AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

MINUTEMAN RAPID RETARGETING

MAJOR DOUGLAS R. HILL 88-1215

"insights into tomorrow"

DISCLAIMER

The views and conclusions expressed in this document are those of the author. They are not intended and should not be thought to represent official ideas, attitudes, or policies of any agency of the United States Government. The author has not had special access to official information or ideas and has employed only open-source material available to any writer on this subject.

This document is the property of the United States Government. It is available for distribution to the general public. A loan copy of the document may be obtained from the Air University Interlibrary Loan Service (AUL/LDEX, Maxwell AFB, Alabama, 36112-5564) or the Defense Technical Information Center. Request must include the author's name and complete title of the study.

This document may be reproduced for use in other research reports or educational pursuits contingent upon the following stipulations:

- Reproduction rights do not extend to any copyrighted material that may be contained in the research report.

- All reproduced copies must contain the following credit line: "Reprinted by permission of the Air Command and Staff College."

- All reproduced copies must contain the name(s) of the report's author(s).

- If format modification is necessary to better serve the user's needs, adjustments may be made to this report--this authorization does not extend to copyrighted information or material. The following statement must accompany the modified document: "Adapted from Air Command and Staff College Research Report (number) entitled (title) by (author)."

- This notice must be included with any reproduced or adapted portions of this document.

REPORT NUMBER 88-1215
TITLE MINUTEMAN RAPID RETARGETING

AUTHOR(S) MAJOR DOUGLAS R. HILL, USAF

FACULTY ADVISOR LT COL MANUEL TORRES, ACSC/EDM

SPONSOR LT COL ROBERT WILSON, HQ SAC/XPQO

Submitted to the faculty in partial fulfillment of requirements for graduation.

AIR COMMAND AND STAFF COLLEGE
AIR UNIVERSITY
MAXWELL AFB, AL 36112-5542

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

A192 623

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT STATEMENT "A" Approved for public release; Distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 88-1215	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION ACSC/EDC 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Maxwell, AFB Al 36112-5542	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

MINUTEMAN RAPID RETARGETING (U)

12. PERSONAL AUTHOR(S)

Hill, Douglas R., Major, USAF

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
	FROM _____ TO _____	1988 April	30

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Strategic Air Command has validated a requirement to decrease the time it takes to retarget the Minuteman Missile. Air Force System's Command Ballistic Missile Office contracted with four aerospace companies to develop concepts to satisfy the Minuteman rapid retargeting requirements. The method that will be incorporated into the ICBM Integrated Electronics Upgrade program is still being debated. This analysis looks at the four studies and compares the study results against a base timeline and recommends a solution that will save the most time from targeting information generation in the launch control center to when the new targeting information is loaded into the missile's memory.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
ACSC/EDC Maxwell AFB Al 36112-5542	(205) 293-2867	

DD Form 1473, JUN 86 — Previous editions are obsolete. — SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

PREFACE

This analysis was prepared at the request of the Headquarters Strategic Air Command's Intercontinental Ballistic Missile (ICBM) Requirements Directorate (HQ SAC/XPQ). It provides a comparison and evaluation of different methods proposed to satisfy SAC's Minuteman ICBM rapid retargeting requirements. The analysis also looks at a hybrid of several proposed methods which will also satisfy, and perhaps better satisfy, the retargeting requirement. This study is intended to be used by HQ SAC/XPQ when deciding which retargeting approach to use in the next modification to the retargeting hardware and software of the Minuteman Weapon System. This proposed modification is currently undergoing the contracting process under the program title ICBM Integrated Electronics Upgrade (I2EU).

This study is organized into five chapters. Chapters one and two are general weapon system descriptions and an explanation of the changes proposed in the I2EU study which prompts this study. Chapter three compares the different retargeting study results and proposes a hybrid solution that takes advantage of a concept not covered in any of the studies. Chapter four briefly discusses the impacts of each approach to the weapon system and Chapter five recommends a course of action.

For comparison purposes, all weapon system operation and reaction timing is that of the Minuteman III WS133-B Weapon System. Study results are also applicable to the Minuteman III WS133-AM Weapon System, but the actual timing would be slightly different.

Although two of the source documents were classified, the material included in this analysis from those sources is unclassified.

In the process of accomplishing this analysis, the author was given much assistance from many individuals and is grateful for that help. A special thanks to Lt Col Bob Wilson, HQ SAC/XPQ, for sponsoring the effort and Lt Col Manuel Torres, ACSC faculty advisor, for providing guidance and direction throughout the project.

ABOUT THE AUTHOR

MAJOR DOUGLAS R. HILL

The author, a native of North Dakota, received his commission via the Reserve Officer Training Corps program upon graduation from North Dakota State University in 1975. Major Hill was awarded a Bachelors Degree in Zoology. In 1979, he was awarded the Master of Science Degree in System Management from the University of Southern California.

