

EXECUTIVE OFFICE OF THE PRESIDENT
BUREAU OF THE BUDGET
WASHINGTON 25, D. C.

MAY 12 1960

MEMORANDUM FOR GENERAL GOODPASTER

Subject: Comparative costs of MINUTEMAN and POLARIS

There is attached for your information a memorandum giving our staff estimates of comparative costs of MINUTEMAN and POLARIS. The basis of our estimates is explained in the memorandum and the tables attached thereto.

Also for your information I am submitting a comparative cost analysis of MINUTEMAN and POLARIS originating in the Air Force. These estimates were developed on a different basis from our staff study. For example, they exclude research, development, test and evaluation costs which are included in our staff analysis, but on the other hand, they include estimates of five-year operating costs of the two weapon systems which are not included in our staff comparison. A brief evaluation is provided in the accompanying memorandum.

Mannix H. Stans

Director



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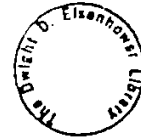
MEMORANDUM

TO: The Director

Date: May 11, 1960

FROM: Military Division *W. H. Schaub*

SUBJECT: Cost comparisons, POLARIS and MINUTEMAN



Based on the best information available to us at this time, we have developed the rough estimates of comparative cost of the POLARIS and MINUTEMAN missile systems shown on the attached sheets and summarized below:

	Procurement & construction costs only-- <u>Present programs</u> ^{1/} (Table I)	(In millions)	
		<u>Total Capital Costs</u> Present approved programs	Service program <u>objectives</u> ^{2/} (Table II)
Cost per launch-ready missile in operational units:			
POLARIS	\$9.2	\$14.6	\$15.3
MINUTEMAN-fixed	3.2)	14.7	4.1
MINUTEMAN-mobile	3.2)		
Cost per launch-ready missile in operational units <u>on station</u> :			
POLARIS	\$16.7	\$26.3	\$27.8
MINUTEMAN-fixed	3.2)	14.8	4.1
MINUTEMAN-mobile	3.4)		

- 1/ 21 POLARIS submarines with 1,500 mile missiles; 150 MINUTEMAN missiles.
- 2/ 45 POLARIS submarines with 2,500 mile missiles; 1,500 MINUTEMAN missiles.

The above estimates are necessarily subject to many qualifications. Both systems are still in the development phase and there has been little actual production cost experience in the case of POLARIS and none at all in the case of MINUTEMAN. The total development costs of both systems are still uncertain and depend on technical progress being made as called for by the present very tight schedules. In the case of MINUTEMAN the launching system equipment requirements for both the fixed and mobile concepts have not yet been finally determined.

Reliable estimates of comparative annual operating costs of the two systems are not feasible at this time in the absence of adequate data on military personnel requirements and other aspects of the operational systems.

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The attached staff estimates have recognized that Air Force estimates for MINUTEMAN have consistently been low. The three-stage MINUTEMAN missile should cost at least 20-25 percent more than the two-stage POLARIS. Navy currently estimates that the initial quantities of the POLARIS missiles will cost \$1,261,000 each, based on the latest contractor estimates (for missiles 135 through 150). Production experience and larger quantities should result in a lower average unit cost for the total program. Accordingly, for purposes of these staff estimates we have assumed an average cost of \$1.0 million for POLARIS missiles and \$1.2 million for MINUTEMAN missiles. This compares to estimates quoted at various times by the Air Force in the range of \$400,000 to \$800,000 per MINUTEMAN missile which, of course, have no supporting experience at this time and are obviously out of line compared to the experience to date in the POLARIS program, the only long-range solid propellant missile that is at all comparable.

MINUTEMAN ground equipment costs have been assumed to be the same for both fixed and mobile versions, on the assumption that a large portion of the rolling stock for the mobile concept would be obtained from Defense mobilization reserve or on a lease basis, in line with current discussions in the Air Force, avoiding the cost of new procurement. The Navy factor of 33 1/3 percent for back-up support missiles, while subject to question, has been used in developing the POLARIS estimates. Also, the Navy factor of 1 tender for every 9 submarines has been applied. In the case of MINUTEMAN, the 10 percent factor for back-up support missiles now used for ATLAS and TITAN was applied.



