AIR FORCE SPACE COMMAND

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HIGH FRONTIER

THE JOURNAL FOR SPACE & MISSILE PROFESSIONALS

50th Anniversary *of the* Intercontinental Ballistic Missile

INSIDE:

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Cover: 91st Space Wing - Minuteman Missile Silo.
Back Cover: 20 May 2008, Vandenberg AFB, California - A Minuteman III intercontinental ballistic missile configured with a National Nuclear Security Administration joint test. The launch was an operational test to determine the weapon system's reliability and accuracy.

HIGH FRONTIER

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Introduction

General C. Robert Kehler
Commander, Air Force Space Command

"The US nuclear deterrent mission capability forms the ultimate backstop of our nation's strategic defense—dissuading and deterring opponents and reassuring allies."

~ Secretary of the Air Force Michael B. Donley and Air Force Chief of Staff General Norton A. Schwartz

Fifty years ago this year, the first nuclear-tipped US intercontinental ballistic missile (ICBM) was placed on strategic alert at Vandenberg AFB. Today, nuclear deterrence remains the ultimate backstop of our security, dissuading our opponents and assuring our allies through extended deterrence. Our nation's security relies on the remarkable attributes of the ICBM force and the dedication and professionalism of those who proudly stand watch with that system. Air Force Space Command (AFSPC) is dedicated to ensuring a credible, safe and combat-ready ICBM force that convinces potential adversaries of our unwavering commitment to defend our nation, its allies, and friends. We have defined perfection for ourselves through tough standards. We follow these standards to the letter and focus on structured, intensive, and perfection-oriented training for our maintenance, security, and operations personnel. We will never take our responsibilities or our nation's trust and confidence for granted.

In this issue of *High Frontier*, past and current Air Force senior leaders provide their insight into the current status of the nuclear enterprise as well as the future of deterrence. General John A. Shaud, PhD, USAF, retired, leads off the "Senior Leader Perspective" section by explaining how capability, commitment, and communication shape the success of our ICBM force. Maj Gen Roger Burg, the Twentieth Air Force commander, provides a glimpse into the future of ICBMs as we transition to the new Global Strike Command and continue development of the Prompt Global Strike mission. Next, Maj Gen Don Alston, assistant chief of staff for strategic deterrence and nuclear integration, discusses the history of Air Force ICBMs as well as our current efforts to reinvigorate the nuclear enterprise. Reflecting on the time he spent in the ICBM force, Maj Gen Tim McMahon, USAF, retired, former Twentieth Air Force Commander, points out that despite the recent challenges, the current ICBM team will continue to do what it has done for half a century—get the job done. As the Air Force Nuclear Weapons Center enters its fourth year, Brig Gen Ev Thomas discusses how his center evolved over the last five decades into a single cohesive organization with complete control of the sustainment supply chain. The Senior Leader Perspective concludes with an article from Dr. Lani Kass, senior policy advisor to the Air Force chief of staff. She describes deterrence as a product of capability, will, and perception, and points out we must expand our idea of deterrence beyond traditional constructs to include new "pressure points."

Continuing through this issue, we present two articles focused on the future of ICBMs. Lt Col Andrew Kovich offers ideas on the proper development of ICBM experts in the new Global Strike Command. Next, Maj Jason Seyer provides details on adding the Conventional Strike Missile to the US's weapons inventory to strike global targets quickly.

The remaining four articles and one book review span a multitude of topics. First, in the "Industry Perspective," Mr. James Meyers shows us the positive impact contractors have made through decades of ICBM development as well as his thoughts on extending the life of the Minuteman III. Next, Dr. Rick Sturdevant interviews Col Joe Hale, USAF, retired, in the "Historical Perspective." One of our treasured Air Force Space and Missile Pioneers, Colonel Hale, discusses his involvement in the shift from the liquid-fueled Thor, Atlas, and Titan ICBMs to the easier to maintain, solid-fueled Minuteman missile. Third, in this edition's "Warfighter Focus," Royal Air Force (RAF) Flt Lt David Smith explains the history and operation of the Ballistic Missile Early Warning System site at RAF Fylingdales. Then, in the "Reader's Rebuttal," Col James D. Rendleman, USAF, retired, responds to several articles from the November 2008 issue of High Frontier as he focuses on a new strategic framework for delivering space protection. Finally, we conclude this quarter's volume with Dr. Sturdevant's review of the book, *Bomb Scare: The History and Future of Nuclear Weapons*.

I encourage everyone to explore the *High Frontier* to increase your knowledge of space, cyberspace and missiles. In the interest of educating our AFSPC team on the cyber mission, the next issue's topic will be "Cyberspace." I look forward to your thoughtful articles and I encourage you to consider what issues and challenges we will face during this time of transition.

General C. Robert "Bob" Kehler (BS, Education, Pennsylvania State University; MS, Public Administration, University of Oklahoma; MA, National Security and Strategic Studies, Naval War College, Newport, Rhode Island) is commander, Air Force Space Command (AFSPC), Peterson AFB, Colorado. He is responsible for the development, acquisition, and operation of the Air Force's space and missile systems. The general oversees a global network of satellite command and control, communications, missile warning and launch facilities, and ensures the combat readiness of America's intercontinental ballistic missile force. He leads more than 39,700 space professionals who provide combat forces and capabilities to North American Aerospace Defense Command and US Strategic Command (USSTRATCOM). General Kehler will assume cyberspace responsibilities as directed by CORONA Fall.

General Kehler has commanded at the squadron, group, and twice at the wing level, and has a broad range of operational and command tours in ICBM operations, space launch, space operations, missile warning, and space control. The general has served on the AFSPC Staff, Air Staff, and Joint Staff and served as the director of the National Security Space Office. Prior to assuming his current position, General Kehler was the deputy commander, USSTRATCOM, where he helped provide the president and secretary of defense with a broad range of strategic capabilities and options for the joint warfighter through several diverse mission areas, including space operations, integrated missile defense, computer network operations, and global strike.

Senior Leader Perspective

The Success of our ICBM Force: Capability, Commitment, and Communication

General John A. Shaud, PhD, USAF, retired
Director, Air Force Research Institute
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Dr. Dale L. Hayden
Military Defense Analyst, Air Force Research Institute
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Now that the US Air Force has more clearly defined the future organizational direction of the service's nuclear component, it is time to ask what comes next? Strategic deterrence in the post-Cold War era remains a fluid concept. Without a focus on a single foe, any strategy would be complicated and likely debatable. One approach suggests that deterrence is stronger when: (1) a state has the **capability** to impose great costs on a potential attacker, (2) a state is **committed** to respond to an attack by imposing such costs, and (3) a state's commitments are clearly **communicated**.[1] A clear understanding of these three C's of deterrence theory—capability, commitment, and communication—are critical to our nation's success and the future success of our intercontinental ballistic missile (ICBM) force.

In a recent editorial in *Strategic Studies Quarterly*, I reminded the readers that today our Air Force is the best in the world; however, to remain the best we must take on some of the most critical challenges we have ever faced—especially with regard to modernization. In transforming the US Air Force's structure for the future, the nation must not place its sovereignty at risk or forfeit its current warfighting advantages. To present an effective deterrence, the portrait of formidable American power must remain crystal clear to our adversaries. Capability lies at the heart of our advantage.

Capability

Nuclear deterrence remains critical to our nation's defense and is as important today as at any time in our past, particularly in light of a resurgent Russia, China's additional nuclear force, and the posturing of nations like North Korea and Iran. During the Cold War, nuclear deterrence was the nation's top priority. However, in the latest National Military Strategy, the nuclear issue has shifted from deterrence to limiting the proliferation of weapons of mass destruction and downsizing nuclear assets. Nevertheless, it is important to emphasize that nuclear capabilities provide the overarching umbrella to national security not offered by any other set of weapon systems. At the height of the Cold War, the US had more than 1200 land-based ICBMs; with the recent closing of the last "B" side missile squadron in Montana, as for now the number is 450. Ongoing modernization and upgrade programs will allow the existing missiles, warheads, and command and control systems to remain operational through the 2020 timeframe, notionally to 2030, but how far beyond that remains unclear. The question with an aging fleet then becomes—does the nation substantially reduce nuclear forces and rely upon its strategic bombers and ballistic missile submarines for nuclear defense or does it fund needed modernization of all its nuclear forces?

Forging a consensus for nuclear modernization will be problematic. Some propose that ICBMs are outdated and that eliminating one leg of the triad would save money which could be used for other pressing national requirements. Following simple math, in eliminating the ICBMs the US would rely upon the remaining two legs: strategic bombers, and ballistic missile submarines. However, the world is rapidly reaching a time when stealth and altitude—high or low—will no longer be sufficient to penetrate an adversary's airspace. Additionally, the recent Blue Ribbon review of nuclear security commissioned by Secretary of Defense Robert M. Gates found that, "Without an alert commitment for 17 years … the bomber force has seen a dramatic atrophy of its nuclear operational and academic skill sets." Thus, without returning to the Cold War strategy of bombers on alert, the preponderance of reliance and risk then moves to the submarine force, essentially requiring the US to rely upon a single nuclear system. If a technical fault were to "ground" that single system, the US would be without a viable nuclear deterrent.

The nuclear triad has served America and her allies well for over 60 years. The rationale for its existence continues today and will so into the future. As horrific as 9/11 was, it did not place the nation's survival at risk. Today, only a nation with strategic nuclear delivery capacity can do so. The October 1998 Defense Science Board Task Force on Nuclear Deterrence concluded that, "Significant numbers of ICBMs deny any adversary the benefit of a limited attack. Without the ICBMs, surprise attacks against a handful of bomber bases and sea-launched ballistic missile facilities, with plausible deniability, could drastically alter the correlation of forces."[2]

Continued reliance on a triad enhances national security through nuclear deterrence while simultaneously reducing strategic and operational risk. To ensure a creditable defense strategy, sustainable and affordable modernization programs are required. As Secretary of Defense Gates warned, unless the US modernizes its inventory of nuclear weapons and develops a replacement warhead, the atomic arsenal's long-term safety and reliability will deteriorate.[3] The first step in creating a sustainable force involves upgrading the present ICBM command and control structure. The next step requires modernizing the launch system. In doing this, the Air Force should consider basing a new launch system on a common family of vehicles—one used for commercial spacelift or for wider military application. A missile with wide application allows research and development costs to be spread over a larger number of vehicles, while at the same time reducing maintenance costs through use of common hardware.

Affordability of any new system in a constrained fiscal environment will become increasingly important. One way to reduce cost is by decreasing the number of ICBMs in the fleet. Fewer numbers, accompanied by a corresponding reduction in warheads can also be viewed as a stabilizing factor under the deterrence construct of

assured destruction. However, as Secretary of Defense Gates said, "To be blunt there is absolutely no way we can maintain a credible deterrent and reduce the number of weapons in our stockpile without resorting to testing our stockpile or pursuing a modernization program." Consistent with national priorities, a comprehensive policy review evaluating the entire triad would be required before reducing the numbers significantly below the current 450. Any future study directing a new nuclear force structure must take into account deterrence against rogue nations and future near-peer competitors in the post 9/11 security environment.

Commitment

The second element in a credible deterrence strategy is commitment. Here, I am not referring to the resolve of our nation's leaders to use nuclear weapons, but rather the commitment of the men and women involved in the day-to-day business of executing our nation's nuclear deterrence policy. While a renewed focus and reemphasis on the Air Forces' nuclear mission is occurring at a rapid pace, what must not be overlooked is that our people are the essential element that will determine our service's failure or success. Thus, organizational change alone will not address the myriad of issues currently facing our nuclear force. The larger issue is about leadership and instilling a culture where officers and senior noncommissioned officers will take charge and lead. Leadership basically has two essential elements—*the mission*, objective, or task to be accomplished, and *the people* who accomplish it. All facets of leadership must support these two basic elements. Effective leadership transforms human potential into effective performance in the present and prepares capable leaders for the future. A leader must never forget that people perform the mission.

No matter how advanced our technology or how complex the equipment, people-to-people relations get things done. People determine our success or failure. The success of our ICBM force and its deterrence capability depends on success at the critical junctures in leadership. These critical junctures are between *officers and senior noncommissioned officers (NCOs)* and *senior NCOs and junior Airmen*. The officer to senior NCO juncture often involves communication within the same generational group—or age group—but between individuals who often have dramatically different backgrounds and experiences within the service. Officers and enlisted members are acculturated differently within the service. For example, Air Force officers involved in operations, both rated and missiles, generally spend their formative years around other officers. Not until they reach command level—operations officer/squadron commander—will they find themselves working on a daily basis with NCOs. Senior NCOs must deal with a similarly complex issue when interacting with junior Airmen; they must be successful across a generational divide, separated not just in years, but by outlook and motivation, as well. When a weakness exists at either of these junctures, mission failure becomes more likely.

The Air Force core values form the bedrock of leadership. The core values are statements of those institutional values and principles of conduct that provide the moral framework in which military activities take place. The three fundamental and enduring values of integrity, service, and excellence require personal focus—one that is face-to-face that directly influences human behavior and values. Successful leaders tailor their behavior toward their fellow Airmen's need for motivation, achievement, and sense of belonging, recognition, self-esteem, and control over their lives. Leaders foster growth by insisting that their people focus attention on the aspects of a situation or mission they control. When Airmen assume away the importance of leadership, *compliance* with established procedures and *accountability* are placed in jeopardy.

Compliance in the nuclear world is the realm of checklists; enforcement dependent upon leadership, and accountability paramount in ensuring a quality force. Strict adherence to established procedures is vital to the success of the nuclear mission. Compliance remains the cornerstone of our nuclear force, be it within operations, maintenance, or force protection. Human behavior will inevitability drive some to attempt to find the "easy way." Compliance provides the backstop that guards against failure and simultaneously ensures mission success.

Accountability is about taking responsibility for initiating action and the results of that action. It is the cohesive element that holds our command structure together. Former Air Force Chief of Staff General Ronald R. Fogleman once said that Air Force "standards must be uniformly known, consistently applied, and non-selectively enforced. Accountability is critically important to good order and discipline of the force, and failure to ensure accountability will destroy the trust of the American public—the very people living under the Constitution we swore to support and defend, and who look to us, the members of their nation's Air Force, to embrace and live by the standards that are higher than those in the society we serve."[4]

Communication

Communication, or the third "C," is critical to the service's success in the global environment. However, for any strategy to succeed, the nation must recognize that communication takes place in a globalized, interconnected environment—an environment in which our adversaries are quite competent and effective. To develop a broad strategy, the US Air Force must collectively, persistently and convincingly communicate its unique capability. The key to successful strategic communication lies in understanding that desired effects drive options rather than the other way around.

Communication is effective only when actions and words remain consistent. Accordingly, without the adversary knowing intent, strategic deterrence becomes irrelevant or worst case catastrophic. In the movie *Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb*, the US president calls the Soviet premier to inform him that a rogue general has launched a B-52 nuclear strike against the USSR. In the conversation, the president learns that the Soviets have a "Doomsday Machine;" a device that will "kill all human and animal life on earth, and render the earth as dead as the moon for ninety-three years if a nuclear weapon is detonated on Russia." Dr. Strangelove, the president's advisor, explains that the point of such a device is lost if the Russians keep it a secret, whereupon the Soviet ambassador replies that it was to be announced the next Monday.[5]

It is the responsibility of civilian leadership to communicate the nation's intent, but it is paramount that the Air Force communicate its resolve to accomplish the nuclear deterrent mission for the nation by fielding and operating a force that is well trained and prepared to respond upon direction of the president. Lore is that when President John F. Kennedy announced during the Cuban missile crisis that he had his "first ace in the hole," he was communicating

intent. However, it was the ICBM crews at Launch Control Center Alpha outside of Malmstrom AFB, Montana, in concert with their fellow bomber and submarine crews that turned the intent into reality.

Modernization of the nation's strategic deterrent force will communicate a message to the world. That message must be one that effectively integrates capability and commitment into a coherent position. However, as Secretary of Defense Gates observed, "Currently, the US is the only declared nuclear power that is neither modernizing its nuclear arsenal nor has the capability to produce a new nuclear warhead."[6] Therefore, it is imperative that we shape our message carefully and communicate effectively in light of current realities.

Conclusion

The Air Force faces many challenges in the years ahead. In an era of reduced budgets and increased worldwide commitments, we are challenged to meet the needs of the nation; despite having fewer Airmen in the entire US Air Force since 1950. Notwithstanding these challenges, the Air Force and Air Force Space Command (AFSPC) remain the most capable and lethal force on the globe. Daily they employ systems using professional, highly motivated Airmen who are recognized internationally as "world class."

The free world depended upon the US' nuclear umbrella for strategic deterrence during the Cold War. Today, in the post 9/11 environment, some view nuclear deterrence as irrelevant or inconsequential—either because it did not deter the attacks on the World Trade Center and the Pentagon, or because the weapons are so horrific some believe they will never be used. It is within the context of these arguments that capability, commitment, and communication are paramount. A return to a strategic Cold War is unlikely; despite Chinese economic and military growth and Russia's awakening from a period of decline. Nuclear deterrence provides a measure of security, still today, that is not offered by any other system—the security that comes from knowing that the nation has the ability to ensure that its sovereignty will never be placed at risk.

The new Global Strike Command appears to be the immediate future home for the nation's ICBM force. This new command will carry with it not just the legacy of Strategic Air Command, but the heritage of AFSPC, as well. As a force provider to US Strategic Command, this new major command, to be commanded by a three-star general officer, will be responsible for the organize, train, and equip function of ICBMs for the Air Force. This may only be the first step toward redefining global strike and strategic deterrence. Strike, in the Cold War sense, refers to nuclear weapons; strike in the pre-atomic age construct, denotes strategic impact and effects. The future of strategic deterrence within the Air Force may well be within an effects-based command where air, space, and cyberspace operations are integrated across all three domains. Only time will tell. This would be a significant challenge, but one that the nation may require. Whatever the case, the Air Force will stand ready to meet the challenge.

Notes:

[1] P. C. Stern, R. Axelrod, R. Jervis, and R. Radner, *Perspectives on Deterrence* (Oxford University Press, 1989) 5.

[2] October 1998 Defense Science Board Task Force, Nuclear Deterrence.

[3] Julian E. Barnes, "Gates Calls for Modernization of US Nuclear Weapons," 29 October 2008, *Los Angeles Times,* http://www.latimes.com/news/nationworld/nation/la-na-gates29-2008oct29,0,7494238.story.

[4] General Ronald R. Fogleman, Air Force chief of staff, text of a video tape on the topic of Air Force standards and accountability, values and ethics page, date of video: 10 August 1995, http://www.au.af.mil/au/awc/awcgate/readings/air_force_standards_and_acc.htm.

[5] Stanley Kubrick, Peter George and Terry Southern, screenplay, *Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb,* 1964.

[6] Julian E. Barnes, "Gates Calls for Modernization."

General John A. Shaud, PhD, retired (BS, United States Military Academy at West Point, New York; MS, The George Washington University, Washington, DC; PhD, Ohio State University) is the director of the Air Force Research Institute Maxwell AFB, Alabama. General Shaud directs an 80-person US Air Force organization charged with conducting independent research, outreach, and engagement to enhance national security and assure the effectiveness of the US Air Force. He provides guidance to a team of 15 operationally savvy air, space, and cyberspace power researchers; the Air University Press, and a directorate charged with Air University Research and Conferences Support. General Shaud also supervises the production of the *Strategic Studies Quarterly* and the *Air and Space Power Journals*

General Shaud retired from the US Air Force after 35 years of distinguished service. General Shaud's last active duty position was as chief of staff, Supreme Headquarters Allied Powers Europe, Mons, Belgium. After retirement, General Shaud worked as the director of the Air Force Aid Society and executive director of the Air Force Association. He participated in a Department of Defense commission on Quality of Life and led an Air Force study on the Officer Assignment System. He also served as a senior mentor for Air War College; as a member of the Air University Board of Visitors; on the National Reconnaissance Office's Gold Team; while working as a key planner and coordinator for the chief of staff's annual meeting of retired Air Force four-star generals; and continuing as a senior mentor with the Capstone Program for newly promoted flag officers of all services.

General Shaud completed Squadron Officer School, Air Command and Staff College, and the National War College.

Dr. Dale L. Hayden (BA, Education, University of Alabama; MS, History, University of Alabama; PhD, Administration of Higher Education, University of Alabama) is a military defense analyst with the Air Force Research Institute at Maxwell AFB, Alabama. Dr. Hayden possesses a broad background in both US foreign policy, space and missile operations.

Dr. Hayden completed a fulfilling career as a member of the US Air Force on 1 September 2008. Early in his career, he served as a member of the Secretary of the Air Force's Staff Group, and assistant professor of history at the United States Air Force Academy. His experience in space and missile operations includes: providing space support and missile warning in-theater during Operations Desert Storm and Provide Comfort and command in missile operations. Dr. Hayden has served as a Harvard Fellow, the director of the Airpower Research Institute and dean of Air Command and Staff College.

Dr. Hayden is a graduate of Squadron Officer School, Army Command and General Staff College, Armed Forces Staff College. He is a National Defense Fellow, Weatherhead Center for International Affairs, Harvard University, Massachusetts. Dr. Hayden has authored and co-authored for numerous publications.

