 (75 PROG)
7,045,000 (73 PROG)



SPACECRAFT COST COMPARISON CHART MILLIONS OF DOLLARS

WH 5-171-17



ESTIMATE OF RESUPPLY SYSTEM COSTS
(MILLIONS OF DOLLARS)

● <u>PHASE O STUDIES</u>	<u>1.0M</u>
● <u>PHASE I C. D. P.</u>	
DESIGN REQUIREMENTS AND PROVISIONS	4.4
SYSTEMS ENGINEERING DOCUMENTATION	1.0
CSE/TD	<u>.6</u>
TOTAL	<u>6.0M</u>
● <u>NON-RECURRING DEVELOPMENT</u>	
TWO SETS RRV HARDWARE FOR GROUND TEST	17.5
DOCKING SYSTEM DEVELOPMENT	15.0
DOCKING SIMULATION	1.5
DESIGN/INTEGRATION, RRV DEV.	40.0
RRV FACTORY TEST EQUIP. (AGE)	10.0
RRV LAUNCH AGE	10.0
LAUNCH SITE AUGMENTATION	77.0
MCC/SOFTWARE	2.0
RIV DESIGN/INTEGRATION	18.0
ROV INTEGRATION/TEST	<u>12.0</u>
TOTAL	<u>203.0M</u>

● <u>RECURRING COST RIV</u> 	
BASELINE M/AM LESS GEMINI B	72.3
NOSE CONE - ADDED AUTOMATIC PROV.	1.5
AUX. ACTS	.7
DOCKING & INTERFACE	<u>.3</u>
TOTAL	<u>74.8M</u>
● <u>RRV</u> 	
GEMINI B	14.5
RRV MODULE	11.8
THI C(U)	<u>15.5</u>
TOTAL HARDWARE	<u>41.8M</u>
MISSION SUPPORT	<u>2.0</u>
TOTAL	<u>43.8M</u>

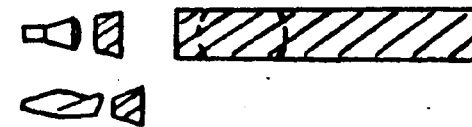
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MOL ADVANCED PLANNING - CONTRACTOR STUDIES

<u>STUDY ITEM</u>	<u>ROM COST ESTIMATE FY-68 THOUSANDS \$</u>					
	<u>DAC</u>	<u>MAC</u>	<u>MC</u>	<u>GE</u>	<u>OTHER</u>	<u>TOTAL</u>
● EXTENDED DURATION AM TEST REQM'T STUDY	150			200		350
● ADVANCED PAYLOAD AVAILABLE 1975 - (AVAILABLE 1973) -					2,600 (3,900)	2,600 (3,900)
● RESUPPLY MISSION & HDWE FOR ADV. P/L 1975 - (FOR ADV. P/L 1973) -	300 (600)	100 (500)	100 (400)	100 (300)		600 (1,800)
● SUBSYSTEM LIFE EXTENSION	100	75		250		425
● EXTENDED DURATION INTEGRAL LAUNCH SYS.	250		100			350
● GEM B LAND LANDING SYS. & REFURBISHMENT		120				120
● LIFTING REENTRY BODY APPLICATIONS					100	100
TOTALS (ADV P/L 1975) -	800	295	200	550	2,700	4,545
(ADV P/L 1973) -	(1,100)	(695)	(500)	(750)	(4,000)	(7,045)

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EARLY INTEGRAL LAUNCH SYSTEMS

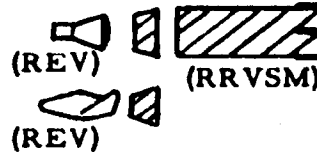
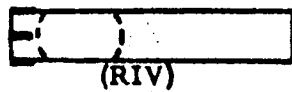


I DISPOSE AT MISSION TERMINATION
(INTEGRAL LAUNCH)

II RETRIEVE/REUSE REV
(INTEGRAL LAUNCH)

