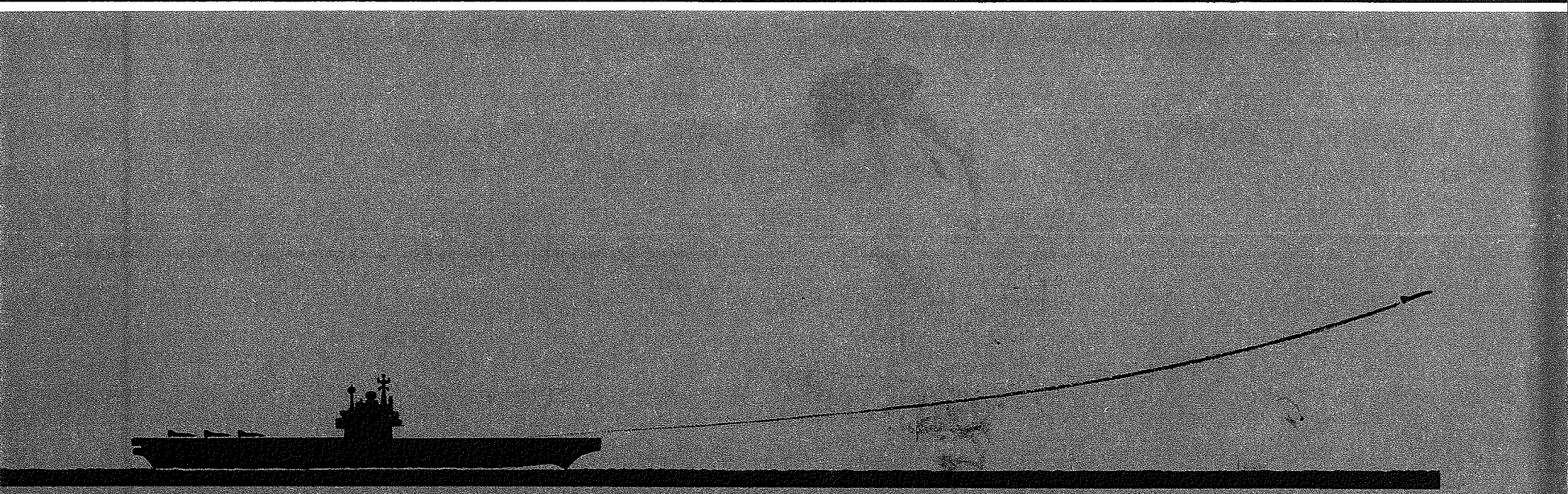
F-4X (U) FOR U.S. NAVY

REPORT NO. F333
JANUARY 1967



MCDONNELL

CONFIDENTIAL

W. P. Murden

F-4X (U)

FOR U.S. NAVY

REPORT NO. F333 JANUARY 1967

MCDONNELL

GROUP 4
DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

CONTROL NO. C-174853 COPY NO. 23

CONFIDENTIAL

F-4X

SCOPE OF STUDIES

- AIRFRAME
  - MINIMUM CHANGE F-4J+
  - INCREASED WING AREA F-4(FV)L
  - HIGH FIXED WING F-4(FV)H
  - VARIABLE SWEEP F-4(FV)S

  } DESIGN CRITERIA
  - 2 HR. CAP
  - 125 KT. V_{APP}

- WEAPON CONTROL SYSTEM
  - IMPROVED AWG-10
  - MODIFIED AWG-9
  - IMPROVED SPARROW (AIM-7F)
  - PHOENIX

- ENGINES
  - J79-GE-10
  - ADVANCED TECHNOLOGY

GA67-00474

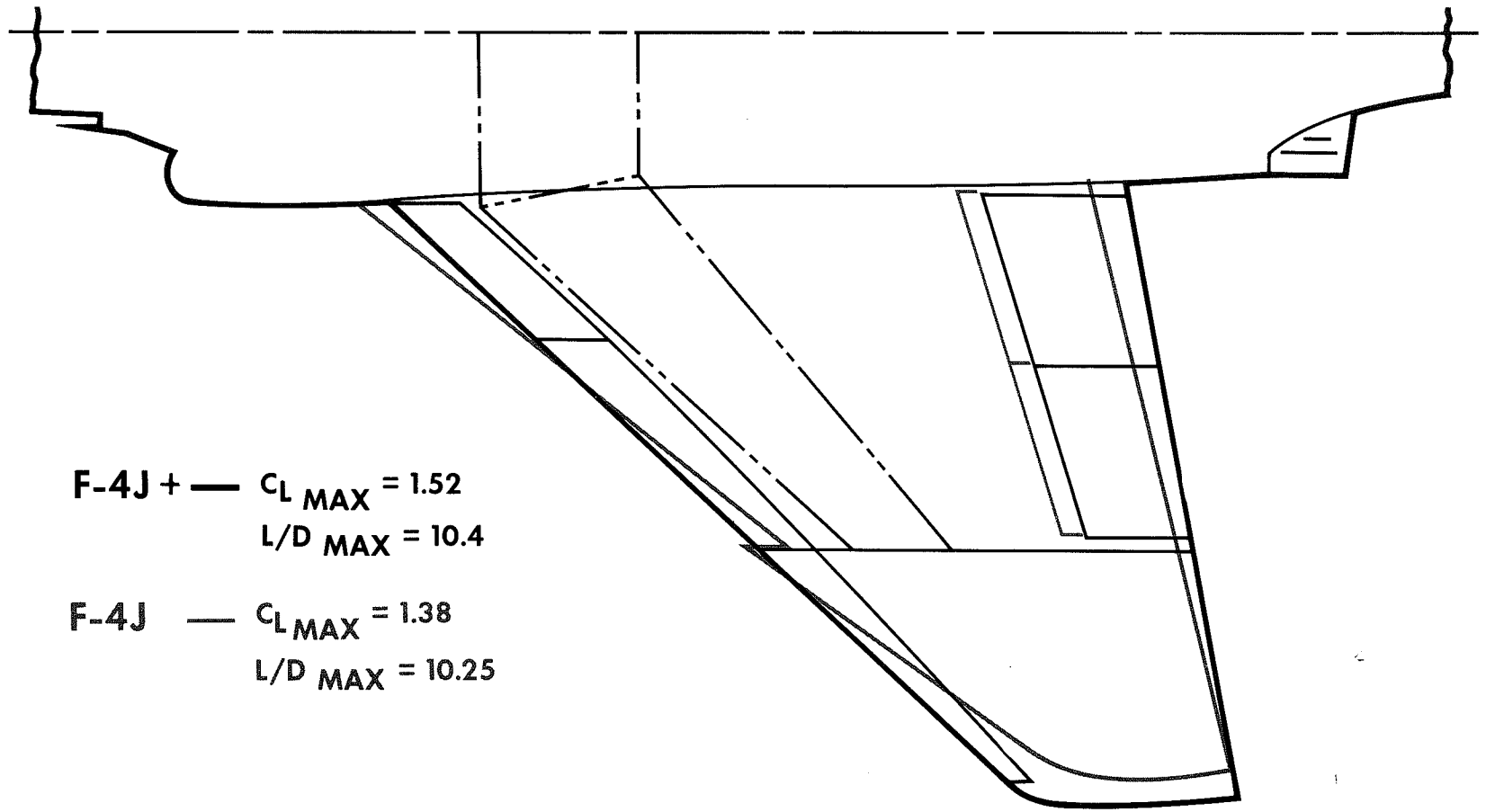
F-4J+

MINIMUM CHANGE F-4J

- IMPROVE $C_{L_{MAX}}$
  - WING AND HIGH LIFT DEVICE MODIFICATION
- IMPROVE CRUISE AND CAP TIME
  - IMPROVED WING CONFIGURATION
  - INCREASE INTERNAL FUEL
- IMPROVE CATAPULT PERFORMANCE
  - NOSE GEAR TOW
  - EXTENDIBLE NOSE STRUT
- MULTISHOT AWG-10
- ADVANCED SPARROW - AIM-7F (MOD)

GA67-00475

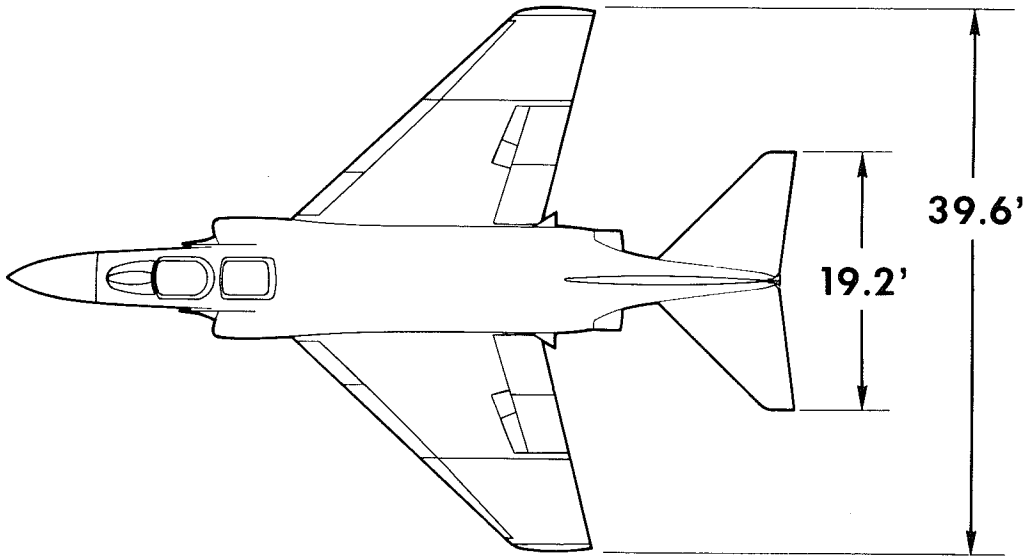
F-4X
WING MODIFICATION
F-4J+

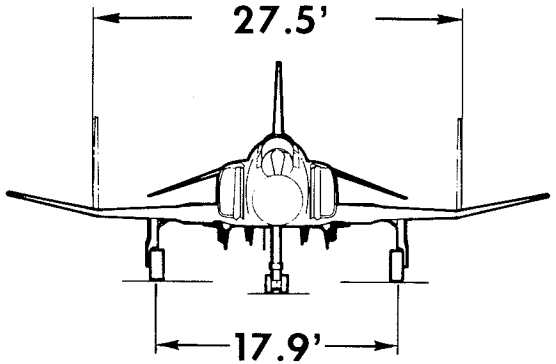


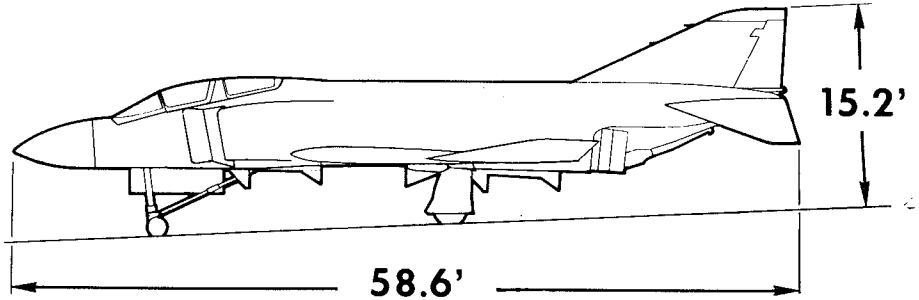
F-4J + — $C_{L\ MAX}$ = 1.52
$L/D_{\ MAX}$ = 10.4

F-4J — $C_{L\ MAX}$ = 1.38
$L/D_{\ MAX}$ = 10.25

F-4J+
LOW FIXED WING
565 SQ. FT.
INTERNAL FUEL=2463 GAL.







GA67-00477

F-4(FV)L
LOW FIXED WING
595 SQ. FT.