Senior Leader Perspective

The Future of the Land-Based Deterrent Under Air Force Global Strike Command

Maj Gen Roger W. Burg
Commander, Twentieth Air Force
F. E. Warren AFB, Wyoming

"The Twentieth Air Force (20 AF) is America's ICBM Team deterring conflict with professional people and safe, secure, combat ready missiles able to employ force upon direction."
~ Twentieth Air Force Mission Statement

The intercontinental ballistic missile (ICBM) holds a significant place in the history of the defense of our country. On this 50th anniversary of the ICBM, we reflect on the achievements of this great weapon system and look to the future as we provide for the sustainment and the adaptive application of the ICBM mission.

As we tackle the monumental task of standing up the new nuclear major command (MAJCOM), Air Force Global Strike Command (AFGSC), I must stress the importance of the day-to-day mission of nuclear deterrence. As stated by both the Secretary of the Air Force Michael B. Donley, and the Air Force Chief of Staff (CSAF) General Norton A. Schwartz, "Reinvigorating the Air Force Nuclear Enterprise is our highest priority."[1] The process of reinvigorating the nuclear enterprise begins with an understanding of the importance of every task and how everyone's efforts relate to the overall mission of providing safe, secure combat ready missiles. In order to refocus, we must adopt a back-to-basics approach by leaders at all levels. And when I say leaders, I mean every Airman, not just commanders. I can think of no other weapon system in our Air Force where we depend so clearly on the discipline, high standards, and professional competence of small, independent teams, normally under the leadership of a young noncommissioned officer or officer to ensure mission success. As leaders in our profession, everyone bears the responsibility to accomplish "this mission with pride, professionalism, and solemn commitment to the highest standards of excellence."[2]

For the remainder of this article, I will focus on near-term and long-term changes as we transition the land-based leg of the nuclear triad under AFGSC with regard to people, weapon systems, and future capabilities. However, in order to recognize where we are going, I first want to begin with a summary of our illustrious history; a history that embodies the culture and lineage in which the nuclear mission is based.

Twentieth Air Force has a proud heritage as America's long-range strategic force. Activated 20 June 1941, the unit's B-29 Superfortresses bombed the Japanese islands. Two of these Superfortresses, the Enola Gay and Bock's Car, brought an early end to World War II after they dropped the first atomic bombs on Japan. Twentieth Air Force units then went on to support United Nations' forces during the Korean War and were inactivated after the conflict ended.

Twentieth Air Force was reactivated, 1 September 1991, as a component of the Strategic Air Command and located at Vandenberg AFB, California. Operationally responsible for all land-based ICBMs, 20 AF's rebirth came at a time when America's nuclear forces were entering a decade of unprecedented force reductions and changes. Spawned by the Cold War's end and the breakup of the Soviet Union, these changes reshaped the basic fabric of the nation's nuclear deterrent forces. For the men and women of America's ICBM team, it proved to be a period of sustained, dramatic change.

Headquarters Strategic Air Command.

Since its rebirth seventeen years ago, 20 AF experienced three major command identities and soon will experience a fourth. After one year in Strategic Air Command and another year in Air Combat Command, 20 AF found a home in Air Force Space Command (AFSPC) in 1993. Twentieth Air Force headquarters also changed locations in 1993, moving from Vandenberg AFB, California, to its current home at F. E. Warren AFB, Wyoming. During the same period, ICBM force structure was reduced dramatically, going from six operational bases to three and from 1,000 alert ICBMs to 450.

Twentieth Air Force headquarters has dual responsibilities to AFSPC and United States Strategic Command (USSTRATCOM). As the missile numbered air force for AFSPC, 20 AF is responsible for maintaining, operating, and securing the Air Force's ICBM force. Designated as USSTRATCOM's Task Force 214, 20 AF provides on-alert, combat-ready ICBMs to the president of the United States.

The story of the evolution of 20 AF does not stop here. The

The men and women who perform our mission of nuclear deterrence have a distinguished heritage as warfighters at the tip of the spear.

Air Force now plans to align all its nuclear deterrent forces under one major command. Under the recent direction of the CSAF, the B-2 and B-52 bombers of Eighth Air Force as well as the Minuteman III (MM III) ICBM missiles of 20 AF will now be aligned under AFGSC. This new MAJCOM will allow for a direct chain of command for the nuclear deterrent forces and allow for an increase of focus, advocacy, and management of the Air Force nuclear mission. On 12 January 2009, the provisional headquarters was established at Bolling AFB, Maryland, with plans to stand up the permanent headquarters by the end of fiscal year 2009. The final location of AFGSC is yet to be determined. In addition, staff changes are underway at 20 AF for us to become a component numbered air force in order to enhance our ability to provide combat ready forces to the combatant commanders.

People

"Handling nuclear weapons—the most powerful and destructive instruments in the arsenal of freedom—is a tremendous responsibility. We owe you the attention, the people, and the resources you need to do the job right. For your part, you must never take your duties lightly. There is simply no room for error. Yours is the most sensitive mission in the entire United States military. I am confident it is in good hands."

~ Secretary of Defense Robert M. Gates, 1 December 2008

The men and women who perform our mission of nuclear deterrence have a distinguished heritage as warfighters at the tip of the spear. The mission of deterrence is no less critical today than it was during the Cold War. Just as our predecessors under Strategic Air Command brought about the end of the Cold War, we stand in the position to continue the long proud legacy of deterring nuclear conflict. The relevance of the nuclear mission and its success rests in the hands of the warfighters of this command. In recognition of the importance of our Airmen and as a result of the nuclear enterprise being the CSAF's number one priority, the programs explained below are currently being developed to obtain an environment beneficial to the support and mission success of our people. In addition, I will emphasize the refocus in culture required by the nuclear profession.

Nuclear Career Path

Recently, several reports have identified a declining level of expertise within the Air Force nuclear enterprise stating "Air Force leadership needs to develop a more effective approach to personnel management for manning critical nuclear positions."[3] As a result, a nuclear career path was formalized to identify personnel early in their careers and develop them in order to fill key nuclear billets in the future. In the past, the goal was to increase an officer's breadth of experience, encouraging them to get exposed to as many space mission areas as possible during their career. This resulted in many space and missile operations (13S) officers spending a significant portion of their careers out of the nuclear arena, diluting the experience base. Working closely with AFSPC, 20 AF is forging ahead to enhance this career path. Current plans are to continue cooperation between 20 AF and AFSPC at several different levels with regard to training and personnel management. The current 13S AFSC will continue to be shared by both space and missile operators with the majority of new officer accessions going to 20 AF to serve as missile combat crew officers. Following their first assignment, these junior company grade officers will either stay in AFGSC and fill follow-on nuclear billets or flow to AFSPC to satisfy AFSPC's requirement to fill space positions with these operationally experienced captains. This 13S career field management will allow AFGSC to retain personnel with the expertise and dedication to excellence required by the nuclear specialty and supply AFSPC with seasoned and experienced officers who fully understand operational discipline. The vision of this career path is to identify critical skill sets and develop those officers who possess them into the leaders of tomorrow. Those leaders will have the breadth of experience within the nuclear community and the depth of knowledge in nuclear operations that will be vital to our future success.

Incentives

Those deployed "in-place" to the nation's missile complexes have long endured the harsh climate and rigorous duty schedule without complaint. The time to recognize and reward their efforts is long overdue. Several initiatives were presented to AFSPC for consideration and ultimately will be presented to Headquarters US Air Force for review and decision. Among those initiatives is the concept of deployment credit for tours of duty within the missile complex in recognition of being combatant commander assigned, as well as, the time spent away from home stations and families. Another proposal is the revitalization of education programs targeted to those within the ICBM community. These proposals and several others are being actively studied with the desire for rapid implementation.

Culture

Over the past year, several incidents and subsequent internal and external reviews have highlighted a substantial deficiency in the procedures, logistics, and sustainment of the nuclear enterprise. Consequently, our credibility to perform the vital mission of nuclear deterrence is in question. For this reason, the reinvigoration of the nuclear enterprise is now the number one priority of the Air Force. As we stand up AFGSC, a command solely focused and dedicated to the nuclear deterrent mission, I rely on airmen at all levels to take the lead and adopt a zero-defect culture in the performance of every task. The reinvigoration of the nuclear enterprise requires everyone's commitment

to right the performance and leadership failures of the past.

Weapon Systems

From the beginning of its development, the ICBM has played a critical role in providing security to our nation. Not only has our nation relied on the nuclear deterrence that our weapons provide, but our friends and allies also rely on our capability. By providing a reliable and capable nuclear deterrence, the ICBM force serves as a key piece in the national policy of the US. Through the enhancement of current systems and procurement of new weapon platforms to our arsenal, we ensure the continuing viability of our nation's nuclear deterrence.

Minuteman III upgrades

In 1999, 20 AF began implementing programs designed to extend the life expectancy of the MM III system through 2020. The current programs, totaling over $6 billion, will give the Air Force a completely overhauled, if not new, MM III ICBM through upgrades or replacements of propulsion, guidance, reentry vehicle, and ground systems. Upgrades are expected to be complete by 2012. Recent congressional guidance directs maintaining the operational capability of the weapon system through 2030. The MM III, in its current form, will continue to play a major role in America's strategic nuclear force. The upgraded MM III will continue to defend the US, its forces, friends and allies well into the future.

Security Modernization

After testing, installation of the remote visual assessment (RVA) modification is well under way at all 450 MM III launch facilities (LF). The intent of the program is to provide a tactical advantage to security forces when responding to security situations at the LFs. Each flight security controller (FSC) has access to a dedicated RVA terminal which displays near real time streaming video of the LFs for which they have primary security responsibilities. In addition, the FSC can rewind the video memory to the time of any alarm to determine the cause. This capability will allow the FSC the ability to monitor the situation at the LF and tailor a response in the event of alarms at multiple LFs. No longer will our Airmen be blind while responding to a security situation.

Missile Alert Facility Closed Circuit Television

Still in the developmental stages, the positioning of closed circuit television cameras at each missile alert facility (MAF) will assist in perimeter defense and situational awareness. Most MAFs are located in areas with limited night time lighting and subject to environmental extremes. These cameras will have infrared capability and be augmented by additional exterior lighting in order to penetrate the darkness and the elements, providing additional awareness to security forces at the MAF.

Fast Rising B-Plug

Our nuclear weapons are at increased risk when the interior of an LF is accessed by lowering the B-Plug enclosure hatch, allowing maintainers access to the launcher enclosure. Now the maintenance team on site will be able to rapidly raise the B-Plug, effectively sealing off access during security situations and when maintenance is completed. This ability to quickly close the LF entryway will increase the security of deployed warheads, provide added protection to the personnel on site and increase denial time significantly while additional security forces respond to the developing situation.

UH-1 Iroquois Replacement

In addition to the currently funded security modernization programs, 20 AF is working on a common vertical lift support platform (CVLSP) program. Twentieth Air Force recognizes the need to replace the aging UH-1N Twin Huey helicopters with a model that will bring suitable capability to the tactical response force. The current UH-1N fleet supports ICBM security through deterrence, response, and convoy surveillance. It contributes to operational readiness with responsive movement of key ICBM personnel and components, and supports homeland security, homeland defense, civil support operations, emergency preparedness, and search and rescue when available. Deficiencies were identified in speed, range, carrying capacity, all-weather/night capability, crew/command and control situational awareness, sustainability, and survivability. The ability to modernize the 39 year-old airframe is limited (maxed in reasonable modifications and gross weight), but it will be sustained until it is replaced. We are upgrading the AFSPC UH-1N vertical lift capability within current resources by shifting some assets, improving our tactics, and updating the UH-1N with the modifications that are possible. However, we still have a vertical lift capability gap that can only be fixed with system replacement; therefore, a rapid CVLSP program start is a top priority.

Remote Code Change

The ongoing implementation of the ICBM Cryptographic Upgrade (ICU) to all 450 LFs and 45 launch control centers provides codes that are unique to each site and are cryptographically protected. In addition, this upgrade will allow for the remote code change of all codes in the field. This task can be accomplished at any time in a matter of hours as opposed to the current timeline of several days per squadron. As a result, this capability decreases the personnel required to conduct code change by 93 percent, equating to 50,000 man-hours saved per year and significantly reducing the security risk involved in transporting code components and accessing each LF.

Through the enhancement of current systems and procurement of new weapon platforms to our arsenal, we ensure the continuing viability of our nation's nuclear deterrence.

The continued modernization of our weapon system capabilities combined with the CSAF focus on the nuclear enterprise as the Air Force's number one priority will ensure the ICBM's ability to meet its vital role in our national strategy.

Future Capabilities

The land based ICBM has proven to be a system that our nation can rely on to fulfill its mission at a moment's notice. The combination of the deployed in place status and its rapid executable ability lends itself to further expansion into new missions. Discussed below is a viable and credible option for application of the ICBM Force.

Prompt Global Strike

Since the "new triad" was first introduced in the 2002 Nuclear Posture Review, USSTRATCOM began to investigate the use of conventional capabilities in order to enhance deterrence. Thus, Prompt Global Strike (PGS) was born. PGS is the rapid, accurate delivery of conventional weapons at intercontinental range. The need for a PGS capability is also reinforced in the most recent Quadrennial Defense Review, where the need is recognized for a shift "from a 'one size fits all' notion of deterrence towards more tailorable approaches for advanced military competitors, regional weapons of mass destruction states, as well as non-state terrorist networks."[4] By using technology derived from a land based ICBM with a reentry vehicle configured with a conventional warhead, we are well on our way to providing this capability. We look to develop the capability to respond to time urgent targets and "be able to globally strike targets and precisely apply effects on targets within minutes to hours to achieve desired effects."[5] Furthermore, a land based system located geographically separate from the existing nuclear capable ICBM fields can be easily distinguished by friend or foe as a conventional system. Naturally, since 20 AF trains and deploys daily with the systems and personnel already capable of this task, the ICBM Force is a natural choice to support the PGS mission.

Conclusion

The changes waiting for us just over the horizon are both historic and dramatic. Just as the ICBM task force underwent a metamorphosis in command structure in the early 1990s, the nation's nuclear forces will again find themselves reporting to a different MAJCOM. However, the men and women of 20 AF will continue to operate, maintain, and secure the weapon systems entrusted to them with the high degree of professionalism that they are known for. The continued modernization of our weapon system capabilities combined with the CSAF focus on the nuclear enterprise as the Air Force's number one priority will ensure the ICBM's ability to meet its vital role in our national strategy. In addition, as we evolve to meet the current challenges of today's world, the development and implementation of the PGS mission will provide the president the ability to respond globally within an hour without the need for forward deployed forces.

The road ahead is not an easy one. However, with the commitment, pride, and professionalism of our Airmen, I am confident you will rise to this challenge and provide the American people with the nuclear deterrent force that our nation relies on.

Notes:

[1] Michael B. Donley, secretary of the Air Force and General Norton A. Schwartz, Air Force chief of staff, to Michael B. Gates, secretary of defense, memorandum, 24 October 2008.

[2] Ibid.

[3] Report of the Secretary of Defense Task Force on DoD Nuclear Weapons Management, *Phase I: The Air Force's Nuclear Mission,* September 2008, 42.

[4] US Department of Defense, Quadrennial Defense Review Report, 6 February 2006, 49, http://www.defenselink.mil/qdr/rep-ort/Report20060203.pdf (accessed 19 November 2009).

[5] Blake Bearden, "The Future of Strategic Deterrence," *High Frontier* 2, no. 4, (August 2006): 36.

Maj Gen Roger W. Burg (BS, US Air Force Academy, Colorado; MS, Guggenheim Fellowship, Columbia University, New York; MA, Naval War College, Rhode Island) is commander, 20th Air Force, Air Force Space Command, and commander, TF-214, US Strategic Command, F. E. Warren AFB, Wyoming. He is responsible for the nation's ICBM force, missile wings with more than 9,600 people. General Burg graduated the US Air Force Academy in 1978 and entered the space and missile career field, serving as a missile crew commander, staff officer, and strategic planner. He has commanded an ICBM squadron, an operations group and a space wing. He has held a variety of staff assignments at Strategic Air Command, US Space Command, US Strategic Command, the Air Staff and the Joint Staff. He served as the Joint Staff representative to the Standing Consultative Commission, a bilateral US-Soviet body established to monitor compliance with the 1972 Anti-Ballistic Missile Treaty, and as a senior research fellow at the National War College. He was also assigned to the White House, where he served as the director for Nuclear Policy and Arms Control on the National Security Council. Prior to his current assignment, he was director of strategic security, Office of the Deputy Chief of Staff for Operations, Plans and Requirements, HQ Air Force, providing policy guidance, expertise, and oversight to the Air Force nuclear, space, counterproliferation, and homeland defense programs. General Burg is a master space and missile officer, and a fully qualified joint specialty officer.

Senior Leader Perspective

Views on Air Force Strategic Deterrence

Maj Gen C. Donald Alston, USAF
Assistant Chief of Staff
Strategic Deterrence and Nuclear Integration
Pentagon, Washington DC

It seems the word 'nuclear' is more prevalent in the news today than 20 years ago. The context varies. Sometimes the story is about post-Cold War relationships and related force structure reductions. Other times the articles are about one of the several nations that have acquired nuclear weapons since the end of the Cold War. Still other stories describe those nations or non-state actors or transnational terrorists who are actively pursuing nuclear weapons capability. The often-unwritten imperative is that deterring the use of nuclear weapons is vital to stability in the world today, and into the foreseeable future. Highly visible, well-maintained Air Force systems, together with well-trained forces, are the key to delivering credible nuclear deterrence.

The Air Force provides deterrence by operating, maintaining, securing, and sustaining ICBMs, dual-role bombers, and dual-capable fighter aircraft. And although the numbers of systems are dramatically smaller than at the height of the Cold War, the Air Force provides national leadership with the most responsive, flexible, and visible nuclear deterrence capability. Events over the past year have provided opportunities for institutional re-examination (more internal than external), nuclear mission revalidation and renewed commitment.

Strategic Deterrence

Today, the international security environment is more complex than during the Cold War, with more nations in possession of nuclear weapons, non-state actors in pursuit of weapons of mass destruction, and significant regional instability in multiple combatant commander areas of responsibility.

The Joint Chiefs of Staff Joint Publication 1-02 defines deterrence as *"The prevention from action by fear of the consequences. Deterrence is a state of mind brought about by the existence of a credible threat of unacceptable counteraction."*[1] Deterrence is truly about shaping other's perspectives; a perspective that their actions will be met with a response that is so overwhelming and devastating that it is not worth the risk. Strategic deterrence is a complex national calculus that includes all elements of national power, with nuclear capability as a vital and essential component.

Credible nuclear deterrence is not only critical to our security, but to the security of our allies and partners, thereby playing a major role in non-proliferation. Many allied and friendly countries continue to depend on the security umbrella provided by the nuclear deterrence capability of the United States. If our commitment to the security umbrella begins to fray in terms of credibility, some non-nuclear allies may perceive a need to develop and deploy their own nuclear capability.

The Air Force Legacy of Strategic Deterrence

Strategic deterrence is in an Airman's DNA; we were born with this mission in 1947. For the past 61 years, we have successfully provided our nation and our allies diverse and effective nuclear deterrence capabilities. Our continued ability to provide a safe, secure, reliable, and credible nuclear deterrence capability underpins our national defense, a sober responsibility that the Air Force (with responsibility for two-thirds of the deterrence force platforms) executes with skill and commitment every minute of every day.

The Air Force nuclear enterprise involves many thousands of professionals across the country. This includes dedicated Airmen operating, securing, maintaining, and sustaining our operational forces; our partners in the industrial base; the exceptional capability at the national laboratories; and our NATO partners. Unique skills and substantial sweat equity is required daily to produce deterrence.

Every day at each of our three ICBM bases, hundreds of disciplined, dedicated, professional Airmen depart their main operating base to travel, oftentimes hundreds of miles on ice-covered roads, to provide the nation and our allies with the ultimate national defense backstop. These Airmen are providing security and performing maintenance on weapon systems that are located in remote areas of the country through the harshest of weather conditions, which provides the most stabilizing and responsive leg of our nuclear deterrence forces. Our Airmen are assuming custody of these weapon systems at launch control centers located deep underground, while still others are providing all of the support needed at the missile alert facility to enable the launch officers, maintenance teams, or security personnel to do their mission.

While our strategic bomber and dual-capable aircraft no longer sit on active alert, dedicated men and women are trained and prepared to generate a nuclear sortie of the most flexible and visible leg of the traditional nuclear triad upon direction from the national command authority. Frequently these Airmen work through the same severe environmental conditions,

"Deterrence is not just aircraft on alert and missiles in the silos. It is not defined by the size of the defense budget. It is the product of both capability and credibility."

~ General Jerome F. O'Malley

"There is no mission more sensitive than safeguarding our vital nuclear capabilities and maintaining nuclear deterrence. We have a sacred trust with the American people to safely operate, maintain, and secure nuclear weapons. We must constantly strive for perfection in this mission area. Rigid adherence to standards, personal accountability at all levels, and leadership are the foundations upon which our success depends."

