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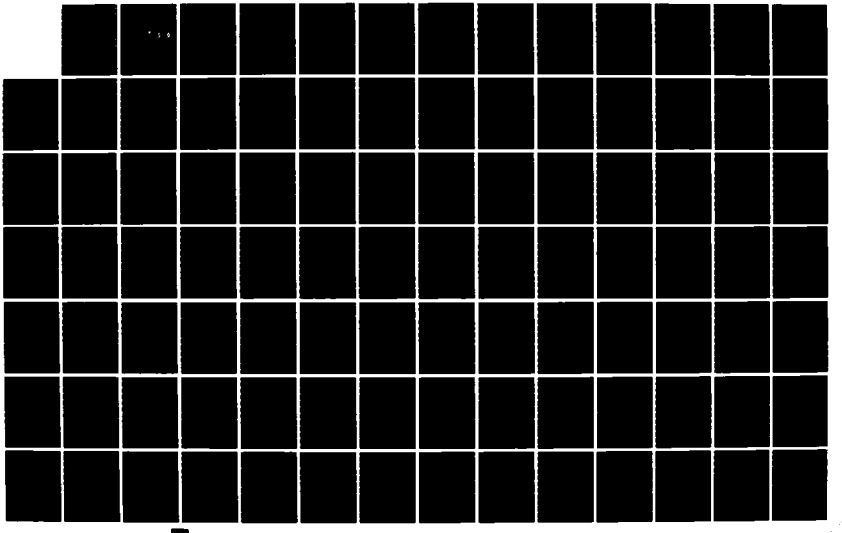

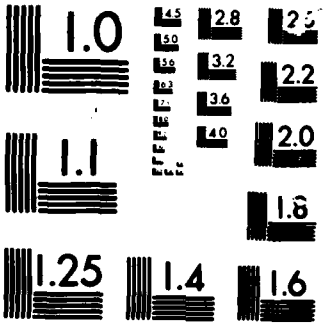

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THESIS

ON LIMITED WAR, ESCALATION CONTROL, AND COMMAND, CONTROL AND COMMUNICATIONS

by

Geo. Mark Waltensperger

March 1986

Thesis Advisor: James G. Taylor

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This thesis is an unclassified examination from a Western perspective of the concepts of limited war, and escalation control in the context of nuclear conflict and command, control and communications (C3). Limited war and escalation control are intrinsically related. To better understand the relationships between limited war, escalation control and C3, as applied to the question of protracted nuclear war, this thesis considers strategic control from a cybernetic view, using a widely accepted model for the command and control process. U.S. strategic C3 systems are discussed from the perspective of limiting war and controlling escalation. Requirements such as, a viable National Command Authority, effective command and control, positive/negative control, damage control/assessment, a shared concept of limited war, civil defense, and a mechanism to terminate conflict are presented as necessary to control escalation, thus, limiting war.

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On Limited War, Escalation Control, and Command, Control and Communications

by

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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

This thesis is an unclassified examination from a Western perspective of the concepts of limited war, and escalation control in the context of nuclear conflict and command, control and communications (C3). Limited war and escalation control are intrinsically related. To better understand the relationships between limited war, escalation control and C3, as applied to the question of protracted nuclear war, this thesis considers strategic control from a cybernetic view, using a widely accepted model for the command and control process. U.S. strategic C3 systems are discussed from the perspective of limiting war and controlling escalation. Requirements such as, a viable National Command Authority, effective command and control, positive/negative control, damage control/assessment, a shared concept of limited war, civil defense, and a mechanism to terminate conflict are presented as necessary to control escalation, thus, limiting war.

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I. INTRODUCTION

Thermo-nuclear war is popularly believed to spell the end of man and civilization in general as we know it. Nuclear war does not necessarily and automatically lead to total destruction, even for the primay participants. This premise implies waging a limited war where the participants hold back their total destructive force and prosecute a war of limited objectives without the conflict escalating to levels of total war-- where the continuation of civilization, "as we know it" would be questionable.

Because of the virtually unlimited destructive power of nuclear weapons, warfare has changed significantly. Intrinsic limitations to combat existed prior to 1945 when nuclear weapons were first used. Before Hiroshima-Nagasaki, conventional weapons (chemical explosives) were limited in their destructive power, and in the accuracy of their delivery systems. Accuracy was good but did not match the pinpoint accuracy today of 'smart weapons'. Technological limitations constrained even all-out efforts toward total, unlimited war. Modest payloads (modest by today's standards) and uncertain accuracy in hitting targets limited effectiveness and created doubt in the efficacy of strategic bombing for purposes of dealing the coup de gras to the enemy. To some, strategic bombing was just another form of attrition warfare. Critics of Allied strategic bombing of Germany during WWII questioned whether it would actually affect or hasten the outcome of the war. Eventually, after institututing day-time raids, and with a substantial increase in monthly ordinance, allied bombing raids in Europe did pay off. Even so, the psychological effect on the civilian populace was considered just as important as the destruction of industrial and political centers. [Ref. 1: pp. 10-12]

With immensly powerful nuclear weapons matched to extremely accurate delivery systems,[1] changed forever is the notion of hitting at the heart of the enemy. Strategic bombing is no longer a form of attrition warfare, it is the method of dealing the quick thrust to the heart of the enemy, having the awesome effect of possibly forever changing the political, economic, and social structure of the recipiant. Estimates from the Office of Technology Assessment, 1979 study on the effects of nuclear weapons cite 2-160 million Americans dead from a Soviet nuclear attack. The large size of the estimate interval is due to the uncertainty in the type of attack and the status of the population at the time of the attack. These deaths are from prompt radiation, blast and short term fallout. Not included in the estimates are the long term effects from a ruined economy, long term radiation, inadequate health care, starvation, crime and insurrection, new social orders, etc., etc. Given an unlimited strike against this country we can expect a total disruption of our social, political and economic system.

When dealing with an adversary in the international arena, a high priority of government should be to avoid nuclear war. But if the use of nuclear weapons becomes a certain necessity, for any reason, then, along with the political objective must come the objective of keeping the conflict constrained to within certain limitations.

During conflict many interactions occur between belligerents. These interactions can be obvious such as, direct combat between ground forces, and some not so obvious such as maneuvering at the diplomatic level, positioning of forces at the geo-strategic level, or signalling and

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[1]Circular error probable (CEP) is the radius of a circular distribution within which 50% of the missiles are expected to fall. Unclassified CEP's are now typically 0.1-0.2 miles.

bargaining. In order to constrain a nuclear exchange to limited proportions, control must be maintained of these interaction between the belligerents. Control seems an obvious requirement for limiting nuclear war, but what exactly is controling nuclear war, or, 'strategic battle management'? How do we know when we have it or don't have it? What are the systems that support strategic battle management and are they adequate to support the concept of limited nuclear war? Does the United States adhere to the concept of limited war? If engaging in total nuclear war is assumed to be suicidal, and it generally is, and, if deterrence fails, then the primary objective will be to limit war. Does our command, control and communications (C3) system support this notion of limiting wars, and at the same time attaining the political objective which precipitated the conflict?

> We may be likened to two scorpions in a bottle, each capable of killing the other, but only at the risk of his own life.

These words of Robert Oppenheimer succinctly describe the relationship between the two nuclear superpowers. But if the risk is taken by the nuclear powers that war will not be suicidal, then it must be recognized that the war will be fought toward limited ends and the problem of controlling the conflict,i.e., controlling escalation, will be the paramount objective. This is something of a contradiction, since the objective of keeping limited war limited is the attainment of limited political goals which preceeded and necessitated the exchange. Lawrence Freedman, in his book, "The Evolution of Nuclear Strategy", attributes the following quote to Liddell Hart, the father of limited war, after the bombing of Hiroshima.

> When both sides possess atomic power, total warfare makes nonsense. Total warfare implies that the aim, the effort and the degree of violence are unlimited. Victory is pursued without regard to the consequences . . . . Any limited war waged with atomic power would be worse than nonsense, it would be mutually suicidal.

This makes sense! Then, assuming the participants not to be suicidal psychopaths, it will be through limited actions and limited means, that nuclear war should be fought, if it is to be fought at all.

But what does limited war mean in the nuclear age? Would it be possible for nuclear belligerents to constrain themselves after having been on the receiving end of an ICBM attack, perhaps after having lost a substantial portion of their population? Would the president respond in kind if he knew 50 million Americans had just been killed by a Soviet counterforce attack; and that his response meant a Soviet counter response against American cities was a certainty? How could he not respond given typical political pressures from home and from allies to respond in some manner? What would keep one side or the other from using all its nuclear assets early in conflict if it feared it may lose them? Once the threshold, or 'fire -break'[2] of first use has been breached, to keep from falling into a total nuclear confrontation, the war must be limited and it must remain so by definition. To accomplish this no less than amazing feat, escalation must be controlled and it must be mutually understood, if only tacitly, by both sides, since for any war to remain limited, it must be limited by all participants.

In order to better understand the dynamics of limiting nuclear war and to identify the relationship of some elements of nuclear war to strategic command, control and communications, this paper will examine concepts of limited

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[2] Fire-breaks are the threshold points at which very sharp changes in escalation take place leading to nuclear war. These are threshold points in Herman Kahn's escalation ladder [Refs. 1,2: pp.217,6].

nuclear war from a Western perspective, the requisite control necessary to keep limited war limited, that is, to control escalation, and the systems and organizations currently expected to control strategic battle management.

II. LIMITED WAR

The concept of limited war in the nuclear era presents many penetrating problems of military interest. One problem asks the question: Does the United States have a command and control system that will support the control of escalation and thereby keep a limited war limited? This chapter will examine some aspects of limited war. It is important to realize that Western beliefs of limited war may not be equally held by the Soviet Union. If true, this conceptual asymmetry between East and West presents a problem to the limiting process, and will be discussed later. The following is a Western view of limited war.

A. NUCLEAR STRATEGIES

1. Massive Retaliation

The early U.S. nuclear policy of massive retaliation, whereby deterrence is maintained by the threat of a total and massive nuclear response to any communist inspired aggression has been gradually rejected and replaced by a policy of assurred destruction and flexible response. Massive retaliation had many flaws, some theoretical, some moral, but mostly the doctrine of massive retaliation contained a paradox that theorists and polititians could not resolve: Since total war is assumed to be totally destructive for all participants and is therefore, suicidal; then, if the deterrent threat of assured destruction fails it becomes suicidal to carry out the threat and the deterrent policy is nothing more than a bluff. Massive retaliation is actually thought in some circles to be destabilizing and therefore, increases the threat of nuclear war. An empty

threat would seriously reduce the credibility of the U.S. deterrent for effectiveness and may invite worldwide aggression and/or attack against this country. A deterrent threat is only effective if it is believed to be reasonably credible by the opponent. [Ref. 1]

2. Flexible Response

Beginning with the Kennedy administration and principally behing the suppport of then Secretary of Defense Robert McNamara, the concept of 'flexible response' grew from the need for options other than total nuclear war, ineffectual response, or no response at all to communist aggression. Flexible response called for balanced and, if required, incremental response options, conventional and non-conventional, to all levels of aggression. What was sought was a response menu covering any and all circumstances requiring a response. If the only options left to American leaders boil down to total and most likely suicidal war, or, no response at all followed by a grave loss in political esteem and power, the leaders are ham-strung and the situation becomes destabilized. Would the president of the United States risk the loss of hundreds of millions of lives in order to save face in the international scene; would he choose to not respond at all to a serious transgression by the Soviets, afraid to play the nuclear card? The National Command Authority (NCA) must have more than the choice of total war, or 'strategic retreat', because otherwise, we are "likened to two scorpions in a bottle". According to Bruce Blair, "A strategy of flexible response sets up an elaborate experiment in conflict resolution, requiring an ability to tailor responses, to test and learn and to adopt to changing circumstances." [Ref. 3: p. 212] This implies an ability to control the process of war.

Flexible response, which provides the national decision makers, principally the National Command Authority

(NCA), the ability to act according to the threat. It provides for a response to be tailored to the situation necessitating the action; at any place and in any manner in the choosing of the NCA. Flexible response is intended to offer alternatives. The cost/benefit is calculated for each option and one is chosen to either maximize the strategic payoff or the political objective. NATO adopted the strategy of flexible response in 1967 and in a communique stated:

> The concept is based on a flexible and balanced range of appropriate responses, conventional and nuclear, to all levels of aggression, or threats of aggression. These responses, subject to appropriate political control, are designed first to deter aggression and thus preserve peace; but, should aggression unhappily occur, to maintain the security of the North Atlantic Treaty area . . . [Ref. 1:p.285]

After all, deterrence for national security should not be based on genocide and terror, but rather upon a rational and gradual response in kind to any and all communist aggression if war is to be constrained. It will be more effective to deter by convincing the enemy of purposeful and certain response, executed effectively, than it is to deter by fear. Deterring by fear may provoke the opponent into the very response meant to be deterred.

Deliberately included in the NATO communique is political control over the response. Political control becomes a crucial element and is fundamental to the notion of control of limited war. As I will discuss later, the relationship of politics to limited war is tightly bound and becomes a major control element. But what is this thing called limited war, the concept that flexible response implies?

3. Limited vs. Unlimited War

Robert Osgood, an early strategic theorist in America described limited war as:

> One in which the belligerents restrict the purposes for which they fight to concrete, well defined objectives that do not demand the utmost military effort of which the belligerents are capable and that can be accomodated in a negotiated settlement. [Ref. 4: p.1]

Osgood further constrained limited war to two (or few) players; targets selected strictly for their military importance; specific geographic areas; and a specific political objective [Ref. 4: p.2]. The scope of the action, i.e., the limited war, must be kept within the confines of the political objective and political control for the war to remain limited. Since warfare is not an end in itself, but a means to an end, the war should revolve around and be controlled by the objective, or the end, and that objective, usually political, should exercise some control over the action. This is in contrast to unlimited war that Osgood describes as:

> . . . war . . . fought with every means available in order to achieve ends that are without objective limits or that are limited only by the capability of the belligerents to destroy the enemy's ability to resist. [Ref. 4: p.2]

That is, unlimited war is characterized by no well defined objectives--the only objective is to win; or is characterized by the situation where limited war begins to go out of control and the original objectives are replaced by the more highly sought and immediate goal of not losing; where the players are compelled to fight on at all costs.

Most importantly though, is to link the political objectives to the limitation. For, without political objectives war becomes politically unlimited and termination becomes elusive. If the objectives are unlimited, then when do you stop? When do you say we've reached the end of the action and now it's time to compromise and settle the dispute? Short of total military committment, elements of

termination, compromise and settlement possibilities must exist to control war, thus limiting its nature. Without these elements there is no motivation for restriction in the action; without motivation for restriction there is no limitation. Of course, unlimited wars too have constraints, giving them an element of limited character. A well worn example is the non-use of chemical weapons during World War II when all sides possessed the capacity. And too, limited war can seem unlimited in some respects, especially if the limitations are one sided. This could be the case if one belligerent, seemingly with unlimited resources were at war with an opponent of lesser resources. The waring party with many resources may feel the war is limited, whereas the party with less, may feel the war to be of an unlimited nature, since it demands most of its effort and resources. This produces an asymmetry between opponents in viewing the conflict, and may result in miscalculation in subsequent decisions and actions. Miscalculation may then cause the conflict to slip beyond previous constraints.

B. TRADITION AND PERCEPTION

Much of the idea of limited war is dependent upon the perspective of the observer. To some, any war is unlimited and out of control; and the nature of war is treated like an illness to be cured at all costs. Thomas Schelling, an early "formal strategist"[3] believed a division existed dividing conflict theorists

> . . . between those that treat conflict as a pathological state and seek its causes and treatment, and those that take conflict for granted and study the behavior associated with it. [Ref. 5: p. 3]

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[3]Lawrence Freedman describes formal strategists as those prescribing to elements and tools of game theory for stategic insight. Formal Strategists attempted to build a new strategic outlook not based on East-West relations but relevant to them, and use deciplined and formalized reasoning as major tools of analysis. Other formal strategists were Herman Kahn, Mortan Kaplan, Daniel Ellsberg, Oskar Morganstern, et al. [Ref. 1:p.181]

Warfare is not an illness but rather one of many states of relationship between societies, as normal as birth and death. And, since it is a natural occurrance in the history of man it can be studied as such and a rational description of its composition and complexities is useful. [Ref. 5: p. 3]

Schelling, a game theorist in strategic matters believed conflict to be essentially situations of bargaining, occurring between conflicting players. This fits in well with Osgoods requirement for room for compromise and settlement leading to termination and thus limiting warfare. If no bargaining were possible to terminate the war under some favorable conditions, then, there is no point in keeping the war limited. Schelling though believed limited war to be strongly dependent upon tradition, precedent, convention and the force of suggestion. [Ref. 5: p.260]

There is a traditional worldwide revulsion to the use of nuclear weapons, so, anything involving their use must be avoided at all cost, or, if not avoided, at least limited. Another tradition of nuclear weapons is their non-use. 'The bomb' has not been used since Hiroshima-Nagasaki; transcending that de facto moratorium presents the crossing of a threshold beyond which control of the process of war may be difficult or lost. Once the threshold of first use is crossed, further use may be more readily resorted to. The first crossing will be the most difficult, but once it has been made, the shock value will be gone and a second use may be easier. So, transcending that saliency is avoided or at least limited. Schelling states:

> Traditions or conventions are not simply an analogy for limits in war, or a curious aspect of them; tradition or precedent or convention is the essence of the limits. [Ref. 5: p. 260]

Of fundamental importance is that the warring parties all perceive the traditions and precedents which shall limit war. The total perception need not be equal but there should be a mutual recognition that wars can be limited. This recognition may be agreed upon or tacit; but, if either side feels unsure of this mutual recognition, then uncertainty is injected into the equation of balancing the limitations on war--stressing the situation and escalation may result. That is, the intended limits of the action must be perceptible by both parties. Not only does this imply an effective command and control system at home, but also implies an information link between warring parties to communicate their intentions. This communications link does not have to be a link in the technological sense, such as the Washington to Moscow 'Hotline' known as MOLINK. It could be a communication based upon agreed actions signalling certain intent. For example, the crossing of river will mean one thing, and the holding back of the bombing of cities will mean another. Perception of intent on the part of the enemy, and your own perceptions of expectation are crucial to the concept of limited war [Ref. 5]. These perceptions can be manipulated and the Soviets actively attempt to exploit this aspect of command and control through measures of reflexive control and disinformation.[4] According to Godson and Shultz, "This frequently involves attempts to deceive the target and to distort the targets perception of reality." [Ref. 6:p.16]

Is nuclear war unique in this result? Is conventional war thought of differently? Schelling states that most people, even those who see no difference between being

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[4]Reflexive control is a Soviet notion of the indirect implementation of control over an opponent by influencing his decision making process, and advancing the implementor's interests by predetermining his opponent's logical decisions. It is via the methods and philosophy of reflexive control that the Soviets employ deception. Disinformation is a subset of reflexive control.

burned to death in a nuclear fireball or by napalm, recognize the revulsion of nuclear weapons. There is no intrinsic difference; rather it is a matter of psychological and intellectual distinction as well as an intuitive feeling of what the adversary believes. By believing nuclear weapons to be 'just-another-weapon' there exists no basis to the limiting process. [Ref. 5]

C. SUMMARY

Early U.S. nuclear strategy was known as 'Massive Retaliation' and implied a prompt, total and massive response with nuclear weapons to deter communist inspired aggression wherever it might have occurred. Massive retaliation was thought to be a flawed policy because people believed no President would order such a potentially devastating reaction to communist adventures. They believed it to be nothing more than a bluff. It was clear that the U.S. required flexible strategies and capabilities to deter war and aggression. Flexible response was an idea born in the Kennedy administration that assurred destruction to aggressors based on a response menu to fit the aggression. It allows for an ability to pick options to fit the situation, within the capability of the forces structured to respond to a variety of conditions. If the response is nuclear, then, flexible response means limiting nuclear war. Rather than total, spasic war, a nuclear conflict would consist of limited actions tailored to the particular situation.