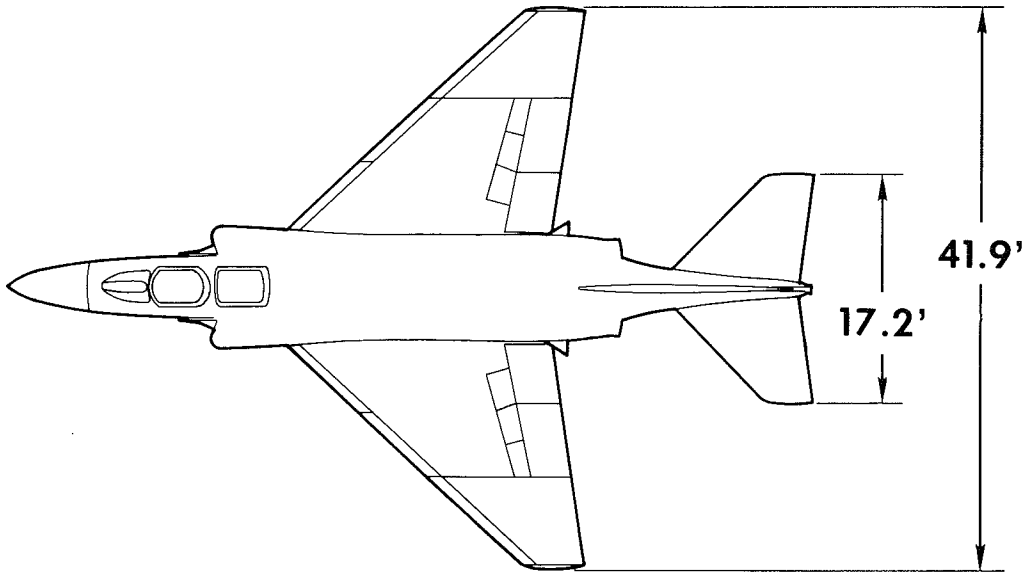
- BASED ON NAVY FUNDED F-4(FV) STUDY CONFIGURATION
- DECREASED WING AREA (WAS 640 SQ. FT.)
- IMPROVED HIGH LIFT
  - FLAP AND AILERON AREA
  - L.E. SLATS
  - T.E. BLC
  - BETTER TRADE-OFF CARRIER SUIT, RANGE, AND WEIGHT
- NOSE GEAR TOW
- GROWTH FACTOR ON LANDING GROSS WEIGHT

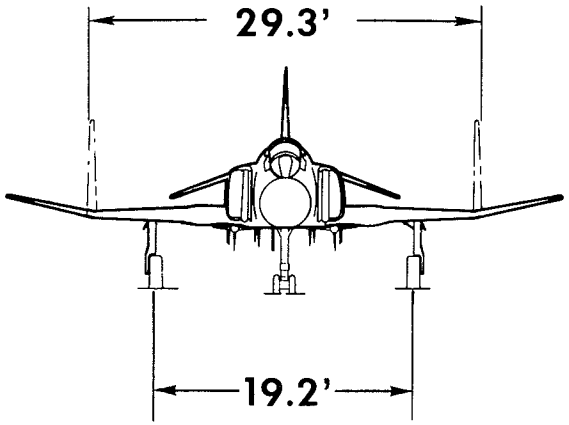
GA67-00478

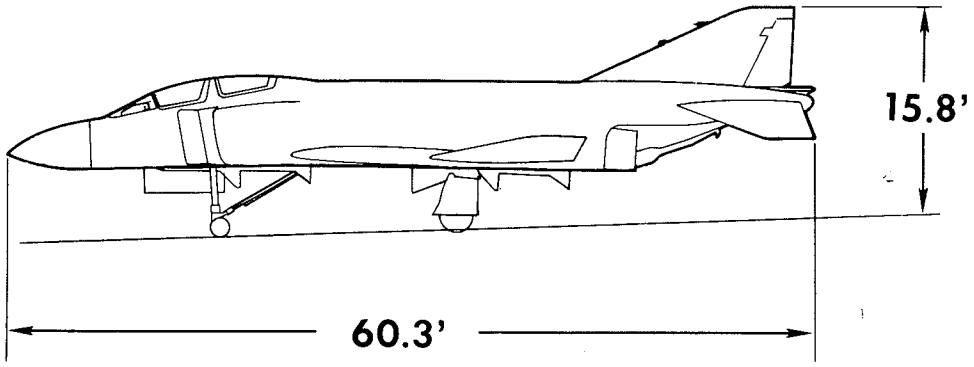
F-4 (FV) L
LOW FIXED WING
595 SQ. FT.

INTERNAL FUEL=2535 GAL.

GROWTH VOLUME=222 GAL.







GA67-00479

F-4(FV)H
HIGH FIXED WING

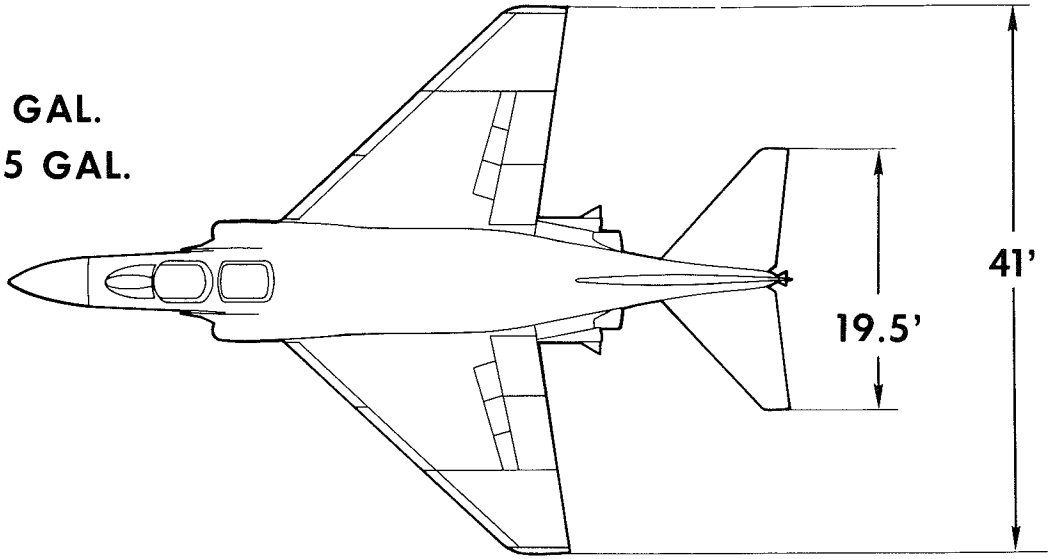
560 SQ. FT.

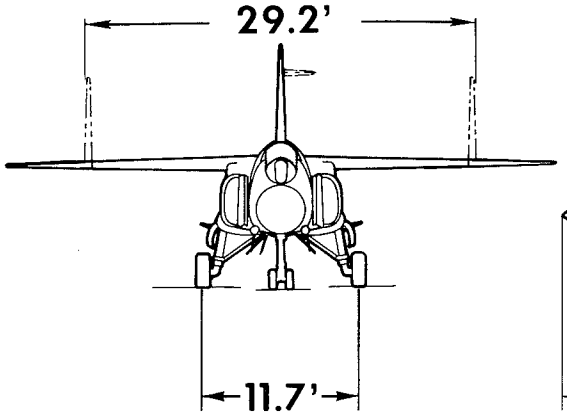
- HIGH WING VARIATION OF F-4(FV)L
- REDUCED WING THICKNESS (Δ=0.7%)
- MORE GROWTH POTENTIAL - INTERNAL VOLUME
- NOSE GEAR TOW

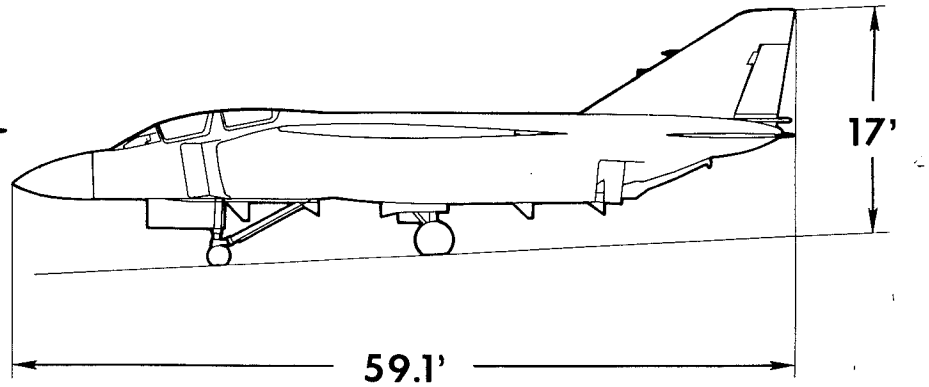
GA67-00480

F-4 (FV) H
HIGH FIXED WING
560 SQ. FT.

INTERNAL FUEL=2570 GAL.
GROWTH VOLUME=275 GAL.







GA67-00481

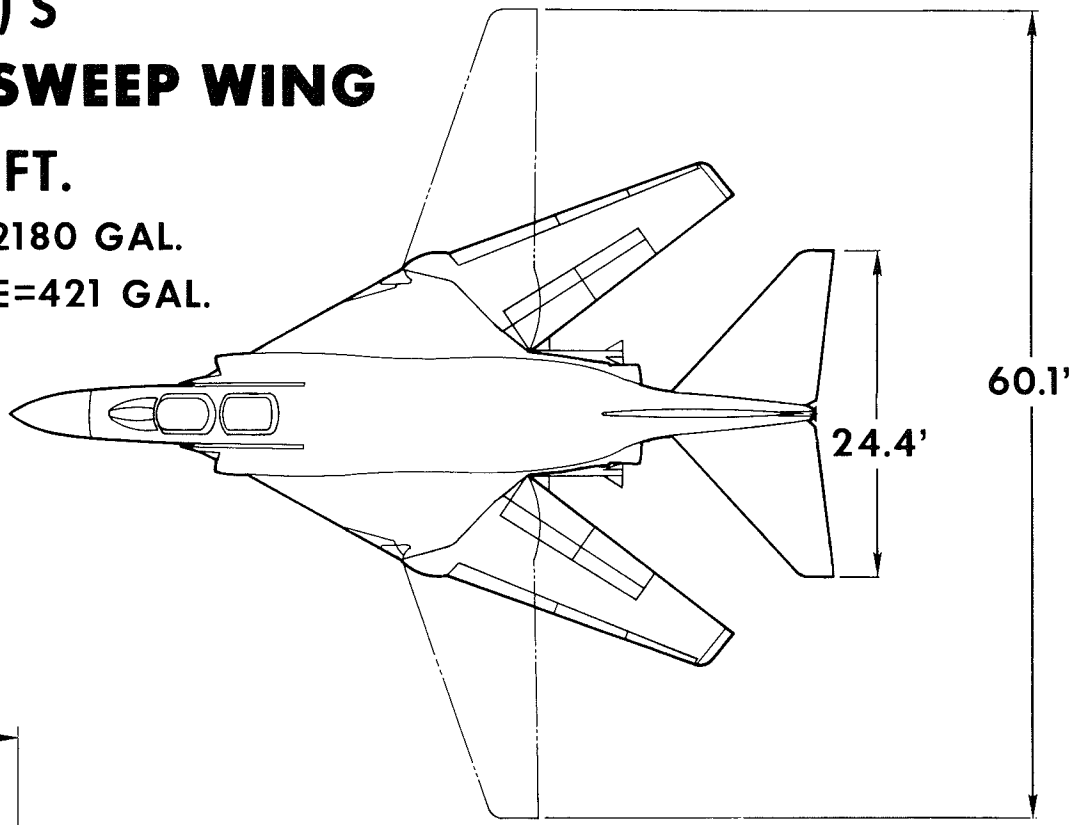
F-4 (FV)S
VARIABLE SWEEP WING
500 SQ. FT.

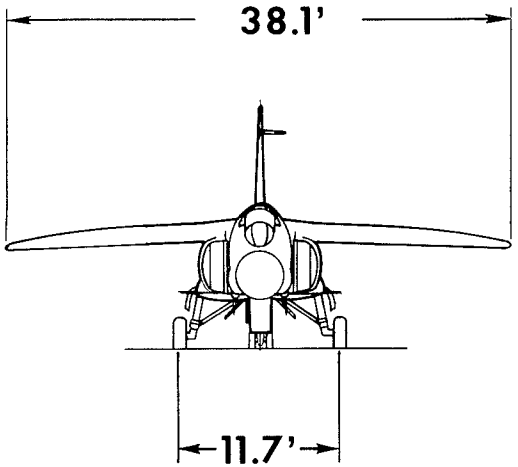
- REVISION TO F-4(FVS) PROPOSAL
- INCREASED WING AREA (FVS = 420 SQ. FT.)
  - IMPROVED MANEUVERABILITY
  - LOWER APPROACH SPEED
- BLC TRAILING EDGE FLAP SYSTEM
  - IMPROVED LIFT vs LATERAL CONTROL TRADE-OFF
- LARGER HORIZONTAL TAIL
  - IMPROVED LOW SPEED TRIM
- LARGER VERTICAL TAIL
  - IMPROVED DIRECTIONAL STABILITY

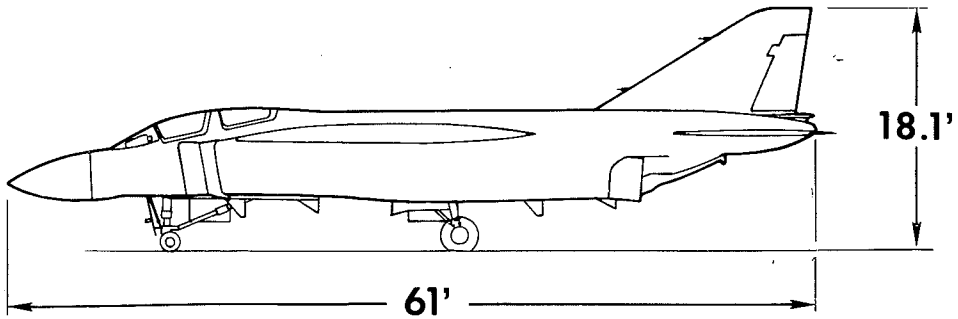
GA67-00482

F-4 (FV) S
HIGH VARIABLE SWEEP WING
500 SQ. FT.