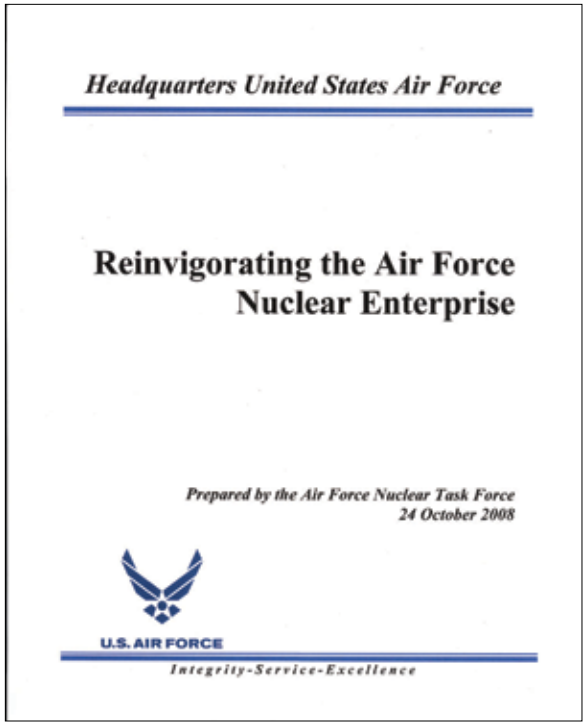
~ Honorable Michael B. Donley, 26 June 2008

ensuring airframes over 40 years old are capable of providing a credible air-delivered deterrence force. They carry out these responsibilities in the face of demanding deployment schedules as the Air Force fulfills its highly-valued bomber commitments to regional combatant commanders.

Nuclear-related duties are different from other Air Force duties. The Airmen and civilians involved in this business are uniquely qualified to perform this mission and are known for their discipline, rigor, precision, and reliability. Thousands are certified under the Personnel Reliability Program (PRP) and many others have critical duties supporting PRP. All our nuclear units across five different major commands (MAJCOM) undergo rigorous and unforgiving nuclear surety inspections with necessarily high standards that demand consistent precision and reliability. It's a tough business, but the stakes are too high for it to be any other way.

From the Cold War to Today

At the end of the Cold War, significant changes in the global security environment prompted national leadership to reconsider defense force structure. Anticipating and adapting to global challenges and resource constraints drove shifts in priorities. These shifts resulted in the Air Force undertaking the largest organizational force restructure since its inception. The service's increased focus on conventional operations and support to irregular warfare resulted in historic success in combat operations over the past 15 years, with extraordinary achievements in conventional bomber operations. But there was a price we were paying: a decreased emphasis on the Air Force's most sensitive mission area—nuclear deterrence.



Incremental changes over time put the nuclear mission at a competitive disadvantage with other Air Force priorities. The cumulative effect led to a diminished sense of mission importance, but as reminded by Secretary Robert M. Gates in his speech on 1 December 2008 at Minot AFB, North Dakota, "as stewards of America's nuclear arsenal, your work is vital to the security of our nation. Handling nuclear weapons—the most powerful and destructive instruments in the arsenal of freedom—is a tremendous responsibility. We owe you the attention, the people, and the resources you need to do the job right. For your part, you must never take your duties lightly. There is simply no room for error. Yours is the most sensitive mission in the entire US military. I am confident it is in good hands."[2]

We are aggressively addressing the institutional changes needed to bolster the nuclear deterrence mission area, and our senior leaders are committed to giving our nuclear enterprise the attention, resources, and personnel needed to sustain excellence.

Reinvigorating the Nuclear Enterprise

We have spent a lot of time and energy this past year conducting and responding to internal and external reviews, and we have made tough decisions on the way forward. The end state we are moving towards is getting beyond documented deficiencies and back to our legacy of excellence in the nuclear mission area. Our development of well-prepared, forward-looking leaders actively examining the global environment and adapting to meet future challenges will provide a deterrence quality all its own.

If you have not read *Reinvigorating the Air Force Nuclear Enterprise*, a roadmap to reinvigorate the Air Force nuclear enterprise published on 24 October 2008, consider it an excellent opportunity to catch up on your professional reading. The content is a result of root cause analysis applied to all the internal and external reviews of the Air Force nuclear enterprise over the past year. That effort revealed recurring themes that became imperatives:

- Restore a culture of compliance
- Rebuild our nuclear expertise
- Invest in our nuclear capabilities
- Organize to enable clear lines of authority providing sustained institutional focus
- Reinvigorate our Air Force nuclear stewardship role

The action plans in the roadmap will contribute to reestablishing a recognized standard of excellence in the Air Force nuclear enterprise and provide fundamental direction needed to organize, train, and equip our nuclear deterrence forces to ensure mission excellence and nuclear surety.

Restoring a Culture of Compliance

Like many other mission areas in the Air Force, our nuclear enterprise demands precision and reliability. Considering the potential consequences, failure is not an option in the nuclear mission area. As a result, we depend a great deal on quality assurance and frequent evaluation. To that end, the Air Force is making changes to the nuclear surety inspection process, providing for greater oversight, an Air Force Inspection Agency—administered inspector training and certification program, and a core team of inspectors that will participate in all nuclear surety inspections across all major commands. All will contribute to ensuring common inspection standards, consistent inspection policy, accurate functional guidance, and standardized checklists. These changes are designed to help further restore a culture of compliance and rigid adherence to standards.

Rebuilding Our Nuclear Expertise

Ensuring we have the right depth of experience in the right position at the right time has never been more important. This requires careful management throughout the mission area, to include education and training across the enterprise; improving identification and tracking of nuclear experience and expertise; and establishing a force development governance construct to ensure continual, formalized senior leadership involvement in the development of future nuclear leaders. Air Force training experts are developing inspection and evaluation criteria for non-Air Education and Training Command courses to ensure consistency and adherence to training objectives. Key nuclear billets have been formally identified and special experience identifiers developed and assigned to ensure individuals filling key positions possess the required background and experience to effectively lead the nuclear enterprise.

Finally, senior leadership involvement in developing nuclear leaders will be institutionalized through the Nuclear Enterprise Advisory Panel (NEAP). The NEAP serves as a cross functional review and advisory panel to the Force Management and Development Council chaired by the vice chief of staff of the Air Force. The NEAP will provide force development oversight for officers, enlisted, and civilian personnel—those within purely nuclear career fields and those in critical supporting roles.

Investing in Our Nuclear Capabilities

Reinvigorating the nuclear enterprise is the number one priority in the Air Force Strategic Plan. To accomplish this we are developing more content related to strategic systems, as well as modifying the way the Air Force resources programs to ensure nuclear deterrence programs have the right emphasis and focus. These shifts drive institutional change. Given that the Air Force is responsible for delivering deterrence with ballistic missiles, cruise missiles and gravity bombs, strong stewardship will ensure focus in maintaining the right strategic capabilities in the near-, mid-, and long-term.

Reorganizing to Insure Clear Lines of Authority

Three key decisions made over the past few months are intended to correct fragmented lines of authority. Each is important; all taken together represent the foundation of our way forward. The establishment of Air Force Global Strike Command (AFGSC) will improve nuclear focus in our deployed operational strategic forces. Convergence of all nuclear sustainment activities in Air Force Materiel Command, more specifically the Air Force Nuclear Weapons Center, will improve focus and management of our systems. And an Air Staff office focused exclusively on strategic deterrence and nuclear integration across the enterprise will contribute to bind these broad efforts together.

Air Force Global Strike Command

The new major command will foster a robust strategic deterrence and standardized self-assessment culture while providing combat-ready forces to conduct strategic nuclear deterrence and global strike operations in support of combatant commanders. AFGSC will place an emphasis on developing and sustaining strategic, operational, and technical nuclear expertise as well as increasing the number of experienced nuclear personnel to fill key leadership positions. AFGSC will also advocate for nuclear infrastructure and weapons system development, sustainment, and modernization. All the while, this command will continue to ensure Air Force commitments to regional combatant commanders are met with trained and ready forces performing conventional operations.

Air Force Nuclear Weapons Center

To further clarify the lines of authority within the nuclear sustainment community, Air Force Materiel Command is consolidating all nuclear sustainment activities within the Air Force Nuclear Weapons Center at Kirtland AFB, New Mexico. Under this organizational construct the commander of Air Force Materiel Command is responsible for consolidated sustainment of Air Force nuclear weapons and extends positive inventory control over all nuclear weapons-related materiel. The vision is for all nuclear-related program management activities, systems, and associated warheads to be sustained by the Air Force Nuclear Weapons Center.

Assistant Chief of Staff for Strategic Deterrence and Nuclear Integration

The assistant chief of staff (ACS), Strategic Deterrence and Nuclear Integration (HAF/A10) has been created to increase the level of advocacy and oversight of the unique strategic deterrence mission, and to streamline the lines of authority at Air Force headquarters. HAF/A10 provides a headquarters ACS reporting directly to the chief of staff of the Air Force with direct access to the secretary of the Air Force and the authority to directly impact nuclear enterprise policy, guidance, requirements, and advocacy across the Air Staff. The establishment

"I don't ever, ever, ever want to hear the term logistics tail again. If our aircraft, missiles, and weapons are the teeth of our military might, then logistics is the muscle, tendons, and sinews that make the teeth bite down and hold on—logistics is the jawbone! Hear that? The JAWBONE!" *~ Lt Gen Leo Marquez, US Air Force*

of HAF/A10 sends a clear signal that the Air Force is committed to restoring the institutional focus at the headquarters and across all levels of the nuclear enterprise.

Reinvigorating Our Nuclear Stewardship Role

The Air Force is also undertaking significant corporate modifications to enhance our nuclear stewardship role with a goal of improving senior leadership visibility and improving the resourcing process for the nuclear mission area. We are refining the Air Force corporate process by assigning HAF/A10 as the nuclear advocate on the Air Force Council, Group, and Board.

To ensure the highest level of attention is provided to the nuclear enterprise, a Nuclear Oversight Board has been established, co-chaired by the secretary and the chief of staff of the Air Force with membership including the MAJCOM commanders with nuclear responsibilities. This board will meet quarterly to oversee the implementation of the roadmap and review Air Force performance across the nuclear enterprise.

Summary

All of the changes underway—the increased focus, the shifting of priorities—are about one thing: deterrence. These actions will ensure the Air Force continues to deliver effective strategic deterrence, thereby reinforcing the confidence of the American people and national leadership, assuring allies, and dissuading and deterring potential adversaries.

Secretary Gates has repeatedly stated that strategic nuclear deterrence "is the most sensitive mission in the entire US military."[3] The Air Force is committed to ensuring mission focus and necessary resources to ensure sustained success. Urgent action is required now to achieve sustainable improvements in the coming years.

Consider these final thoughts:

- All Airmen, from all disciplines in the US Air Force, need to have a fundamental understanding and appreciation for all Air Force capabilities. Together, we deliver an unrivaled range of effects, producing strategic and tactical successes with global impact. Step back to appreciate this fact and you will not only be even prouder to be an Airman, but you will better understand how you fit and how vital you are to our success.
- Today, and for the foreseeable future, deterrence is achieved through the application of all elements of national power. Credible nuclear deterrence systems are central to our nation's security as long as other nations possess nuclear weapons.
- Credible nuclear deterrence is re-created everyday with extraordinarily skilled Airmen and civilians; it is very hard work.
- The consequence of failure in this business is substantially different from the consequence of failure in any other military discipline.

The road we are on to reinvigorate the Air Force nuclear enterprise is filled with challenges and opportunities. It is being paved, one mile at a time, by precise delivery of deterrence in the field—everyday—and by purposefully building on the initiatives underway. It is urgent and important—and we will see it through.

Notes

[1] Chairman of the Joint Chiefs of Staff Publication 1-02, Department of Defense Definitions of Military and Associated Terms, 12 April 2001 (as amended through 17 October 2008).

[2] The Honorable Robert Gates, "Address to Minot Airmen," address as delivered, Minot AFB, ND, 1 December 2008.

[3] The Honorable Robert Gates, "Nuclear Weapons and Deterrence in the 21st Century," address, Carnegie Endowment for International Peace, Washington, DC, 28 October 2008.

Maj Gen C. Donald Alston (BS, US Air Force Academy, Colorado Springs, Colorado; MBA, Business Administration, Golden Gate University, San Francisco, California) is the assistant chief of staff, strategic deterrence and nuclear integration, Headquarters (HQ) US Air Force, Washington, DC.

General Alston is responsible for increasing nuclear focus by ensuring corporate advocacy and cradle-to-grave stewardship of Air Force nuclear systems and weapons; integrating and synchronizing HQ Air Force strategic nuclear mission management supporting major commands; engaging with joint, departmental, and national agency mission partners to facilitate integrated nuclear enterprise solutions; and maintaining synchronization in Air Force strategic deterrent responsibilities.

General Alston was commissioned in 1978 following graduation from the US Air Force Academy. He has commanded at the squadron, group and wing levels. He has worked as a liaison officer to the US House of Representatives, and also performed duties as the executive assistant to the secretary of the Air Force in Washington, DC. The general has held numerous positions while serving at HQ Air Force Space Command and US Space Command. General Alston also served as the deputy chief of staff for strategic communications and the spokesperson for Multi-National Force - Iraq in Baghdad.

Vital Mission – Elite Team. A Reflection on the ICBM Force

Maj Gen Timothy J. McMahon, USAF, retired
Former Commander, Twentieth Air Force,
Air Force Space Command, and
Task Force 214, US Strategic Command
F. E. Warren AFB, Wyoming

On 30 May 2003 I relinquished command of Twentieth Air Force (20 AF), marched off the parade field at F. E. Warren AFB, Wyoming and retired from active duty after 32 years of service. My feelings that day were probably very much like most who have retired from the military. I was grateful for the opportunity to serve and I felt pride in having been a part of the Air Force Space Command team for nearly 12 years of my career. What made that day and retirement truly special to me, is the fact that I was able to complete my career where it began. I wrapped it up supporting a mission that remains absolutely vital to the nation. I had the high privilege of serving as a part of a force which prides itself on its integrity, sense of high purpose, and unapologetic commitment to the uncompromising standards of nuclear surety. I feel no differently today then I did that day. I take great pride in having been a small part of this special force. I have enormous respect for what it contributes to the nation's security; and, I have absolute confidence that with the needed leadership affirmation and resource support, they will deliver on their mission responsibilities as they always have.

Events during the past year and a half have focused critical attention on the Air Force and its nuclear operations. Those events were clearly serious in their own right, but on reflection, it seems to me that they were essentially the result of the end of the Cold War influencing many poor decisions (including some of my own) resulting in insufficient institutional support for the mission. As a result, the Air Force's nuclear activities, organizations, and processes have been subjected to rigorous and appropriate internal and external reviews. The public has been assured corrective actions are underway and the Air Force leadership team has clearly committed themselves to this effort as their highest priority. It has been a highly challenging time, and for that reason, I believe it is important to focus and reflect on cardinal points which always have applied to the strategic deterrence mission and the intercontinental ballistic missile (ICBM) force.

The ICBM force has achieved 50 years of service to the deterrence mission and the Minuteman system will reach the 47th anniversary of its deployment at Malmstrom AFB, Montana this October. That's about 17,155 days of continuous nuclear alert! So with that in mind, I would like to offer two assertions. First: No military mission has been, or remains more vital to the security of this nation then the deterrence of strategic attack against our homeland and our allies. A credible and reliable ICBM force, at its current level not only deters, but it also serves to dissuade others from attempting to compete with us at this level, and it assures our allies that our deterrent extends to support their national security as well. Any one of these three political objectives—or military effects—is sufficient to justify the existence of our current strategic forces, and the ICBM force has critical attributes which address each objective in unique ways. The second assertion I would like to offer is that no component of our strategic deterrent capability has contributed as decisively to the daily success of the mission of deterrence since the end of the cold war than the ICBM force. Retained on continuous alert here in the homeland, the ICBM force represents America's ability to defend ourselves under the most desperate circumstances, and if necessary, to impose our national will by projecting devastating power over near-global distances, and with a promptness unmatched by any other military force on the planet.

At the same time there is a paradox associated with deterrence. The utility of the ICBM force is often questioned because of the faulty assertion that it has not "been employed operationally." That's the paradox, but that's also the point. The political objective and military effect of deterrence is to make our capability so overwhelmingly clear to potential adversaries that the mere presence of an alert, reliable ICBM force is by definition an "employment" of the force. Some have difficulty understanding that the deterrence of violence, at all levels, transcends warfighting in both national security and moral terms. The extent to which the ICBM force achieves this effect is again a sufficient purpose to justify its existence.

While we believe the likelihood of a strategic attack has declined since the end of the Cold War (although no one can say with authority by how much), we cannot be certain that the possibility of attack equals zero. On the other hand, the failure of deterrence or a nuclear attack of any size would have utterly grotesque consequences. Multiplying the high number (consequences) by the low number (probability), yields a high

A credible and reliable ICBM force, at its current level not only deters, but it also serves to dissuade others from attempting to compete with us that level, and it assures our allies that our deterrent extends to support their national security as well.

No other weapon system or combat force provides the nation with the political and military power that resides on alert—in their custody. Their mission is deterrence, and the core imperative of their daily effort is nuclear surety.

number. Either way, the result is always a high number. So the paradox of deterrence is that it addresses a low probability/high consequence event at a level commensurate with our supreme national interest—our survival as a nation and a society. Deterrence is therefore, important on a scale which defies measurement.

By virtue of their mission and the weapon system they operate, secure, maintain, and support, the men and women of our ICBM force stand in a league of their own when it comes to the level of responsibility that rests on them. No other weapon system or combat force provides the nation with the political and military power that resides on alert—in their custody. Their mission is deterrence, and the core imperative of their daily effort is nuclear surety.

Surety is comprised of two straightforward, absolute guarantees that the force must deliver to the nation. First, if the president directs the force to execute a nuclear option then he or she, and the American people, can have unconditional confidence that the ICBM force will execute and produce nuclear yield at precisely the time and place ordered. Second, absent such an order, the president and the American people must have absolute confidence that the ICBM force is safe—that it is secure—and, it remains reliably ready. If they can't provide the first guarantee, then the force is irrelevant. If they can't provide the second guarantee, then the force's existence is intolerable. Not being able to deliver on both guarantees is clearly unacceptable.

Making good on both of these guarantees drives standards throughout the weapon system and the force that are extremely high and rigid, and compliance with them must continue to be absolute—as it always has been. Meeting the demands of the mission and nuclear surety over the years drove some of the best and toughest, training, standardization/evaluation, and "quality assurance" programs in the Air Force. These programs drove readiness, confidence, and the credibility of the force. I would argue that meeting the demands of nuclear surety has made the ICBM force "elite" in many ways. They are elite because they are responsible for a sensitive mission of national importance. They are elite because they are continuously and highly trained and rigorously evaluated. They are held to the highest standards of military professionalism and discipline. They are accountable for all they do—for every step, of every checklist. They respect and take care of each other, and while many take them for granted, they have rightfully earned and enjoy the respect of millions—including me.

While I commanded the 341 Missile Wing and 20 AF, I was motivated and inspired by their energy, their intense focus, and what they accomplished each day. From the morning surge into the field, to their safe return that night or days later, these professional Airmen made it seem so routine; so standard. Like the weapon system itself however, it is actually extraordinary in its complexity. Mission success in these wings required detailed, deliberate, and adaptive planning with extremely high levels of coordinated and synchronized action through all kinds of conditions and lousy weather. The "big dog eats" and they get it done.

On the morning I retired, I reflected on the legacy built by the ICBM force over the years. I thought of their thousands of trips to the field and the many millions of miles they drove, the sorties they generated, the alerts they pulled, the meals they prepared, the facilities they proudly maintained, and the countless security situations they struck. I was proud and grateful that I was able to be a very small part of their effort, and that sense of pride will never go away.

It's been a challenging time for the ICBM force, but there's a plan, and I am certain they will stay the course, keep pressing as a team, get it done, and build on their great legacy in the process!

Maj Gen Timothy J. McMahon, USAF, retired (BA, History, Quincy College, Illinois; MPA, Public Administration, Golden Gate University, California) was commander, 20th Air Force, Air Force Space Command, and commander, Task Force 214, US Strategic Command, F. E. Warren AFB, Wyoming. He was responsible for the nation's ICBM force, including three operational space wings with more than 9,500 people. General McMahon entered the Air Force in 1970. After missile operations duty at F. E. Warren AFB and Vandenberg AFB, California, he held staff assignments at Strategic Air Command headquarters, the Air Staff, and at Air Force Space Command headquarters. General McMahon commanded the 13th Missile Warning Squadron at Clear AFB, Alaska, the 21st Operations Group at Peterson AFB, Colorado, and the 341st Missile Wing at Malmstrom AFB, Montana. He then returned to Offutt AFB, Nebraska, as deputy director of operations and logistics with US Strategic Command. General McMahon served as the director of nuclear and counterproliferation with the deputy chief of staff for air and space operations at the Pentagon.

The Air Force Nuclear Weapons Center, An Introduction

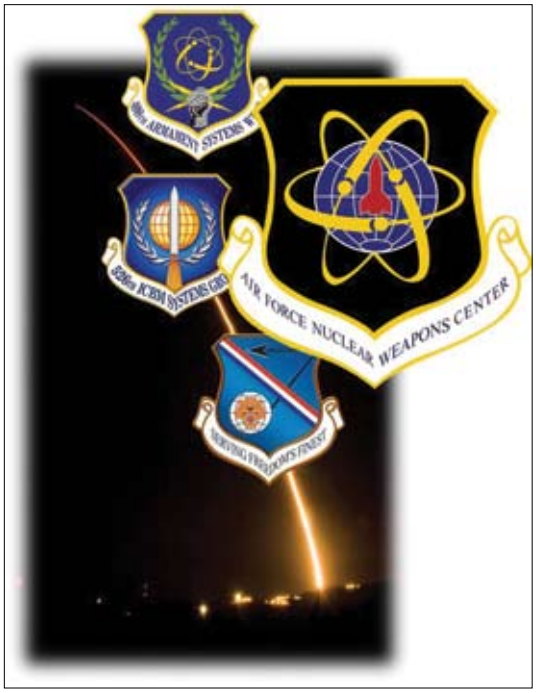
Brig Gen Everett H. Thomas, USAF
Commander, Air Force Nuclear Weapons Center
Kirtland AFB, New Mexico

An obscure, little noticed event in 1933 essentially shaped how the world viewed conflict, international politics, and science itself when Dr. Leo Szilard hypothesized the possibility of a self-sustaining nuclear chain reaction in uranium. Launched by this postulate, the United States embarked upon the Manhattan project, changing the face of scientific endeavor forever and producing the most powerful weapons the world has seen to date.