With respect to average on-station time, two-thirds of the POLARIS submarines will be on station until the overhaul cycle begins. Then only 5 of every 9 submarines, or 55 percent, will be on station. The mobile MINUTEMAN, under present plans, will be on-station for 14 days and return to its depot for one day and then return to its mobile status the following day for another two-week period. This means that the mobile missiles will be on station 93 percent of the time.

It should be recognized that our estimates are pure cost comparisons in the sense that they do not make any assumptions with respect to the relative effectiveness of two systems. A "cost-effectiveness" comparison of the two systems would have to reflect assumptions with respect to the comparative accuracy, vulnerability, and other pertinent factors related to the military effectiveness of the systems under assumed "deterrence" or "combat" situations.

Attachments

Copy: Dr. Reid

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Estimated Cost Comparison - POLARIS and MINUTEMAN

Table I - Procurement and Construction Costs Only
(In millions)

	<u>POLARIS</u>	<u>MINUTEMAN - Fixed</u>	<u>MINUTEMAN - Mobile</u>
Operational unit	Submarine	Squadron	Train
Launch-ready missiles per operational unit	16	50	3
Percent of units on station	55% ^{1/}	100%	93%
 Estimated average total capital cost per operational unit:			
Missiles	16 @ \$1.0 = \$16.0	50 @ \$1.2 = \$60.0	3 @ \$1.2 = \$3.6
Submarines	1 @ 110.0 = 110.0	-	-
Construction	-	50 @ 0.4 = 20.0	-
Ground equipment	-	25.0	4.0
Support	-	-	-
Tender	1/9 x 55.0 = 6.1	-	-
Missiles	1/3 x 16.0 = 5.3	6.0	.4
Control sites	-	25.0	-
Initial spare parts	10.0	22.0	1.6
Total average cost per operational unit	\$147.4	\$158.0	\$9.6
 Average cost per launch-ready missile in operational units	 \$9.2	 \$3.2	 \$3.2
 Average cost per launch-ready missile in operational units on <u>station</u>	 \$16.7 ^{1/}	 \$3.2	 \$3.4

Above costs exclude for each system: Supporting research and surveys; development, test, and evaluation; production and overhaul facilities; training and training facilities; communications to operational units; general support; and all operating and personnel costs. Mobile MINUTEMAN estimates assume that railroad cars will either be leased or obtained from Army mobilization reserve.

^{1/} The percent of submarines on station is 67% until overhaul cycle begins in CY 1963; thereafter it decreases to 55%.



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Estimated Cost Comparison - POLARIS and MINUTEMAN

Table II - Total Capital Costs
(In millions)

	POLARIS		MINUTEMAN	
	Present Approved Program	Service Program Objectives	Present Approved Program	Service Program Objectives
Number of Units	21 Submarines	45 Submarines	150 Missiles	1500 Missiles ^{1/}
Total launch-ready missiles in operational units	336	720	150	1500
Launch-ready missiles in operational units on station	186	396	149	1479
Research, Development, Test and Evaluation	\$1,700	\$3,000	\$1,700	\$1,700
Procurement	900	2,670	450	3,900
Construction	100	130	50	500
Shipbuilding	2,200	5,200 ^{2/}	-	-
Total Cost of Program	\$4,900	\$11,000 ^{2/}	\$2,200	\$6,100
Average Cost per launch-ready missile in operational units	\$14.6	\$15.3	\$14.7	\$4.1
Average Cost per launch-ready missile in operational units on station	\$26.3	\$27.8	\$14.8	\$4.1

Above costs include: Supporting research and surveys; development, test, and evaluation; procurement; construction, shipbuilding; and production and overhaul facilities. They exclude: Communications to operational units, training and training facilities, general support costs, and all operating and personnel costs.

^{1/} Assumed distribution of 1,500 missile MINUTEMAN program: 1,200 fixed, 300 mobile.
^{2/} Includes replacement of 1,500 mile A-2 missiles with 2,500 mile A-3 missiles as contemplated by Navy. Development and procurement of A-3 missiles and necessary shipbuilding modifications estimated at approximately \$2 billion.



