A Briefing Paper from

Hudson Institute

Nuclear Weapons Reconstitution and its Discontents: Challenges of "Weaponless Deterrence"

Christopher Ford

November 2010

Hudson Institute
1015 15th Street, N.W.
Sixth Floor
Washington, DC 20005
www.hudson.org

Nuclear Weapons Reconstitution and its Discontents: Challenges of "Weaponless Deterrence"

by

Christopher A. Ford*

Submitted to the Conference on "Nuclear Deterrence: Its Past and Future"
Hoover Institution
(November 11-12, 2010)

Synopsis

Countervailing reconstitution (CR) – also known as "weaponless deterrence" or "virtual nuclear arsenals" – is a concept with roots going back to the beginning of the nuclear age, but which became a part of modern disarmament debates with Jonathan Schell's book The Abolition *in 1984. This paper explores a range of issues raised by CR's central insight of trying to find a way to take advantage of nuclear deterrent dynamics in order to help provide stability against "breakout" from a regime abolishing nuclear weapons.*

The study begins by discussing and evaluating a range of crisis stability critiques made against reconstitution theory by Herman Kahn, Thomas Schelling, Kenneth Waltz, and others, explains the analytical and practical connections between reconstitution theory and current debates over nuclear force "de-alerting," and surveys a range of issues and concerns raised by this specific application of nuclear deterrence. Among the matters discussed are: challenges of crisis stability and reconstitution "racing"; incentives for weapon design and reconstitutive technology development; the impact of missile defense and other defensive systems; "wildfire proliferation"; and problems of CR survivability. These questions are examined in particular with respect to what is termed herein a possible "Tier One" reconstitution policy – that is, the maintenance of a CR capability after the point of weapons abolition, as a matter of deliberate policy, and with deterrent and strategic "hedging" purposes in mind, rather than simply

---

* Dr. Ford is a Senior Fellow at Hudson Institute in Washington, D.C. A former U.S. Special Representative for Nuclear Nonproliferation and Principal Deputy Assistant Secretary of State, he is a reserve intelligence officer in the U.S. Navy, an ordained chaplain in the Zen Peacemaker Order of Soto Zen Buddhism, and a contributing editor for *The New Atlantis* magazine. He runs the *New Paradigms Forum* website (www.NewParadigmsForum.com), and may be contacted at ford@hudson.org. The author is grateful to the Carnegie Corporation of New York for its generous support and encouragement for this study, and to the many experts at the Los Alamos and Sandia National Laboratories who graciously agreed to be interviewed in the preparation of this report.

as a byproduct "option" resulting from the possession of dual-use nuclear technology.

*The next part of this study examines some of the various practical and programmatic challenges that might arise if a major industrial and nuclear-knowledgeable power (*e.g.*, the United States) tried to implement a thoroughgoing "Tier One" CR policy as a post-abolition nuclear security strategy. Drawing in part upon the post-Cold War experiences of the U.S. nuclear weapons complex, it explores the many challenges of such an approach, including: uncertainties in sizing a reconstituted nuclear arsenal and its associated infrastructure based upon post-"zero" concepts of potential nuclear use and considerations of redundancy and survivability; issues of re-learning, human capital management, and knowledge retention; verification problems; delivery system retention; and the challenge resisting program atrophy over time.*

The study concludes by suggesting that despite the many challenges suggested by these excursions into reconstitution theory and programmatics, CR seems nonetheless to be securing for itself an enduring role at least *as tool for facilitating some additional weapons reductions. Even were "Tier One" CR deemed to be unmanageably problematic through the prism of "nuclear zero," therefore – or were "zero" itself deemed too unworkable for a deterrence-based theory such as CR to salvage it – the basic idea of substituting* potential *weapons for "weapons-in-being" remains a valuable one.*

I. *Countervailing Reconstitution as a Disarmament Tool*

Though it has not always received the analytical attention it deserves – leading some proponents to describe the question of its costs, benefits, and risks as being "terra incognita"[1] – the idea of developing approaches to nuclear deterrence that rely not upon the *actual* but rather upon the *potential* existence of nuclear weapons dates almost to the beginning of the nuclear age. This concept has been known by various names, including "weaponless deterrence," "virtual nuclear weapons," and "countervailing reconstitution," but it has a conceptual genealogy with an antiquity akin to that of weapons-based nuclear deterrence itself. It remains controversial – and not without reason, as we shall see – but it may already be contributing to success in reducing the nuclear arsenals of at least some possessor states, may well be at some level inescapable no matter *what* is done with existing nuclear stockpiles, and certainly deserves consideration as a potential means to handle at least *some* of the challenges of deterring "breakout" from any abolition regime that might eventually be achieved. This paper, the initial work product of a

---

1 Marc Dean Millot, Roger Molander, & Peter A. Wilson, *"The Day After ..." Study: Nuclear Proliferation in the Post-Cold War World*, MR266-AF (Santa Monica, California: RAND Corporation, 1993), Volume I, at 14 (discussing "virtual abolition" of nuclear weapons); *see also* Brad Roberts, "On Order, Stability, and Nuclear Abolition," *in* George Perkovich & James M. Acton, *Abolishing Nuclear Weapons: A Debate* (Washington, D.C.: Carnegie Endowment for International Peace, 2009), at 163, at 168 ("We know well what restraint the abolition vision requires, but we know far less about what deterrence that vision requires.").

study undertaken by Hudson Institute with funding from the Carnegie Corporation of New York, will examine the issue in some detail.

In this study, I will favor the term "countervailing reconstitution" (CR) as a means to denote the deliberate maintenance of a nuclear weapons *production capacity* in order to provide at least some states – presumably, but not necessarily or exclusively, the nuclear weapons states (NWS) presently recognized by the Nuclear Nonproliferation Treaty (NPT)[2] – with the ability to conjure up a nuclear military capability relatively quickly in response to another country's moves to begin or resume nuclear weapons production, or in response to the discovery of a clandestine cache of illicit weaponry. The specific terminology used, however, is less important than the basic insight: that it may not be necessary always to rely upon actual "weapons-in-being" in order to take advantage of whatever stability nuclear deterrence could be said to offer.

A. *The Genealogy of CR*

(1) *The Acheson-Lilienthal Report*

This idea goes all the way back to early 1946, only months after the existence of nuclear weaponry was revealed to the world by the instant destruction first of Hiroshima and then of Nagasaki as the closing act of the Second World War. The Acheson-Lilienthal Report – America's first serious attempt to deal with the emerging long-term challenges and strategic issues presented by the new world then being created by the advent of atomic firepower – envisioned an elaborate scheme for controlling nuclear energy through an international authority, denying national governments (including the United States) any ownership of nuclear technology. Most of this scheme, subsequently embodied in the famous but ill-fated Baruch Plan presented to the young United Nations, is not relevant for present purposes. Significantly, however, the Acheson-Lilienthal Report included a remarkable appeal to what was in effect the idea of countervailing reconstitution.

Central to the problem of international ownership and control of nuclear energy was the challenge of how to prevent nation-states from breaking the rules and developing a national nuclear weapons capability with which they could intimidate and overawe others. This challenge was made particularly acute by the largely unavoidable fact that internationally-run nuclear facilities (*e.g.*, for uranium mining, reactor fuel production, and electric power generation) had to be located *somewhere*, and it was very difficult to envision an international authority capable of militarily defending facilities against aggressive moves by the security services and armed forces of their host governments. To address this problem – that is, the fact that facility and material seizure, and hence an atomic weapons "breakout" capability, was essentially unpreventable by direct physical means – the Report imagined seizure being nonetheless *deterrable*.

---

[2] This term is meant to reflect the potential utility of nuclear weapons manufacture in (a) facilitating nuclear reductions by providing current possessors with a strategic "hedge" against worsening threats, and (b) providing one or more countries with a potential response to "breakout" from an abolition regime. The "*re*" in "reconstitution" thus encompasses two possibilities: the ability of a current possessor to *rebuild* its shrinking arsenal in a contingency, and the potential *re-emergence* of some nuclear weapons in a disarmed world.

With the critical production facilities that had produced the Hiroshima and Nagasaki weapons located in the United States, the Report noted, other nations would likely feel no real security against atomic warfare – even under an international control regime run by the proposed Atomic Development Authority – "except the security that resides in our own peaceful purposes or the attempt at security that is seen in developing secret atomic enterprises of their own." This was felt to be an unstable situation, with asymmetry in the physical location of what were in effect *seizable* weapons-facilitating plants giving any who might dislike or fear the Americans powerful incentives to cheat. To reduce this danger, the Report envisioned that the Authority would deliberately "locate[] similar dangerous operations within the[] borders" of *other* countries as well.[3]

The idea was to engineer something of an *incipient* strategic balance of terror by distributing the possession of *potential* weapons production capabilities. This would, it was hoped, help preserve the security of any *particular* facility against seizure by the knowledge that any such violation would quickly be followed *and countered* by *other* countries' seizure of analogous facilities that would give these states, too, the ability to produce nuclear weapons. The Authority's inability to preclude seizure might thus be turned into an advantage by distributing facilities amongst the key players in the international system on the basis of "strategic" calculations and "security considerations" designed to ensure preservation of "the physical balance between nations."[4] The resulting ability of *all* key players to expropriate facilities and turn them to weapons purposes would, it was felt, help ensure that no one would actually feel it worthwhile to do so:

> "Once such operations and facilities have been established by the Atomic Development Authority and are being operated by that agency within other nations as well as within our own, a balance will have been established. It is not thought that the Atomic Development Authority could protect its plants by military force from the overwhelming power of the nation in which they are situated. Some United Nations military guard may be desirable. But at most, it could be little more than a token. The real protection will lie in the fact that if any nation seizes the plants or the stockpiles that are situated in its territory, other nations will have similar facilities and materials situated within their own borders so that the act of seizure need not place them at a disadvantage."[5]

The prospect of a multi-player nuclear armament race, therefore – a situation which would preclude anyone's achievement of a nuclear weapons monopoly and was thus felt likely to undercut any strategic gains a violator might anticipate from regime "breakout" – was expected to help deter violations of the nuclear technology control regime established under the proposed Authority. Potential atomic weapons, in other words, would deter the pursuit of actual ones.

---

3 Report on the International Control of Atomic Energy (March 16, 1946) [a.k.a. Acheson-Lilienthal Report] (Washington, D.C.: U.S. Government Printing Office, 1946 [U.S. Department of State, Publication 2498]), at 47.

4 Acheson-Lilienthal Report, *supra*, at 48-49.

5 *Id.*, at 47.

(2) *Cold War Analyses*

This idea seems to have been largely forgotten in subsequent years, during the early escalation of the nuclear arms race that followed the Soviet Union's success in testing its own weapon in 1949. The idea that productive capacity might at least *contribute* to deterrence, however, was not forgotten. In 1960, for instance, the seminal nuclear strategist Herman Kahn made the general point – applicable to many areas of military technology, not merely to nuclear weaponry – that "one of the major values of a Preattack Mobilization Base may well be in an arms control situation."[6] "Mobilization capabilities," he subsequently explained, "can reinforce arms control, particularly in making so-called 'breakout' effects unprofitable." If a nation can react quickly to violations of an arms-control agreement or unwelcome shift in the strategic balance, he wrote,

> "that nation will be much more secure in accepting agreements with some potential problems (like breakout) than if it did not have a mobilization base with which to enforce the arms limitations. Thus, maintenance of a mobilization base can help the United States in pursuing its arms control objectives in peacetime, deterring provocations that disrupt the international order, resolving crises on terms consistent with our security interests, and waging war successfully if deterrence breaks down."[7]

Confronting Moscow with the prospect of an accelerated technological and material arms race, Kahn believed, might help deter cheating on arms control agreements: "an effective mobilization base" would make such a penalty for cheating "very credible to any Soviet leaders contemplating the costs and benefits of violating an arms treaty."[8]

Disarmament activist Jonathan Schell – coming at these issues from a perspective quite different from Kahn, who was notoriously willing to "think the unthinkable" about potential nuclear war – offered his own contribution to the subject beginning in 1978, and most elaborately with his publication of *The Abolition* in 1984. According to Schell, the problem with disarmament planning prior to that point had been the lack of "a way of abolishing nuclear weapons that does not require us to found a world government, which the world shows virtually no interest in founding." To break this impasse – exemplified by the collapse of the Acheson-Lilienthal Report's idea of an Atomic Development Authority – Schell proposed not repudiating but actually *taking advantage of* the "solid" foundations of nuclear deterrence.[9]

This was possible, he argued, because "the knowledge" of how to build nuclear weapons could not be erased from mankind's collective memory – and *this knowledge itself*, rather than any actual nuclear weapons, could be relied upon to deter breakout from an abolition regime. In a world with such ineradicable knowledge, Schell contended, any one power's decision to "suddenly and swiftly build[] up, and perhaps actually us[e], an overwhelming nuclear arsenal"

---

6 Herman Kahn, *On Thermonuclear War* (Princeton, New Jersey: Princeton University Press, 1960), at 250.

7 Herman Kahn, *Thinking About the Unthinkable in the 1980s* (New York: Simon & Schuster, 1984), at 162-63.

8 *Id.*, at 198.

9 Jonathan Schell, *The Abolition* (New York: Alfred A. Knopf, 1984), at 88 & 100.

would be met by "a response in kind: a similar nuclear buildup by the threatened nations, returning the world to something like the balance of terror as we know it today."[10] Observing that "deterrence doesn't dissolve when the weapons are abolished," he envisioned the deliberate maintenance of a countervailing reconstitution capability, whereby the abolition regime would permit (and regulate) the upkeep of "considerable preparations for the manufacture of nuclear arms" with which key players would "hold themselves in a particular, defined state of readiness for nuclear rearmament."[11]

This ability of multiple players quickly to become – or in the case of the NWS, return to the status of – formidable nuclear weapons powers would be "the final guarantor of the safety of nations against attack," making nuclear force just as "self-canceling" in the *absence* of any weapons as he felt it to be in the deadly nuclear standoff of the Cold War. The abolition agreement, in other words, would represent "an *extension* of the doctrine of deterrence: an extension in which the most terrifying features of the doctrine would be greatly mitigated, although not finally removed." In this system of "weaponless deterrence," Schell said, "factory would deter factory, blueprint would deter blueprint, equation would deter equation." The *knowledge* of how to rebuild the weapons was thus "just the thing that would make abolition *possible*, because it would keep deterrence in force."[12]

(3) *CR in the Post-Cold War Era*

In 1990, a pair of defense industry consultants named Ted Gold and Rich Wagner built upon Kahn-style observations about the potential value of an industrial base for military mobilization in noting that "a developed and demonstrated *potential* to produce or deploy certain systems" should in fact be considered "a product in its own right," because it "can provide options and hedges against an unknown future and mitigate the consequences of surprise." Perhaps more importantly, they believed,

> "the potential of future deployment can influence possible adversaries' behavior: providing incentives for arms control, dissuading against cheating and breakout of treaties, convincing them, now or at some future time, that they would have nothing to gain from resuming a military build-up. In effect, the R&D casts a long shadow forward, its influence felt long before any deployment."[13]

Viewing a post-Cold War environment that was then just beginning to emerge, they suggested shifting increasingly to a "rearmament paradigm" in which small standing forces would be augmented by a potent mobilization base, with *potential* weapons – that is, "a 'virtual deployment' … brought to within some time before actual deployment ... and then put on hold to be maintained at that (or a time-varying) state of future deploy ability" – thus helping to augment the deterrent effect of existing ones, which could for this reason safely be possessed in smaller

---

10 Schell, *The Abolition*, *supra*, at 117.

11 *Id.*, at 118.

12 *Id.*, at 118-20 (emphasis added).

13 Ted Gold & Rich Wagner, "Long Shadows and Virtual Swords: Managing Defense Resources in the Changing Security Environment," unpublished paper (January 1990), at 3 (emphasis added).

numbers.[14] Theirs was a general observation about post-Cold War armaments, but they did not ignore the potential impact of this logic in the nuclear weapons arena, noting that some nations seemed *already* to manage nuclear weapons research and development in this fashion.[15]

In 1993, a RAND Corporation study for the U.S. Air Force developed the concept somewhat further, and in a specifically nuclear context. One of the scenarios it envisioned was "[t]he 'virtual abolition' of nuclear arsenals undewritten by a comprehensive and intrusive international inspection and enforcement regime."[16] As with the Gold and Wagner analysis, this RAND study did not expressly suggest countervailing reconstitution as a potential solution to the problem of deterring breakout from an *actual abolition* regime, as the Acheson-Lilienthal Report and Jonathan Schell had envisioned. It pondered instead a system in which CR would help *facilitate* reductions, making it safer for possessors to go lower, but in which they would still retain "a small number of nuclear weapons required to deter nuclear attacks on their homelands." (The possession of *actual* weapons would be "heavily de-emphasized," in other words, but not entirely ended.) The key idea, however, was that "a 'virtual nuclear arsenal' of nuclear weapons production capability" would help "to hedge against breakout from the regime."[17] Maintenance of a capability to reconstitute a potent weapons program in response to breakout, it was suggested – which two of the study's authors subsequently explained meant that "[t]he United States and other major powers would ... plan to be able to rebuild large nuclear arsenals (*i.e.*, many hundreds or even one or two thousand nuclear weapons) in a relatively short time (*e.g.*, a matter of months)"[18] – would permit "virtual denuclearization by the major powers."[19]

A major step forward in analyzing potential nuclear applications of the concept of CR came in 1997 with publication of an edited volume by Michael Mazarr that focused directly on the issue of "virtual nuclear arsenals" (VNAs). In his description, the VNA concept

> "seeks to remove all nuclear weapons from operational status by partially dismantling them – removing the warheads from the missiles, for example. Virtual nuclear arsenals aim to achieve some of the advatanges of complete nucllear disarmanent, removing all nuclear weapons from day-to-day operational status and thereby seeking to push them to the margins of world politics while allowing current nuclear powers to retain some of the core missions for nuclear forces by threatening to rebuild a few dozen weapons within a period of a few days or weeks."[20]

---

14 Gold & Wagner, "Long Shadows and Virtual Swords," *supra*, at 5 *et seq.*

15 *Id.*

16 Millot, et al., *"The Day After ..."* Volume I, *supra*, at 10.

17 *Id.*, at 10, 12, & 14.

18 Roger C. Molander & Peter A. Wilson, *The Nuclear Asymptote: On Containing Nuclear Proliferation*, MR-214-CC (Santa Monica, California: RAND Corporation, 1993), at 49.

19 Marc Dean Millot, Roger Molander, & Peter A. Wilson, *"The Day After ..." Study: Nuclear Proliferation in the Post-Cold War World*, MR252-AF (Santa Monica, California: RAND Corporation, 1993), Volume II, at 60.

20 Michael J. Mazarr, "The Notion of Virtual Arsenals," *in Nuclear Weapons in a Transformed World* (Michael J. Mazarr, ed.) (New York: St. Martin's Press, 1997), at 3, 4.

With VNAs, he explained, "nation-states would retain components of strategic nuclear arsenals – missiles, guidance sets, fissile material, warheads – that could be reassembled within a given amount of time."[21]

B. *Reconstitution and U.S. Policy*

Apparently somewhat to the surprise of disarmament activists, the concept of countervailing reconstitution received an additional boost a decade later during the administration of President George W. Bush, when the United States explicitly endorsed it as a subject worthy of study on account of its potential contribution to nuclear weapons abolition. As I explained it in 2007 on behalf of the U.S. Government, CR had *already* been

> "incorporated explicitly into U.S. nuclear weapons planning as a way to provide a 'hedge' against a technical surprise or geopolitical risk. As directed by President Bush, and later codified in the Moscow Treaty, we are steadily reducing our numbers of 'operationally deployed strategic nuclear weapons' toward the band of target numbers set by that agreement for the year 2012. At the same time, we are continuing with – and indeed accelerating – our program for dismantling nuclear weapons. We are not yet, however, dismantling every single warhead that we remove from 'operationally-deployed' status. For now, at least, we feel it necessary to keep some warheads in existence, but in a non-deployed status, in case some unanticipated unfavorable change should occur in the strategic environment or a technical problem arise with any of our delivery systems or warheads that would render that portion of our deterrent ineffective."[22]

The logic of productive capacity as a potential replacement for weapons-in-being, therefore, was officially declared sound – and a key question for disarmament was presented in whether this logic could be pushed to the asymptote of abolition. With these remarks, the Bush Administration suggested that "[t]he possibility that the potential availability of countervailing reconstitution would need to be a part of deterring 'breakout' from a zero-weapons regime."[23]

C. *Current Debates*

Hypothesizing that for some countries in some circumstances, nuclear weapons may yet have "deterrence/security value" even when these countries possess *no* actual weapons, a subsequent treatment in 2009 by Garry George also endorsed the idea of "[nuclear] deterrence

---

21 *Id.*, at 5.