The US wrestled with the task of managing its newfound capabilities—creating new government departments and entities, such as the Atomic Energy Commission (AEC) and the National Laboratory system to develop, oversee, and safeguard the new nuclear weapons stockpile. Meanwhile, the rapid rise of the Soviet Union as a competitor to US nuclear supremacy ensured that the US must realize a vigilant, finely honed, and constantly functioning military force to deliver deterrence at a moment's notice. Tasks that once fell under the civilian control of the AEC to deliver deterrence were ceded to the military, demanding an immediate change in the ways munitions operations, and technical training were conducted.

The AEC, and later the Department of Energy (DoE), retained and safeguarded the design and production of nuclear weapons, working closely with the US Air Force, and US Navy to revolutionize global strike capabilities. These AEC designed weapons, combined with Department of Defense (DoD) developed delivery systems, completely revolutionized the idea of global strike capabilities. The result was the emergence of intercontinental ballistic missile (ICBM) and submarine launched ballistic missile (SLBM) technologies, which when coupled with lightweight, high-yield warheads ushered in the era of true strategic deterrence. Suddenly, the race and the game had changed.

In the years that followed Air Force organizations also changed. The Strategic Air Command (SAC) was supplanted by Air Combat Command (ACC) and Air Force Space Command (AFSPC) as holders of the nuclear mission, and more recently Air Force Global Strike Command arose to consolidate nuclear missions in SAC's footsteps. However, the fundamental relationship between the warfighter and developer/sustainer remains crucial. This has been true from the time that Manhattan project scientists and the Army Air Forces revolutionized the battlespace in closing out World War II. In the spirit of this legacy, whether the warfighter is ACC, North Atlantic Treaty Organization, AFSPC, or Air Force Global Strike Command, the Air Force Nuclear Weapons Center is committed to providing 24/7 development, sustainment, maintenance, and logistical excellence.

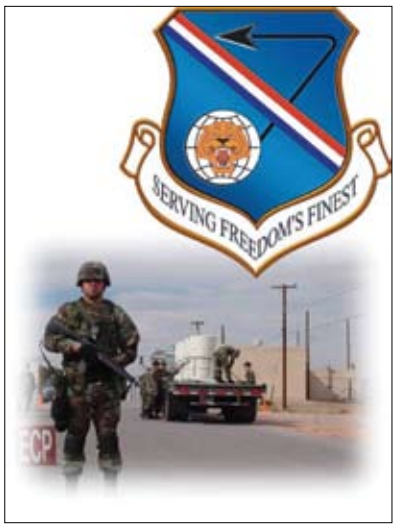


Air Force Nuclear Weapons Center.

What is Today's Air Force Nuclear Weapons Center?

The Air Force Nuclear Weapons Center (AFNWC) is a relatively new organization, having stood up on 31 March 2006 as the newest of the Air Force Material Command's specialized product centers. While young, the center's responsibilities are enormous and growing, as the AFNWC represents the consolidation of all major nuclear sustainment activities within the US Air Force in a single organization. This sustainment focus and the perspective behind the creation of the AFNWC are clearly evident in Secretary of Defense Robert M. Gates' recent comments to the Carnegie Endowment for International Peace, "the Nuclear Weapons Center at Kirtland AFB, New Mexico is being revitalized and expanded—with a focus on sustainment and clearing up ambiguous chains of command that have created problems in the past."[1]

AFNWC's far-reaching set of responsibilities span many missions, technical development programs, system sustainment phases, and continents. From the nation's national laboratory system, to continental United States (CONUS) missile sites, storage facilities, contractor production facilities, and air logistics centers across the Air Force, AFNWC personnel work tirelessly to ensure a reliable, viable, and sustainable deterrent. These personnel are ensuring Minuteman III (MM III) operations and system sustainment, performing sustainment operations on the full scope of Air Force nuclear assets, guaranteeing DoE nuclear systems are battle-ready, managing nuclear systems certification, overseeing cruise missile systems integration, and managing a host of other crucial nuclear weapons sustainment operations worldwide. All of these disparate activities are coordinated and



377th Air Base Wing.

526th ICBM Systems Group.

498th Missile Sustainment Group.

overseen by the AFNWC headquarters, located at Kirtland AFB and our associated units located throughout the country.

Two wings, the 498th Armament Systems Wing and the 377th Air Base Wing (377 ABW), as well as the 526th ICBM Systems Group (526 ICBMSG) report to the AFNWC commander. The first of these, the 377 ABW, performs vital base support functions at Kirtland AFB. Additionally, the 377 ABW has crucial security and surety responsibilities in support of the AFNWC mission.

The 526 ICBMSG, located at Hill AFB, Utah is responsible for inception-to-retirement weapons system management of the nation's land-based strategic deterrent. The group began in July 1954 as the Western Development Division under Brig Gen Bernard A. Schriever to develop the Titan I ICBM and intermediate range ballistic missiles. Re-designated as the Air Force Ballistic Systems Division and then the Ballistic Missile Office, the organization developed and fielded the nation's ICBM fleets of Atlas, Titan, MM I, II, III, and Peacekeeper weapons systems from 1962 to 1987. In 1993, the organization relocated to Hill AFB and merged with the ICBM Product Directorate to form the ICBM Systems Program Office (SPO). The ICBM SPO was responsible for completing the deployment of Peacekeeper, long-term sustainment of the ICBM fleets, as well as planning the next generation missile system. When the decision was made to extend the life of the MM III fleet in 1995, the SPO embarked upon several major modifications to extend the service life to 2020. The ICBM fleet was downsized in 2005 with the deactivation of 50 Peacekeeper missiles and a subsequent reduction in the MM III fleet to 450 missiles on alert. As of today, the 526 ICBM Systems Group is charted to sustain and modernize the current MM III fleet thru 2030 and be prepared to execute any developmental work for a follow-on system as required by the warfighter to ensure the viability of the nation's land based strategic deterrent.

498th Nuclear Systems Group.

The 498th Missile Sustainment Group (498 MSUG), 498th Nuclear Systems Group (498 NSG), and 498th Munitions Maintenance Group (498 MUMG) comprise the 498th ARSW. While the wing is headquartered at Kirtland AFB, along with the AFNWC headquarters, these groups and their geographically separated units span more than nine sites on two different continents.

The 498 MSUG, located at Tinker AFB, Oklahoma, is responsible for development and sustainment of cruise missile based nuclear delivery platforms, such as the air launched cruise missile and derivatives, the advanced cruise missile, and related bomber integration equipment. The group serves as the US Air Force system program manager for all assigned long range stand-off cruise missiles, supports users in five states and coordinates the actions of depots and contractors in eight locations throughout the continental US. Systems acquisition, sustainment upgrades and system modifications, configuration management, depot maintenance, field support, and system safety are just a few of the system responsibilities that the group carries out every day. That's why there can be no question that from "cradle to grave," the US Air Force counts on the 498 MSUG wherever and whenever the cruise missile force is called upon.

498th Munitions Maintenance Group.

The 498 NSG is located at Kirtland AFB and is responsible for managing the nuclear certification process for all US Air Force nuclear capable systems, performing logistics support for all US Air Force nuclear weapons, and managing technical orders for nuclear warheads. The group also plays a key role in the interagency process of designing, building, and sustaining nuclear systems in conjunction with the National Nuclear Security Agency and the DoE laboratory system. These roles demand a diverse, experienced, and highly educated workforce.

Within the 498 NSG, retired and active chief master sergeants work with the Defense Threat Reduction Agency and Sandia National Laboratory to ensure that technical data for nuclear systems is technically correct and current, while doctorate scientists work with Los Alamos and Livermore National Laboratories to manage the development and modification of nuclear systems. The group also performs daily management of the US Air Force nuclear certification process, ensuring that every nuclear weapon system component, from storage facilities to B-2 Spirit bombers, are certified and ready for nuclear operations at all times. While the master nuclear certification list (MNCL) is the primary certification product, teams of engineers work daily to ensure that every item on the list is suitable for nuclear operations, and that any change to a nuclear system results in a safe and reliable nuclear system.

The 498 NSG hosts not only maintenance, logistics, and certification support functions, but the lead project officers (LPOs) for each US Air Force nuclear warhead system. Previously a direct reporting unit to the Air Staff, the 709th Nuclear Systems Squadron carries out technical management and interaction with the DoE and national laboratory system through these weapon LPOs. This tight-knit coordination of the DoE and the DoD in development, acquisition, and sustainment of the nuclear deterrent is both a requirement and validation of the principle laid down in the Atomic Energy Act of 1953. In short, the 498 NSG is the home of the US Air Force's technical nuclear weapons expertise.

The 498 MUMG, also headquartered at Kirtland AFB, has overall responsibility for Air Force-wide nuclear maintenance operations. With recent changes currently in the implementation phase, the AFNWC and the 498 MUMG will assume responsibility for all CONUS-based nuclear weapons storage area operations. These operations include all nuclear weapons maintenance operations, but also extend to include weapon movement, weapons control and status tracking, and quality assurance. The group and its constituent squadrons maintain crucial nuclear maintenance expertise on a variety of assets, including the B61 and B83 gravity bomb systems, W80 and W84 cruise missile systems, and the W62, W78, and W87 ICBM systems, performing hundreds of successful maintenance operations every year. The dedicated professionals of the 498 MUMG represent the "tip of the spear" for the AFNWC sustainment process, ensuring that each and every nuclear asset provided to the warfighter is mission-ready every time.

The Future and the Focus of the Air Force Nuclear Weapons Center

The AFNWC continues with its charter of nuclear sustainment consolidation, successfully integrating new units and new personnel. With the recent inclusion of new maintenance, technical and program management units into the AFNWC, a critical mass of common missions has become obvious. In the words of the US Air Force Chief of Staff, General Norton A. Schwartz, "the AFNWC now has complete control over the whole sustainment supply chain, that wasn't the case earlier and so now we have a … single entity that is responsible for sustainment."[2]

In the very near future, AFNWC will integrate nuclear weapons maintenance and storage operations throughout the CONUS and will add much needed expertise throughout the organization, bringing on nearly 300 new personnel. Synergy will be even greater under these next phases of the AFNWC's growth, and the safeguarding of the Air Force's and nation's nuclear expertise will be paramount amongst the center's plans and priorities.

It quickly becomes obvious that the women and men of the AFNWC face a variety of challenges and a wide array of mission requirements in providing focused support to the warfighter. While the AFNWC's roles are many and varied, strict attention to detail and consistent accountability is still essential to success in today's nuclear mission. Just as the Cold War forced a sea of change in operations during the 1950s, the continuing US Air Force nuclear mission in the post-911 world demands a re-examination of the ways that we approach nuclear munitions operations, management, and technical training. Rest assured that the AFNWC is proud to lead the way forward.

Notes:

[1] Secretary of Defense Robert M. Gates, Carnegie Endowment for International Peace, speech, Washington DC, 28 October 2008.

[2] General Norton Schwartz, speech, Los Angeles, California, 04 December 2008, quoted by SSgt Matthew Bates,"Re-invigorating nuclear enterprise a top priority," *Air Force Print News*, 4 December 2008.

Brig Gen Everett H. Thomas (BS, Environmental Health, Mississippi Valley State University; MS, Industrial Safety, Central Missouri State University, MA, National Security and Strategic Studies, Naval War College, Rhode Island) is commander of the Air Force Nuclear Weapons Center (AFNWC), Kirtland AFB, New Mexico. The AFNWC is responsible for the entire scope of the nuclear weapons support functions and comprises units at Kirtland AFB, Hill AFB, Utah, Tinker AFB, Oklahoma, Ramstein AB, Germany, and Lackland AFB, Texas.

General Thomas was commissioned through the Reserve Officer Training Corps program in 1980. He spent his career in a variety of career fields including missile and space operations and maintenance. The general has commanded an Air Force station, a space launch squadron, a missile operations group and a space wing.

Senior Leader Perspective

Rethinking Deterrence

Dr. Lani Kass
Senior Policy Advisor to the
Chairman of the Joint Chiefs of Staff
Pentagon, Washington DC

September 11 was a strategic inflection point—a historic point in time when tectonic change caused strategists to not only reconsider the answers to questions, but even the basis of the questions themselves. Specifically, concerns of weapons of mass destruction in the hands of religiously motivated zealots have raised questions as to the applicability of concepts long taken for granted. In fall 2008, the chairman of the Joint Chiefs of Staff rightly challenged the military saying, "It is way past time to reexamine our strategic thinking about deterrence."[1] The current global environment demands this kind of examination of how best to adapt deterrence policy. However, before one can fully understand how to adapt to the 21st century challenges, a more complete understanding of deterrence is required. While applied in an ever-changing context, the nature of deterrence is constant primarily because it is rooted in human psychology and behavior.

Deterrence is both exquisitely simple and devilishly complex. In its purest form, it's nothing more than a rational calculus of costs and benefits, reinforced by the threat of punishment.

Deterrence is both exquisitely simple and devilishly complex. In its purest form, it is nothing more than a rational calculus of costs and benefits, reinforced by the threat of punishment. In this pure form, deterrence is as old as war itself. Since time immemorial, humans attempted to avert hostile action by threatening retaliation that would far exceed any potential gain the opponent might expect. In its rawest manifestation, deterrence is seen among animals (e.g., a dog baring its teeth). The stories of Adam and Eve and Pandora's Box—as well as parental behavior—are good examples of this simple proposition: "don't do that (or don't go there) or I'll smack you real hard."

The devilishly complex aspect of deterrence was born at the dawn of the nuclear era. It dates back to Bernard Brodie's famous statement upon learning about Hiroshima and Nagasaki: "This changes everything. Till now, the purpose of the military was to fight and win wars. Henceforth, their purpose is to avert them." After the USSR tested its nuclear (and then thermonuclear) devices and the two superpowers became locked in a Cold War—a stand-off predicated on the reality of mutually assured destruction—a new class of civilian experts (political scientists, accountants, gaming experts, mathematicians, and physicists) displaced uniformed strategists. Their rise reflected the notion that, in a nuclear world, military experience did not matter—indeed, it was both irrelevant and dangerous.

The civilians (Thomas Schelling, Bernard Brodie, Herman Kahn, and others) based their theology on the premise that nuclear weapons are **qualitatively different** from any other weapon. **Their utility lies in their non-use.** In contrast, during these early years, most military experts (and many civilian decision makers, to include Presidents Truman and Eisenhower) believed that nukes are distinct in the degree and speed of destruction (bigger bang) but otherwise akin to other weapons—and, thus, militarily useful. Ultimately, in the US, (but not in the USSR) the civilian approach prevailed. Deterrence theory—and such notions as "escalation control," "signaling," "secure second strike capability," "counter force and counter value," and so forth—supplanted the enduring principles that have traditionally guided the employment of military power. When the North Atlantic Treaty Organization (NATO) was created to confront the Warsaw Pact, the notions of "extended deterrence" and "deterrence stability" were added to the lexicon. Insofar as NATO was, effectively, a mutual suicide pact, US credibility and reliability became key. Thus, France's—and, to a lesser extent, Britain's—decision to deploy an independent nuclear capability may have stemmed from their leaders' doubt that the US would ever be ready to "trade Chicago for Hamburg" as part of its response to a Soviet attack.

Deterrence did not prevent direct military confrontations between the US and the USSR. Limited, proxy wars—as well as a nuclear "arms race" became the outlet for their competition. The super-powers came to the brink only twice: Cuban missile

"As we've seen in recent years, and again in recent weeks, in so many ways, the basic nature of man and the iron realities of nations have not changed, despite the fondest hopes of so many for so long, especially after the end of the Cold War. What has changed is that the international environment today is more complex and unpredictable perhaps than it has ever been."

~ Secretary of Defense Robert M. Gates, National Defense University, 29 September 2008

crisis in 1962 and the October 1973 Yom Kippur War.

In spite of the ever increasing complexity of the civilian—and, during the Robert McNamara years, military—theorizing, at its core deterrence remained what it's always been: an attempt to avert hostile action by threatening punishment that would far exceed any potential gain the opponent (in this case, the USSR) might expect. Henry Kissinger framed deterrence as the product (multiplication, not addition) of three variables: Deterrence *equals* your capability (**the total capability of a nation,** not merely its nukes) *times* your will to actually employ that capability *times* opponent's perception of that capability and will. The logic underpinning this formula is several-fold:

Deterrence is a product (not a sum) of three inter-related factors—capability, will (intent), and perception. If any one shifts up or down, the product is proportionally affected, even if the other two remain unchanged.

1. Deterrence is predicated on a rational calculus of costs and benefits. (However, few deterrence theorists ever acknowledged that there are no universal standards of rationality or recklessness; even fewer considered the risks of mirror imaging—that is, ascribing your own standards of behavior to the opponent).
2. In the Cold War the calculus was quite transparent to both actors—in other words, both sides knew each other's behaviors, red lines, and what each held dear.
3. Deterrence is a product (not a sum) of three inter-related factors—capability, will (intent), and perception. If any one shifts up or down, the product is proportionally affected, even if the other two remain unchanged. Likewise, if any factor is zero, the product is zero. Thus, absent perception of hostile intent, there's no deterrence relationship between the US and Britain (will being zero, deterrence is zero).
4. Deterrence is ultimately in the eye of the beholder—it is predicated on the opponent's **judgment** of not only your physical capability to inflict unacceptable damage, but also on your *will* to do so. **Intent and perception are, by definition, the most unstable factors in the equation,** since they reflect human behavior under stress. This reality produced increasingly complex gaming theories and calculations designed to minimize uncertainty and predict the unknowable.
5. Deterrence is a strategy of a negative aim. It leaves the initiative with the opponent (the object of deterrence). Success or failure is measured only in the breach. Every day that goes by without an attack is counted as success.
6. International signaling is inherently complex. Input does not equal output. Action designed to signal "resolve" might be seen as a sign of weakness—or, worse, provocation—by the adversary.

Theorizing aside, Cold War deterrence was an unprecedented relationship: a weapon that was used only twice in August 1945 established an effective taboo—even though the technology proliferated, the weapons were never employed again. With the collapse of the Soviet Union, the attention to nuclear weapons and deterrence progressively atrophied. The fact that Russia remains the only nation capable of destroying the US in 30 minutes became increasingly obscure. Concerns with proliferation led many experts to argue for various forms of "denuclearization," wherein the US would "lead by example," declare a "no first use" policy, and/or dismantle its arsenal—so others would follow. While these notions failed to gain traction, they effectively relegated the entire nuclear triad (submarine launched ballistic missiles, ICBMs, and nuclear armed bombers) to "crazy aunt" category: burdensome, rarely mentioned, and largely out of sight and out of mind.

One notion that did gain traction in this new age was the creation of the "new triad." The "new triad" combines the three nuclear elements of the "old triad" with non-nuclear strike assets into one leg—offensive strike systems. This recognizes that all offensive capabilities have some coercive power in their ability to impose costs on adversaries. It also indicates an ability to leverage conventional capabilities to facilitate a reduction of offensive nuclear capabilities. In many ways, however, this blurs a critical dichotomy—nuclear weapons are not just a "bigger bang," they are fundamentally, qualitatively different in both their political and physical effect. While physically devastating in immediate and long-term effects, nuclear use would be equally devastating to policy, crossing an important threshold that has been taboo for six decades. Nuclear weapons continue to have a psychological effect unmatched by any amount of TNT or Tritonal.

The "new triad" also includes two entirely new elements not previously seen as integral to the traditional US triad— responsive infrastructure and defenses. Responsive infrastructure refers to the nuclear enterprise activities behind the weapons—research, development, and sustainment. More robust research, development, and sustainment are intended to maintain confidence in the future of the cold war arsenal as systems age. This is the longer term effort to maintain a credible nuclear deterrent over time.

The third leg of the "new triad" is defenses. This element begins to address the notion that some actors are much more difficult to influence than others. When an adversary lacks evident "pressure points," defenses (active and passive) work to reduce the benefits of adversary action. Since it is difficult to impose costs on some actors, this approach denies them the benefit of their contemplated actions. Unfortunately, this negates many of the advantages of coercion. Coercion is, at its heart, a way to eliminate the heavy costs of conflict—conflicts do not have to be fought, nor resources expended to attack or defend—creating significant savings in lives and treasure. Offensive systems that threaten an adversary's very existence do not begin to compare with the expenditures required to physically defend one's own survival.

Non-state actors present the biggest challenge for 21st century

The lack of readily apparent pressure points does not mean non-state actors are unable to weigh costs and benefits, it simply means new pressure points need to be discovered or developed.

deterrence. The complicated nature of these threats often lead them to be characterized as "irrational actors" with the subsequent conclusion that these groups are undeterrable. More likely; however, is that the leadership of these groups is quite rational but with value systems that are either unclear or difficult to hold at risk. Daniel Byman and Matthew Waxman capture this problem in their concept of "pressure points."[2] For an item to be a pressure point—an effective target for coercion—it needs to be within reach and sensitive to influence. If an item has tremendous coercive value, but for whatever reason is impossible to locate, it is a poor target for coercion. In the same way, the deaths of over 900,000 Japanese civilians in World War II were insufficient to generate a revolt—the population simply was not sensitive to influence. The lack of readily apparent pressure points does not mean non-state actors are unable to weigh costs and benefits, it simply means new pressure points need to be discovered or developed. While easier said than done, this is a far cry from irrationality.