CONCEPT	I		II	
	GEMINI B (WATER LANDING)	GEMINI B (LAND LANDING)		LIFTING BODY (MEDIUM L/D)
REV TYPE				
LAUNCH VEHICLE	T III C (U)	T III C (U)	LDC 1	LDC 1
LAUNCH WEIGHT (i=90°)	31.0 K	31.0 K	42.0 K	42.0 K (i=90°)
P/L TYPE	Baseline	Baseline	Baseline	Baseline
MISSION DURATION	30 Days	15 Days	40 Days	30 Days
DEVELOP. STATUS:				
REV	Current Phase II	NASA Mod.Test	NASA Model Test	Model Tests & Studies
LM	Current Phase II	Current Phase II	Current Phase II	Current Phase II
MM	Current Phase II	Current Phase II	Current Phase II	Current Phase II
LV	Current Phase II	Current Phase II	Martin/UTC In-House Design	Martin/UTC In-House Design
DEVELOPMENT CYCLE	5 Yr	2 Yr	3 Yr	5 Yr
Δ NON RECURRING COST ABOVE BASELINE OPT. #6	0	130 M\$	190 M\$	450 M\$
RECURRING COST				
INITIAL LAUNCH	78.2 M\$	79.7 M\$	87.2 M\$	99.2 M\$
REFURBISHED VEH. LAUNCH	--	77.2 M\$	84.7 M\$	87.2/78.2 M\$ (60%-30% Refurb.)

INITIAL RENDEZVOUS SYSTEM



III REVISIT RIV - DISPOSE OF RRV EACH RESUPPLY CYCLE (RENDEZVOUS/RESUPPLY)

IV REVISIT RIV - DISPOSE OF RRV SUPPLY MODULE - RETRIEVE/REUSE REV (RENDEZVOUS/RESUPPLY)

CONCEPT	III		IV	
REV TYPE	GEMINI B (WATER LANDING)	GEMINI B (LAND LANDING)	LIFTING BODY (MEDIUM L/D)	
LAUNCH WEIGHT ($i=96.4^\circ$)	30.0 K	30.0 K	30.0 K	41.4 K
LAUNCH VEHICLE TYPE	T III C (U)	T III C (U)	T III C (U)	LDC 1
P/L TYPE	Baseline	Baseline	Baseline	
MISSION DURATION	Cont. OPS - 1 yr Res. Cy. - 60 days	Cont. OPS - 1 yr. Res. Cy. - 53 days	Cont. OPS - 1 yr Res. Cy. - 45 days	Cont. OPS - 1 yr Res. Cy. - 90 days
DEVELOP. STATUS	Current Phase II Current Phase II Current Phase II Current Phase II	NASA Model Tests Current Phase II Current Phase II Current Phase II	Mod. Test & Studies Current Phase II Current Phase II Current Phase II	Mod. Test & Stud. Current Phase II Current Phase II Martin/UTC In-House Design
DEVELOP. CYCLE	3 yr	3 yr	5 yr	5 yr
Δ NRC ABOVE OPT #6	203 M\$	323 M\$	603 M\$	673 M\$
RC				
RIV	66.2 M\$	66.2 M\$*	66.2 M\$	71.7 M\$
RRV (NEW REV)	43.8 M\$	45.3 M\$	59.3 M\$	69.8 M\$
RRV (REFURB REV)*	--	42.8 M\$	47.3/38.3 M\$	57.8/48.8 M\$

*Cost based on 60%/30% Refurbishment

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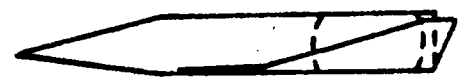
LIFTING BODY RE-ENTRY VEHICLE
RENDEZVOUS SYSTEM



RRV



RIV



RRV (MMM)



RIV (MM)

V REVISIT RIV
RETRIEVE/REUSE RRV
(RENDEZVOUS/RESUPPLY)

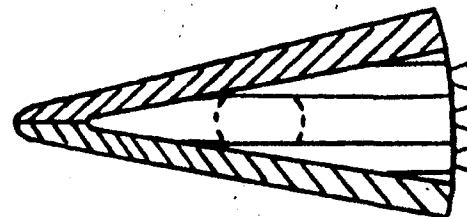
VI REVISIT MM
RETRIEVE/REUSE MMMV
(RENDEZVOUS/RESUPPLY)