INTERNAL FUEL=2180 GAL.
GROWTH VOLUME=421 GAL.







GA67-00483

MCDONNELL

F-4(FV)S

GROWTH VERSION - ADVANCED ENGINE

- COMBINE SWING WING, F-4K INLET, AND GE-1 ENGINE

- ENGINE

  0.9 BPR, AMSA AND LIFT/CRUISE CORE, GE-1 AIRFLOW MATCHED TO F-4K INLET SIZE

- AIRFRAME

  CHANGE INLET AND ENGINE ONLY

GA67-00484

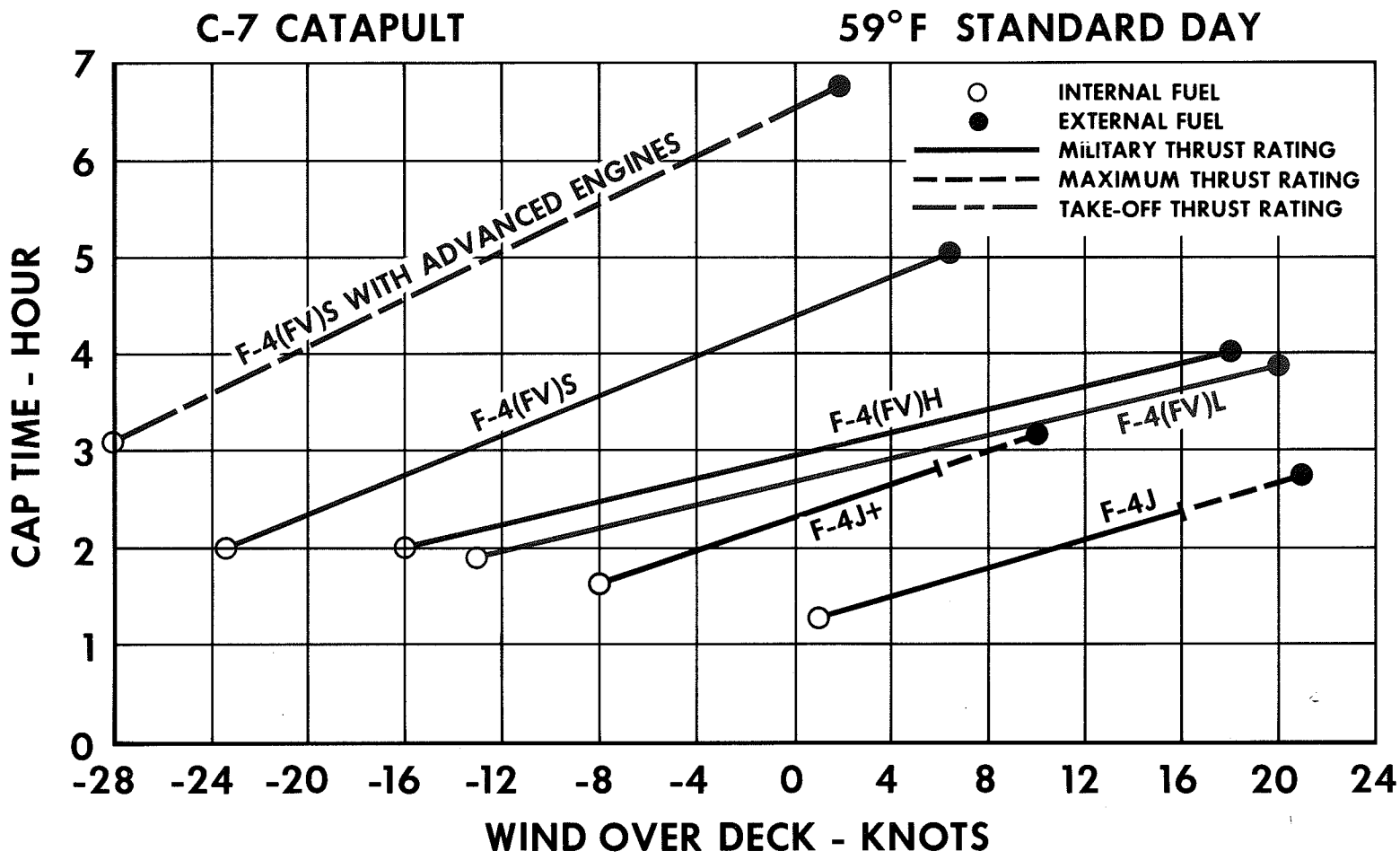
F-4X
PERFORMANCE SUMMARY

	F-4J	F-4J+	F-4(FV)L	F-4(FV)H	F-4(FV)S	F-4(FV)S ADVANCED ENGINES
TAKEOFF GROSS WEIGHT	**46,049**	**49,630**	**50,800**	**50,420**	**50,910**	**48,970**
WING AREA	530	565	595	560	500	500
WIND OVER DECK (C-7 CATAPULT)	**1**	**—8**	**—13**	**—16**	**—23**	**—28**
APPROACH SPEED	**136**(1)	**128**(2)	**125**	**124**	**125**	**122**
M_{MAX}	2.25	2.19	2.13	2.20	2.27	2.53(3)
CEILING (MAXIMUM POWER)	**58,300**	**56,100**	**54,600**	**55,950**	**58,000**	**61,950**
ACCELERATION TIME (0.8 - 1.8M AT 36,089 FT.)	2.46	2.97	3.04	2.83	2.87	2.28