In the wake of 9/11, the National Security Strategy proclaimed "traditional deterrence constructs" as no "longer applicable." And yet, despite new challenging threats, the logic underpinning it is enduring. In a world characterized by proliferation, religiously-motivated terrorism, and non-state actors, a new deterrence theory is both essential and difficult. It is yet to fully emerge.

Dr. Lani Kass is the senior policy advisor to the chairman of the Joint Chiefs of Staff. The views expressed in this article are those of the author and do not necessarily reflect the official policy or position of the Air Force, the Department of Defense, or the US government.

Notes:

[1] ADM Michael G. Mullen, *Joint Force Quarterly,* issue 51, 4th quarter 2008.

[2] Daniel L. Byman and Matthew C. Waxman, *The Dynamics of Coercion: American Foreign Policy and the Limits of Military Might* (Cambridge, UK: Cambridge University Press, 2002), 30.

Dr. Lani Kass (BA, Political Science and Russian Area Studies, Hebrew University of Jerusalem; PhD, The Kaplan School of Economics and Political Science, Hebrew University of Jerusalem and Columbia University's School of International Affairs) is the senior policy advisor to the chairman of the Joint Chiefs of Staff, Pentagon, Washington DC. She serves as the principal advisor on all policy and strategy matters within the office of the chairman of the Joint Chiefs of Staff and maintains contacts throughout the Joint Staff, Office of the Secretary of Defense, the military departments, directors of defense agencies and similar Department of Defense and interagency components. Dr. Kass formulates, develops, and implements the policies, strategies, programs, and goals of the Joint Staff as well as conducts numerous complex, high priority special assignments involving research and fact-finding to develop analyses, position and issue papers, and generate new initiatives based on a variety of strategic subjects of critical importance to the Joint Staff and/or the Joint Force.

Dr. Kass served as a professor of military strategy and operations at the National War College, National Defense University prior to taking on the role of director of the Cyberspace Task Force, Pentagon, Washington DC. Prior to assuming her current position, she was the special assistant to the chief of staff of the Air Force and senior mentor to the chiefs CHECKMATE. Among her many awards, Dr. Kass has been awarded the Secretary of Defense Meritorious Civilian Service Award, Chairman's Joint Civilian Meritorious Service Award, Secretary of the Air Force Exceptional Civilian Service Award and the United States Navy Meritorious Civilian Service Award.

Safeguarding the Nuclear Enterprise: Building and Maintaining Expertise in AFGSC[1]

Lt Col Andrew S. Kovich
Commander, 90th Maintenance Operations Squadron
F. E. Warren AFB, Wyoming

In response to the B-52 nuclear incident of August 2007, other missteps within the nuclear enterprise, and the resulting inquiries, Air Force Space Command (AFSPC) has embarked on a journey to better develop and sustain its nuclear expertise. Undoubtedly Air Force Global Strike Command (AFGSC) will carry on this endeavor. This article will discuss key aspects of that effort and provide recommendations for action. The ideas presented here are not necessarily the author's alone. However, the commentary and recommendations represent the opinion of the author and may not represent consensus or approval by AFSPC or AFGSC leaders. The purpose of this article is to provide leadership with courses of action for nuclear officer development. Further, my goal for this effort is to chart a course to develop intercontinental ballistic missile (ICBM) officers with the objectives of establishing optimum experience levels and identifying broadening opportunities within the nuclear enterprise. Specifically, the article will focus on career tracking, nuclear munitions/ICBM maintenance opportunities, the ICBM weapons school, and a way ahead for implementation. In order to effectively accomplish the intent of this article, two important points need to be made up front with regard to the definitions/perceptions of officer "broadening" and "stove piping."

Redefining Career Broadening/Changing Stovepipe Perception

Vital to improving the nuclear expertise is the need for a more comprehensive view of career broadening and a revised outlook on the values of a "stove-piped" career field. First, the US Air Force must change its definition of broadening with regard to the ICBM mission. Broadening is not simply moving from ICBM duty to space operations duty and vice versa. An officer has successfully broadened if they have experiences in different areas and at different levels with the primary goal being an overall expertise in a particular area (i.e., ICBM/nuclear enterprise). Within the nuclear enterprise, there are many duties into which our officers can broaden. Second, officers who have only served in the ICBM business should not necessarily be considered as "stove-piped." For example, an officer with a mix of experiences in ICBM operations, maintenance, policy, nuclear command and control (NC2), acquisition, testing, or planning is well rounded but also has depth in the nuclear enterprise. We must ensure nuclear depth of experience is not considered "stove-piping." Again, the intent of developing and sustaining nuclear expertise must be the primary focus.[2] As such, there needs to be a deliberate plan for those officers who will become the leaders in the nuclear enterprise.

Most of what needs to be done to better the nuclear enterprise is within reach today. The nuclear career path is well established with all the traditional billets still in play.[3] The way forward is to increase emphasis on the traditional career path while adding a couple enhancements. Those enhancements are: (1) to formalize broadening into maintenance with the intent of moving officers back and forth between operations and maintenance over their entire career (versus going to maintenance and never returning to operations).[4] Additionally, the inclusion of nuclear munitions maintenance could expand nuclear experiences/leadership opportunities as well as base choices. (2) Creating weapons officers with the goal of improving ICBM operations. These items will be discussed further in this article and recommendations will be made to implement solutions to the expertise challenge. An important first step to accomplishing this goal is to effectively identify and track the expertise needed by AFGSC.

Tracking Nuclear Expertise

AFGSC must develop a sufficient pool of officers with a breadth and depth of experience in ICBM/nuclear related assignments. In order to accomplish this, career broadening opportunities must provide diverse ICBM/nuclear experiences with the goal of creating experts. The ICBM community does not have enough senior leaders with the depth of experience to be effective advocates for the ICBM/nuclear community. Further, the current ICBM operations squadron commanders and operations officers experience levels show that our leaders average only eight to nine years of ICBM experience.[5] Many of these officers only have four to six years experience with most of that occurring at the lieutenant or captain level.[6] This lack of experience is not the fault of the officers themselves. These officers are what AFSPC built them to be—generalists. As a result, it is extremely important that AFGSC establish a development program to ensure the US Air Force has the right level of nuclear expertise. To complement this program, a more detailed system for tracking experience is needed. The Air Force Personnel Center and AFGSC should add fields to the ICBM/nuclear expertise tracking process in order to better track nuclear experiences. Just tracking a nuclear shredout does not effectively track whether the right skill sets in our field grade officers (O-4s, O-5s and O-6s) exist. Similarly, AFGSC and the US Air Force also need a solid mechanism for tracking the nuclear expertise of ICBM/nuclear maintenance and security forces personnel.

> ***Recommendation:*** The nuclear shredout in a personnel tracking program should be expanded to include: operations, maintenance, acquisition/sustainment, munitions, security, planning,

requirements, NC2, Test (Air Force Operational Test and Evaluation Center/Top Hand), weapons school, and strategy/policy experience codes to better track our nuclear expertise.

Recommendation: Establish ICBM officer experience/development areas with the following criteria for tracking purposes: *Initial Operational Experiences* include ICBM crew, ICBM maintenance/nuclear munitions officer, security forces, and space crew (related to strategic mission). *Operational Staff Experiences* include US Strategic Command (USSTRATCOM) duty in the Air Room (strike planning), GOC (NC2), or at 20 AF where officers are intimately involved with emergency war order (EWO) procedures, Stan/Eval, codes, joint plan interim change process. The Depot/System program office (Depot/SPO) (sustainment), 576th Flight Test Squadron (test), and 392nd/532nd Training Squadrons (Air Education and Training Command) could possibly be included here as well. Finally, *Headquarters Staff Experiences* include USSTRATCOM J5 (strategy/plans/policy—J51), J38 (guidance), and J8 (requirements), AFSPC/A3N (guidance), A3T (stan/eval and training guidance), A5M (requirements), A4M (sustainment), and A8 (money). Similar Air Staff, Joint Staff, Department of Education, Air Force Nuclear Weapons Center (AFNWC), or Office of the Secretary of Defense functions would also be included here. In this construct, it will still be acceptable to broaden off the nuclear path and then come back. However, we must ensure we have officers with experience at each ICBM/nuclear level (or maybe two of three areas). Time (i.e., 10 years in ICBMs to command) is not the requirement; experiences are what are important.[7]

Recommendation: Security forces personnel with nuclear experience need to be tracked as part of a similar mechanism. No formal crossflow/broadening is needed. Our ICBM experienced security forces members need to continue performing nuclear security or broaden and then return to the nuclear enterprise.

Nuclear Munitions/ICBM Maintenance Separate from Conventional/Aircraft Maintenance[8]

The ICBM maintenance community tends to have leaders with more total ICBM experience than ICBM operations but lacks a solid foundation in nuclear sustainment. The average number of years of maintenance experience for ICBM maintenance officer leadership at the squadron commander, operations officer, or chief of quality assurance positions is problematic and averages around five years. The ICBM maintenance community simply does not produce enough officers to fill leadership billets although officers with primary expertise in nuclear sustainment and maintenance are still needed.

Recommendation: AFGSC, in conjunction with AFNWC, should oversee both the ICBM operations and ICBM/nuclear munitions maintenance for the US Air Force. The munitions and missile maintenance officer (21M) community should split between conventional and nuclear. 21Ms on the conventional side should become 21As (aircraft maintenance). The nuclear side should move under the control of AFGSC/AFNWC. The nuclear munitions and ICBM mnx officers (21Ms) should be the nuclear/ICBM sustainment arm for the Air Force. These officers could also broaden into ICBM operations. Further, to ensure we have the right number of ICBM mnx and nuclear muns officers, ICBM operators should broaden into missile and nuclear munitions maintenance since sufficient numbers of 21M officers cannot be sustained or assessed.[9]

Recommendation: The ICBM maintenance community has short and long term manning issues to address. In the short term, there is an immediate need for senior ICBM officers to bridge the leadership gap until experienced 21Ms can be created from the ICBM maintenance/nuclear munitions community *and* from operations crossflows over the long term. With this in mind, AFGSC should consider using senior ICBM officers selected in the operations squadron command process but who have not been matched to an operations squadron. This move would benefit maintenance groups (MXG) as well as the ICBM business as a whole. First, it puts a lieutenant colonel into vacant maintenance operations officer (MOO) positions. Second, it allows these officers to gain valuable maintenance experience over the next two years. Whether these officers go back to operations or stay in maintenance, the ICBM mission wins. Third, these officers will remain competitive for operations squadron command selection *and* would now be eligible for maintenance squadron command. For example, an officer who was selected by the operations command board in 2008 but not matched would then be able to perform two years in maintenance as an operations officer. The officer would not meet another operations command board until 2009 for a squadron commander opportunity in 2010. Additionally, the officer could also meet a 21M squadron commander board after two years in maintenance. As a result, the officer has the opportunity to command in either operations or maintenance beginning in 2010.

Recommendation: The following is a rank structure breakout for ICBM maintenance officers: First assignment lieutenants and crossflowed junior captains rotate through different maintenance sections during their first assignment. Junior flight commanders (captain [O-3] billets—facilities flight, training flight, munitions flight) should be on second assignment and have five to nine years experience; senior flight commanders (major [O-4] billets—mnx operations flight, resources flight, generation flight) should have 10-13 years experience and be an O-4(S) or O-4 (equivalent to missile control flight [OSB], current operations flight [OSO], weapons and tactics flight [OSK] in operations group [OG]); quality assurance (QA) chiefs/MOOs should have two of three experience/development areas, be 13-16 year O-4, lieutenant colonels (O-5[S]) or O-5; squadron commanders should be an O-5, have two to three years mnx experience minimum, and have 2 of 3 experience/development areas.

ICBM Weapons School

In 2005, 20 AF Emergency War Order Plans and Procedures (A3NK) began writing an ICBM tactics, techniques, and procedures (TTP) in conjunction with AFSPC A3 Nuclear Operations Branch and the ICBM Strike Team at USSTRATCOM. The intent of the TTP is to allow "new personnel to immediately gain access to generations' worth of expertise."[10] The ICBM TTP differs from most USAF three-series TTP volumes (such as tactical employment of the F-16) in that it provides more strategic level information. "The nature of the ICBM business dictates this volume to be more educational than employable at the crew level because tactics are applied at the combatant command (COCOM) level."[11] However, the volume does contain many techniques designed to better employ the weapon system.[12]

The most recent initiative carried out by 20 AF was to send ICBM officers to the Space Tactics Instructor Course at the US Air Force Weapons School at Nellis AFB, Nevada. The objective of this initiative is to return fully trained weapons officers

to the ICBM community.[13] These weapons officers will use their expertise in critical thinking, instructor skills, and understanding of the USAF flying culture of open, honest, and direct feedback in crew training to facilitate the education of the ICBM force. Additionally, weapons officers will provide operations expertise to initiate improvements. One such improvement would be the implementation of the debrief process by 20 AF crews. The debrief process is a technique used by air crews to critically think through actions and identify root causes of mistakes made in operations in order to make improvements to TTPs. Additionally, US Air Force Weapons School graduates will be charged with integrating different aspects of the ICBM community. For example, the weapons officer could implement ICBM familiarization programs at the unit level to ensure operations, maintenance and security forces personnel have a complete understanding of the nuclear business as a whole. In total, the 20 AF weapons officer initiative will provide a cadre of operations experts focused on the ICBM mission.[14]

The creation of an ICBM weapons school is an important aspect in the development of AFGSC nuclear expertise. Not only will an ICBM weapon instructor course (WIC) produce ICBM experts from a USAF "accredited" school, these officers have the opportunity to improve missile operations. Unfortunately, community buy-in for the ICBM weapons school and weapons officers may be a challenge. Very little socialization of this idea has occurred below the group commander level and in the wider ICBM community. Further, since there are currently no weapons officers at the operational ICBM units, they are an unproven commodity. Additionally, the fact that many of the duties today's EWO sections perform are extremely similar to Air Force weapons and tactics program requirements is not understood. Finally, the need/use of the TTP is not well understood or misunderstood by operational units and therefore the TTP is not being used.

Recommendation: The weapons and tactics brief given by 20 AF/A3NK and AFSPC Weapons and Tactics Branch to operations group commanders in 2006 needs to be updated and delivered to wing, group and squadron commanders preferably at a 20 AF commander's call by officers who already possess credibility in the ICBM community.[15]

Recommendation: Begin ICBM weapon school at F. E. Warren AFB, Wyoming or Vandenberg AFB, California modeled after the bomber community—weapon system specific training occurs at Barksdale AFB, Louisiana and Whiteman AFB, Missouri and broader weapon system integration training occurs at Nellis AFB, Nevada. Further, the ICBM weapons school should not be a part of the Space WIC as they have distinctly different mission areas.

Recommendation: To enhance community buy-in, the WIC squadron commander does not necessarily need to be a weapons officer. Recommend a highly experienced ICBM officer as the commander with a weapons officer as the director of operations. If the ICBM WIC does remain a part of the Space WIC, the initial ICBM cadre will need to be senior O-3s/junior O-4s with extensive ICBM/nuclear expertise. Not junior captains recently graduated from WIC.[16]

Recommendation: AFGSC should consider a combined operations and maintenance weapon school consisting of curriculum from ICBM WIC and the Advanced Munitions Maintenance Officer School nuclear munitions and ICBM maintenance lesson plans.

Way Ahead—Implementation

AFGSC's desired end state should be the development of a sufficient pool of officers with broad nuclear experience to serve in key leadership positions. The ideal squadron commander must have at least two of three experience levels (initial, operational staff, headquarter staff) covered. With that said, there has been much talk about how AFSPC/AFGSC will determine who should be on the nuclear track and who needs to move to fill space operations billets (although separate space and nuclear officer accession needs to be explored). If an officer leaves his initial crew tour and goes to an ICBM/nuclear job, then he is on the ICBM/nuclear track. The numbers of officers needed to fill these nuclear billets is a known—they are the traditional billets that reside at the schoolhouse, Top Hand and 20 AF as well as the post-crew jobs at the wings.[17] The only billets that are new to the ICBM business are weapons officers and those involved with maintenance/munitions broadening.

What are the requirements for experience? What do you have to do to be a nuclear squadron commander? Using the approach of education, training and experience to determine the best officers for the need, the following paragraphs will highlight the requirements of the nuclear career path.[18] Education needed for the ICBM/nuclear officers should include: AFNWC Nuclear Management Fundamentals Course, Sandia Weapon Familiarization Course, ICBM WIC, ICBM Center of Excellence (ICE) courses, Maintenance Officer Intermediate course, Advanced Munitions course, the Defense Nuclear Weapons School courses, and the National Security Space Institute's (NSSI's) ICBM Advanced Course.[19] Of these, the best opportunity for a comprehensive nuclear education for AFSPC officers will come from the AFNWC Nuclear Management Fundamentals Course and the NSSI ICBM Advanced Course.

The AFNWC's Nuclear Management Fundamentals Course will be essential to the education of our AFGSC ICBM/nuclear personnel. The AFNWC was tasked by the Air Force Nuclear General Officer Steering Group to create a management-level course and the pilot version went through validation in May of 2008. The target audience for this course is personnel working on the Air Staff, Joint Staff, major command and COCOM staffs, numbered air force staffs, and at field units in the grade of O-4/master sergeant (E-7) or above who hold nuclear operations, logistics or support positions. The purpose of the course is to enhance awareness of the Air Force nuclear mission and to educate airmen to be able to effectively articulate Air Force nuclear weapons policies, practices, positions, and to be able to effectively discharge their nuclear related responsibilities. The specific objectives of the course are to "provide a broad overview of the nuclear weapons enterprise and create a standard frame of reference across the Air Force within which to explore our nuclear mission, capabilities, and issues."[20] Specifically, the course will cover the Air Force nuclear surety program and

"describe/discuss the Air Force nuclear mission, force structure, policies and challenges."[21] Additionally, the course will "explore the relationships between the Department of Defense, US Air Force, and Department of Energy within the nuclear weapons complex."[22] In all, the AFNWC effort provides a broad overview for senior leaders. It will be the responsibility of specific organizations (AFGSC and US Air Forces in Europe) to execute their own courses that will add more detail relevant to their specific mission areas. Following the broad treatment of the nuclear enterprise at the AFNWC course, the NSSI offers the best potential for an in-depth ICBM education.

The 20 AF Advanced ICBM course was instituted in 2006 with the goal of educating every officer in all unit OSKs on ICBM planning and tactics skill sets not typically learned until the senior O-3/junior O-4 timeframe by personnel assigned to USSTRATCOM. Over the past two years, attendees from ICBM security forces and maintenance were included in the course to facilitate integration of all facets of the nuclear business. As the ICBM TTP stated, "20 AF has the opportunity to teach officers valuable information in the first six years of their career that took their superiors 15-plus years to experience firsthand."[23] The Advanced ICBM Course capitalizes on this opportunity and serves as both an ICBM familiarization and an introduction to nuclear policy, planning, and tactics.[24] The last 20 AF course held at Offutt AFB, Nebraska attended by operations, security, and maintenance personnel proved highly successful.

In 2008, 20 AF transferred the ICBM course to the NSSI and much of the ICBM detail present in the 20 AF version is still intact. The intent of the NSSI assuming responsibility for the Advanced ICBM Course from 20 AF is to harness the necessary resources to execute the course. The original target audience for the course focused on unit personnel in key positions (instructor, evaluator, EWO, codes, maintenance) in order to expose them to the larger ICBM business. However, senior personnel could certainly benefit from the original course as well. The NSSI has produced a course that eliminates some of the detail from the original 20 AF version but still provides a comprehensive look at the ICBM mission. One drawback to the "beta" version held in May 2008 was the focus on senior leader education. Personnel of all ranks can benefit from the course and tactical level detail is needed by the AFGSC ICBM community as a whole. The NSSI version as recently executed contains some information already being taught by the AFNWC but also contains comprehensive lessons on most aspects of the ICBM business.[25] Moreover, the course presents the opportunity to focus on both senior leaders (E-7/O-4 and above) and junior personnel (E-6/O-3) as an ICBM/nuclear refresher or a primer. For this reason, it is important that the course continue to teach subjects from the strategic to tactical levels of the nuclear enterprise. Further, assuming senior leaders should focus on strategy/policy and already understand the operational portions (such as maintenance, security, planning, EWO revision, tactics) of the ICBM business is a false assumption. One only needs to look at the average operational ICBM experience levels of our current squadron commanders to realize that more in-depth ICBM/nuclear education at all levels is needed. As a result, the operational focus in the NSSI course should continue and perhaps deepen to achieve knowledge requirements for our nuclear leaders.[26]

> ***Recommendation:*** AFSPC will need to determine how to transfer the NSSI course to an AFGSC entity. Additionally, funding for the ICBM Advanced Course should be transferred as well. An expanded 20 AF/ICE might be the proper organization to conduct this course. Bottom-line: this course and its resources should not be lost during the transition from AFSPC to AFGSC.
>
> ***Recommendation:*** AFGSC should require all officers going to nuclear command assignments (to include operations, maintenance, security, support personnel) to attend AFNWC and NSSI (until relieved) course *before* assuming command. This would be similar to the nuclear refresher pipeline done by nuclear officers in the Navy.
>
> ***Recommendation:*** The NSSI (until relieved) should continue to deliver the course on no less than a quarterly basis. Additionally, technical blocks of instruction on ICBM propulsion, guidance, and re-entry systems should be included in future courses. To ensure these skill sets are effectively presented to the ICBM community, NSSI (or its successor) needs to execute a plan to bring system experts in to help teach the concepts.
>
> ***Recommendation:*** Ensure the correct officers (ones with recent USSTRATCOM and/or AFSPC/A3N experience; crew time is not enough) are placed at the NSSI (or its successor) to teach the ICBM Advanced Course.
>
> ***Recommendation:*** The AFNWC's course is a senior leader course. The ICBM Advanced Course should be a venue where junior ICBM officers can learn the big picture and senior officers get a refresher and discuss current issues. By not allowing junior personnel to attend the advanced course, a valuable education and retention opportunity is lost.