22 Christopher A. Ford, U.S. Special Representative for Nuclear Nonproliferation, "Disarmament and Nuclear Security in Tomorrow's World," remarks at the Conference on Disarmament and Nonproliferation Issues, Nagasaki, Japan (August 31, 2007), *available at* http://www.newparadigmsforum.com/NPFtestsite/?m=20070831. This thinking was further discussed in my subsequent remarks – now in a private capacity – to a conference at the Hoover Institution in 2009. *See* Christopher A. Ford, "Learning to Speak Disarmament in the Language of Security," remarks to the "Conference on a World Without Nuclear Weapons: End-State Issues," Hoover Institution (September 29, 2009), *available at* http://www.newparadigmsforum.com/NPFtestsite/?m=200909.

23 Ford, "Disarmament and Nuclear Security in Tomorrow's World," *supra*.

that is fully based on latency."[24] The CR concept is also addressed in not unfavorable terms by Sidney Drell and Raymond Jeanloz.[25]

There certainly has been no shortage of people who have expressed grave doubts either about the feasibility of CR to provide the requisite level of stability at a nuclear "zero," or about its merit on other grounds. As George Perkovich and James Acton recounted in 2009, in their own summary of the countervailing reconstitution debate, some disarmament activists dislike the idea for "political" reasons, feeling that it "could undermine the principle of global nuclear equity championed by the many non-nuclear-weapons states dissatisfied with the current nuclear order."[26] Harald Müller, for instance, has argued that "[v]irtual arsenals, if meant as a fixed end state of disarmament, are a bad idea" in part because they "reinforce the mentality that nuclear war is possible at any time," and because they would prolong the existence of institutions ("arsenal-keepers") who have an interest in preventing the final abolition of all such capabilities.[27] By carving out a "precarious interim position between a nuclear weapons posture and a truly non-nuclear world," he writes, the CR concept might "undo the whole project of a nuclear weapon free world."[28]

Today, there seems to have developed a widespread understanding that states will probably insist upon at least *some* "hedging" against possible future threats in a more- or fully-disarmed world – and indeed that hedging strategies may to this degree be inescapable.[29] The concept of countervailing reconstitution, in which "an eventual nuclear breakout would probably be answered by other breakouts and the restoration of deterrence,"[30] remains controversial, but now forms an important theme in the modern disarmament debates.

Amidst the unquestioned certainties that have characterized so much of contemporary disarmament argumentation, therefore, CR thus stands on ambiguous ground, as an invitation, as it were, to question or reconceptualize what is meant by "zero" nuclear weapons in the first place.[31]

---

24 Garry J. George, "Integrated Nuclear Security in the 21st Century," Sandia Report SAND2009-5641 (October 2009), at 7 & 15.

25 *See* Sidney D. Drell and Raymond Jeanloz, "Nuclear Deterrence in a World without Nuclear Weapons," paper presented the Conference on *Deterrence: Its Past and Future* at the Hoover Institution (November 11, 2010). They note carefully, however, that it is not yet "clear that a world with no nuclear weapons is consistent with establishing strategic stability among nations on a global scale." *Id.* at 1.

26 Perkovich & Acton, *Abolishing Nuclear Weapons*, *supra*, at 122.

27 Harald Müller, "The Importance of Framework Conditions", in Perkovich & Acton, *Abolishing Nuclear Weapons*, *supra*, at 171, 175. For these reasons and others, Müller argues that virtual arsenals should "never" be conceived as end-state: at best, they should be seen only as "a transitory stage on the way to a more genuine zero." *Id.* at 176.

28 Harald Müller, "Enforcement of the rules in a nuclear weapon free world," paper presented to the Hoover Institution conference on "Deterrence: Its Past and Future" (November 11, 2010), at 2.

29 *See, e.g.*, Perkovich & Acton, *Abolishing Nuclear Weapons*, *supra*, at 117-18.

30 Achilles Zaluar, "A Realistic Approach to Nuclear Disarmament," *in* Perkovich & Acton, *Abolishing Nuclear Weapons*, *supra*, at 187, 199.

31 *Cf.* George, "Integrated Nuclear Security in the 21st Century," *supra*, at 29 & 31.

- Does it mean merely a sort of minimalist "*almost*-zero" – a *functional* zero, if you will – in which a handful of countries still possess a few such devices but "virtual" deterrence and prevalent defensive systems have made them more or less useless except as the expandable core of a "hedge" capability against ugly new changes in the security environment?

- Does "zero" instead mean simply no *deployment* of such devices, making full "disarmament" equate merely to the "de-alerting" of nuclear arsenals that is also propounded by the disarmament community (albeit usually as only a waystation on the road to full abolition)?

- Does it mean no national *ownership* of nuclear weapons, with the possibility held out of *international* control either of some kind of collective nuclear arsenal or a Baruch-style Atomic Development Authority?

- Does "zero" mean that no nuclear weapons exist, but that some capability to produce them is nonetheless maintained indefinitely and the principle of "irreversibility" is emphatically abandoned in favor of notions of "virtual" deterrence rooted in countervailing reconstitution?

- Does it mean that no weapons exist, and that ongoing international efforts will monitor or suppress the possession of facilitating technologies with the aim of ensuring that no one will *ever* reconstitute?

- Or does "zero" imply or require some transformed future world in which there no longer remains even the *desire* for such weaponry and nuclear deterrence is thus *itself* genuinely transcended?

As a suggestion that purports to offer a chance to eliminate weapons-in-being while yet retaining "nuclear deterrence" through a reliance upon *potential* weapons, CR has some on both the left and the right mulling over what potential it might have to facilitate further reductions, and perhaps even to counteract the powerful incentives *for* proliferation that near-total or complete nuclear disarmament would create. It CR, as Schell contended, the blade that can let the world undo the Gordian Knot of getting to "zero"?

Thanks to the generous support of the Carnegie Corporation, this paper offers a contribution to these debates, setting forth some thoughts on countervailing reconstitution in two parts. First, it will examine "big-picture" questions of the strengths and weaknesses of the CR concept as a tool of strategic stability, exploring these issues in a discussion that will focus heavily upon questions of crisis stability and will draw – as one might expect, given the fundamental aspiration of reconstitution thinking to *retain* nuclear deterrence even after the elimination of actual nuclear weapons – upon a long history of thinking about deterrence theory in the nuclear age. The second part of this paper will *assume* favorable answers to questions about the merit of CR – answers that the first part will *not* necessarily provide, but which it is useful here to posit as a sort of *gedanken* experiment – in order to explore the *programmatic*

issues that might arise were one actually to try to *pursue* countervailing reconstitution as a deliberate policy over the long-term.

It bears emphasis that if CR is to survive consideration as a policy option for struggling with disarmament, it must overcome challenges raised in each of the two parts of this study: it must be *both* a "good idea" on strategic and deterrence-theory grounds *and* something that is achievable and indefinitely maintainable in practical terms of technology, human capital, and funding. (After all, not all good ideas are feasible, nor are all feasible things advisable.) It is the hope of this study that the reader will hereafter be at least somewhat better equipped to evaluate countervailing reconstitution – and any potential policies that may be proposed to flow from this concept – with greater wisdom and insight.

D. *The Inescapability of CR*

Before going further, however, it is worth making an additional observation: many of the issues raised by the concept of countervailing reconstitution will likely remain with us, in *some* form, whether or not anyone adopts CR as a deliberate policy, and whether or not further nuclear disarmament is achieved. "Virtual nuclear deterrence" is in some sense *already* an important part of the world security environment, and seems in no danger of disappearing.

In fact, CR-type thinking has been important to U.S. nuclear strategy – and to American nuclear weapons reductions – ever since the end of the Cold War, with policies associated with the Strategic Arms Reduction Treaty (START) of 1991 setting a powerful precedent of combining shrinking operational forces with maintenance of a fairly large "reserve" force to hedge against the danger of a renewed souring of the strategic environment.[32] The authors of the abovementioned RAND study, in fact, speculated in 1993 that "something like a unilateral version of virtual abolition may already be in train" in the post-Cold War United States,[33] and indeed the Clinton Administration's 1994 *Nuclear Posture Review* explicitly adopted such a general goal. It articulated a "lead and hedge" strategy as a way to reduce the size of the deployed U.S. nuclear Force while retaining the ability to "respond to future challenges that could be more stressing than estimated at that time." Under this strategy,

> "the United States would take a 'lead' role in nuclear reductions, but would 'hedge' against adverse trends by retaining a significant number of non-deployed nuclear warheads that could be re-deployed, if warranted, and a force structure capable of uploading and employing those warheads, if needed."[34]

As the Bush Administration's comments in 2007 emphasized, CR is also already with us as an important facilitator for arms reductions. As U.S. officials – including this author – made clear at that time, efforts to modernize the U.S. nuclear weapons infrastructure into a smaller but more "responsive" complex capable of responding to future threats by *resuming* weapons

---

32 *See* Mazarr, "Virtual Nuclear Arsenals: A Second Look," *supra*, at 375.

33 Millot, et al., "*The Day After*," Volume II, *supra*, at 71.

34 U.S. Department of Energy and U.S. Department of Defense, *National Security and Nuclear Weapons in the 21st Century* (Washington, D.C.: Departments of Energy and Defense, September 2008), at 11; *see also id.*, from the forward, at *i*.

production are explicitly part of the rationale for continuing shrinkage in our "reserve" stockpile of non-deployed weapons. Under Bush, the United States sought to build upon the Clinton-era "lead and hedge" approach "by relying, over time, more heavily on a responsive nuclear weapons design and manufacturing infrastructure to manage risk, and less on an inventory of non-deployed warheads."[35] The Bush approach openly proclaimed itself to be "an extension of the approach first adopted in the 1990s and a testament to the continuing strength of these ideas."[36]

These essential elements of the CR concept have also been enthusiastically embraced by the Obama Administration, which declared in its 2010 *Nuclear Posture Review Report* that

> "As critical infrastructure is restored and modernized, it will allow the United States to begin to shift away from retaining large numbers of non-deployed warheads as a technical hedge, allowing additional reductions in the U.S. stockpile of non-deployed nuclear weapons over time."[37]

It is a longstanding plank of post-Cold War American strategy, therefore, both that non-deployed nuclear weapons can to some extent replace deployed devices, *and* that *potential* (*i.e.*, rapidly producable) weapons can to some extent replace weapons-in-being. (As Garry George has also noted, a variation on the theme of "virtual" deterrence has arguably also existed for many years, in the form of the "extended [nuclear] deterrence" the United States provides for allies who themselves possess no nuclear weapons.[38]) The key question for debates over countervailing reconsitution is whether this logic can be pushed to the "nuclear asymptote"[39] of weapons abolition.

Nor is this the only way in which CR seems *already* to be a reality. As many of those who have studied CR issues to date have recognized, "virtual deterrence" by *other* countries "already bedevil[s] U.S. deterrent policy,"[40] as can be seen in U.S. struggles in recent decades with proliferation challenges in Iraq, North Korea, Iran, Syria, and elsewhere. Clearly, the mere

---

35 *National Security and Nuclear Weapons in the 21st Century*, *supra*, from the forward, at i; *see also id.* at 2 (noting that "in the absence of a production capability for new warheads, the United States retains a significant stockpile of non-deployed legacy weapons as a hedge against technical failure of a warhead type and against adverse geopolitical or operational developments that could require augmentation of the force" and that Until a truly responsive nuclear infrastructure is operational, however, the United States will need to retain an appropriate inventory of non-deployed warheads to manage geopolitical, technical and operational risks"); *id.* at 10 ("A responsive infrastructure and a modern stockpile are needed to provide a cushion or hedge against [unforeseen threats].").

36 *Id.*, at 11; *see also, e.g.*, Steven W. Hatch et al. "Contributions of the Nuclear Weapons Complex and Stockpile to U.S. Defense Policy Goals," unpublished paper (August 2008), at 5 (noting that both the existing U.S. stockpile and the broader nuclear weapons complex contribute to deterrence because contingency responses to changing threats could involve actions ranging from re-deployment of warheads from the reserve stockpile to the development of new weapons).

37 U.S. Department of Defense, *Nuclear Posture Review Report* (Washington, D.C: Department of Defense, April 2010), at 40.

38 George, "Integrated Nuclear Security in the 21st Century," *supra*, at 14.

39 *Cf.* Molander & Wilson, *The Nuclear Asymptote*, *supra*.

40 Michael J. Mazarr, "Virtual Nuclear Arsenals: A Second Look," *in Nuclear Weapons in a Transformed World*, *supra*, at 369, 379.

prospect that a "rogue regime" might soon be able to develop nuclear weapons can have significant real-world consequences – either in deterrence or provocation.

As I have noted elsewhere,[41] some U.S. allies may also be said already to employ a sort of "proto-deterrence" whereby they are able to take advantage of Washington's *fear* that they *might* use a clearly-possessed technical capability to develop nuclear weapons. The possibility of such a response to regional security threats has helped make the Americans especially eager to re-emphasize the strength of their alliance guarantees to the possessor(s) of such "virtual" arsenals. In this fashion, one might say, potential *future* nuclear weapons are exploited in order to reap *current* security benefits – as Secretary of State Condoleeza Rice demonstrated in October 2006 on her hurried visit to Tokyo to reassure Japanese leaders of the solidity of the U.S. relationship in the wake of North Korea's first nuclear test. Responding to her assurances, Japanese Foreign Minister Taro Aso reassured the world that the Japanese government was "absolutely not considering a need to be armed by nuclear weapons," because this was not necessary in light of the "assurance by U.S. Secretary of State Rice that the bilateral alliance would work without fault."[42]

It has also been understood for years that the number of countries in a technical position to employ some kind of "virtual deterrence" – that is, those having some meaningful potential to develop nuclear weapons – has been increasing. By the time of Michael Mazarr's 1997 study of "virtual nuclear arsenals," for example, there were said to be "at least three dozen nations are now technically capable of building nuclear weapons, an option intextricably embedded in their scientific-technological know-how."[43] Perhaps as many as 40 were then "deemed technically capable" of building nuclear weapons, with a global total of 65 states then operating reactors, and of 22 "possessing or controlling separated plutonium."[44] Not all countries with nuclear weapons *potential* were equally "close" to actually having them, of course, but the numbers were striking – and have only grown in the intervening years.

As then-CIA Director James Woolsey observed in 1993 of India and Pakistan – which by then both clearly had "the capability to assemble the components of nuclear weapons ... within a very short period of time" – the "distinction between whether those weapons are in fact assembled or only able to be assembled within a few days is a very small distinction."[45] One should not oversell this point outside the context of South Asia prior to those governments' overt weaponization in 1998. As we will see below, details *do* matter, and most countries with latent arsenals certainly could not field arsenals "within a few days." Nonetheless, Woolsey's comment illustrates the point that "virtual nuclear deterrence" is to a great degree *already* a reality of our security environment. It would thus appear to be true – at least to some extent, at

---

41 *See, e.g.*, Christopher A. Ford, "To Repair, Reconstruct, or Re-imagine the NPT Regime" *in Strategic Asia 2009-2010* (Seattle: National Bureau of Asian Research, 2009), at 261, 276.

42 *Quoted by* Scott Conroy, "Rice Tries to Prevent Asian Arms Race," CBS News (October 18, 2006), *available at* http://www.cbsnews.com/stories/2006/10/18/world/main2100778.shtml.

43 Fred Charles Iklé, "Forward," *in Nuclear Weapons in a Transformed World*, *supra*, at ix.

44 Brad Roberts, "VNAs and the Contemporary Latent Weapon State," *in Nuclear Weapons in a Transformed World*, *supra*, at 263, 264.

45 *Quoted by* Devin Hagerty, "Virtual Nuclear Deterrence and the Opaque Proliferants," *in Nuclear Weapons in a Transformed World*, *supra*, at 239, 242.

any rate – that "the calculus of deterrence ... does not *axiomatically* require a nation-state to have deployed [weapons]."[46]

Most major industrial powers might be described as having "an inherent virtual arsenal with their extensive nuclear power infrastructure that may include facilities for the chemical reprocessing of plutonium as a future source of reactor fuel." [47] As Achilles Zaluar has observed, therefore, "virtual arsenals" presently "exist in many non-nuclear weapons states," and their proliferation should be regarded as "inevitable" because "every advanced industrial nation will retain, in the future, as today, at least a theoretical capability to build nuclear weapons."[48] Garry George agrees, arguing that "industrial nation-states will inevitably drift or grow towards a latent/virtual [nuclear weapons] capability" because of perceived needs for strategic hedging in a complex threat environment, improvements in overall science and technology competencies, increases in computing power and other commercially-available technologies useful for weapons development. In this context, he suggests, "intrinsic" and "knowledge-based" nuclear deterrent threats cannot help but influence international affairs.[49]

Even were countervailing reconstitution *not* to be adopted by any of today's possessor states as a deliberate policy, therefore, some of the dynamics discussed in this study might still operate. We would seem to be stuck, therefore, with having to give at least *some* thought to the challenges of "virtual nuclear deterrence." It is nonetheless useful to distinguish between (a) possession of a virtual arsenal as an almost unavoidable consequence of possessing a certain bundle of dual-use nuclear capabilities, and (b) possession of a virtual arsenal as the result of a *deliberate policy* of keeping this option available – especially in the case of present-day NWS reducing their arsenals and contemplating the possibility of a future nuclear "zero." It is this latter possibility that is the principal focus of this study, and which I will refer to herein as "Tier One" CR. To adopt a "Tier One" approach is to adopt countervailing reconstitution as policy. (The derivative or incidental possession of a latent arsenal is thus "Tier Two" CR.)

These categories have some basic similarities, but will likely differ considerably in their programmatic implications, and perhaps their behavior in terms of crisis stability. Of the two, "Tier One" approaches to countervailing reconstitution are for present purposes the most analytically interesting, for this kind of *purposive* CR already represents an explicit component of U.S. strategic planning, and it is talked of in some quarters as a means to facilitate further arms reductions and even to deter "breakout" in a future abolition regime. Accordingly, it is time to move to an examination of CR as a *application* of deterrence theory – and thence to a discussion of the challenges of actually implementing a "Tier One" approach if indeed its pursuit were thereby found to be advisable.

---

46 George, "Integrated Nuclear Security in the 21st Century," *supra*, at 18 (emphasis added).

47 Peter Wilson, "Issues of Force Structure, Nuclear Infrastructure, and Survivability," *in Nuclear Weapons in a Transformed World*, *supra*, at 77, 81.

48 Zaluar, "*A Realistic Approach to Nuclear Disarmament*," *supra*, at 199.

49 George, "Integrated Nuclear Security in the 21st Century," *supra*, at 19.

II. *The Big Picture: Good Idea, or False Hope?*

Because "Tier One" CR policy contemplates the deliberate maintenance of nuclear weaponry – and presumably to some extent the delivery systems that would be associated with such devices – in a state of *temporary* non-availability, one should regard the debate over "virtual nuclear arsenal" as the analytical sibling of longstanding discussions about the merits and demerits of nuclear force "de-alerting" as propounded by scholars such as Bruce Blair and others.[50] More specifically, in fact, one might describe de-alerting as a variation on "Tier One" CR policy in which nuclear weapons remain in *existence* but are not immediately available for use. Mere de-alerting is thus not the same as abolition, though one might reconceptualize CR policy as an extreme form of de-alerting in which the weapons *themselves* are disassembled rather than just "de-mated" from delivery systems or in some other way prevented from being quickly dispatched. The timeframe for abolition-based force-reconstitution would thus be notably longer than simply for "re-alerting" an arsenal of weapons-in-being, but the issues involved here are clearly closely related.