(1) FLIGHT TEST (2) $V_{PA}/V_{PA\ MIN}$ SAME AS F-4J (3) STRUCTURAL LIMIT M = 2.4

GA67-00485

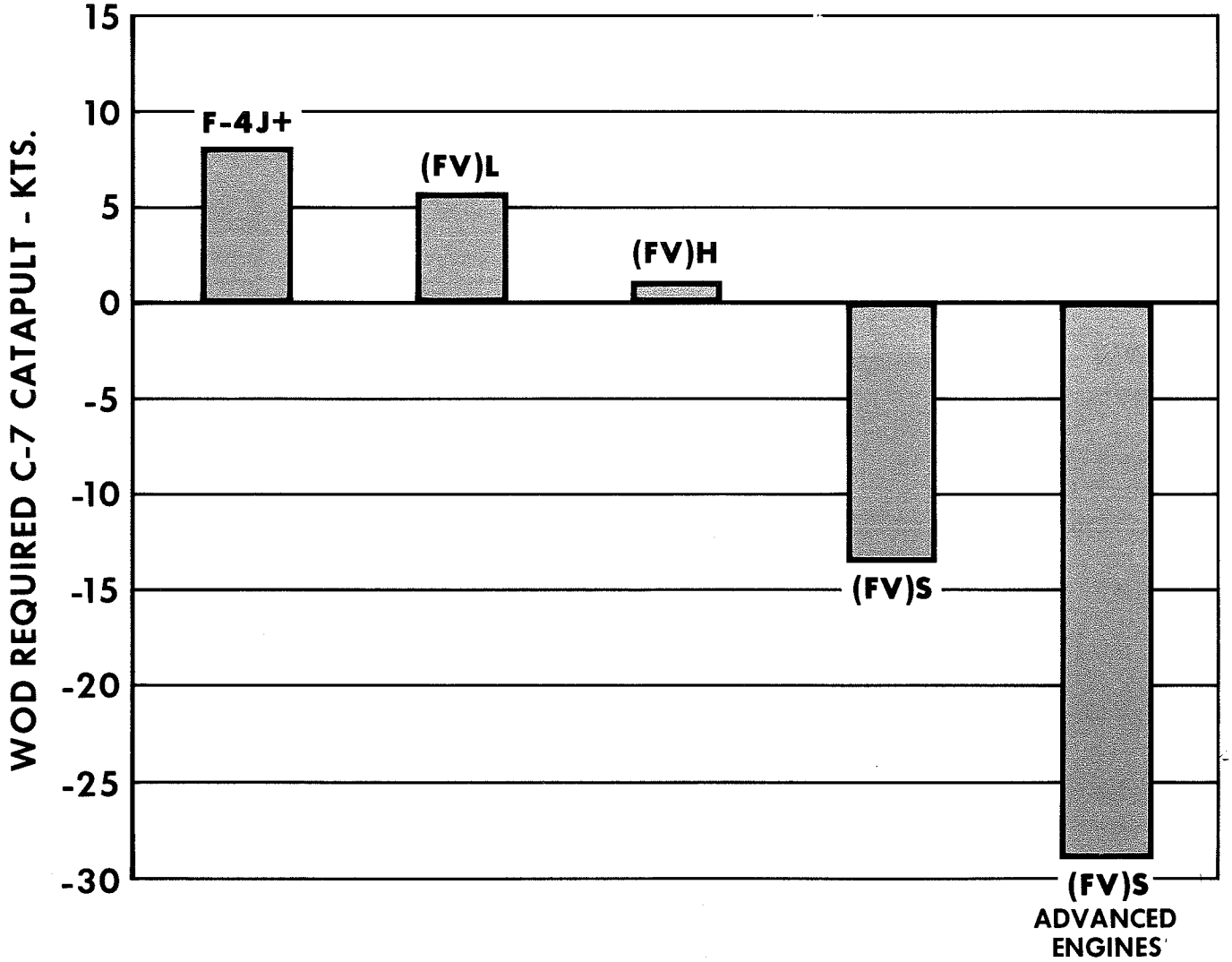
F-4X
CAP TIME vs WOD



GA67-00487

CATAPULT REQUIREMENTS

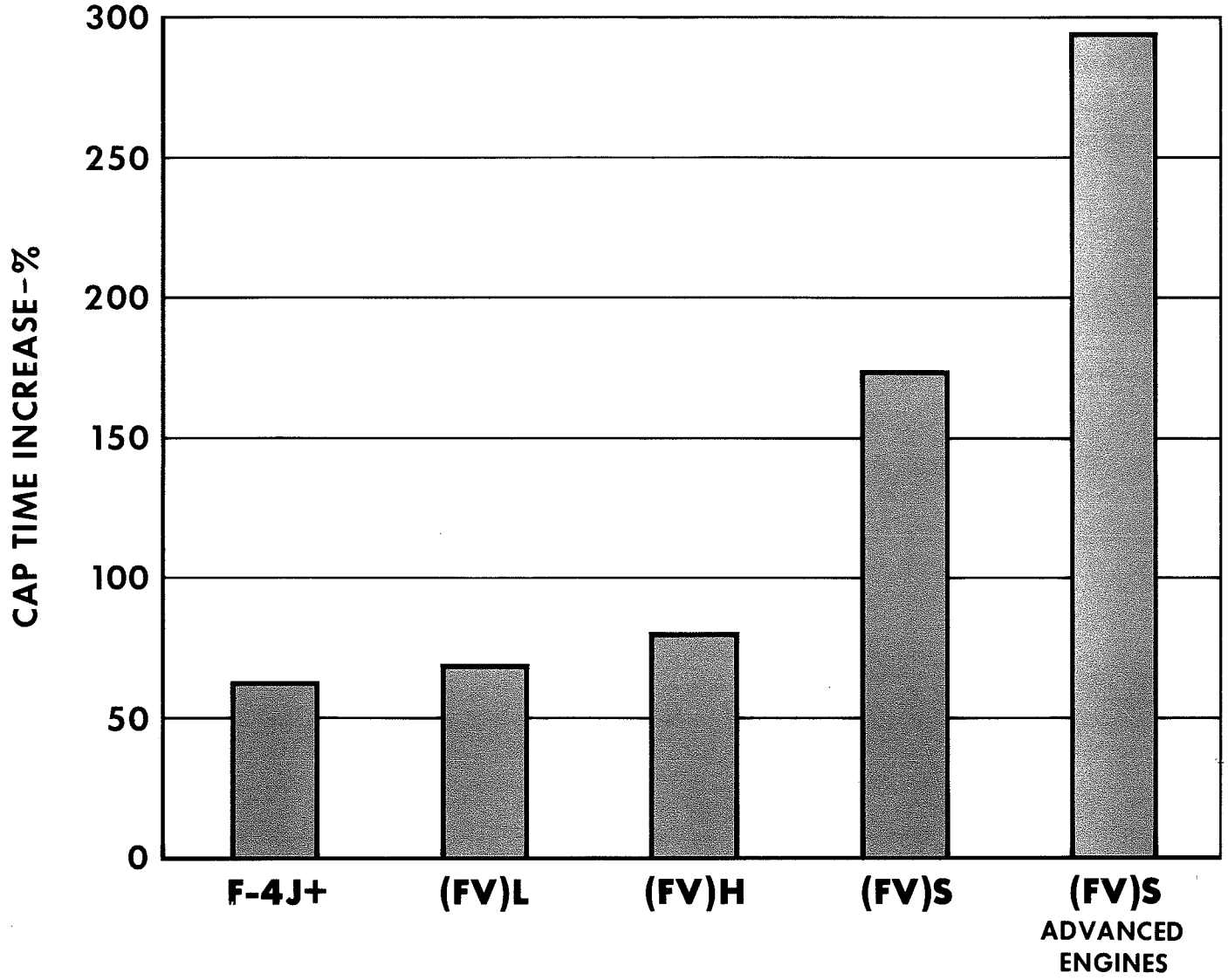
3 HOUR CAP



GA67-00486

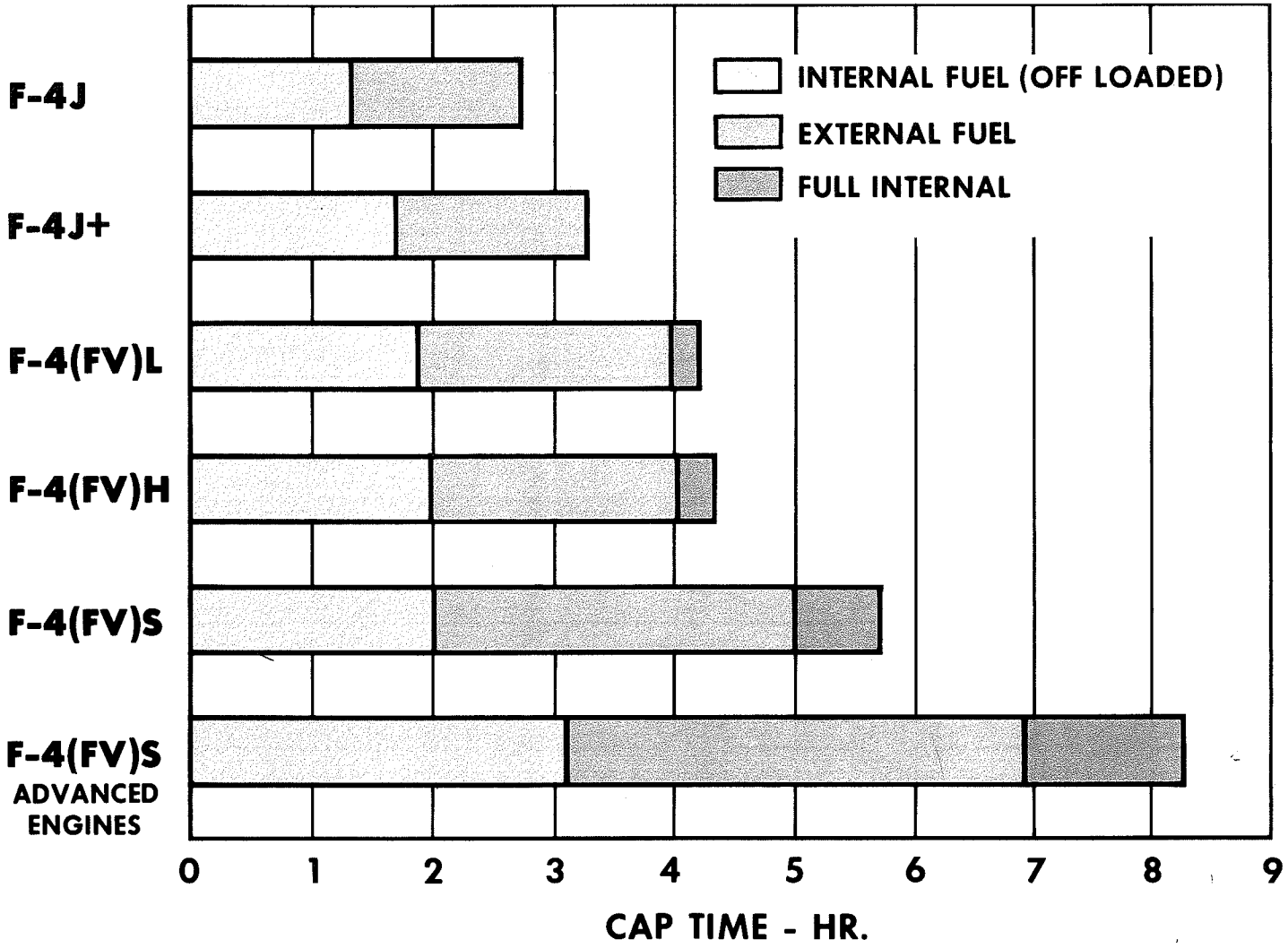
FLEET DEFENSE IMPROVEMENT

10 KNOTS WOD LAUNCH



GA67-00488

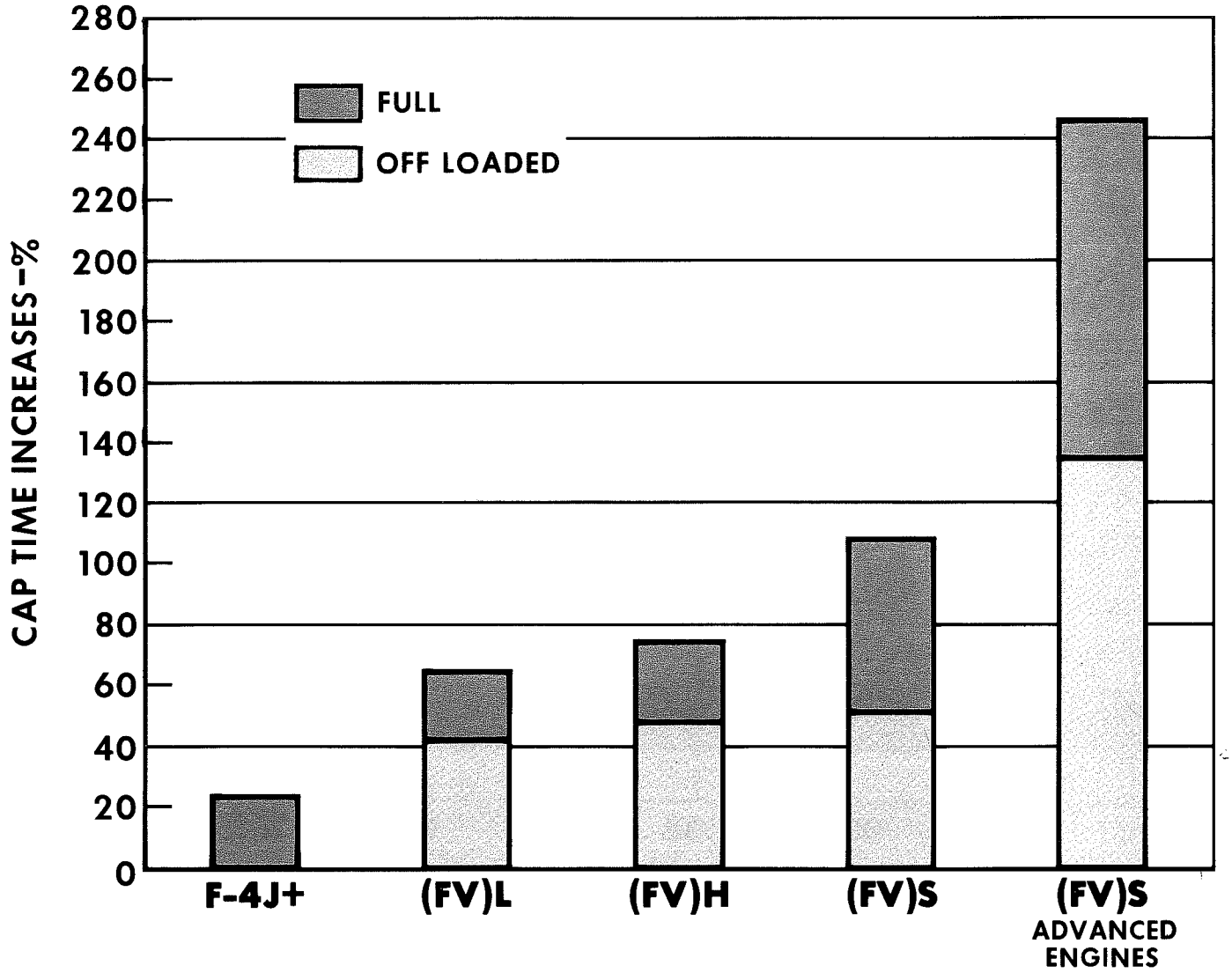
FLEET DEFENSE



GA67-00490

FLEET DEFENSE IMPROVEMENT

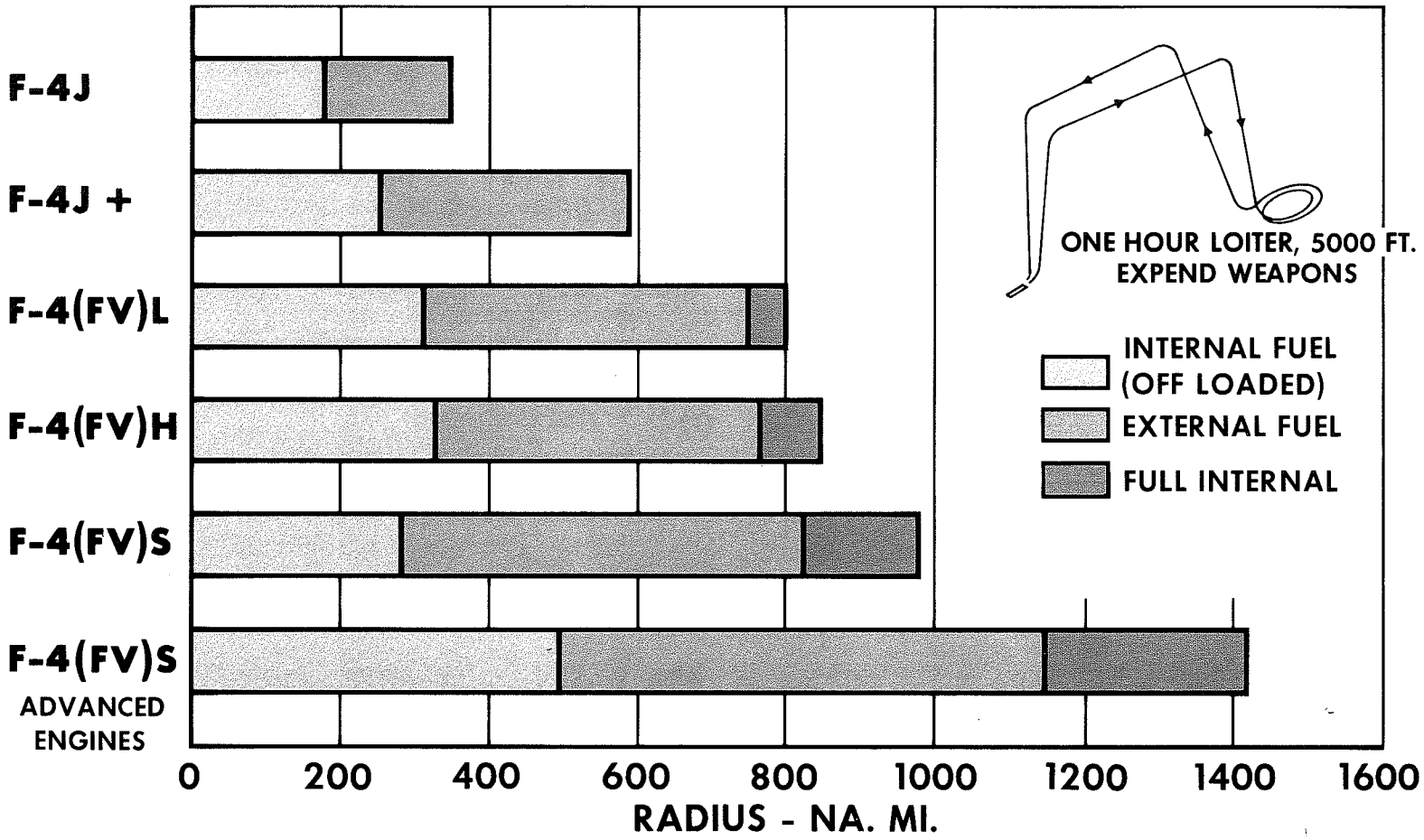
INTERNAL FUEL



GA67-00489

AIR-TO-GROUND

HI-LO-HI, (6) MK-82 S.E.