At the unit level, education must also occur. Twentieth Air Force must develop programs to build the next generations of ICBM/nuclear leaders.[27] Unit Familiarization Programs should be implemented that target operations group unit qualifying training students, officers upgrading to crew commander, security personnel, and maintenance personnel. Such programs not only provide familiarization, they also provide opportunity to reinforce logistics/mnx, security, and operational issues while encouraging crosstalk. Furthermore, an additional duty-Strategic Air Command-like program is needed by which operators can learn maintenance or security skills on their off days.[28] This program increases officer knowledge but also could generate interest in broadening. Further, such a program provides a pool of personnel to select from if more officer crossflow is needed. With regard to training, our nuclear experts will continue to have Minuteman III Initial Qualifying Training, Maintenance Officer Fundamentals Course, Missile Maintenance Officer Course, and the Nuclear Munitions Officer Course available to them. Once educated and trained, the final piece of nuclear officer development is job experience.

Operational experience is needed to grow the officers the US

Air Force needs in the future. Criteria for squadron commander could be: three years of experience at the operational level (maintenance officer or crew member); operations officer experience; and experience in two of three levels with preference given to those with experience in all three (time should not be a requirement).[29] To help establish solid experience, we need to be able to keep ICBM officers at their first assignment (missile units) for at least six years. During this time officers will have the opportunity to gain diverse experiences. For example, four years on crew followed by two in EWO, codes, or maintenance. Within that time, instructor or evaluator opportunities are also available. A second example could be three years in maintenance followed by three in operations.

Credibility will be the most important aspect of the development program. Officers must gain credibility in operations by holding positions such as instructor, evaluator, competitor, senior crew, EWO instructor/planner, or codes controller. Officers who will command in maintenance or munitions must also be credible by serving a minimum of two years maintenance experience (three or more preferred) and holding key positions (i.e., showing progression). In this way, AFGSC will be able to create officers competitive for *any* nuclear squadron. The key to progression/competitiveness is for officers to flow back and forth between nuclear disciplines.[30]

> ***Recommendation:*** AFGSC needs to establish comparable positions in operations and maintenance. For example, junior majors should be assigned to OSK, OSO, OSB, maintenance operations flight, generation flight, munitions flight, or resources flight. Junior to mid-level captains should hold positions such as: munitions accountable systems officer, electro-mechanical team section OIC, missile maintenance team section OIC, team training section OIC, vehicles and equipment section OIC, weapons and tactics flight training section, weapons and tactics flight plans section, missile control flight training section, or smaller flights such as training flight and facilities flight. Senior O-4s/O-5s should be assigned as operations officers, and QA or operations group standardization/evaluation chiefs.
>
> ***Recommendation:*** Establish the number of operations moves to maintenance per year in 2009. Additionally, establish the number of new 21M accessions to maintenance per year starting in 2010.
>
> ***Recommendation:*** AFGSC needs to ensure officers have the opportunity to stay in the nuclear business with no career penalties. Development Teams and squadron command boards need to modify their views from a space or missile focus to one that embraces space expertise and ICBM/nuclear expertise. Further, leadership needs to avoid rhetoric that gives the perception of diminished importance to AFGSC mission areas. A consistent message from senior leaders concerning the nuclear career path must occur. Another challenge will be to get our 13S commanders, who grew up under the old paradigm, to push their top folks to the ICBM/nuclear path.
>
> ***Recommendation:*** AFGSC commander/vice commander and 20 AF commander need to go on a road show to garner support for the ICBM/nuclear expert career paths. The young ICBM officer corps is the target audience and has not yet been convinced to stay on a nuclear track. Additionally, the current 13S leadership (who was not socialized this way for the most part) will need to be convinced that their strong officers are not being led down a dead-end career path. We have all heard "if you're not in space, you're not in the race" too many times.
>
> ***Recommendation:*** Creating a separate nuclear career field should not be discounted. There may come a time when the good of the space/cyber community and the good of the nuclear community will be at odds. As a minimum, the 13S career field functional authority should not reside in either AFSPC or AFGSC. Further, a better 13S allocation system should be developed to the same level of detail as pilot allocation. On the ICBM maintenance/nuclear munitions front, the nuclear career fields must be separate from the conventional ones.

Conclusion

The Air Force must take immediate action on personnel development to be good stewards of the nuclear enterprise. Current experience levels aside, the number of years in the nuclear business does not necessarily equate to expertise and/or superior officership/command ability. Rather, AFGSC should deliberately develop officers who are not only experts in the nuclear business but who also possess superior command/leadership ability. Twentieth Air Force currently has some very strong commanders who simply lack experiences that would make them even more valuable to the nuclear enterprise.

With the ICBM operations, maintenance, and nuclear munitions functions tracked by AFGSC, there are 30 plus nuclear squadrons available to include munitions, munitions support, maintenance, and operations (more if you count ICBM acquisition units). This provides an increased command opportunity for those officers who have sufficiently broadened into nuclear billets. Further, these nuclear command billets will give officers the opportunities necessary to make them competitive for general officer rank. However, our focus should be on producing *experts* in the nuclear enterprise and not be trying to manage a corporate Air Force process. In other words, we should not be distracted with trying to build officers above the O-5 level. Rather, AFGSC needs officers at the squadron commander level to be experts in the ICBM/nuclear business. Group commanders and above can become generalists as needed.

With this in mind, AFGSC must change the focus of how it selects officers for leadership positions. This is not to say that our current ICBM officers at the squadron level or higher are not outstanding leaders. AFSPC simply has not provided the experiences to our superior officers that will help them lead the nuclear enterprise into the future. However, AFGSC will have the mechanisms to remedy this problem today. As a start, strategic communication from the highest levels of AFGSC is needed. The Blue Ribbon review underscores this requirement when it recommended the USAF "develop a sufficient pool of officers with broad experience in ICBMs to serve in key missile leadership positions, including squadron, group, and wing command."[31] To accomplish this, senior officers must convey a new intent to promotion boards, squadron command boards and development teams. That intent should be that future ICBM/nuclear squadron commanders and operations officers should have robust expertise. Officers at the group and wing

commander level can begin to focus more on being generalists. To place experienced officers in all squadron leadership positions will take time. If we begin now, it will most likely take 10 years to get the expertise levels correct. The time to improve the nuclear enterprise is at hand. Implementing the recommendations in this article will put AFGSC and the US Air Force on the right path for success.

Notes:

[1] This article is the result of ongoing dialogue within the ICBM community and the ideas presented by 20 AF, AFSPC/A3, and AFSPC/A4 on the subject of nuclear officer development.

[2] AFSPC should also think about its experience levels on the space side of the equation. Developing experts in particular areas rather than generalist will be essential to future success.

[3] It is the traditional path to Code 39 folks to stay at the wing in codes, EWO or mnx; 392d/532d; Top Hand; 20 AF.

[4] The 20 AF/CC recently wrote a letter to AFSPC advocating this initiative and AFSPC is acting on it. However, the 21M community is resistant to significant numbers of operations and maintenance crossflows.

[5] The space operations community faces a similar challenge of growing the right level of expertise. This challenge should not distract the command from addressing the vital issue of nuclear expertise.

[6] The latest Vigilant Eagle board had six matches in 20 AF. Only two of the six have extensive (more than 10 years) ICBM experience.

[7] There are a fair amount of career broadening options at DTRA, DoE/NNSA, NWC, and OSD/Nuclear Matters, a problem is the perception of these jobs, but they do offer a bigger picture view and add to Nuclear Expertise weather you are a 21M or 13S.

[8] Andrew Kovich, "Sustaining Nuclear Expertise in AFSPC: A Way Ahead for ICBM Maintenance and Operations," *High Frontier* 4, no. 1 (November 2007): 48.

[9] See AFSPC/A4 13N career field proposal.

[10] AFTTP 3-1.ICBM Tactical Employment Minuteman III, 19 March 2007, 1-1.

[11] Ibid.

[12] Andrew Kovich, "20th Air Force: Developing 21st Century Strike Planners," *High Frontier* 3, no. 4 (August 2007): 53.

[13] See 20 AF Weapons Officer Manning Plan

[14] Andrew Kovich, "20th Air Force," 54.

[15] The brief delivered by 20 AF/A3NK and AFSPC/A3TW in 2006 needs to be updated and redelivered. This brief defined the requirements of a weapons and tactics program, the role of weapons officers and discussed the processes already in place in the ICBM business that easily fits the definition of W & T program.

[16] Current WIC initiatives are being conducted without necessary expertise in place at Nellis. Students currently going through WIC to become ICBM weapons officers are developing their own curriculum to be taught to future classes. I believe these junior officers should be augmented by seasoned ICBM experts.

[17] Traditional jobs include: codes controller, EWO instructor/planner, maintenance officer, 20 AF evaluator, Top Hand test conductor, 532d/392d instructor.

[18] Each career path (space control, missile warning, etc.) could have "experts" and should. The Air Force lost space experts out of the merger just like we lost nuclear ones.

[19] 61/62/63s have a great list of required courses for career progression, a 13S/21M should have taken five to six nuclear specialty courses by the time they are a squadron DO/CC.

[20] Taken from AFNWC course introduction slides.

[21] Ibid.

[22] Ibid.

[23] AFTTP 3-1.ICBM, 1-1.

[24] The April 2007 course at Offutt consisted of four days of instruction. The familiarization portion included: USSTRATCOM, AFSPC, and 20 AF mission briefs and a history of the Minuteman III weapons system brief. Additionally, briefs on helicopter and security support were given. USSTRATCOM tours were also included as part of the familiarization. The tours included: the Airborne Command Post, Global Operations Center, and the Air Room. Finally, blocks of instruction were presented on nuclear weapons effects, ICBM employment tactics, the ICBM strike planning process, and nuclear policy.

[25] The pilot version of the Nuclear Weapon Center's nuclear management course is a senior leader course. "The purpose of the Air Force Nuclear Management Fundamentals Course is to enhance awareness of the Air Force nuclear mission … This course is aimed at Air Force officers, senior enlisted, and equivalent civilian personnel (O4 and above, E-7/8/9, GS 13 and above), at the Air Staff, Joint Staff, MAJCOMs, COCOMs, intermediate headquarters, and field units with nuclear operations, maintenance, logistics, or acquisition responsibilities within the nuclear enterprise."

[26] For example, there are operators who don't understand security forces, mnx, NC2, or strike planning and leaders who don't know what the Force Commit, JSCP-N, or NUWEP documents are/do. Additionally, there is a need for officers to understand EWO revision implementation, EAP build, security forces, maintenance, Air Room tactics, and strike planning processes.

[27] 20 AF/A3's T7 initiative is a good idea but it lacks proper coordination with the maintenance and security communities.

[28] Additional duty-Strategic Air Command was an additional duty program that allowed crew members to learn another AFSC in their off time. Depending on the AFSC, the program was a set amount of time, there was a set training program that paralleled the requirements of an officer with the primary AFSC, there was a requirement for the training schedule to be set in advance before entering the program, and a weekly meeting with a designated POC for the applicant.

[29] Experience: codes, EWO, test, instructor, evaluator, flight/cc, generation flight, mnx operations flight, resources flight, MASO, EMT/MMT, requirements, strategy/policy, strike planning, NC2, operations officer.

[30] A separate squadron commander board will be needed for the ICBM/nuclear enterprise for the 30 or so squadrons AFSPC will have once nuclear munitions, ICBM mnx, and ICBM operations are combined.

[31] USAF Blue Ribbon review, 110.

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Adding the Conventional Strike Missile to the US's Deterrence Toolkit

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"We live in a world in which traditional nation-states and alliances are asymmetrically challenged by adversaries who are unconstrained by geographic boundaries … these adversaries are pursuing the means for sudden and catastrophic strikes using weapons of mass destruction (WMD) armed ballistic missiles, or with little or no warning using WMD delivered by irregular means. The capability we lack is the means to deliver prompt, precise, conventional effects at intercontinental ranges." ~ General James Cartwright, then commander, US Strategic Command (USSTRATCOM)

An al-Qaeda terrorist cell in Iran has recently acquired a WMD and intelligence reports indicate this cell plans to employ the weapon at a crucial US command and control node and center of gravity, within the next three hours. Iran has fielded and flight-tested a new short-range ballistic missile (SRBM) that can easily reach the node with minimal indication and warning. The terrorist cell has stolen a missile-erector-launcher (MEL) with an SRBM loaded and ready for launch. Intelligence efforts have geo-located the site of the training camp where the MEL is in garrison and the coordinates have been confirmed. Time is of the essence, the US must act now!

As long as the US is engaged in the Global War on Terrorism, which it will be for the near future, we must be prepared to deal with this type of scenario because it gives terrorists the ability to attack US interests on non-US soil. A number of countries with regional ambitions do not welcome the US role as a stabilizing power in their regions and have not accepted it passively. Because of their ambitions, they want to place restraints on the US capability to project power or influence into their regions. They see the acquisition of missile and WMD technology as a way of doing so.[1]

With the collapse of the Soviet Union, the rise of international terrorism, and the availability of WMD, the situations in which the US may be required to defend our national interests have changed drastically. A variety of Congressional Research Service (CRS) reports have identified a number of scenarios like the one previously mentioned that require rapid response and precise targeting on a global scale.[2]

CRS Report RS21057, Missile Defense, Arms Control, and Deterrence: A New Strategic Framework, 31 October 2001, states "the challenge is to deter multiple potential adversaries not only from using existing weapons but also dissuade them from developing new capabilities in the first place. These potential adversaries include nations such as China and a number of other states such as North Korea and Iran for whom terror and blackmail are a way of life. These nations might threaten US allies and interests, US forces advancing US interests, and US territory in an effort to blackmail the US to retreat from its interests around the world." It is crucial to understand an adversary's mindset as terror and blackmail could be a means to carry out their deterrence strategy.

The future will continue to be dynamic and complex, with greater emphasis placed on non-traditional struggles, environments, and adversaries. The spectrum of projected threats to national security includes enduring and emerging nuclear challenges, proliferation of WMD and delivery systems, large conventional forces, and non-traditional threats and adversaries.[3] According to G. Peter Nanos, former director of the Los Alamos National Laboratory, there are two reasons why a country would want to acquire WMD. The first reason is to counter an overwhelming conventional threat and the second is they want to be perceived as a bad actor on the international scene. The US must be postured to counter and defeat these future challenges.

Dr. Lewis Dunn, senior vice president with Science Application International Corporation and a former assistant director of the US Arms Control and Disarmament Agency, stated in a peer review titled, "Cooperative Security Management—Exploring a Concept" that there are three strategic challenges in terms of containing the threats of chemical, biological, radiological, and nuclear terrorism. First, the US must continue to strengthen global habits of cooperation across a spectrum of responses. The second challenge is building up national control capabilities. The third deals with reducing terrorist cell's motivation behind acquiring and ultimately using WMD.

The March 2006 National Security Strategy stated the Department of Defense (DoD) is transforming itself to better balance its capabilities across four categories of challenges: (1) traditional challenges posed by states employing conventional armies, navies, and air forces in well-established forms of military competition, (2) irregular challenges from state and non-state actors employing methods such as terrorism and insurgency to counter our traditional military advantages, (3) catastrophic challenges involving the acquisition, possession, and use of WMD by state and non-state actors, and (4) disruptive challenges from state and non-state actors who employ technologies and capabilities … in new ways to counter military advantages the US currently enjoys. For the purpose of this article, the irregular challenges described in number two above are synonymous with irregular warfare.

The 2006 Quadrennial Defense Review defines irregular

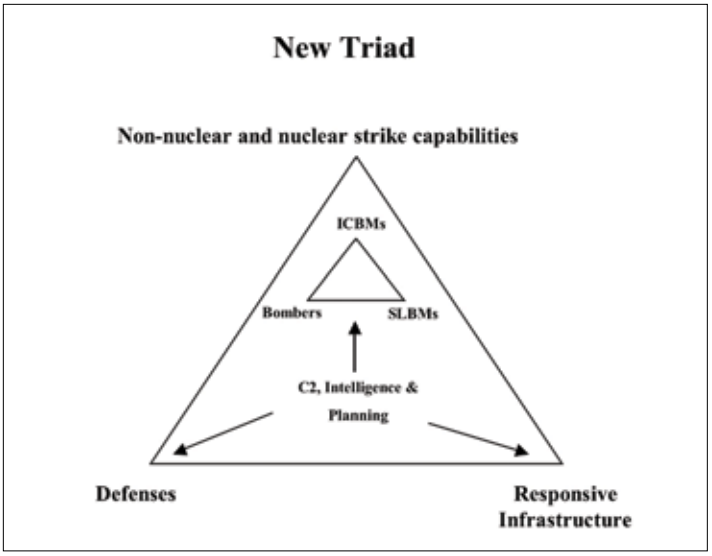

Figure 1. The New Triad.

warfare as conflicts in which enemy combatants are not regular military forces of nation states. When the US has no forward-based military presence or when faced with robust enemy air defenses, we must turn to an unconventional use of conventional capabilities to deter and defeat irregular warfare challenges.

The Nuclear Posture Review (NPR) of 2001 put in motion a major role of nuclear forces in our deterrent strategy. The NPR emphasized the need for a broader range of deterrent options and capabilities and established a new triad composed of offensive strike systems (nuclear, non-nuclear, and non-kinetic); defenses (both active and passive); and a revitalized defense structure—all supported by adaptive planning, command and control, and intelligence, surveillance, and reconnaissance capabilities (reference figure 1). The new triad intends to reduce our dependence on nuclear weapons and improve our ability to deter attack in the face of proliferating WMD.[4]

The NPR called for the integration of precision conventional weapons with strategic nuclear forces in the offensive strike systems. Ballistic and non-ballistic missiles armed with conventional warheads are one possible option for a new type of precision conventional weapon. In addition, the Pentagon identified a new mission—Prompt Global Strike (PGS).[5]

The purpose of this article is to articulate to key decision-makers the need to develop a new PGS capability that would keep Airmen out of harms way should deterrence ever fail. The US needs a weapon capable of rapidly engaging a high-value target in a timely manner.

The PGS and deterrence section sets the framework for this article by defining PGS and examining PGS as it relates to deterrence. Deterrence has worked for the US due to our abundant nuclear stockpile, but with the dwindling number of nuclear weapons and recent asymmetric attacks, the US needs a new capability soon.

The article then examines three technical considerations associated with the US Air Force Conventional Strike Missile (CSM). The CSM will be a key addition to the PGS and deterrence toolkit. While some reports suggest this capability should be ready by 2015, a top priority should be accelerating this capability to meet the challenges that the US may face in the coming years.

Next, political considerations associated with PGS and the CSM, to include the strategic dialogue that must take place with Russia and China and the selection of a viable warhead option to make the CSM successful, are discussed. The article concludes by providing additional recommendations requiring consideration in the near future.

Prompt Global Strike and Deterrence

"We maintain our strength in order to deter and defend against aggression—to preserve freedom and peace."

~ President Ronald Reagan

PGS is a concept that provides national leadership and combatant commanders the ability to respond to emerging threats promptly before an enemy can inflict grievous harm to US national interests. The concept envisions shortening the "time-to-effect" window from days/hours to hours/minutes and can consist of a range of response options to include kinetic and non-kinetic options. Currently, PGS is largely limited to nuclear-armed ballistic missiles while an operational capability gap exists to produce prompt, global conventional kinetic and non-kinetic effects. To distinguish between nuclear and conventional capabilities, the term Conventional PGS (CPGS) is used to describe the various conventional munition delivery systems being proposed by the DoD Services and Industry. CPGS includes cruise missiles, ballistic, and non-ballistic systems. The CSM missile is one option for filling this capability gap and, when operational, would provide a capability to strike anywhere on the globe.[6] The CPGS mission provides:

Improved responsiveness to hold targets at risk on timelines consistent with commander's intent and national security objectives.