Major Hill is a career missile officer. In 1976, he was a distinguished graduate from missile combat crew training and was assigned to Malmstrom Air Force Base, Montana, as a Minuteman ICBM launch officer. Over the next four years he held positions as Wing Senior Evaluator, and Alternate Command Post Flight Commander. He was then chosen to participate in the TOPHAND program at SAC's 1st Strategic Aerospace Division, Test and Evaluation Directorate (1STRAD/TE). Here, he was involved in all aspects of the test launch program of the Minuteman II and III missiles. In 1982, he was chosen to participate in the Air Staff Training Program (ASTRA). He spent the year working in two offices of Directorate of Development and Production, DCS/RD&A, (USAF/RDPM and RDPN). In 1983, following the ASTRA tour, he was assigned to HQ SAC, DCS Plans, Directorate of ICBM Requirements. There he served as an ICBM requirements officer with the responsibility of managing Minuteman hardware and software modification programs.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

TABLES

FIGURES

EXECUTIVE SUMMARY

Part of our College mission is distribution of the students' problem solving products to DOD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

"insights into tomorrow"

REPORT NUMBER 88-1215

AUTHOR(S) Major Douglas R. Hill, USAF

TITLE Minuteman Rapid Retargeting

I. Purpose: To evaluate proposed methods to improve Minuteman retargeting in response to Strategic Air Command's Statement of Operational Need (SON) 06-85 for Rapid Retargeting.

II. Problem: HQ SAC has validated a requirement to shorten the time it takes to retarget Minuteman missiles. The requirement covers the entire retargeting process which starts at HQ SAC and ends with the missile on alert. While the entire retargeting process is being looked at for streamlining, the Ballistic Missile Office (BMO) feels the most time to be gained is at HQ SAC. HQ SAC doesn't necessarily agree with this same assumption or at least feels the time savings in the launch control center operations (both combat crew and weapon system time) should be evaluated.

III. Data: The Ballistic Missile Office contracted three prime Aerospace contrators to help define a program to satisfy the requirements of an ICBM Integrated Electronics Upgrade program (I2EU) which included the rapid retargeting requirement. The three contractors were a Boeing/Rockwell International (Boeing/RIC) team, an Accurex/Ford Aerospace team and GTE. The BMO also contracted with TRW to study only the Minuteman

retargeting process and to recommend changes that would satisfy SAC SON 06-85 requirements. The three contractor teams briefed their program concepts in May 1987 to representatives of the BMO, HQ SAC, and Ogden Air Logistics Center (AFLC/OO-ALC). TRW briefed their retargeting approach to a similar audience in June 1987. The different agencies varied in their opinions on the best way to satisfy the HQ SAC requirement for rapid retargeting. A limited budget has also tended to make the entire community shy away from the approach that would save the most time in the retargeting process because of the cost of opening and modifying the Minuteman Operational Ground Programs (OGP). HQ SAC still felt more comparisons of time savings were needed in order to define the rapid retargeting approach to be included in the I2EU program. This analysis shows a great potential to save substantial time by making changes to the OGP and the way the Minuteman is retargeted today.

IV. Conclusions: After comparing the results of the three study contracts on the rapid retargeting proposals, one approach (GTE's) appears to save the most time. The author has also introduced an additional concept of stacking target cases for the remote data change (RDC) process that can save additional weapon system reaction time along with reducing the squadron's combat crew workload. Acceptance of the GTE retargeting approach along with incorporating improved RDC, would substantially decrease the time it takes to retarget the Minuteman missile both day-to-day and in time of crisis.

V. Recommendations: In order to satisfy the rapid retargeting requirements set forth by HQ SAC, the I2EU program should include the following in the contract requirements:

1. Incorporate the TRW concept of speeding up the Minuteman Operational Targeting Program (MOTP) calculations within the weapon system processor.

2. Incorporate the GTE approach of using only the required number of targeting constants to bias to the new target.

3. Incorporate the Operational Executive Program/Operational Ground Program software changes to allow for the above plus the capability to stack and send RDC targets to multiple launch facilities without individual crew actions.

Chapter One

Weapon System Description and Change Requirements

As the Minuteman (MM) Weapon System (WS) celebrates its 25th year on alert, the Ballistic Missile Office (AFSC/BMO), Ogden Air Logistics Center (AFLC/OO-ALC), and Headquarters SAC (HQ SAC) are launching a major update to its capabilities. Before starting into the scope of the update, a general background of the Minuteman Weapon System is in order. This chapter will cover a weapon system description which will review top level day-to-day operations of the missile system and the change requirements set forth by the ICBM Integrated Electronics Upgrade Program (I2EU).