Some of the kinship between de-alerting and "virtual deterrence" debates can be seen in scholars' treatments of CR issues. As Garry George has observed, for instance, the existing practice of distinguishing within an overall nuclear weapons stockpile between deployed weapons and non-deployed devices which are nonetheless fully *usable*, in a technical sense, reflects a longstanding understanding of "logistics latency" as its own sort of short-term strategic hedge.[51] Conceptually speaking, this is basically the same kind of hedging represented by de-alerting – with warhead de-mating,[52] in fact, being a close variation on the theme of George's "logistics latency." As Mazarr has observed, the basic point of "virtual nuclear arsenals" is "to remove all nuclear weapons from operational status by partially dismantling them – removing the warheads from the missiles, for example."[53]

A. *Crisis Stability Challenges of CR*

(1) *Concerns*

In assessing the challenges of "Tier One" CR, therefore, it is useful to recount some of the deterrence-theory arguments most frequently made against de-alerting, because similar concerns are often raised about countervailing reconstitution as an answer to the problems of stability at "zero." In a companion paper presented at this conference, I summarize the case usually made against de-alerting as follows:

> "… [B]y making it take longer to ready nuclear forces for use, [skeptics assert] de-alerting measures would exacerbate pressures to undertake *re-alerting* as a crisis worsened, as each side would fear being caught unprepared if things

---

50 *See, e.g.*, Bruce G. Blair, "De-Alerting Strategic Forces," in *Reykjavik Revisited* (George P. Shultz, Steven P. Andreasen, Sidney D. Drell, & James E. Goodby, eds.) (Stanford, CA: Hoover Institution, 2008), at 47.

51 George, "Integrated Nuclear Security in the 21st Century," *supra*, at 46.

52 *See, e.g.*, Canberra Commission on Eliminating Nuclear Weapons (August 1996), from the Executive Summary, *available at* http://www.dfat.gov.au/cc/cc_report_exec.html.

53 Mazarr, "The Notion of Virtual Arsenals," *supra*, at 4.

> indeed came to blows. This could produce a dangerous 're-alerting race,' and would create deeply troubling incentives for the winner of such a race actually to *use* nuclear weapons against the side that got started second, or which moved more slowly. Because it would thus become *very* important which party could 're-alert' more quickly, de-alerting might also ignite a new arms race in re-alerting technology and procedures, as well as creating strong incentives for each party to cheat by trying to maintain some nuclear assets on clandestine launch alert. ...
>
> "The conceptual model for this counter-narrative is thus the preemption-engendering mobilization dynamics at the outset of the First World War – epitomized in particular, by the German 'Schlieffen Plan,' the notorious war plan strategy of Wilhelmine Germany under which the Kaiser's forces felt it imperative to rush to mobilize and achieve certain major wartime objectives before Tsarist Russia was able to complete its own ponderous mobilization. With the rival European powers having powerful incentives for reciprocal mobilization in order to avoid being caught unprepared, and Germany fearing that it would lose the military advantage if it waited until the larger Russian army reached full readiness, any one power's decision to mobilize made the escalatory process basically unstoppable and was therefore functionally equivalent to a decision for total war. The skeptics' argument against de-alerting is a classical deterrence-theory critique of crisis stability dynamics, with the Schlieffen Plan as its paradigmatic classical illustration of the catastrophic war-inducing incentives of a mobilization race.
>
> "Just as Germany's perceived need to beat its potential opponents to the punch in mobilizing ground troops helped precipitate the ghastly trench warfare of World War One, so the de-alerting skeptics fear that de-alerting measures could ignite a crisis-exacerbating race to re-alert nuclear forces."[54]

Much of this critique of de-alerting could be – and has been – made in raising questions about the stability of a system based upon "virtual nuclear deterrence" at the "nuclear asymptote" of abolition.

Thomas Schelling is one of the most articulate of such CR skeptics, and indeed offered a cogent critique of countervailing reconstitution at a small Hoover Institute conference on the subject in 2009. In a subsequent article, he explained that his concern derives from wondering what would happen "in the event of a major war" in a nuclear weapons-free world. His analysis is not necessarily dependent upon the existence of "Tier One" CR capabilities: it seems intended to apply equally to *any* world of "zero" in which all nuclear weapons-related knowledge has not magically been erased.

Because it would be impossible to eliminate all potential nuclear weapons "mobilization bases" – that is, countries' capability to build nuclear weapons, in at least some period of time –

---

[54] Christopher A. Ford, "Playing for Time on the Edge of the Apocalypse: Maximizing Decision Time for Nuclear Leaders," paper presented to the Conference on *Nuclear Deterrence: Its Past and Future* at the Hoover Institution (November 11-12, 2010) (citations omitted).

Schelling worries that in the event of a major war, or the imminent possibility of one, "every responsible government must consider that other responsible governments will mobilize their nuclear weapons base as soon as war erupts, or as soon as war appears likely." As a result, "there will be at least covert frantic efforts, or perhaps purposefully conspicuous efforts, to acquire deliverable nuclear weapons as rapidly as possible." Worse yet, there might be incentives for the country that acquired nuclear weapons first actually to *use* them preemptively, in order to halt its opponent's analogous rush toward nuclear armament. "Would a government lose a war," he asks "*without* resorting to nuclear weapons? Would a war include a race to produce weapons capable of coercing victory?"[55]

In Schelling's description, it is not at all clear that a world of commonplace CR capabilities would be a more stable or otherwise preferable one to the world of today. Summarizing an article on the subject he wrote back in 1962,[56] he suggests that a world without nuclear weapons would become one in which many countries

> "would have hair-trigger mobilization plans to rebuild nuclear weapons and mobilize or commandeer delivery systems, and would have prepared targets to preempt other nations' nuclear facilities all in a high-alert status, with practice drills and secure emergency communications. Every crisis would be a nuclear crisis, any war could become a nuclear war. The urge to preempt would dominate; whoever gets the first few weapons will coerce or preempt. It would be a nervous world."[57]

In this respect, Schelling thus echoes concerns expressed in 1960 by Herman Kahn, who warned that

> "[d]isarmament can … create pressures toward preventative war. If a disarmament agreement breaks down and if one side obtains a significant lead either because of previous evasion or greater ability to rearm, then it might feel compelled to perform a great public service by arranging a stop to the arms race before a dangerous balance of terror was restored. It could do this most reliably by stopping the cause of the arms race – its opponent."[58]

Kahn basically saw what we would term a reconstitution race as a "mobilization war," and posted that "[a] plausible outcome" of such a scenario was "that the side that mobilizes most effectively within a relatively brief period of time ... can achieve a militarily dominant position, enabling it to inhibit the diplomatic or military initiatives of its opponent."[59]

---

55 Thomas C. Schelling, "A World Without Nuclear Weapons?" *Daedalus* (Fall 2009) at 124, 125-26 (emphasis added).

56 Thomas C. Schelling, "The Role of Deterrence in Total Disarmament," *Foreign Affairs* 40 (1962), at 392-406.

57 Schelling, "A World Without Nuclear Weapons?" *supra*, at 127.

58 Kahn, *On Thermonuclear War*, *supra*, at 230.

59 Kahn, *Thinking the Unthinkable in the 1980s*, *supra*, at 156.

He also feared that "[i]t has probably always been impractical to imagine a completely disarmed world," because disarmament itself would create such powerful incentives for clandestine cheating on an abolition agreement that "we must presume that there would be the hiding of some nuclear weapons or components as a hedge against the other side doing so." Such a world would be "hopelessly unstable" absent the development of some reliable way to cope with the problem of "the clandestine nuclear cache."

Such incentives to cheat and/or to engage in rearmament racing were, for Kahn, a reason to be cautious about disarming "too much." He believed that a nuclear deterrent balance might actually be *more* stable with arsenals that were not extremely small, because such a posture might be able to absorb the impact of the sudden discovery of a hidden cache of illegal weaponry. "The ability to correct violations means that the military effect of the violations must be small in percentage terms of the current strategic balance," and a larger arsenal base offers better chances of ensuring this. By contrast, *complete* disarmament was a posture almost "absolutely dependent upon there being a zero rate of violation," a success rate he felt highly unlikely actually to be achieved.[60] As I have myself argued elsewhere – picking up the themes articulated in the so-called Nitze-Baker standard of "effective verification" – sudden discovery of a handful of weapons would not automatically upend a deterrent balance between adversaries each already possessing large numbers. It could be vastly significant, however, where other players have *none*.[61]

It might be argued, of course, that the whole *point* of "Tier One" CR is to try to address this concern by allowing others the ability to respond to violations by building (or rebuilding) countervailing nuclear arsenals. Much of the debate over the wisdom of "virtual arsenals" as strategic policy consists of arguments and counter-arguments about whether or not CR could in fact fill this gap.

Kenneth Waltz, for one, is pessimistic, arguing that nothing short of an actual *existing* capability to fight wars can really deter. Taking his cue from Schell's phrasings in *The Abolution*, Waltz feels that "[f]actories *cannot* deter factories from producing their goods. Only the *products* of factories can serve as instruments of deterrence. Factory deterrence is deterrence one step removed."[62] Waltz also dismisses the ability of "virtual" arsenals to provide the kind of "extended" deterrence upon which so much U.S. strategic policy and alliance relationships rely today. Even when the United States had many *thousands* of warheads, he notes, many questioned the plausibility of "extended" deterrence, and U.S. officials fretted constantly about its credibility. Deterrence through mere latency, Waltz feels, is "shaky" even when applied to

---

60 Kahn, *On Thermonuclear War*, *supra*, at 248.

61 *See, e.g.*, Christopher A. Ford, "FMCT Verification: 'Effective' or Not?" *New Paradigms Forum* website (July 20, 2009), *available at* http://www.newparadigmsforum.com/NPFtestsite/?m=20090720 (discussing Nitze-Baker test and noting that the "threshold of 'military significance' surely arrives essentially immediately when you're talking about whether a country has any nuclear weapons in a world from which all other such devices have been eliminated"). When numbers are higher, Herman Kahn felt, it is easier not to worry about "minor violations on the number and kinds of weapons." In the event of a "total ban," however, even minor violations quickly become highly problematic. Kahn, *On Thermonuclear War*, *supra*, at 235.

62 Kenneth Waltz, "Thoughts on Virtual Arsenals," *in Nuclear Weapons in a Transformed World*, *supra*, at 309, 311 (emphasis added).

core interests of homeland protection, and "it will find no credit abroad" in any "extended" incarnation.[63] Steven Hatch and his co-authors also sound somewhat skeptical note, observing that "currently" deterrence only really works with maintenance of a *deployed* nuclear force, and leaving unanswered the question of whether CR-minded nuclear planners can meet the challenge of changing this perception.[64]

(Waltz also worries about the potential for worrisome gamesmanship during the interval *between* one country's move to break out of an abolition regime and its rivals' construction of countervailing arsenals. He frets, for instance, about the old Cold War hypothetical of a "Hamburg grab," in which an aggressor seizes territory before its adversaries are able to mobilize their own forces, and then relies – in order to deter reconquest – upon the glaring disproportion between the value of the thing seized and the subsequently-remobilized victim's "remedy" of waging nuclear war over its return.[65] In interviews undertaken for this paper, some experts at the U.S. weapons laboratories also expressed similar concerns, worrying that CR – which, by definition, would not *initially* be able to confront an aggressor with the threat of nuclear use – might not be able to deter short-term attacks, which might in fact be calibrated precisely in order *not* to outlast the victim's anticipated reconstitution cycle. In addition to suggesting a degree of general weakness in nuclear deterrence theory when it comes to small-scale aggression, such scenarios highlight the challenge of managing asymmetries in arsenal reconstitution *rates* – in order to "ensure that no state could achieve enormous leverage by sprinting out of the reconstitution starting gates and rapidly acquiring a handful of operational weapons"[66] – which we will see further herein.)

Even if virtual arsenals *did* provide real deterrence value, moreover, it would presumably still be the case that they deter less "well" (*i.e.*, persuasively) than *extant* ones. When it comes to nuclear sabre-rattling, after all, weapons-in-being surely must be considered to trump merely *potential* weapons. As a result, CR skeptics suggest, participants in a system of "virtual" deterrence would still face incentives to move toward overt weaponization, particularly in times of crisis or outright conflict such as in Schelling's war scenario. As Kahn suggested, the fear of "losing" a potential rearmament "race" would tend to encourage cheating in the form of at least a small clandestine arsenal held for the proverbial rainy day – and indeed, as Waltz noted, would provide strong incentives for a "race" in technologies and procedures that would facilitate *speed* in rearmament.[67] Troubling incentives toward preemptive *use* by the "winner" might also obtain

---

63 Waltz, "Thoughts on Virtual Arsenals," *supra,* at 312. Sidney Drell and Raymond Jeanloz, by contrast, postulate a sort of extended *virtual* deterrence, in which states lacking a reconstitution capability could ally themselves to former nuclear weapons states that retain CR capabilities. Such an approach, they contend, would be both "plausible and effective." Drell & Jeanloz, "Nuclear Deterrence in a World without Nuclear Weapons," *supra*, at 8.

64 Steven W. Hatch et al. "Contributions of the Nuclear Weapons Complex and Stockpile to U.S. Defense Policy Goals," unpublished paper (August 2008), at 7.

65 Waltz, "Thoughts on Virtual Arsenals," *supra*, at 314-15.

66 Mazarr, "Virtual Nuclear Arsenals: A Second Look," *supra*, at 387.

67 *See, e.g.*, Waltz, "Thoughts on Virtual Arsenals," *supra*, at 312 ("With virtual arsenals, countries would have to worry incessantly lest their capability for rapid production and deployment fall behind the similar ability of others to do so.").

in the event that any such race actually took place.[68] By these accounts, we thus return to the "Schlieffen Plan" problem identified by skeptics of nuclear force de-alerting.[69]

(2) *Responses*

In response to such concerns, Michael Mazarr has argued that a reconstitution race would *not* be unstable, because it would be "highly unlikely" that participants in such a race would adopt "nuclear doctrines that called for reconstituted forces to be launched as they were reassembled."[70] It is not clear, however, upon what foundation his confidence rests in this regard. Unless the reconstitution capabilities possessed by the "loser" of such a race were made entirely invulnerable to attack – a demanding requirement understood by almost everyone who has examined issues of "Tier One" CR[71] – the "winner" might indeed face powerful incentives to strike preemptively agaisnt a not-yet-rearmed "loser" as soon as the former's own breakout rush made weapons available. (Given the reliance of much de-alerting advocacy upon the idea that states facing incentives to launch weapons upon first warning of attack would be likely to do so *regardless* of whether their stated policies actually called for such a step,[72] it is somewhat curious that Mazarr should take such solace in mere "nuclear doctrines.") One returns here to Schelling's question of how confident one could really be that a country facing defeat and having the opportunity preemptively to forestall it by employing a temporary monopoly upon nuclear weaponry – or simply seeing the chance to foreclose an adversary's return to the nuclear weapons business – would exercise such restraint.

Bruce Blair has similarly discounted skeptics' concerns about the instabilities associated with reconstitution racing. He contends that a rearmament contest from abolition would probably not be *too* unstable, because such a crisis would unfold through a phase characterized by "a gradual heightening of combat readiness for some forces." This *partial* alerting, he writes, "could have the effect of moderating the instability of the subsequent phase, as alert forces already in place, combined with invulnerable inactive weapons, would provide ballast."[73] Blair apparently reasons that where *some* forces have *already* been returned to alert status, *further* agumentations of such alerts are *not* necessarily provocative – or even visible to potential adversaries – in ways that should worry CR skeptics. (As an example of this, he recounts that during the Cold War, the Soviets apparently raised the alert levels of their strategic nuclear forces "on numerous occasions during crises," but U.S. intelligence was none the wiser.)

---

68 *See, e.g.*, Schelling, "A World Without Nuclear Weapons?" *supra*, at 125-26 (discussing use incentives); Waltz, "Thoughts on Virtual Arsenals," *supra*, at 314 ("The temptation to move first, eliminated by second-strike forces [when nuclear arsenals actually existed], would be reintroduced by a system of virtual nuclear arsenals.").

69 *See, e.g.*, *See, e.g.*, Kahn, *Thinking About the Unthinkable in the 1980s*, *supra*, at 128 (discussing mobilization dynamics associated with outbreak of the First World War); Kahn, *On Thermonuclear War*, *supra*, at 368-70 (same); Waltz, "Thoughts on Virtual Arsenals," *supra*, at 314 (same).

70 Mazarr, "Virtual Nuclear Arsenals: A Second Look," *supra*, at 387-88.

71 *See infra*.

72 *See, e.g.*, Bruce C. Blair, *The Logic of Accidental Nuclear War* (Washington, D.C.: Brookings Institution, 1993), at 8-9, 20, 36, 43, 53-55 & 185; *see also* Blair, *Strategic Command and Control* (Washington, D.C.: Brookings Institution, 1985), at 209.

73 Bruce Blair, "Command, Control, and Warning for Virtual Arsenals," *in Nuclear Weapons in a Transformed World*, *supra*, at 55, 65.

Accordingly, Blair apparently feels that once some nuclear forces had been rebuilt during a reconstitution race, *additional* reconstitution would not be too problematic.[74]

This is, however, a rather astonishing concession for Blair to make, for it essentially makes a hash of his broader arguments in favor both of de-alerting and of an abolition-regime world of merely "virtual" nuclear arsenals. By the reasoning he offers here, after all, a balance of immediate terror between arsenals of alerted weapons-in-being sounds *more* stable than a race-provoking balance between de-alerted or dismantled nuclear arsenals – indeed, *so* much more stable, it would seem, that such ready-alert forces could serve as "ballast" to prevent reconstitution races from getting out of hand in a crisis. If *that* is the case, however, one wonders why it would not be foolish ever to de-alert or go to "zero" in the first place. It is hard to know what to make of Blair's argument in this respect, except that it seems an inadequate response to concerns about crisis stability in a world of "Tier One" CR programs.

Some scholars of the subject have defended the idea of reconstitution by pointing to what is said to be a hopeful analogy in the Biological and Toxin Weapons Convention of 1972. Even though the technology that makes biological weaponry possible is largely of a "dual-use" character – that is, it is equally usable for benign and malign purposes – and is radically proliferated around the world, there still exists an international agreement banning biological weapons. Thus, the reasoning goes, it may similarly be possible to prohibit nuclear weaponry notwithstanding the spread of dual-use nuclear capabilities and reconstitution capacities.[75] It is not clear, however, that the BTWC analogy is really that reassuring, for that treaty is essentially a purely normative one.

Precisely because dual-use and potentially weapons-facilitating biotechnology is ubiquitous, is has not proven possible to devise any kind of verification and enforcement system. The BTWC might indeed be an attractive model for nuclear weapons abolition if all one desired were to *declare* such devices prohibited, but for those actually seeking to *eliminate* nuclear weapons it surely provides less encouragement. Some states refuse to join the BTWC, others quietly retain weapons programs even while *within* the regime, numerous countries possess the ability to weaponize on short notice, terrorists presumably have relatively easy access to dual-use biotechnology, and there exists no verification or enforcement mechanism for BTWC compliance. Since neither disarmament advocates nor current nuclear weapons possessors would likely accept any kind of *nuclear* "zero" on such terms, one probably should not oversell the BTWC model.