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The Director

May 11, 1960

Military Division

Air Force Comparative Cost Analysis of POLARIS and MINUTEMAN



There is attached a comparative cost analysis between POLARIS and MINUTEMAN, originating in the Air Force, which indicates that POLARIS is 6.5 times more costly than MINUTEMAN. This analysis is based on Air Force estimates of the missile, ground support, shipbuilding, construction and five-year operating costs of the two weapon systems. It is on a different basis from the Military Division comparative cost staff study, the chief differences being that (1) the Air Force study excludes research, development, test and evaluation costs which are included in the Military Division study, and (2) the Air Force study includes operating costs which are not covered in the Military Division estimates.

The MINUTEMAN estimates contained in this analysis appear to be low, especially for the cost of the missile, estimated to be \$516,000 for the 500th missile, compared to the Air Force estimate for POLARIS of \$1,150,000 for the 250th missile. For these quantities, it can reasonably be expected that the three-stage MINUTEMAN will be more expensive than the two-stage POLARIS. Ground equipment costs for MINUTEMAN also appear to be conservative. No support missiles have been included and the Air Force is assuming a 100 percent MINUTEMAN operational force on station, whereas, without support missiles, a 93 percent estimate would be more realistic. MINUTEMAN operating costs were estimated to be only \$348,000 per missile, compared to other recent preliminary estimates, based on ATLAS and TITAN experience, of \$692,000 for a fixed site and \$923,000 for the mobile force. On the other hand, the POLARIS estimates used by the Air Force appear to be reasonable on an order of magnitude basis for both investment costs and estimated operating costs.

Using the same general approach and method of computation, we would estimate the ratio between POLARIS and MINUTEMAN to be in the order of 3 to 1, rather than the Air Force estimate of 6.5 to 1. Of course, this still represents an appreciably lower cost for MINUTEMAN as compared to POLARIS.

Attachments

cc: Dr. Reid

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POLARIS COSTS (COST PER BOAT)

(IN MILLIONS OF DOLLARS)

SUBMARINE	\$ 107.0
MISSILE UE -16 PER SUB @ 1.150 (COST AT 250th MISSILE)	18.4
SHAKEDOWN MISSILES 2 @ 1.150	2.3
SPARE MISSILE 16 PER 3 BOATS = 5 1/3 PER EACH	6.1
TENDER TO SERVE 9 BOATS \$55 ÷ 9	<u>6.1</u>
	\$ 139.9
COMMISSIONING COSTS	.5
CREW TRAINING	3.2
ASSEMBLY & CHECKOUT AT NAVAL PLANTS	1.0
TRAINING EQUIPMENT	1.0
SHIPPING CONTAINERS - .3 x 23. 1/3	7.0
COMMAND COMMUNICATIONS	<u>2.0</u>
	\$ 154.6

ANNUAL OPERATING COSTS

OVERHAUL COST:	
SUB - 30 MO. @ 8.0 ÷ 2 1/2	3.0
TENDER - 30 MO. @ 1.0 ÷ 2 1/2	.4
OPERATING COST SUB	5.1
OPERATING COST TENDER	.4
MISSILE MAINT, BASE SUPPORT, ORGN, EQUIP. ETC	<u>3.5</u>
	\$ 12.4

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POLARIS VS MINUTEMAN

(COST COMPARISON)

(IN MILLIONS OF DOLLARS)

SYSTEM	TOTAL COSTS				5-YR ON STATION PER MISSILE
	INITIAL INVEST.	5-YR OPS	5-YR ON STATION *	5-YR INVEST.	
POLARIS (SUB W/16 MSLs)	154.6 (9.66)**	62.0 (3.875)**	393.8 (24.6)**	216.6 (13.54)**	24.6
MINUTEMAN (PER MSL)	2.032	1.740	3.772	3.772	3.772

COST RATIO : $\frac{\text{POLARIS ON STATION}}{\text{MINUTEMAN ON STATION}} = \frac{6.52}{1}$