WEAPON SYSTEM DESCRIPTION

At the wing level,the Minuteman command structure and physical layout consists of three or four missile squadrons, each containing five launch control centers (LCCs) and 50 missiles. Within each squadron, each LCC and its assigned missiles is called a flight. A crew of two officers is on duty at all times in each of the LCCs. While normally responsible for monitoring and controlling only their flight of ten missiles, the system permits interaction, if required, throughout the 50 missile squadron. The LCCs are connected to each of the Launch Facilities (LFs) with a Hardened Intersite Cable System (HICS) which is used by the LCC's computer (Weapon System Controller) to monitor and send commands to the missiles and LFs in the squadron. (3:02)

Each LCC has numerous racks of equipment that monitor the status of the LCC and the LFs. This status is gathered by the Weapon System Controller (WSC) and presented through lighted panels, printouts, and audible alarms to the crewmembers at their two crew work stations or consoles. Each console has specific tasks assigned, such as monitoring the missiles or issuing commands to prepare missiles for launch. Common to both consoles is the higher authority communications input channels and capability to communicate to the rest of the squadron and the world. (3:08)

The bulk of the day-to-day monitoring occurs between the WSC in the LCC and the Missile Guidance Set (MGS). The MGS is the guidance system on the Minuteman missile. It monitors not only the missile status, but also the condition of other launch facility equipment. This process is controlled by the software program in the MGS called the Operational Ground Program (OGP). Other important functions of the OGP include monitoring retargeting functions of other missiles in the squadron, and storing its assigned Emergency War Order (EWO) targets. (3:13-15)

The retargeting process for the missile starts with identification of a new designated ground zero (DGZ) at HQ SAC. However, for purposes of this report, the process will be considered to start at the point where target changes are already fed into the WSC in the LCC. The software program that monitors the LFs in the squadron is called the Operational Executive program (OEP). This program is also responsible for controlling the retargeting actions. The OEP retargeting functions this study will concentrate on are Target Constant Generation (TCG), Execution Plan Generation (EPG), Preparatory Launch Commands (PLCs), and Remote Data Change (RDC). With this in mind, a review of the change requirements is in order.

CHANGE REQUIREMENTS

A requirement exists to update the EWO retargeting capability of the Minutemen Weapon System. These requirements are spelled out in two validated Statements of Operational Need (SONs) from HQ SAC/XPQ. The two SONs are SAC SON 14-86 ICBM Launch Control Center Integration(U) and SAC SON 06-85 ICBM Rapid Message Processing and Retargeting.

The ICBM Integrated Electronics Upgrade (I2EU) program combines the requirements of SAC SON 14-86, ICBM Launch Control Center Ingration, plus a supportablity modification which had been planned for the WSC, as well as the improvements of SAC SON 06-85 (Rapid Retargeting). This combined program addresses all the hardware and software improvements needed in the LCC to support an ever expanding day-to-day and EWO workload. Prime items for replacement include the crewmenber consoles, the WSC, and integration of new EWO communications requirements. (2:--)

While SAC SON 06-85 addresses the end-to-end retargeting improvements intended in LCCs, including communications systems weapon system changes, this analysis will concentrate on weapon system Rapid Retargeting requirements only. It will ignore the communications requirement. (1:--)

Chapter Two

RETARGETING EFFORTS

This chapter discusses the targeting process and contractor studies that affect it. The chapter begins with an explanation of how retargeting is accomplished. Next, the chapter gives a short description of the desired rapid retargeting system capabilities. Finally, the reasons for contractor studies will be discussed.

RETARGETING DESCRIPTION

To do this analysis one must understand the weapon system components involved and how the retargeting processes work. Weapon system components involved include: the launch control center Weapon System Controller and its planned replacement, plus the D37D computer in the missile MGS. Software programs involved are the OEP, resident in the WSC, and the OGP, resident in the D37D. The OEP in the launch control center monitors and controls the missile by interfacing with the OGP on the missile via the HICS.

The weapon system retargeting process starts when the targeting coordinates have been entered into the weapon system processor and memory (either the current WSC or the new processor). The first process accomplished by the computer is the generation of targeting coordinates into a "generated targeting case" which the OEP sends to the missile in a format which the D37D computer can recognize as a valid target. The second step the computer in the LCC performs is to generate the execution plan information in the same way as the target data. Next comes the actual transfer of targeting information during the Remote Data Change process. After the targeting and execution plan information is in the the D37D memory, the missile stands ready with this targeting information (plus other stored targets). The missile could then be launched against whichever of its targets a launch message specifies. The last process of the retargeting process is commanding a preparatory launch command (PLC) to tell the missile which of the stored information is the appropriate targets. (3:13-15)

STUDY CONTRACTS

In preparation for the detailed contractual Request for Proposal (RFP) documentation, Air Force Systems Command's Ballistic Missile Office (BMO) conducted independent studies with three aerospace contractors. Study contracts were let to Boeing Aerospace Corporation/Rockwell International (Boeing/RIC) team, GTE Defense Division, and Accurex/Ford Aerospace team in order to help define and scope the level of effort required to fulfill the SAC requirements as outlined in SAC SONs 06-85 and 14-86. These studies covered all aspects of the hardware and software requirements. Concurrent to these studies, the BMO tasked its TRW engineering support team to look at the retargeting problems outlined in the Rapid Retargeting (RRT) portion of the SAC SONs. The results of the studies were briefed to the three main elements of the management team from the BMO, HQ SAC, and OO-ALC.

The BMO, the project management office, is in the process of accomplishing the contracting functions to support the most important requirements that can be covered with the current funding profile.

In accordance with SAC SON 06-85, the rapid retargeting system must provide the following capabilities.

1. Retargeting timelines must be reduced to less than half the current time, exclusive of the time savings achieved with the incorporation of rapid message processing.

2. A shortened RDC routine must be provided that will transfer only the minimum required data for a particular target change.