- Improved employment flexibility against preplanned and emergent targets and rapid retargeting and execution through integration of real-time intelligence updates.
- Improved reliability and accuracy to deliver appropriate weapons to meet planned mission effectiveness criteria as required by combatant commanders while minimizing collateral effects.
- Linkage to highly accurate, complete, timely, and usable intelligence, surveillance, and reconnaissance support.
- Survivability to operate effectively in the defense environment projected to exist during the system's operational life.
- Robustness necessary to satisfy competing global mission requirements in a multi-theater environment.[7]

CPGS provides the capability to strike globally, precisely, and rapidly with effects against high-payoff, time-sensitive targets: (1) in a single or multi-theater environment, (2) when US and allied forces have no permanent military presence or only limited infrastructure in a region, (3) regardless of anti-access threats.[8] The goal of anti-access threats, which include advanced air defenses and surface attack capabilities, is to threaten or discourage US intervention, disrupt coalitions, or make

it more difficult for coalition forces to operate from desired locations.[9] Adversary Integrated Air Defense Systems (IADS) and ship-based air defense systems include legacy systems, incorporating more capable surface-to-air missile systems such as the SA-10, SA-12, SA-20, S-400, and SAN-6. Additionally, IADS may include the deployment of advanced anti-aircraft artillery systems and man portable air defense systems, such as the SA-16, SA-18, SA-24, and HQ-9. Determined adversaries may incorporate a sophisticated command and control network to coordinate their efforts and may employ a vast array of countermeasures.[10] These systems inherently put lives at risk in a combat environment. Adversaries are increasingly reluctant to oppose US military force-on-force and are seeking new asymmetric ways to counter American strengths, particularly air and space power.

CPGS will provide conventional kinetic and non-kinetic global strike capabilities to achieve national or combatant commander objectives. CPGS contributes to Joint Force efforts to achieve: (1) freedom to operate (gain and maintain operational access), (2) significant reductions in enemy's will or capabilities, and (3) conditions favorable for decisive follow-on operations.[11] This article will only focus on the kinetic effects associated with CPGS.

The problem is the US has no true CPGS capability. B-1s, B-2s, and B-52s have the ability to deliver conventional weapons at intercontinental ranges with several limiting factors. Depending on the situation, long-range bomber flight times usually preclude prompt effects on target sets without timely pre-positioning, require in-flight refueling, are subject to foreign nation overflight approval requirements or routing over international airspace, and may be vulnerable to enemy air defenses.[12]

The US can use nuclear delivery options in a prompt, global role but intercontinental ballistic missiles (ICBMs) and sea-launched ballistic missiles (SLBMs) are not currently equipped with conventional warheads. An interim solution considers 24 of the US Navy's Trident II D-5 SLBMs being modified to carry conventional warheads, known as the Conventional Trident Modification (CTM). Congress, however, has raised concerns about whether a CTM launch could be misinterpreted as the launch of a nuclear weapon.[13] The development of a new land-based, non-ballistic missile with a conventional warhead is needed to address future deterrence challenges and irregular warfare. Though typically associated with nuclear weapons, such missiles are merely a means to deliver a payload. They can deliver a several thousand-pound payload over a long range in a matter of minutes.[14] This new capability could be used to hold multiple targets at risk, in more than one theater, simultaneously, and prove a useful deterrent to dissuade an adversary's hostile intentions.

Deterrence, whether diplomatic, economic, or military, has always been regarded as the first US course of action. Deterrence operations convince adversaries not to take actions that threaten US vital interests by means of decisive influence over their decision-making. Decisive influence is achieved by credibly threatening to deny benefits and/or impose costs, while encouraging restraint by convincing the actor that restraint will result in an acceptable outcome.[15]

Throughout the Cold War, the US relied on ballistic missiles armed with nuclear weapons as the primary source of deterrence. Since the end of the Cold War, until recently there had been a marked decline in the level and intensity of focus on the nuclear enterprise and the nuclear mission. Beginning with the implementation of the Strategic Arms Reduction Treaty agreement and accelerated by the end of the Cold War, the DoD has focused on reducing nuclear forces and nuclear weapons.

In 2002, President George W. Bush and Russian President Vladimir V. Putin signed the Moscow Treaty, which will reduce the number of our operationally deployed strategic nuclear warheads to a level between 1,700 and 2,200 by 2012. In 2004, President Bush issued a directive to cut the entire US nuclear stockpile, both deployed and reserve warheads, in half by 2012. This goal was accelerated and achieved five years ahead of schedule in 2007. As of the end of 2007, the total stockpile was almost 50 percent below what it was in 2001, when President Bush took office.[16]

On 18 December 2007, the White House announced the president's decision to reduce the nuclear weapons stockpile by another 15 percent by 2012. This means the US nuclear stockpile will be less than one-quarter its size at the end of the Cold War—the smallest stockpile in more than 50 years.[17] This may or may not provide a credible nuclear deterrent against nation states.

The attacks on 11 September 2001 proved that something had to change in terms of dealing with non-state actors. However, adversaries with ballistic missiles that are able to strike US interests or allies, especially those pursuing chemical, biological, and nuclear programs, view ballistic missiles as their source of deterrence. Ballistic missiles provide a cost-effective delivery system for both conventional and non-conventional weapons. For those seeking to thwart the projection of US power, the capability to combine ballistic missiles with WMD provides a strategic counter to US conventional and information-based military superiority. With such weapons, these nations can pose a serious threat to the US, to its forward-based forces and staging areas, and to US friends and allies.[18]

General Kevin P. Chilton, in an article titled "Strategic Deterrence in the Post Cold War/911 Era," for the Air Force Space Command (AFSPC) *High Frontier Journal* states, "The capability to strike targets with PGS or deliver timely non-kinetic effects will be dependent on our ability to operate inside the adversary's decision cycle. The importance of effective intelligence, command and control, and agile planning systems are further magnified as decision cycles become more compressed." General Chilton goes on to say, "Many adversaries we face will not be deterred by the threat of a tardy response on our part regardless of the speed of our weapons. They must know that we possess the capability to strike them at any time, at any place, and with whatever degree of force our national leaders choose. Combined with the will to use such force, we present the opportunity to deter future adversaries just as successfully as we deterred nuclear aggression and major attacks over the last half century."[19]

The evolving strategic environment requires new approaches to deterrence and defense. CPGS gives national leadership and combatant commanders the capability to respond to emerging threats promptly before an enemy can inflict grievous harm to US national interests. Our deterrence strategy no longer rests primarily on the grim premise of inflicting devastating nuclear consequences on potential foes. Both offensive and defensive systems are necessary to deter state and non-state actors, through denial of the objectives of their attacks and, if necessary, responding with overwhelming force.[20]

Deterrence, where feasible, may not depend solely on an adversary's fear of a nuclear response. Even if an adversary fears a nuclear response, the threat of such a response to the adversary's aggression may not be sufficiently credible to deter adversaries in all potential WMD-related scenarios. Reliance on offensive nuclear weapons alone for deterrence is no longer sufficient.[21] Therefore, the US must look to alternate options, using conventional capabilities, to continue the success of deterrence. Our future deterrence success will be a function of how well we bring all of our capabilities and resources to bear to achieve commensurate and decisive influence over an adversary's decision-making process.[22]

Technical Considerations Associated with the Conventional Strike Missile

The US has deployed long-range, ballistic missiles in its strategic offensive nuclear forces for more than 40 years. Recently, Congress has been considering various CPGS proposals that utilize conventional warheads on nuclear legacy, long-range ballistic missiles, as well as, non-nuclear endoatmospheric (within the atmosphere as opposed to exoatmospheric meaning used in space) hyperglide delivery vehicles to mitigate treaty and overflight concerns. This would provide the US the ability to strike promptly anywhere in the world, regardless of the presence of overseas bases or nearby naval forces.[23]

The Air Force and Navy have both studied the possible deployment of conventional warheads on their long-range ballistic missiles. The Navy sought funding, in fiscal year (FY) 2003 and FY 2004, for research into a reentry vehicle that would be able to maneuver when approaching its target. The FY 2007 Defense Budget requested $127 million to pursue the deployment of conventional warheads on Trident missiles, but the 109th Congress rejected most of this request; the FY 2008 budget requested $162.4 million.[24] Congress approved $100 million to be applied across the military services for CPGS technologies with an emphasis on the Air Force CSM and Army Advanced Hypersonic (Mach 5 or five times the speed of sound) Weapon.

The Air Force is pursuing, with the Defense Advanced Research Projects Agency (DARPA), research into a number of technologies that might enhance the US long-range strike capability. In particular, the Air Force is looking at developing a payload delivery vehicle (PDV) derived from DARPA flight tests of a hyperglide vehicle (HGV), previously known as the common aero vehicle, that can carry existing conventional munitions on modified Minuteman, Peacekeeper, or future missiles, or used to deploy newly developed "purpose-built" conventional warheads.

The CSM is proposed as a land-based, surface attack, space traversing weapon system capable of delivering conventional payloads at near-global ranges providing effects on target within minutes to hours of launch.[25] Basing this new weapon system in the continental US (CONUS), with one on the west coast and one on the east coast, would distinguish the CSM from nuclear ICBMs. Current US ICBM bases; Malmstrom AFB, Montana, Minot AFB, North Dakota, and F. E. Warren AFB, Wyoming are well known and understood by our adversaries. A CONUS-based conventional capability is easier to distinguish from a SLBM that could carry either a conventional or a nuclear warhead. CONUS basing of the CSM also provides access to on-going treaty inspection agreements. This future capability would enable rapid target engagement and the ability to conduct deep attack operations in an environment that prevents access by traditional means.[26]

Three Issues

The Air Force needs to examine many issues when choosing to fund and develop a CSM that meets the needs of CPGS. There are however three issues of vital importance. First, what booster and delivery vehicle is required to deliver the warhead and its "kill mechanism" at the required accuracies? Second, how can collateral damage, which directly relates the missile's guidance system and warhead lethal radius, be minimized when delivering a kill mechanism at speeds up to or exceeding 15,000 mph or Mach 23 (23 times the speed of sound)? Lastly, what warhead and kill mechanism is required to meet commander's intent or achieve the desired effect?

Booster and Delivery Vehicle

With the deactivation of the 400th Missile Squadron (MS) at F. E. Warren AFB and the deactivation of the 564 MS at Malmstrom AFB, there are a number of boosters that are readily available to carry a newly developed CPGS warhead. The Peacekeeper-class of boosters and the Minuteman-class of boosters are two options. From a strictly operational perspective, a Minuteman-class booster offers more flexibility in basing due to its smaller size, while the Peacekeeper-class booster's throw weight advantage provides roughly three times the payload as well a significant range advantage.[27]

The PDV, is envisioned as being capable of transporting its payload on a suborbital, non-ballistic trajectory at hypersonic speeds and delivering and/or dispensing that payload into the atmosphere at the target. The basic vehicle technology is now a part of Force Application and Launch from Continental United States, which is a joint project between the Air Force and the DARPA. The DARPA HGV Program will demonstrate a maneuvering aerobody that can fit into the desired PDV that allows the system to course-correct for maximum accuracy and delivers its kill mechanism at various speeds.

Guidance and Collateral Damage

In terms of accuracy, the guidance system developed for the

CSM could be global positioning system-aided (GPS). Recent advances in conventional GPS-aided capabilities have demonstrated that these weapons are extremely accurate. The CSM would have to leverage these advances to minimize collateral damage, the unintended damage to civilian life or property during a military operation. Some conventional weapon accuracies are at the sub-meter level but they are never going to be perfect until Target Location Error (TLE), the difference between the actual location of the target and the expected location, is minimized. Understanding and predicting TLE is particularly crucial to autonomous weapons development to minimize collateral damage. The total overall accuracy associated with any conventional weapons is a statistical combination of TLE, GPS signal-in-space error, and weapon guidance errors. Another viable solution could use laser ring gyros as the primary guidance system with GPS coordinate updates.

Warhead and Kill Mechanism

Three warheads were being considered for a portion of the $100 million in FY 2008 funding Congress allocated for PGS and critical technology demonstrations. Textron System's BLU-108 Sensor Fuzed submunition, Sandia National Laboratory's (SNL) "Rods from God," and Lawrence Livermore National Laboratory's (LLNL) "Hell Storm" warheads were evaluated as possible PGS warhead solutions.

The BLU-108 represented the utilization of existing conventional munition concepts in PGS. The BLU-108 PGS warhead concept contains 10 submunitions each with four "smart" skeet warheads. The skeet's explosively formed penetrator (EFP) is the kill mechanism of the warhead. The one-pound copper EFP, moving at hypersonic speeds, performs a kinetic energy kill of the target, thus minimizing collateral damage. The CBU-97 Sensor Fuzed Weapon and the AGM-154 Joint Stand-Off Weapon utilize the BLU-108. However, Textron Systems must modify the BLU-108 for placement in a hypersonic delivery system, successfully demonstrating hypersonic dispense while slowing down to transonic speeds (350 - 750 miles per hour or Mach 0.8 to 1.2), and deploying its submunitions.

Both SNL and LLNL have designed a kinetic energy projectile (KEP) warhead that delivers various sized fragments at the intended target. The characteristics of an ideal hypersonic warhead are quite simple: preserve and deposit the maximum warhead kinetic energy onto the target and maximize its lethal area across a target set ranging from hard to soft targets (i.e., a command and control bunker, terrorist training camp, etc.). Both SNL and LLNL have considered these characteristics in the design of their warheads with each having fundamental differences.

SNL originally designed "Rods from God" for the Navy's CTM as a near-term CPGS solution. LLNL designed "Hell Storm" to be scalable and fit multiple delivery and booster systems for the mid- to long-term CPGS solutions. The SNL design is limited to a KEP-only capability while the LLNL design has both a KEP and a penetrator capability combined into a single warhead. LLNL's "Hell Storm" warhead provides greater military utility, because of the KEP/penetrator capability across the defined PGS target set. The LLNL design provides a uniform fragment distribution over a larger target area while depositing more of the available kinetic energy when compared to other KEP designs.

All three warheads required further evaluation. USSTRATCOM awarded a contract to Johns Hopkins University's Applied Physics Laboratory to evaluate design and performance for the BLU-108, the SNL warhead, and the LLNL KEP/penetrator warhead to be utilized in future CPGS systems.

US CPGS weapons will need the ability to strike several categories of targets promptly, throughout the spectrum of conflict. For example, if an adversary deployed air defense or anti-satellite weapons that could disrupt the US ability to sustain an attack, the US might choose to strike promptly at the start of the conflict with CPGS weapons that can penetrate and destroy these defenses. A prompt strike against an adversary's ballistic missiles or caches of WMD might allow the US to destroy these weapons early before an adversary could use them. Some targets could emerge quickly and remain vulnerable for only short periods of time during a conflict. These might include leadership cells that move regularly during a conflict or mobile military systems that the adversary had chosen to keep hidden prior to their use.[28]

The timeframe for fielding a CSM capability is as early as FY 2012. AFSPC has selected the LLNL KEP-only warhead for its future CSM flight test and lethality demonstration in calendar year 2010/2011. Accelerating the development of the CSM warhead will contribute to meeting existing war plans so we can be prepared to deter and defeat future challenges.

Addressing these three issues: booster and delivery vehicle, guidance and collateral damage, and warhead and kill mechanism are crucial. The author believes the kill mechanism is the most important technical issue because the US flight test program has been in existence for nearly 50 years and can adequately certify the booster and delivery vehicle but the kill mechanism is unproven in combat. Another issue that needs further clarification deals with the strategic dialogue that needs to take place with Russia and China regarding overflight/mitigation concerns and treaty implications, or lack thereof.

Political Considerations Associated with the Conventional Strike Missile

In the Bush administration's view, offensive strike weapons with conventional warheads could address some missions now assigned to long-range nuclear forces. While some critics claim this concept would blur the distinction between conventional and nuclear weapons and increase the likelihood of a US use of nuclear weapons, the administration has argued that the availability of precision conventional weapons would, possibly, provide the president with more options in a crisis, and, therefore, reduce the likelihood of the use of nuclear weapons.[29]

Strategic Dialogue with Russia and China

The US must concern themselves with Russia and China in regards to the CSM. There are several reasons for this concern. Russia and China could view this new conventional capability

as destabilizing, providing the US with a superior advantage that neither nation possesses. In addition, depending on the target location, the CSM may overfly either nation and potentially escalate into conflict. Possible Russian or Chinese miscalculation, viewing the launch as a nuclear-armed missile aimed at them, is the most important political concern. Convincing either nation to allow CSM overflight access, and not to react as if the launch has a hostile intention to them, is not going to be easy task, but is not impossible.

There are two uncertainties with Russia and China in the strategic environment. The first uncertainty leads one to think both Russia and China are watching and waiting on the US deployment of missile defenses and the pursuit of advanced conventional capabilities. The second uncertainty indicates China's nuclear modernization is linked directly to advances of US missile defense and advanced conventional capabilities. The US must seek to reduce Russia and China uncertainties about US strategic intentions, which may involve convincing them that the US would never use this new technology against them without a valid reason.[30]

The US must manage emerging strategic interactions with both Russia and China. There are three major challenges in today's US—Russia strategic relationship: (1) reduce mutual uncertainties, (2) broaden habits of cooperation, and (3) in terms of nuclear weapons, avoid arms creeping. The key shaping factor with respect to these challenges is Russian uncertainty about US strategic intentions. Another factor could also be a sense of lost prestige from the former Soviet Union era.

There are also three major challenges in today's US—China strategic relationship: (1) avoid mutual strategic miscalculation, (2) avoid a strategic arms race, and (3) build habits of cooperation. The key shaping factor with China is US—China mutual strategic uncertainty.[31] The key assumption here is that China is willing to cooperate with the US vice compete with the US.

There is no agreed US or international definition of overflight or of the boundary line between controlled national airspace and outerspace. Both US practice and international law acknowledge that unauthorized transit of another country's controlled national airspace would violate that country's sovereignty. However, the line or altitude of demarcation between controlled national airspace and outer space remains undefined and ambiguous.[32] Utilization of an advanced HGV by the CSM may help mitigate overflight concerns.

Treaty Implications

The CSM would have to comply with all applicable treaties in force at the time of deployment. These include those restrictions imposed by Article IV of the Outer Space Treaty, potential applicability of the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms of 31 July 1991 (expires in 2009), and the Intermediate-Range Nuclear Forces Treaty.[33]

There is a current framework for the notification of launches with Russia but not China. The Agreement on Notifications of ICBM and SLBM Launches, signed on 31 May 1988 during the Moscow Summit, reflects the continuing interest of the United States and the Soviet Union in reducing the risk of nuclear war because of misinterpretation, miscalculation, or accident. The agreement provides for notification, no less than 24 hours in advance, of the planned date, launch area, and area of impact for any launch of an ICBM or SLBM. The agreement also provides that these notifications be provided through the nuclear risk reduction centers. The agreement entered into force on the date it was signed.[34] This agreement should be modified to include the CSM, especially if separate basing options were utilized. The agreement would also have to be modified to include the Chinese. The US will have to strengthen strategic relationships with China before this happens.

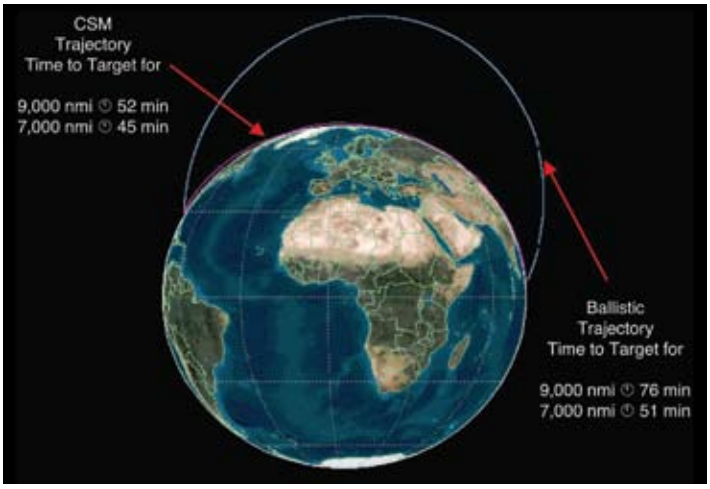

Figure 2. Conventional Strike Missile and Ballistic Trajectory Comparison.

Recommendations

Having identified some key strategic challenges facing the US, the US must develop a toolkit to meet these challenges. The US must put mitigations measures in place to avoid miscalculations. These measures would involve taking an "outside of the container" approach to how the US deals with Russia and, more importantly, China.

There are a wide range of usable measures that could be put in place while not excluding legally binding negotiated treaties, in terms of Russia, that would mitigate overflight concerns. Russia's missile warning and defense systems are degrading. The US could offer Russia assistance to help upgrade these systems in return for allowing CSM overflight.

Another option is to create specific launch profiles for conventional systems. The launch trajectory for the CSM would be distinctly different from a typical ICBM flight path (reference figure 2). ICBM reentry vehicles essentially travel downrange after being lofted to a high altitude by the launch vehicle and then, after release from the reentry bus, follow a relatively steep and well-characterized ballistic flight path to the target. The CSM, on the other hand, relies primarily on its aerodynamic design to achieve range. The CSM launch vehicle will follow a depressed trajectory and insert the payload delivery vehicle at a shallow reentry angle, thereby maximizing the vehicles inherent lift capabilities.[35]

CSM launch options must ensure other nations, particularly Russia and China, can distinguish between a conventional launch and the launch of a nuclear-equipped system through the use of both materiel and non-materiel precautions. Some concepts for accomplishing this include the sharing of flight profile, characterization data, basing, and site inspections.[36]

Combined war gaming and exercises with Russian participation, as well as the future possibility of placement of Russian military officers into newly established CSM launch squadrons or in a liaison role at USSTRATCOM, would break new ground. In the past, the very idea of Russian participation would have been ruled out by the Cold War US—Soviet relationship. Nevertheless, in the past decade, a variety of productive meetings and workshops with non-official Russian participation—including by retired senior Russian military officers—have occurred.[37]

It could prove more difficult than in the case of Russia, to put in redundant notification mechanisms in China. Neither political nor technical precedents exist, for example, as with the US—Russian president-to-president "hot line," the US—Russian risk reduction centers, and for that matter the existing agreement to provide notification of ballistic missile launches.[38]

The US must consider several mitigations measures for dealing with China. First, discussions with Chinese officials at the same time as discussions with Russia could help to avoid surprises and would be consistent with the overall emphasis on increasing US—China political-security cooperation.[39] As US deployments of the CSM take place, the possibility of open visits by Chinese military officials to the basing locations could be considered as a confidence-building measure.[40] The US and China could also take part in a joint study and analysis regarding strategic miscalculation and mitigation efforts. The development of codes of conduct regarding outer space may strengthen US—China political relationships.[41]

While the CSM concept matures, the US must begin the strategic dialogue with Russia and China. With depressed trajectory flight paths and maneuvering, there is the possibility that the CSM will never have to overfly either country but mitigation measures must still be in place to avoid even the slightest miscalculation that either country is under attack.