CONCEPT	V	VI
LAUNCH VEHICLE TYPE	LDC 1	LDC 1 & 2
LAUNCH WEIGHT (i=96.4°)	41.4 K	47.0 K
P/L TYPE	Baseline	Baseline
MISSION DURATION	Continuous to 1 Yr - 60 Day Resupply Cycle	Continuous to 1 Yr - 50 Day Resupply Cycle
DEVELOPMENT STATUS		
REV	Technology Studies	Technology Studies
LM	Current Phase II	Components in Phase II
MM	Current Phase II	Components in Phase II
LV	Martin/UTC In-house Design	Preliminary Studies
DEVELOP. CYCLE	7 Yr.	7 Yr.
ΔNRC ABOVE OPT. #6(ROM)	770 M\$	1,170 M\$
RC		
RIV	71.7 M\$	58.0 M\$
RRV (NEW)	71.0 M\$	93.0 M\$
RRV (REFURB)*	51.0/36.0 M\$	67.0/46.0 M\$

*Based on 60%/30% Refurbishment Cost

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ADVANCED INTEGRAL LAUNCH SYSTEM



VII RETRIEVE/REUSE COMPLETE M. O. V.
(INTEGRAL LAUNCH)

VIII RETRIEVE/REUSE COMPLETE
M. O. V.
(INTEGRAL LAUNCH)

CONCEPT	VII	VIII
LAUNCH VEHICLE TYPE	LDC 1 & 2+156" SRM	Strap-On Tankage
LAUNCH WEIGHT	62 K	~70 K
MISSION DURATION	60 Day	60 + Day
DEVELOPMENT STATUS	Vehicle/Technology Studies Major Subsystems - Phase II	Proposed by Industry
DEVELOPMENT CYCLE	8 Year	10/12 Year
Δ NRC ABOVE OPTION #6	1,230 M\$	1,500 to 2,000 M\$
RECURRING COSTS		
INITIAL	133 M\$	200 M\$
REFURB.	93/63 M\$ (60%-30% Refurbish.)	30 M\$ (~10% Refurbish.)