3. The shortened RDC time lines must be as short as possible within accuracy constraints once "RDC-Comm" discipline has been established.

4. The new targeting information must be compatible with Expanded Execution Plan and executable by either PLC-A or PLC-B.

5. All retargeting data must be selectable during hostile (seismic) or seismic protected modes.

6. A retargeting action must provide the missile crew with the current checksum number for retargeting actions.

7. Maintain full accessibility to the targeting constants in that target constant calculations can be made without reusing the fly-out mode. (1:--)

The bottom line goal of this analysis will be to best satisfy the above requirements of reducing the retargeting time. The approach that will be recommended will be the one that will save the maximum amount of time prescribed by the parameters of this study.

With the contracted studies complete, three different approaches to the RRT requirements came forth. Two of the approaches (TRW and Boeing/RIC) were briefed as meeting the minimum requirements of the RRT SON. (5:--)(8:--) Only one of the contractors (GTE) has actually demonstrated and proven the retargeting approach. (6:--) Accurex/Ford Aerospace did not propose a retargeting solution, but planned to incorporate the GTE approach of retargeting. (4:--) Therefore, this analysis will only deal with the GTE, Boeing/RIC and TRW retargeting proposals. Their approaches and associated timelines will be explained in chapter three.

The BMO TRW studies concentrated primarily on shortening the time it takes to generate the targeting constants and not on shortening the RDC time. (8:--) In contrast, the GTE and the Boeing/Rockwell studies provide a way to shorten the RDC time but involved a change to the OGP software as well as the operating system in the OEP software. The BMO has been leaning heavily to merely do the OEP changes (TCG/EPG) and leave the OGP alone. The BMO cites two reasons for not including the OGP changes. One is the cost of the program associated with the rapid retargeting perceived ranking in the overall I2EU program and second, the limited memory remaining in the D37D computer. The money issue will be addressed at the HQ SAC level while the memory issue will be addressed in more detail in chapter four. As a preview though, there is sufficient memory available to do either the GTE or Boeing/Rockwell approach.

Chapter Three

ANALYSIS

This chapter compares the results of the contractor studies and proposes a fourth way of accomplishing rapid retargeting. The chapter begins by defining the baseline for comparing the various studies. Next, each of the studies is analyzed. Finally, an alternate retargeting procedure is proposed.

BASELINE

In order to compare the study proposals, there must first be a baseline time for comparison. The basic time lines are the weapon system reaction times and do not reflect crew reaction times. The crew time lines will be addressed after each method is compared against a standard timeline. This calculation is actually quite simple, for it is merely the sum of all the operating times for TCG, EPG, RDC, and a PLC.

For puposes of comparison, this analysis will be run at four different work levels. A work level reflects the number of retargeting actions that need be done at a given time. The work levels will be one, four, ten, and fifty retargeting actions. A typical retargeting action totals approximately 10 minutes and 25 seconds. Of that total, the TCG takes about 4:45 (min/sec), EPG about 1:03, RDC about 3:37 and a PLC about 1:00 (total of 10:25). (3:--) The other work levels (4, 10, 50) are then sequentially additive to this single case. In other words four cases take 41 min 40 sec, ten cases 104 min 10 sec, and fifty cases 520 min 20 sec.

GTE STUDY

The GTE approach to retargeting takes into account all aspects of retargeting. This concept is built around the idea of gridding the target areas around a centrally located nominal aim point, and then biasing the missile's guidance off that aim point to arrive at the desired map coordinates when the target moves. This allows moving the aimpoint using the minimum necessary number of computer readable targeting constant changes. Thus, this approach shortens the retargeting process compared to simply starting from scratch with a "new" DGZ. The time lines in Table 1 are based on the premise that the execution plan data needed for retargeting does not change due to properly reassigning

targets when generated at HQ SAC. The printout function for the TCG is also suppressed at the time of generation and can be printed out for record keeping and verification at a less critical time. The RDC time is longer for the first target case because of the computer's internal overhead time of setting up the RDC-Comm discipline. (7:--)

	BASELINE(one)	GTE			
		ONE	FOUR	TEN	FIFTY
				(Not Provided)	
TCG	4:45	:01	:05	:20	
EPG	1:03	0:00	0:00	0:00	
RDC	3:37	2:56	6:23	15:23	
PLC	1:00				
TOT	10:25	4:11	7:23	15:43	

Table 1. Baseline and GTE Timeline

TRW

The next approach for attacking the retargeting timeline problem is one proposed by TRW. This effort was funded by the BMO on contracts separate from the initial I2EU studies. While other TRW proposed changes to support rapid retargeting deal mainly with HQ SAC improvements, only those TRW proposals for the identified (with the weapon system) retargeting processes will be covered here. This approach is fair to TRW, because in this way the relative information is used but not taken out of context. TRW's study concentrates in cells or particular steps in the retargeting process from HQ SAC to the LCC, to the missile, and each cell or step stands on its own merit.