Limited war is characterized by each opponent in the conflict employing fewer resources than are available, and restricting the political objectives of the conflict. By comparison, unlimited war is characterized by the use of all means available to each side in the conflict, and usually has no well defined political objective, other than victory.

Much of the idea limiting war is dependent on the traditions and perceptions of the opponents with respect to the

limiting process and the conflict in general. Some mutual recognition of the traditions and perceptions should exist. Traditional non-use of nuclear weapons is presently a strong constraint against nuclear first-use. Once that threshold has been crossed though, subsequent nuclear-use may not have such strong constraints. Perceptions of limiting war can can be manipulated to one's advantage and the Soviet Union engages in extensive active measures of reflexive control and disinformation to change such perceptions. It must be remembered that the ideas presented here are for the most part Western in nature and this perspective represents only a part of the overall conflict paradigm. Explicit Soviet perspectives in the matter of limited war are extremely important in analyzing conflict between our nations but is beyond the scope of this paper.

Limited war is closely related to the concept of escalation control--the subject of the next chapter.

III. ESCALATION

A. INTRODUCTION

Control of escalation is the central element that is unique in distinguishing limited war from total war. Escalation control is what keeps tension between two powers from rising to the point of direct military confrontation. Richard Smoke says of limited war and escalation:

> Escalation is the process by which the previous limits of a war are crossed and new ones established, (or, in the end, the last limits crossed). Conversely, the expanding limits of a war are the barriers or thresholds or stages of the escalation process. From this point of view, limited war and escalation are co-extensive: neither is larger an idea, or encountered more frequently in reality, than the other. [Ref. 7:p.17]

According to Smoke, the term escalation did not appear in dictionaries or scholarly literature until about 1960. This was the time when many proflic thinkers such as Herman Kahn, Thomas Schelling, Bernard Brodie, William Kaufman, et al. were developing what has become fundamental thinking on nuclear war. Lawrence Freedman attributes the term to the English in the 1950's and succinctly describes escalation as "the intensification of any conflict." [Ref. 1:p.210]

During the 50's and 60's, two views of escalation developed. One view, a precursor of Schelling's compellence theory was of the raising of the stakes between belligerents by a deliberate action resulting in heightened violence, or by deliberately expanding the area of dispute. The whole idea of compellence was to "compel" the adversary to change his decision process or expectation of the outcome of conflict, and to change it in such a way that his behavior was that desired by the initiator. The other notion of escalation was that of an increasing series, or continuum of

events in which the players were involuntarily caught and swept along toward total war out of control [Ref. 2:p.4]. These two views of escalation are paralled and expanded by Richard Smoke in his book "War: Controlling Escalation", where escalation by a deliberate act he calls the "actor image" model, and the continuous events type he calls the "phenomenal image" model [Ref. 7:p.21]. More will be said about these two models later.

B. KAHN'S ESCALATION LADDER

Herman Kahn, in his books "On Escalation: Metaphors and Scenarios", and "Thinking about the Unthinkable", proposed in the early 1960's a ladder of escalation steps through which any conflict may proceed, culminating in nuclear war. The steps represent a structure upon which to view escalation phenomena. The steps provide no procedural information, but are considered a classic attempt at discretizing the escalation process of rising tensions between two belligerents from a level of initial disagreement to general war. From "Thinking about the Unthinkable" in 1962 the first escalation ladder: [Ref. 8:p.185]

1. Subcrisis Disagreement
2. Crisis
3. Political, Diplomatic and Economic Gestures
4. Show of Force
5. Modest Mobilization
6. Acts of Violence
7. Limited Military Confrontations
8. Intense Crisis
9. Limited Evacuation
10. Super-Ready Status
11. Spectacular Show of Force
12. Controlled Local War
13. Limited Non-Local War
14. Complete Evacuation
15. Some Kind of All-Out War
16. Aftermath

In 1965, Kahn expanded the idea of the escalation ladder in his book: "On Escalation: Metaphors and Scenarios", adding resolution to the 16 step ladder and proposed a 44 step ladder that has been broken down into seven phases, separated by nuclear threshold points or "firebreaks". The crisis grows out of a noise level of some non-specific scenario common to cold war disagreement: [Ref. 9:p.39]

The first phase is "Subcrisis Maneuvering"

1. Ostensible crisis
2. Political, economic and diplomatic gestures
3. Solemn and formal declarations

The first threshold to be crossed is "Don't Rock the Boat Threshold" which moves the proto-crisis into the "Traditional Crisis" phase.

4. Hardening of positions-confrontation of wills
5. Show of force
6. Significant mobilization
7. "Legal" harassment-retortions
8. Harassing acts of violence
9. Dramatic military confrontations

The "Nuclear War is Unthinkable" threshold is now crossed, moving the crisis into the "Intense Crisis" phase.

10. Provocative breaking off of diplomatic relations
11. Super-ready status
12. Large conventional war (or crisis)
13. Large compound escalation
14. Declaration of limited conventional war
15. Barely nuclear war

16. Nuclear 'ultimatums'
17. Limited evacuation (approimately 20%)
18. Spectacular show or demonstration of force
19. 'Justifiable' counterforce attack
20. 'Peaceful' worldwide embargo or blockade

The "No Nuclear Use" threshold has now been crossed and we move into the "Bizarre Crisis" phase. (Exemplary here to mean "warning")

21. Local nuclear war-exemplary
22. Declaration of limited nuclear war
23. Local nuclear war-military
24. Unusual, provocative, and significant countermeasures
25. Evacuation (approximately 70%)

The "Central Sanctuary" threshold is crossed next into the "Exemplary Central Attacks" phase.

26. Demonstration attack on zone of interior
27. Exemplary attacks on military
28. Exemplary attacks against property
29. Exemplary attacks on population
30. Complete evacuation (approximately 90%)
31. Reciprocal reprisals

Escalation at this point crosses the "Central War" threshold moving the "Military Central Wars" phase.

32. Formal declaration of 'general' war
33. Slow- motion counter-'property' war
34. Slow-motion counterforce war
35. Constrained force-reduction salvo
36. Constrained disarming attack

37. Counterforce-with-avoidance attack
38. Unmodified counterforce attack

The "No Cities" philosophy is lost now and the "City Targeting" threshold is crossed. This moves the conflict into the "Civilian Central Wars" phase--the last.

39. Slow-motion countercity war
40. Countervalue salvo
41. Augmented disarming attack
42. Civilian devastation attack
43. Some other kinds of controlled general war
44. Spasm or insensate war

Kahn realized that any escalation process is context dependent and did not claim his ladders to be correct for all circumstances. He also realized that his ladders distinctly represented a Western point of view. In particular they (1)de-emphasize the nature of the conflict leading to war; (2) imply a control of movement up and down the ladder with the possibility of stopping at any rung; (3) focus at any one time on a single state of conflict and thresholds, rather than the security threat, balance of power, or accomplishment of objectives. This is the bargaining or signalling approach to escalation and, though known to the Soviets, is more a Western approach [Ref. 2:p.5]. The fact that one nation views escalation differently from another represents an asymmetry in the process and violates the mutual perception requirement for limited war.

C. SALIENT RECOGNITION

Schelling distinguishes between the attainment of goals directly in conflict and signalling, or actions directed at bargaining. Because direct communication may not be possible between belligerents, signalling would occur via tacit actions, or moves. Schelling stated the need to "coordinate expectations via maneuver", knowing that each side must base its actions on what the other side is expected to do. Salient points would be chosen and crossed as actions to signal intent. Here each action would have to be chosen (supposing the other side would recognize it) as a limiting maneuver and not an escalation. Otherwise, quite naturally, the conflict would rise up the escalation ladder instead of descending as the action intended.

The salient points or limits must be recognized by both sides equally. And simple recognition of an escalation point or saliency is not enough. For example, if one side believes a nuclear strike existing of a single weapon on a military base with the subsequent loss of say, 50,000 people (including civilians due to collateral damage) as a limited act used to signal resolve to the other side; but, the opponent considers it to be a prelude to all-out attack, then the act and intent of limitation has been lost. Escalation control then requires both sides to recognize specific acts equally, that is to say, ground rules of some sort are required, even if only tacit in nature. If not, the acts must be of such a simple nature that they can only be interpreted in the way they were intended, otherwise all-out or total war is at risk.

The term escalation is derived from the English infinitive "to scale" and the Latin word for ladder. It is a back-formation of the word "escalator" [Refs. 7,10: pp.17,446]. The analogy is precise because the escalation of conflict in limited war is the discrete, step-wise

increase of tensions and actions leading to total war. The requirement for discrete steps or thresholds is within the framework of Kahn's escalaion ladder concept since any single escalation must be finite to be recognizable to the opponent as being within the framework of limitation. If not, and a continuous sequence of actions takes place, then there is no discernable point where the action can be recognized as a limited move. And, again, the point of limitation and escalation control is lost.

Richard Smoke, in "War: Controlling Escalation", uses a model that is primarily characterized by defining escalations as the crossings of saliencies. He attributes this idea of saliecy crossing to Schelling. The saliencies are the limits of the conflict perceptible to both parties. Crossing or transcending a saliency is analogous to taking a step up Kahn's escalation ladder.

D. THE UPWARD DYNAMIC

Each saliency is discrete or discontinuous and the movement is generally upward, that is, there tends to be an upward dynamic to escalation as the conflict moves from one saliency to another.[5] By nature ,war seems to favor escalation. Because decision makers do not have perfect information, the impact or interpretation of their decisions by the adversary may not be correctly understood, thus creating unforseen events or circumstances. There tends to be a process where an action by one party is countered by the other party, in sequential moves, creating an opened ended cycle of escalation. This is what creates the upward dynamic in the escalation process leading to total war.

> Escalation is not a mere possibility-something that may happen or may not, like a rainstorm over a battlefield. It is an ever-present 'pressure' or temptation or

[5]The escalator analogy continues with each saliency similiar to the discrete steps.

likelihood, something that requires more deliberate thought and action to stop and reverse than to start. [Ref. 7:p.35]

1. Two Western Models of Escalation

Smoke uses two "image"s of escalation that he joins together into one model in his analysis of escalation: (1)"The 'actor image' model presents escalation as being a unilateral act of specifiable individuals and institutions; an independent and conscious decision to commit a certain kind of action and the deliberate execution of that decision." (2) Complimenting the actor image model, the "phenomenal image" model presents escalation as being a natural phenomenon of war, a process that seems to get started and keep going on its own, partly outside the control of any participant. In other words wars naturally tend to expand. [Ref. 7:p.21]

The actor image model implies an ongoing cognitive process where the decision to escalate or not to escalate is a descrete step--a decision to cross a saliency. It is a model where someone does something, i.e., someone takes some purposeful action or makes a purposeful decision. The phenomenal image model on the other hand, represents a continuous process where something happens, beyond the control of the decision maker who is swept along by the force of the escalation which automatically tends to a higher position naturally. The upward dynamic is somewhat analogous to a falling object tending to a position of least potential energy through the force of gravity.

Which model is correct? Neither the actor image nor the phenomenal image model are complete and correct in themselves. Each tends to simplify the process. Instead, a combination of the two should be the model for escalation. That is, escalation has a dual nature, both discrete and continuous, both are correct, neither is complete alone [Ref. 7:p.22].

Is the upward dynamic tendendacy toward general war analogous to the thermodynamic concept of entropy and the tendancy to greater disorder and chaos? In physical systems, unless the requisite work is performed on a system, it will tend to a state of greater randomness or disorder. Since society and conflicting states represent a system, society may tend, through "social thermodynamics", to a more disordered state during war. This disordered and random state could then climax in total, uncontrolled war.

2. Six Elements of the Upward Dynamic

Smoke lists six elements in the escalation process that reinforce the upward dynamic--the natural tendancy toward uncontrolled or unlimited war.

1. The desire to take a step that will greatly contribute to winning the war.
2. The desire not to lose.
3. Escalation of the stakes--the more I risk, the more I pay, therefore the more it is essential that I win.
4. The psychological notion of leaders that their effectiveness as national leader is contingent upon their victory.
5. Opportunity exists for military advantage even though it means escalation.
6. Action-reaction effect

These six elements can occur singly, or in any combination. Any one can drive a conflict to uncontrolled total proportions. The first five elements tend to be more descriptive of a one-time event or period of time. For example, taking an escalatory step that you believe will greatly contribute to winning the war. The dropping of atomic weapons in Japan certainly falls into this category. It was the last escalatory step of WWII. The last element--the "action-reaction" effect can characterize the entire escalation process. [Ref. 7:pp. 23-25]

3. Action-Reaction

Action-reaction occurs when one party counterescalates in response to the other's escalation step. This may

go on without apparent control to unlimited proportions, though not necessarily so. Smoke sees two types of action-reaction effect escalation. The first he calls "reciprocal escalation" [Ref. 7:p.27] which is a tit-for-tat process that stops after two steps. This type of escalation, constrained to two steps, then stopping implies a certain stability between the two escalation steps. If the stability is not there the escalation process would unlikely stop at two steps. The other type of action-reaction effect Smoke calls "cyclical-sequence escalation" [Ref. 7:p.27]. This is a continuous escalation model and is different from reciprocal escalation in that theoretically, it could go on forever. Escalation is met with counterescalation, met with counter-counter escalation, etc. The escalation process here is "interactive", where the consequences of each escalation interaction creates a new situation or state of conflict which was probably unforseen by the belligerents. This process may even be engaged in purposefully by decision makers, not really understanding the possible outcomes, but taking a chance on bumping the tensions up a notch and hoping that chance and uncertainty are on your side. This is what Schelling calls compellence. This type of escalation may also be engaged in to take the opponent to the "brink", where you calculate, and hope, that he will want to bargain. This is known as brinksmanship[6] where the adversary is forced into a position of uncertainty as to how far you , the initiator of the escalation, will go. He is forced to the brink of uncertainty and must be cautious for fear of death or destruction. This also leads to the game of 'chicken' where two adversarys drive toward each other in a speeding car, the one to swerve first--loses. If neither swerves--both lose. One of the most important strategies to

[6] See Freedman p. 186-89 for additional information on brinksmanship.

remember when playing chicken is to convince your opponent that you are stark raving mad, irrational, and intend to win at all costs, such as by wearing a blindfold. Do you then go to the brink with the madman, or do you negotiate? Disaster results through miscalculation.

E. A BROADER VIEW ON ESCALATION

Escalation then is an ever increasing series of events characterized by ever increasing scope and intensity; and, these events are either part of a natural process of war beyond the explicit control of the players; or a man-made process where escalation occurs at discrete decision points with implicit control. Crucial to the decision makers for control of the escalation process is the mutual recognition by both parties of the escalation events for what they are, no more and no less. Asymmetries existing in culture, forces, and doctrine play a crucial role. If an action is misinterpreted, then the escalation process tends to go out of control and the limits of war have been breached. How do the Soviets view escalation and limited war? Benjamin Lambeth of the Rand Corporation sees 5 constant themes in their strategic doctrine [Ref. 2:p.15].

1. The best deterrent is an effective warfighting capability
2. Victory is possible
3. It pays to strike first
4. Restraint is foolhardy
5. Numbers matter

In contrast Lambeth attributes the following to NATO doctrine [Ref. 2:pp.15-16].

1. The best deterrent to large-scale Soviet aggression is the threat of Massive Retaliation.
2. Concepts of military campaigns and victory are meaningless on general nuclear war.
3. Preparing offensive campaigns (even counteroffensives) is destabilizing-and to be avoided.
4. Restraint during NATO-Warsaw Pact war is essential.
5. Numbers mean less in the nuclear age.

What is immediately apparent in reading these lists is the asymmetry in the emphasis toward victory and maintaining the initiative on the part of the Soviets, and the idea--"Since there are no winners in a nuclear war, let's limit the damage if deterrence fails"--for NATO. When does the conventional battle escalate to nuclear proportions, i.e., when does deterrence fail? Knowing when deterrence fails--that point in the escalation ladder and what to do about the escalation process after it fails is something that many people do not think much about. It seems that most of our energies are placed into planning an effective deterrence but little, if any planning is done to win a war should deterrence fail.

1. A Soviet View

According to Davis and Stan at Rand, the Soviets view war as conducted in phases rather than focusing on escalation levels [Ref. 2:p.21]. These phases begin with a "preparation phase" where all forces and command and control assets are mobilized, and by the forward deployment of conventional forces. Next is the "conventional phase" with the outbreak of war and a NATO invasion of the Warsaw Pact. Also included in this phase is the use of conventional air forces against Soviet strategic nuclear forces, conventional war at sea, and anti-submarine warfare. The third phase is the "transition to nuclear war". Because NATO forces are losing the invasion effort, they begin small scale tactical nuclear use in hope of regaining the initiative and reversing the course of the war. While the theatre tactical battle continues, the Soviets detect a NATO plan to initiate full-scale theater nuclear weapons. The Soviets preempt at this point with counter military, inter/intra continental targeting. The United States then retaliates with intercontinental and theater nuclear forces. A "follow-on" phase is anticipated where protracted war will continue as necessary

[Ref. 2:p.22]. This view is not strictly a limited war view, but is in the sense that after the initial NATO invasion, events incrementally increase in intensity to where intercontinental nuclear weapons are used. How much restraint and how much understanding of escalatory actions, i.e., how much control, during the protracted aftermath will determine whether or not the war remains limited.

