TECHNOLOGY FOR GLOBAL SECURITY

WHAT DO WE WANT FROM THE NUCLEAR COMMAND AND CONTROL SYSTEM?

TECHNOLOGY FOR GLOBAL SECURITY SPECIAL REPORT

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OCTOBER 24, 2019

I. INTRODUCTION

In this essay, Paul Davis suggest that US NC3 modernization "should place increased emphasis on assuring control, avoiding accidents, and avoiding ill-informed or unwise employment of nuclear weapons."

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A podcast with Paul Davis, Peter Hayes, and Philip Reiner on NC3 goals is found here.
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II. TECHNOLOGY FOR GLOBAL SECURITY SPECIAL REPORT BY PAUL K. DAVIS

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Summary

In this paper I take a step back to ask afresh in the year 2019 what we should demand of nuclear command and control and what priorities we should establish when tensions exist among objectives. The answers are different now than in the Cold War, and we should take positive measures not to propagate or resurrect dangerous features that were considered necessary in that earlier period. Nuclear weapons remain distressingly relevant. After years of neglect, there are compelling reasons for recapitalizing and selectively modernizing both the weapons and their command and control systems. As the United States does so, however, it should place increased emphasis on assuring control, avoiding accidents, and avoiding ill-informed or unwise employment of nuclear weapons. That shift of emphasis would be consistent with the trend of nuclear policy for decades, but vestigial mindsets and procedures are still problematic and

resistant to change—probably more so than is generally recognized. Desirable changes will come about more readily if the functions and imperatives of nuclear command and control are routinely presented and taught with 21st century sensibilities.

Introduction

I was asked to write a short paper conceptualizing desirable attributes of nuclear command, control, and communications. In doing so I have necessarily omitted much of what is ordinarily front and center in such discussions. In particular, I do not address the myriad of structural and technical issues associated with modernizing the system's personnel, procedures, facilities, equipment, and communications. Instead, I ask what core functionality should be demanded and how those demands should differ from those of the Cold War. Doing so raises provocative issues of which readers may disagree.

The paper proceeds as follows. After some background largely pointing to Cold War literature on nuclear command and control (Section 2), Section 3 presents a functional model and points out what appear to be important differences between Cold War priorities and those suitable today. In Section 4, I draw conclusions.

Background

Terminology

The terminology associated with command and control issues is confusing. Table 1 distinguishes among nuclear command and control (NC2), the nuclear command and control system (NCCS), and the nuclear command, control, and communication system (NC3) that DoD operates through its NC3 enterprise to implement the NC2 functions. Table 1 also lists many of the attributes traditionally demanded of NC3 (Department of Defense, 2016).

Background Literature

A significant literature exists from the Cold War regarding nuclear command and control (NC2). Although NC2 and NC3 were shrouded in secrecy, an early book by Paul Bracken addressed credibly many of the most fundamental issues and described apparent characteristics of actual NC2 (Bracken, 1983). Bruce Blair highlighted vulnerability problems related to early warning systems, command procedures, and security (Blair, 1985). The next major contribution was the large and detailed edited book (Carter, 1987) on managing nuclear forces. Soon thereafter, the lead author, Ashton Carter (later the Secretary of Defense), published a good overview for a broad audience (Carter, 1987). Although disagreements existed, the most credible assessment in the mid-1980s was that the NC3 system would assure massive, devastating retaliation in the event of a Soviet first strike (Carter, 1985, p. 605 ff).

That said, the coherence and effectiveness of retaliatory attack might be degraded, especially if the Soviet attack achieved operational surprise with U.S. forces not on full alert. The reader should pause and ponder about the plausibility of that even during the Cold War.[1]

Despite such analyses concluding that retaliation capability was indeed assured, the worry always existed that, in the event of extreme crisis, military authorities would tell the President that (1) launch under attack was necessary if the Soviets began a major attack and that (2) preemption was crucial for national survival in the event that Soviet attack was imminent. The argument for the first of these was that no one could be certain that NC3 would not be paralyzed from an attack and that, even if was sufficiently functional to conduct a retaliatory attack, the attack would be much less effective. The argument for the second claim was simple: there must be military advantage in going first rather than second. The post-exchange balance of forces would favor the side going first and might allow coercion and forced surrender of the other. A speculative variant imagined the hushed hallway conversation, “Mr. President, no one knows what will happen, but the only chance for meaningful national survival (even if not a strong chance) would be if we attack preemptively. Given our intelligence, we might get

