SUPFIRE # 26
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SYSTEMS ANALYSIS SUPPORT FOR GENERAL SUPPORT ROCKET SYSTEM PROJECT

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INTRODUCTION:

The following remarks are keyed to the "GSRS SYSTEMS ANALYSIS QUESTIONS" documented in SUPFIRE 25 dtd 18 Nov. 74.

PART I of this paper discusses the referenced Questions one by one, presenting the proposed method of analysis, form of the results, and an estimate of effort involved.

PART II propounds and discusses certain additional questions which may arise. They are four in number as follows:

QUESTION 10. How should the GSRS round and launcher load be optimized?

a) What is the optimum size for a single round?
b) What is the optimum number of rounds to be carried launch-ready on a single launcher?

QUESTION 11. Is a land navigation system necessary or beneficial?
QUESTION 12. How are ammunition requirements for GSRS to be satisfied?
QUESTION 13. Is a "shoot-and-scoot" techniques achievable?

Finally, a recommended analysis support plan is presented in PART III.

PART I : DISCUSSION OF THE QUESTIONS

QUESTION 1. Is there a need for a General Support Rocket System (GSRS)?

a) What is its role or mission in attack, defense, and retrograde situations?

1) APPROACH : This question is to be answered by using the Capability Model (CAPMOD) to establish the percent enemy target value denied over time by mixes of Blue weapons (see Question 1. b) below) with and without GSRS candidates against Red target lists (see Question 2.a) below) extracted from three different parts of the existing Northern NATO Flank (NNF) Scenario.[1] The situations used will be:

Retrograde: West German II Corps versus USSR 1st Tank Army and 1st Combined Arms Army, D-day to D+3.

Defense: West German I and II Corps elements versus USSR 3rd Combined Army, D+6.

Attack: U.S. 2-Division counter-attack versus elements of USSR 2nd Combined Arms Army.

2) DISCUSSION : It is believed proper to concentrate on a European Scenario since this is the normal context in which the Army discusses this system. We have previously done some work on other scenarios (Mid-East and SE Asia) but not for Support Fire. If there is a later requirement for extension to other scenarios, about 4 man-weeks per scenario would be required to get us to the "starting point" we now have with the NNF Scenario.

The NNF Scenario is not that conventionally used for Army studies; we believe it to be a better test for systems because the FULDA Gap area normally used is comparatively quite restrictive on USSR attack capabilities. If we should have to shift to a Central European Scenario (and we advise against it) allow two additional man-weeks for general scenario preparation.

[1] Chapter 8.5. The Utility of ARM Weapons. THE ANATOMY OF COMBAT.

3) FORM OF ANSWER; The analysis will identify specific roles within the firepower mix which can be assumed by the GSRS. Based on past work it is expected that two such roles will emerge:

A. A weapon for engagement of hard point targets (e.g., Tanks) at extended range

B. A weapon which complements tube artillery by delivery of heavy concentrations of fire (probably primarily sub-munitions and scatterable mines) at extended range.

Of course, the analysis may reveal other roles.

The basic output will take the form shown in Figure 1. Of course, other types of presentation can be generated from the considerable detailed output of CAPMOD.