2. A View from the West

The Western view predictably differs from the Soviet view in two main areas: (1) The initial conflict begins with a Soviet incursion into western Europe; and (2) Nuclear weapons are used under strict command and control procedures on an extremely limited scale to demonstrate resolve and the will to 'go nuclear'. The Soviets do not speak of demonstration uses of nuclear weapons. Here lies another significant asymmetry in the escalation process. Remember, both parties in the conflict must perceive the escalation equally for the escalation to remain within the intended limits. If we prescribe to the doctrine that nuclear weapons can be used in a limited manner, for a demonstration of resolve, and the Soviets see any limited use as a precursor to all-out attack, then their option is to preempt and the attempt to limit war by controlling the escalation has failed.

Kahn describes escalation as a process set into motion that may seem safe, and extensibly without serious consequences, but in fact may be the beginning of a sequence of disasterous decisions and actions.

> One may readily imagine some intensifying crisis in which neither side really believes the issue is big enough to end in war, but in which both sides are willing to accecpt some small risk of error. Escalation might develop as a result of other parties becomming involved, as a consequence of the issues taking on new significance, or as a result of accident, miscalculation, unauthorized behavior, or other inadvertant cause. Escalation can also be deliberate-as in the game of chicken. [Ref. 8:p.48]

F. ESCALATION DOMINANCE

Escalation dominance is central to and derived from Kahn's theory of escalation and is a function of existing asymmetries of capability at any rung in the escalation ladder. By definition, the side with escalation dominance has the advantage or initiative at any step, where escalation occurs, to control the movement of the conflict between the states of war (rungs on the ladder). Freedman cites Kahn on escalation dominance:

> This is a capacity, other things being equal, to enable the side possessing it to enjoy marked advantages in a given region of the escalation ladder. . . . It depends on the net effect of the competing capabilities on the rung being occupied, the estimate by each side of what would happen if the confrontation moved to these other rungs, and the means each side has to shift the confrontation to these other rungs. [Ref. 1:p.218]

Having a little of the "madman" image helps to maintain escalation dominance. Bertrand Russel said:

> If one side is unwilling to risk global war, while the other side is willing to risk it, the side which is willing to run the risk will be victorious in all negotiations and will ultimately reduce the other side to complete impotence. [Ref. 8]

A nation that possesses a requisite variety of forces with which to meet any threat, that is, the proper balance of forces to absorb the exhaustive variety of threats it may meet, can freely execute escalation dominance over an adversary not in possession of requisite variety.

G. SUMMARY

Escalation is the raising of the stakes in the game of nuclear war. It is the intensification of actions and violence by the single act of a decision maker, or by the continuous force of events sweeping through the conflict.

This intensification tends to have an upward dynamic leading to all-out conflagration and total, unlimited war rather than any downward tendency to de-escalation. Even maintenance of the status quo, or a static tendency of stability is absent. This upward dynamic can have many causes but typically it involves the warring parties being overcome by events. There is the win-at-all-costs mentality on the part of policy makers that escalates war; action-reaction forces such as tit-for-tat events; and cyclical-sequence escalation where one party takes an action that creates a new situation which must be responded to by the other party, which creates a new situation which must be responded to by the first party, etc. The mechanisms which are at work in the escalation process work on man--the decision maker and the decision making process, his politics, and his forces, for it is he who escalates, it is he who is caught up in the cyclical-sequence of escalation.

IV. CONTROL

A. INTRODUCTION

Three components of offensive forces make up the strategic nuclear arm of our military instrument of national power. The three pronged "triad" consists of land based intercontinental ballistic missiles (ICBM); seabased submarine launched ballistic missiles (SLBM); and long range bomber aircraft--including air launched cruise missiles. Essential to the triad is a nervous system linking it together into an integrated system with central control at a main control center--the brain of the operation. The nervous system is a network of communications, people, procedures and hardware otherwise known under the umbrella phrase "Command, Control and Communications (C3)". This C3 system consists of early warning ground based radars, orbiting geosynchronous communications satellites, infra-red detecting satellites, airborne command centers, hardened underground command centers, soft command centers, communications links, computer systems, procedures, plans, decision aids for the commanders--ultimately the National Command Authority (NCA) consisting of the President of the United States and the Secretary of Defense, and the people who make the system work.

It is the mission of strategic command, control and communications to provide attack information, strategic and tactical, to the NCA along with intelligence information expanding its assessment; to notify all other nuclear commanders of attack warning/attack assessment (AW/AA) and coordinate and direct any response back to the nuclear forces from the NCA. See Figure 4.1 [Ref. 11:p.2] for a general representation of the U.S. strategic command and control relationships and operational connectivity.

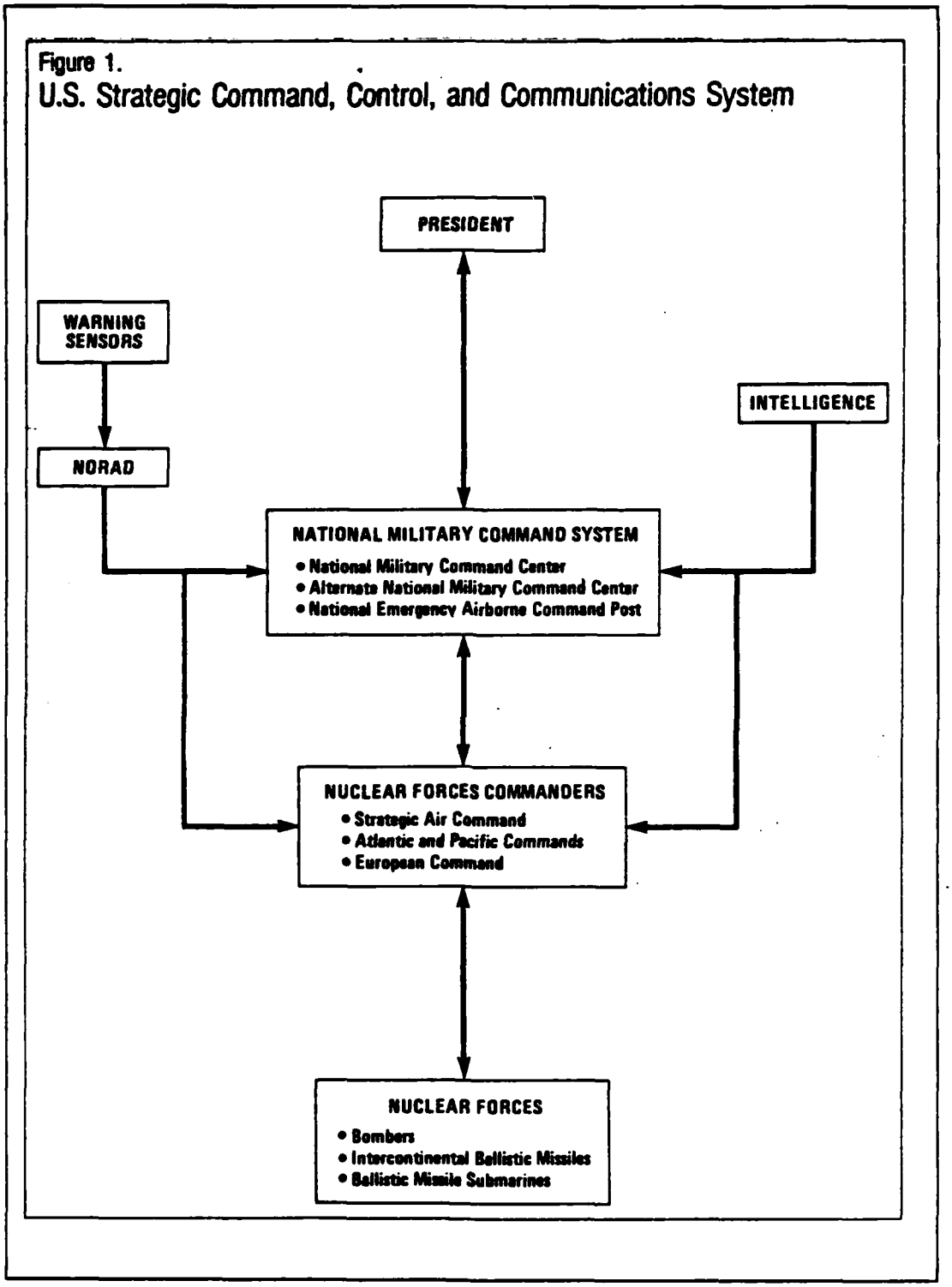

Figure 4.1 Strategic Command, Control and Communications.

Concentration on the early strategies of massive retaliation and assured destruction has given way to much focus on limited and flexible nuclear response options. These flexible options which tailor the response of the decision maker to the particular aggression put a great deal of emphasis and importance on the command, control and communications system. The C3 system must respond to the attack warning accurately, i.e., it must consistently give a positive warning when there is in fact an attack in progress and just as consistently not give spurious attack warnings; and it must disseminate the attack information to all relevant parties in a timely manner. The system muct be reliable, survivable, flexible and able to rebound to a functionally working state after degradation from severe stress. In short, the C3 system must be robust. In its robustness it must be able to accept a certain amount of variance in its own execution, and variance in the environment and still perform its function. Properties inherent in nuclear attack and nuclear war cannot be entirely forseen. There is much uncertainty and variance in the effects of nuclear confrontation--apart from the obvious ones such as blast, shock and prompt radiation. The C3 system must be expected to perform robustly if limited war is to be kept limited and if the United States intends not to lose a nuclear war.

Much strategic thought stops at the point where deterrence fails. If deterrence does fail and war escalates to nuclear proportions without going to general war, then the trans-attack period, once thought to last only minutes or a few hours may actually last days, weeks or months in protracted conflict. It is therefore of critical importance that the nervous system of our strategic offensive forces survives to control those forces through limitation and final acceptable cessation of conflict.

B. THE COMMAND AND CONTROL PROCESS

1. Control-Cybernetics

Control is the quintessential element in conflict between opponents whether the opponents be in a conflict system of sports, politics, economics, or, modern warfare. What is meant to control forces and how is it done?

Following World War II a theory of control mechanisms and related phenomena was developed by Norbert Wiener, and expanded by W.R. Ashby, Stafford Beer, and others, called 'cybernetics'. Simply put, cybernetics is the theory of control processes of systems, where the systems can be electrical, mechanical, biological, social, political, or any combination thereof. Of course this list is not exhaustive. Any activity that can be described as a system that interacts with its environment can be modeled by cybernetic relationships. Of cybernetics Stafford Beer says,

> Cybernetics is the science of control and communications--wherever these occur in whatever kind of system. The core of cybernetic research is the discovery that there is a unity of natural law in the way control must operate, whether the system is animate, inaminate, physical, biological,social or economic. [Ref. 12:p.239]

Central to control theory and the cybernetic approach is the flow of information through a system. Cybernetics as applied to C3 theory is different from the electro-mechanical engineering concepts of control where energy input into the control system produces a proportionate output response. In C3 systems the stimulus input into the system and the commodity flowing through the system is information. In terms of command and control, the information content of any stimulus can have an enormous impact on the system as a whole--often many times greater than the intended response. This is a potential cause of losing

control of limited war. Therefore, it is of critical importance that there is control of information flow through the system as well as control of the system itself. Controling the information flow aids in controlling the system.

2. The Cybernetic Paradigm

The basic cybernetic paradigm includes an object of control and a controlling device, or, master control center. Through channels of communication, the control center affects the object of control in a way pre-determined by the master control, much the way the brain--the control center--manipulates the dexterity of the fingers--the controlled object--in goal oriented behavior. A characteristic and usually essential element, though not always,[7] of the cybernetic model is the inclusion of a feedback loop between the master control and the controlled object. Feedback is accomplished through some sensor system and an information return loop. Behavioral information of a parameter of interest is sensed and subsequently sent back through the system to the control mechanism where that parameter's value is compared the intended norm. If any deviation from the norm is evident, the master control center generates and signals an instruction to bring the outlying parameter back to within controlled, normal limits. In other words, the feedback loop conveys behavioral information of the controlled object to the master control where the information is examined to determine whether the object of control is behaving within the limits of the intended behavior.

Cybernetics is important to command and control (C2) theory since most C2 models are cybernetic variants. A simple and effective command and control process model that is cybernetic in nature and that will be used in this paper is the work of Dr. Joel S. Lawson, Sr.

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[7]Cybernetic models of reflexive control have been demonstrated without the inclusion of feedback loops [Ref. 13:p.4].

C. LAWSON'S COMMAND AND CONTROL MODEL

The Lawson process model consists of five basic functions that constitute a C2 subsystem within an overall conflict system. The functions are: (1) Sense, (2) Process, (3) Compare, (4) Decide, (5) Act. These five functions interact with the environment (or the other major subsystem--the opponent) through a stimulus received by the sense function; and through a response on the environment by the act function. See Figure 4.2 for a depiction of this model. [Ref. 14]

The sense function is the receiving mechanism of the stimulus into the C2 subsystem and conducts all data gathering activity. Using sensor data and 'external' data from inside the system, the process function acts on the information gathered and begins the analysis, an activity which it shares with the compare function. The compare function not only takes the output of the process function and compares whether the present state of the enviromnment is the state desired by the decision maker or master control, it also compares the present state to all states, past and future. Together, the process and compare functions perform the analysis for the subsystem in general and the decision maker in particular. Based on the output of the compare function, the decide function then determines, through internal decision aids, what must be done to change the environment (the present state of the system) to the desired state. The appropriate decision is then executed by the act function directly on the environment. This command and control model can be embedded into another of the same form resulting in complex C2 processes. For example, each decision maker may have many subordinates who have subordinates and each may have a C2 system with the five functions working as a system nested within a system and this can occur numerous times. Of course, as the system expands and becomes more complex,

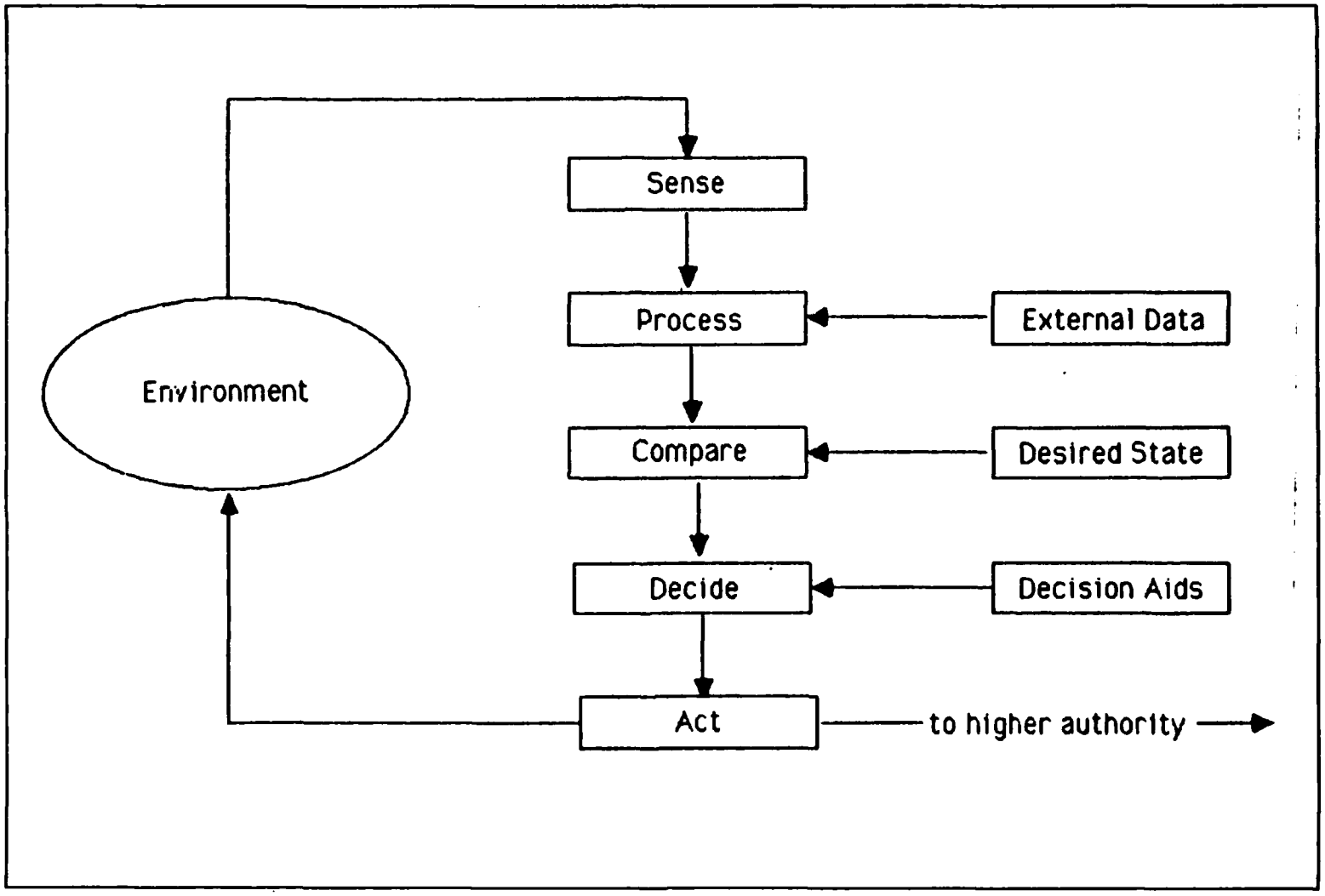

Figure 4.2 The Lawson Command and Control Process Model.

span of control is then extended and effective control becomes tenuous. This is a significant area to be studied but will not be developed further here.

Lawsons's model is exceptionally simple and therein lies its beauty. What is actually an extremely complicated system of radars, satellite early warning sensors, scores of data and intelligence analysts, thousands of communications devices and computers, complicated algorithms for decision making, command centers, and all the interlocking procedures that tie them together into strategic command and control can be simply represented by a few boxes connected by arrows. Not included explicitly in Lawson's model is a planning function which may be equally important as the other 5 functions. Little meaning can be made of control without knowing what is to be controlled and how it is to be controlled through planning.

D. SUMMARY

Tying together the U.S. nuclear forces is a complex nervous system known generically as command, control and communications (C3). It consists of sensor systems, communications devices, command centers, procedures and people. The mission of strategic C3 is to sense an attack against the United States accurately, not giving false alarms, and to disseminate the attack characterization information to appropriate command centers, principally the National Command Authority (NCA), and the nuclear CINCS; to process the attack information through analysis; and finally to transmit and disseminate any decision action the NCA may have made.

The command, control and communications systems must be robust. That is, they must be able to perform satisfactorily under conditions of nuclear war if effective control of nuclear forces is expected. The nuclear environment of the trans-attack and post-attack phases will be extremely

stressful to C3 systems and if limiting nuclear war is sought, requisite control must survive.