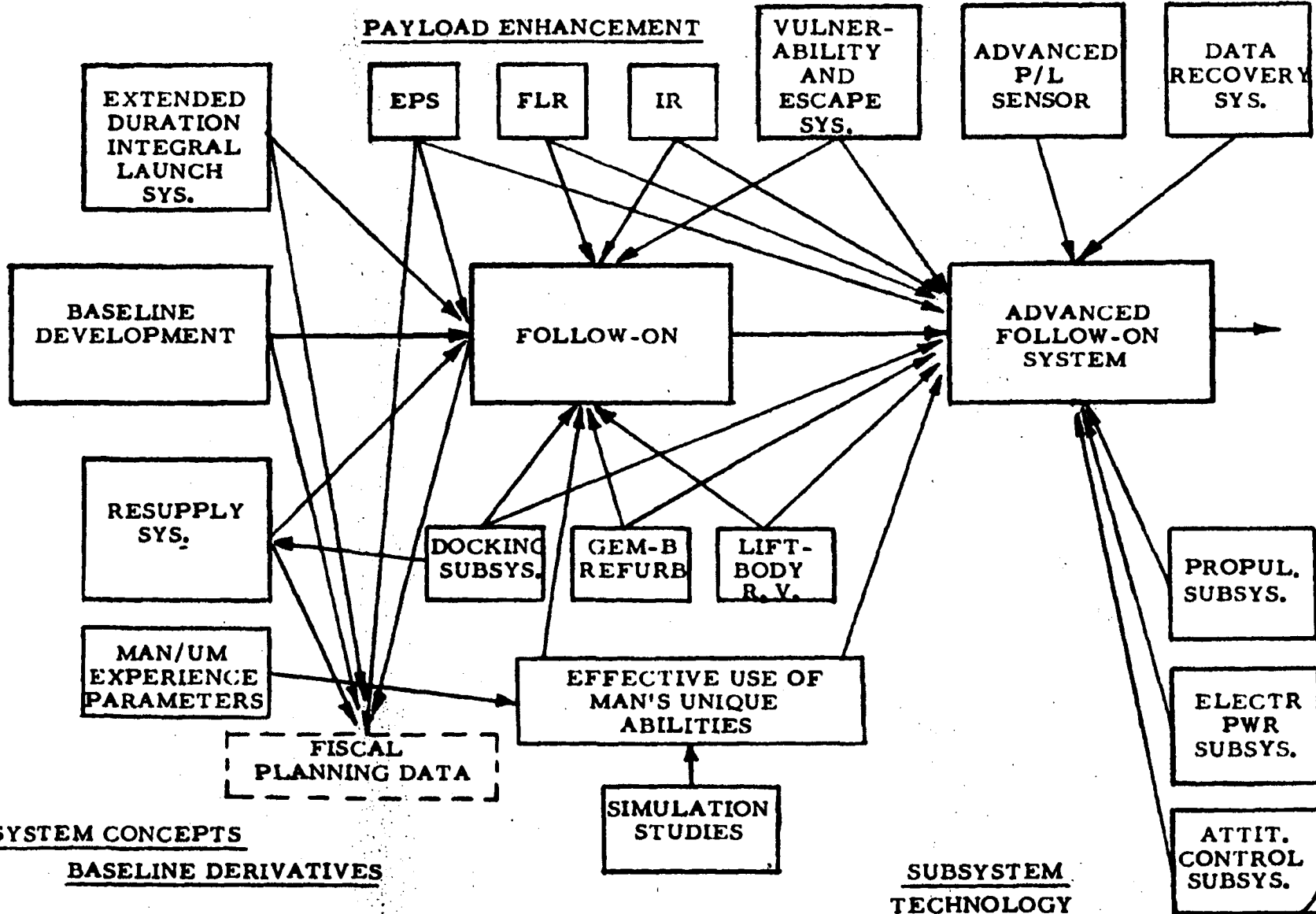
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STUDY RELATIONSHIPS - MOL ADVANCED PLANNING