It must also be noted that reconsitution skeptics might go further than merely raising questions about whether CR would be able to deter other countries from breaking out of an abolition regime. The logic of reconstitution would seem to presuppose what the disarmament community often takes as axiomatic, but what is in fact a highly contested issue – namely, that

---

74 Blair, "Command, Control, and Warning for Virtual Arsenals," *supra*, at 69.

75 *See, e.g.*, James M. Acton, Edward Ifft, & John McLaughlin, "Arms Control and Deterrence," paper presented to the Hoover Institution conference on "Deterrence: Its Past and Future" (November 12, 2010), at 51; Drell & Jeanloz, "Nuclear Deterrence in a World without Nuclear Weapons," *supra*, at 18.

the only use of nuclear weapons is in fact for deterring the use of similar weapons by others.[76] To the degree this this assumption is not true, the analytical basis for seeing reconstitution capabilities as a source of stablity at "zero" erodes sharply.

If and to the extent that a particular country might seek nuclear weapons for *other* reasons – such as to deter overwhelming conventional attack, to deter the use of *other* forms of weapons of mass destruction (WMD),[77] or simply for reasons of geopolitical status and prestige – it seems rather improbable that other powers' possession of the ability to build their *own* countervailing nuclear arsenals would do much to dissuade that country from regime breakout. A country greatly afraid of the *conventional* military capabilities of a muscular neighbor or strategic rival, for instance, might find provoking a return to a world of actual nuclear arsenals to be preferable to facing an indefinite future of denuclearized vulnerability in the face of its adversary's non-nuclear power. For such states, "Tier One" CR policies elsewhere in the world would provide very little, if any, deterrent value. This issue has as yet received little attention in the CR literature.

B. *Other Issues*

(1) *Defenses*

One question that *has* been much debated is the role that *defenses* against ballistic missiles and other delivery systems might play in a world of "zero" nuclear weapons, but in which "Tier One" CR capabilities are retained. Keith Payne, for one, has long maintained that both active and passive defenses could help make a world of "virtual deterrence" more stable – not least by helping protect countries' reconstitution capabilities from preemptive attack (*e.g.*, by convenetional weapons, or by nuclear weapons secretly retained by a violator or quickly built by the winner of a reconstitution race). Defenses could, Payne has argued, reduce the potential for problems in a CR world by undercutting the strategic gains likely to accrue to a violator during the period before his arsenal would be countered by nuclear weapons reconstitution in other countries.[78]

And Payne is hardly alone. Jonathan Schell, for instance, has also argued that defenses could help make abolition more sustainable, because they hold out the prospect of rendering cheating less profitable, thereby helping avoid a point of "maximum – indeed, total – imbalance" in which the violator is able to deliver nuclear weapons against a victim who lacks them. Accordingly, Schell has written that it may be helpful to have "defenses ... against the kind of force that could be put together in violation of an abolition agreement." If one party were to develop "a sharply restricted, untested, and clandestinely produced and maintained offensive

---

76 *Cf., e.g.*, Millot at al., "*The Day After* ...," Volume II, *supra*, at 68 (noting that "virtual abolition" requires no reliance on nuclear weapons for any purpose *other* than deterring nuclear weapons use against one's homeland).

77 *Cf.* Philip Zelikow, "Virtual Visions, Past and Future," *Nuclear Weapons in a Transformed World*, *supra*, at 359, 364 (worrying about possibility that threatening the use of biological weaponry might be used to deter nuclear reconstitution).

78 *See, e.g.*, Keith Payne, "Strategic Defenses and Virtual Nuclear Arsenals," *in Nuclear Weapons in a Transformed World*, *supra*, at 145, 160-61.

force," in other words, it would find this attack force opposed by "a large, fully tested, openly deployed, and technically advanced *defensive* force."[79]

The Bush Administration articulated just such an approach to defenses in setting forth its vision, in 2007, of the sorts of conditions that might make complete nuclear disarmament feasible. As I explained it then on its behalf, there was felt to exist an important "link between disarmament stability and the development and improvement of ballistic missile defenses and other means of defeating WMD delivery." Defensive capabilities might, it was argued,

> "powerfully contribute to stability in a zero-option world in two ways. First, by making it harder to deliver to a target any nuclear weapon that is developed in violation of a zero-weapons regime, defenses would reduce the anticipated strategic utility of such weapons, making 'breakout' less attractive and therefore presumably less likely. Second, even if defenses could at some point be surmounted, the existence of relatively robust defensive networks around the world could, at the very least, buy time in which the international community could rally to develop or implement other means of responding to the threat. As we have seen with the world's painfully slow responses to the ongoing threats posed by the Iranian and North Korean nuclear weapons programs, the international community does not always act decisively and swiftly. It could be valuable indeed to have a little more time before a violator could fully realize strategic benefits from zero-option 'breakout.'"[80]

Some such vision also seems to lie behind the Obama Administration's approach to missile defenses, though the connection between defenses and disarmament has apparently not yet been so clearly and directly outlined since the beginning of 2009. The recent 2010 *Nuclear Posture Review Report*, however, does make clear that "major improvements in missile defenses" are already helping "enable us to fulfill [U.S. national security] objectives at significantly lower nuclear force levels and with reduced reliance on nuclear weapons."[81]

Defenses, however, remain controversial and analytically challenging in the CR context. Other analysts have worried that the small size of the nuclear forces likely to be quickly reconstitutable pursuant to a "Tier One" CR policy might require that defenses actually be *banned* so that such rebuilt arsenals could successfully deter the aggressor against whom such reconstution was being undertaken.[82] But while this concern relates principally to defenses that might be possessed by the *aggressor*, the *responding* power(s) would have much use for defenses – as the Bush Administration suggested in 2007 – precisely in order to neutralize the initial forces that an aggressor might be able to muster, thereby buying time for CR to be implemented.

---

79 Schell, *The Abolition*, *supra*, at 116.

80 Ford, "Disarmament and Nuclear Security in Tomorrow's World," *supra*.

81 U.S. Department of Defense, *Nuclear Posture Review Report*, *supra*, at 6.

82 *See, e.g.*, Michael Brown, "Nuclear Doctrine and Virtual Nuclear Arsenals," *in Nuclear Weapons in a Transformed World*, *supra*, at 33, 48.

Harald Müller offers a response to the challenge that would be presented by defenses in the hands of a regime *violator*, however. If the ballistic missile defenses (BMD) in any one country's possession could be kept "numerically substantially inferior to the *combined* ballistic missile capabilities of the international community that could be mustered" against a violator's attempt at breakout, he has argued, the threat of such compliance enforcement *combinations* might help deter breakout notwithstanding the prevalence of BMD capabilities.[83] This presumes that a would-be violator would indeed feel it *likely* that other countries would cooperate in this fashion by both reconstituting and combining their resulting nuclear forces, but it may provide at least a partial answer to the conundrum.

However one might hope to crack this analytical nut, however, it is certainly the case that at the low numbers that would exist in the early stages of a reconstitution race, the "offense-defense ratio" might be highly unstable in at least *some* circumstances.[84] Payne himself admits that the prospect that balance-affecting defense capabilities might be asymmetrically possessed could make it much harder to achieve a CR-based abolition regime in the first place.[85] It might also be said that the existence of limited time-buying defenses could force CR planners in former nuclear weapons states[86] to program their reconstitution efforts for the rapid development of nuclear arsenals large enough able to overwhelm such defenses (*i.e.*, larger than they would presumably otherwise feel necessary). Defenses might perhaps thus be able to play at least some role in stabilizing a "zero" regime, but they would be no cure-all, could be problematic in some circumstances, and their logics might exact a significant price by requiring the maintenance of quite elaborate (and expensive) dormant reconstitutive capabilities.

(2) *Proliferation Dynamics*

Another problematic issue concerns the potential for what Mazarr has called "virtual proliferation" – that is, the spread of CR-related capabilities to an increasing number of states.[87] As we have seen, this dynamic is to some extent already well underway, and inherent in the continued development of nations' scientific and technological capabilities, especially with regard to dual-use technologies associated with nuclear power generation. To the extent that CR policies become an important part of major states' post-abolition nuclear planning, however, one might see a more general shift from "Tier Two" (derivative) to "Tier One" (deliberate) reconstitution planning – making CR races all the more likely and unstably quick to develop once they begin. Brad Roberts has referred to this as the spreading potential for "wildfire" proliferation, and has correctly suggested that it could create its own vicious cycle of insecurities, as nations observe the global spread of "Tier One" CR capabilities and themselves move to hedge against the potential threats this entails by ramping-up their own analogous preparations.

---

83 Müller, "Enforcement of the rules in a nuclear weapon free world," *supra*, at 18 (emphasis added).

84 *Cf.* Mazarr, "Virtual Nuclear Arsenals: A Second Look," *supra*, at 389.

85 *See* Payne, "Strategic Defenses and Virtual Nuclear Arsenals," *supra*, at 164-65.

86 Peter Wilson has suggested that deliberate reconstitution programs might be limited to the permanent members of the U.N. Security Council – countries which also happen to be the five powers recognized as nuclear weapons states under the Nuclear Nonproliferation Treaty – though he also suggests that the Council's membership might be expanded. Wilson, "Issues of Force Structure, Nuclear Infrastructure, and Survivability," *supra*, at 90.

87 Mazarr, "The Notion of Virtual Arsenals," *supra*, at 24.

The inevitable gaps and asymmetries in the pursuit of such capacities by increasing numbers of countries might itself create new instabilities and dangers.[88]

(Peter Wilson, by the way, also wonders whether the potential for such "wildfire" proliferation might make the decision to *activate* a CR capability more problematic. What U.S. president, he wonders, would choose to re-commence weapons production in response to anything but the most extraordinnary threat, if doing so would instantly trigger a blossoming of nuclear weapons capabilities around the globe?[89])

In his CR classic *The Abolition*, Jonathan Schell suggested that "the complexity of the nuclear balance at the level of zero weapons" would likely not be as great as the complexity of the nuclear balance of the Cold War,[90] but this seems unlikely to be the case. In fact, a CR world might increasingly become one in which a very great number of states face each other in elaborate proto-deterrent relationships of bewildering multi-player game-theoretical complexity, each seeking to hedge against the reconstitutive capabilities (and reconstitutive speed) of its myriad potential adversaries – at least individually, but perhaps also in combinations – and one that therefore hovers increasingly on the edge of Roberts' potential "wildfire" of generalized nuclear armament. If Schell is right that the "knowledge [of how to build nuclear weapons] ... is destined to spread over the whole globe,"[91] this could be a very unstable globe indeed.

Of course, precisely *because* the further proliferation of what amount at least to "Tier Two" CR capabilities is to a great extent inevitable – at least without some rather dramatic reversal of current trends in the international community's loss of control over uranium enrichment and plutonium reprocessing technology – this worrisome "wildfire" world may be arriving whether or not anyone pursues deliberate programmatic CR. In this context, some maintenance of "Tier One" reconstitution capabilities may be the "least worst" option available to former NWS under an abolition regime. The challenge of "virtual proliferation" is not one that can lightly be dismissed whether we reach "zero" or not.

---

88 *See* Roberts, "VNAs and the Contemporary Latent Weapon State," *supra*, at 276-77.

89 *See* Wilson, "Issues of Force Structure, Nuclear Infrastructure, and Survivability," *supra*, at 95. In a different twist on this logic, David Kay wonders how willing politicians would be to find *reason* to reconstitute in the first place, at least in the absence of shockingly inarguable evidence. Historically, he recounts, there has sometimes been a tendency for leaders to discount or ignore evidence of arms control violations because the cost of *recognizing* such a problem was so high – *e.g.*, in terms of facing tough choices about rearmament, the disruption of important relationships, or outright military action. Consequently, says Kay, "the verification process is often twisted to avoid finding violations because of the uncertainty or unpalatability of political choices that would arise from confirmed violations." (He gives the example of Allied inspectors ignoring evidence of German violations of the Treaty of Versailles during the interwar period, and U.S. officials turning a blind eye to Chinese proliferation transfers in the 1990s.) Kay worries that in a world of "virtual nuclear arsenal" capabilties, the consequences of finding a violation would be severe enough that heroic efforts would be made to avoid such a compliance conclusion. David Kay, "The Challenge of Inspecting and Verifying Virtual Nuclear Arsenals," *in Nuclear Weapons in a Transformed World*, *supra*, at 103, 111. Herman Kahn also noted the difficulties presented – inn a political and psychological sense – by ambiguous indications of a violation. *See, e.g.*, Kahn, *On Thermonuclear War*, *supra*, at 234.

90 Schell, *The Abolition*, *supra*, at 136.

91 *Id.*, at 144.

(3) *CR Survivability*

As mentioned earlier, nearly everyone who has considered the issue stresses the critical importance to any "virtual deterrence" scheme of ensuring that CR capabilites are able to survive preemptive attack, either with conventional forces or with such nuclear weapons as may become available to the winner of a reconstitution race. Given the potential incentives for such preemption identified by Schelling and others – especially should a reconstitution race occur in the context of a war already underway – it is hard to understate this point.

Schell, for instance, emphasized in *The Abolition* the need to ensure that one's "capacity for nuclear rearmament … could not be destroyed in a first strike by a nation that took the lead in rearmament by abrogating the abolition agreement, secretly or openly." It was vital, in fact, that "the retaliatory force … be invulnerable" and Schell posited that

> "the most important question to ask about a nuclear-weapon-free world is whether it could be arranged in such a way that no nation, by sudden or surreptitious rearmament, or by military action, could defeat an adversary or blackmail it into submission."[92]

Mazarr has similarly noted that a "truly survivable" virtual arsenal would help deny a potential aggressor the "significant advantage" it might otherwise expect from breakout.[93] Several other authors worry about the potential vulnerability of reconstitution capabilities even to *non*-nuclear attack, noting that whatever benefits CR might offer would evaporate were an adversary by such means to "paralyze the reconstitution of ... nuclear arsenals and means of long-range delivery."[94] Bruce Blair also stresses survivability, agreeing that virtual arsenals would have to be held "in such a way that a portion of them would remain invulnerable and reconstitutable even if an egregious failure of verification occurred and warning of a breakout was not provided." In fact, "stability would depend on having a zero-alert posture that provides for invulnerable and reconstitutable forces in any case" – making it essential for the reconstitution *process* to be able to "ride out" even a nuclear first strike.[95]

Some have suggested that the challenge of CR survivability might be met with relative ease. Sidney Drell and Raymond Jeanloz, for instance, contend that "the technology for tunneling and construction at depth is so available and effective that the likelihood of successful pre-emptive attack can be greatly diminished" because reconstitution capabilities could be "hardened, buried, and distributed" in deep underground bunkers highly resistant to attack with

---

92 *Id.*, at 119, 133, & 135.

93 Mazarr, "Virtual Nuclear Arsenals: A Second Look," *supra*, at 380; *cf.* Perkovich & Acton, *Abolishing Nuclear Weapons*, *supra*, at 121 (noting issue of survivability).

94 Wilson, "Issues of Force Structure, Nuclear Infrastructure, and Survivability," *supra*, at 91; *see also* Alexei Arbatov, "Virtual Arsenals: A Russian View," *in Nuclear Weapons in a Transformed World*, *supra*, at 319, 328 (worrying about potential for *non*-nuclear attack upon reconstitution-related facilities in order to cripple the victim's nuclear rearmamaent capability); *cf.* Perkovich & Acton, *Abolishing Nuclear Weapons*, *supra*, at 121 (noting issue of survivability).

95 Blair, "Command, Control, and Warning for Virtual Arsenals," *supra*, at 63 & 69.

by conventional or even nuclear weapons.[96] It is not clear how far this argument can go, however, because one would need to ensure the survival and functional integrity of an entire reconstitution *system* – not merely disaggregated component elements entombed and isolated from each other in deep caverns – as well as a system for potentially *employing* the weaponry that one reconstitutes.

Given Blair's stress in other writings upon how desperately difficult it can be to provide a genuine "ride out" capability able to guarantee operational functionality and effective retaliation after a sizeable nuclear attack,[97] ensuring such survivability would be a demanding task for nuclear planners even in today's world. But the challenge today is "only" that of protecting command-and-control systems and deployed and alerted nuclear forces, however, not least among them ballistic missile submarines and mobile land-based missiles, systems which are specifically designed to be survivable.

In a world of nuclear weapons abolition relying upon the deterrent integrity of CR programs, one would presumably need to protect much more – namely, the entire panoply of capabilities that it would be necessary to have intact if one wished to rebuild, deploy, and potentially *use* a nuclear arsenal: production and assembly facilities; warhead component and fissile material storage depots; delivery systems and the institutions and processes by which they are loaded with warheads, managed, and employed; and the logistics and communications linkages that tie together the system of arsenal reconstitution and enable it to function. All of *these* things would *also* have to be protected, lest the CR system be subject to paralysis by adversary aggression.

Through this prism, therefore, a pessimist might describe a regime of "virtual nuclear deterrence" as an *opponent's* dream. Bruce Blair has admitted that a de-alerting scheme – and, by likely implication, a "Tier One" CR program – could raise the preemption incentives facing an adversary, such as by concentrating de-mated warheads in storage facilities less numerous than the deployed launchers from which such devices had been removed.[98]

In fact, however, the CR survivability challenge would be worse than that, because it would actually *multiply* the number of what one might call "showstopper" targets, *any* of which an adversary could hit in order to paralyze the reconstitutive system. An alerted and nuclear-armed ballistic missile deployed on a patrolling submarine, for example, can be taken entirely out of an adversary's threat equation only by direct destruction of the missile or its submarine – both of which are quite difficult tasks to accomplish. A disassembled warhead stored separately from a demobilized missile that is itself merely *capable* of being sent to sea on a submarine

---

96 Drell & Jeanloz, "Nuclear Deterrence in a World without Nuclear Weapons," *supra*, at 11.

97 *See, e.g.*, Blair, *Strategic Command and Control*, *supra*, at 5-6, 26-28, 37, 39, 42-45, 72, 183-84, 207, 236, 242-49 (recounting generally unsuccessful U.S. and Soviet struggles with command-and-control survivability during the Cold War); Blair, *The Logic of Accidental Nuclear War*, *supra*, at 33, 115-17, 119, 121, 127, 166-67 & 212 (same).

98 *See, e.g.*, Blair, "De-Alerting Strategic Forces," *supra*, at 93 & 97; *See also* Michael Wheeler, "Reconstitution and Reassembly of a Virtual Nuclear Arsenal," *Nuclear Weapons in a Transformed World*, *supra*, at 123, 133 (noting that "[n] Nuclear weapons in monitored storage will be more vulnerable than nuclear weapons that are operationally dispersed").

presently mothballed at pierside, however, can be effectively neutralized by attacking the long chain of necessary reconstitutive events at essentially *any* point: warhead reassembly, missile remobilization, re-mating, submarine loading, the port, transit to patrol areas at sea, or any part of the logistics process that connects (and controls) these elements.[99] Protecting all of *this* from conventional *and* nuclear attack would surely be very difficult.

A CR program would force its possessor to defend a large number of targets, but require a preemptive attacker to hit only a few of them.[100] Worse still, the process of *targeting* all these reconstitutive elements would presumably be made all the easier for a potential adversary by the very accuracy of any verification procedures that might be put in place as part of the abolition regime pursuant to which such CR capabilities were to be maintained. If it were to work *as* a verification system and be trusted by its participants, the verification scheme would likely have the side-effect of assisting potential aggressors in identifying the key targets the destruction of which would paralyze their adversary's CR programs. This may be why Mazarr concedes that virtual arsenals "raise a powerful dilemma between verification and survivability: the two trade off fairly directly, and it is not clear that the trade-off can be resolved."[101]

All this presents a formidable challenge to CR planners, though it might have the potentially beneficial side-effect of restricting the possession of credible "Tier One" reconstitution to only a handful of wealthy and sophisticated states willing to invest in the sprawling productive *and* protective infrastructures necessary to meet CR-survivability requirements – thus perhaps at least somewhat mitigating Brad Roberts' concerns about "wildfire" proliferation. For most countries, however, it is not at all clear that CR could be accomplished in a credible, stabilizing, and genuinely survivable fashion, especially vis-à-vis a potential adversary with sophisticated targeting and strike capabilities.