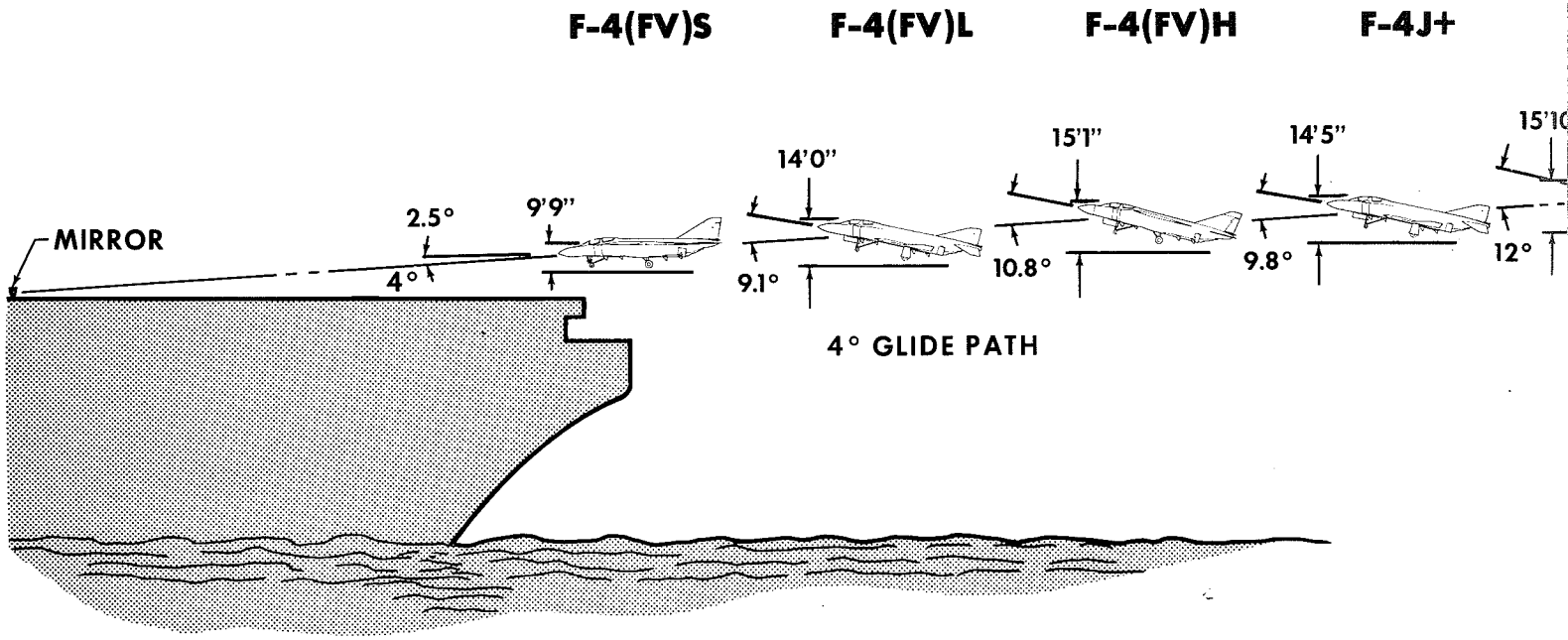
GA67-00493

F-4X
MISSION SUMMARY

		F-4J	F-4J+	F-4(FV)L	F-4(FV)H	F-4(FV)S	F-4(FV)S ADVANCED ENGINES
INTERNAL FUEL	GAL.	1998	2463	2535	2570	2180	2180
CAP TIME (CLEAN)	HR.	1.32	1.64	1.88	1.97	2.00	3.11
QRI RADIUS (CLEAN)	NA. MI.	246	319	309	338	284	305
CAP TIME	HR.	2.70	3.17	3.94	4.00	5.00	6.86
EXTERNAL FUEL	GAL.	1340	1340	1800	1800	1800	1800
HI-LO-HI RADIUS (6MK-82 S.E.)	NA. MI.	343	584	746	762	822	1147
EXTERNAL FUEL	GAL.	740	1340	1800	1800	1800	1800
HI-LO-LO-HI (MK-28)	NA. MI.	387	496	658	696	669	942
EXTERNAL FUEL	GAL.	740	740	1200	1200	1200	1200
FERRY (RETAIN TANKS)	NA. MI.	1791	2003	2298	2333	2390	3123
DROP TANKS	NA. MI.	1977	2343	2564	2607	2638	3482

GA67-00494

CARRIER APPROACH



GA67-

APPROACH SPEEDS

	F-4B 34,000 LB.		F-4J 36,500 LB.	
	KTS.	$\frac{V_{PA}}{V_{PA\ MIN.(NASC)}}$	KTS.	$\frac{V_{PA}}{V_{PA\ MIN.(NASC)}}$
V_{PA} (1.15 V_{SPA} CRITERION)	136	1.03	141	1.02
V_{PA} (NASC CRITERION)	145	1.10	152	1.10
V_{PA} (NATC RECOMMENDED)	140	1.06	136	0.98
ARRESTING BULLETIN	140	1.06	N.A.	—

GA67-00492

COMBAT MANEUVERABILITY
0.85M AT 35,000 FT.

	BUFFET ONSET n_z	MAXIMUM USABLE n_z
F-4J	1.62	2.43
F-4J+	1.65	2.48
F-4(FV)L	1.96	2.94
F-4(FV)H	1.86	2.79
F-4(FV)S Λ = 45°/70°	1.88 /2.06	2.83/3.38
F-4(FV)S Λ = 45°/70° ADVANCED ENGINES	1.96/2.14	2.94/3.51

GA67-00495

SUMMARY
LOITER PERFORMANCE

	TOS (HR.)	LOITER ALTITUDE (FT.)	LOITER M	BUFFET ONSET (N_Z)
F-4J	1.32	36,700	0.83	1.49
F-4J+	1.64	36,100	0.82	1.55
F-4(FV)L	1.88	35,570	0.78	1.70
F-4(FV)H	1.97	35,800	0.80	1.65
F-4(FV)S	2.00	32,800	0.61	1.30
F-4(FV)S ADVANCED ENGINES	3.11	34,100	0.61	1.24

GA67-00496

WING LOADING
BASED ON TOTAL PLANFORM AREA

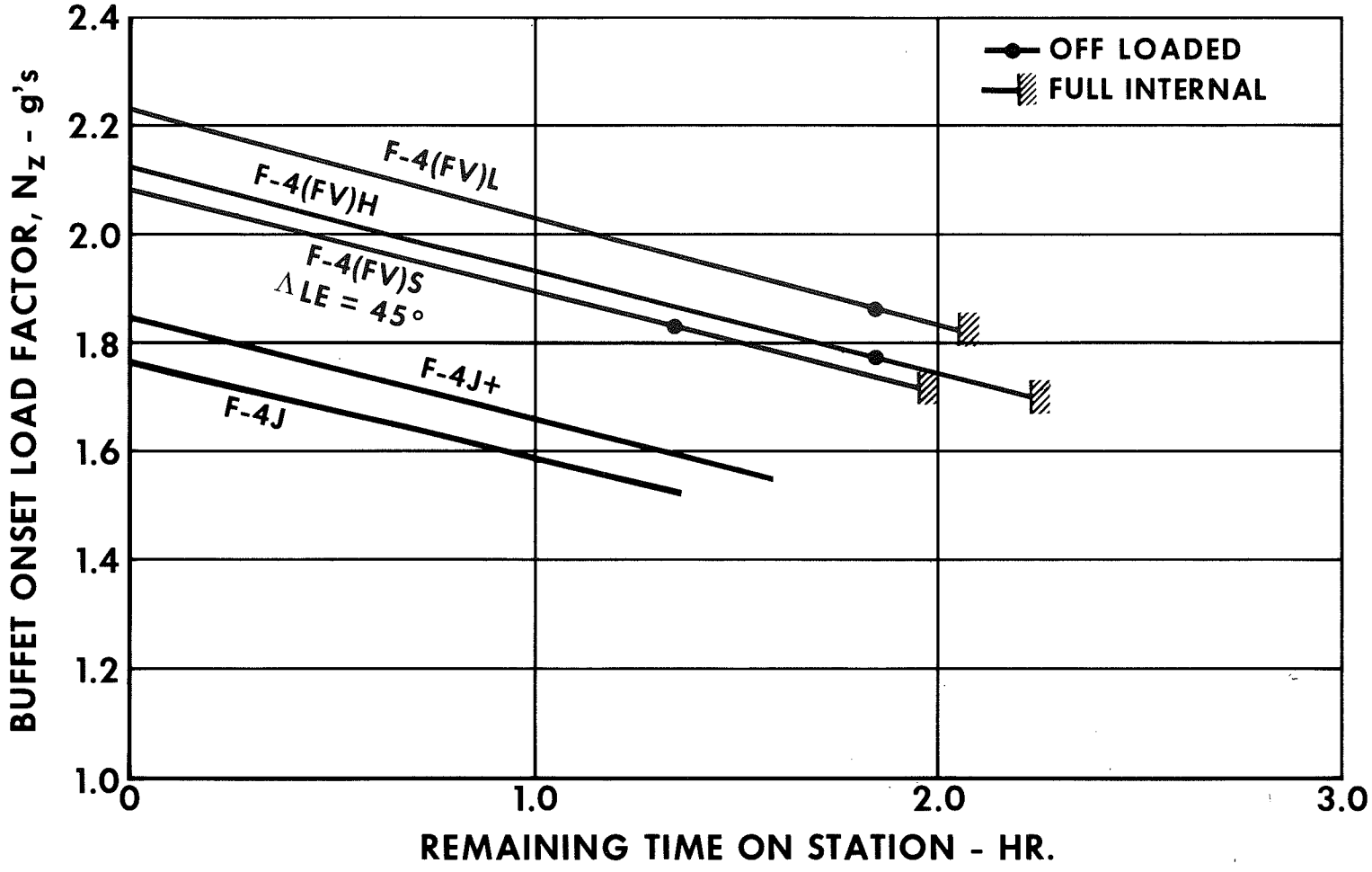
	TAKEOFF		COMBAT	
	Λ L.E.	W/Sw	Λ L.E.	W/Sw
F-4J	51°	85.7	51°	75.8
F-4J+	47°	87.8	47°	76.0
F-4 (FV) L	47°	85.4	47°	73.8
F-4 (FV) H	47°	90.0	47°	77.6
F-4 (FV) S	19°	74.9	70°	72.9
F-4 (FV) S ADVANCED ENGINES	19°	71.9	70°	69.8

GA67-00497

MANEUVERABILITY vs LOITER TIME

LOITER AT MACH = 0.85 AT 35,000 FT.

CAP MISSION (150 NA. MI. RADIUS)

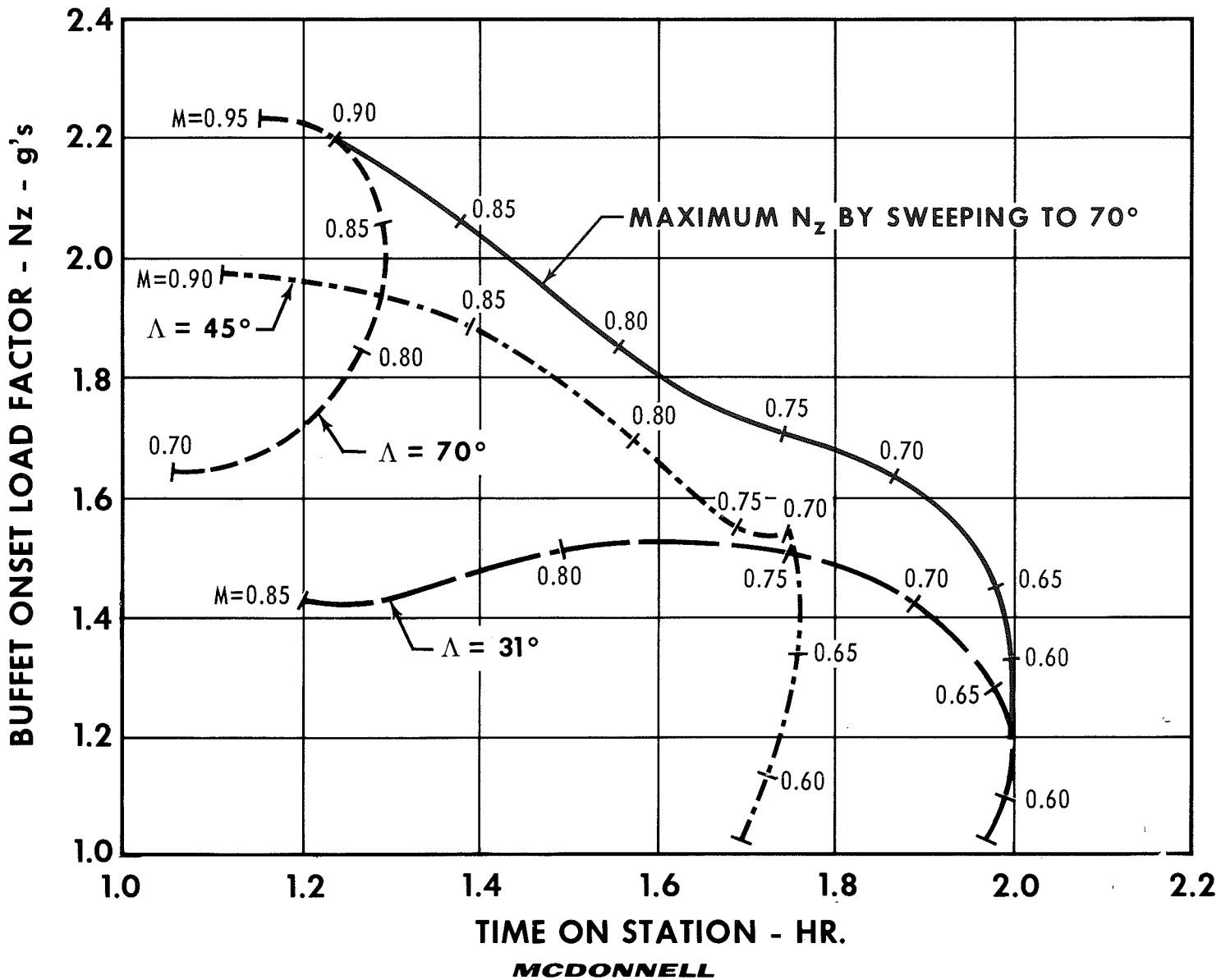


GA67-00498

F-4(FV)S

MANEUVERABILITY vs CAP TIME

COMBAT GROSS WEIGHT NO EXTERNAL FUEL 35,000 FT.