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IMPROVED OPS. FLEXIBILITY

IMPROVED MISSION PERFORMANCE

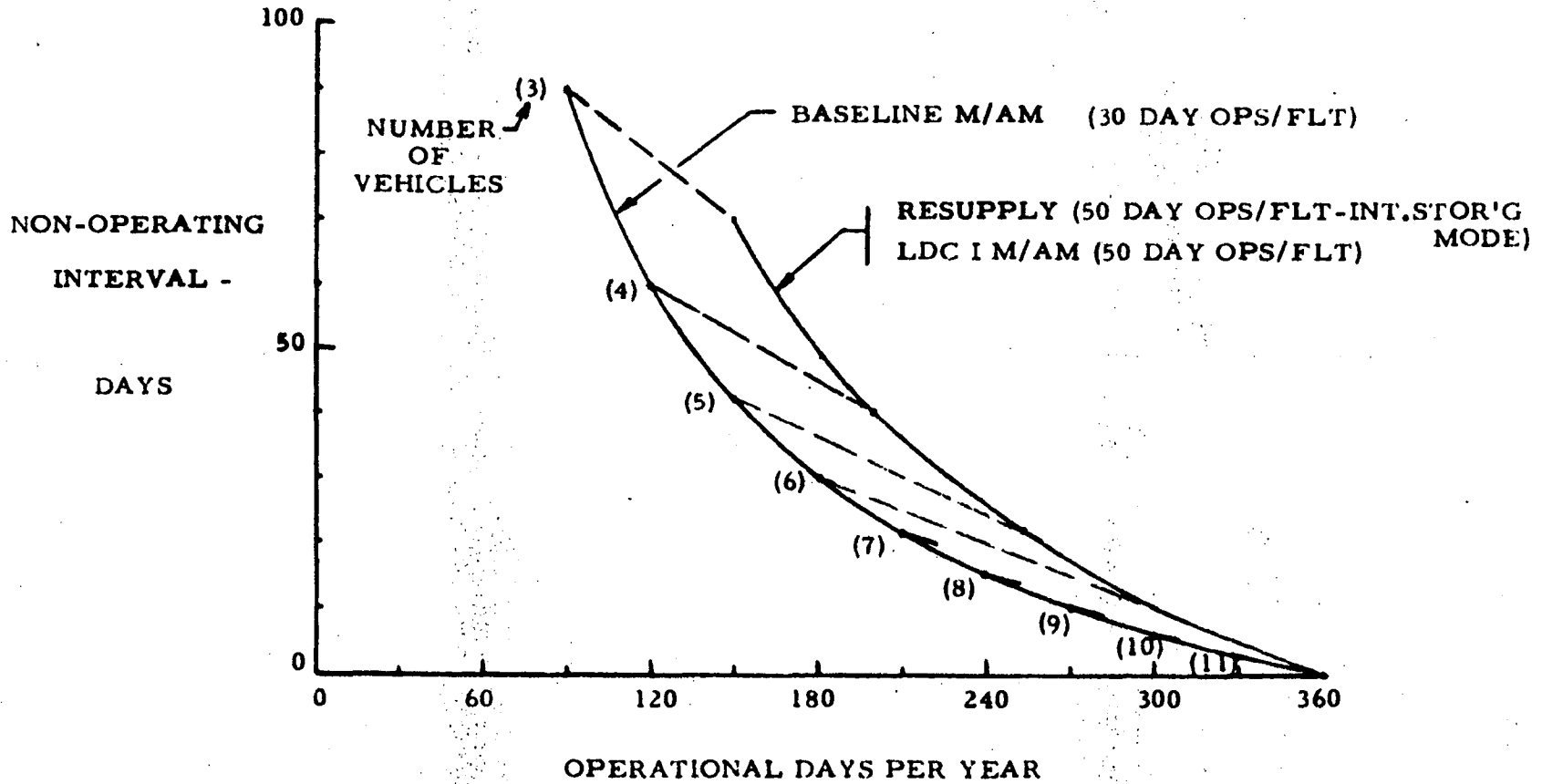