(4) *Additional Challenges*

(a) *Non-Nuclear Deterrence*

As we have already seen, some experts who have examined issues of "virtual deterrence" have wondered whether CR could meaningfully substitute for "extended" *nuclear* deterrence as currently practiced by the United States in its alliance relationships with countries such as Japan, South Korea, and most of its NATO allies. This question bears not only upon the ability to reassure allies who might in some cases otherwise feel more of a need to explore nuclear deterrence themselves, but also upon the U.S. ability to deter potential regional adversaries.[102] In part, this is a question of deterring "rogue regimes" from pursuing nuclear weapons development themselves, or from actually using any nuclear weapons they might obtain.

---

99 Thomas Schelling makes a similar point about the way in which nuclear force "de-alerting" measures such as warhead de-mating could create new vulnerabilities by increasing the number of "disabling points." *See* Schelling, "A World Without Nuclear Weapons?" *supra*, at 128.

100 *Cf.* Wilson, "Issues of Force Structure, Nuclear Infrastructure, and Survivability," *supra*, at 86 (noting that a virtual nuclear arsenal would be vulnerable at a "small number of aim points").

101 Mazarr, "The Notion of Virtual Arsenals," *supra*, at 16.

102 *See, e.g.*, Mazarr, "The Notion of Virtual Arsenals," *supra*, at 24.

To this extent, CR's likely efficacy is uncertain. With regard to deterring nuclear weapons *use*, it is not clear that such governments would actually fear U.S. nuclear weaponry – or at least that U.S. nuclear muscle would be of anything more than marginal concern to them in comparison to the threat of *non*-nuclear attack. With regard to deterring nuclear weapons *development*, the availability of American CR would presumably depend – as mentioned earlier – upon why such "rogues" might desire such weaponry in the first place. To the extent that they seek to overawe and intimidate their immediate neighbors, acquire global prestige and status, or deter forcible outside "regime change" employing *conventional* armaments, for instance, a U.S. ability to reconstitute nuclear weapons might have very little dissuasive impact indeed.

One way to consider the stability of a CR-based abolition regime might be to examine the extent to which such a regime relied particularly or solely upon countervailing nuclear weapons reconstitution in order to deter breakout. Simply put, the demands placed upon CR would be less onerous to the degree to which the system also enjoyed recourse to *other* means of deterring wrongdoing. In a system blessed with prompt and effective collective security mechanisms, for example, it might be possible to mitigate imperfections we might expect to encounter in the "self-help" remedies of reconstituting (or constituting) a national nuclear arsenal. Where *non*-nuclear mechanisms could provide redress, countries would presumably feel less need to activate any CR capability they might have retained. There would exist, one might say, an "alternatives buffer" insulating CR programs from hasty activation.

In this respect, however, there is reason to suspect that an abolition regime might find it unavoidable to rely heavily upon CR, at least in relationships between the major powers. As Dean Millot, Roger Molander, and Peter Wilson have suggested, after all, while it is not impossible to imagine prompt individual collective *non*-nuclear military responses to neutralize an emergent nuclear arsenal in "a state like North Korea," it is very hard to posit the availability of such options vis-à-vis cheating or breakout by a major power such as China or Russia.[103] Where large and advanced industrial states are concerned, an abolition regime would be hard put to use non-nuclear military deterrence as an alternative to reliance upon nuclear weapons reconstitution.

(b) *Reconstitution Speed*

As discussed previously, one of the most vexing challenges of stability in a CR-based abolition regime is the danger of reconstitution races. Even putting aside the danger of outright cheating – which Herman Kahn argued would make abolition unenforceable by creating powerful incentives to retain or create a "clandestine cache" of nuclear weaponry[104] – "virtual deterrence" puts an enormous premium upon *how quickly* reconstitution can be achieved.

"Perhaps the most serious challenge to be overcome," says Michael Mazarr of "virtual nuclear arsenals," is "the risk of asymmetries in reaction times that could emerge in a virtual arsenal context. If one nation could reconstitute its foces more rapidly than others it might have

---

103 Millot, *et al.*, *"The Day After ..."* Volume II, *supra*, at 68.

104 *See, e.g.*, Kahn, *On Thermonuclear War*, *supra*, at 236.

a strategic advantage."[105] (Worse still, it might *use* that advantage preemptively during the brief window in which it is available – particularly if such reconstitution has taken place in the context of the sort of non-nuclear war envisioned by Schelling's critique.) Other authors have also noted the importance of avoiding "disparities in mobilization capabilities" and ensuring against "asymmetrical mobilization."[106] Students of CR theory, therefore, cannot avoid grappling with the specter of what one might call a "racing race": an arms race taking the form of a competition in rearmament methodologies and technologies, in which each participant aims to secure for itself the ability to constitute or reconstitute nuclear weapons faster than any potential adversary.[107]

Handling this challenge of asymmetric mobilization rates seems almost bewilderingly difficult. It seems likely, of course, that the time required to implement a "Tier One" CR capability would vary from one country to the next, and probably considerably. Some "legacy" warhead designs or delivery systems, for instance, might be capable of being returned to service quickly (*e.g.*, reassembled or redeployed) and others not. Differences may also exist in the ability of existing weapons production infrastructures to be mobilized for rapid force regeneration. As James Acton, Edward Ifft, and John McLaughlin have noted, for instance, Russian design and infrastructure choices in favor of ongoing nuclear warhead remanufacturing – as opposed to one-time production followed by long-term weapon surveillance and maintenance, as practiced by the Americans – mean that Moscow probably possesses the ability to manufacture plutonium "pits" in far higher annual volumes than can the United States. Such a discrepancy, they note drily, could be "strategically problematic" in a CR race.[108]

Nuclear delivery systems, moreover, do not exist and cannot be operated in a military vacuum, but are rather embedded in complex systems of military maintenance, doctrine, technology, logistics, personnel management, and command, control, communications, and intelligence (C^3I) systems – all of which will differ from one country to the next, yet all of which can *themselves* have a potentially significant impact upon how long it takes from a "standing start" for a newly-assembled or reconstituted nuclear weapon actually to be brought to a rendezvous with its target.[109]

Some authors have, for instance, suggested that an abolition regime based upon "virtual" nuclear deterrence would need to control ICBM-class small space launchers and cruise missile delivery systems, because such systems – if unevenly possessed – could provide destabilizing

---

105 Mazarr, "The Notion of Virtual Arsenals," *supra*, at 24.

106 Gold & Wagner, "Long Shadows and Virtual Swords," *supra*, at 6.

107 Herman Kahn, for instance, once suggested that one might prepare for "mobilization war" in part by establishing a "premobilization R&D program" – an example of which he identified in German efforts during the interwar years to conduct research efforts specifically in order to prepare for a future, sudden ramp-up to their desired optimal force. Also with an eye to maximizing anticipated build rates, Kahn recommended preparing "preplanned 'stop' and 'trigger' orders and policies" for mobilization. Kahn, *Thinking About the Unthinkable in the 1980s*, *supra*, at 166-71.

108 James M. Acton, Edward Ifft, & John McLaughlin, "Arms Control and Deterrence," paper presented to the Hoover Institution conference on "Deterrence: Its Past and Future" (November 12, 2010), at 57-58.

109 *See generally, e.g.*, Patrick Garrity, "Managing Asymmetries and Instabilities in Nuclear Reconstitution," *in Nuclear Weapons in a Transformed World*, *supra*, at 337, 339-41.

advantages in a breakout scenario.[110] The problem of harmonization, however, may extend far beyond delivery systems.

A CR-based abolition regime would give governments incentives to fine-tune reconstitution capabilities with speed in mind, and would perhaps tend to drive acquisition and development strategies, either before or after zero, toward warhead designs and delivery system technologies that minimized the time necessary for re-achieving operational status.[111] The "best" technology in terms of the combat effectiveness of a given weapons system, after all, is not always "best" for rapid mobilization.[112] A CR-minded country with an existing weapons program contemplating accession to an abolition regime would have some reason to switch to weapons designs optimized for rapid assembly. It might even choose to *pre-build* weapons components designed for such speed, storing them separately for future contingencies in order to facilitate minimum rearmament times if it should become necessary suddenly to reconstitute.[113]

Even with nuclear weapons banned and none (hopefully) actually in existence, in other words, a potentially dangerous arms race in nuclear technology might nonetheless remain underway – a competition in the speed of potential reconstitution. And for countries that felt unable to compete in such a race by developing sophisticated solutions to such rapidity challenges, there would presumably be some temptation to cut corners, perhaps through half-baked improvisational "MacGyver" solutions that could prove worryingly unsafe in operational practice.

In theory, it might be conceivable to "legislate" some kind of harmonized technological standards as part of an abolition agreement such that all possessors of "Tier One" CR capabilities would end up being stuck with comparable reconstitution rates. In practice, however, it is very hard to imagine how such harmonization could possibly work – either in getting all players to a baseline standard in the first place (*e.g.*, in their highly-classified weapons designs or in operational military procedures), or in maintaining harmonization against the inevitable cheating

---

110 *See, e.g.*, Kay, "The Challenge of Inspecting and Verifying Virtual Nuclear Arsenals," *supra*, at 103, 114; Wilson, "Issues of Force Structure, Nuclear Infrastructure, and Survivability," *supra*, at 92.

111 *See, e.g.*, Mazarr, "Virtual Nuclear Arsenals: A Second Look," *supra*, at 372 (discussing possibility of "more 'modular' warheads whose fissile material could be removed more easily [and which thus] might have important advantages in a reconstitution race").

112 Citing one Hudson Institute study from the early Cold War, for instance, Herman Kahn once argued – in a discussion of "mobilization war" – that while the ideal way to manufacture he turret of an M-60 tank was to cast it as one solid piece, this created mobilization problems because such a procedure could only be done at a few foundries, creating "a latent production bottleneck" and ensuring low production rates in the event of crisis mobilization. If surge mobilization were one's objective, he said, it would be better to switch to multi-piece turrets the parts of which could be cast almost anywhere – thus sacrificing a bit of individual tank performance for a considerable increase in production numbers. Kahn, *On Thermonuclear War*, *supra*, at 165-66.

113 There is some precedent in the U.S. weapons complex for pre-building components: in the mid-1990s, excess inventory "buffer stocks" of some non-nuclear components of nuclear weapons (*e.g.*, neutron generators from the Pinellas plant) were pre-produced in order to help the complex meet its weapons needs during the period *after* some facilities were closed and *before* their smaller replacement operations came on line. *See, e.g.*, Lani M. Sanders & Linda J. Branstetter, "Change and the Nuclear Weapons Complex," Sandia Report SAND2005-3505 (June 2005), at 22. Pre-built stocks of this sort, of course, would also greatly simplify cheating scenarios because they could easily be stored almost anywhere.

incentives that such a system would create – especially given current weapons possessors' greatly varying current starting points in terms of "legacy" systems, degrees of technical sophistication, and available funds.[114]

Furthermore, because of the importance of ensuring CR survivability against adversary disruption, it might be that harmonization would have to extent to non-nuclear military forces and *their* mobilization base, particularly with respect to rapidly-employable long-range precision strike capabilities. The complexities of legislating such a harmonized world into existence seem somewhere beyond daunting, particularly given the "wild card" effect that advances in any of a broad range of scientific and technological research and development areas might have upon one or more of the variegated elements of, and factors likely to contribute to, a country's nuclear weapons reconstitution rate. Herman Kahn, for instance, has noted that even where they do not directly involve or contribute to the deployment of actual weapons, races in technology development can be remarkably tense: "one side is worried about the other side getting a technological lead, and ... a single experiment may be sufficient to establish such a lead."[115] If some such lead held out the prospect of allowing one party to "win" a reconstitution race, grave consequences might ensue. How could one possibly harmonize *that*?

It might even be argued that different *political systems* are also likely to be capable of different degrees of rapidity and decisiveness in nuclear weapons reconstitution. Mazarr, for instance, frets that "dictatorships might have an edge over democracies, in which legislatures and pressure groups might serve to obstruct a rapid reconstitution in time of crisis."[116] This raises the possibility that "Tier One" CR planning might end up giving strategic advantages to wealthy dictatorships able to marshal the deep pockets, decisiveness, and consistency of purpose that would be necessary for optimal competitiveness in maintaining a potent CR capability over time and implementing it as rapidly as possible. (Reconstitution rates might also vary according to the complexity of the environmental and safety regulatory frameworks imposed by different governments upon future nuclear weapons work involving to radioactive materials or other exotic material components or substances.[117]) Such disparities, if indeed they exist, would also seem quite insoluble.

(c) *Preventing Accidents*

Another concern that has been raised about the stability of a deterrent balance maintained by virtual nuclear arsenals concerns the possibility that stockpiles in the throes of a rushed

---

114 *Cf.* Wheeler, "Reconstitution and Reassembly of a Virtual Nuclear Arsenal," *supra*, at 123, 133-34 (noting complexity of variables contributing to likely reconstitution rates, and difficulty of ensuring harmonizatoin thereof).

115 Kahn, *On Thermonuclear War*, *supra*, at 235.

116 Mazarr, "The Notion of Virtual Arsenals," *supra*, at 24.

117 In interviews conducted for this study with U.S. nuclear weapons experts, for instance, some expressed doubt that the United States could today legally resume underground testing anywhere in the country on account of the complexity and rigor of modern environmental and safety regulations. Such rules might perhaps be waived by the President in a grave crisis, but simply *having* to go through such additional hurdles might be said to give a reconstitutive advantage to countries not having such scruples in the first place – and whose scientists might thus be somewhat more free either to prepare for rearmament or to implement it.

reconstitution process might be particularly vulnerable to accidents. Bruce Blair, an analyst with a keen eye for accident vulnerabilities in nuclear command and control systems, has himself noted that rusty command systems moving from some kind of a demobilized standing start to a re-deployed high-alert status "without the benefit of recent experience in mating warheads to missiles and in generally managing high-tempo operations, would be more prone to errors and accidents."[118] Such problems might be particularly serious if, as suggested earlier, reconstitution "race" pressures led one or more countries to cut corners on safety and control technologies or procedures in order to hasten a return to operational status.

This would certainly seem to be a valid worry, particularly in light of the error problems that appear already to have materialized even with the comparatively modest shift away from nuclear missions within the U.S. military since the end of the Cold War.[119] If the post-1991 era has indeed seen increased error rates due to "rustiness" in maintaining readiness for strategic nuclear missions, how much more problems might be expected during a reconstitution race potentially occuring *decades* after anyone last actually possessed a "live" nuclear weapon?

Credible maintenance of a "Tier One" CR capability, therefore, is likely to demand remarkable fortitude and attention – not to mention scrupulous and repeated reconstitution exercises and drills – if its possessor is to retain a credibly sharp and minimally accident-prone "virtual" nuclear infrastructure. Even if it were possible, however, maintaining such a sharp "edge" could place great demands on the verification system of an abolition regime, which would have to be able to distinguish between such "routine" practice and the *actual* reconstitution of a nuclear arsenal. (We will also discuss this problem later.) Such drills could prove destabilizing and prone to misinterpretation, moreover – potentially igniting a real reconstitution race – if a CR-possessing country engaged in them during a period of special tension or conflict.

C. *"The Least Worst?"*

Despite all the considerable challenges that CR would thus seem to present in terms of strategic stability, however, it may still be premature to dismiss it as a potential policy goal for those desiring a way to bring about nuclear weapons abolition. True, countervailing reconstitution clearly is no semi-miraculous "silver bullet" solution to stability in a world of nuclear "zero." It would remain notably unstable on its own terms, and maintaining a serious "Tier One" capability would be demanding and costly and yet might not deter some countries' pursuit of regime breakout anyway. It would place enormous stresses on any verification scheme, and it could present dangerous incentives for nuclear weapons *use* in a crisis. Yet it would be wrong, and an analytical mistake, to evaluate a CR-based abolition regime solely in

---

118 Blair, "Command, Control, and Warning for Virtual Arsenals," *supra*, at 67.

119 According to an Air Force investigation into the notorious 2007 incident in which nuclear-armed cruise missiles were accidentally and unknowingly flown for several hours within the United States on a B-52 bomber, this incident had its roots in "a diminished focus on the nuclear mission" that can be traced "back to 1991 and the end of the Cold War." Michael Hoffman, "Nuclear safety slipped for years before Minot," *Air Force Times* (February 26, 2008), *available at* http://www.airforcetimes.com/news/2008/02/airforce_250208_nukesafety/.

comparison to some hypothesized system of deep peace and harmony. Instead, CR should be evaluated in light of the potential alternatives.

One must remember, for example, that even today's post-Cold War world of lessened superpower nuclear tensions hardly lacks critics alleging that it is itself troublingly unstable, prone to proliferation, beset by verification challenges, needlessly costly, and bedeviled by temptations to hasty nuclear weapons use. And even if a possible CR-based abolition regime still looked problematic when placed alongside today's world, one must also remember that there is no guarantee that today's nuclear balance will in fact continue tomorrow.

As we have seen, the ongoing proliferation of uranium enrichment and plutonium reprocessing and other dual-use nuclear-related technology is causing a concomitant spread of the nuclear weapons "option" around the world. It is thus arguably moving us gradually into a world of proliferated CR capabilities – of at *least* the "Tier Two" variety, and quite possibly also "Tier One" – whether we wish it or not. The operative question may not turn out to be *whether* to have a world the security dynamics of which revolve around CR challenges even more than around those of weapons-in-being, but rather *when* such a world is likely to arrive and *how* we should best hope to be able to manage life within it. In this regard, it is surely useful for us to be as painfully aware as possible of the great *challenges* presented by CR theory, even if they show a CR-based world to be for some reason *less* desirable than our own today.

III. *Programmatic Challenges of Reconstitution*

Let us now assume, for the sake of argument, that a genuine CR capability in the absence of extant nuclear weapons *is* in fact desirable, or at least unavoidable. In this hypothesized case, what would it actually be necessary to do in order to maintain such a capability both credibly *and* indefinitely?

A. *A Conceptual Framework for CR Planning?*

Perhaps the most important threshold question in this regard is presumably: *reconstitute what, and how many of them?* How many weapons one would need to plan to be able to build as a "Tier One" response to some other participant's attempt at breakout from an abolition regime would depend upon the kind of threat one anticipated having to meet, and how one desired to be able to meet it.[120] Optimal arsenal size, after all, is a function of the requirements one has for its potential employment, and the answer different countries might wish to give could vary.

How one answers such questions, however, could have dramatic implications for the kind of CR infrastructure one would need to maintain – and for how *quickly* one would be able to build the responsive arsenal one desires. (It is also likely that different countries would come to different conclusions based upon their differing strategic situations. Depending upon the circumstances, for example, the United States, China, or Russia might not necessarily feel an overwhelming need to initiate nuclear reconstitution in reaction to a potential adversary's

120 *See, e.g.*, Wheeler, "Reconstitution and Reassembly of a Virtual Nuclear Arsenal," *supra*, at 123, 136.

development of only a handful of weapons, whereas the reconstitution-provoking threat threshold of a small country such as Israel would surely be much lower. On the other hand, if a major country *did* feel the need to reconstitute, it might need or want to have much more ambitious rearmament plans than a small power.) As yet, it would appear that essentially no serious thought has been given anywhere to nuclear use concepts and force planning logics for some future road *back* from "zero."[121]

(1) *Countervalue or Counterforce?*

It might be argued that force reconstitution should be predicated upon a fairly simple concept of what nuclear planners refer to as "countervalue" targeting – that is, a plan that revolves around threatening the deliberate mass incineration of civilian populations as a deterrent to nuclear attack or general war. If this is the objective of CR planning, one might imagine that a reconstituted arsenal might be considered sufficient even if quite small. (How many cities would one need to vaporize?) It might also be possible to get by with a fairly simple set of weapons and delivery systems, because massive yields, tailored weapons effects, or precise accuracy would probably be unnecessary for such missions.