The TRW recommended solution to the retargeting changes in the LCC addresses one particular area only, the Minuteman Operational Targeting Program (MOTP). The MOTP is a subroutine in the OEP that does the lion's share of the work during the TCG process. The TRW solution takes the TCG process and speeds it up by doing the MOTP calculations faster. According to their June 1987 report this process reduces the MOTP run time for a normal target case from 128 to 67 seconds. The TRW approach reduces

the baseline time by slightly over a minute for each target calculated and RDCed. Table 2 compares the results to the baseline. (8:--)

	BASELINE(one)	TRW			
		ONE	FOUR	TEN	FIFTY
TCG	4:45	3:44	14:56	37:20	173:20
EPG	1:03	1:03	4:12	10:30	52:30
RDC	3:37	3:37	14:28	34:40	180:50
PLC	1:00	1:00	4:00	10:00	50:00
TOT	10:25	9:24	37:35	92:30	456:40

Table 2. Baseline and TRW Timelines

BOEING/RIC

This study attacks the retargeting problem in yet a slightly different manner. Boeing/RIC addresses a slight reduction in time for doing the TCG and takes the approach of only RDCing the targeting constants that need to be changed, rather than rebuilding the entire set of 134 constants. They advocate a change to the OGP to allow for the new RDC routine and to provide for the fact the combat crew won't have to redo the execution plan set already on board the missile. (5:--) This approach most closely approximates the GTE approach. Table 3 compares the approach against the baseline.

	BASELINE(one)	BOEING/RIC			
		ONE	FOUR	TEN .	FIFTY
TCG	4:45	3:31	14:04	35:10	157:40
EPG	1:03	0:00	0:00	0:00	0:00
RDC	3:37	1:12	4:48	12:00	60:00
PLC	1:00	1:00	4:00	10:00	50:00
TOT	10:25	5:43	22:52	57:10	267:40

Table 3. Baseline and Boeing/RIC Timelines

HYBRID PROPOSAL

While the GTE, TRW and Boeing/RIC studies are good, they can be improved on. The author proposes a combination of the best ideas of these studies plus a new concept in a hybrid proposal. This new concept calls for an all-call RDC which is the capability to RDC targets to a series of launch facilities without stopping. The proposal requires a single LCC be responsible for generating and RDCing all changes tasked in a given block. This block could be bounded by a total number of target changes (perhaps 50) or by a time block (perhaps a 24 hour period). This approach will allow for the most accurate comparison of timelines with the way business is done today, only one LCC doing one RDC at a time in a given squadron. What is this all-call RDC?

An all-call RDC would be a new procedure by which a single LCC would stack all generated targeting actions to all affected LFs in a sqadron. A single LCC or the remaining ones would then act as the monitor LCC. The advantage to this approach is the time savings of not having to go through the RDC-Comm discipline setup for each new LF being changed. Additionally, there would be only one crew action to command the RDC and no crew actions for each new target being sent. The result is a time savings not only in the target generation functions, but also crew workload in performing the actual RDC.

This would be the procedure for the active LCC:

1. Crew or weapon system processor would stack all targets for generation.

2. Crew or weapon system processor would stack all generated targets for RDC and the crew would execute after coordination with the monitor LCC.

3. New targets would be active for the execution plan upon acceptance. This means after a new target is RDCed, it would be active and no PLC would be required to make it active.

In comparing the timelines for the retargeting process, this study is addressing the processing time for each RDC process. It is then reduced by the amount of time of RDC-Comm discipline set-up takes which is just over one minute, but for purposes of this study it will be rounded down to one minute. The greatest time savings for this method is the crew time savings of not having to set up each retargeting action upon completion of the previous one. These savings would be dependent on the crew's proficiency, but for purposes of this study a reasonable figure of three minutes to set up, verify and execute a single RDC action will be used. Likewise, the crew time cost to setting up ten or fifty targets to RDC would be slightly longer and figures of five and ten minutes are used respectively in the time comparison that follows. These times are based on the author's Minuteman crew experience and program management responsibility for the GTE Minuteman Flexible Retargeting demonstration in October 1984.

	BASELINE			
	ONE	FOUR	TEN	FIFTY
TCG	4:45	19:00	47:30	237:30
EPG	1:03	4:12	10:30	52:30
RDC	3:37	14:28	36:10	180:30
CREW	3:00	12:00	30:00	150:00
PLC	1:00	4:00	10:00	50:00
TOTAL	13:25	53:40	134:10	670:30

Table 4. Baseline time including crew reaction times

These crew times must then be added to the GTE, Boeing/RIC and TRW study times in order to compare the time lines for the new approach. This is accomplished in Tables 5, 6, and 7.

	GTE			
	ONE	FOUR	TEN	FIFTY (not provided)
TOT	4:11	7:23	15:43	
CREW	3:00	4:00	5:00	
NEW TOT	7:11	11:23	20:43	

Table 5. GTE with Crew Time

	BOING/RIC			
	ONE	FOUR	TEN	FIFTY
TOT	5:43	22:52	57:10	267:40
CREW	3:00	4:00	5:00	10:00
NEW TOT	8:43	26:52	62:10	277:40

Table 6. Boeing/RIC with Crew Times

	TRW			
	ONE	FOUR	TEN	FIFTY
TOT	9:24	37:35	92:30	456:40
CREW	3:00	12:00	30:00	150:00
NEW TOT	12:24	49:35	122:30	606:40

Table 7. TRW with Crew Times

The totals can be combined for comparison.