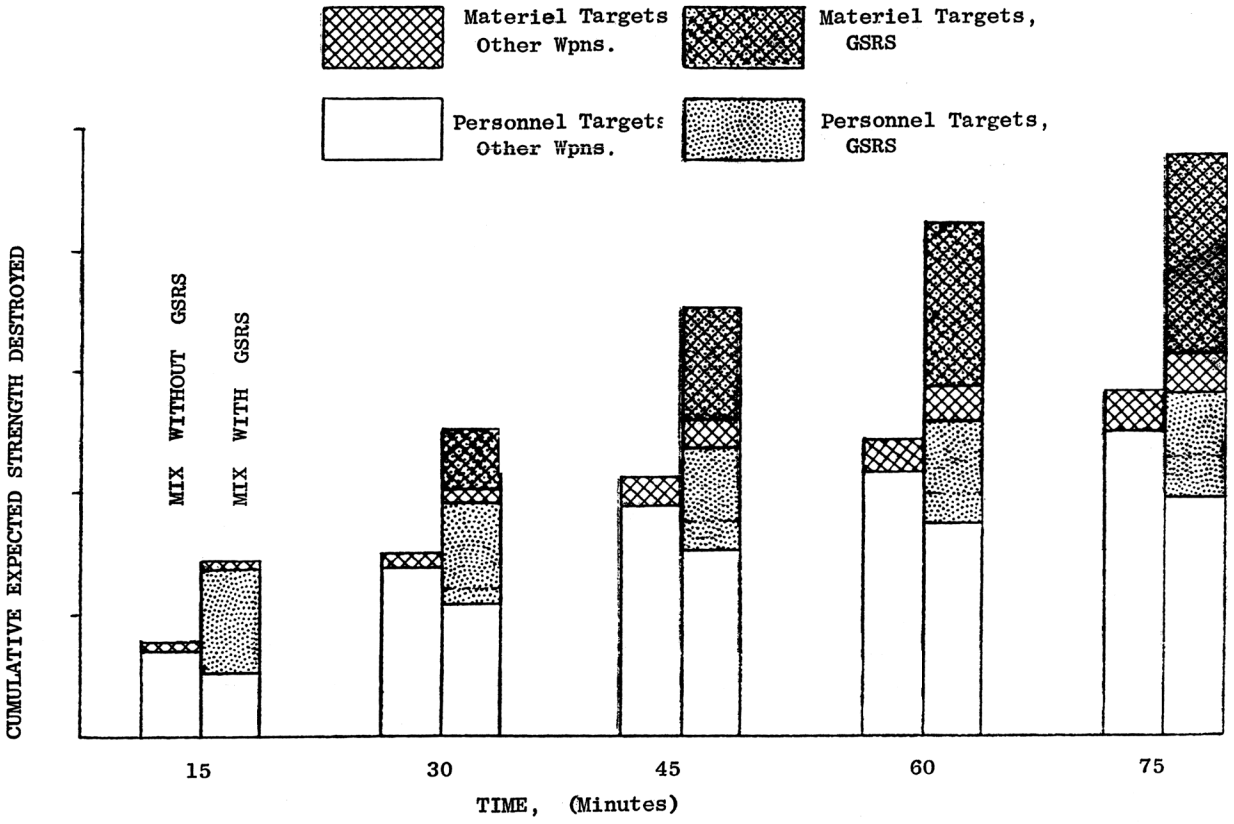

Figure 1 - Expected Reduction of Enemy Strength vs Time

4) EFFORT INVOLVED: CAPMOD is operational. We may make certain improvements to the model (for greater convenience in data handling, not for basic capability, which already exists).

Excluding target list preparation (see Question 2 below) the effort is as follow:

1. Verification and insertion of basic weapon capabilities (except for GSRS - to be furnished by design team) and target vulnerabilities -- 3 man weeks

2. Insertion of specific target list - 1 man-week.

3. Runs and reduction of output - 1 man-day per mix variation. (Provided there are at least 4 or 5 variations, there will probably be many more depending on desires.)

This sums to 6 man-weeks input effort for the three planned situations, plus run and output effort as called out by Huntsville.

QUESTION 1. Is there a need for a GSRS? (Cont'd.)

b) What is its relative value compared to other weapon systems?

1) APPROACH: The relative target value denied will be established by the mix studies described above. CAPMOD reports damage by weapon class and by target class, so it is easy to tell just what each weapon type contributes to the overall mix effect.

Our mix runs should include all systems which may bear. These include:

For ROLE A - "Tank Killer": 1) Armed Reconnaissance or "on-call" CAS Aircraft, 2) Helicopter Systems, 3) Tanks, 4) Direct-fire Anti-Tank Weapons, and 5) Tube Artillery. (The latter for political purposes, though indirect fire of tube artillery is not considered a serious competitor.)