[1] Soviet leaders put little stock in a “bolt from the blue” scenario. They were, however, prepared to preempt an imminent U.S. attack (Musgrave Plantation, 1994).

lucky and paralyze their command and control while destroying most of their nuclear offensive forces."[2]

The NC3 system did not fare well after the Cold War. The equipment became obsolete due to a lack of new investment. Questions arose about "degradation of authority, standards of excellence, and technical competence." Embarrassing blunders caused Secretary of Defense Robert Gates to sack the Air Force Chief of Staff and the Secretary of the Air Force (Shanker, 2008). DoD created a task force chaired by James Schlesinger to review nuclear management (Schlesinger et al., 2008a; Schlesinger et al., 2008b). The Air Force reorganized to reinvigorate the nuclear enterprise and related efforts continue (Air Force, 2014; Air Force, 2015). Beginning in the latter years of the Obama Administration, a trillion-dollar effort was begun to modernize U.S. nuclear forces and NC3 over 30 years (Congressional Budget Office, 2017). This reflected a rare bipartisan agreement after years of dispute. It was also contrary to what might have been expected given the administration's incoming emphasis on deemphasizing nuclear weapons and moving toward their elimination. It was, however, necessitated by the recognition that nuclear strategy and nuclear weapons remained important (Roberts, 2015) and that U.S. capabilities had badly degraded.

Rethinking Functional Requirements

Obviously, much has changed since the Cold War. The changes in the strategic situation include multipolarity, the rise of additional nuclear powers (North Korea, Pakistan, India), the reemergence of Russia as a security problem, and the potential for nuclear crisis to involve more than two parties (Perry and Schlesinger, 2009; Bracken, 2012; National Research Council, 2014; Roberts, 2015). Further, the potential of cyberattacks is now ominous, with consequences for crisis stability among other matters (Cimbala, 2018b). To make things worse, NC3 now depends increasingly on integrated systems and software that are too complex ever to be fully verified. Many accidents may just be waiting to happen (Hayes, 2018a).

I was struck in writing this paper by how differently the NC2 requirements might be framed now, relative to when I was a DoD nuclear analyst in the Cold War. It is not so much that new issues exist (although some do), but rather that the relative importance of issues and cases has changed. This point is sometimes lost in discussions about the decrepit state of infrastructure, the high costs of modernization, cyber threats, and controversial matters such as whether the United States should be developing new weapons, including new low-yield weapons.

[2] [2]John Steinbruner, sensitive to how people often exhibit non-rational behavior, raised such issues early (Steinbruner, 1976). I confronted some of them, speculating about what, *really*, might motivate someone to launch (e.g., desperation and a sense of responsibility) (Davis, 1989).

Table 2 Requirements, Then and Now

Cold War Requirements	*Possible Requirements for Today*	*Questions*
Certainty of massive and immediate retaliation to Soviet attack • Even after surprise first strike • Even with worst-case assumptions about system survivability • Related need for hedges – Launch under attack (LUA) – Pre-delegation (seldom discussed) – Redundant targeting	As before but with less concern about surprise first strike and with more attention on plausible vulnerabilities to cyberattack than on worst-case assumptions	Why require extreme timeliness when disarming first strikes seem implausible? Why should LUA ever be required? Should pre-delegation be disallowed? Do reduced arsenals imply lower goals for retaliatory damage? Do smaller forces create incentives for countervalue responses?[a]
Ability to manage and execute nuclear employment options that may be – Small and demonstrative – Limited but both demonstrative and lethal – Full counterforce and/or countermilitary – As last resort, countervalue – With target withholds (e.g., Soviet NC3).	As before but with much smaller arsenals and less emphasis on massive counterforce or countermilitary attacks	Isn't prolonged full-scale nuclear war much less likely and viable, but prolonged limited nuclear war more plausible than before? Do smaller forces create incentives for countervalue responses?[a]
Coercive power and NC3 capability to deescalate on favorable terms	As before and with more emphasis on deescalation per se and on economic and political power to win battle of residual capability	
Support escalation control and even escalation dominance	As before, but escalation dominance is no longer feasible (if it ever was after the 1960s)[a]	Is anything lost if the US and NATO use "strategic" platforms for theater-level purposes?[b]

Table 2 is my attempt to show some contrasts. It describes the high-priority requirements during

the Cold War in the first column and my sense of what related requirements would look like today in the second column.