On the other hand, it might be considered more important – or perhaps more moral, since a pure-countervalue strategy smacks of boldfaced mass murder, and faces its own set of long-recognized deterrent credibility problems – to direct one's CR strategy more toward "counterforce" planning, perhaps aiming one's reconstituted arsenal at an adversary's own reconstituting nuclear force, his CR infrastructure, or the C^3I system that he would need in order to employ it. Arguably, such a strategy would be more consistent with the basic logic of countervailing reconstitution, too. It would seek to deny a violator's ability to employ his breakout force for strategic advantage.

In *that* case, a more sophisticated, and potentially larger, rebuilt arsenal might be needed, including delivery systems capable of considerable precision, and perhaps weapons optimized for specific effects not always easily obtainable from simple designs (*e.g.*, earth penetration capability in order to target deeply-buried facilities, and/or enhanced radiation outputs for the degradation of communications systems, computers, and other electrical equipment[122]). At the least, entertaining counterforce ambitions for one's reconstituted nuclear arsenal might require retaining the much more sophisticated production infrastructure and scientific knowledge base needed to make miniaturized thermonuclear devices. Ballistic missile accuracy – a key ingredient for serious counterforce targeting, especially against hardened targets – is in part a function of how far forward one can place a warhead's "physics package" within the conical shell of a re-entry vehicle (RV). (An RV with a center of gravity toward its nose is more stable in flight.) Very small designs, though they can be hard to build and maintain, permit greater accuracy for any given RV diameter.[123] As this example suggests, being able quickly to build a

---

121 *Cf.* Brown, "Nuclear Doctrine and Virtual Nuclear Arsenals," *supra*, at 48 (noting importance of having nuclear planners think through use concepts for small weapons stockpiles implied by reconstitution from "virtual nuclear arsenals").

122 *Cf.* Garrity, "Managing Asymmetries and Instabilities in Nuclear Reconstitution," *supra*, at 338.

123 *See generally*, Dr. Joseph Martz, "Evolution of the U.S. Nuclear Weapons Arsenal and Current Nuclear Issues," MSE 193/293, lecture presented at Stanford University (October 6, 2010).

counterforce capacity after what might have been many years of nuclear weapons abolition could be quite challenging from a programmatic perspective.

(2) *Available Alternatives*

Counterforce planning might be made somewhat simpler, however, for a country that possessed *non*-nuclear precision strike capabilities on a scale and of a nature capable of prosecuting such targets. Such conventional military options would presumably not be symmetrically available – or available at all – to every participant in an abolition regime, of course. For countries that *did* have them, however, the demands of counterforce CR could be attenuated by the availability of conventional alternatives to nuclear weapons.

Nevertheless, it is far from clear that non-nuclear methods would be able to handle such missions alone, at least on any scale, particularly if the understandable demands of reconstitutive survivability have by that point led other participants in the system to invest in deeply-buried underground facilities that are resistant to attack by anything *other* than hastily-reassembled earth-penetrating nuclear weapons. Here the requirements of CR survivability and the demands of CR force-posture planning – and specifically, any need planners might feel to be able to threaten an adversary's ongoing breakout effort – exist somewhat in tension.

(3) *"Reconstitutability" as a Design Criterion*

As noted, moreover, post-"zero" nuclear use concept planning would also have an potentially major impact upon force "reconstitutability," and could drive the CR planning process in idiosyncratic directions. This might be as simple a question as developing a new warhead design specifically with an eye to how easily it could be built or reassembled in a future reconstitution effort – particularly if one anticipated having a less experienced workforce then available for such tasks in the future.[124] Some designs are surely much more easily replicated, potentially years later, than others. (As one U.S. expert put it in an interview conducted for this study, "Are you trying to rebuild an F-22 from scratch? Or just a biplane?")

The issue might, however, be more complicated than that, insofar as in this arcane business of weaponeering, one might have to make tradeoffs between various design characteristics (perhaps *including* warhead simplicity) in order to optimize the *speed* at which a reconstituted arsenal could become available to counter another power's breakout attempt. The "perfect" weapon for one's CR needs, in other words, might not necessarily be the easiest or

---

[124] There are precedents within the nuclear weapons world for shifts toward more easily-produced technologies in connection with infrastructural shrinkage. When production of neutron generators for U.S. weapons was transferred from the Pinellas Plant to a new facility at the Sandia National Laboratory in the 1990s, for example, efforts were made to develop "a more producible design" better suited the much smaller new facility. *See, e.g.*, Lani M. Sanders, et al. "Transfer of the Neutron Generator Production Mission to Sandia," Sandia paper SAND2005-2875 (Albuquerque: Sandia National Laboratories, May 2005), at 13. More generally, the so-called "Foster Panel" began calling in late 1999 for a general shift to more robust *and manufacturable* U.S. nuclear weapons designs and away from complicated Cold War legacy devices. *See, e.g.*, Sanders & Branstetter, "Change and the Nuclear Weapons Complex," *supra*, at 32 (*citing* FY1999 Report of the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile (November 8, 1999)).

even quickest to reassemble: complex trade-offs might be necessary between performance, reliability, and speed of assembly, and these calculations would likely have to be done according to an equation likely much different from that which informed Cold War design strategies.

One would also have to decide how to prioritize safety and surety issues, factors for which additional design trade-offs could be necessary if they remained a top priority. Arguably, long-term warhead safety and surety would be *less* important in the CR context of rushed reassembly and deployment (and at least the potential for quick use thereafter), but this is not a given. CR planning might even anticipate reconstitution on something of a sliding scale between multiple designs, building a number of "easy" ones quickly in order to provide at least *some* response to adversary breakout, and then phasing in more complicated and difficult designs better suited to deterrence in a rapidly-evolving "post-zero" threat environment. It is worth emphasizing, however, that CR planning for such a world would require very difficult conceptual work and there is little sign of anyone yet being interested in doing it.

From a U.S. point of view, all of these factors would seem to have significant implications for weapons design even well *before* "zero," moreover, because *whatever* the optimal weapons design emerges from such complicated risk-tradeoff analyses, it probably will *not* look too much like the warhead types presently in the American inventory. Our current designs may be elegantly designed and perfectly tailored for Cold War missions – *e.g.*, with extreme yield-to-mass or -volume ratios in order to maximize the number of re-entry vehicles that can be delivered from a single missile[125] – but they are hard to maintain over time and would surely be devilishly difficult to *rebuild*, either quickly or reliably, decades after their dismantlement. Taking "Tier One" CR seriously, therefore, may require significant advance planning and design work for new weapons designs optimized precisely for their speedy and dependable reassembly[126] by a scientific workforce that may not possess anything like the technical "edge" it enjoyed during the Cold War and is today struggling to maintain even while we yet have thousands of weapons actually in our inventory.

(4) *Intelligence, Verification, and Surprise*

The issue of *how many* weapons one should rebuild – and perhaps also how many dedicated specialist delivery systems are needed, especially if warheads were not suitable for "plug-and-play" employment with whatever otherwise *non*-nuclear delivery capabilities one might retain – would also require judgment calls to be made long in advance on the basis of the relative ability of the verification regime (and/or one's own future intelligence means and methods) to guard against surprise. If one has reasonable confidence that one will not suddenly be surprised by a large arsenal in the hands of an adversary engaged in breakout – or perhaps one engaged in reconstituting in *response* to breakout by a third party – it might not be necessary to prepare for a particularly large initial reconstitution effort even if one's concept-of-use planning involved counterforce targeting. If one lacks high confidence in detecting noncompliance with

---

125 *Cf.* Garrity, "Managing Asymmetries and Instabilities in Nuclear Reconstitution," *supra*, at 341.

126 Analogously, Garry George has speculated about the need for new weapons designs specifically optimized for *disarmament verifiability*. *See, e.g.*, George, "Integrated Nuclear Security in the 21st Century," *supra*, at 48.

an abolition regime, however, one would presumably wish to plan for a more formidable responsive force.

(Strategic geopolitical calculations might also come into play, particularly to the extent that one might worry about the possibility of having to confront *combinations* of arms-building adversaries in a world in which "virtual nuclear arsenals" had become widely available. The possibility of facing such combinations would surely put considerable additional demands upon post-"zero" force-sizing requirements.)

All of this means that it is difficult to have a coherent discussion of the specific programmatic needs of a serious "Tier One" CR program without doing a very considerable amount of study of admittedly hypothetical force posture requirements for a rearming post-"zero" world. Nevertheless, it may be possible to offer at least a few observations.

B. *Programmatic Musings*

(1) *The Problem of Re-Learning*

To begin with, any serious "Tier One" CR program for a former nuclear weapons possessor would need to take careful account of the fact that in an arcane and sophisticated arena such as nuclear weapons design, it can be terribly hard to *re-learn* after a long absence what one was previously able to do. It may be the case, as Jonathan Schell has argued, that "the knowledge" of how to make nuclear weapons cannot be erased from the world, but one must qualify this by an appreciation that there are a great many different *levels* of knowledge of nuclear weapons design.

It was obviously possible to design workable atomic weaponry in the 1940s while doing calculations on what are by modern standards only the crudest of instruments, but those weapons were large, inefficient, and quite unsuited to present-day delivery systems. If the "*Reconstitute What?*" question were answered with a requirement for a more sophisticated weapon – not least a ballistic missile re-entry vehicle that must not only be fairly small but also carefully engineered for mating to and precise detachment from its booster under the demanding physical and environmental circumstances of trans-atmospheric travel – preserving "the knowledge" is a much more demanding requirement.[127] If one were additionally constrained by reflexive political neuralgia holding it for some reason taboo to develop "new nuclear weapons," moreover, the requirements would be tougher still. According to some experts interviewed for this study, quickly and reliably rebuilding *present* U.S. "legacy" designs years from now – and with a workforce none of the members of which had been involved in building or testing them in the first place – might scarcely be possible at all. Details, therefore, matter a great deal.

The post-Cold War experience of the U.S. nuclear weapons labs offers what may be some important lessons about the challenges of re-learning. The Rocky Flats plant in Colorado, which used to make plutonium "pits" for U.S. implosion-type nuclear weaponry, was closed in 1989 for

---

[127] *See also, e.g.*, Perkovich & Acton, *Abolishing Nuclear Weapons*, *supra*, at 123-24 (noting distinction between basic knowledge that cannot be erased and highly perishable knowledge related to such things as machining sophisticated weapons components).

environmental reasons, cutting off all pit production right in the middle of the production run for the W-88 warhead used on Trident D-5 ballistic missiles. With the Cold War then already winding down, there was initially felt to be no particular need for more pits, but it was soon discovered – after the U.S. nuclear testing moratorium of 1992 – that if the W-88 were to be maintained reliably for years in a no-testing environment for which it had not been designed, it would be necessary to have a supply of new pits to replace those removed from the stockpile for *non*-explosive testing and materials evaluation. Consequently, the United States determined that it needed a new pit-production facility. Nothing like the huge scale of the Rocky Flats operation was felt necessary at that point, but some years after that facility had been closed the Americans began working to construct a new pit plant at the Los Alamos National Laboratory (LANL) in New Mexico.

Even though it was then just a few years after Rocky Flats had been closed, however, it turned out that this re-learning process was considerably harder than had been anticipated, not least because the *new* facility had to be built – and to produce pits that met demanding "certification" requirements just like the old ones had – using safety standards and materials compliant with modern health and environmental requirements. (The much older Rocky Flats plant, closed after having been discovered to be an environmental disaster of plutonium contamination, had not been built to comply with such rules.) This was *not* impossible, but Los Alamos needed to develop what were in some respects entirely new machining, welding, and inspection capabilities and processes.

LANL delivered its first new pit in 2003, after a great deal of effort and expense, but there remained problems. Rocky Flats had *wrought* its pits, whereas because of space constraints and lower production volume considerations the new Los Alamos operation *cast* them. As it turned out as U.S. experts put the new Los Alamos pit through certification testing – testing which, it should be added, had for the first time to be undertaken *without* yield-producing underground explosions as in days of old – casting changed the performance of the pit somewhat. (Cast materials tend to be slightly weaker than wrought ones.) The change was not great, but it was more than enough to raise questions about the exacting demands of the performance margins demanded by the sophisticated W-88 design. It was not until 2007 that LANL's first pit passed quality review by the National Nuclear Security Administration (NNSA).[128]

The LANL pit-production story was thus ultimately a success, and is considered a great triumph for the laboratory. (NNSA plans for Los Alamos to maintain the capability to make between 20 and 80 new pits a year.) For anyone interested in "Tier One" CR planning, however, it is a cautionary tale. Re-learning pit fabrication – even after only a decade, and without the complete turnover in scientific, engineering, and other technical personnel within the weapons complex that one might expect after a longer delay – was slow, costly, and difficult. "We could do it after ten years," one expert told me, "but it was really hard. Could we do it after 20? Fifty?"

---

[128] The foregoing account is drawn from interviews with Los Alamos experts, and from an account in the Los Alamos science and technology magazine. *See* "W-88 Pit Certification," *1663* (August 2007), *available at* http://www.lanl.gov/news/index.php/fuseaction/1663.article/d/20078/id/11870.

Another laboratory success – and cautionary tale – can be seen in the recreation of the material known as "Fogbank." The precise nature of "Fogbank" is classified, but media accounts have speculated that it is an aerogel used to take up some of the space between the "primary" and "secondary" explosive stages of a thermonuclear weapon (a.k.a. hydrogen bomb).[129] Whatever Fogbank really is, it was apparently used in the W-76 warhead initially deployed in 1978 on U.S. Minuteman missiles. When the W-76 came up for reconditioning as part of a Life Extension Program (LEP) for which planning began in 2000 and which was scheduled to begin in 2007, however, it was discovered that no one could make Fogbank anymore – and that there was apparently no adequate modern replacement for the material. According to the Government Accountability Office, NNSA had "lost knowledge of how to manufacture the material because it had kept few records of the process when the material was made in the 1980s and almost all staff with expertise on production had retired or left the agency."[130]

Accordingly, the U.S. weapons complex had to learn how to rebuild a manufacturing process for this exotic material, essentially from scratch. Too little was known about precisely how Fogbank had been made before, and in any event the new process had to be compliant with 21st-century environmental and safety regulations in a way that had not concerned its original manufacturers. New procedures were duly developed, but to the dismay of U.S. officials, they could not produce Fogbank quite equivalent to the old version. By 2007 – the scheduled commencement of the W-76 LEP – the situation had reached crisis proportions. After what are said to have been almost heroic efforts, proper new Fogbank *was* indeed produced and officially certified in 2008. Even then, however, this seems to have been partly serendipitous: at first, the scientists who had succeeded in this endeavor reportedly did not know what had actually fixed the problem, nor how the material characteristics worked that determined the quality of the final product.[131]

The struggles to re-learn W-88 pit and Fogbank production illustrate the degree to which re-learning old skills and processes in the complicated arena of nuclear weapons design and engineering can be very challenging even when not *that* much time has passed. "Tier One" CR planning efforts must take such considerations into account, for depending upon *what* one wants to be able to rebuild, it can be very difficult indeed to retain what Schell called "the knowledge." Future weapons reconstitutors might not necessarily have to *rebuild* capabilities from scratch as LANL did for the W-88, of course, for prudent CR planning might undertake simply to *retain* things on an indefinite basis. Nevertheless these stories illustrate a basic point that manufacturing something *later* can be very different than manufacturing it *now*, and that it can

---

129 *See, e.g.*, Jeffrey Lewis, "Fogbank," *Arms Control Wonk* blog (March 7, 2008), *available at* http://lewis.armscontrolwonk.com/archive/1814/fogbank.

130 *See, e.g.*, Walter Pincus, "Nuclear Weapon's Refurbishing Woes Draw Congressional Attention," *Washington Post* (August 4, 2009), *available at* http://www.washingtonpost.com/wp-dyn/content/article/2009/08/03/AR2009080302776.html.

131 After much study, it was determined that *old* process had inadvertently introduced an impurity that had helped improve quality by slightly changing morphology of the Fogbank material. The reconstituted process, developed with 21st-century methods, had actually produced Fogbank that was *too* pure to work properly. Today, proper Fogbank is produced by *intentionally* adding a tiny bit of the impurity in question. *See* Jennifer Lillard, "Fogbank: Knowledge Regained," *Nuclear Weapons Journal*, issue 2 (2009), at 20, 20-21.

be extremely difficult to recoup lost knowledge – or cope with technological surprise – once one has become unpracticed in a complicated business.

Some disarmament advocates seem to *like* the idea that such details can be highly perishable. For them, the notion of countervailing reconstitution is attractive precisely because while it *appears* to offer deterrence-focused solace, they feel that in reality it might equate to a sort of "stealth disarmament" – with today's nuclear weapons states suddenly waking up one morning, as it were, to discover that they had accidentally disarmed themselves by forgetting how to reconstitute their former programs. More skeptical minds, however, worry that even if such "surprise" disarmament might occur, it would certainly not occur evenly, at the same rate for, or with the same operational impact upon, all participants. Asymmetries in the rate or implications of such atrophy could be greatly destabilizing, and offer strategic advantages – and perhaps even a nuclear weapons monopoly at some point – to those who were for some reason or another better positioned to retain their *own* weaponeering "knowledge" while others forgot theirs.

Michael Mazarr claims that the challenge of "long-term, rather than short-term, reconstitution asymmetries" of this sort is actually "a rather easy problem to solve." In his view, atrophy disparities would not produce grave instabilities in a reconstitution context because "marginal differences of a few hundred weapons would not produce a first-strike capability for any side."[132] It is not clear why this should be reassuring, however, even if such asymmetries did produce an imbalance of "only" several hundred nuclear weapons. Depending upon the circumstances and the country targeted, after all, that number of devices could make a tremendous difference in a first-strike context. Furthermore, since CR program atrophy might well occur in areas vital to the *speed* at which reconstitution could be achieved – *e.g.*, if some unforeseen future Fogbank-type problem with a particular country's warhead design were to result in the delay of weapons production for months or years – it stands to reason that asymmetric atrophy could well also produce great imbalances even in the initial stages of a reconstitution race, with potentially disastrous results. This is one reason why CR might create pressures to develop an entire new generation of nuclear weapons – with countries devising and perhaps even testing them well *before* abolition – specifically designed, at least in part, to minimize re-learning problems in the event of reconstitution many years later.

(2) *Human Capital Retention*

A closely-related problem is the challenge of retaining the *people* who possess "the knowledge" that one must preserve in order to ensure a credible "Tier One" CR program. Personnel retention has already become a major problem for the U.S. nuclear weapons complex during the arms reductions and de-emphasis upon nuclear weapons missions of the post-Cold War world.

Even in the 1990s, studies were warning of dangerous expert attrition within the complex, with the so-called Chiles Commission, for instance, noting at that time the U.S. weapons infrastructure had a technical workforce significantly older (and thus closer to

132 Mazarr, "Virtual Nuclear Arsenals: A Second Look," *supra*, at 388.

retirement) than their peers in the general economy.[133] Ongoing U.S. infrastructure downsizing has made retention both a continuing headache and, by some accounts, a battle NNSA is slowly losing – even under current conditions well *short* of abolition. If we are having such problems even with all the money we currently spend on "stockpile stewardship" efforts, and even when we retain thousands of nuclear weapons, some U.S. weapons laboratory experts wonder, how could we possibly handle this challenge over decades in a CR-based abolition environment?[134]

According to U.S. nuclear weapons designers, their craft is in some regards as much art than science, and is passed along between the generations by a process akin to apprenticeship learning. Their refrain is that "you've got to *do it* [in order] to learn it," and they worry that the passage of time *without* "doing it" will rapidly create ignorance and incapacity. By these accounts, the twin issues of human capital retention and knowledge retention within the workforce are the biggest potential challenges for any serious effort to maintain a serious "Tier One" CR capability over time. As one scientist put it, *physical* capital can be reconstructed with enough money – after all, "you can rebuild almost anything, technically" – but when *knowledge* disappears it may well be, for practical purposes, flat-out *gone*.[135]

U.S. weapons experts interviewed for this study repeatedly emphasized that maintaining a first-rate human capital stock in sophisticated fields such as weapons design, precision machining, re-entry vehicle engineering, and other exotic specialties can be very difficult if one cannot offer employees the sort of qualitative *frisson* associated with working on issues that are both of paramount national and global importance, and involve formidable intellectual and technical challenges. In the U.S. weapons complex, this was not a problem during the Cold War, when national security was felt to depend hugely upon the work of miracle-working weapons scientists engaged in a desperate, decades-long intellectual dual with their counterparts in a predatory Soviet empire – a competition upon the outcome of which the fate of the entire world might depend.