The cybernetic paradigm consists of a system acting on a controlled object and is centered around a master control center where decisions are made. It can consist of other subsystems, as appropriate, to act on the environment. There must be communication between the master control center and the other subfunctions. Important to many cybernetic models is the inclusion of a feedback loop to convey behavioral information of the controlled object back to the control center to regulate responses in order to keep the controlled object within intended limits. One important cybernetic varient of command and control relationships is the Lawson Process Model. Included are the 5 major functions: (1) Sense, (2) Process, (3) Compare, (4) Decide, and (5) Act. It can be argued that any C3 system will contain these 5 functions. The strategic command and control system of the United States is one of those C3 systems.

V. THE WORLDWIDE MILITARY COMMAND AND CONTROL SYSTEM

A. SENSE, PROCESS, COMPARE, DECIDE AND ACT--WWMCCS

The sense function of Lawson's command and control process model is equated to the warning function for strategic command and control, since the sense function's purpose is to use all systems, people, and procedures to gather data from the environment. Sensor systems here would be all the early warning detection devices and methods employed to alert the National Command Authority (NCA) of a tactical warning (attack in progress), or strategic warning (attack probable and imminent), through the proper agencies, people, and procedures. These warning systems include radars based around the world and infra-red sensors in space on constant surveillance that warn of the air-breathing and intercontiental ballistic missile threat. Also included in the sensor or warning function are the people and procedures needed to collect the data and intelligence, and the communications hardware and procedures to pass the stimulus on to the subsequent functions of the overall process. What is required on a worldwide basis is constant, comprehensive monitoring of the environment.

To determine the validity of an attack warning, the Commander in Chief, NORAD initiates a series of emergency action procedures (EAP) with the National Military Command Center (NMCC) in Washington , the Strategic Air Command at Offutt AFB, Neb., and other nuclear commanders in charge (CINCS). These procedures are highly classified and will not be discussed here, but let us say thay are an institutionalized system of checks and balances to prevent the unauthorized, inadvertant use of nuclear weapons (negative control) and to ensure the launch of nuclear forces when so ordered by the National Command Authority (positive

control). Once validity of the attack has been established, the NCA is notified and the decision to release or not to release must be made.

If the decision to respond is made by the President, then a series of encrypted, preformatted 'go-code' emergency action messages (EAM) will be transmitted via many communications media. Positive control--the ability to launch a strike when ordered--is the main concern when the decision to go nuclear is made. The transmitted EAM must get to the various nuclear forces: the bombers on alert and in the air, air refueling tankers, the missile launch facilities, and the fleet ballistic missile force to scramble, or to launch their weapons at targets decided upon by the NCA, or target planners and contained in the EAM. An essential ingredient of positive control is an assurrance or a belief with some certainty that positive control is in fact present and the forces will be launched. Once the EAM's have been received, the 'two-man' rule is in effect, whereby a requirement for at least two people to concur on the validity of the EAM and work in concert in launching from separate work stations within the launch control center. The problem of the reception of a valid EAM and the confirmation thereof is a significant command and control problem. To perform the sense, process compare, decide, and act functions the United States employs a vast array of strategic command, control and communications systems. But these C3 systems cannot function autonomously. They must be coordinated and controlled through a central system-- something analogous to the nervous system of the human body, that nervous system is WWMCCS!

B. ELEMENTS OF WWMCCS

1. Background

The command and control process functions: Sense, Process, Compare, Decide, and Act can be lumped into the

responsibility of the commander, his staff and the command center. But since, the commander, his functions, his subordinates and his command architecture is often distributed and decentralized in execution, a nervous system controlling the entire network is required.

As a result of a breakdown in communications between command centers and operational forces, which seriously contributed to a loss of control and the subsequent loss of those forces in several international, crisis level incidents in the 1960's, a need developed to design, field and integrate a system that would would allow NCA control of all national military resources. Beginning with the Cuban missile crisis, the Kennedy administration realized that the national decision making and execution capabilities were suffering from a lack of command, control and communications ability over its military forces, diplomatic centers and other government agencies worldwide.

In 1962 Department of Defense directive 5100.30 provided the first definition of the World Wide Military Command And Control System--WWMCCS. But the development of WWMCCS received little top-level direction [Ref. 15:p.60]. The sinking of the USS Liberty in 1967, the North Korean seizure of the USS Pueblo in 1968, and the shooting down, again by the North Koreans, in 1969 of an EC-121 electronic intelligence aircraft dramatically pointed out that deficiencies in WWMCCS existed.

These incidents, along with weak points found in the the Minimum Essential Communication Network[8] spawned a re-evaluation of WWMCCS. Under then Deputy Secretary of State David Packard[9] and the Office of Assistant to the

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[8]MEECN--the Minimum Essential Emergency Communication Network are the necessary elements of WWMCCS to control nuclear war and thought most likely to survive a nuclear attack without strategic warning.

[9]David Packard was Deputy Secretary of Defense from 1969-1972 and was a strong proponent of reviewing strategic

Secretary of Defense for Telecommunications a WWMCCS council was formed. It was the view of this effort that much more focus must be placed on the strategic threat and the requisite control to maintain deterrence and control of forces if deterrence fails. According to Blair, "Packard attempted to rectify a decade of misplaced emphasis within the combat commands and military departments by designating the National Military Command System as the priority component of WWMCCS." Blair quotes Packard as saying, . . ." instead of the local commanders now having as their first priority to design their command system to meet the requirements of their mission, they first have to have a design to meet the requirements of the national command system." [Ref. 3: p.57]

Department of defense directive 5100.30, WWMCCS, 1971, revised the initial WWMCCS concept and provided a definition of the National Command Authorities as consisting of the President and the Secretary of Defense and their duly appointed alternates or successors; defined the National Military Command System as the primary component of the WWMCCS, and its primary mission to support WWMCCS; designated the chairmnan, JCS as having overall responsibility for WWMCCS; established the Assistant Secretary of Defense as responsible for the WWMCCS within the Office of the Secretary of Defense; established a WWMCCS council; and identified the command and control systems that constitute the WWMCCS [Ref. 15:p.61].

The World Wide Military Command and Control System (WWMCCS) includes all the hardware, software, personnel, policies, procedures, communications systems, and command centers, for the control of the U.S. military forces. The

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C3I capabilities. He believed command and control deficiencies to be a serious problem with the greatest requirement being for modernization of airborne command and control [Ref. 3:p.124].

WWMCCS allows for the sensing of warning information, transmission and integration of data and intelligence information, transmission of administrative information enabling the NCA to employ, and deploy forces of the military departments and provide direction to the unified and specified commanders. Generally, WWMCCS stops at the tactical command level. In short, WWMCCS is the vehicle for the operational direction, and the management and administrative support of U.S. military forces worldwide. It is through WWMCCS that the President, the Secretary of Defense, and the CINC's keep their finger on the pulse of the national security environment. It is the nervous system for the sense, process, compare, decide and act functions. WWMCCS has 6 functional capabilities: (1) situational assessment, (2) tactical warning, (3) briefing of the NCA and option selection, (4) executing the selected option, (5) strike and damage assessment, (6) termination of a previously transmitted order. [Ref. 16:p.38].

2. The National Military Command System

The National Military Command System (NMCS) is the primary component of WWMCCS and is the command node directly below the NCA. The NMCS provides information on the status of forces and the world situation to the NCA and is the beginning of the conduit of command and control from the President to the forces in the field.

a. National Military Command Center

The NMCS is headquartered at the National Military Command Center (NMCC) located at the Pentagon. The NMCC provides direct support to the president and operates and maintains a direct communications link (DCL): the Washington-to-Moscow teletype link (MOLINK), also known as the 'Hotline'. The NMCC also supports the Secretary of Defense and Joint Chiefs of Staff. The National Military Command Center is a 24 hour operations center, manned by

five watch teams who monitor crises, analyze world situations of national interest, advise the JCS, and provide briefings to high-level decision makers [Ref. 17:p.67].

b. Alternate National Military Command Center

Since the Pentagon, and the NMCC would not survive a nuclear strike launched against the nation's capital, an alternate command center exists about 80 miles from Washington near Ft. Richie, Maryland. The Alternate National Military Command Center (ANMCC), built deep inside the Catoctin mountains is considered to be a moderately hard [Ref. 3:p.104] command facility with direct communications to the NMCC at the Pentagon, and other military and defense agency command centers. The ANMCC operates around-the-clock and is intended to "mirror-image" the NMCC. In the event the NMCC is no longer functioning, the ANMCC will assume full operational control of the NMCS. Computer data bases are constantly updated remotely by the NMCC, NORAD, SAC, and other command centers. The ANMCC also has facilities for the relocation of many VIP's and can operate in the "button-up" mode for many days. The ANMCC, commonly referred to as the 'Alternate', or as 'Site R', beneath millions of tons of rock notwithstanding, will not survive a direct nuclear attack. Soviet weapons were much less accurate when the ANMCC was built in the 1950's. It was designed to be hardened against a Soviet bomber attack but those days are long gone. To overcome the dual vulnerability of the NMCC and the ANMCC, airborne command posts make up the third component of the National Military Command System.

c. National Emergency Airborne Command Post

The National Emergency Airborne Command Post (NEACP), is probably the most survivable of all the National Military Command System command posts and has the communications on-board to receive the threat warning from NORAD and

to transmit the retaliatory commands to the nuclear forces--but survival is not assurred in the nuclear age. Originally NEACP forward operated out of Andrews Air Force Base, Maryland, to provide the President and other VIP's access to escape in the event of attack. With the shortened warning time from the SLBM threat, NEACP moved forward operations away from the coast to Grissom AFB, Indiana with primary operations at Offutt Air Force Base, Nebraska. This inland move has provided NEACP precious extra minutes in escaping certain destruction on the runway at Andrews where only 6-8 minutes warning time from the SLBM threat is commonly expected.

NEACP presently consists of 4 E-4B aircraft (modified Boing 747 airframes) and is the responsibility of the Director of Operations, Office of the Joint Chiefs of Staff [Ref. 17:p.67]. The NEACP aircraft are capable of assuming command and control of the NMCS if the NMCC and the ANMCC are rendered inoperable. It is also intended to be the airborne command post for the President or his successor in the event of nuclear attack. The NEACP can issue the order for release authority if the President or his successor is onboard.[10] The E-4B is capable of a variety of line of sight communications as well as low frequency (LF) and very low frequency (VLF) communications via trailing-wire antenna. In addition, each NEACP carries a satellite communications terminal, is EMP hardened,[11] and accomodates a battle staff of approximately 45 persons.

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[10]By law, only the President or his successor can direct the release of nuclear weapons. The survival and location of the President or his successor is therefore of extreme strategic importance.

[11]Electromagnetic Pulse (EMP) is a sudden voltage spike propagated through the atmosphere following nuclear explosions and may cause damage to electronic equipment.

The unified and specified commanders CINCPAC, CINCLANT, CINCEUR and CINCSAC also have airborne command posts. These aircraft, along with NEACP, and other relay aircraft make up the World Wide Airborne Command Post (WWABNCP).

3. WWMCCS Communications Systems

a. Defense Communications Agency

In May of 1960 the Defense Communications Agency (DCA) was established as the overall manager of the Defense Communications System (DCS). DCA was established primarily to help solve the communications coordination problems between the Army, Navy, and Air Force. It had long been recognized that a unification of service communications toward interoperability and compatibility was needed but the services were unable to agree to a workable plan. The Defense Communications System was to be the primary network providing long-haul, point-to-point communications from the NCA on down to the unified and specified commanders, linking together all military bases, functions, and command centers. Excluded from the DCS were tactical communications; intra-base communications, to include launch and firing complexes; ship, land and airborne terminal broadcast facilities--including ship-to-ship, ship-to-shore and ground-air-ground systems. Along with communications channels, DCA provides engineering and management support to NMCS command centers, national emergency command posts, telecommunications facilities, as well as automatic data processing (ADP) support [Ref. 3:p.53]. The primary communication systems of the DCS that support WWMCCS are AUTOVON, AUTODIN, AUTOSEVOCOM, and DSCS.

(1) AUTOVON. The Automatic Voice Network (AUTOVON) is the non-secure circuit switching network of the Department of Defense. It is a highly redundant system with many switching center nodes in the continental United States

(CONUS) and in the European and Pacific theaters. This system of switches forms a polygrid network that can claim a certain amount of survivability through redundancy. These switches are commercially leased in CONUS and are government-owned overseas. AUTOVON also provides the backbone to the narrow-band Automatic Secure Voice Communications Network (AUTOSEVOCOM). AUTOSEVOCOM is the long distance, encrypted voice communications system. All AUTOVON traffic is official and is characterized as being command and control, operations, intelligence, logistic, diplomatic, or administrative [Ref. 18:p.41].

(2) AUTODIN. The Automatic Digital Network (AUTODIN) is DoD's worldwide data and teletype network. It is a secure record communications system that is also redundant through many Automatic Switching Center (ASC) nodes throughout the world. In 1982 DoD directed the phase-out of AUTODIN to be replaced by the Defense Data Network (DDN)-- an Advanced Research Projects Agency Network (ARPANET) based, packet switched, common user, data communications system.

(3) Defense Satellite Communications System. The Defense Satellite Communications System (DSCS) is the government and commercially owned satellite communication system that supports the Department of Defense and other government agencies. DSCS III satellites now operational provide multichannel, jam resistant, EMP resistant secure voice and high data rate communications for fixed as well as mobile subscribers.

4. National Communications System

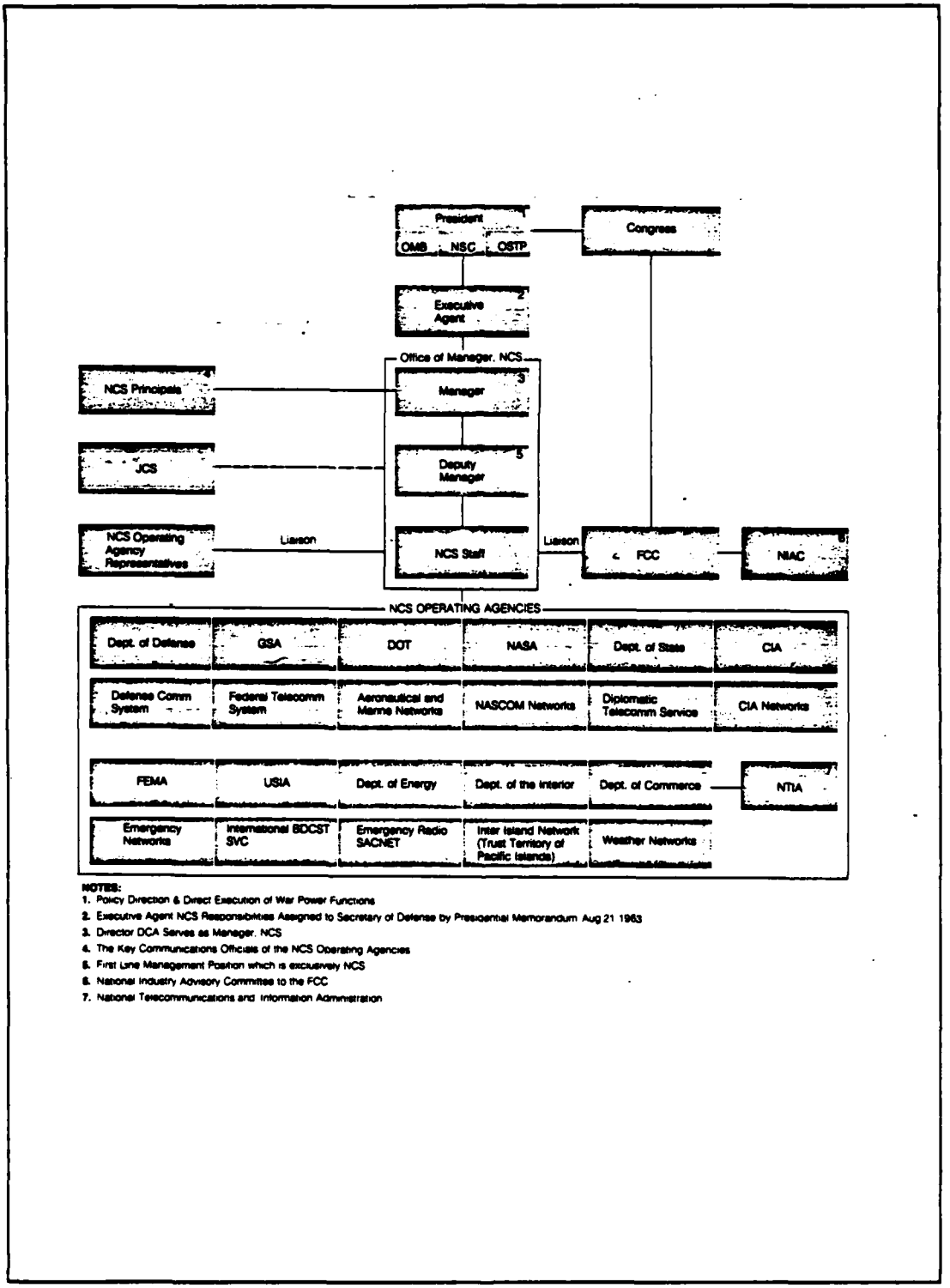
The National Communications System (NCS) is a confederation of federal departments and agencies who participate in providing their telecommunications assets to the federal government for essential communications under all conditions ranging from national disaster to nuclear

war. Principally the assets of the NCS are composed of organic systems of the Department of State, Defense, Interior, Commerce, Energy, Transportation, the Federal Emergency Management Agency, the U.S. Information Agency, National Aeronautic and Space Administration, the General Services Administration, and the Central Intelligence Agency [Ref. 19:p1]. These assets come under NCS direction in times of national crisis for emergency preparedness (EP). The NCS owns no national level communications assets of its own. The manager of the NCS is the director of the Defense Communications Agency. See Figure 5.1 [Ref. 19].

The Defense Communications Agency and the National Communications System are not specifically part of WWMCCS. The NCS is the agency unifying the communications of the federal government in times of emergency and DCA provides planning, engineering and management support to WWMCCS. Together, the Defense Communications System and WWMCCS provide the DoD contribution to the National Communications System's emergency preparedness effort to provide reliable communications at a national level to the National Command Authority under all conditions from natural disasters to nuclear war. [Refs. 15,19]

C. WWMCCS SUMMARY

The World Wide Military Command and Control System is the primary vehicle for the operational direction, managerial control, and administrative support of the U.S. military forces; therefore, WWMCCS is the primary system for controlling U.S. strategic forces at the NCA level and is the system that will be expected to support the President in controlling escalation and limiting nuclear war. It is the nervous system linking our forces together, providing the backbone and stimulus connections for the "Sense, Process, Compare, Decide and Act" command and control functions. These five elements function together in WWMCCS to promote



NOTES:
1. Policy Direction & Direct Execution of War Power Functions
2. Executive Agent NCS Responsibilities Assigned to Secretary of Defense by Presidential Memorandum Aug 21 1963
3. Director DCA Serves as Manager, NCS
4. The Key Communications Officials of the NCS Operating Agencies
5. First Line Management Position which is exclusively NCS
6. National Industry Advisory Committee to the FCC
7. National Telecommunications and Information Administration

Figure 5.1 The National Communications System.

and assure coordination capability for U.S. forces to appropriately respond to any attack; to maintain deterrence of conflict between the U.S. and any adversary, and to provide communications to adequately manage any crisis situation that may develop throughout the world.