	ONE	FOUR	TEN	FIFTY
BASELINE	13:25	53:40	134:10	670:30
GTE	7:11	11:23	20:43	
BOEING/RIC	8:43	26:52	62:10	277:40
TRW	12:24	49:35	122:30	606:40

Table 8. Timeline comparison

The hybrid approach will now subtract the RDC-Comm discipline time (1 minute) for each case RDCed except case number one. The hybrid approach will only be used on the Boeing/RIC and GTE approaches. It could work with the TRW approach also, but TRW doesn't advocate the OGP opening this change would require. Even when this approach is applied to the TRW times, they are only slightly better than the baseline cases.

	HYBRID			
	ONE	FOUR	TEN	FIFTY
BASELINE	13:25	53:40	134:10	670:30
GTE	7:11	8:23	11:43	
Boeing/RIC	8:43	23:52	53:10	228:40

Table 9. Hybrid comparison

Looking quickly back over what this chapter has shown, without using any improved methods for RDC, the retargeting timelines grow quickly whenever the number of RDC cases increases dramaticly. It is important to SAC to reduce these timelines given the expectation of being tasked to do more and more frequent target changes. (1:--) The BMO studies have brought forth some promising methods to decrease the retargeting time and combat crew workload. Applying the hybrid approach to those alternatives enhances the approaches presented in these studies and further decreases the weapon system reaction times and combat crew workload. These proposed solutions, and in particular the hybrid approach in concert with them, all hold promise in satisfying the SAC SON requirements. As stated earlier, this analysis is looking for the approach which best meets the SAC SON requirements by reducing the retargeting time lines the greatest.

The time differences of the above retargeting methods is even more damatic when graphed. Table 1 shows the above approaches without the Hybrid method applied while Table 2 shows the hybrid solution applied to the GTE and Boeing/RIC approach. Both tables use the baseline timeframe as a reference point. The results of the analysis favors the GTE and the Boeing/RIC approach for they save significant time over the baseline and TRW approach.