For ROLE B - Area Fire Weapon: 1) Pre-Planned or "On-Call" CAS, 2) Helicopter Systems , 3) Tube Artillery, and 4) Other SSM's. (Honest John and "non-nuclear" Lance, though the latter is believed inferior.)

To establish "relative value" we must consider not only enemy target value denied, but also input effort - this establishes productivity, whose index is the ratio of enemy effort denied over friendly input effort to do so. The effort recommended here (1 man-month) will establish the rationale and furnish and answer we believe supportable. However, on this subject we can expect considerable "flak" from the proponents of other systems. This may lead to additional justification work later - the magnitude of this effort cannot be estimated.

One argument which will come up immediately will be the survivability of aircraft and helicopters. We probably cannot afford the effort to get into this in detail. Our answers may have to be parametric on assumed probabilities of survival, with some degree of credibility established by our on-going work on Air Defense.

2) FORM OF RESULTS: The basic output will take form of Productivity Indices for various weapon types in differing situations as indicated in Figure 2. This will be supported by other charts of assumptions, estimates and calculations.

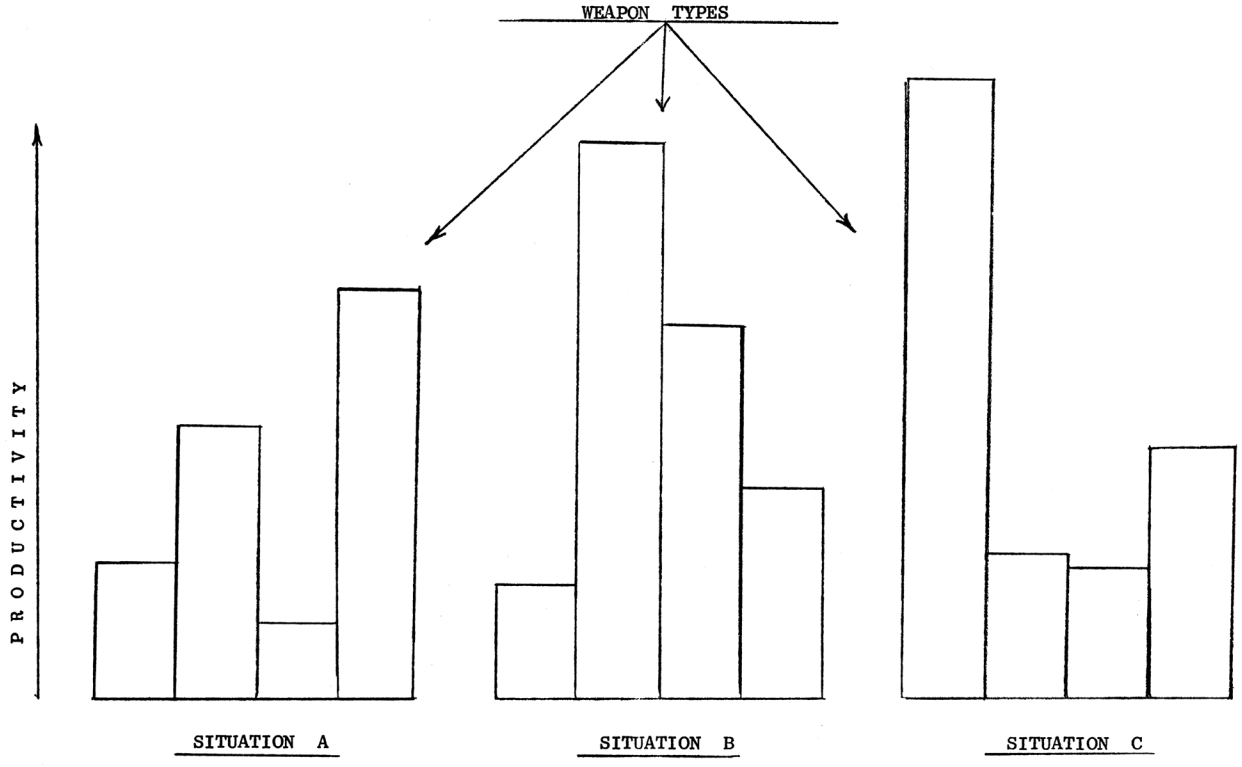

Figure 2 - Relative Productivity of Weapon Systems

3) EFFORT INVOLVED: One man-month for input effort and productivity factor calculations.