PAYLOAD ENHANCEMENT



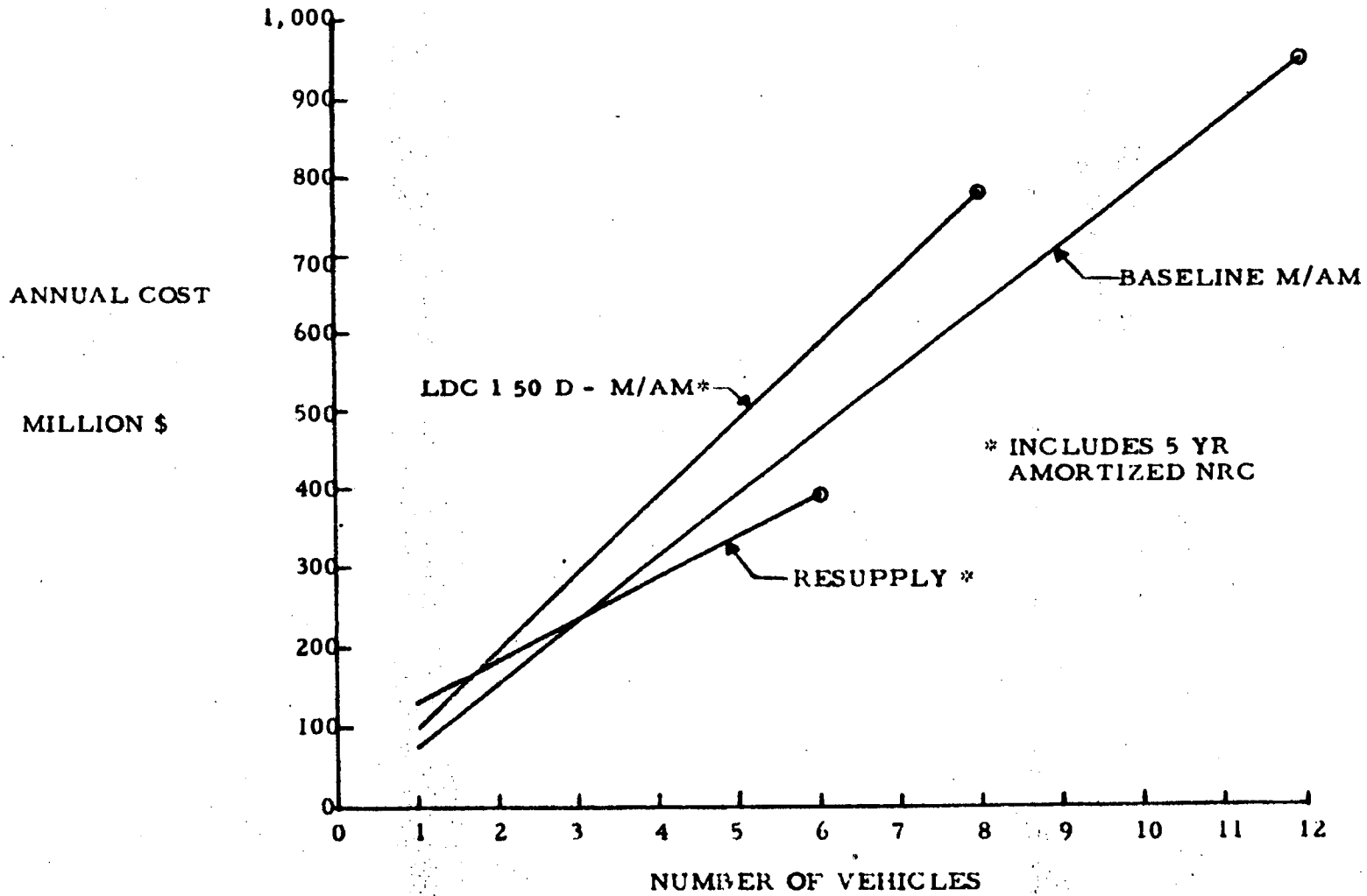
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VEHICLE OPERATIONAL CAPABILITY