Zero tolerance for mistakes (false warning of attack, mishandling of weapons, insubordination)	Even more important than previously	How can the quality and dedication of "human capital" in NC3 be improved even though the mission is less prestigious?
Effective prolonged nuclear warfighting if deterrence fails	As before and perhaps more so	What might "prolonged nuclear warfighting" be like given the more numerous nuclear states?
Legitimate political control and sound decision processes	As strongly as before but with heightened concerns	What have we learned on this matter?
• Continuity of government	• Checks on Presidential actions • Wise decision aids	What would be constitutional and appropriate?
Continued control by the Presidency • Communication • Continuity of government	Even more than before (presumably less difficult)	Should pre-delegation be anathema except perhaps in extreme crisis?
Superior quality of NC3 for strategic competitiveness,	As before	

[a] See the rethinking of nuclear matters in Cimbala, 2018a, especially Chapters 4 and 5.

[b] One concern is ambiguity: would a limited use be misinterpreted and trigger Armageddon? That concern has been exaggerated (National Academy of Sciences, 2008, pp. 61-84; Miller, 2018a).

The third column poses some questions.[3] Table 2 reflects my own review of Cold War strategic thinking (Davis et al., 2016, pp. 2-14). It includes as objectives the always-controversial objectives associated with limited war, prolonged war, and long-term strategic competition. See also Chapter 2 of National Research Council, 2014.

[3] Table 2 reflects my own review of Cold War strategic thinking (Davis et al., 2016, pp. 2-14). It includes as objectives the always-controversial objectives associated with limited war, prolonged war, and long-term strategic competition. See also Chapter 2 of National Research Council, 2014.