QUESTION 2. What are the candidate targets for a GSRS?

a) Types and number?

1) APPROACH: When CAPMOD is used, each component of the firepower mix, in effect, picks out the targets for which it is best suited. The detailed output will show against which targets any given GSRS candidate system is used.

To make possible the use of CAPMOD we must establish a list of "potential" targets, estimate acquisition probabilities, and assign target values (importance) for use by the internal fire direction routine. CAPMOD is only semi-dynamic; that is, it does not continuously move the targets but accepts sequential time "snap-shots" of the current state of the targets. Thus we must provide a movement scheme for the targets, from which the snap-shots can be extracted.

The number of potential targets will probably be in the thousands, but CAPMOD presently accepts only 500 total. Although this limit can be extended fairly easily, we shall probably, for input and processing economy, continue our previous method of taking a representative "slice" of both weapons and targets for analysis.

What constitutes a "target" is to some extent dependent on the weapon . (Battery of battalion volleys are treated in toto and considered by the model as different "weapons" from single rounds.) A sizable concentration of men and materiel might be a single target for a battalion volley or many smaller targets for single weapons. CAPMOD has internal logic which will consider any target in several different ways , apply the best available weapon, and then straighten up the books on both weapon availability and target condition.

To list potential targets we must consider three basically different kinds - 1) Destruction Targets, 2) Delay Targets, and 3) Suppression Targets. Destruction Targets (this does not necessarily mean K-kill, but at least damage to temporarily deny functional performance) are the simplest - they are simply enemy elements or collections of enemy elements. Delay Targets (suppression of movement) are terrain locations at which well-timed and perhaps periodic deliveries of fire may result in delay of th enemy's advance. Suppression Targets are those where the mere delivery or threat of fire may preclude the enemy from functioning, with or without destruction. (See Question 3 below for discussion of value of delay and suppression targets.)

In the proposed "retrograde" situation, we are picturing the movement and attack over three days of two USSR Armies, a total of about 125,000 men and 27,000 vehicles - not counting Front-level supporting and attached units. This would amount to at least 50,000 elemental targets alone - obviously a prohibitive task for complete detailing. Therefore our approach will be as follows:

1. Plot the positioning, movement, and "posture" (essentially what they are doing) of all units down to battalion level (company-level for some specialized units) over the three day period. Movement, posture, and attrition will be determined by postulated Blue responses, using estimating factors drawn from Army Field Manuals 101-10 and 105-5.

2. From above determine, in probably 3-hour increments, the fluctuating "population" of each 5-kilometer square in zone - including its posture.

3. Stylize the targets in each square according to an average for type unit and posture.

Of course, this will give only one solution - and that represents only one set of Red and Blue tactics, in one situation drawn from one scenario. However, it will be definite and adequately detailed, and serve as a take-off and central reference point for "what-ifs" leading in any direction.

Having the list of potential targets, we next need to establish their vulnerability, signature and value. Vulnerability depends on element configuration, element dispersion (for composite targets), hardening, posture, and local cover. It will be necessary to lump the infinite variety of targets into general classes (e.g.: Armored Vehicles, Lightly-Armored Vehicles, Unarmored Vehicles) and establish vulnerability factors according to class of weapon used. This is a part of the three-week input effort under Question 1.a) above.

Signature (liability to acquisition) is much more of a problem. A comprehensive study of this subject could absorb (and probably has) uncountable man-years of effort. However, what we are really interested in here is relative ease of acquisition. Therefore we will run a base-line in which all targets are known to Blue, and then introduce admittedly arbitrary (but carefully estimated) factors which discriminate among targets. Such factors will be based on size of unit, degrees of activity, local concealment, range from sensor, distinctive signatures (e.g.: electromagnetic radiation), etc.

For discussion of value assignment, see Question 3 below.