GA67-00499

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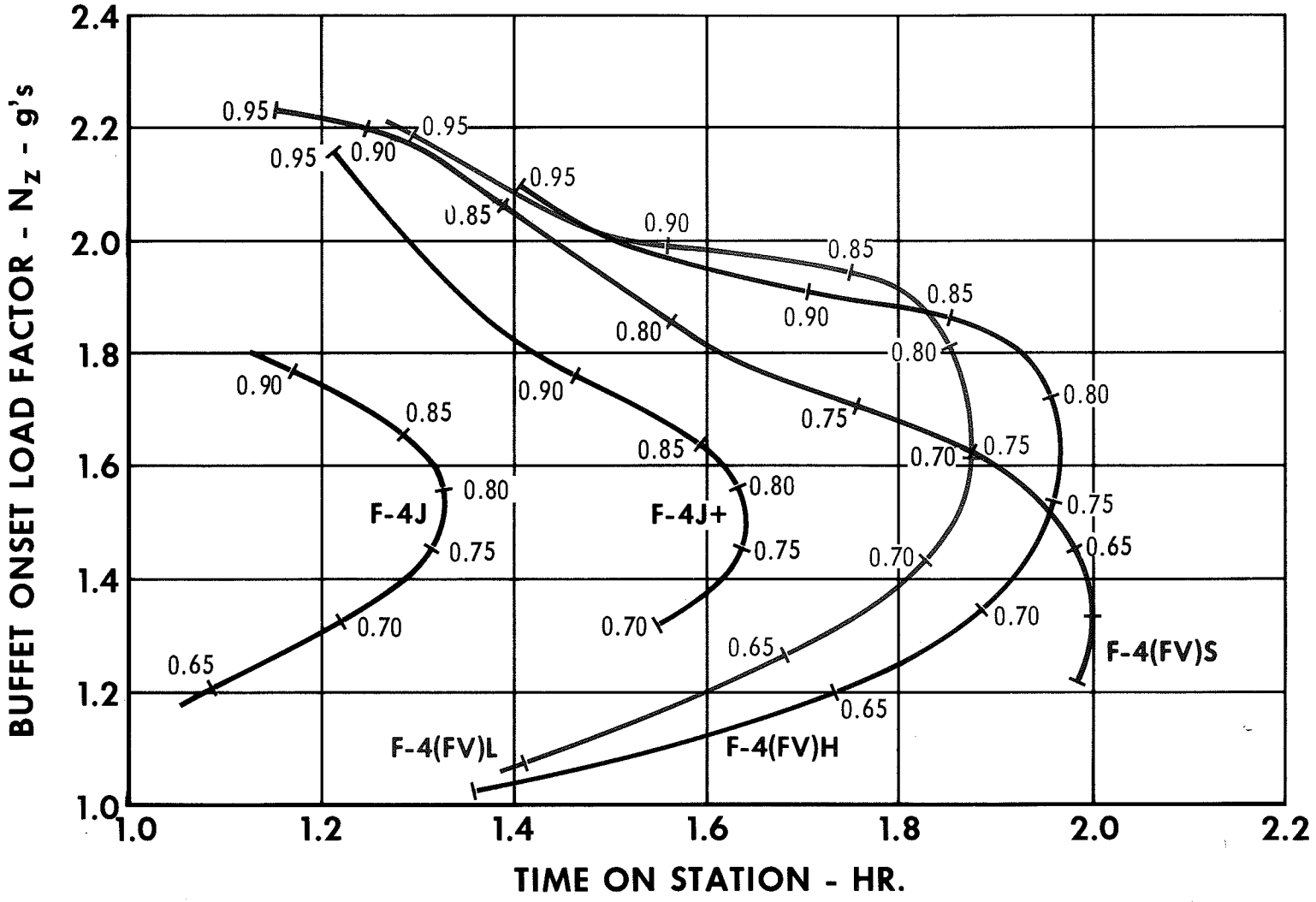
MANEUVERABILITY vs CAP TIME

COMBAT GROSS WEIGHT NO EXTERNAL FUEL 35,000 FT.



GA67-00500

F-4X
TEST PROGRAM

- 1966 WIND TUNNEL WORK 4700 HOURS

- FUTURE INVESTIGATIONS - WIND TUNNEL AND FLIGHT TESTING

  CRUISE IMPROVEMENTS
  - VARIABLE AFT FUSELAGE GEOMETRY
  - ENGINE NOZZLE CHANGES
  - IMPROVED ENGINE COMPARTMENT SEALING
  - INLET BOUNDARY LAYER BLEED SYSTEM

  HIGH LIFT SYSTEM IMPROVEMENTS
  - VARIABLE GLOVE GEOMETRY

  MANEUVERABILITY IMPROVEMENTS
  - LEADING EDGE MODIFICATIONS
  - MANEUVERING SLATS AND FLAPS

- 1967 WIND TUNNEL PROGRAMS - 4800+HOURS

GA67-00501

SPOTTING SUMMARY

CVA 59

	F-4J+	F-4(FV)L	F-4(FV)H	F-4(FV)S
NUMBER A/C FLIGHT DECK	67	61	64	58
NUMBER A/C HANGAR DECK	49	43	46	40
TOTAL	**116**	**104**	**110**	**98**

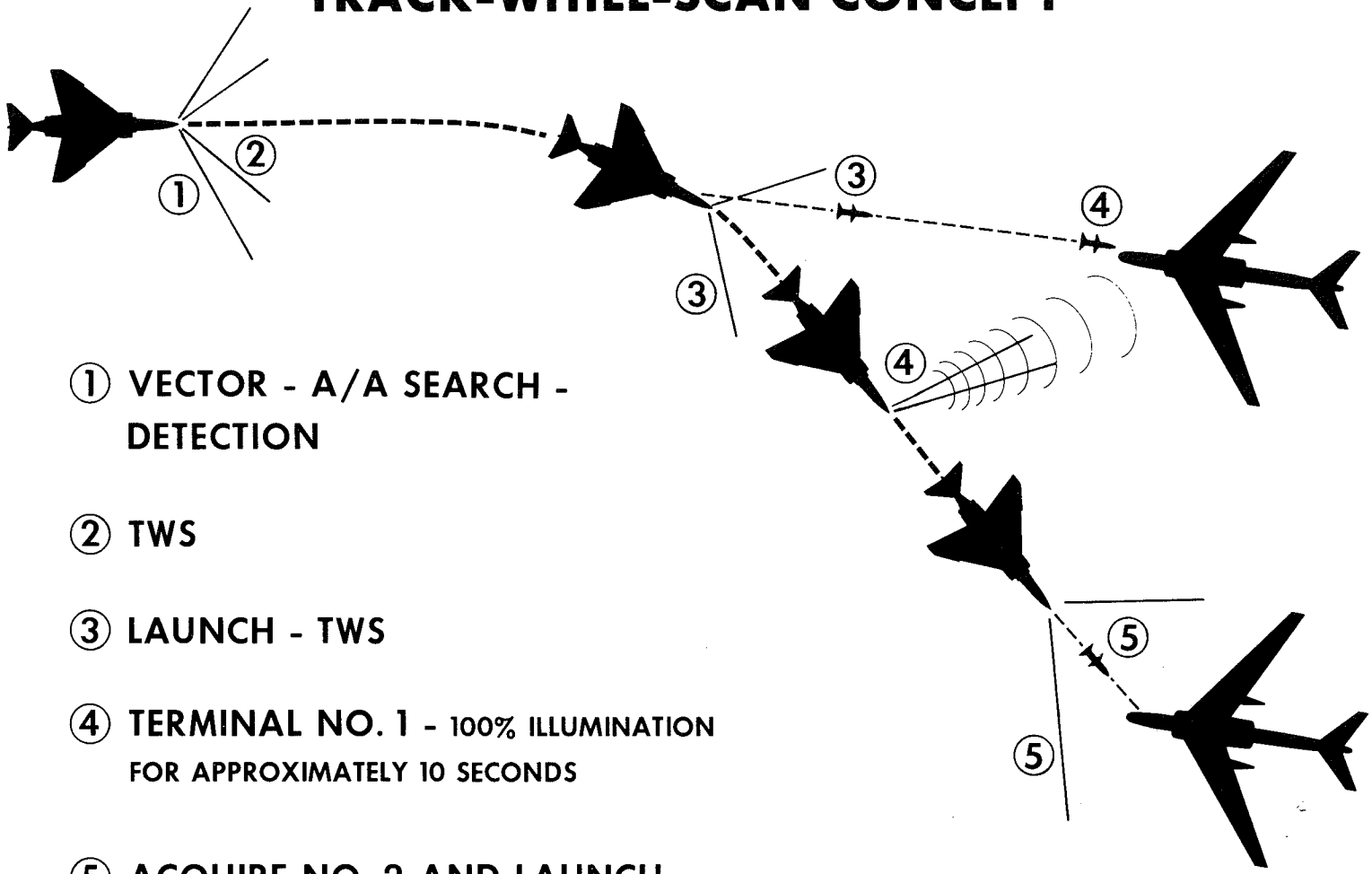
GA67-00502

AMCS COMPARISON

	AWG-10 (SINGLE-SHOT)	AWG-10 (TRACK-WHILE-SCAN)	AWG-10 (MULTISHOT)	AWG-10 (MULTISHOT)	AWG-9 (MODIFIED)
TRANSMIT POWER (KW)	1	1	1	1	3
ANTENNA DIAMETER (IN.)	32	32	32 X 26	32 X 26	34
MISSILES	AIM-7F	AIM-7F(MOD.)	AIM-7F(MOD.)	AIM-7F(MOD.) AIM-54A	AIM-54A AIM-7F(MOD.)
AMCS WEIGHT (LB.)	1107	1135	1221	1408	1692
AMCS VOLUME (CU. FT.)	34.6	34.6	37.5	40.5	50.2
COST ESTIMATE					
NON RECURRING $M	—	15.4	90.8	110.6	52.1
RECURRING $M	0.42	0.50	0.86	0.94	1.7

GA67-00503

TRACK-WHILE-SCAN CONCEPT



① VECTOR - A/A SEARCH - DETECTION

② TWS

③ LAUNCH - TWS

④ TERMINAL NO. 1 - 100% ILLUMINATION FOR APPROXIMATELY 10 SECONDS

⑤ ACQUIRE NO. 2 AND LAUNCH (IN EITHER TWS OR 100% ILLUMINATION)

GA67-00504

F-4X
AMCS COMPARISON

RADAR DETECTION RANGE ($P_D = 0.85$)

NAUTICAL MILES

	TARGET ASPECT ANGLE		
	NOSE-ON	NEAR BEAM	TAIL-ON
SINGLE-SHOT AWG-10	43.5	53.0	37.8
TRACK-WHILE-SCAN AWG-10	43.5	53.0	37.8
MULTISHOT AWG-10:			
AIM-7F	40.2	49.0	35.0
AIM-54A	37.4	45.6	32.8
MULTISHOT AWG-9	111.3	129.0	88.5

$V_I = V_T$ = M 1.5
ALTITUDE: 40,000 FT.
TARGET SIZE: $5M^2$
WIDE SCAN

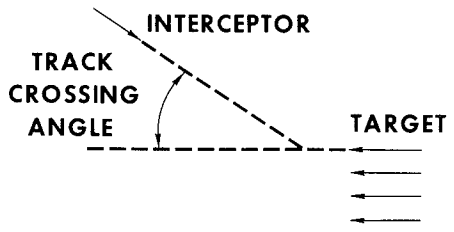
GA67-00505

F-4X
AMCS COMPARISON

AVERAGE NUMBER OF MISSILES LAUNCHED

TARGET SPACING NA. MI.	TRACK CROSSING ANGLE 0° 2	0° 5	30° 2	30° 5	50° 2	50° 5
SINGLE-SHOT AWG-10	1.0	1.0	1.2	1.7	1.7	2.3
TRACK-WHILE-SCAN AWG-10	3.5	1.0	4.8	2.0	5.7	5.4
MULTISHOT AWG-10:						
AIM-7F	3.5	3.5	5.3	5.0	6.0	5.8
AIM-54A/AIM-7F	5.0	5.0	6.0	6.0	6.0	6.0
MULTISHOT AWG-9						
AIM-54A/AIM-7F	5.0	5.0	6.0	6.0	6.0	6.0