VI. STRATEGIC COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS

A. WARNING

In strategic C3, the 'sense' function is called Attack Warning and Attack Assessment (AW/AA). The (AW/AA) systems detect inbound enemy missiles or aircraft and are the responsibility of the North American Aerospace Defense Command (NORAD). Ground-based and space-based sensors transmit launch data to the NORAD Cheyenne Mountain Complex (NCMC), Colorado. The NCMC is the third U.S. hardened underground command center.[12] It consists of 15 steel buildings mounted on anti-shock springs, built inside a mountain near Colorado Springs, Co. When a missile is detected, Cheyenne Mountain contacts other sensor sites worldwide to determine the validity of the detection. Confirmation of the attack must come from at least two independent warning sensor systems. This confirmational requirement by two sources is known as 'dual phenomenology' and usually invloves a positive tracking by ground-based radar and the identification of the missile's hot exhaust plumes by spaced based infra-red sensitive satellites. After analysis and verification, NORAD passes the tracking status on to the NMCC and other nuclear CINC's. The NMCC begins a missile display conference with NORAD and SAC command posts. NORAD then confirms or denies the attack as real and imminent [Ref. 17].

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[12]The Cheyenne Mt. complex was preceeded by the ANMCC and the Federal Emergency Magement Agency (FEMA) special facility.

1. The Air-Breathing Threat

a. The Distant Early Warning Line

The first sensors used to detect the air-breathing bomber aircraft threat, known as the Distant Early Warning line (DEW), initially consisted of a network of radars strung about 3,000 miles across northern Canada from Greenland to Alaska along the arctic circle. The DEW line though, has become old and outdated since it first became operational in 1957. It suffers from a serious lack of effective coverage of low flying penetrators. The DEW line is planned for augmentation and eventual replacement in the 1990's by the over-the-horizon backscatter (OTH-B) radar system known as North Warning. North Warning will consist of 52 General Electric FPS-117 radars which will be minimally manned or totally unattended [Ref. 17,15].

b. The Joint Surveillance System

The SAGE[13] network has been replaced by the Joint Surveillance System (JSS) which is shared with the Federal Aviation Administration (FAA) and consists of 47 radar sites including seven Region Operation Control Centers (ROCC). The JSS provides air traffic data to both the FAA and the ROCC's and covers a range out to about 200 miles around the continental United States. These sites are connected with the Alaskan Seek Igloo and Canadian radar sites. Airborne Warning and Control System (AWACS) aircraft also augment the system by supplying low-level "gap" coverage.

To respond to the air-breathing threat, NORAD has 31 alert sites: 15 fighter squadrons with two fighters at each on constant alert. This force can be augmented if necessary by other Air Force, Navy, Marine, Air Force

[13] Semi-Automatic Ground Environment (SAGE) was the first warning and control system of the nuclear age. At its development, SAGE was the largest data base processing system in existence and was used to coordinate fighters and missiles with attack-warning information [Ref. 21:p.11].

Reserve, Air National Guard, and Canadian fighter aircraft. [Refs. 17,20]

2. Missile Warning Threat

For the non air-breathing threat, NORAD employs six ground-based radar systems and a space-based infra-red sensing satellite system: (1) Ballistic Missile Early Warning System (BMEWS), (2) Pave Paws, (3) the AN/FPS-85 radar, (4) the AN/FSS-7 radar, (5) Perimeter Acquisition Radar Attack Characterization System (PARCS), (6) Cobra Dane and (7) the Defense Support Program. The ground based sensor systems will detect a missile launch very shortly after they are first detected by space based assets. These sensor systems provide confirmation of launch attack parameters and impact location predictions.

a. BMEWS

The Ballistic Missile Early Warning System located at three sites: Thule Air Base, Greenland; Clear Air Force Station, Alaska; and Fylingsdales, United Kingdom, transmits ballistic missile tactical attack data via high-speed circuits dependent on commercial carriers [Ref. 21:p.217] to NORAD where the information is forwarded on to other comand centers [Ref. 17:p.66].

b. PAVE PAWS

Two phased-array PAVE PAWS radars, one located at Otis AFB, Mass. and the other at Beale AFB, Ca. provide wide coverage with their electronically steerable antennas and can track hundreds of targets simutaneously out to a range of 3000 miles. PAVE PAWS data consists of object identification, launch time, impact time, and impact location primarily for submarine launched ballistic misiles (SLBM). [Ref. 17:p.66]

c. AN/FPS-85 AN/FSS-7

Also targeted against the SLBM threat is the AN/FPS-85 SPACETRACK radar located at Eglin AFB, Fl. The

AN/FPS-85 will be our only south-looking phased-array radar until two new PAVE PAWS come on line at Robins AFB, Ga. and Goodfellow AFB, TX. The AN/FSS-7 mechanical radar located at McDill AFB, Fl. also looks south and is an SLBM threat radar. [Ref. 17:p.66]

d. PARCS

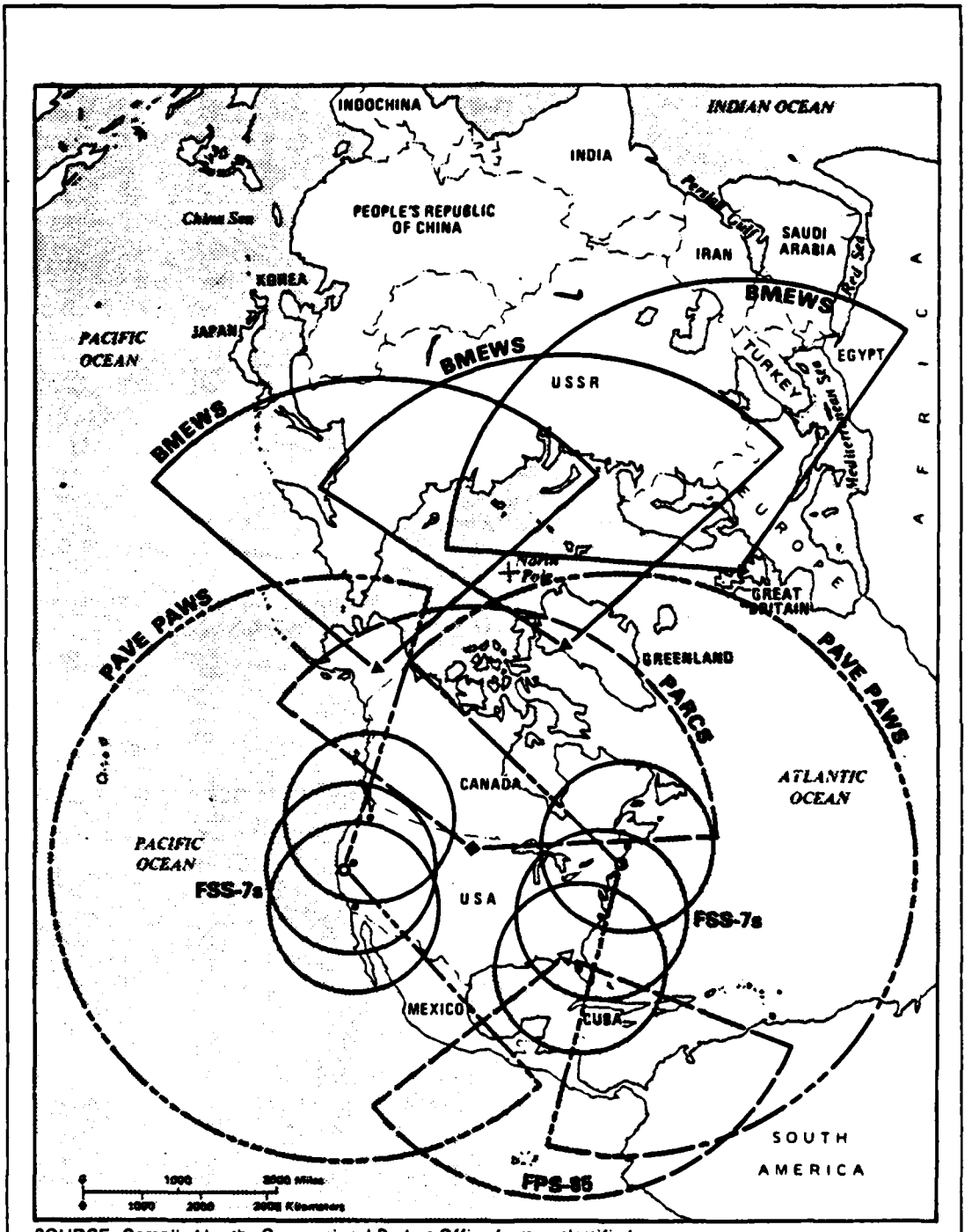
Perimeter Acquisition Radar Attack Characterization System (PARCS), originally part of the Army's Safeguard anti-ballistic missile system, provides SLBM warning for Soviet arctic launches behind BMEWS coverage as well as ICBM warning from conventional Soviet launch points [Ref. 17].

e. Cobra Dane

Located at Shemya, Alaska at the tip of the Aleutian Chain is Cobra Dane, a phased array radar. Cobra Dane routinely monitors Soviet ballistic missile tests. It too has attack characterization capability and communicates directly with NORAD. [Ref. 17] See Figure 6.1 [Ref. 11:p.9]. for land based ballistic missile warning sites and detection sweeps

f. The Defense Support Program

The Department of Defense employs a system of infra-red sensing satellites for early warning of ICBM and SLBM attack --the Defense Support Program (DSP). Three satellites are reported to exist covering the Sino/Soviet mainland looking for ICBM launches, and over the Atlantic and Pacific Oceans looking for SLBM launches. The DSP satellites pick up the infra-red signatures of the hot exhaust plumes of ballistic missiles while they are in boost phase, within about 30 seconds of liftoff. Data from the satellite system is down-linked through sites in Australia and Colorado and on to NORAD. Because of the time-urgent nature of the data, SAC command center and the NMCC receive the warning data simultaneously. [Refs. 3,21: p.36, pp.141-44]



SOURCE: Compiled by the Congressional Budget Office from unclassified sources.

Figure 6.1 Missile Warning Sites and Detection Sweeps.

B. RESPONSE--SYSTEMS FOR THE ACT FUNCTION

Once the attack characterization information has been processed and analyzed, and a decision to act has been made, the response or 'act' function follows. The systems for disseminating the decision order, i.e., the Emergency Action Message (EAM) for strategic forces are:

1. PACCS

The Post Attack Command and Control system (PACCS) is the airborne command and control system of the Strategic Air Command and is focused primarily around the airborne alternate of SAC's command center; called 'Looking Glass', since it's supposed to mirror-image Strategic Air Command's semi-hardened command post at Offutt AFB, Nebraska. The airborne SAC command post flys in EC-135 aircraft, and has been in the air constantly since 1961. The Looking Glass command post also has launch capability in the case of destruction to ground launch control facilities.

2. PAS

The system of dedicated landlines for voice communications between command centers and launch control centers is known as the Primary Alerting System (PAS). The PAS links SAC headquarters together with approximately 200 sites around the world.

3. IEMATS

The Improved Emergency Message Automatic Transmission System (IEMATS) uses AUTODIN connectivity and automatic switching centers to transmit the EAM go-codes.

4. JCSAN

The Joint Chiefs of Staff Alerting Network allows non-secure voice conferencing between the NMCC, the Joint Chiefs and the CINCS.

5. Giant Talk

Giant Talk is a Strategic Air Command long distance, surface-to-air high frequency (HF) communications system

that provides connectivity between CINCSAC and the airborne nuclear forces.

6. Green Pine

Green Pine is a ultra high frequency (UHF), line of sight (approximately 200 miles) communication system used in the arctic regions where high frequency (HF) communications can suffer serious signal degredation. The system of ground based sites extends from Alaska to Iceland. Again, like Giant Talk, Green Pine provides CINCSAC positive control over its airborne nuclear forces. [Ref. 3:p.104]

7. ERCS

The Emergency Rocket Communications System (ERCS) is a "last chance" method to disseminate the emergency action message to the nuclear forces. Housed inside a Minuteman missile is a UHF radio with a taped execution message. If the EAM cannot be transmitted via other means, the ERCS missile will be launched on a trajectory over CONUS and any launch control center within line-of-sight range will receive the go code message. ERCS will be used only if other communications systems are not available.

8. SLFCS

The Survivable Low Frequency Communications System (SLFCS) is a LF/VLF teletype system connected to launch centers, base wing command posts, Green Pine facilities, SAC airborne command posts (Looking Glass) and NEACP. Since LF/VLF depends on ground wave propagation of its signal, it is not succeptable to serious degradation from nuclear effects on the atmosphere, SLFCS is expected to have trans-attack and post-attack communications capability [Ref. 3:p.164].

9. SACCS

The SAC Automatic Command and Control System (SACCS) is the high-speed data transmission system linking together all SAC command posts. It is an automated system for trans-

mitting alert and execution messages, and is being upgraded as the SAC Digital Network (SACDIN).

10. AFSATCOM

The Air Force Satellite Communications system (AFSATCOM) became operational in 1979 and was designed specifically for strategic C3. AFSATCOM operates in the UHF band and consists of transponders on Navy FLEETSATCOM satellites, Satellite Data System satellites and other classified systems. Terminals are located at major military installations, on E-4B, EC-135, EC-130, and B-52 aircraft, and at Minuteman Launch Control Centers.

11. SBS

The Submarine Broadcast System (SBS) is a LF/VLF network of transmitters at ground stations and on airborne platforms throughout the world. Since high frequency radio signals are severly attenuated by sea water, low frequency communications systems are used to communicate to the nuclear submarine forces. The system of relay aircraft for transmitting EAMs to nuclear missile submarines (SSBN) at sea are modified C-130's called TACAMO (Take Charge and Move Out).

The Navy's extremely low frequency communications system, known as ELF, hampered since the early 1970's by environmentalists and political opponents is finally reaching the latter stages of full-scale development, with initial operationl capability planned for the summer of 1986. The ELF system will allow continuous communications with submerged submarines without the necessity of requiring the submarines to surface. The extremely low frequency signals (40-80 Hz) resonate within the earth-ionospheric cavity, thus the signal will have very long range propagation. The data rate will be very low, but continuous strategic communications without endangering the SSBN's will be possible for the first time. [Ref. 22]

C. NEW SYSTEMS

1. Milstar

Milstar will be the next generation of military satellite communications scheduled to be deployed in the early 1990's. Milstar will operate in the EHF spectrum and will be less susceptible to nuclear effects from high altitude bursts. It will serve the tactical and strategic communities in worldwide, jam resistant survivable communications. Especially important will be Milstar's capability to provide direct, secure voice channels connecting NEACP and the CINCLANT, CINCPAC, CINCSAC, and CINCEUR airborne command posts--WABBNCP--for EHF conferencing during trans-attack and post-attack periods [Ref. 3].

2. GWEN

The Ground Wave Emergency Network (GWEN) is a system of low frequency radio sites that will connect sensor sites such as PAVE PAWS to NORAD, SAC HQ, and ICBM Launch Control Centers (LCC). GWEN is to be EMP hardend but is susceptible to blast and shock effects. Therefore, GWEN will be useful as a tool to get the message out before the first nuclear weapons fall, i.,e., its importance is in providing attack information to command posts and aircraft before the GWEN sites themselves are destroyed. The utility of the system lies in the few minutes of communications it will provide between the onset of the EMP effects of high altitude bursts from SLBM's and jamming, and the time of impact of ICBM's See figure 6.2 [Ref. 3:p.254].

3. IONDS

The Integrated Operational Nuclear Detection System (IONDS) will be the space-based sensor package for the detection and precise location of nuclear explosions in the atmosphere and in space. Expected to be on 18 NAVSTAR navigation satellites by 1988, IONDS will provide real-time attack damage assessment, accurate up to within 100 meters

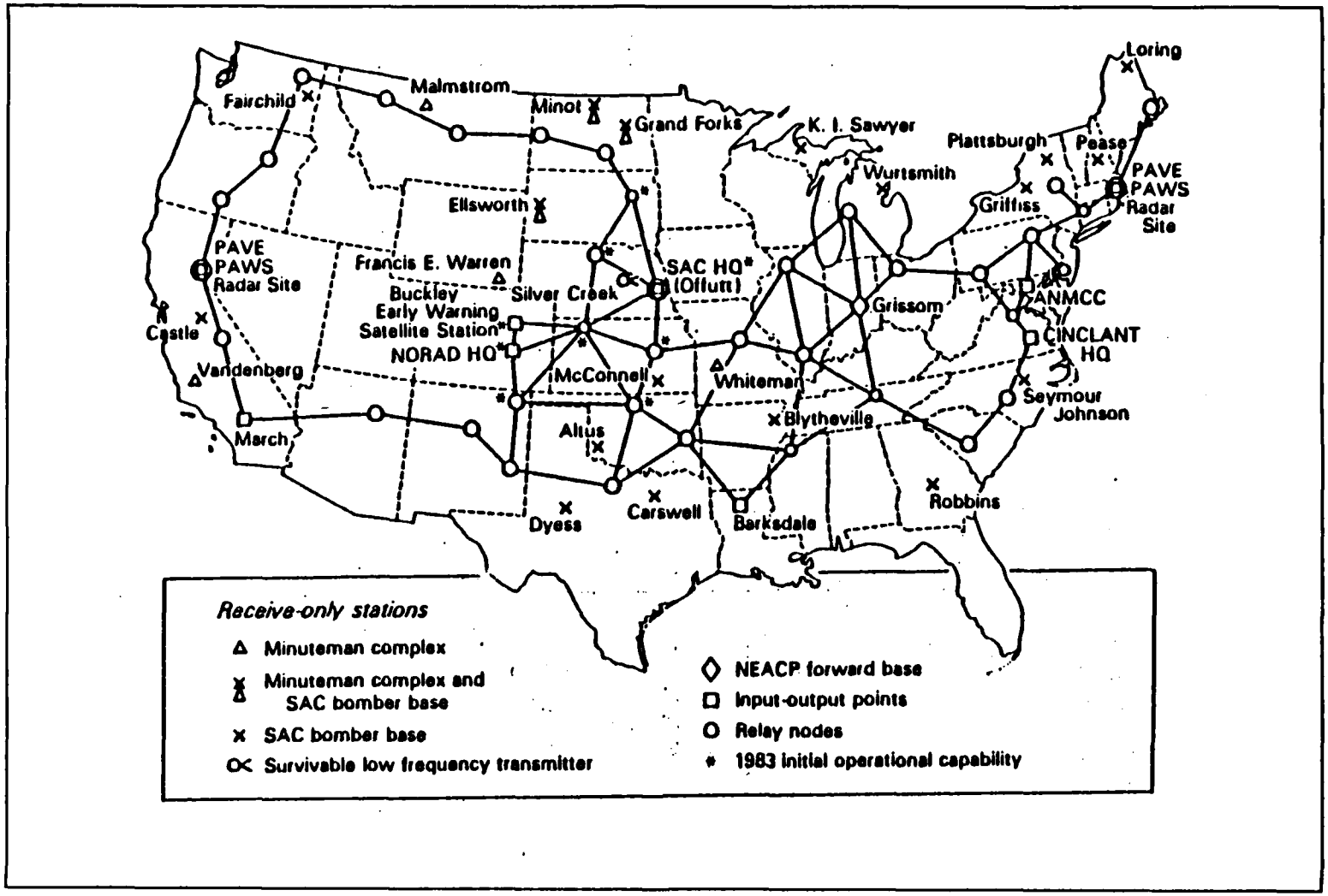


Figure 6.2 GWEN.

