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TACTICAL NUCLEAR STUDIES: A MORE COMPREHENSIVE APPROACH

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December 18, 1975

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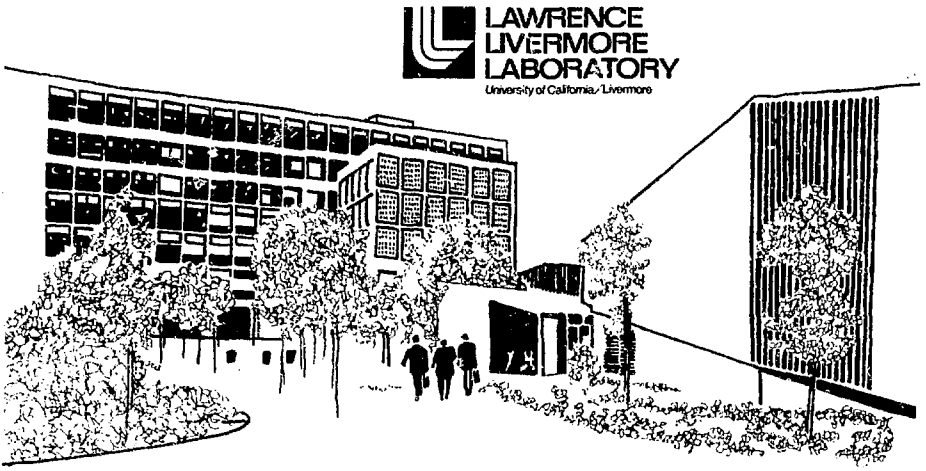

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Abstract

Proposes a matrix scheme for evaluating complex tactical nuclear systems. Advantages resulting from consideration of system characteristics in peace and crisis as well as war include avoidance of scenario-dependent conclusions, ease of maintaining awareness of relationships between immediate concerns and the complex whole, and highlighting of areas or concerns that have been overlooked or neglected.

Introduction

Any analysis of tactical nuclear weapons is complicated by an interrelated set of technical, operational, and political factors. Because of this most studies start with a number of simplifying assumptions designed to make the subject more tractable, either by treating isolated portions of the problem or by introducing a specific scenario as a setting. Either approach leads to conclusions that often prove to be shortsighted, unduly scenario dependent, or otherwise wrong.

We suggest a conceptual framework that can alleviate such problems by enabling the analyst to more easily maintain his perspective; that is, to maintain an awareness of the relationship of his immediate concern to the complexities of the whole. The approach lends itself to use as a platform for discussion and comparison both of weapon system concepts and actual hardware. It can further be used to reveal areas which have suffered from incomplete evaluation.

A Choice of Scenarios

All analyses that are scenario dependent rely on the analyst's guess as to what specific future may be most realistic or most helpful in evaluating a nuclear posture. We suggest that this is dangerous in

that, without a basic philosophy to guide him, the analyst may choose an inappropriate scenario that favors one particular tactical posture at the expense of another when in fact an entirely different scenario may be of dominant importance.

In general, the military planner evaluates tactical nuclear systems for their war-fighting capability. In contrast the politician and the diplomat seem to think primarily of the deterrent value of tactical nuclear forces, assuming, perhaps implicitly, that the world will remain at peace. Thus tactical nuclear systems are typically evaluated in the light of extreme conditions, i.e. either peace or war. This can produce requirements or characteristics that are in conflict, inconsistent, or incompatible.

A third condition, one that has received little analysis and one that in many cases may be of overriding importance, is the condition midway between peace and war: crisis. Here we refer to the critical periods that accompany such events as the Six-Day War, the British-French intervention in Suez, the Soviet intervention into Czechoslovakia, the Cuban Missile situation, or the Greek-Turkish confrontation in Cypress. Proliferation of critical and highly sensitive issues affecting tactical nuclear weapons is likely to occur under this third condition. In order to reduce both restrictive scenario dependence and embarassing inconsistencies in requirements or characteristics we argue that any military posture, any tactical nuclear system, must be evaluated in the light of all three conditions, peace, crisis, and war, not merely in a single detailed peace or war scenario.

A Checklist

We have suggested that these three conditions be used to shape thinking about tactical nuclear systems. Within each of these, one can then construct a checklist of important attributes characterizing the concepts or systems under study. In our experience this approach has been useful in maintaining balanced analysis.

We have been able to group these attributes into six major areas: (1) Military effectiveness and collateral damage, (2) Vulnerability, (3) Dual capability, (4) Costs, (5) Safety, and (6) Communications,

control and release.* These six neither exhaust the subject, nor are they mutually exclusive, but they do form a logical set for discussion. Much of the confusion that sometimes surrounds the issue of nuclear weapons comes from an attempt to deal with these factors singly as if they could be isolated from each other. But the real problems inherent in evaluating our nuclear posture are precisely due to the mutual interaction of these factors, and also to the necessity for the posture to be acceptable across the entire scenario spectrum from peace through crisis to war.