$V_I = V_T$ = M 1.5
ALTITUDE: 40,000 FT.
TARGET SIZE: $5m^2$



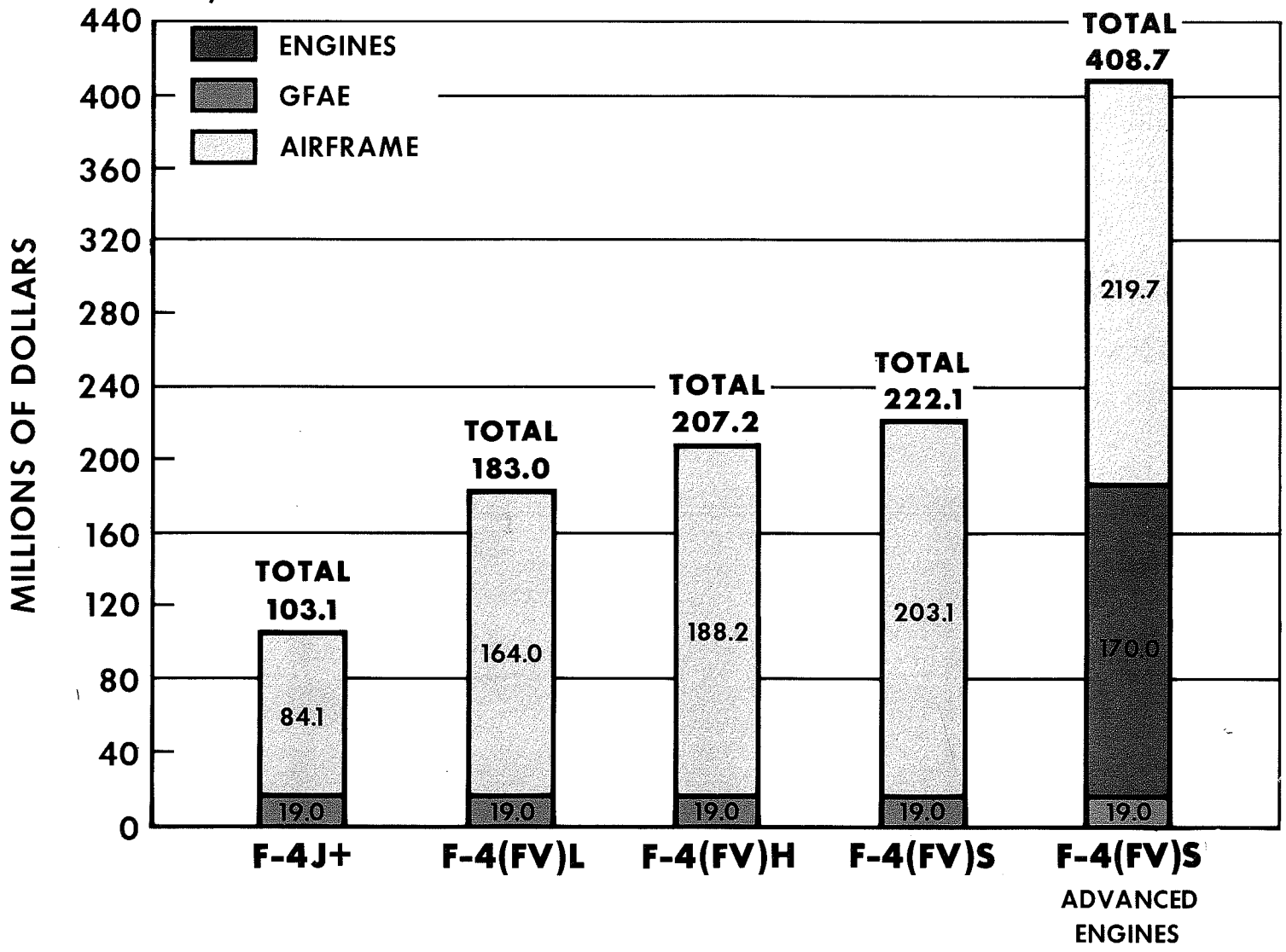
GA67-00506

F-4X
AMCS INSTALLATION COMPARISON

		AWG-10 T.W.S. (6) SPARROW	AWG-10 SINGLE-SHOT (6) SPARROW	AWG-10 MULTISHOT (6) SPARROW	AWG-10 MULTISHOT (4) SPARROW (2) PHOENIX	AWG-9 MULTISHOT (4) SPARROW (2) PHOENIX
Δ TOGW	LB.	—	-80	+90	+960	-640
Δ EQUIPMENT VOLUME	CU. FT.	—	0	+3.5	+7	+23.2
Δ FUEL	GAL.	—	0	0	-104	-412
Δ COST (RECURRING)	$M	—	-0.12	+0.39	+0.48	+1.43
Δ COST (NON RECURRING)	$M	—	-15	+91	+112	+74
Δ TOS	HR.	—	NEG.	NEG.	-0.16	-0.93
Δ RANGE	NA. MI.	—	+6	-5	-81	-296