[Ref. 3:p.261]. Equipped with visible light sensors, X-ray and EMP sensors, the IONDS spacecraft will identify nuclear detonations on U.S. territory as well as in the Soviet Union and will have the capacity to transmit this data directly to airborne command posts such as NEACP, Looking Glass, etc. This system will be crucial for attack characterization and decision making for controlling any nuclear response. In the event of nuclear attack, with precise data from IONDS, the President will be better able to decide to launch our nuclear forces or to hold them back for later use or bargaining.

D. SUMMARY

To control escalation and limit nuclear war, the NCA must have a command and control system that exercises the functions necessary to sense the environment, to decide on a response appropriate to the environment, and to execute that response, or act on the environment. The sense function of U.S. command, control and communications is known as Attack Warning and Attack Assessment (AW/AA) and is carried out by the North American Aerospace Defense Command (NORAD). NORAD is primarily located beneath a mountain near Colorado Springs, Colorado. NORAD AW/AA systems sense a missile launch or detect bombers in flight and transmit the information to the NCA and the nuclear CINCS. Detection systems can conviently be separated into those looking at the air-breathing threat--bombers; and those looking for the non air-breathing threat--missiles.

To detect the air-breathers, the U.S. has the Distant Early Warning (DEW) line and the Joint Surveillance System (JSS). The DEW line, a network of radars strung from Greenland to Alaska across Canada is being replaced by the North Warning system. The JSS has replaced the old SAGE system and is shared between NORAD and the FAA. JSS provides the FAA and the Regional Operation Control Centers

air traffic information out to about 200 miles from the coast of the continental United States.

To detect the non air-breathing threat NORAD employs six ground-based radar systems and a space based infra-red sensing system. The ground-based radars are: (1) BMEWS, (2) PAVE PAWS, (3) AN/FPS-85 phased-array radar, (4) AN/FSS-7 radar, (5) PARCS, and (6) Cobra Dane. The DSP satellites make up the space-based system.

In order to respond to an attack, an Emergency Action Message (EAM) or go code message must be transmitted to the nuclear forces. The strategic systems for transmitting such a message, and for high-level conferencing are: (1) PACCS, (2) PAS, (3) IEMATS, (4) JCSAN, (5) Giant Talk, (6) Green Pine, (7) ERCS, (8) SLFCS, (9) AFSATCOM, and (10) SBS. New systems are GWEN, Milstar, and IONDS.

VII. FIVE SCENARIOS FOR NUCLEAR WAR

A. INTRODUCTION

Under what conditions or scenarios would a nuclear war begin that could be be limited in nature? In his book, "Thinking About the Unthinkable in the 1980's", Herman Kahn outlines five canonical scenarios developed by the Hudson Institute to help think about the beginning of World War III. If these 5 scenarios are assumed plausible, they can be used as a backdrop for looking at our command and control process of strategic battle management and the concepts of limited war and escalation control. Unfortunately we do not have 5 command and control systems with one to specifically deal with each scenario. Instead we have one overall system that is expected to be flexible, survivable and endurable. It is with these qualities of the command and control process that war will remain limited or protracted at a low level of intensity and be constrained from escalating to unimaginable general nuclear war.

It is important to remember that Western views of limited war, escalation, and the very nature of war itself may be significantly different from Soviet views. If so, this asymmetry existing between Eastern and Western culture and their views on the concept of conflict is itself an important contributor to the control of escalation, but enumeration of Soviet views on this subject is beyond the scope of this thesis. It is with this caveat that the 5 scenarios of possible beginnings to nuclear war are presented.

B. KAHN'S 5 SCENARIOS

Herman Kahn's 5, "not implausible", scenarios are: (1) Surprise Nuclear Attack, (2)Early Eruption to Nuclear War

from an Intense Crisis, (3) U.S. First Strike to Defend Western Europe, (4) Escalation to Nuclear War from a Protracted Crisis, (5) Escalation to Nuclear War from a Mobilization War.

1. Surprise Nuclear Attack

Surprise nuclear attack, commonly thought of as a 'Bolt out-of-the Blue', is probably the least likely of all possible beginnings to nuclear war. Motivation for such a surprise attack must be questioned. Why would the Soviets risk war and almost certain destruction by suddenly striking without provocation. Certaintly there seem to be other, less risky ways to obtain political and economic objectives. What form would the attack take? Would the Soviets demand total capitulation? If for some reason they did, a constrained attack would seem counter-productive. Total capitulation would call for an all out attempt to destroy the enemy. One does not politely 'sucker-punch' an opponent. You hit him hard with all you have got to take him out swiftly. That is the reason for such action in the first place. Anything but an all out unconstrained counterforce first strike attack would lead to certain counter attack by the U.S. Of course it can be argued that by constraining the first strike the follow-on retaliation by the U.S. would also be constrained, or possibly not come at all. The reasoning follows: If the Soviet Union is very careful in its targeting and hits only counterforce targets and command and control centers and minimizes collateral damage to the civilian poulation, the U.S. (recognition of limited intent here is crucial) may choose to strike back only at counterforce targets, or because of its degraded force may not strike back at all, since its command and control and damage assessment capabilities would be far below operational certainty. Without the proper command and control to direct the forces and without the requisite

damage assessment to know what forces still exist and are operational and what targets are viable, any counter strike may be better left for later when control and coordination are reconstituted. Any spasm counterstrike against Soviet cities would only be followed by countervalue strikes against U.S. cities. But any president, for political, diplomatic and psychological reasons would have to respond in some way.

An effective surprise nuclear attack could involve a decapitation strike against the National Command Authority (NCA), and the major command and control centers such as the NMCC, the ANMCC, NORAD, SAC command posts, and the FEMA special facility; with follow-on, or simultaneous strikes against major communications nodes such as telephone switching centers, satellite ground stations, AUTOVON and AUTODIN switches, early warning radar centers and VLF stations. The decapitation of the brain from the body of the decision making process--the NCA-- combined with the loss of major command, contol and communications nodes, would seriously paralyze any reprisal action contemplated without even attacking the SIOP[14] forces themselves. This would hardly seem like a limited attack since separating these targets from the civilian population would be impossible. But it is a limited scenario, when compared with a countervalue attack against American cities where possibly as many as 200 million casualties can be expected from prompt and long-term effects.

2. Early Eruption of Nuclear War from an Intense Crisis

Nuclear war erupting early from an intense crisis would probably come from one of four situations: (1) Uprising in Eastern Europe with NATO involvement, (2) Soviet military intervention in the Persian Gulf with U.S. counter

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[14]The Single Integrated Operations Plan (SIOP) is the U.S. nuclear attack plan.

intervention, (3) Sino/ Soviet war with the U.S. allying itself with China, (4) other East Asian conflicts. [Ref. 23:p.135] These are examples of what could actually be an endless list of possible crisis scenarios leading to first use of nuclear weapons. One common thread that runs through them all is the resort to nuclear use to either prevent a conventional military loss, or to prevent loss of political control by redirecting the emphasis of the conflict. If a conventional military crisis in Europe were being lost by NATO, the U.S. may strike first with tactical nuclear weapons at supply lines and command centers in Eastern Europe. Or, nuclear weapons may be used in the Persian Gulf if oil fields were threatened there by the Soviets; or, an attack on Cuba may be used to draw attention away from a European theatre crisis, or just to threaten Soviet security interests. This lateral initiation of events is called "horizontal escalation." [Ref. 23:p.135]

During an intense crisis in the nuclear age, the decision makers at the NCA level must consider nuclear release. It is always a possibility in the extended or severe crisis and the uncertain dynamics of nuclear war requires realistic thinking. The master control center--the NCA--must consider whether to 'go nuclear' is less dangerous than to not 'go nuclear.' Moral issues aside, it must be considered whether to strike first is safer then to not strike first. Obviously any first strike is a significant escalation, and escalation to nuclear war is what is being avoided, but, if nuclear war is inevitable, use must be considered. A partially or wholly disarming attack would be better to inflict than to receive, and the one who attacks first has a certain advantage. It could be argued that to control nuclear war, one must resort to nuclear war. But, as cited by Kahn, Bismarck said, "Preventive war is like commiting suicide for fear of death." [Ref. 23:p.136]

A demonstration use of nuclear weapons has to be considered in this scenario. If either side wanted to demonstrate will and resolve in the seriousness of the situation, 'shooting across the bow' of the opponent is an option, albeit a dangerous one. This act would demonstrate to the opponent that the situation was serious enough to demonstrate a show of force with the formally taboo use of nuclear weapons. The objective would be to slow the upward dynamic and limit the crisis to any further escalation. This is extremely risky though, since the opponent must recognize the demonstration show of force precisely as a demonstration and the opponent must also then be unwilling to up the ante. Escalating to control escalation through first use of nuclear weapons as a demonstration is frought with uncertainty and could lead to total loss of control of escalation. On the other hand, it may give the practitioner escalation dominance by rising the state of the conflict to a step on the escalation ladder where the opponent is either not able or unwilling to go, or remain; hence, compelling him to deescalate.

3. Defense of Western Europe

A U.S. nuclear fist strike to defend Western Europe is the way most people envisage the beginning of a nuclear World War III. This scenario begins with a Soviet attack on Western Europe for unspecified reasons, usually with Warsaw Pact forces--East German, Polish, etc. Since NATO is not as prepared for conventional war as the Warsaw Pact forces, the Red thrust is successful and pushes the NATO forces back. Rather than lose Western Europe to the Soviets, tactical nuclear weapons are used to signal resolve and seriousness. If this message fails, tactical nuclear weapons are used on advancing Red forces and rear echelons. To effectively destroy the rear echelons and support forces, attacks would have to be made against targets in the Soviet Union. This

would call for the use of intermediate range ballistic missiles (IRBM) and Soviet IRBM's could be targeted. This is a major escalation and probably the Soviets would respond with at least IRBM attacks against major NATO military installations and cities and CONUS. A corollary to this hypothesis: after the Soviets invade Western Europe, they sense desperation on the part of NATO and preempt any plans of nuclear first use NATO may have.

Any attack on NATO by the Warsaw Pact would probably be responded to early with nuclear weapons, if at all, because to hold off would mean that the weapons would have to be used to slow the advancing Red forces on the very ground being protected. It hardly seems that the West Germans would understand the destruction of their homeland with nuclear weapons as a measure to protect it.

4. Escalation to Nuclear War from a Protracted Crisis

Any protracted crisis becomes a very dangerous situation in the nuclear age. Nuclear war could potentially erupt for many reasons, but the reason of interest here is that any protracted crisis implies that strategic forces for both nations would probably be on an increased alert status for extended periods of time. This protracted alert status presents special problems and pressures for man and machines and for the system that ties them together. Systems fail under the best of conditions, and the stress of crises demand more than just additional vigilance and increased channel capacity. Crisis situations have the tendency to support Murphy's Law, and it is the uncertainties of crisis and the uncertainties in supporting command and control processes during crisis situations that will require the system to perform in ways that it may not have been designed to perform, and will severely stress the system. During the protracted crisis many maneuvering tactics may be employed by both sides to convince the opponent to back down. This

could be the time for taking the opponent to the brink, or for playing 'chicken'. In any case, both sides must recognize the actions of the opponent if escalation is to be controlled. Miscalculation during a period of protracted crisis and extended alert status could set the mechanism in motion toward a cascade of events all leading to uncontrolled, unlimited war.

5. Escalation to Nuclear War from a Mobilization War

The last of Kahn's five scenarios: Nuclear war beginning as a result of the mobilization process of opposing nations is probably the most likely of the five. Mobilization is the increased activity of a nation preparing for war. It involves the transfer and conversion of peacetime industrial and civilian power to wartime military power. It is commonly suggested that World War I began as a result of mobilization slipping beyond control of the players. Bracken says, "What set off the interlocking alerts of the European armies in 1914 was not the isolated assassination of the archduke in Sarajevo, but the decision to mobilize." [Ref. 21:p.53] If mobilization does not lead directly to war then it will probably at least change the strategic balance. Kahn believed that a competition of mobilization between the U.S. and the Soviet Union would give the United States a dominant strategic advantage [Ref. 23:P.145]. Given these five or any other plausible scenario leading to nuclear war, there must be some requirements necessary which must be filled in order to keep any confrontation limited.

C. SUMMARY

The idea of nuclear war conjures many dark questions that are difficult to answer for many reasons. So much uncertainty exists around nuclear war, much of it thanks to the fact that one has never been fought. Another source of uncertainty centers around the exact circumstances around

which the war begins. Herman Kahn and the Hudson Institute suggested 5 most probable scenarios of interest for the beginning of war between the Soviet Union and the United States. There is no certainty that war will in fact result from one presented. The five scenarios again are: (1) Surprise nuclear attack, (2) Early eruption of nuclear war from an intense crisis, (3) Defense of Western Europe, (4) Escalation to nuclear war from a protracted crisis, (5) Escalation to nuclear war from a mobilization war.

VIII. REQUIREMENTS FOR LIMITED WAR

Stafford Beer says that the science of control is cybernetics and the profession of contol is management. For those whose job it is to conduct nuclear war, their profession is management of nuclear forces, or strategic battle management. According to Paul Bracken, "Deterrence, second strike capability, and limited nuclear war are logical concepts but are incomplete. The job of management and command and control is to turn these concepts into actuality. . . ." [Ref. 21:p.238]

Limiting war to a final and favorable conclusion is the goal of strategic battle management and this is obtained through the control of escalation. The technological apparatus for waging nuclear war though, is a vastly complex system, replete with uncertainties as to its control effectiveness. With this in mind we may ask: What are the elements that a nation must possess to limit war? What effect will the trans-attack and the post-attack environment have on our C3I systems? Does our C3I system support battle management of protracted nuclear war?

A limited war requires deterrence and control by the major decision makers before the actual confrontation begins and during intra-war, and post-attack environments. But deterrence and control mean much more than just convincing the enemy that his destruction is in fact assurred if he attacks or escalates. He must also be convinced that the second strike capability of his opponent, that is, the strategic forces, can be managed, controled, organized and coordinated into an effective fighting force. The dynamics of escalation have become of major interest to strategists and the increased command and control capabilities of strategic forces is seen as a prerequisite to force effectiveness and

escalation control, and to some, a co-equal to the nuclear forces themselves.

The list of requirements to effectively limit nuclear war could be long and varied depending on the context framing the objectives of the war. This chapter will look at some requirements to keep limited war limited, and discuss some C3 implications of the limited war concept. Offered are some elements I feel necessary for limitation, but do not imply that the list is exhaustive. Some of the required elements overlap and they are presented in no particular order of importance. Priority would be determined to a large extent by the exigencies of the particular crisis situation and would; therefore, be scenario specific.

A. VIABLE NATIONAL COMMAND AUTHORITY

For a quick kill, to destroy the body, one must attack the head. Once the brain, or the master control center is destroyed--the body soon follows. An attack on the brain of the command and control structure--the NCA--before it is able to perform its decide and act function and transmit an order for retaliation is known as "decapitation". To effectively neutralize the strategic forces of any nation, an attack at the top of the decision making process creates a situation of confusion and impotance. To help ensure the survival of the NCA various mechanisms exist. Most of the details are highly classified and no attempt will be made here to outline the procedures. However, it can be said that: (1) the President, given adaquate early warning of an ICBM launch, could escape on NEACP, or rendevous with NEACP later if warning time did not allow airborne escape from the Soviet Yankee class SLBM threat; (2) if the President did not survive an attack on Washington, measures for the devolution of authority for the release of nuclear weapons exist. Given any scenario for the beginning of nuclear war, other than no attempt at NCA decapitation, the President

would probably not make the helicopter ride to Andrews AFB to escape on NEACP. Assumming that all emergency procedures worked as planned, without delay, the ride from the White House to Andrews is 8 minutes. That 8 minutes is just for the ride. Not included is the delay time it would take to find the President, interrupt whatever he was doing, quickly brief him, allow him to react, get him and whatever cadre he required to the helicopter and fly him to NEACP. Of course if the President were somewhere other than the White House, the problem is compounded and the time would probably take considerably longer. When one considers that the average flight time of an SLBM to strike the Washington area, from first warning to impact could be less than 5 minutes, it seem unlikely that the President would be aboard NEACP. [Ref. 16:p.14]

The President is empowered to delegate his authority for nuclear release under certain and special circumstances. These special circumstances would probably be in effect if the President were disabled and no immediate successor were available. The succession of presidential authority is well known and would be in effect in case the President is killed by a first strike decapitation. But finding the constitutionally designated successor[15] and briefing him on the nuclear options would be less than an optimal situtation. According to Blair, the right of predelegation by the president is succinctly stated by the Congressional Research Service:

> The realities of command and control in the nuclear age would seem to increase the necessity for prior delegation under certain carefully defined conditions. For example, in the event that the president were disabled in a surprise attack and his lawful successor were not immediately accessible, a contingency plan containing a delegation or authority to order the use of nuclear

[15]The management of, and the location process for the lawful sucession of the president is a responsibility of the Federal Emergency Management Agency (FEMA).

> weapons under certain conditions would seem to be a logical and prudent precaution--perhaps necessary to national survival. [Ref. 3:p.112]

Predelegation takes away some of the incentive of a decapitation strike against the U.S. If the Soviets know that authority to release nuclear weapons survives, even if the President does not, then, they may be less inclined to attack the brain and master control of our command and control process. The loss of the NCA would directly lead to loss of attack coordination which is a vital element of positive control and negative control--the next element.