2) FORM OF ANSWER: The output here is simply an input to CAPMOD of a potential target list, plus vulnerabilities, acquisition factors, and values. These lists will be furnished as part of the report, of course. Also, as previously discussed, the CAPMOD runs will isolate those targets of particular interest to GSRS candidates.

3) EFFORT INVOLVED: For 1st Target List (Retrograde?) - 3 man-weeks. For each succeeding - 2 man-weeks.

QUESTION 2. What are the candidate targets for a GSRS? (Cont.)

b) Condition - stationary versus moving, protected versus exposed ?

1) APPROACH: Covered above - "posture" and movement schedule. Note - movement is always a combination of actual tactical movement and local (administrative-logistic) movement. Appropriate factors for local movement will be assigned, based on FM 101-10.

c) How are they deployed across a Division Front; a Corps Front?

1) APPROACH: The method described above will make it possible to inventory targets in 5-km wide strips from the FEBA back to Army Rear (~ 60 - 80 km). This will give deployment across any specified front, this is expected to vary widely according to Red tactical plan.

d) How does the deployment vary with time prior to and during a battle, i.e.,how fast can a SAM site be moved?

1) APPROACH: Movement patterns and associated times will be established as described above.

How fast a SAM site, as any other installation, can be moved is not necessarily the critical question. The movement has to be consistent with some planned pattern which ensures constant adequate defense, leap-frogs forward as necessary to extend coverage, and possibly reduces vulnerability by periodic switching of positions, use of dummies, etc. Such a pattern will be postulated for the air defense units. As far as actual speed of movement - this will generally be taken from estimating factors in FM 101-10 and other references.

QUESTION 3. What is the relative value of the targets to the enemy?

a) What single target type should exert the most influence on a GSRS design?

b) The second most influence?

c) etc.

1) APPROACH: As discussed above the selection of targets for GSRS will emerge from the CAPMOD runs on GSRS. However, the general assignment of values to targets remains to be discussed.

Strictly speaking, it is the value of destruction of targets to the friendly force (Blue) which needs to be established. This value is established by the amount of harm the undamaged and fully functioning target element(s) can do to Blue's intended course of action. As an example, a fixed Red fortification is of no interest to Blue if Blue is withdrawing, but may be of critical importance to a Blue attack unless it can conveniently be bypassed.

Our basic target valuing system has been discussed[2]. However the values thus established are average long-term situational values. The immediate value will fluctuate widely with the local situation. We expect to develop and justify examples of this fluctuation, but will probably just use the average values for much of the CAPMOD run schedule. The truth is that almost any combat target can become the most important target in some situation at some time.

The values of delay targets are based on the reaction of Red. For example, if the target is a minefield, Red can 1) Take a route around the minefield, which loses time, 2) Clear a path through the minefield, which uses up time and may cause casualties, or 3) Drive through the minefield, accepting the resulting casualties in order to save time. Each of these values is calculated, and the least is assigned as target value, on the assumption that Red will take the course most advantageous to him.

The value of suppression targets are also based on Red reaction. Suppose for instance, a Red artillery battery is in hasty position and the personnel must be exposed to serve the weapons. A weapon which poses some continuing threat to the personnel - e.g., a cluster of frag bomblets with variable delayed fuzes and booby-trapped against clearance - poses a dilemma. Red can continue

[2] Valuing Targets for Interdiction Fire. *The Anatomy of Combat*, Chapt. 6.

to fire and accept his losses, or interrupt firing and sacrifice combat potential for some period. Again both alternatives are calculated, and the lesser value is taken.

2) FORM OF ANSWER: The answer to this question forms an input to CAPMOD runs. Of course additional presentation of results will include explanation of the valuing system, tables of the values used in CAPMOD, and identification of those targets which have emerged as most suitable for GSRS.

3) EFFORT INVOLVED: The total of 7 man-weeks (for three situations) listed under Question 2 above is intended to cover sufficient target valuation to enable the required CAPMOD runs. Target value will emerge as a controversial subject and follow-on effort may very well be required (optional as the program develops).