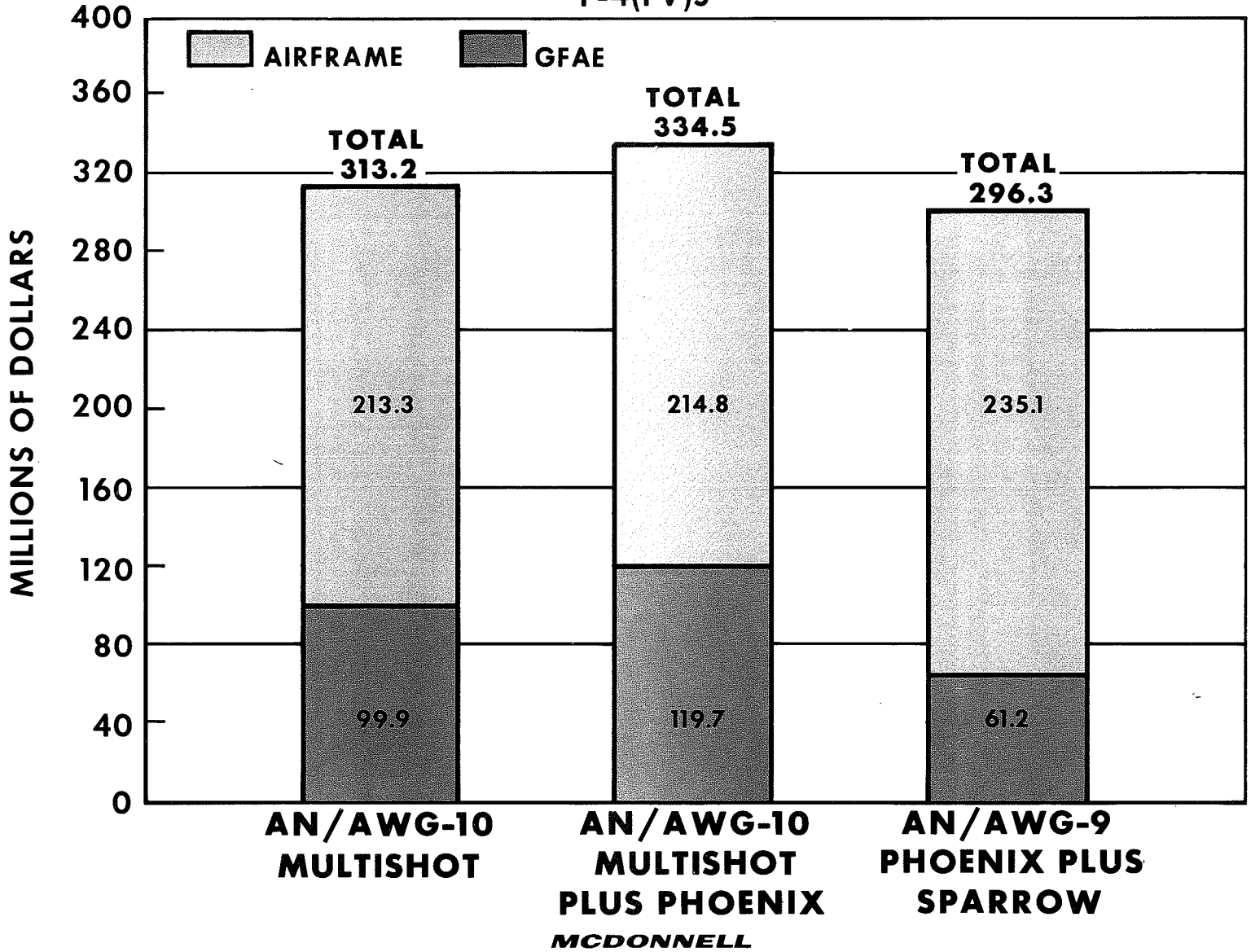
GA67-00507

F-4X
NON-RECURRING PRICE SUMMARY
AIRFRAME AND ENGINE VARIATIONS
AN/AWG-10 SINGLE SHOT WITH TRACK WHILE SCAN



GA67-00508

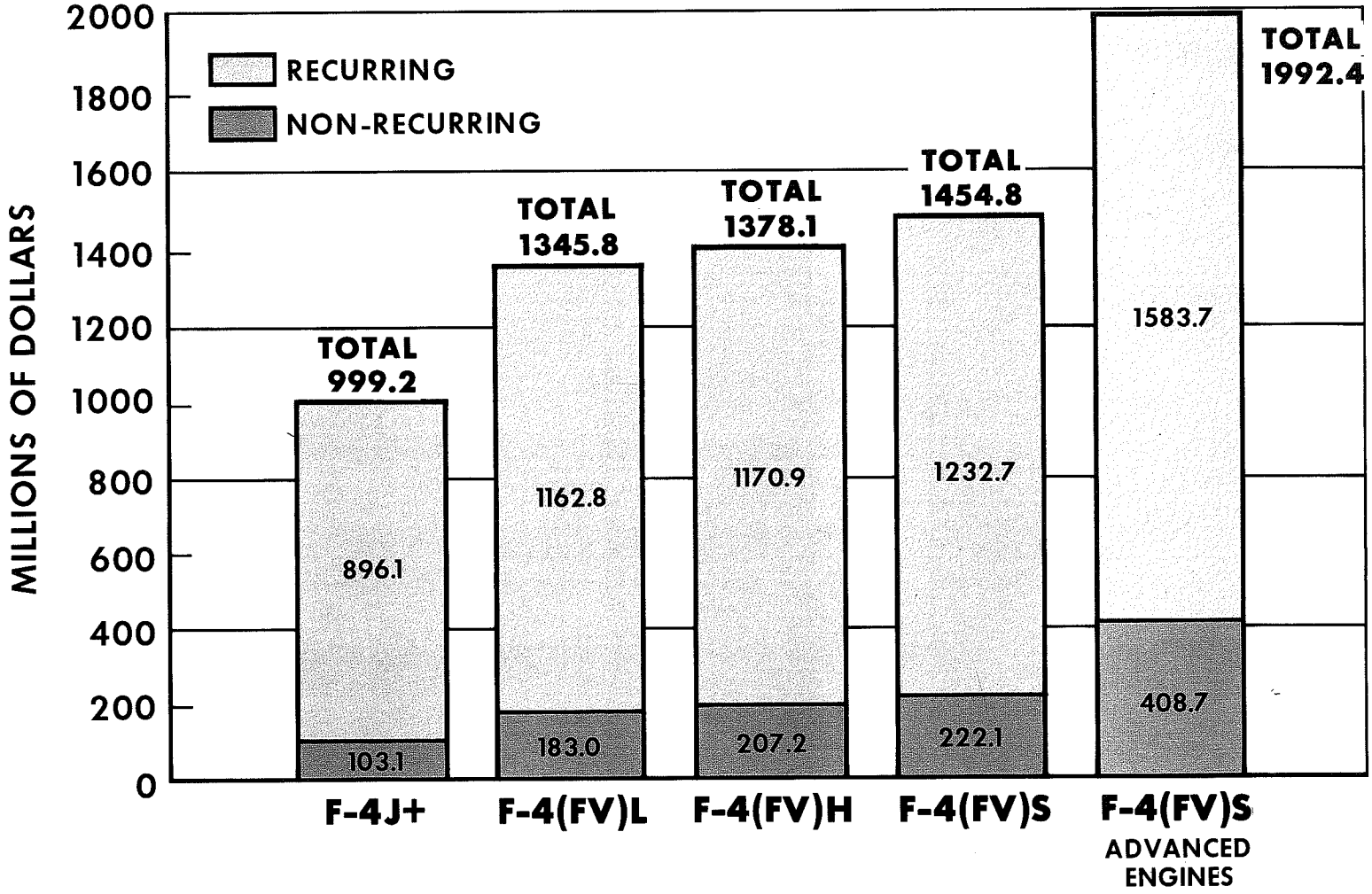
F-4X
NON-RECURRING PRICE SUMMARY
AMCS VARIATIONS
F-4(FV)S



GA67-00509

MCDONNELL

F-4X
TOTAL RECURRING AND NONRECURRING COST
AIRFRAME AND ENGINE VARIATIONS
300 AIRCRAFT AN/AWG-10 TRACK WHILE SCAN



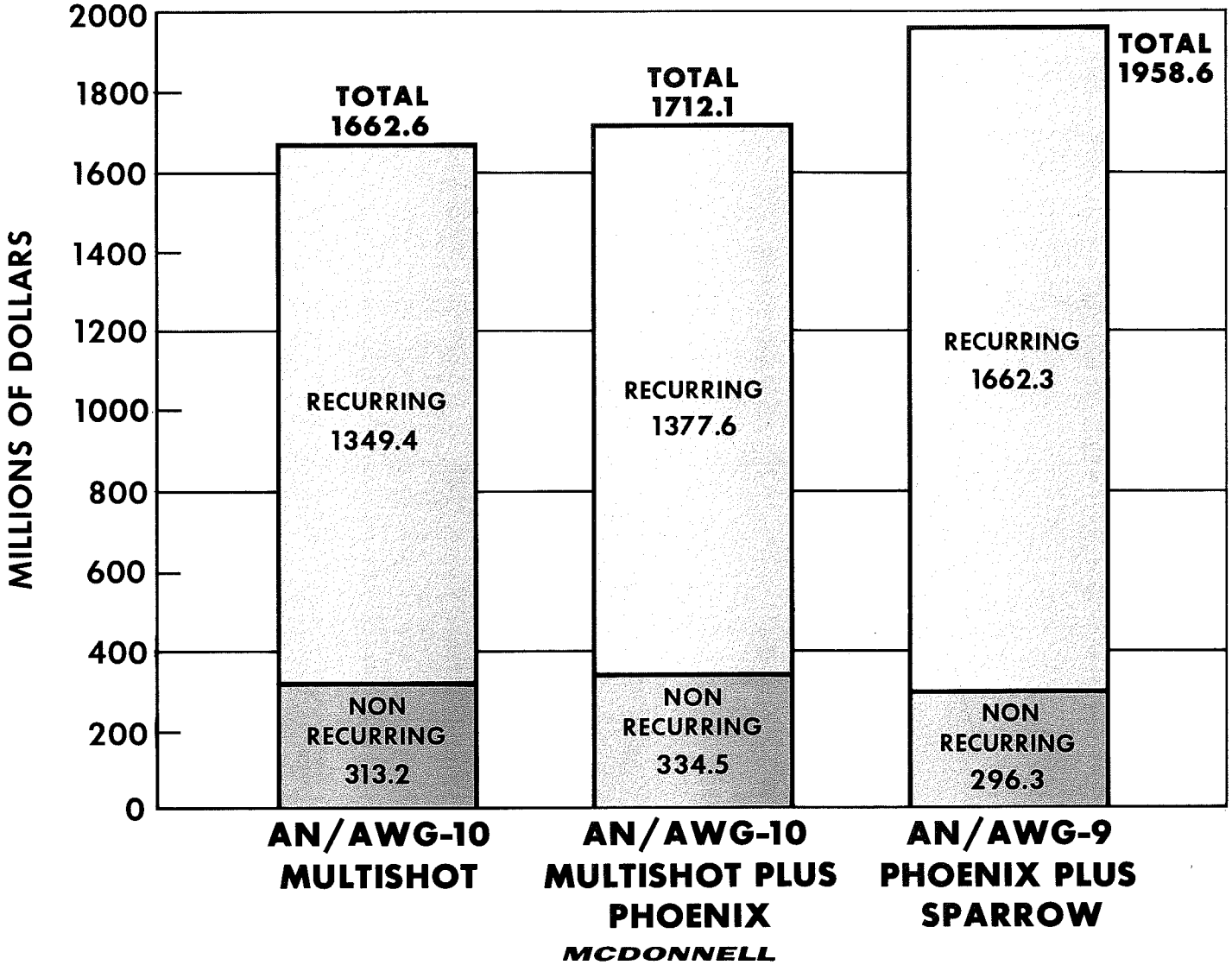
GA67-00510

F-4X

TOTAL RECURRING AND NONRECURRING COST

AMCS VARIATIONS

300 F-4(FV)S AIRCRAFT

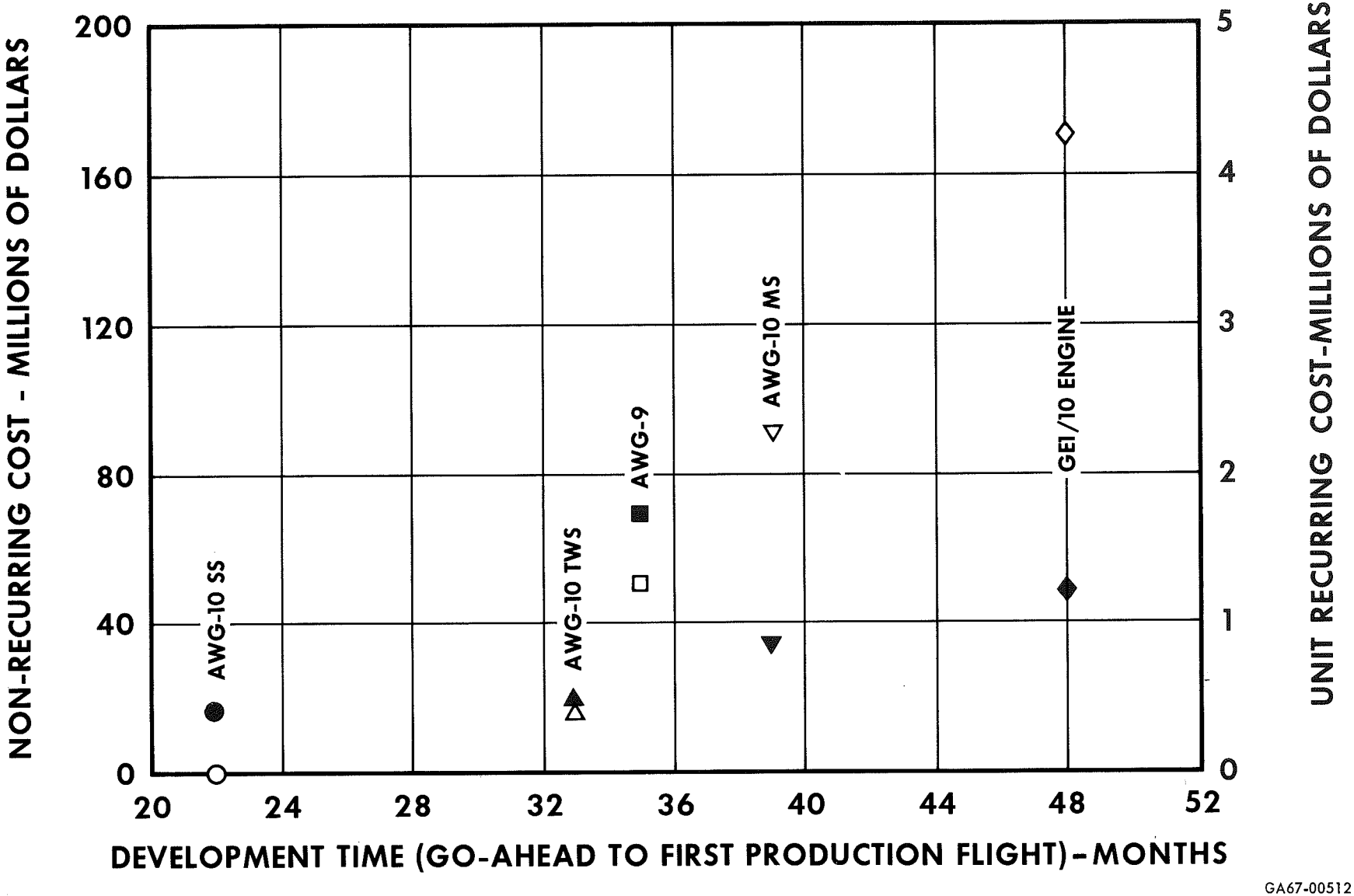


MCDONNELL

GA67-00511

F-4X

AWCS AND ENGINE COST vs TIME



GA67-00512

SYSTEM EQUIPMENT SUMMARY

OTHER THAN AMCS

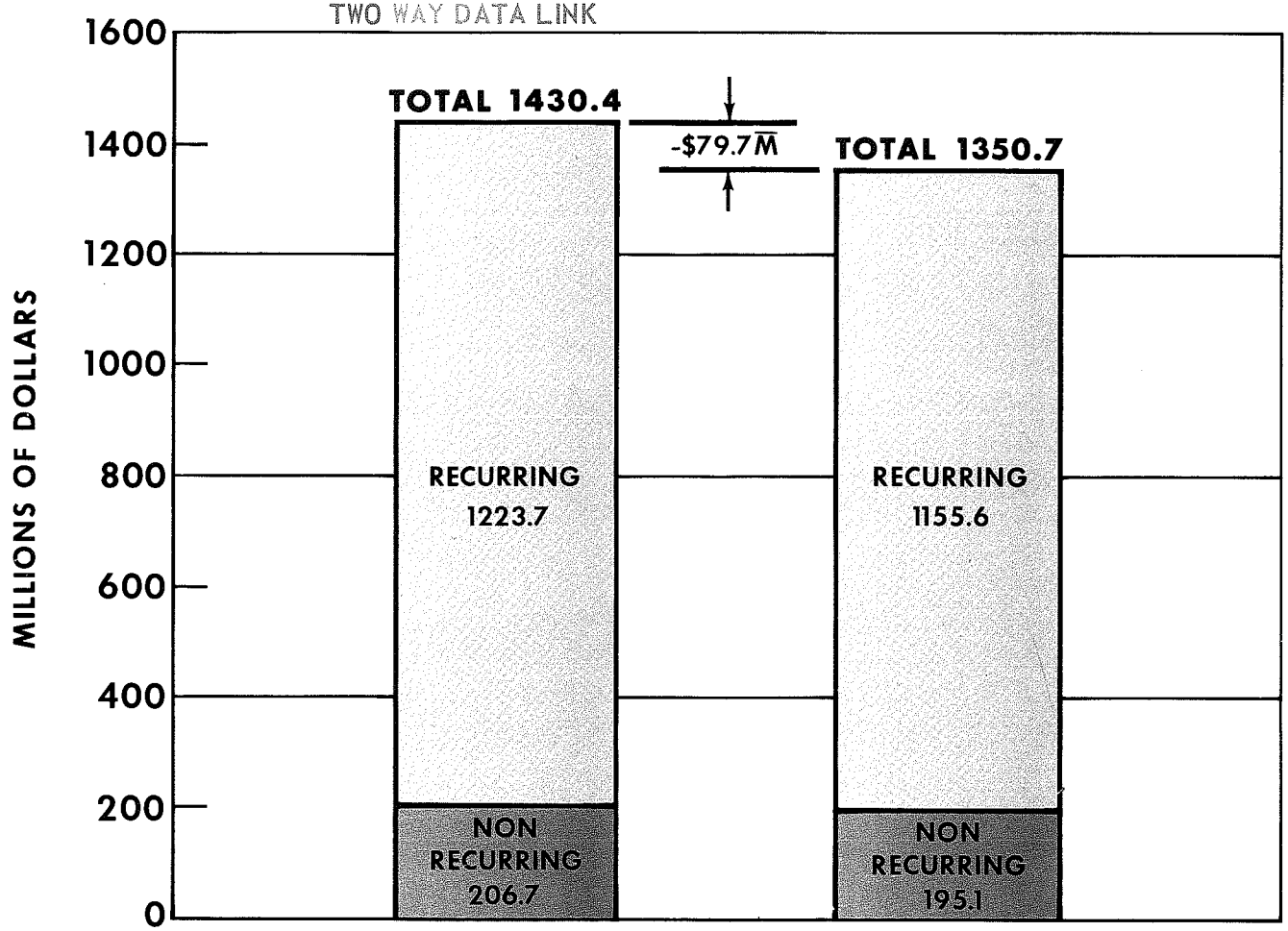
F-4J+	F-4(FV)L, (FV)H & (FV)S
IMPROVED CNI	IMPROVED CNI
RADAR WARNING & HOMING	RADAR WARNING & HOMING
F-4J BOMBING SYSTEM	INERTIAL DIGITAL BOMB /NAVIGATION SYSTEM
F-4J NAVIGATION SYSTEM	
F-4J OPTICAL SIGHT	LEAD COMPUTING SIGHT SYSTEM
AIR-TO-AIR IFF	AIR-TO-AIR IFF
CADC	CADC
AUTOPILOT	AUTOPILOT

GA67-00514

F-4(FV)S WITH AWG-10 SINGLE SHOT
TOTAL RECURRING & NONRECURRING COST
ALTERNATE SYSTEMS EQUIPMENT

INERTIAL DIGITAL BOMB/NAV. SYSTEM
LEAD COMPUTING SIGHT
IMPROVED CNI
RADAR WARNING & HOMING
TWO WAY DATA LINK

F-4J BOMBING & NAV. SYSTEM
F-4J OPTICAL SIGHT
IMPROVED CNI
RADAR WARNING & HOMING
TWO WAY DATA LINK



MCDONNELL

GA67-00513