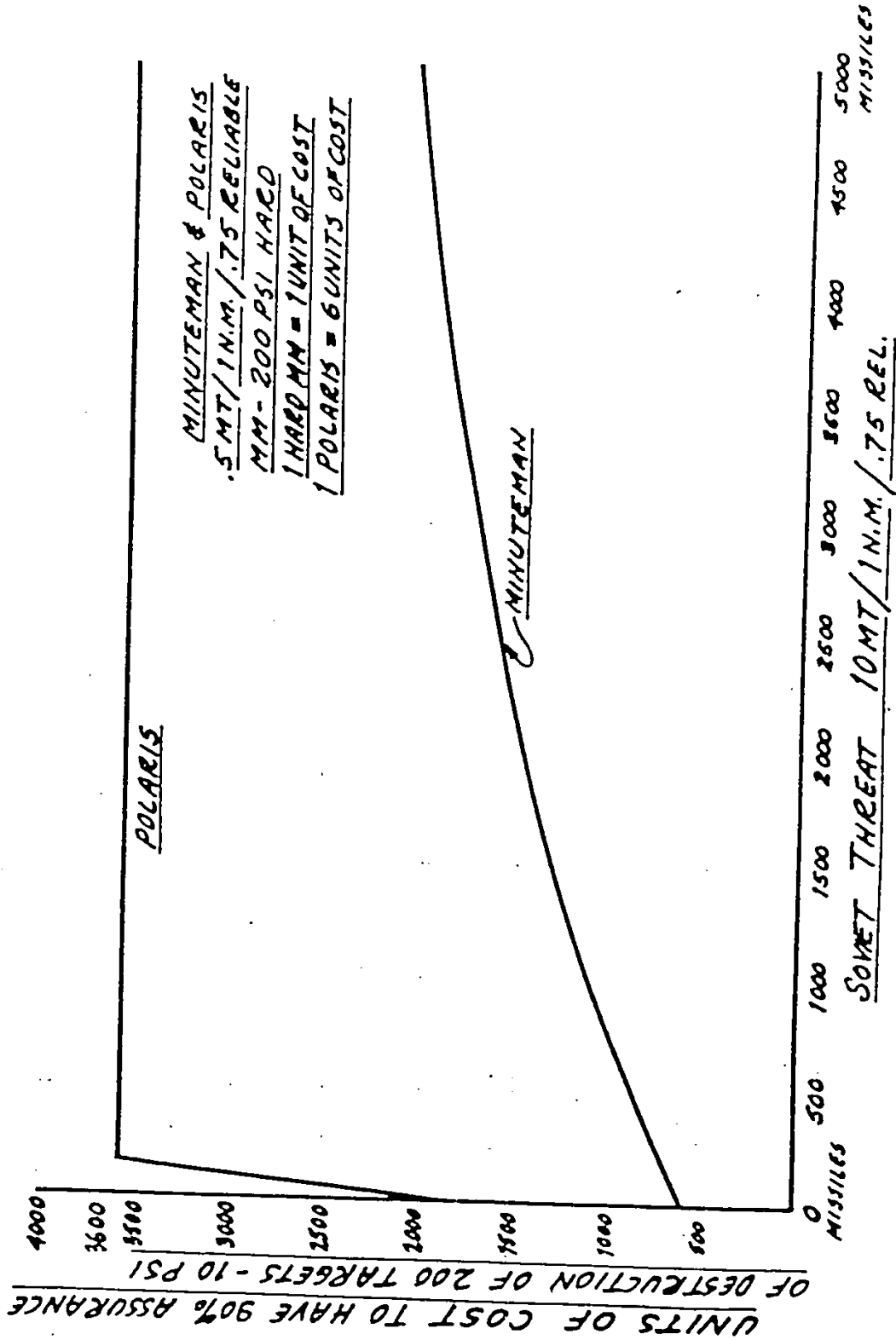
(FOR THIS ANALYSIS A RATIO OF 6:1 HAS BEEN USED)

* 55% OF POLARIS FORCE ON STATION
** PER MISSILE COST

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MINUTEMAN / POLARIS



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ANALYSIS OF COST EFFECTIVENESS POLARIS AND MINUTEMAN

BASIS OF ANALYSIS

- SPECIFIED TASK - 90% ASSURANCE OF DESTROYING 200 SOVIET TARGETS AFTER ATTACK BY SOVIET ICBM'S WITH CHARACTERISTICS SIMILAR TO NIE
- FOR LATER TIME PERIOD - 90% ASSURANCE OF DESTROYING 400 SOVIET TARGETS AFTER ATTACK BY EXTREME ENEMY THREAT (NEAR PERFECT ICBM)