QUESTION 4. What should the damage criteria for one launcher load against one target be -- 30% (the standard), 50%, 75%, or 90%?

1) DISCUSSION: This is actually an essentially meaningless question, although it is solemnly debated in many analyses. It is suggested that this question be replaced with a Question 10 -- "How should the GSRS round and launcher load be optimized?" -- which will be discussed in PART II.

The original question is meaningless for both weapon-connected and target-connected reasons. The weapon should have a volley-fire capability, as does any other artillery. If one round is insufficient, fire a launcher-load; if that is insufficient, use a section or battery concentration, etc.

In regard to targets, we must make a distinction between elemental targets and area targets (composite, delay, suppression). Against elemental targets we are normally interested in p_k the probability of kill and one round may do the job. The N-round probability of kill is $1-(1-p_k)^N$, which means that the Nth round adds only $p_k(1-p_k)^{N-1}$ to the probability that the target will be killed. Obviously, the most economical procedure is to fire one round at a time on a "shoot-look-shoot" principle.

Against area targets each additional round will have an "expectation" of adding to previous damage by doing damage to new and previously undamaged elements. Again the return of each additional round is diminished, but by a lesser factor, especially the sheaf is appropriately matched to the

target area. (This incremental value can be calculated by our model, but cannot be simply expressed.)

There are of course, many situations in which it is absurd to fire one round at a time - in fact they are probably the majority - but the basic reason is usually some type of time pressure. These situations should be understood and considered in detail, rather than applying some blanket rule, such as 30% or 90%. Some are:

1. Observation of results is impossible - precluding "shoot-look-shoot",

2. The target may move or change posture, and thereby reduce vulnerability, if warned by an opening shot.

3. The weapon must accomplish its fire task rapidly, either because additional targets are waiting or to reduce vulnerability of the weapons.

4. The weapon, for internal operating reasons, characteristically fires in volleys - e.g., in a medium artillery battery.

2) EFFORT INVOLVED: We do not recommend additional work on this subject. However should it become a political issue with MICOM or other, the above remarks can be expanded and illustrated with two man-weeks of effort. Such work would be based on our general principle of maximum return for each round fired.

Incidentally, this is an area in which the artillery probably possesses good, practical, target-by-target solutions, if they haven't been knocked off base by floods of impractical analysis.

QUESTION 5. What are the threats to a GSRS ?

a) Weapon - types, ranges, and accuracies?

b) Their reaction time - delta time from GSRS detection until munitions are on the GSRS?

1) DISCUSSION: The input data requested above will be developed in the course of the work previously described. For discussion of vulnerability studies, see Question 7 below.

QUESTION 6. What percent of the candidate GSRS targets are deployed within:

a) 20 km of FEBA?

b) 30 km of FEBA?

c) 40 km of FEBA?

d) 80 km of FEBA?

1) DISCUSSION: The method described above for generation of target lists will automatically give a target inventory in 5-km bands beyond the FEBA, and in 3-hr increments. The population will of course, fluctuate with time.

This inventory will be of potential targets - a complete list of those things you would shoot at given perfect target acquisition and unlimited ammunition. The selection of targets made in a real situation would depend upon the target acquisition capability and the value (importance) of the targets. The detailed inventory will serve as a basis for discussion of the questions of target acquisition and target value, but cannot be expected to answer them.

QUESTION 7. What are the relative value of the various means of increasing GSRS survivability ?

a) Mobility - how quickly should we move after a round is fired?

b) Camouflage

c) Armor plating to reduce damage and thereby attrition

d) None or limited RF attrition

1) APPROACH: This is certainly on of the most important and difficult questions on the list, and deserves a very careful answer. However, it cannot be answered by system analysis alone - what is required is very close collaboration between the design team and the analysts.

There will be extreme difficulty in obtaining a precise answer; both the design implications and tradeoffs and the threat and system performance capabilities can only be estimated. The approach must be one of narrowing the range of uncertainty, and then making a professional judgment.