This sense of scientific and national-imperative *élan* only imperfectly survived the end of the Cold War, however, and the complex has struggled with recruitment and retention ever since, especially because it has also had to cope with considerable downsizing. The U.S. weapons complex can still offer its employees fascinating technical and scientific challenges, but it no

---

133 By the late 1990s, only 20 percent of employed scientists and engineers in the U.S. were over 50 years of age, but within the weapons complex this figure was 34 percent – with some 60 percent of the weapons designers at LANL, for example, then being between ages 50 and 65. Annual losses within the complex due to retirement were reckoned to be between 60 and 150 percent higher than in the general economy. Sanders & Branstetter, "Change and the Nuclear Weapons Complex," *supra*, at 31 (*citing* Report on the Commission on Maintaining the United States Nuclear Weapons Expertise (March 1, 1999)).

134 *See also, e.g.*, Perkovich & Acton, *Abolishing Nuclear Weapons*, *supra*, at 121 (noting that "given that weapons establishments are worried even today about the loss of expertise and the difficulty of recruiting and maintaining skilled staff" and wondering how long skilled cadres could be maintained after abolition).

135 One U.S. laboratory official whose job is precisely to help ensure the continuation of his laboratory's technical edge worries that once lost, such capabilities are perilously hard to recover. Historically, he says, companies and institutions that lose the kind of commanding technological "vitality" that makes them leaders in their field are rarely – if ever – able to regain it. Complex technical arenas are characterized by a process of gradual waxing and waning, and he could not think of an example of anyone ever having succeeded in regaining the lost "bubble" of technical mastery associated with first-place position in their field.

longer seems able to supply quite the overarching sense of mission importance in nuclear weapons work that it once did, and the laboratories have for years now been scrambling to find post-nuclear missions to ensure their continued relevance and streams of taxpayer funding. This can have consequences. As one study of infrastructure consolidation put it, "[k]nowledge walks out the door, and the best leave first."[136]

These human capital retention issues thus present serious challenges to long-term "Tier One" CR planning. Any former nuclear weapons possessor with a CR program will presumably have to struggle with such issues, particularly since knowledge atrophy seems likely to occur asymmetrically depending upon what measures particular countries take to preserve their weapons workforce, the knowledge *demands* of each country's specific reconstitution weapons, and other factors. Command economies or dictatorships, for instance, might be able simply to *decree* workforce retention as a matter of government fiat, but market-based economies will presumably find it harder to ensure that work in *not* producing nuclear weapons remains an attractive and competitive career field for top-notch scientists and engineers. Similarly, different weapons designs may simply require less sophisticated technical competencies than others, with the result that countries aiming to reconstitute such devices will fare better over time than those more reliant upon more demanding systems.

(3) *"Set a Thief to Catch a Thief"*

Quite apart from its own need for potential reconstitution, another reason for a country planning a serious "Tier One" CR program to ensure the maintenance of high-caliber nuclear weapons design and engineering expertise is in order to help prevent intelligence or technical surprise in the context of foreign breakout attempts. It may be, for instance, that nuclear weapons designers are indispensable to intelligence-based threat analysis, and to abolition verification, precisely because they can help national leaders understand when breakout actually *is* underway somewhere else, and to guard against someone's dangerous excursion down an unanticipated technical road that could offer the possessor significant and destabilizing military advantages.

This is an issue that was, to some extent, foreseen in the Acheson-Lilienthal Report in 1946, which envisioned this sort of "set a thief to catch a thief" logic being embedded into the organization of its proposed Atomic Development Authority. According to the Report, "the controlling agency must itself be active in research and development, and well informed on what is an essentially living art."[137] Notwithstanding the fact that the whole point of the Authority was to ensure the abolition of nuclear weapons, it would have to employ nuclear weapons experts in order to help *ensure* such abolition. As the Report explained,

> "one of the important things that the Authority will have to do is research in atomic explosives. We are by no means sure that important new discoveries in this field do not lie ahead. Possibly the study of atomic explosives may yield byproducts useful in peaceful activities. But this will not be the main purpose of

136 Sanders, et al. "Transfer of the Neutron Generator Production Mission to Sandia," *supra*, at 30.

137 Acheson-Lilienthal Report, *supra*, at 6.

> the Authority's research. Only by preserving its position as the best informed agency will the Authority be able to tell where the line between the intrinsically dangerous and the non-dangerous should be drawn. If it turns out at some time in the future, as a result of new discoveries, that other materials lend themselves to dangerous atomic developments, it is important that the Authority should be the first to know. At that time measures would have to be taken to extend the boundaries of safeguards."[138]

Analogously, a "Tier One" CR program might well depend upon nuclear weaponeers to help know *when* reconstitution might need to be triggered, and identify potential new nuclear weapons-related threats as they emerge on the horizon.

Additionally, the needs of nuclear safety and security in the face of potential nuclear *terrorism* – a problem analytically distinct from that of countervailing reconstitution, in part because deterrence theory is less obviously, or less directly, relevant in the terrorism context – or the discovery of one country's cheating on an abolition regime, might also require the continuation of weapons-related expertise for purposes of handling, neutralizing, dismantling, and identifying the origins of illicit weapons. Even if countries' nuclear arsenals are abolished, therefore, there might remain a continuing need for weapons expertise analogous to today's American Nuclear Emergency Support Team (NEST) organizations and NNSA's Accident Response Group (ARG).[139]

(4) *Complex Morphology*

Since the end of the Cold War, the U.S. weapons complex has undergone considerable shrinkage, and complex downsizing remains a focus of U.S. planners even as they simultaneously seek to modernize the American infrastructure. One should not assume, however, that "Tier One" planning would not ultimately require the creation and indefinite maintenance of a *larger* and/or *differently structured* weapons complex. What precisely would be required for "Tier One" CR is unclear, but some commentators have suggested that at the very *least* there is probably some minimum of complex size and diversity below which it would not be possible for reconstitution to be credible – and that this minimum might not actually be very small.

Michael Wheeler, for instance, has argued that "much of what constituted a nuclear posture for the United States during the past fifty years will likely remain, even in a world of VNAs," and that "[a]lmost all, if not all, of the specialized procedures that are associated with the safety of the current nuclear stockpile would continue to obtain with a virtual nuclear stockpile." By his acount, in other words, "the ability to reconstitute a larger nuclear stockpile

---

138 *Id.*, at 36.

139 This was emphasized in my discussions with some U.S. nuclear weapons experts. It has also been more publicly noted by Garry George. *See* George, "Integrated Nuclear Security in the 21st Century," *supra*, at 22-23.

from a starting point defined by a VNA world may not differ signficantly" from what exists in today's world of *extant* arsenals.[140]

Indeed, Wheeler may understate the problem, inasmuch as no country's *present-day* nuclear weapons infrastructure is structured and sized with an eye to relying *entirely* upon productive capacity to provide deterrence. The United States is the weapons possessor today most explicitly planning to rely upon productive capacity to make possible *reductions* in its reserve stockpile, but it is not presently planning to replace its entire *deployed* stockpile with "virtual" weapons. Already, even such U.S. shifts as *are* occurring involve significant new investments in production facilities such as the new pit-making operation at LANL and the new Tritium Extraction Facility being built at the Savannah River Site.[141]

If and when attention shifts from sizing a revitalized productive infrastructure for the mission of supporting a small stockpile of weapons-in-being to the potentially much more demanding mission of supporting *reconstitution* when there *are* no longer any weapons-in-being, it might appear that the *scale* of production needs to be increased. Without the kind of force-sizing concept work on post-"zero" nuclear requirements that no one seems yet to have done, of course, it is hard to say *how* many weapons a "Tier One" CR program would need to anticipate being asked to produce. It is not a given, however, that these numbers would be the same low numbers of weapons for which present-day officials are sizing the complex.

The new LANL pit-production facility, for instance, is not designed to exceed 80 new W-88 pits per year. That number is designed to support ongoing stockpile maintenance needs, but it might prove hopelessly low if full-blown *reconstitution* ever becomes the order of the day. Preparing for such a CR mission at notably larger numbers, however, would require an entirely new facility and perhaps an entirely new location. (Space limitations at Los Alamos probably preclude much expansion at Technical Area 55, where this new pit work is presently being done.)

To illustrate this problem, it should be noted that an analogous issue developed in the 1990s when production of neutron generators (NGs) for U.S. weapons was transferred from the Pinellas Plant in Largo, Florida, to the Sandia National Laboratory (SNL) in Albuquerque, New Mexico. In the middle of this transfer process, it was decided that in order to provide for the possibility of reactivating out-of-service nuclear warheads in the American inactive stockpile – as just the sort of strategic "hedge" against emerging threats that CR planning would itself seek to provide – Sandia needed to be able to produce NGs not just for the active stockpile but also for the *inactive* one. SNL thus had to revise its planning in order to accommodate a much greater potential NG throughput. It succeeded in absorbing the relocated NG production mission and began producign new generators in 1999, but the change was tricky and difficult – and even

---

140 Wheeler, "Reconstitution and Reassembly of a Virtual Nuclear Arsenal," *supra*, at 129 & 135-36.

141 The "Complex-21" study in 1991 had concluded that no more plutonium production from reactors would be needed. American planners thereafer realized, however, that their ongoing need to replace decaying tritium gas in "boosted" nuclear weapons designs required a new tritium source to replace the now-closed reactors at Hanford and Fernald. *See, e.g.*, Sanders & Branstetter, "Change and the Nuclear Weapons Complex," *supra*, at 14 & 30; Garrity, "Managing Asymmetries and Instabilities in Nuclear Reconstitution," *supra*, at 341.

with the changes SNL never came anywhere near the volume of output at Pinellas when it was in the business not merely of maintaining but of *increasing* the size of the U.S. arsenal.[142]

The Sandia NG example also suggests the lesson that different anticipated needs can have an important impact upon the productive *processes* around which new facilities must be constructed. Originally, the plan was to co-locate design and production functions for neutron generators at the new SNL NG facility. These functions had been separated at Pinellas, but studies indicated that there would be efficiency gains in having these operations occur at the same place, for co-location would facilitate coordination between the design and production staffs, to the benefit of both (*e.g.*, through fabricating development components on the production floor). When it was realized that Sandia needed also needed to be able to handle "rapid reactivation" needs for the inactive stockpile, however, it became necessary to *re-separate* design and production. The larger anticipated volumes of *that* form of reconstitution made colocation unworkable, and Sandia adopted a process much more akin to what had been done at Pinellas (albeit still on a much smaller scale).[143]

To be sure, the NG example should not be pressed too far, because Sandia's present maximum capacity of about 1,500 units a year might well be adequate to support a significant "Tier One" CR effort. Nevertheless, the more general question of anticipated volume at least needs to be asked and answered in a coherent fashion, and facilities need to be sized appropriately. In an internal "lessons-learned" study of the NG production transfer, Sandia experts warn strongly – in considering the broad questoin of "how to configure the Complex when the future stockpile is unknown" – *against* "sizing to the small end of notional stockpiles." Instead, they argue that it is much safer to size the complex based upon anticipated needs more toward the *high* end of the landscape of stockpile estimates, in order to improve the system's ability to handle contingencies.[144] It is presumably difficult to build a CR-focused complex unless one has some idea of the design types and numbers that one might need to reconstitute. To the extent that one faces uncertainties in this regard, however, it may be better to "guess high" as a form of infrastructure-management "hedging."

Stockpile uncertainty, however, is not the only factor that might tend to drive "Tier One" CR planning toward more elborate and expensive configurations. It has been observed that as a general rule, for instance, strategic "hedging" is best served by diversity, such as in keeping a range of operationally deployed and stockpiled weapon types available in order to protect against single-mode failure or unwelcome technological surprise.[145] Greater diversity in weapon types, however, requires support from a more diverse weapons infrastructure.

---

142 When last operational in 1992, Pinellas could produce up to 6,900 NGs annually – and at its peak in 1965 actually produce 12,000 – but usually made only about 3,000. Sandia's NG mission was smaller, involving only about 1,000 units a year, with an anticipated maximum capacity of 1,500. *See* Sanders, et al. "Transfer of the Neutron Generator Production Mission to Sandia," *supra*, at 3, & 7-10.

143 *Id.*, at 15-17, & 31.

144 *Id.*, at 14-16 & 22-24.

145 *See, e.g.*, Patrice Stevens, "Strategic Weapons in the 21st Century: Hedging Against Uncertainty," *Nuclear Weapons Journal*, issue 2 (2009), at 3, 4.

Moreover, as we have seen, the emerging field of what one might call "reconstitution theory" also suggests that a CR-based abolition regime would put a premium on redundancy and survivability of CR-associated facilities. A reconstitution capability that is easily targeted or disrupted by conventional weapons, sabotage, or special operations forces – or vulnerable to preemptive attack by the winner of a nuclear reconstitution race – is a CR capability that cannot be counted upon either to deter others or in fact to reconstitute a nuclear arsenal if this were desired. This introduces a new element into infrastructure sizing, for even beyond output-volume considerations of "surge" capacity in support of reconstitution, it may be felt necessary to plan one's CR force posture with an eye to avoiding single-point-of-failure reconstitutive bottlenecks. If one were not quite confident of one's ability to *defend* a critical part of the reconstitutive process from any form of potential adversary attack, for example, one might have to build (and protect) a back-up facility capable of doing what is needed in the event that the first operation were successfully attacked.

In part because of its post-Cold War shrinkage and consolidation – though process-protective redundancy never really seems to have been a priority – the U.S. weapons complex is quite heavily concentrated in a small number of non-hardened and relatively undefended critical sites and is thus poorly designed for resistance to deliberate disruption. Weapons designers and engineers at the U.S. national laboratories interviewed for this study, for instance, noted that even a very simple attack with conventional weapons upon the Pantex weapons-assembly and disassembly plant in Amarillo, Texas, would immediately cripple our present infrastructure.

Post-Cold War consolidations had by 2005 reduced the site "footprint" of the U.S. weapons complex considerably, from only eight facilities working on Defense Program missions from a total of 15 in 1980,[146] and current planning envisions further shrinkage to between four and six locations. It is open to argument whether CR planning would need to push the number back up through intentional redundancy, imposing what would likely be very significant additional costs.[147]

(5) *Delivery Systems*

It should also be remembered that CR planners probably cannot restrict their programmatic thinking solely to the recreation of actual nuclear weapons themselves. As we have seen, nuclear weapons – in order actually to be usable – fit into a complex web of capabilities, institutions, and procedures. If "Tier One" countervailing reconstitution planning is to be taken seriously, it cannot entirely ignore the challenge of ensuring that if and when new weapons were produced after a long hiatus, these systems will be able actually to employ them in a reasonably effective manner. This might involve many things, some major and some minor, no doubt varying greatly from one CR-possessing country to the next. One of the most obvious of these is the challenge of ensuring the future availability of appropriate delivery systems.

---

146 Sanders & Branstetter, "Change and the Nuclear Weapons Complex," *supra*, at 9.

147 Clearly, distributing weapons production facilities is as a general rule notably more expensive than consolidating them. Even within the comparatively limited context of the new W-88 pit facility at Los Alamos, it was estimated that a new stand-alone facility would cost $180 million more (in 1995 dollars) than embedding pit fabrication at LANL's current location with regard to construction costs alone. *See Id.*, at 27.

To some extent, delivery system availability could be assured by such comparatively simple expedients as retaining dual-capable aircraft with ordinance hard points suitable for nuclear weapons release, paying what Pentagon acquisition officials call the "tax" of installing and maintaining radiation-hardened avionics and communications gear, and periodically training pilots in the specialized techniques of delivering nuclear weaponry. Maintaining the ability to field nuclear-armed ballistic missiles, however, might be much more challenging – though for some countries the development of Conventional Prompt Global Strike (CPGS) technologies for delivering *non*-nuclear payloads might make this burden less onerous by providing a reason to keep such systems around despite nuclear weapons abolition.

Today there is talk of diverting a few missiles for use in CPGS operations from a large stock of boosters ordinarily devoted to nuclear missions. In the future, however, the issue may be more one of diverting a few missiles for nuclear delivery from a large stock of CPGS delivery systems. (The same might perhaps be said of exotic non-ballistic delivery systems such as hypersonic cruise missiles.) The need to provide a "hedge" in delivery system alternatives might help drive CR-possessors toward modular "plug-and-play" warhead and guidance systems designed to allow a single warhead design to be used on as large a number of legacy or anticipated delivery systems as possible. Such solutions would presumably not be beyond the reach of most of today's nuclear weapons possessors, though they might require a period of new warhead development before abolition is actually achieved.

(6) *Funding and Attention Over Time*

It is not enough, of course, merely to get the force-planning and complex-sizing answer "right" and establish a serious "Tier One" CR capability. Even if one figures out a way to handle re-learning and knowledge-retention challenges, actually succeeding in these endeavors would require an ongoing commitment of attention, energy, and funding for the indefinite future. Many experts who have considered reconstitution issues worry about the sustainability of such an effort, particularly in a Western democracy.

Writing about the importance of a wartime mobilization base, Herman Kahn fretted not long before his death about what he said was a danger that the then-current nuclear "freeze" movement might encourage an environment of nuclear policy "stagnation" that would create "a false sense of security that would be exposed as soon as the popular pressure subsided and a hostile confrontation seemed imminent."[148] More directly, a 1996 study of the U.S. weapons infrastructure by the JASONs group warned that the scientific and infrastructural demands of long-term complex management in the absence of nuclear testing would be very vulnerable to budgetary and political pressures over time.[149] In this vein, Peter Wilson has cautioned about "virtual nuclear arsenals" that there can develop a sort of "out of sight, out of mind" phenomenon in which abolition would breed inattention to and disinterest in the difficult work of maintaining a serious CR capability.

---

148 Kahn, *Thinking About the Unthinkable in the 1980s*, *supra*, at 209.

149 Sanders & Branstetter, "Change and the Nuclear Weapons Complex," *supra*, at 25 (*citing* Preliminary Review of Stockpile Stewardship and Management, JASON, The MITRE Corporation, JSR-96-320 (February 1996)).