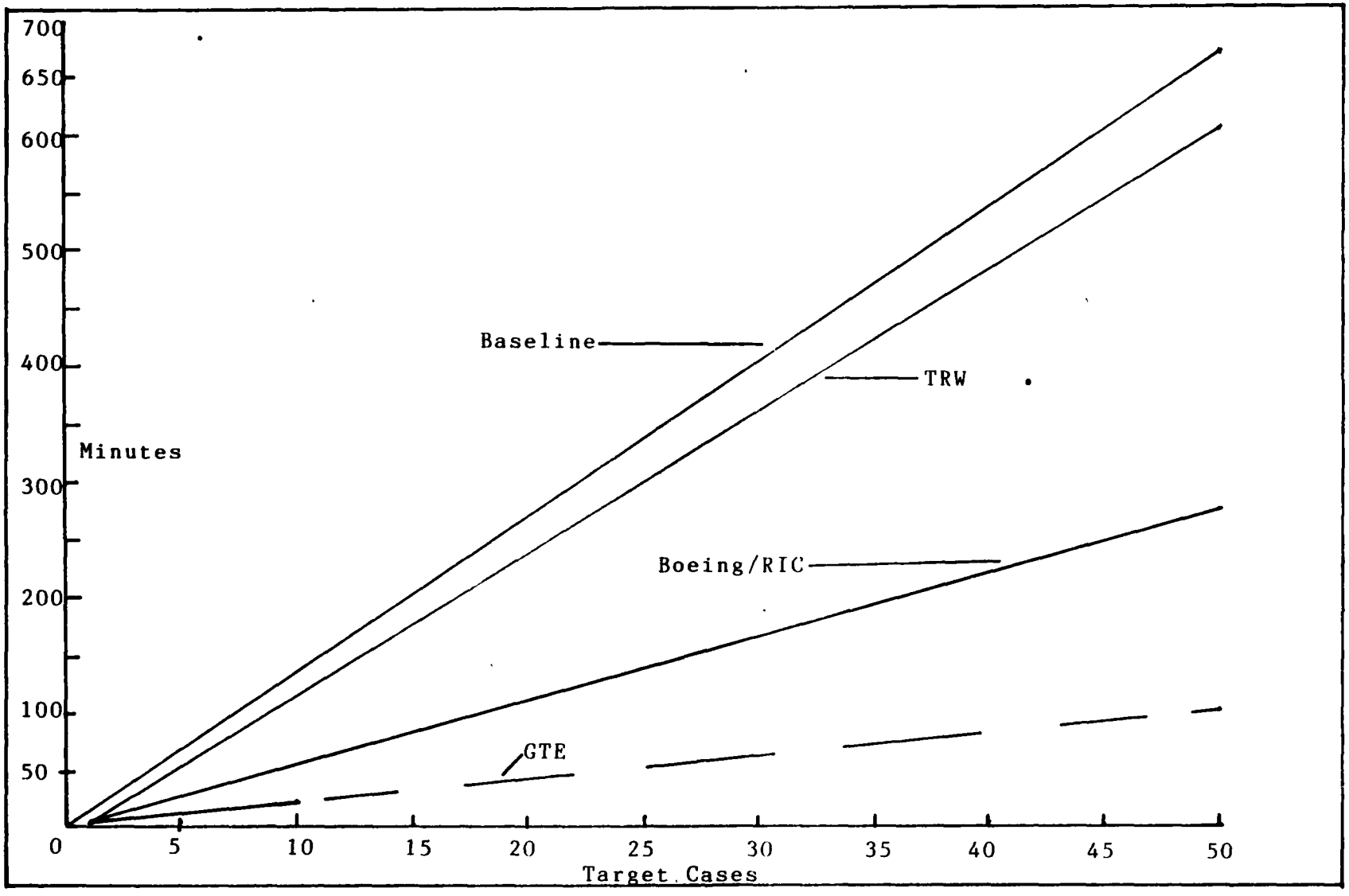

Figure 1. I2EU Timeline Comparison

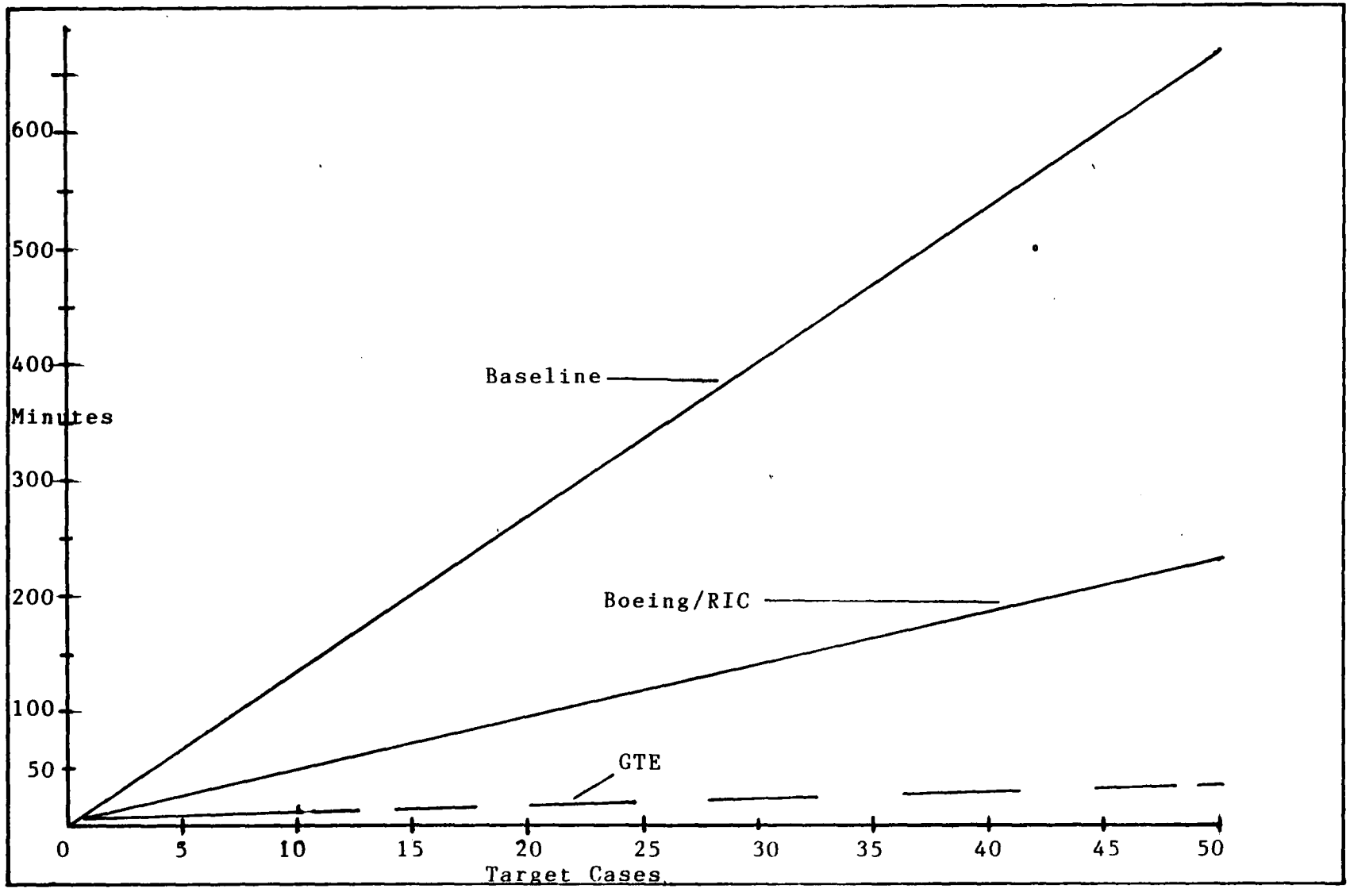

Figure 2. Timeline Comparisons with Hybrid Solution

Chapter Four

WEAPON SYSTEM IMPACTS

Having looked at the various approaches proposed to satisfy the rapid retargeting requirement, it is now time to look at what impacts they would have to the weapon system. The impacts will be focused in three areas: changes to the OEP, OGP, and crew work load. The changes proposed by all these studies are relatively minor when considering the overall I2EU changes. Due to the scope of the I2EU change, the OEP will be opened and major changes made anyway. This report will look at each study seperately and will recommend a particular approach in chapter five.