Work must be done on two analytic levels. On Level III (Theater Level) the systems analyst can develop the threat versus Blue target (including GSRS) situation from the overall scenario. It must be recognized that there will be losses of GSRS, but also that there will be other targets available and the Red threat will not concentrate exclusively on GSRS. Red fire direction should be credited with selecting the best product of vulnerability and value $\left(P_{k,B_i} V_{B_i}\right)$ on which to expend ammunition. However, if GSRS is made into an effective weapon, there will be times when it is a preferred Red target. With these considerations, plus an inventory of Red weapons, estimates can be made of the threat to GSRS.

The other type of analysis must be combined Level V (Duel) and Level VI (Elemental Capability). Presumably every decrease in vulnerability must be purchased in exchange for some decrease in capability or increase in dollar cost - or else one protective measure offsets another - added armor reduces mobility. It is the task of the analyst to define the threat and situation, and set up the necessary algorithm for solution. System engineers must furnish data as to performance for various configurations.

2) FORM OF RESULTS: A Level III (Theater) - Tabulation of expected threat to GSRS (considering availability of other Blue targets) as a function of time.

At Levels V - VI -- Estimates of probability of kill of GSRS by various threats as a function of: displacement time, signature, armor protection. These estimates will include sensitivity of results to input values.

3) EFFORT INVOLVED: Threat definition - In the order of one man-week for a specific presentation for those Red elements threatening GSRS.

Level V - VI -- Three man-weeks, coordinated with design efforts.

QUESTION 8. If, in order to obtain a GSRS, the Army has to "give up" an existing system, what should it be?

1) APPROACH: The mix studies described in Question 1 above will result in an indication as to what system, if any, should be replaced by GSRS. This answer will be based almost entirely on capability - the damage that can be inflicted on the enemy. Other considerations enter the overall problem; e.g., vulnerability, training, facilities. It is suggested that we need not

attempt to answer the whole question unless specifically requested. This is fundamentally a TRADOC responsibility.

QUESTION 9. Should a GSRS attempt to engage (defeat) moving targets versus slowing down or delaying an advance?

1) DISCUSSION: This question will be answered by postulating different versions of GSRS with different capabilities and then examining effectiveness within various mixes under Question 1. It is expected that the chief determinant will be target acquisition capability. If this is unclear, the answer will be somewhat indefinite and more investigation and experimentation will be indicated.

PART II : ADDITIONAL QUESTIONS

Certain additional questions may arise in the course of the investigation and they are mentioned herein. The first of which is suggested as a substitute for Question 4 .

QUESTION 10. How should the GSRS round and launcher load be optimized?

a) What is the optimum size for a single round?

1) APPROACH: There are three general considerations which should bear on this answer: Capability, Design Limits, Compatibility.

As discussed under Question 4 above, because of the possibilities of volley fire or "shoot-look-shoot", the single round need not necessarily destroy any specific target. Capability considerations set a lower limit and an upper limit to warhead size. The warhead should be large enough to have substantial lethality against the hardest elemental target for which it is intended. The warhead should not be so large as to create a substantial wasteful overkill against the softest target it may normally engage.

From a missile or warhead design standpoint, there will probably be certain sizes at which design is easiest. An example is that of sub-munition warheads: some specified number may produce a good packaging scheme and efficient deployment, while an attempt to add a few more for

"capability" reasons may ruin the whole concept. These design "steps", if they exist, should have major weight in the decision as to optimum size.

"Compatibility" covers all interactions with the friendly force; where missile size is concerned the chief considerations are logistics and firing-site handling. Even though the missile system may be designed to have its own loader/transporter, there is definite advantage if it can be handled on site by alternate methods in emergency. There are really two step sized here; that which can be man-handled by 2 to 3 men with crude engineering expedients, and that which can take advantage of the lifting capability (e.g., wrecker) normally available in a battery.

As far as logistics are concerned, the prime consideration is to make the packaged missile, in quantity, stow efficiently in common transport vehicles.

2) FORM OF RESULTS: The above considerations were developed in some detail in material prepared for the MARS report. This can be a take-off point for further study on missile sizing. It is suggested that this be performed primarily by the systems engineers, with consultation as required from system analysts.