RESULTS

- WITH REALISTIC SOVIET THREAT AGAINST MINUTEMAN (1000 ICBM'S OR LESS) IT COSTS AT LEAST 243% MORE TO ACCOMPLISH SPECIFIED TASK WITH POLARIS THAN WITH MINUTEMAN
- EVEN WITH 5000 SOVIET ICBM ATTACK, IT COSTS 64% MORE TO ACCOMPLISH TASK WITH POLARIS THAN WITH MINUTEMAN
- WITH EXTREME ENEMY THREAT (5000 NEAR PERFECT ICBM'S) IT STILL COSTS 20% MORE FOR 90% ASSURANCE OF DESTROYING 400 SOVIET TARGETS WITH POLARIS THAN WITH MINUTEMAN



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APPROACH

SYSTEM	COST PER UNIT	DESTRUCTION POTENTIAL PER UNIT	NUMBER UNITS REQUIRED DEPENDS ON
MINUTEMAN	LOW	SAME	NATURE OF TARGET SYSTEM & SEVERITY OF ENEMY THREAT
POLARIS	MODERATE	SAME	NATURE OF TARGET SYSTEM

DETERMINE FOR EACH SYSTEM OR COMBINATION OF SYSTEMS
THE FORCE, SIZE AND COST REQUIRED TO MEET VARIOUS ASSIGNED
OBJECTIVES.



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BASIS AND ASSUMPTIONS

ASSIGNED OBJECTIVES - SURVIVE ASSUMED ENEMY ATTACK
AND WITH A 90% CONFIDENCE OF DESTROYING EACH TARGET

1. ATTACK 200 USSR TARGETS OF 10 PSI HARDNESS
2. ATTACK 400, 10 PSI POINT TARGETS (LATER TIME PERIOD)

SOLUTIONS CONSIDERED -

- ALL MINUTEMAN FORCE
- ALL POLARIS FORCE



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BASIS AND ASSUMPTIONS (CONTD)

ENEMY THREATS

- *ENEMY THREAT VS LAND BASED SYSTEMS*
 1. VARIOUS NUMBERS OF 10 MT, 1 NM CEP .75% REL MSLS
 2. VARIOUS NUMBERS OF 30 MT, 1/3 NM CEP .90% REL MSLS
(REPRESENTS WORST POSSIBLE CONTINGENCY FOR U.S. IN LATER TIME PERIOD)
- *ENEMY THREAT VS POLARIS*

THAT PORTION OF THE POLARIS FLEET WHICH IS AT SEA IS INVULNERABLE TO ENEMY ATTACK



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SYSTEM CHARACTERISTICS

WPN SYSTEM	YIELD	CEP	RELIABILITY	PERCENT OF OPERATIONAL FORCE ON STATION AT ANY GIVEN TIME
MINUTEMAN	1/2 MT.	1 NM.	75%	100%
POLARIS	1/2 MT.	1 NM.	75%	55%*

* BASED ON NAVY PLANNING FACTORS OF 60 DAYS ON STATION,
30 DAYS ALONGSIDE TENDER & OVERHAUL EVERY 30 MONTHS
FOR EACH SUBMARINE.

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MINUTEMAN HARDENED & DISPERSED (COST PER MISSILE)

(IN MILLIONS OF DOLLARS)

	500 TH	1000 TH
MISSILES	.516	.419
MISSILE SPARES	.052	.042
GROUND SUPPORT EQUIPMENT	.586	.482
GROUND SUPPORT EQUIPMENT SPARES	.087	.072
COMMUNICATIONS	.300	.300
PERSONNEL TRANSITIONAL TRAINING	.082	.082
INITIAL SUPPLIES	.009	.009
GILD CONSTRUCTION	.400	.400
	<u>2.032</u>	<u>1.806</u>

ANNUAL OPERATING COSTS

	PER MISSILE
PERSONNEL	.018
REPLACEMENT TRAINING	.005
BASE SUPPORT COSTS	.030
TRANSPORTATION	.004
TRAINING MISSILES	.022
MISSILE MAINTENANCE & REPLACEMENT	.077
GSE MAINTENANCE & REPLACEMENT	.142
FACILITY MAINTENANCE	.020
FUEL, SUPPLIES, ETC.	.010
MAINTENANCE OF ORGANIZATIONAL EQUIPMENT	.020
TOTAL COST PER MISSILE	.348