Without arguing for a particular priority of importance for these attributes, we feel that all weapons systems must achieve desired military effects without causing unacceptable levels of collateral damage; must be as survivable as possible within the constraints of force structure, use, and priority; should be dual capable at least for the forseeable future; must meet cost constraints in terms of dollars, special nuclear materials, and manpower; must be safe; and must be controllable and releaseable in timely fashion.

The Matrix

This leads us to our basic concept: that analysis of tactical nuclear systems can be guided by a matrix of attributes vs conditions. In one dimension are the conditions of peace, crisis, and war. In the other are the attributes mentioned above. Thus the basic matrix is only 3 by 6 in size (Fig. 1). A system or concept can then be evaluated against each of the matrix elements to determine areas of strength and weakness. Similarly, different systems can be compared for redundancy, complementarity, etc.

For each attribute, one can define a set of evaluation characteristics. From these, a set of questions can be constructed that relates to the advantages and disadvantages of any given system when evaluated against the pertinent condition and attribute. Some of these questions may be common to all three conditions; others specific to one or two. Table 1 illustrates a nonexhaustive set of

*See W. S. Bennett, R. P. Gard, and G. C. Reinhardt, Tactical Nuclear Weapons: Objectives and Constraints, Los Alamos Scientific Laboratory, Albuquerque, New Mexico, Rept. LA-5712-MS (1974).

Tactical nuclear system evaluation matrix

	Peace	Crisis	War
Military effectiveness/ collateral damage			
Vulnerability/ survivability			
Dual capability			
Costs			
Safety			
Communications, control and release			

Fig. 1. The basic matrix.

evaluation characteristics and Appendix A a resulting set of questions.*

The matrix is used to generate questions in the mind of the analyst, permitting him to move from one detailed consideration to another. Its magnitude, however, is such that the interplay of pertinent scenarios and attributes can be assessed at the beginning and at the end of the detailed analysis. The forest is seen as well as the trees.

*In the hands of the skilled and experienced tactical analyst, the conceptual matrix may well be enough to focus attention on issues of critical importance. Indeed, different sets of questions may be pertinent to different studies.

Table 1. Typical evaluation characteristics for a given tactical nuclear system.

1. Military effectiveness/ collateral damage
   - 1.1 Response time
   - 1.2 Accuracy
   - 1.3 Range
   - 1.4 Yield flexibility
   - 1.5 Rate of fire
   - 1.6 All weather
   - 1.7 Availability
   - 1.8 Kill mechanism
   - 1.9 Collateral damage mechanism
   - 1.10 System reliability
   - 1.11 Target applicability
   - 1.12 Mobility
   - 1.13 Combat readiness
   - 1.14 System usable in training
   - 1.15 Complexity of skills required
   - 1.16 Tests and inspections
   - 1.17 Target acquistion limitation
   - 1.18 Tension aggravation in alert
   - 1.19 Overall credibility as deterrent

2. Vulnerability/survivability
   - 2.1 Preemptive strike
   - 2.2 Nonnuclear attack
   - 2.3 Tactical actions
   - 2.4 Paramilitary action
   - 2.5 Transportation (accident)
   - 2.6 Proliferation (redundancy)
   - 2.7 Signature (EW, IR, photographic)
   - 2.8 Mobility
   - 2.9 Proximity to friendly units

3. Dual capability
   - 3.1 Conventional utility
   - 3.2 Nuclear capability add on costs
   - 3.3 Transition flexibility (time)
   - 3.4 Deterrence value
   - 3.5 Tactical flexibility
   - 3.6 Tension aggravation (visibility)

4. Costs

   4.1 ERDA dollars
   4.2 DOD dollars
   4.3 Personnel
   4.4 Critical materials
   4.5 Time to replace in war
   4.6 Political costs
   4.7 Allied constraints
   4.8 Training

5. *Safety*

   5.1 Nuclear
   5.2 Command disable
   5.3 Storage
   5.4 Transportation
   5.5 Repair and inspection

6. Communications, control and release

   6.1 Risk of unauthorized use
   6.2 Time to release
   6.3 Time to secure
   6.4 Selective yield release
   6.5 Countermeasure risk
   6.6 Flexibility to allied force
   6.7 Risk with allied force
   6.8 Mobility vs communication

Utility

We suggest that this concept can be particularly helpful to planners of tactical force structures by highlighting those areas that have been neglected in previous studies. For example, the subject of military effectiveness in war has been analyzed extensively, but the subject of dual capability has been generally neglected.

As we have pointed out, the matrix approach may also be used to assist studies in a number of ways. For example, a new idea or concept may be analyzed to see in which areas it offers improvement over the existing posture and to understand more completely areas where present capabilities could possibly be degraded. Alternatively, systems or hardware

can be compared in various ways. The comparisons can be specific, for example an examination of alternatives for realizing a particular concept; or they can be of a broader nature wherein characteristics of generic weapon types are compared.

The virtue of this approach is conceptual completeness, a framework permitting serious and orderly study of complex issues and questions. We make no claim for reductions in the time and effort expended in studies and analyses. We do claim that through its use the analyst will be challenged to understand and cope with all of the issues at hand. In our experience this concept has pointedly identified our weaknesses and biases.