(FUNCTION OF NON-OPERATING INTERVAL AND NUMBER OF VEHICLES)



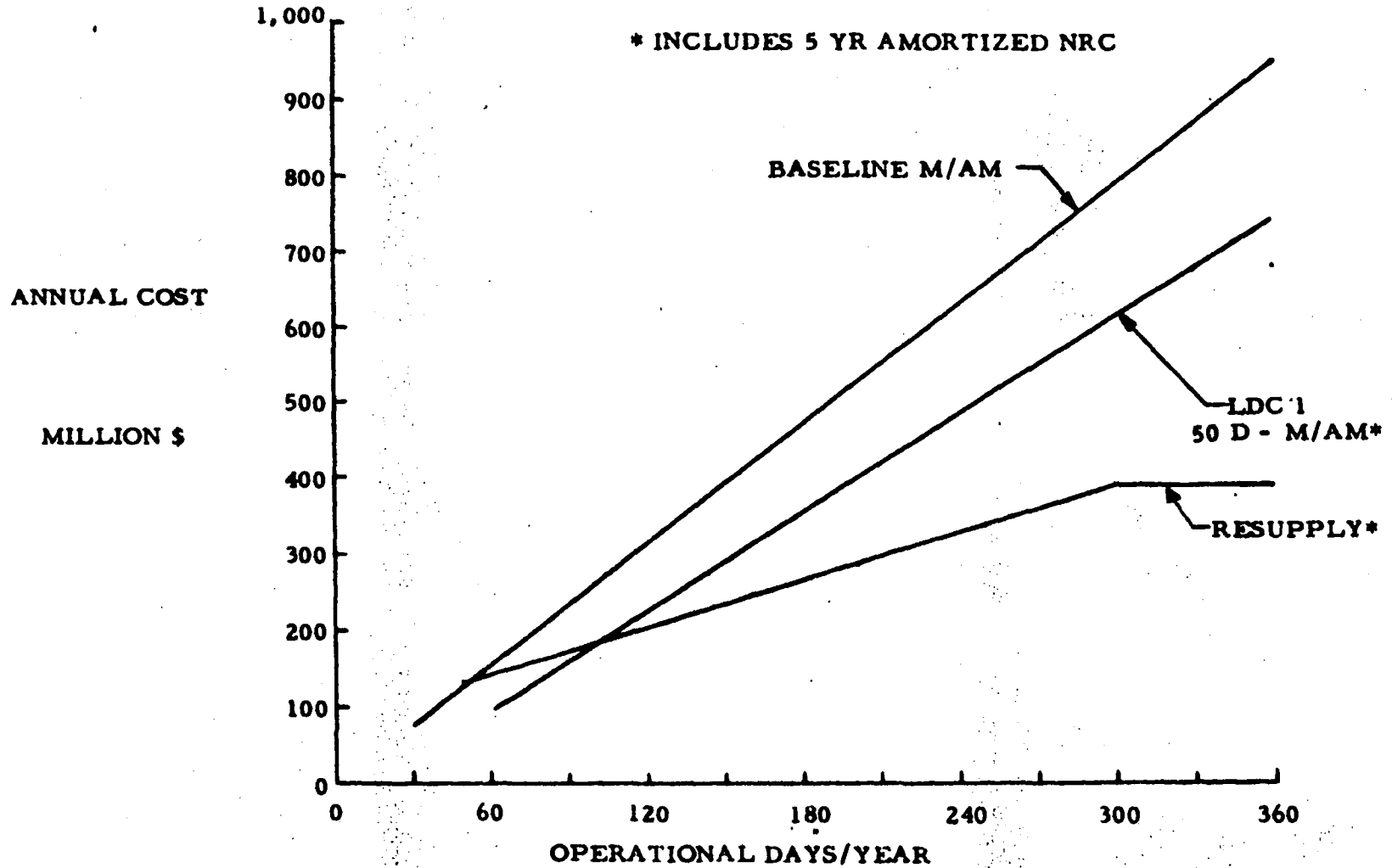
ANNUAL COST COMPARISON BASED ON VEHICLE QUANTITIES



⊙ NO. REQ'D FOR CONTINUOUS COVERAGE

WHS-17-27

EFFECT OF OPERATIONAL DAYS ON ANNUAL COST



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WHS-171-24

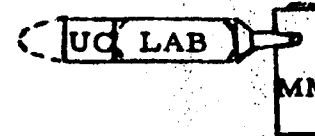
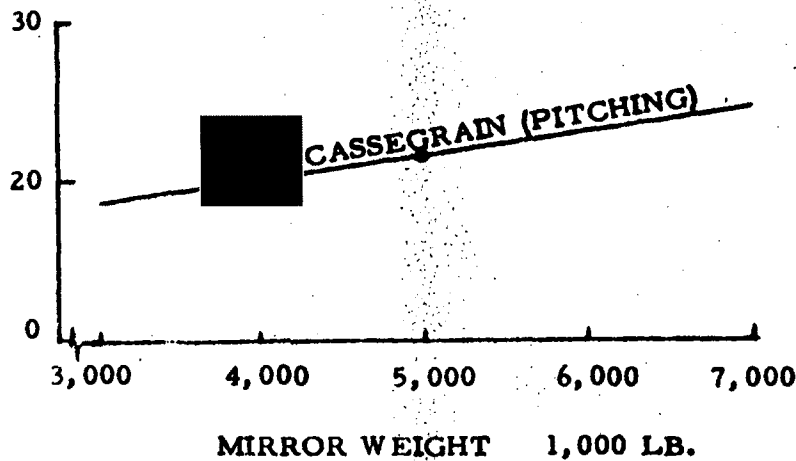
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GROWTH PAYLOAD CONSIDERATIONS



RESOLUTION OPTICS

MISSION PAYLOAD SEGMENT WGT* - 1,000 LB.



MISSION MODULE	17,500
LABORATORY MODULE	9,500
IN-FLIGHT LOSSES (30 DAY STORAGE CAPABILITY)	3,100
TOTAL	<u>30,100 LBS</u>

* WEIGHT INCLUDES

- COCKPIT EQUIPMENT
- R/V'S (6)
- R/V RACKS & LAUNCH PROVISIONS
- FILM
- CONTINGENCY (20%)

~~SECRET~~ SPECIAL HANDLING