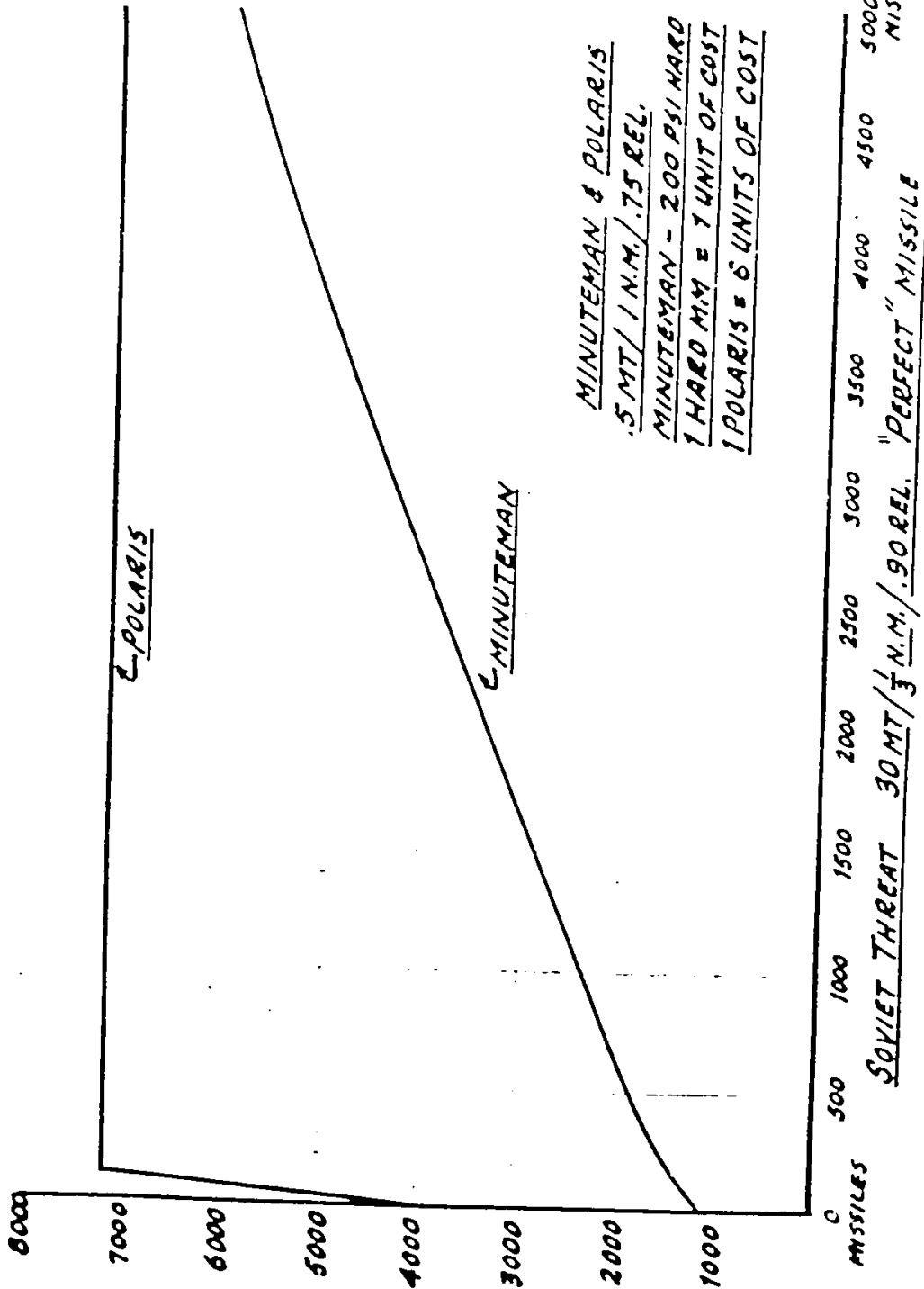
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UNITS OF COST TO HAVE 90% ASSURANCE
OF DESTRUCTION OF 400 TARGETS - 10 PSI

MINUTEMAN / POLARIS



MINUTEMAN & POLARIS
.5 MT / 1 N.M. / .75 REL.
MINUTEMAN - 200 PSI/HARD
1 HARD MM = 1 UNIT OF COST
1 POLARIS = 6 UNITS OF COST

SOVIET THREAT 30 MT / 3 N.M. / .90 REL. "PERFECT" MISSILE

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