GTE

The impacts generated by the GTE approach affect all three areas. The OEP would have to be modified to do the new TCG, EPG, and RDC routines. The OGP would have to be opened and modified to allow the LF to accept the abbreviated RDC routine: The impact to the D37D is approximately 80 words. The D37D has approximately 200 unused words remaining after inclusion of the current Expanded Execution Plan program update that will be fielded in 1988. The impact to the crews would be a positive one. This approach would decrease crew work load by automating and shortening the time it takes to retarget the missile. (6:--)

IRW

This approach will impact only the OEP software. To be more specific, it involves changes to the MOTP within the OEP. There are fewer positive crew impacts than there might be under other approaches in that it does not change the way crews do business today. It only shortens one aspect of the retargeting process. (8:--)

BOEING/RIC

The impacts of this approach are virtually the same as the GTE approach. The software memory impacts to the OEP and OGP are about the same. Likewise, the crew improvements are virtually the same with the only difference being in the time it takes the software/hardware to do its jobs. (5:--)

HYBRID APPROACH

In the hybrid approach the software impacts are very similar to the GTE and Boeing/RIC approach. The difference is adding the capability to the OEP of stacking RDC commands to different LFs. This protocol lies in the OEP and would require very little if any additional change to the OGP over the shortened RDC requirement. Crew workload would be lessened significantly with this method. Instead of each crew doing their own retargeting, one designated crew could do it all with another LCC monitoring. This frees up the remaining squadron crews to continue other time critical functions. The new procedure of stacking the RDC commands will decrease the man-machine interface time in setting up each RDC individually. This new procedure coupled with the most efficient software improvements in shortening the retargeting process, will greatly enhance the system flexibility and response time.

Chapter Five

CONCLUSION

This chapter will briefly recap the purpose of this analysis and will then offer a recommendation based on the results of the analysis and weapon system and operational impacts outlined in chapters three and four.

The purpose of this study was to review the options available to the weapon system manager to help fulfill the requirements of the SAC SON concerning rapid retargeting. The criteria to evaluate the retargeting studies are in SAC SON 06-85. The recommendation that follows is based on which retargeting approach will save the most time and decrease combat crew workload exclusive of cost.

RECOMMENDATION

The following recommendation is truly a mix or hybrid of the best time savings proposals of the contractors plus the idea of stacking RDC cases. The formal recommendation is:

1. Incorporate the TRW concept of speeding up the MOTP calculations within the weapon system processor.

2. Incorporate the GTE approach of using only the required number of targeting constants to bias to the new target.

3. Incorporate the OEP/OGP software changes to allow for the above plus the capability to stack and send RDC targets to multiple launch facilities with out individual crew actions.

These three changes best satisfy the SAC SON 06-85 requirements of reducing the retargeting time within the scope of this analysis. This recommendation will also fit into the entire retargeting process as proposed by the GTE study. (6:--)

In summary, the proposed recommendation not only minimizes weapon system reaction time to accomplish the retargeting actions, but also takes positive steps to lessen the combat crew workload at potentially critical times.

BIBLIOGRAPHY

Official Documents

1. Strategic Air Command. Statement of Operational Need (SON) 06-85, Format A: ICBM Rapid Message Processing and Retargeting. Offutt AFB, NE: HQ SAC/XPQ, 22 Aug 86, Secret. Classified by multiple sources. Declassify on OADR.

2. -----. SON 14-86: ICBM Launch Control Center Integration. Offutt AFB, NE: HQ SAC/XPQ, Draft. Unclassified.

3. US Air Force Systems Command. Operational Review of the Minuteman Weapon System. Kirtland AFB NM: Directorate of Nuclear Surety, Deputy Inspection and Safety, March 1984. Secret--NATIONAL SECURITY INFORMATION. Declassify on OADR.

Unpublished Materials

4. Accurex/Ford Aerospace. ICBM Integrated Electronics Upgrade Concept Definition Study Final Presentation to HQ SAC/XPQ on 05 May 1987.

5. Boeing/Rockwell International. ICBM Integrated Electronics Upgrade Concept Definition Study Final Prsentation presented to HQ SAC/XPQ on 06 May 1987.

6. GTE. ICBM Integrated Electronics Upgrade Concept Definition Study Final Presentation to HQ SAC/XPQ on 07 May 1987.

7. -----. Minuteman Flexible Targeting System Architecture and Operational Concept. Director, Defense Nuclear Agency, Alexandria, VA. Draft final report DNA001-83c-0310, February 1985. SECRET--NATIONAL SECURITY INFORMATION. Classified by multiple sources. Declassify on OADR

8. TRW. Rapid Retargeting Presentation to HQ SAC/XPQ by TRW/Space Park on 24 Jun 1987.