> "In essense, the very success of a virtual abolition regime, much less a virtual nuclear arsenal regime, will induce a powerful sense of political *ennui* if not indifference about all matters dealing with nuclear weapons. ... Without any immediate threat to the viability of a smaller operational nuclear force, the tendency of bureaucratic indifference would likely come into play in which near-term financial and other concerns take clear priority over the 'remote worries about survivability.'"[150]

(Harald Müller offers a different but related critique, worrying that the perceived *availability* of reconstitution might have the perverse effect of encouraging atrophy of the sophisticated *non*-nuclear arsenals that one might otherwise be able to use in order to achieve compliance enforcement goals *without* recourse to nuclear rearmament.[151])

To the extent that such atrophy problems would indeed exist, this logic would presumably apply with even more force to the challenges of CR maintenance after abolition than Wilson believed it would vis-á-vis maintenance merely of a "smaller operational nuclear force." It is indeed not hard to imagine that the demands of maintaining an expensive CR infrastructure and workforce would exist in tension with more immediately "useful" requirments, and that there might in time occur what Patrick Garrity has called a crisis in "the political will required to maintain a credible virtual capability."[152]

And in fact it must be admitted that the U.S. record of assiduous attention to such details in the post-Cold War era is not particularly encouraging. American weapons experts complain privately that we have on multiple occasions in the past allowed little-used technical or intelligence capabilities to disappear even though they had earlier been deemed important – including for the verifiability of arms control agreements – in order to maintain our *ability* to call upon them in contingencies. Essential funding for stockpile surveillance under our "Stockpile Stewardship Program" (SSP), they say, has also lagged. As a 2009 report by the JASONs scientific assessment team summarized things, the U.S. warhead surveillance program "is becoming inadequate," and "continued success of stockpile stewardship requires implementation of a revised surveillance program."[153] Despite longstanding requirements that the U.S. underground testing facility in Nevada remain prepared to resume testing within two years of some future command to do so, moreover, the site's current readiness on this schedule has reportedly long been more rosily theoretical than actual. In a series of reports beginning in 2001, the so-called Foster Panel repeatedly castigated the NNSA for failing to reverse a longstanding decline in the U.S. infrastructure.[154] As the JASONs put it, "[c]ontinued success of stockpile stewardship is threatened by lack of program stability":

> "All options for extending the life of the nuclear weapons stockpile rely on the

---

150 Wilson, "Issues of Force Structure, Nuclear Infrastructure, and Survivability," *supra*, at 87.

151 Müller, "Enforcement of the rules in a nuclear weapon free world," *supra*, at 19.

152 Garrity, "Managing Asymmetries and Instabilities in Nuclear Reconstitution," *supra*, at 341 & 346.

153 JASON Group, "Life Extension Program (LEP) Executive Summary," JSR-09-334E (September 9, 2009), at 3-4.

154 *See, e.g.*, Sanders & Branstetter, "Change and the Nuclear Weapons Complex," *supra*, at 40-42.

> continuing maintenance and renewal of expertise and capabilities in science, technology, engineering, and production unique to the nuclear weapons program. … [T]his expertise is threatened by lack of program stability, perceived lack of mission importance, and degradation of the work environment."[155]

Nor is the situation necessarily better on the military side of the nuclear weapons equation. Despite great ambitions of developing a "New Triad" of strategic programs in which non-nuclear elements were to be augmented as nuclear mission retrenchment occurred, the promised non-nuclear deterrent augmentation has not yet materialized. At the same time, as we have already seen, worrying signs continue of a decline in nuclear mission competence associated with the waning relevance of nuclear weapons matters within the U.S. military and the Defense Department – as epitomized by the B-52 cruise missile incident at Minot Air Force Base in 2007. CR skeptics must surely wonder whether long-term maintenance of an effective "Tier One" capability at "zero" is possible if we are struggling so much even with our post-Cold War decline to a current total of "only" just over 5,000 total nuclear weapons.

One should probably not hope for dramatic cost savings from further complex consolidation, either. Quite apart from issues of CR survivability which might actually provide reasons to build a *more* sprawling and redundant complex than the one NNSA is trying to build today, studies of the U.S. infrastructural consolidations of the 1990s make clear that "major stockpile reductions do *not* generally translate directly to commensurate cost savings." Fixed costs dominate the infrastructural landscape, with savings made by reductions in production throughput (*e.g.*, through arms reductions) being "generally minimal."[156] This is another way of expressing the complex-sizing challenge that we have already seen: even if production rates were zero, one must still maintain a sizeable complex if one wished to take reconstitution capacity seriously.

One U.S. study undertaken in 1992 highlights this dynamic. In the wake of the dramatic unilateral reductions ordered by President George H.W. Bush in his Presidential Nuclear Initiatives (PNIs) of 1991, U.S. experts studied the degree to which these cuts had allowed cutbacks in the size of the overall weapons complex, and in the amounts of money that the U.S. taxpayer had to spend in order to maintain it. Apparently, there was very little such effect. The PNIs resulted in cutting by about 50 percent the rate at which U.S. weapons were then being produced, but this had little impact on the overall size or expense of the infrastructure. "[S]ignificant reductions in stockpile size," it has thus been concluded, "have not translated directly into commensurate cost savings within the complex." This may be a "counterintuitive reality," but it appears to be a reality nonetheless.[157]

These are lessons that reconstitution planners must keep in mind. If indeed reconstitution theory dictates the maintenance of a distributed CR capability sized in order to cope with relatively large potential reconstitution demands, this will be not merely technically and organizationally demanding, but also quite costly. The expense of a serious "Tier One" CR

---

155 JASON Group, "Life Extension Program (LEP) Executive Summary," *supra*, at 3-4.

156 *Id.*, at 8, 11, 20 & 28.

157 *Id.*, at 20, 28, & 36.

capability, in turn, would all but guarantee an ongoing struggle – for the indefinite future – against the sort of "out of sight, out of mind" dynamics discussed by Peter Wilson.

(7) *Verification*

It is beyond the scope of this study to examine the technical, institutional, or political challenges of verifying compliance with an abolition regime. That said, however, it seems clear that under the best of circumstances, these verification tasks would probably be extremely challenging, and that the likely error margins that today's weapons possessors would likely demand before agreeing to such a regime in the first place would probably be quite low. Missing even a handful of weapons in a world of "zero," after all, could have very great military significance.

Yet deliberate efforts to retain "Tier One" CR capabilities could make the verification job especially difficult, insofar as many of the steps countries might wish to take in order to maintain a reconstitution option would be hard to monitor (or detect if done secretly), hard to distinguish from real reconstitution, or both. In the preceding pages, for instance, we have discussed such things as: the pre-production of nuclear weapons components for rapid future re-assembly; the maintenance of deep expertise in nuclear weapons design and engineering for intelligence and compliance analysis purposes; the wide distribution and potential concealment (for survivability purposes) of CR facilities; the way in which a wide range of scientific, technical, military, and organizational systems might contribute to reconstitution racing and must therefore be understood (and conceivably even controlled, to some degree, in the interests of reconstitution rate harmonization); the need to maintain dual-capable delivery capabilities; and the need to drill remobilization procedures on an ongoing basis. All of these things would place tremendous stresses upon any verification regime.

In fact one might even perceive the danger of a vicious cycle developing, inasmuch as verification uncertainties might lead former weapons possessors to insist upon more elaborate CR preparations as a "hedge" against potential surprise – yet some of these very CR preparations might make verification all the *more* difficult, and hence all the more likely to elicit insecurity and thus more strategic "hedging" from system participants. Unless one could devise a verification system so reliable, and a compliance enforcement scheme so dependable, that parties essentially *stopped* demanding "hedges" as a condition of their accession to an abolition regime, it is not clear how one could break such a cycle of opacity and distrust.

Such verification complications would have to be given serious attention in preparing for any hypothetical future CR-based abolition regime. What tradeoffs might current weapons possessors be willing to accept between "verifiability" values and the incentive structures suggested by reconstitution theory (*e.g.*, with regard to survivability, or component pre-production)? What tradeoffs might *other* countries feel it necessary to *demand*, and what might be the outcome of such a negotiation? One can at this point, of course, only speculate. Nevertheless, it seems clear that the list of factors that must be considered in any serious effort at CR planning is long indeed.

IV. *Conclusion*

What, then, is one to make of all this complexity? The disarmament optimists may see this study as a roadmap: an outline of some of the conceptual and practical issues that one should now set out systematically to examine and address along the difficult – but yet *possible* – road to nuclear weapons abolition. For them, despite the problems raised and difficulties presented by countervailing reconstitution, a CR-based world is yet one that would be preferable to a continuing "balance of terror" between powers wielding not merely *potential* weapons but murderously threatening *weapons in being*. Alternatively, some abolition optimists may see these complications as confirming their initial instinct that deterrence theories are fundamentally incompatible with disarmament discourse, and may thus simply be ignored or dismissed.

Alternatively, the disarmament pessimist might see this outline as a series of talking points demonstrating just how impossibly hard it would really be to make CR "work" in the way that Schell and other advocates seem to have hoped. A world with many players tensely hovering on the edge of nuclear armament and afflicted by all the uncertainties and instabilities described herein would be, for the pessimist, *not* one to be preferred to today's world – or at least to a more "realistically" imaginable future in which the nuclear balance had been made somewhat more stable by modest additional reductions, more effective non- and counter-proliferation policies, augmented territorial defensive systems as a "proliferation buffer," and steps to lessen launch-on-warning incentives through improvements in the ability of nuclear forces and command-and-control systems to "ride out" a nuclear assault. Whose side one takes depends, to some extent, upon one's predilections.

A. *A Self-Solving Problem?*

It might yet be, however, that if one restricts the discussion to the hypothetical context of nuclear weapons abolition – a scenario that not all CR skeptics would agree is realistic in the first place, though those dubious about the merits of CR are to be found on both sides of the disarmament debate – most of the issues discussed in this paper do not matter all that much. As Michael Mazarr once noted, arms control can face something of a dilemma: when it seems most *possible*, it seems least *necessary*.[158] In the context of CR – and particularly in light of the challenges we have discussed herein with regard to crisis stability and reconstitution racing, asymmetric reconstitution rates, verification challenges, force- and complex-sizing and post-"zero" use concepts, differential program atrophy, and obstacles to re-learning and knowledge retention – one might recapitulate this dilemma as a sort of CR "Catch-22."

Countervailing reconstitution, in other words, may be problematic enough on its own terms – that is, within the discourse of nuclear deterrence theory in the context of a still competitive strategic environment – that it is difficult to imagine today's weapons possessors actually agreeing to it without some quite fundamental transformation in international politics already having taken place. Indeed, this seems to be the basis of Harald Müller's critique of CR, in which he argues that virtual arsenals are a response to current ideas about deterrence, but "no

---

158 Mazarr, "The Notion of Virtual Arsenals," *supra*, at 3.

one today could have any idea whether these concerns will exist in the final phase" of abolition.[159]

If such a transformation *has* taken place, it might no longer be necessary to approach post-"zero" planning through the competitive and deterrence-focused prism that CR presumes. To this extent, one might argue that the problem of CR-based stability at "zero" – perhaps like the challenge of achieving "zero" itself – is either so intractable as to be abolition-preclusive or in fact a *self-solving* problem by virtue of becoming unnecessary under the only conditions that would make abolition possible in the first place. In neither case, perhaps, is there much need actually to try to *solve* the puzzles and challenges presented by reconstitution theory.

Some commentators who have struggled with the idea of "virtual arsenals" seem to tend toward such a view. Alexei Arbatov, for instance, has argued that "much more important" than solving the many "concrete problems" presented by the CR concept is the likely precondition it demands of "profound improvements in the world's political and military environments and in great powers' ability to cooperate and trust one another."[160] Peter Wilson has also suggested that "[t]raditional worries associated with nuclear crisis stability disappear if all states no longer find the need to maintain an operational assured nuclear retaliation capability."[161] For his part, Harald Müller also argues that "[i]n order to realize the vision of a nuclear weapons free world, the relationship among the great powers must be one of cooperation and mutual trust, not one of sharp geopolitical rivalry in which the security dilemma reigns,"[162] while Drell and Jeanloz have averred that "a world free of nuclear weapons would likely become a reality only after significant political developments around the globe, leading to more stable and secure international relations than at present."[163]

Others seem to disagree, however, with Mazarr defending CR concepts with the assertion that states participating in a CR-based abolition regime "need *not* view one another in fundamentally different ways from the way they did in the wake of the Cold War in order to accept VNAs."[164] Indeed, this is said to be the great advantage of reconstitution theory: it postulates a nuclear "zero" that does *not* depend upon first achieving some near-miraculous transformation of international politics.

Either way, however, there is little disagreement that broader issues of political context and politics *do* to some degree condition what is felt to be "possible" from any sort of arms control. In Mazarr's words, "the verification of a virtual nuclear regime is first and foremost a *political* rather than a technical question." [165] Brad Roberts concurs, observing that "the nuclear weapons problem cannot be separated analytically, politically, or militarily from the larger

---

159 Müller, "The Importance of Framework Conditions," *supra*, at 175.

160 Arbatov, "Virtual Arsenals: A Russian View," *supra*, at 321.

161 Wilson, "Issues of Force Structure, Nuclear Infrastructure, and Survivability," *supra*, at 89.

162 There need not be "complete harmony," Müller believes, but abolition at least requires a "cooperative relationship among the great powers." Harald Müller, "Enforcement of the rules in a nuclear weapon free world," *supra*, at 20.

163 Drell & Jeanloz, "Nuclear Deterrence in a World without Nuclear Weapons," *supra*, at 5.

164 Mazarr, "Virtual Nuclear Arsenals: A Second Look," *supra*, at 370 (emphasis added).

165 *Id.*, at 378.

strategic context."[166] This problem was also noted years ago by Herman Kahn, who warned against drawing the false conclusion, in the context of a high-profile arms race, that "the weapons themselves are more dangerous than the enemy or the quarrel."[167] Indeed, President Ronald Reagan himself – who so famously contemplated his *own* version of "zero" as Cold War tensions began to wane – once declared that "[w]e have arms because we have tensions, not the other way around."[168]

B. *CR as a Tool to Facilitate Reductions*

Perhaps the only context in which CR theory seems more or less contentious is as a means of facilitating nuclear weapons *reductions*.[169] As we have seen, it has been the U.S. position at least since the Bush Administration that potential weapons (*i.e.*, productive capacity) can help make it less necessary to rely upon weapons-in-being (*i.e.*, a large reserve stockpile). CR as an instrument for making possible arms reductions – at least in a context in which some alerted operational forces are still to be retained indefinitely – thus already seems to be a valuable tool.

It is not clear the degree to which such ideas are reflected in other possessors' stockpile management theory, but it is noteworthy that Britain's Atomic Weapons Establishment (AWE) at Aldermaston, in Berkshire, is presently working hard to rebuild its capabilities – including weapon manufacturing. In recent years, AWE has apparently adopted a strategy focused upon long-term knowledge and personnel retention by deliberately stretching out development projects (*e.g.*, warhead life extension programs) in lengthy, slow-rate production runs. This approach, on which U.S. weapons designers look with unconcealed envy, arguably guarantees good work for AWE technicians for as long as the United Kingdom retains any nuclear weapons.

By 2005, AWE's workforce had fallen to about a third of its peak Cold War level. A three-year £350 million per annum recapitalization decision in July of that year, however – coupled with a recruitment campaign to hire 1,000 new scientists as "some young blood … to perpetuate the skills base" – has provided additional funding designed to ensure what the Ministry of Defense has described as "a high level of confidence that the current warhead design can, if required, be maintained in service to at least into the 2020s." This investment, it is said, "will sustain core skills and facilities that could also be used in future to develop a successor [warhead]."[170] According to a House of Commons report in 2006, moreover, AWE's focus is now on making British warheads

---

166 Roberts, "VNAs and the Contemporary Latent Weapon State," *supra*, at 273-74.

167 Kahn, *On Thermonuclear War*, *supra*, at 232.

168 *Quoted by* George P. Shultz & Henry S. Rowen, "Diplomacy of the Future," in *Reykjavik Revisited*, *supra*, at 455, 455.

169 *See, e.g.*, George Perkovich & James M. Acton, Abolishing Nuclear Weapons, *supra*, at 120-21 (noting, citing Bush Administration comments, that CR's role in "legitimising virtual nuclear arsenals or surge capabilities" might have the advantage of making current nuclear weapons states "more willing to pursue disarmament in the first place").

170 *Quoted by* House of Commons Defense Committee, *The Future of the UK's Nuclear Deterrent: The Strategic Context*, HC 986 (London: House of Commons, June 20, 2006), at 30, §§ 118-19, *available at* http://www.publications.parliament.uk/pa/cm200506/cmselect/cmdfence/986/986.pdf; *see also id.* at Ev 41 (comments by Commodore Hare and Mr. Harvard) (*discussing* hiring of scientists).

> "more straightforward and cost-effective to manufacture and maintain. … [T]he new investment programme at Aldermaston addresses similar issues of reliability, performance, longevity and safety of the UK's existing warheads [to those that U.S. officials sought to address with their "reliable replacement warhead" project and which may now be being folded quietly in to ongoing U.S. LEP programs]."[171]

The new AWE investments are said to include money for "new laboratories, a super-computer, and laser and hydrodynamics facilities for designing, refurbishing and testing nuclear warhead components." The UK Ministry of Defense also signed a new 25-year contract with AWE's management consortium that was reportedly worth more than £5 billion.[172]

Less is publicly known about Russian approaches to nuclear infrastructure management, but according to experts at the U.S. national laboratories, Moscow had adopted a very different strategy than the United States has used for many years. According to 1998 Congressional testimony by then-Assistant Secretary of Energy for Defense Programs Victor Reis, rather than producing weapons in discrete batches, the Russians "have a somewhat different system where they do tend to go back and remanufacture the whole system." In effect, they remake warheads on a continuous basis – each year, for instance, disassembling and rebuilding a certain fraction of their stockpile, so that no particular warhead actually remains in existence for more than 10 or 15 years.[173]

This Russian approach may have been adopted in part because the Kremlin has less faith than the Americans do in ongoing stockpile stewardship efforts for weapons kept "on the shelf" for many years, or because of some peculiarity of Russian warhead design or fabrication that makes remanufacture more appropriate. U.S. weapons scientists, however, have suggested that it may have the practical effect of keeping the Russian complex workforce better employed and experientially "sharper" over the long term than following a U.S.-style batch-production model characterized by episodic bursts of effort followed by long periods of inactivity. The Russians, in a sense, are never *not* building new nuclear weapons.

The French nuclear weapons establishment also seems to have adopted an approach that stresses ongoing manufacturing capability. According to experts interviewed for this study, France tested a simplified, "dumbed-down" version of its principal nuclear warhead in the 1990s – just before signing the Comprehensive Test Ban Treaty – precisely with an eye to having available a warhead design more suitable for manufacture and maintenance in a no-testing

---

171 House of Commons Defense Committee, *The Future of the UK's Nuclear Deterrent*, *supra*, at 31, § 120.

172 Rebecca Johnson, memorandum submitted to the House of Commons Defense Committee, *reprinted in* House of Commons Defense Committee, *The Future of the UK's Nuclear Deterrent*, *supra*, at Ev 64.

173 *See* Kingston, "Nuclear weapons: The modernization myth," *Bulletin of the Atomic Scientists* (December 8, 2009), *available at* http://www.thebulletin.org/web-edition/features/nuclear-weapons-the-modernization-myth (*quoting* Reis).

environment for the indefinite future.[174] France even plans to introduce a *new* warhead for its M-51 SLBMs starting in about 2015.[175]

None of these weapons state approaches seem to have been adopted with any particular idea of "zero" in mind, of course, so these arguably recurring themes of long-term knowledge management and productive capacity retention do not necessarily speak to CR's feasibility in the context of abolition. Nor, except in the U.S. case (where this is openly stated), is it clear that productive capacities have had, or are expected to have, any particular impact in allowing reductions in the stockpile. They do seem generally suggestive, however, of weapons infrastructure management philosophies that prize productive capacity to a great and perhaps increasing extent *over* long-term maintenance of weapons-in-being.

In any event, it should be clear by this point that reconstitution theory turns out to be an enormously complicated and problematic topic – and one that sometimes seems to reward deeper study only by the progressive unfolding of greater complications. As indicated, abolition optimists and "zero" pessimists may well draw very different conclusions from this exploration of CR-related issues. One can hope, at least, that all parties in today's disarmament debates will gradually come to approach these questions with a bit more perspective, sharpen their own inquiries, and thereby help the public policy community in its ongoing struggle with such matters.

* * *

174 Such a "dumbing-down" approach, of course, could easily be adopted for purposes of ensuring rapid and reliable reassembly in a "Tier One" CR context.

175 *See generally, e.g.*, Steve Andreasen & Michael Gerson, "Deterrence Seen Through the Eyes of Other Nations," paper presented to the Hoover Institution conference on "Deterrence: Its Past and Future" (November 12, 2010), at 29. The M-51 is itself a new delivery system, having only begun to come on line in 2010.