Figure 1: A factor-tree depiction of NC2 requirements

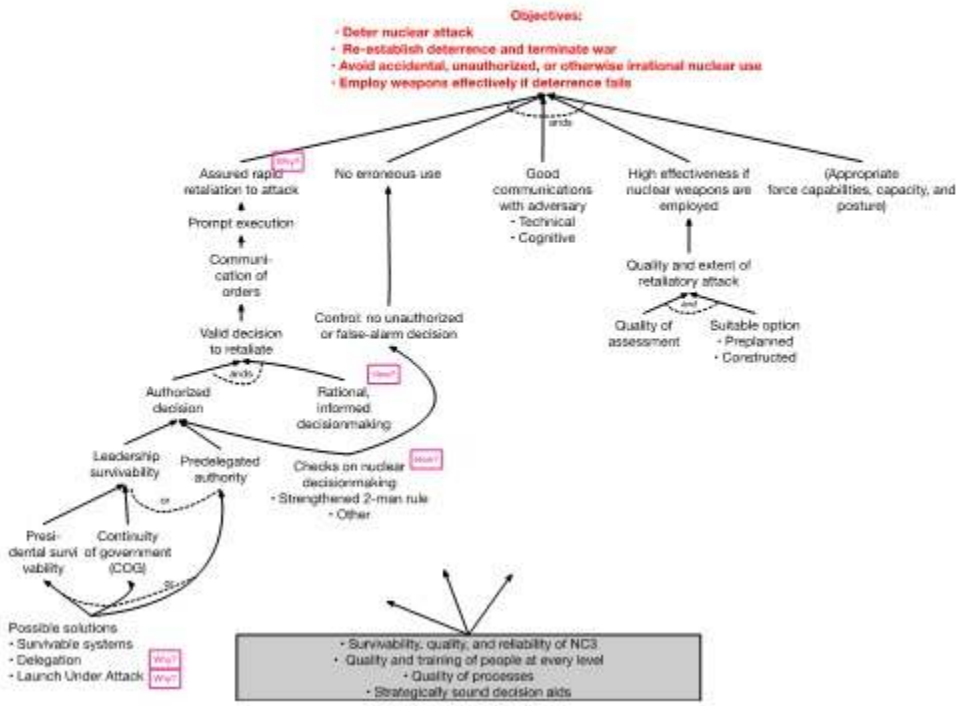

Figure 1 shows a related factor-tree depiction of issues.[4] Objectives are shown at the top and an approximate hierarchy of factors contributing to achieving the objectives are shown below. The first tier of factors decomposes the objectives. The factors are connected by "ands" because the objective is to achieve *all* of them—to include employing nuclear weapons effectively if deterrence fails. Toward the lower left, Figure 1 indicates that an authorized decision to retaliate could be accomplished by assuring survival of leadership *or* by pre delegating authority. Assuring survival of leadership long enough to order retaliation might be achieved by riding out an attack or launch-under-attack (LUA). Obtaining an authorized decision, however, is not enough. As indicated by factors to the immediate right, the decision needs to be legitimate, rational, and well informed. Although some of those involved with nuclear strategy and NC3 have been concerned about these issues, most effort on NC3 has gone into engineering capabilities and procedures to implement whatever the President's decision is. The issue was highlighted in the last days in office of President Nixon—an extraordinary period when Nixon was drinking heavily, sleep-deprived, depressed, and anxious as the Watergate Crisis unfolded (Weiner, 2015).[5]

[4] Factor trees are simplified versions of influence diagrams (Davis and O'Mahony, 2017). They indicate the approximately hierarchical factors causing an effect *at a point in time*.

[5] Mr. Schlesinger, as he confirmed years later, became so worried that Nixon was unstable that he instructed the military not to react to White House orders, particularly on nuclear arms, unless cleared by him or Secretary of State Henry A. Kissinger. He reportedly also drew up plans to deploy troops in Washington in the event of any problems

Conclusion

As characterized as recently as 2016 by the former CIA director Gen. Michael Hayden, the NC3 system for launching U.S. nuclear weapons "is designed for speed and decisiveness. It's not designed to debate the decision" (Lewis, 2016). Similar points have been made for decades. It has long since been time to re-conceive the system. This paper is a think piece to provoke discussion. With the benefits of a full study and associated facts my own attitudes might change. Nonetheless, I suggest consideration of the following when designing, modernizing, and evaluating NC2 and NC3. Considering them seriously seems appropriate even if (as do I) one opposes further reductions in U.S. strategic nuclear weapons, applauds nuclear modernization, and thinks well overall of the new Nuclear Posture Review (NPR) (Department of Defense, 2018).[6] In any case, my candidates for serious consideration are as follows.[7]

Requirements and Authorities

- Assume that nuclear response after a surprise nuclear use could reasonably be delayed for many hours, allowing for maintaining the presidency's control through continuity of government measures as necessary and for deliberation. Corollary steps would then be reasonable:
    - Banish Launch Under Attack (LUA) postures and procedures except as an option under conditions of extreme alert. Even then, do not allow a LUA posture to be the default.[8]

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with a peaceful presidential succession" (McFadden, 2014; Hirsh, 1983). This report was seemingly contradicted by Schlesinger in an oral interview in which he said that his concern was only assuring proper chain of command and, in particular, protecting against the directives of "hotheaded free-lancers" in the White House (Naftali, 2007, pp. 39-40). It may be that Schlesinger, understanding the constitutional limits of his authority, finessed the matter in his interview. Since he was confident that any troublesome orders would come through Nixon's national security advisor (i.e., not from Nixon himself), he could rightfully interject himself to assure adherence to the chain of command.

[6] For debate on the NPR, see, e.g., Miller, 2018b; Acton, 2018; Miller, 2018a; Rose, 2018

[7] Longer lists often include admonish not to attack the adversary's NC3 and to maintain NC3 distinct from that for conventional war. I am skeptical.

[8] LUA was the Cold War operational default, despite policymaker intentions (Blair, 2004; Butler, 2016). Most strategists deplore a LUA posture, although favoring the technical capability. Harold Brown made clear that he did not see LUA as a long-term solution (Brown, 1981, p. 41). Although he lost the debate within the Reagan administration, Under Secretary of Defense for Policy Fred Iklé described LUA as a "hair trigger and irresponsible" (Mohr, 1982). The Soviets had related internal debates and developed a system called "Dead Hand" or "Perimeter" (Hoffman, 2009) that would assure retaliation if the Soviet Union were attacked and its leadership disconnected. Those acquainted with historical false alarms are particularly wary of LUA. On 9 November 1979, National Security Advisor Zbegniew Brzezinski received a 3 a.m. call about the North American Aerospace Command (NORAD) reporting a large-scale Soviet attack. A follow-up call confirmed the attack. That, fortunately, was followed by yet another call declaring a false alarm. Not until 2012 were details released, including admission that the news media had been given false reports underplaying the seriousness with which the warning was taken at the time and the source of error. The claim had been that an airman had inserted the wrong training tape; the truth was that the alarm had been due to a software glitch that apparently could not be reproduced (Burr, 2012).