B. POSITIVE/NEGATIVE CONTROL.

> Nuclear organizations do not behave like highly abstract models of rational decision commonly used to explain and describe nuclear operations. The organizations instead operate according to built-in decision rules that link information to pre-programmed responses. These diffuse rules serve two basic purposes: to prevent unauthorized launch of nuclear forces and to ensure that fully authorized launches will be carried out. [Ref. 3:p.281]

Positive control is the attribute required during war, and provides assurance that any authorized order to release nuclear weapons will be carried out precisely as ordered. Negative control is the attribute mainly required during peace, and provides strict assurance that nuclear weapons will not be used unless authorized. The NCA must have total trust, knowing that when the execution order is given, it will be carried out as planned. Limited war and escalation control intrinsically depend on this because: to contol war conclusively to one's advantage, one must have dominance in the escalation process; to have dominace in the escalation process, one must have control over one's forces. For example, if it is thought required to deliver a nuclear weapon against the opponent's homeland as a signalling function of serious intent, and will to use nuclear weapons, but

in a limited way, say, to a target away from populated areas--Siberia for example--then it is crucial that exactly that happens. High accuracy in release orders, correct targeting and correct timing, as well as the right weapon type and number are all necessary to limit collateral damage. Otherwise the opponent may not see the attack as a limited and signalling act; hence, escalation control may be lost. Of course, positive control is also crucial if escalation control is lost and limited war becomes total war. In that case the NCA must have the assurance that all SIOP forces are deployable and employable to meet whatever requirement is necessary.

There is a complex system of checks and balances of technical safeguards, organizational structures and operational procedures precluding unauthorized use and ensuring release orders are carried out precisely. The 'two-man' concept and attendant procedures is one of these safeguard systems where operational control of the launching of missiles and the dropping of atomic bombs requires at least two people to act seperately and simutaneously while being physically separated.

Positive/negative control for the long-range bomber leg of the triad minimally consists of: (1) Authentication from several levels of command at SAC headquarters must validate attack and targeting instructions. This authorization must occur before any message is transmitted to the SAC airborne bombers for release orders. However, authentication does not have to occur to Positive Control Launch (PCL) the bombers from the air base to avoid destruction on the ground; (2) Bombers will not proceed to their targets without positive orders to do so and these orders must be according to pre-arranged times, plans and in particular format; (3) The entire process must go according to a pre-arranged sequence, otherwise the bomber crew must return to

base. On board the aircraft, to release bombs or cruise missiles, once the release order has been verified, similiar constraints and procedures apply.

For positive/negative control of Minuteman ICBM's, a two-man crew operates a Launch Control Center (LCC) having operational control over a 10 missile flight. When the emergency action message (EAM) or go code is received, both officers in the LCC must independently validate the message through standardized authentication procedures. They then select the missiles and targets according to the EAM. To launch, each officer must insert and turn a key from his console--both keys must be turned simultaneously and held for several seconds. This is an example of the two-man rule where it takes independent and separate actions by at least two people to launch nuclear weapons. Coupled to this set of procedures is a 'vote' to launch from another LCC within the same squadron of missiles. Reception of the vote from the outside LCC in the same squadron is necessary for the launch to be executed. This is an example of negative control, preventing the unauthorized launch by any single LCC. Navy SLBM's have similiar safeguards requiring at least two men in different parts of the boat taking simutaneous action. It is reported that at least 15 different individuals at various duty positions are required to launch an SLBM [Ref. 16:p.42].

Negative control, so necessary in peacetime to prevent the unauthorized start of nuclear war results in a hinderence to positive control in time of war. An electronic locking device on nuclear weapons known as the Permissive Action Link (PAL) system requires the input of an enabling code before those weapons can be armed and fired. The PAL system is good to have to avoid unauthorized use, but when positive control is needed--during war--PAL becomes a delaying factor and slows down the process. When do

negative control procedures and systems so complicate the execution of a launch order that the overall confidence of the decision makers in positive control falls and the overall launch sequence fails? Desmond Ball, in his often cited analysis, "Can Nuclear War Be Controlled?", adds that these fail-safe mechanisms may lull authorities into a false sense of security because the systems are so complex to operate when needed. Hermann Kahn, in his "Thinking About the Unthinkable in the 1980's", suggests that the Soviet Union and the United States have built into their nuclear systems an increased risk that their forces will not work well in war, so that the risk that they will be used when they should not is decreased. He also suggests that because of this many analysts believe that accidental nuclear war is unlikely, though not impossible [Ref. 23:p.125].

C. COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE

A third requirement for limited war and escalation control is reliable, survivable, flexible and endurable command, control, communications and intelligence C3I. The "Report of the President's Commission on Strategic Forces", April 1983 said of C3I: "Our first defense priority should be to ensure that there is continuing, constitutionally legitimate, and full control of our strategic forces under conditions of stress or actual attack. No attacker should be able to have any reasonable confidence that he could destroy the link between the President and our strategic forces". The commission went on to say that the President's C3I program should have the "highest priority". [Ref. 24:p.10]

C3I systems in this country are vastly redundant, reliable and endurable--during peacetime. But what are the expected capabilities of the systems when they are needed most--during the tran-attack and post-attack nuclear environments? How will these systems support the limited war effort after they have sustained one or more attacks? For

the conduct of limited or protracted nuclear war and escalation control, C3I is second only in importance to the SIOP forces themselves. This is not to imply that perfection in these systems is required--"survivability does not mean immortality."

According to Charles A. Zraket, writing for Science magazine in 1984, as executive vice president of the MITRE Corporation, C3I,

> . . . must have the capabilities to (1) maintain peacetime readiness and performance of command and control elements and strategic nuclear forces without serious accidents and without unnessarily increasing tension around the world; (2)function during crises, providing secure conferencing for national authorities and military commanders, tracking status of nuclear forces worldwide, providing dependable intelligence, communicating to the nuclear forces, and permitting joint planning with our allies and coordination with the Soviet Union; (3) prevent mistakes or unnecessarily dangerous events and expedite correct actions; (4) ensure continuity of national command, positive control of nuclear weapons and selective retaliation; (5)provide surveillance during and after an attack to assess our status and that of the adversary; (6) integrate strategic offense and defense operations; (7) be reconstituted with proliferated, prepositioned and replenished C3I assets; and (8) help us coordinate with our allies to negotiate the end to a war. [Ref. 25:p.1307]

That is quite a list! I think all who consider problems of strategic C3I would agree. But is our C3I system robust enough to survive the stress that it would have to endure during a protracted war to accomplish these goals?

1. Factors to Degrade the System

Any nuclear war, but especially a bolt out-of-the blue, would probably begin with an electromagnetic pulse (EMP) precursor attack characterized by the detonation of 5-10 weapons high in the atmosphere fired from SLBM's at short range. This would probably be coincident with jamming from various sources such as AGI's[16] and covert ground

[16] AGI's are electronic intelligence collecting ships employed by the Soviet Union that usually appear as fishing trawlers but are actually sophisticated listening platforms.

sites; and sabotage committed against soft communication centers and antennas.

a. Radiation Effects

Electromagnetic pulse (EMP) is an intense electromagnetic spike of short duration generated by a complex process of gamma rays released by a nuclear blast ripping away electrons from atmospheric molecules which in turn react with the Earth's magnetic field. This is especially significant at height of bursts above 19 miles. The field created by a single weapon in the megaton range at an altitude of several hundred kilometers would cover much of the United States. For example, a one magaton bomb exploding at 300 km would produce strong EMP effects out to 500 miles from the point of detonation. [Ref. 16:p.11] Typical predictions for the magnitude for the electromagnetic field are on the order of 50,000 volts/meter and occurs in an extremely short period of time, on the order of microseconds. This sudden voltage surge is harmless to humans but is thought to be extremely damaging to solid state electronics, and other electrical devices. Not much empirical data exists on EMP since shortly after its effects became fully appreciated, atmospheric testing of nuclear weapons was stopped by treaty in 1963. Since then much effort has been put into hardening C3I facilities and hardware from the effects through grounding, bonding and shielding of electronic equipment and components, and through the development of exotic new semi-conductor materials resistant to EMP. Electromagnetic pulse radiation has a broad spectrum from very low frequency to very high frequency with most in the radio frequency range. Electronic equipment is affected by the voltage surge burning out sensitive electrical components such as transistors and diodes and by overloading integrated circuits designed for low current flows.

Another type of radiation effect on C3 systems known as Transient Radiation Effect on Electronics (TREE), is caused by the excitation of electrons by high energy x-rays, gamma rays, and neutrons causing an induced secondary current pulse and atomic displacements in materials used in electronic equipment. These effects damage sensitive components such as diodes, transistors and integrated circuits in radios, radars, gyroscopes, inertial guidance systems, computers, etc. [Ref. 26:p.chap.8,11]

Other radiation effects from nuclear explosions are many and varied, causing signal attenuation, distortion and interference on command and control systems just at the time when they are needed most. These degradations in performance can last from minutes to hours depending on the portion of the electromagnetic spectrum being used , the height of burst and the time of day. Electromagnetic signals that pass through the atmosphere, e.g., VHF and UHF, commonly used as line-of-sight (LOS) and satellites links, are affected over localized areas and are usually only degraded for only a few seconds to a few minutes. However, systems that depend on signals being reflected, refracted or scattered by the ionosphere can be degraded for long periods of time and over great distances. Line-of-sight systems that propagate below the ionosphere, between ground stations, or between ground stations and aircraft, or between aircraft will not experience severe degradation unless the explosion takes place within the line of sight. The major consequences of nuclear effects on signal propagation are phase anomalies and signal attenuation caused by noise, phase, refraction and scattering effects.

Absorption of energy is the major source of signal attenuation following a nuclear burst in the atmosphere and occurs in electron dense regions caused by high energy radiation that rips electrons from atmospheric

components. Absorption, in general, is inversely proportional to the square of the signal frequency. This means that signal absorption is most important for lower frequency wave forms, that is, for systems that use low frequency signals. The location of the transmission path relative to the burst point and the time of transmission relative to the time of burst are directly related to the amount of signal loss. Empirical data of nuclear effects on communications is from testing that was not designed to maximize these effects on communications per se. Many of the proposed effects contain a significant residual uncertainty. [Ref. 26:pp.479-482].

VLF (3-30 kHz) systems suffer from phase changes due to the lowering of the ionosphere caused by an increase in electron density by the nuclear blast. The lowering of the ionosphere lowers the reflection altitude and reduces the transmission range and produces phase anomalies. The loss of VHF would have serious consequences on communicating with the fleet ballistic submarines and aerial navigation systems. LF (30-300kHz) systems are not as susceptible to ionizing effects in the atmosphere unless they depend on skywave propagation between the earth and the ionosphere. Skywave propagation can be degraded from minutes to hours following an atmospheric nuclear explosion. MF (300kHz-3mHz) systems, typically the AM broacast band, normally depend on ground wave propagation during the day and degradation will occur if the detonation occurs within the path of the ground wave. Military systems are not highly dependent on MF systems. However, civilian AM stations are, and they broadcast warnings to the public along with other vital information. These broadcasts will be crucial to the civil defense effort. HF (3 mHz-30 mHz) systems will probably be seriously affected by atmospheric nuclear explosions. Many strategic systems depend on HF

communications. The reflection region of the atmosphere will be lowered by the blast induced electron dense regions, thus changing the propagation path. Blackout can occur from several minutes to several hours with recovery time being a function of weapon yield and detonation altitude. Daytime, high altitude bursts at 200 miles would disrupt HF communications out to 1500 miles from the blast point and it would be hours before the interference subsided. VHF (30-300mHz) systems, usually used for LOS communications such as commercial television, FM radio, and many military applications will not suffer significant disruption since these systems do not depend on any appreciable reflection by the ionosphere to reflect their signals. However, degradation could be significant if the blast occurred in the path of propagation. UHF (300mHz-3 gHz), commonly used for satellite communications will suffer no appreciable long term effects unless, again, the transmission path passes through or near the fireball. See Figure 8.1 for a tabular summary of these effects. [Ref. 26:pp. 482-490]

b. Jamming

Jamming is the selective and deliberate transmission of electromagnetic energy to interfere with, and to deny the opponent's use of, the electromagnetic spectrum. Selective C3I elements would certaintly be targets for jamming in the nuclear war environment. Satellites, radios, radar, infra-red and optical sensors are all susceptible to the effects. Jamming effects have been lessened for some strategic communications systems. Defense Satellite Communications System III (DSCS III) satellites have been made jam resistant and Milstar, when operational in the early 1990's, will provide significant anti-jam capability.

c. Blast and Shock Effects

The most readily visible nuclear effects are blast and shock and both severely threaten command and

EFFECTS OF NUCLEAR DETONATIONS ON RADIO AND RADAR SYSTEMS

Frequency Band	Degradation Mechanism	Spatial Extent and Duration of Effects*	Comments
VLF	Phase changes, amplitude changes	Hundreds to thousands of miles; minutes to hours	Ground wave not affected, lowering of sky wave reflection height causes rapid phase change with slow recovery. Significant amplitude degradation of sky wave modes possible
LF	Absorption of sky waves, defocusing	Hundreds to thousands of miles; minutes to hours	Ground wave not affected, effects sensitive to relative geometry of burst and propagation path
MF	Absorption of sky waves, defocusing	Hundreds to thousands of miles; minutes to hours	Ground wave not affected
HF	Absorption of sky waves, loss of support for F region reflection, multipath interference	Hundreds to thousands of miles, burst region and conjugate, minutes to hours	Daytime absorption larger than nighttime, F-region disturbances may result in new modes, multipath interference
VHF	Absorption, multipath interference, or false targets resulting from resolved multipath radar signals	Few miles to hundreds of miles; minutes to tens of minutes	Fireball and D-region absorption, FPIS circuits may experience attenuation or multipath interference
UHF	Absorption	Few miles to tens of miles, seconds to few minutes	Only important for line-of-sight propagation through highly ionized regions

*The magnitudes of spatial extent and duration are sensitive functions of detonation altitude and weapon yield.

Figure 8.1 Nuclear Effects on Radio and RADAR Systems.

control centers. The most survivable of the non-airborne command posts, the NMCC, ANMCC and NORAD, can withstand overpressures in the 3,000-5,000 pounds per square inch (psi) range [Ref. 16:p.9] but would almost certainly not survive a near hit.[17] All other command posts are more vulnerable--except the WWABNCP. Communications hardware such as exposed antennas and cables are very soft and will not withstand any overpressures greater than 5 psi. Underground, retractible, pop-up antennas give some added protection, perhaps as much as 10-40 times more than the standard aboveground type. The reason that airborne command posts are more survivable is only because they probably will not be near the detonation point. If they are; however, their chances of survival are low. [Ref. 16:p.10]

d. System Failure

'Operational pathologies', and equipment failures will always be the achilles heel of C3I operations during times of crisis and stress. Reliability of performance for large-scale, complex systems will contain some residual uncertainty which will never be relieved. The goal of planning for these crisis situations then, is to reduce the uncertianty as much as possible so that any failures that do occur are not totally unexpected; and, contingency operations can be planned and practiced. Measures other than mean time between failure (MTBF) and other statistical probabilities for equipment malfunction need to be examined. During crises, unforseen stresses must be endured and often times no reliable data exists to analyze these stressed situations except for command post and field training exercises. Of course, by definition, unforseen circumstances cannot be planned for, but realistic exercising of the systems would greatly help in reducing the number of

[17] Current Soviet missile accuracies and a 20 megaton warhead give a 95% single shot kill probability against a target hardened to 5,000 psi [Ref. 16:p.10].

unforseen situations that could arise. Any large C3I system has many subsystems that have to function reliably for overall proper system functioning. Seemingly unimportant pieces of equipment such as power supplies and air conditioners can stop or impair any large scale, technically complex system.

Also to be of sure significance in the protracted nuclear environment will be the effect on humans. Radiation poisoning, blast, heat and shock effects can easily be predicted. But what about the psychological stresses that must be endured for long term functioning of the command and control processes? How would the C2 functions endure the crisis of limited war if the operators were sick, dying and psychologically unfit to continue. This question can be asked of any war setting, but protracted nuclear war would fiercely demand new and extrodinary human performance.

e. Sabotage

Most, if not all C3I assets are vulnerable to sabotage from Spetsnaz forces.[18] Antennas, repeater sites and most cabling is unmanned and unprotected. The ease of mobility these guerilla forces have throughout this country make us especially vulnerable to sabotage. This is a certain asymmetry between Soviet capabilities and ours since our special forces have no similiar ease of movement throughout the Soviet Union. According to Ball, 380 KGB teams have been organized for operations against NATO command and cotrol centers [Ref. 16:p.32]. Spetsnaz attack can be expected to occur in combination with high altitude detonations for EMP effects and jamming at the onset of any nuclear war.

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[18] Spetsnaz--roughly translates to "special forces"--are Soviet military personnel used for sabotage, kidnapping, assassination, and covert military operations.

2. More C3I required for Limited War

To improve endurance and survivability of C3I facilities and capabilities for limited or protracted nuclear exchanges, increased hardness to blast overpressure, and EMP effects; hard to find ground mobile command centers; redundancy in systems deployment and easily reconstituted systems must be considered as high priority items. Stress on C3I systems will be greater for limited war than for an unlimited spasm war. Unlimited war requires only that C3I support a one-time, all-out response. The limited scenario may last for months and it is crucial for a surviving and enduring system to exist to support bargaining and negotiation for termination of the conflict.

D. DAMAGE ASSESSMENT/DAMAGE CONTROL

1. Damage Assessment

The next requirement for the containment of war is the two sided element of damage assessment and damage control. First, to be able to respond positively and accurately, the NCA must know what damage the SIOP forces have sustained following a strike. The President can not order an ICBM launch against time-critical targets if he does not know whether his missiles exist in their silos. It is vital that he know the operationsl status of his forces through accurate damage assessment. How does the President know, if the very system that supplies the information has sustained nuclear strikes or spetsnaz attacks against it? Information the NCA receives will be fragmented and incomplete, with distortions, deletions and some of plainly erroneous content. The process of net assessment during peacetime is subjective and based on probabilistic and statistical analysis and therefore has built-in uncertainty. Wartime damage assessment would be even more uncertain since input data would be less reliable. The ultimate use of assessment will be for the decision maker--the NCA--to map out strategies,

responses and initiations of actions. Questions such as: What targets are now time critical? What targets are viable? What is my force status? What targets maximize opponent destruction and minimize my vulnerability? How will my opponent react? What damage have I suffered and how much more can I sustain? Accorcing to Bracken: "In the destruction and chaos of such a war it is possible that the only way the president might be able to find out quickly what had happened would be to order a SAC reconnaissance plane to Chicago, for example, to look out of the window and see if it was still there". To carry out the damage assessment mission following a nuclear attack SAC has 50 reconnaissance aircraft capable of providing some of this information--if they survive the attack. [Ref. 21:p.106]

Besides the SAC reconnaissance aircraft, damage assessment information would also come from the SIOP forces themselves, assuming communications links survived connecting them to the NCA. Commercial telephone lines may play a big role here since a portion of the system will survive due to its complex redundancy no matter how severe the attack. There also exist state, local and federal government civil defense agencies who report damage information to the Federal Emergency Management Agency (FEMA). FEMA has direct communication capability to other government agencies including the Department of Defense.