Example

The use of this concept in the analysis of a tactical system is quite straightforward. The result is necessarily lengthy if it is to be complete, making it impractical to include an example in this brief paper. An example is available, however, in a prototype study published by R&D Associates.* This work, describing in exemplary detail four nuclear weapon system, is intended to provide a basis for assessing NATO nuclear force structure. It illustrates how careful application of the approach described herein can produce comprehensive analysis as well as a useful reference.

Summary

The conceptual matrix of conditions and attributes which we have defined can aid in the planning and evaluation of tactical nuclear systems. The matrix is a guide to organizing analyses; its use should help the analyst avoid the pitfalls inherent in scenario-based studies, and help guard against the omission of critical issues.

We believe the use of this structure has value in each of three phases of study development. The first is

*G. I. Taylor, J. W. Maloney, V. S. Dudley, J. J. Esser, B. B. Dillaway, and D. E. Willis, Nuclear Weapons System Manual: Evaluation of Selected Characteristics in the Contexts of Peace, Crisis, and War, R&D Associates, Marina del Rey, California, Rept. LRL-5S-15602 (1975) (title U, report SRD).

in scoping a new study effort by identifying those subelements that have first-order importance. The second is in identifying interrelationships of subelements during the conduct of the study, and the third in reviewing the study for completeness and relevance.

Acknowledgments

We have been encouraged in this work by Commander James Martin of ATSD(AE). Helpful comments on the paper have also been received from R. Gard of this Laboratory and from G. Taylor and J. Maloney of R&D Associates.

Appendix A

TYPICAL QUESTIONS THAT MIGHT ARISE FROM EVALUATION CHARACTERISTICS

	Peace	Crisis	War
Military effectiveness/ collateral damage	What is enemy's perception of system effectiveness? Is the perception influenced by doctrine as well as hardware? How do our allies see the system? What are the military and political requirements the system must meet? Can the system be used in training? Can the system be exercised without degrading its effectiveness in combat?	What degradation occurs in the system if it is held in a ready posture? What is required to move the system into a crisis or war posture? Does deployment of the system itself affect the degree of tension in a crisis situation?	How do effectiveness criteria differ under different scenarios? How does the relative importance of criteria change as the scenario changes? How does the system convert from conventional to nuclear combat? How do organizational and doctrinal constraints affect use of the system? Are specialized target acquisition capabilities required? How does the system react to various countermeasures?
Vulnerability/ survivability	How vulnerable is the system to preemptive strike? Would enemy restraint in causing collateral damage affect the wartime usefulness of the system? What survivability options are open against preemptive strike? What peacetime vulnerability might exist?	Can the enemy prevent or inhibit dispersal? What scenarios will make the system more vulnerable during crisis? What vulnerabilities exist during transition to crisis or war?	How well can the enemy acquire the system as a target? If acquired, what is the survival probability? Will redundancy in the system affect survival? Do survivability measures affect military effectiveness? How do logistics affect vulnerability?
Dual capability	Is the dual capability real or cosmetic? Does the dual capability have peacetime value? Are equivalent enemy systems dual capable? Why? What organizational and personnel benefits and disadvantages accrue from dual capability? Is training affected? What doctrinal advantages and problems accrue from dual capability?	How does dual capability affect the transition to crisis and war?	How does dual capability affect the transition between conventional and nuclear combat? How does dual capability affect survival? Do the same personnel use the system in its conventional and nuclear roles? Can the system be easily switched between conventional and nuclear operations during nuclear combat?
Costs	What are procurement costs? What are personnel and manpower requirements? What kinds and quantities of special nuclear material are required? How much does training cost? Are there political costs?	Does crisis operation alter manpower requirements? Will peacetime training costs affect the crisis posture and wartime effectiveness? What costs are associated with crisis posture?	What is system replacement cost in combat? What will the system cost in protracted conflict? Will nuclear materials be available? Is replacement of key personnel a critical problem?

Appendix A (continued)

Safety	What are possible accident modes for the system? Probabilities? What are the effects of an accident? What does safety cost in posture and credibility? What is the likely political assessment of the safety of the system?	In what way can the crisis situation affect safety? Do safety requirements inhibit a ready posture? How can an accident influence the course and control of the crisis? Do safety considerations make the system vulnerable to enemy countermeasures?	Is the system safe in use? What military effects will an accident have? Does safety constrain operations?
Communications, control and release (CC&R)	In what ways can unauthorized users exploit the system? What are the consequences of such use? What are the enemy's and our own assessments of the timeliness of our release procedures? What manpower costs do CC&R requirements impose?	Are the CC&R procedures appropriate to crisis situations? Will mobility degrade CC&R? Will the CC&R procedures prevent an ex-ally from using the nuclear system?	Can knowledge of our CC&R be exploited by the enemy? What is the CC&R response time? Do the CC&R requirements inhibit the flexibility of the system?

RBC/lc/mp/la