3) EFFORT INVOLVED: Small, if consultation only. Allow one man-week.

b) What is the optimum number of rounds to be carried launch-ready on a single launcher?

1) APPROACH: This question interacts with Question 10.a) to considerable extent. It also will be closely connected to Question 7. If vulnerability considerations lead to a "shoot-look-shoot" concept it will be highly desirable that a launcher-load be normally ripple-fired. This implies that the load should not constitute a serious wasteful overkill on the softest area target normally engaged.

Except for the above, the question of launcher load is primarily concerned with launch vehicle selection. It will be highly desirable to select a general purpose vehicle, modify only to the extent necessary, and fit a launcher load which does not impair the normal operating characteristics of that vehicle.

2) FORM OF RESULTS: It is again suggested that the required study be performed by the system engineers, with consultation as requested from system analysts.

3) EFFORT INVOLVED: Consultation only - one man-week.

QUESTION 11. Is a land navigation system necessary or beneficial?

1) DISCUSSION: We have added this question only because it became a considerable issue on the MARS project. We feel that the answer is "no", and that a land navigation system might be regarded as a frill. To the extent possible, the GSRS should conform to the operating characteristics of tube artillery; this includes reliance on artillery command/fire direction/survey facilities.

2) EFFORT INVOLVED: None recommended, unless the subject is brought up by the Army.

QUESTION 12. How are ammunition requirements for GSRS to be satisfied?

1) DISCUSSION: This was another question rather extensively debated during the MARS study contract. Our "party line" should be that GSRS ammunition is simply one component of the overall flow of artillery ammunition. The CAPMOD runs will be for set rates of ammunition flow, and if GSRS becomes a prime candidate for inclusion in the mix, it will be because it gets better results per ton than some other weapon.

This is not to make light of the question; the ever-increasing ammunition "requirements" are a serious problem for the Army. The problem is compounded by the analytic approach reflected by Question 4 above; the CAPMOD approach can help, since it can exhibit the capability gain per increment of ammunition.

QUESTION 13. Is a "shoot-and-scoot" techniques achievable?

1) DISCUSSION: Assuming that a vehicle can be designed having the necessary movement characteristics, and set-up and shut-down times can be made suitably short, there is still a problem of space. The rear of a combat zone is quite cluttered and road space is limited. Further, a GSRS may well be an unpopular neighbor for critical installations if it draws attention and fire.

2) FORM OF OUTPUT: If a "shoot-and-scoot" concept is adopted (and this seems likely) a study must be made, within the scenario, to show how GSRS units can be positioned and utilized.

3) EFFORT INVOLVED: One man-month.

PART III; TOTAL EFFORT AND PRIORITIZATION

		Man.-weeks	Priority
QUESTION 1:	Basic Capability Input	3	1
	Three Target Lists	3	
	20 (?) Mix Runs	4	
	Blue Input Effort	4	
		14	
QUESTION 2:	Retrograde Target List	3	1
	Defense Target List	2	
	Offense Target List	2	
	Not Recommended		
	Change to Central Europe	(2)	
	Change to other scenario	(4)	
		7	
QUESTION 3:	Included above: some follow-on may be needed dependent on reception.	0	1
QUESTION 4:	If requested for conversations with MICOM (probable)	2	2
		2	
QUESTION 5:	Included Above	0	1
QUESTION 6:	Included Above	0	1
QUESTION 7:	Threat Definition	1	2
	Level V - VI Studies	3	
		4	
QUESTION 8:	No Effort Recommended	0	4
QUESTION 9:	No Effort Recommended	0	4
QUESTION 10:	Consultation Only	2	2
		2	
QUESTION 11:	No Effort Recommended	0	4
QUESTION 12:	No Effort Recommended	0	4
QUESTION 13:	If Required (probable)	4	3
		4	
	TOTAL - Recommended and Probable	32 Man-Weeks	

The above estimates are based upon high-caliber system analyst work time only. Allowance for appropriate administrative support and assignment of some sub-tasks to less experienced subordinates would bring the total effort to an estimated One Man-Year.