The soon-to-be operational Integrated Operational Nuclear Detection System (IONDS) will provide added capability. IONDS will be a worldwide nuclear detection system deployed on 18 NAVSTAR-Global Positioning Satellites to become operational in the late 1980's. Through visible light sensors IONDS will provide data on number, yield and location of above ground nuclear blasts to within 100 meters resolution [Ref. 3:p.261]. Defense Support System (DSP) satellites will provide assessment of Soviet capabilities

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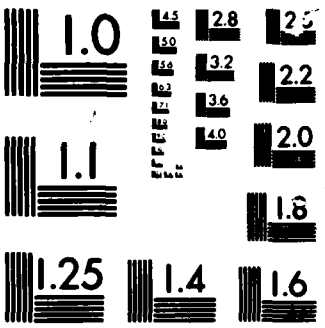

MICROCOPY CHART

after attack, but the DSP ground stations in Australia and Colorado are not hardened sites and sure to be targeted. Submarine commanders will not easily be able to report their status since any transmission from them gives away their position, and the VLF stations supporting them are not expected to survive any attack no matter how limited.

This all adds up to an extreme imperfection in the damage information received by the NCA. Any situation where less than perfect information exists means that either decisions are delayed, or that wrong decisions may be made based on faulty data and analysis. In either case the results could be catastrophic and are detrimental to the concept of limited war. According to Bracken, Soviet inferiority in damage assessment works against U.S. security. "The absence of an assessment system that lets them know the damage inflicted upon the United States, for instance, severely reduces the Soviet's options for waging any form of limited war. They will have reduced information feedback, and this could reinforce their existing proclivity toward large spasm attacks." [Ref. 21:p.198]

Accurate damage assessment then directly influences stability during nuclear war. For escalation not to jump uncontrolled from level to level it is imperative that each side know its capabilities and the capabilities of the opponent. "The ability to ascertain reasonably valid estimates of damage and surviving force status is a cornerstone of politically directed nuclear attacks." [Ref. 21:p.118]

2. Damage Control

Damage control is another requirement for limited war. For escalation to remain constrained to controllable levels, the amount of destruction suffered by the opponent must be limited. This is done to keep the action--the war--within the constraints of the limited political objective. Ideally, in nuclear war, or any war, doctrines of

city-avoidance and counterforce attacks would keep the enemy from attacking population centers for fear of his own cities being attacked in reprisal, thus, limiting attacks to strategic nuclear forces, support facilities and command and control centers. This, however, would be extremely difficult to acheive, if not impossible for two reasons. First, many strategic military targets are located very close to population centers. Therefore, targeting nuclear forces without also targeting civilians is almost impossible. Secondly, the enormous destructive power of nuclear weapons and the far ranging secondary effects create limitation difficulties.

If adhered to, city-avoidance doctrine may be one of the most significant contributors to limited nuclear war. It could be argued that any limited first strike of a strictly counterforce nature, with no collateral civilian damage, say against a naval task force at sea, would be responded to with another similiar strike against only counterforce targets. Of course, this tit-for-tat, action/reaction of events may soon go out of control and escalate to countervalue strikes. This is precisely why the requirement for avoidance of collateral damage is central to control of escalation.

To limit collateral damage, the NCA must have (1) positive control over its nuclear forces, (2) accurate damage assessment of the near real-time or real-time situation, (3) SIOP forces technically and operationally capable of carrying out the limited strike, and (4) the will to limit damage (or no incentive to do otherwise). To maintain limits, along with the precise attack, the opponent must recognize the attack as limited. For it must be realized that an attack of limited proportions by one side may be seen as unlimited to the other side. The opponent, if he chose to respond, then, must limit his attack and this too

must be seen as limited. How long can these self restraints and perfect recognitions go on?

According to Ball, the U.S. SIOP contains more than 40,000 potential targets with only 5% being strategic forces. The remainder are: . . . " other military installations such as airfields, shipyards, ports, army bases, railway marshalling yards, storage depots, and logistic facilities; economic and industrial targets such as oil refineries, power plants, and factories; and political and military leadership facilities, such as CPSU buildings, administrative centers, KGB offices military headquarters and command and control posts." [Ref. 16:pp.26,29] Distinguishing these targets from a countervalue attack by the recipient of such an attack would be most difficult, eventhough these targets do not represent countervalue targeting per se. And, even if strictly counterforce targeting is applied, with Soviet nuclear forces stationed so near major population centers as some are, combined with the many uncertainties involved in ballistic missile targeting such as CEP, weather conditions, intelligence, correct target coordinates, inertial guidance systems, explosive yield, overpressures, interference between detonating warheads, etc., collateral damage of the civilian populace can not be reliably controlled or even predicted. [Ref. 16:p.28]

If constrained attacks are considered to be used for controlling escalation, then the targets must be considered very carefully, since any attack, even one thought to be counterforce in nature may have the unknown, uncertain effects of a countervalue character. Anytime the opponent feels his cities are at risk, escalation control is soon to be gone.

E. MECHANISM TO TERMINATE

As previously mentioned, limited war and escalation control require that a termination of conflict be feasible and expected by the warring participants. If a mutual mechanism for termination were not possible, there would be no incentive to limit actions, in fact, the logical course of action would be to fight as hard and as swiftly as possible. Therefore, a method to terminate a nuclear war must exist if the war is to be kept limited. So much of command and control is focused on the the pre-attack and the trans-attack phases of nuclear conflict, with little emphasis on the post-attack environment and how C2 systems will be employed to communicate intentions and negotiations with the adversary. The Direct communications link (DCL) or Moscow-to-Washington link ('MOLINK'), also known as the 'Hotline', has been in operation since the Kennedy administration realized the need to directly communicate with the Soviets during the Cuban missile crisis. The MOLINK is simply a teletype system and is planned for an upgrade to include facsimilie capability. In the event of war, MOLINK could be used for direct communication between the president and Soviet leaders, except for one thing: the ground terminals for MOLINK are soft targets located at Ft. Detrick, Maryland; and Etam, West Virginia with connectivity to the NMCC by commercial leased circuits. Any attack on the Washington area would most likely preclude any use of the system through direct of collateral nuclear effects. As Ball says,

> The irony is that the DCL is only likely to remain operational during the period in a nuclear exchange when restraint is already being exercised for other reasons; once restraint is abandoned and an exchange progresses to any large-scale level, the availability of the hot line could not be relied upon. [Ref. 16:p.23]

This means that if the Soviets want to communicate with U.S. leaders throughout a nuclear conflict via MOLINK, they must not attack the Washington area--a highly unlikely possibility based upon their often cited remarks on the importance of striking at the top of the command and control structure [Ref. 2].

F. SHARED LIMITED WAR CONCEPT

Related to the requirement for a mechanism to terminate any conflict, is the idea that limited war and escalation control rests upon the notion that war can be limited; and upon the acceptance by the belligerents of the idea that the adversary will play by the same rules. These concepts imply a mutual understanding. The warring parties must have a similar, if not equal view that war can be limited and that it is under these constraints that the adversary is engaging his actions. Recognition of constrained attacks undertaken by either player for what they are is very important. The only way to keep nuclear war limited will be if each action is recognized by the opponent as a constrained action with a discrete objective. Once the recognition is lost, escalation accelerates with the upward dynamic.

As found lacking in their open literature, the Soviets have given little evidence in the past of accepting the notion of limited war [Ref. 2:pp.15-19]. They believe readiness and preparation to wage and win a nuclear war is what achieves deterrence, not the threat of assured destruction. Soviet strategic targeting policy stresses massive rather than sequential nuclear strikes [Ref. 16:p.31]. Soviet writers typically reject the notion of limited war:

> The concept of limited war, especially a lengthy one, is highly speculative...that is, it presupposes that the other side, too, accepts the 'rules of conduct' proposed to it. This supposition is based on the shaky argument concerning the relative determination of the sides to heighten the degree of risk. It is considered that the other side will limit the strength of its blows, since otherwise it would get a strike at a higher step of

nuclear escalation. I.A. Gerasimov, Commander of the Kiev District, General of the Army. [Refs. 2,27: p.83,p.417]

As for me, I never believed in a so-called limited nuclear war. I simply do not imagine how one can establish such limitations once any sort of nuclear weapon is launched. V.D. Sokolovskiy, Marshall of the Soviet Union. [Refs. 2,27: p.84,p.52]

A delay in the destruction of means of nuclear attack will permit the enemy to launch their nuclear strikes first and may lead to heavy losses and even to the defeat of the offensive. The 'accumulation' of such targets as nuclear weapons and waiting with the intention of destroying them subsequently is now absoutely inadmissible. A.A. Sidorenko, Frunze Academy. [Refs. 2,27: p.84,p.374]

The difference in conceiving of how nuclear war should be, or will be fought is a significant asymmetry in the strategic balance between the Soviet Union and the United States. Without a shared concept to limit nuclear war it seems likely what war will be fought toward victory, however defined.

G. CIVIL DEFENSE

The degree of protection of the civilian population and national leaders will significantly affect limitation control. If large segments of the population are able to survive a first strike, massive and spasmotic retaliation will less likely occur in the follow-on second strike for fear of a massive countervalue third strike reprisal. This abilty to survive, a robustness of the population, will add to escalation control. Secondary nuclear effects such as fallout, delayed radiation effects, sickness and starvation, lack of medical care, etc., can be long-term and wide-ranging. Any measure that protects the population of a nation and makes it less susceptible to these secondary effects will restrain the decision maker from taking a step up the escalation ladder. Little can be done to protect

people and property from direct nuclear effects such as blast, shock, thermal and prompt radiation, but survival from secondary effects will ease economic and political strains, and help to maintain a viable work force for industrial production. The better the population is able to protect itself, the less it will be a burden to the government, leaving more options open to the NCA.

Presently the U.S. has little in the way of a civil defense program for nuclear war. It appears to be politically unpopular. The Soviet Union, on the other hand, is reported to have an extensive system to protect the populace and political, economic and military leaders. Ball reports that 110,000 shelters exist for members of leadership. If this is true, the Soviets clearly have the advantage in this asymmetry and could be said to have an extra element in their favor toward escalation dominance when it comes to contemplating the escalation step of targeting cities.

H. SUMMARY

In order to limit war certain requirements must be present and possessed by the warring sides to some extent. Without these elements, war can become unlimited and escalate out of control, or can be lost all together. The elements I have proposed are not exhaustive, nor do I imply that they all be present all of the time. The requirements are: (1) A viable NCA; (2) Positive/negative control; (3)Effective command, control and communications and intelligence; (4) Damage control/assessment; (5) A shared limited war concept between belligerents; (6) A war termination mechanism; and (7) Effective civil defense.

The National Command Authority is required for top-level decision making, authority and leadership. Positive/negative control allows the NCA to apportion the forces appropriately, according to needs. Command, control, communications and intelligence is the nervous system

linking the forces together and provides the control structure. Damage assessment helps allow the NCA to make correct decisions based on the current status of forces, and damage control helps limit the escalation process from going out of control. For limited war to remain so, each side must share to some extent the concept of limitation. This sharing need not be equal but must have some common elements. There must be a mechanism to terminate the conflict at all levels. And, to allow the decision maker as many flexible options as possible in the limiting process, the NCA must be confident to some extent that his people and cities will survive. The cities cannot be protected, but people can. An effective civil defense program gives the NCA more options.

IX. DISCUSSION

Can nuclear war be managed to an acceptable conclusion, stopping at some less than total, all-out level of conflict where both sides are left to be little more than a heap of smoldering ruin? The constraints necessary to keep war limited to a less than all-out level are not well understood since we have no empirical data for protracted nuclear war, and very little experience of nuclear war-- Hiroshima and Nagasaki notwithstanding. The concepts of limited war and escalation control are static in their description and applying them to a dynamic situation of rising tensions and force mobilization may be somewhat arbitrary and unrealistic. However, static models may be acceptable under the circumstances.

This final chapter shall attempt to offer some answers to previous questions raised with respect to the concepts of limited nuclear war, escalation control and command, control and communications.

A. NUCLEAR CAN BE LIMITED

1. Adopt the Actor-Image Paradigm

What is meant to control nuclear war and how do we know when we have it? The idea that nuclear war can be controlled may seem paradoxical. Some may speciously argue that any situation leading to war, especially nuclear war is out of control at the start and therefore cannot be controlled afterwards. Assuming an existing NCA, command and control and the forces necessary to carry out national policy, I believe nuclear war can be controlled if: (1) Each side in the conflict has specific political objectives at the beginning of the conflict and maintains those objectives; (2) Each national level command authority type

decision maker has an expectation that the war will remain limited, i.e., each side shares to some extent a common concept of limiting the war and the political objectives that precipitated the conflict, and structures their actions within the concepts of limitation; (3) A mechanism to terminate the conflict exists; (4) Positive control of forces to launch on command, and negative control to preclude unauthorized nuclear release is firmly in place; and (5) a plan to protect the citizenry. These elements are necessary to maintain some constraints on the upward dynamic attendant with conflict and war. The object of control is to acheive the political objective without moving up the escalation ladder, either as a reaction to the opponent's initiative--the 'actor-image' model, or, because each side is caught up in an ever increasing series, or continuum of events beyond the control of the players--the 'phenomenal-image' model. I believe actual conflict to be an amalgam of these two paradigms, but for limited nuclear war the actor-image model should be the paradigm adopted by decision makers. With this concept in mind, nuclear conflict will be series of discrete steps intended for specific purposes and will then give credence to the idea of limiting war. If the phenomenal-image model is solely adopted as the paradigm, little is to be controlled by each player and the conflict will take its own course--so why bother to exercise constraints? The phenomenal-image model of nuclear war leads to uncontrolled escalation if that is the paradigm of the opposing sides.

2. Two Aspects of Control

a. Control of Forces

We know we have control when we possess two aspects of nuclear war: control over the nuclear forces, that is, properly functioning positive/negative control measures; and control over the process of war, that is,

maintenance of escalation dominance. Properly functioning positive and negative control means that direct control of the forces exists. This is the ability to operate and exercise the nuclear forces as they were designed for the purpose of war. Without absolute assurance of this control, the national level decision makers have many fewer options.

b. Control Over the Process of War

One half of the control of nuclear war then is to possess the necessary resources to fight to win a war, and the ability to use them when planned. The other half of controlling nuclear war is to maintain escalation dominance. That is, the ability to control the movement of the conflict up and down the escalation ladder at whatever step the conflict currently resides. Escalation dominance gives the NCA control over the events of war as it procedes through its phases, i.e., escalation dominance provides control over the process of war.

B. DOES OUR C3 SUPPORT LIMITED WAR?

Does the United States possess C3 capability consistent with the limited war concept? This question is difficult to answer here for two reasons. First, to rigorously analyze our C3 systems, highly classified information must be included. Since this paper is intended for a general audience at the unclassified level, no fully adequate answer can be offered. Secondly, to know if our C3 systems work under conditions of protracted nuclear war, they must be tested under those conditions. We will not know if our command and control systems work as planned unless we use them under actual conditions of war--a problem most of us are glad about and hope will never change.

Given the above qualification, does our C3 sytem support the concept of limited war? I believe it does, but only for very limited war, and only when the necessary elements such as a viable NCA, shared and similiar war concepts between

belligerents, an existing termination mechanism, damage control and assessment, etc. exist. Using Kahn's escalation ladder as a framework, and viewing limited war as existing as somewhere in the lower rungs, certainly below step #40 where cities are beginning to be targeted, (see pp. 25-27) and probably much lower, our systems will probably do the job. We have highly sophisticated computers and communications systems, vast redundancy, comprehensive procedures, and talented and trained personnel. Will these systems work under the severe stresses of protracted nuclear war? No one knows for sure until it happens. However, we do know that the system will not perform under conditions of the trans-attack and post-attack environment as it does during peace. Our command and control capability will be seriously degraded even after a limited nuclear strike against major command and control centers such as the NMCC, the ANMCC, and NORAD; and the SIOP forces, such as missile silos, bomber bases and ballistic missile submarine facilities. Serious degradation of control will result as a consequence of possible loss and/or disorganization of the NCA; loss of major command centers, with subsequent reliance on airborne command centers during the trans-attack phase; degraded communications capability from EMP, blast, thermal and prompt radiation effects; and possible destruction of a social structure not accustomed to adversity, and few if any civil defense measures. Portions of the system will work and most certaintly portions will not work. Determining which will and which will not is dependent on the attack scenario. The systems for disseminating the go code may be redundant enough to transmit the message, but if the NCA does not have proper damage assessment information, there exists little confidence in effective response actions. Submarine forces may survive but if the highly vulnerable VLF stations supporting them and TACAMO are targeted, little

can be made of their fire-power. Can our C3 systems support a limited war? The answer is uncertain. It will depend on the attack scenario, capabilities existing at the time of attack, whether the forces are dispersed adequately when the bombs begin to fall, what decisions the NCA makes with respect to launch on warning or launch under attack, etc., etc.

C. FINAL REMARKS

Limited war and the bases upon which the concept is built, of constraining the means of war, and limiting the objectives of the actions of war, are obtained and described through escalation control. If taken together, escalation control and concepts of limited nuclear war imply a protracted conflict between superpowers that may last days weeks, or months. A protracted nuclear war will be one of unknown stresses and will probably demand a massive human and technological effort. A nuclear war may begin with as many (or as few) as several hundred weapons falling on missile silos, airbases, submarine bases and command and control centers. How will it be possible to pass all relevant information from the silo, up through the system to the NCA where all relevant assessment information must be absorbed and a wise and deliberate response decision made, matching the response to the degree of the attack to avoid uncontrolled escalation? Most likely a rapid action-reaction response will occur, but if war is to be limited and effective, the response should be cold and deliberate to maximize whatever force effectiveness is remaining and to maintain the actor-image paradigm. Action-reaction responses stress the decision makers to make timely and correct decisions, and it pressures the command and control system to present the assessment to the NCA correctly and completely, and then to transmit the execution order correctly and completely. This decision and execution must

all take place in an extremely uncertain environment of primary and secondary nuclear effects, against an opponent who may or may not share our views of the limiting process, and it must be done with a system that will probably support limited war only at low levels and never tested under these conditions.

It is possible that the greatest deterrence to nuclear war is the uncertainty attendent in its occurrence. Nuclear war may be suicidal; although, this near axiom of strategic thought is not an immutable law. Something less than mutual suicide and total destructuion is probably more likely, and that something amounts to limited and protracted nuclear conflict, no matter how unlimited it may seem. What will allow the "something less" than total war for each side is several fold--nuclear forces appropriate to the task of limited and protracted conflict; effective coordination of those nuclear forces through command, control, communications and intelligence; a political and military structure that allows for deliberate, and prescient decision making; economic viability to ride out the conflict period; and the will to limit war. These elements will characterize the nation that seeks to survive.

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