    - Banish pre-delegation of nuclear authority except as an option under high or extreme alert.[9]
    - Banish chain pre-delegation of nuclear authority (e.g., through the chain of President, combatant commanded, major subordinate command, to each service's group commanders) except as an option in ongoing war.
- Require the President to establish a mechanism to assure that the President cannot authorize first use of nuclear weapons without assent by an independent authority (e.g., Congressional leaders or the Secretary of Defense)[10] unless Congress has already given its assent to war.[11]
- Use Congressional action and Presidential guidance warning relevant parties to recognize as potentially unlawful (1) any nuclear-use orders inconsistent with standing procedures regarding the conditions of delegation or (2) White House orders issued without evidence of deliberate decision making.[12]
- Assure that any decision aids are not biased toward a military warfighting perspective.[13]

The Personnel System

- Create incentives for some of the best officers to do *finite* but significant tours responsible for nuclear weapons (and other weapons of mass destruction), and to develop related knowledge, wisdom, and leadership skills (it is doubtful that nuclear-weapon work will again be an attractive full-career field for many top officers).

Standards and Threat Assessments

- Re-establish and enforce the zero-tolerance mindset for nuclear-weapon and NC3 management.
- Deemphasize cost effectiveness and reinstate the importance of redundancy and avoiding common-mode failures.

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[9] A variant would allow pre-delegation to SSBN commanders in periods of major tension with peer powers.

[10] Such a precaution would have limitations, since the President could replace the Secretary of Defense.

[11] Many constitutional issues could be resolved with appropriate language, as considered in the "Restricting First Use" bill introduced in Congress during the Obama and Trump administrations to restrict the President's authority to launch a nuclear *first* strike (Mulligan, 2017).

[12] Confirming evidence might be, e.g., earlier alert orders or orders with the concurrence of the Secretary of Defense.

[13] Such a biased perspective might focus on the post-exchange ratio of nuclear capability. Better decision aids would also characterize devastation levels, the usefulness of residual force, and sensitivity to assumptions (e.g., *how certain* is the massive attack said to be imminent or underway?) (Davis, 1989).

- In evaluating the certainty of minimum NC3 effectiveness, use independentexperts to assure that all threats are considered.

Most of these ideas have been suggested by others over the years, e.g., Senator Sam Nunn (Nunn, 2004) and Bruce Blair (Blair, 2018). A paper by Jerome Conley describes the issues in terms of adjusting the balance between positive and negative controls (Conley, 2007). Figure 2 is adapted from that work (see also Virginia Tech Applied Research Corporation, 2015). Peter Hayes has collected a number of possible norms that might be considered (Hayes, 2018b).

Figure 2: Balancing the always-never challenge

Increased relative emphasis ←

	Negative Controls (-)	Positive Controls (+)
Procedural Controls	• Delayed retaliation posture • N-first use or Launch on Warning • Two-person rue • Restricted access to launch codes • Separation of warhead components • Separation of warheads & vehicles • Other	• Airborne alert status • Launch on Warning (LOW) posture • Strip alert for strategic bombers • Pre-delegation of launch authority • Final assembly of warhead • Mating warhead with delivery vehicles • Other
Technical controls	• One-point safety warhead design • Mechanical/electrical locks • Fail safe weapon designs • Electrical exclusion regions • Weak-link designs • Environmental sensing devices • Other	• Fully automated launch system • Frequency diversity • Hardened communication systems • Sea-based delivery vehicles • Mobile Command systems/posts • Jam/interference resistance • Other

Source: Adapted modestly from Conley, 2007.

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III. ENDNOTES

IV. TECHNOLOGY FOR GLOBAL SECURITY INVITES YOUR RESPONSE

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