Regardless of what the future holds in terms of US—Russia and US—China strategic relationships, they must be strengthened and be mutually beneficial rather than beneficial to just the US. Some of the framework is already in place with Russia but the US must take the lessons learned and apply them towards a cooperative relationship with China, assuming China is willing to cooperate and not compete with the US.

Additional Recommendations

Several areas require further examination. Development of a Concept of Operations (CONOPS) for the CSM by USSTRATCOM or Air Force Global Strike Command (AFGSC) should occur first. This involves implementing a new mindset that utilizes a strategic capability in a non-strategic role. A CONOPS for the CTM was approved by General Cartwright on 19 July 2006 while the only document currently approved for CSM is an enabling concept prepared by AFSPC/A3NO on 10 August 2007. If the US plans to use the CSM as the CPGS solution, USSTRATCOM or AFGSC must develop a CONOPS.

In addition to a CONOPS, the US must establish doctrine for CPGS and the CSM. The CPGS doctrine must define timelines and the capabilities to meet these timelines. CPGS doctrine needs to use language that will clearly differentiate it from current global strike doctrine. This will help in establishing specific design requirements as well as in shaping official perceptions—here in the US and in Russia. Informal and formal ways to do so exist, from reliance on studies undertaken in government "think tanks" to exploration of specific concepts by the Air Force.[42]

A culmination of measures would help ensure that Russian and Chinese political and military officials were not surprised by a US launch of a CPGS weapon. CONOPS, procedures, and mechanisms for shared early warning and US notification of launches—through redundant channels, at multiple levels are essential. As Russia's early warning system deteriorates, shared early warning and such notifications would take on an even greater importance. However, particularly in the event of actual use, operational security needs to be the driver of the type of notification, its timing, and the level of detail provided.[43]

Concerning domestic considerations, due to the potential for short notice CSM launch operations, normal range clearance and safety procedures may not be adequate. The Air Force, depending on the basing locations, needs to develop new procedures to allow for rapid airspace and launch area clearance as well as procedures to ensure safety of the civilian populace near the launch base or bases. Autonomous flight termination systems on the booster may be able to meet the personnel safety requirement.[44]

Finally, the LLNL KEP warhead proposed for CSM may be an option for the US Ballistic Missile Defense System (BMDS). The current BMDS utilizes an integrated architecture to counter current and emerging threats. One part of this integrated architecture is a series of weapons that include Ground-based interceptors, Patriot Advanced Capability-3 Interceptors, and Standard Missile-3 Sea-based Interceptors. These interceptors are equipped with warheads that use "hit-to-kill" technology (directly hitting the incoming missile to destroy it). The LLNL KEP warhead can disperse thousands of multiple-sized tungsten fragments uniformly over areas up to six acres with a fragment every four square feet. If an incoming missile impacted one of these fragments, it could be disabled. This concept requires additional research.

Conclusion

The US must be prepared to confront a broad set of strategic challenges today while looking toward the future. US—Russia cooperation would help to deter Iran's attempt to have a nuclear weapon capability and the same could be said with a US—China cooperation in regards to North Korea.[45]

The future of US nuclear deterrence is uncertain. The recent presidential election may have an impact on the future of

the US nuclear weapon stockpile. One thing is certain though; US adversaries will continue to attempt to acquire WMD. A capability gap to deter and respond to these activities currently exists and the CSM can fill this gap. We as a nation understand the issues and requirements that will propel the US into an uncertain future so we must act now and the CSM is a viable solution.

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[26] Ibid.

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[30] Dr. Lewis A. Dunn, "Foreign Perspectives on US Nuclear Posture and Policy," peer review, Lawrence Livermore National Laboratory, Ca., 6 September 2007.

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[33] AFSPC, "Enabling Concept," 17.

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[44] AFSPC, "Enabling Concept,"

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Some of Major Seyer's accomplishments include 1998 Air Force Space Command, Athlete of the Year; 2001 Air Force Space Command, Instructor/Evaluator of the Year, Category II; 2005 328th Weapons Squadron Instructor of the Year; and 2007 328th Weapons Squadron Lance P. Sijan Leadership Award – FGO Category.

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The History of Minuteman – America's Sole Remaining ICBM

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With the deactivation of the Peacekeeper Intercontinental Ballistic Missile (ICBM) in 2005, the Minuteman III (MM III) weapon system remains as America's only land based strategic deterrent. Given this unique role, the MM III weapon system is a national treasure. As with any national treasure, great discipline, determination, and dedication marked its creation and has been the hallmark of evolution into the premier strategic weapon system defending America today.

Over the last half-century, a dynamic set of military and industry leaders oversaw the development, deployment, and continued modernization of the land-based ICBM weapon system. Among these early giants was General Bernard A. Schriever. As commander of the Air Research and Development Command, where he established the Western Development Division, he was tasked to lead the group tasked with designing and fielding America's first ICBM weapon system. He quickly added Dr. Simon Ramo and Dr. Dean Woolridge to the team. The Ramo-Woolridge Corporation (later to be know as TRW) formed the technical nucleus of the systems engineering and technical assistance function and was responsible for the engineering, scientific discipline, and program management skills required defining the development during its infancy. The addition of other industry partners in the development, test, and manufacturing efforts, solidified a revolutionary Air Force and industry collaboration underwriting the unprecedented ICBM mission success story we know today and in turn provided a national deterrent for the rest of the 20th century that will continue well into the 21st century.

After initial success with liquid-fueled Atlas and Titan missiles, the Air Force secured Department of Defense approval in February 1958 for the development of an advanced solid propellant missile known as Project Q. Project Q would eventually become the Minuteman ICBM Program. From its inception, the Minuteman Program was oriented toward mass production of a simple, efficient, and highly survivable ICBM weapon system capable of executing varying types of missions with consistent reliability. Initial Minuteman requirements included a highly reliable, three-stage, solid-propellant missile, capable of remaining on-alert for long periods of time. Specific requirements included capability for underground launch, ability to overcome overpressure from a nuclear blast during launch, and a range of over 5,000 nautical miles.

The traditional practice of sequential development of weapon system elements could not meet the desired operational system dates. Consequently the US Air Force introduced the concept of concurrency in development to meet schedule needs. Under a concurrent program, the interdependent weapons system elements are developed in parallel, each with well-defined interface requirements enabling precisely defined and fabricated components to be combined into an entire weapon system. Use of a single integrator ensuring all interfaces were properly defined and rigidly controlled, proved critical in achieving mission success.

Although concurrent development programs hold the promise of greatly accelerated deployment, they are also susceptible to large schedule slips due to unanticipated subsystem development problems. Schedule risks were minimized by employing a single systems engineering and technical assistance contractor, with multiple associated contractors, each chosen for its specialized expertise. Through a comprehensive risk assessment/management process, where development of specific subsystems was critical or questionable, parallel contracts were executed to competing contractors in order to minimize development risk. Due to the increased programmatic and technical risk associated with a concurrent program, the ICBM development team defined a disciplined test philosophy demonstrating component and subsystem performance at the lowest possible level, insisting that flight testing be performed only after extensive ground testing.

While considering the stringent requirements associated with deploying a system as large and complex as Minuteman, it is inspiring to note that the first launch of Minuteman I (MM I) was achieved in 1961, just three years after design and development go-ahead. Initial operational capability (IOC) occurred in October 1962 during the Cuban missile crisis with the first 10 sorties being declared on-alert. In June 1965, the entire MM I force of 800 missiles was declared fully operational.

The basic characteristics of the Minuteman weapon system have not changed since the first missiles were operationally deployed. However, advances in technology and changes in national policy made it possible to add improvements to the original design.

Minuteman II – A Major Upgrade

In 1962 design and development of Minuteman II (MM II) was initiated, only four years after MM I go-ahead and the same year it reached IOC. Performance improvements associated with MM II included greater range, increased throw weight, multiple target selection, greater penetration capability, and improved accuracy and reliability.

Major new features provided by MM II:

- Improved first-stage motor with increased reliability.
- A single, fixed liquid injection thrust vector control (TVC) nozzle on a larger second-stage motor increased range. Additional motor improvements provided increased reliability.

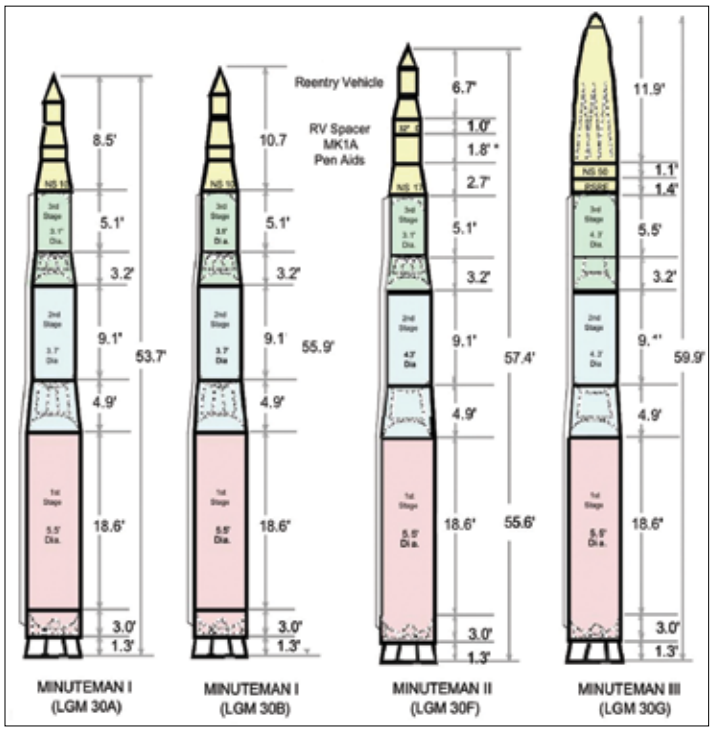

Figure 1. Minuteman Evolution.

- An improved guidance system, incorporating semiconductor integrated circuits, and miniaturized discrete electronic parts increased accuracy and reliability.
- A penetration aids system (chaff) to mask the warhead during its reentry into an enemy environment.
- A larger warhead in the reentry vehicle (RV) to increase probability of kill and damage expectancy.

Within two short years after the start of design and development, MM II embarked on its maiden flight and reached IOC in 1965. In April of 1967, deployment of 200 MMIIs raised the total Minuteman force to 1,000 missiles on-alert. In October 1967, the first MM I wing transitioned to MM II missiles under the Force Modernization Program. By May 1969, with the Force Modernization Program complete, the Minuteman force stood alert with half the force being the new 500 MMIIs.

Minuteman III – Another Major Upgrade

In 1966, four years after the MM II go-ahead and a year after MM II reached IOC, design and development of MM III was initiated. Performance improvements associated with MM III included increased flexibility in RV and penetration aids deployment, increased survivability after a nuclear attack, and increased payload capacity.

Major new features provided by MM III:

- A larger third-stage motor with a liquid injection TVC system on the new third-stage motor (similar to the second-stage MM II nozzle) to increase range.
- A reentry system (RS) capable of deploying up to three independently targeted Reentry Vehicles and chaff.
- A new the Propulsion System Rocket Engine, or PSRE (post-boost propulsion system) to increase range and maneuver the RS. This maneuverability allows the RS to be precisely positioned prior to the deployment of its RVs and penetration aids.
- Improved electronics in the guidance system to provide more computer memory and greater accuracy while reducing guidance system vulnerability to a nuclear environment.

Similar to MM II, MM III embarked on its maiden flight two years after the start of design and development in 1968. The first MM IIIs were fielded in late 1970, at which time the system was declared operational. By July 1975, the Minuteman force stood at 450 MMIIs and 550 MM IIIs on-alert (MM I was deactivated).

Minuteman III Today

The end of the cold war brought many changes to the ICBM world. The MM II weapon system was taken off alert in September 1991 as a cost savings measure. The country anticipated a "peace dividend" due to the end of the Cold War and Presidents George H. W. Bush and Bill Clinton obliged with retiring older weapon systems, which had become more costly to maintain. MM II was completely deactivated by the end of 2005.

The January 2002 Nuclear Posture Review also decided to retire the Peacekeeper ICBM, and by 2005 all 50 Peacekeeper ICBMs which had been deployed in Minuteman silos in 1986 were deactivated leaving only 500 fielded MM IIIs. In 2008, the MM III force structure was further reduced in accordance with the 2005 Quadrennial Defense Review to 450 MM III missiles on-alert when the GTE-Sylvania B-System ground configuration of MM III at Malmstrom AFB, Montana completed deactivation.

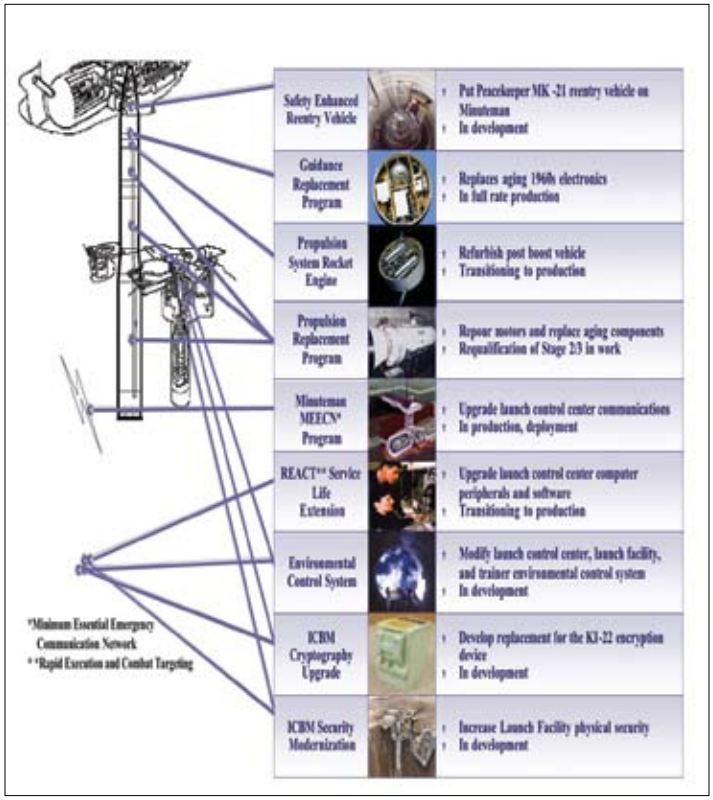

Figure 2. Minuteman Modernization.

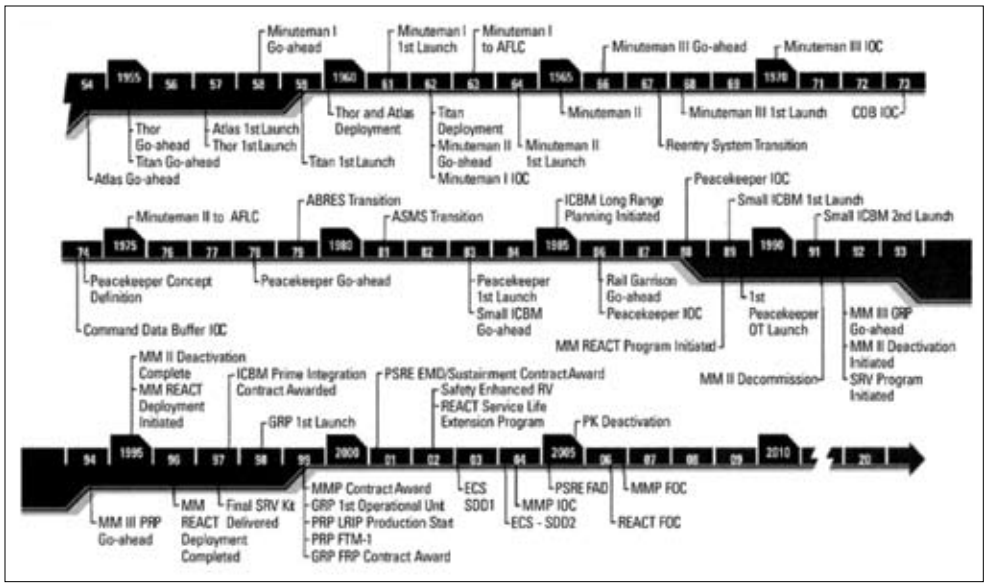

Figure 3. Minuteman Timeline.

Today the 450 MM III ICBM force is undergoing a major modernization effort. In 1998, an ICBM Industrial Prime Contractor Team lead by Northrop Grumman (previously TRW) entered a 15 year partnership with the US Air Force to sustain and modernize the nation's ICBM force. This industry/Air Force partnership is currently performing six major modification programs and over 30 smaller modification programs across the entire weapon system. Three major modification programs have been completed and deployed; one on the communications system (Minuteman Minimum Essential Emergency Communications Network) which was successfully completed in 2005, one on the rapid execution and combat targeting which was successfully completed in 2006, and most recently the Guidance Replacement Program which successfully completed in December 2008. Every major ICBM subsystem on the Minuteman air vehicle, except the RS/RV subsystem, and much of the ground subsystem including communications network and security subsystems will be replaced, upgraded, or refurbished when these modernization efforts are complete in 2012. Although some items may require additional actions, it is anticipated that the current modernization efforts will extend the life of the MM III ICBM force to 2030."

Minuteman's Future

While current modernization efforts will help to provide a reliable weapon system through 2030, the defense community needs to consider our nation's need for a land based strategic deterrent beyond that timeframe. Extending the life of MM III through continuing modernization programs seems feasible as long as the basic capabilities of the system meet the needs of the warfighter. Additionally, sustainment and modification efforts lend directly in retaining an industrial base with the intellectual capital by which ensure viability of the weapon system. Replacing MM III with a follow-on system would require significant investment; however, it may be in the nation's best interest if future needs dictate additional payload, range, or accuracy. The successful track record of current modernization efforts may present the most reasonable and affordable alternative.

The fact that this weapon system has been on-alert since 1970 is a testament to not only the men and women who have operated, maintained, and secured the Minuteman force, but also the Air Force Materiel Command and ICBM industry team who have ensured it remains a credible deterrent force through continuous sustainment and modernization.

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Mr. Meyers leads the industrial team given the responsibility by the Air Force to sustain and modernize the nation's ICBMs. The team was awarded the prime integration contract on 23 December 1997. The ICBM Prime Team is headquartered in Clearfield, Utah, adjacent to Hill AFB, Utah.

Mr. Meyers has over 40 years experience in ICBM operations, logistics, and acquisition. Prior to joining the IPIC, Mr. Meyers held positions with TRW Ballistic Missile Division in Colorado Springs, Colorado as the site manager for SETA support to Air Force Space Command and in Las Vegas, Nevada with TRW Environmental Safety Systems as deputy construction manager for the Yucca Mountain Project in support of the Department of Energy's High Level Nuclear Waste Repository.

Previous to his employment with Northrop Grumman Mission Systems, Mr. Meyers served in the US Air Force, retiring with the rank of colonel. During his final assignment, he was the ICBM system manager and system program director for the Minuteman and Peacekeeper Weapon Systems at Hill AFB.

Prior assignments included staff positions in the deputy chiefs of staff for programs and resources, and logistics and engineering in the Pentagon. In addition, he served in various positions at the squadron and wing level in ICBMs and managed acquisition programs for the Minuteman and Titan II ICBMs.

"No-Man Minuteman" – Pioneering Development of the Solid-Propellant ICBM: An Interview with Col Francis "Joe" Hale

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Through e-mail exchanges in November 2008, Dr. Rick W. Sturdevant interviewed Col Francis J. "Joe" Hale, USAF, retired. After graduating from West Point on D-Day, 6 June 1944, Colonel Hale served with a combat engineer battalion in Europe until mid-1945. He became deputy supervisor of the first military team to assemble atomic weapons at Sandia Base, New Mexico in 1946 and supervisor of the second such team. Transferring to the US Air Force in 1948, Colonel Hale served as a P-51 flight instructor. He reported in January 1956 to Western Development Division (WDD), where he worked with Col Edward N. Hall on the Thor and Minuteman ballistic missile programs. Before he retired from active duty in 1965, Colonel Hale earned master and doctor of science degrees from the Massachusetts Institute of Technology (MIT) and served as chair of the US Air Force Academy's Astronautics Department. He received the Air Force Space and Missile Pioneers Award in 2006.

INTERVIEW

Sturdevant: Thank you, Colonel Hale, for consenting to this interview, which will cover only a portion of your active duty career. Specifically, I would like to discuss your involvement with the Minuteman Intercontinental Ballistic Missile (ICBM) program.

Hale: Let me start with the caveat and disclaimer that these events I am describing occurred 50 years or so ago. Although my answers are based on my recollections and not on notes or documents, I do think that they are fundamentally correct.

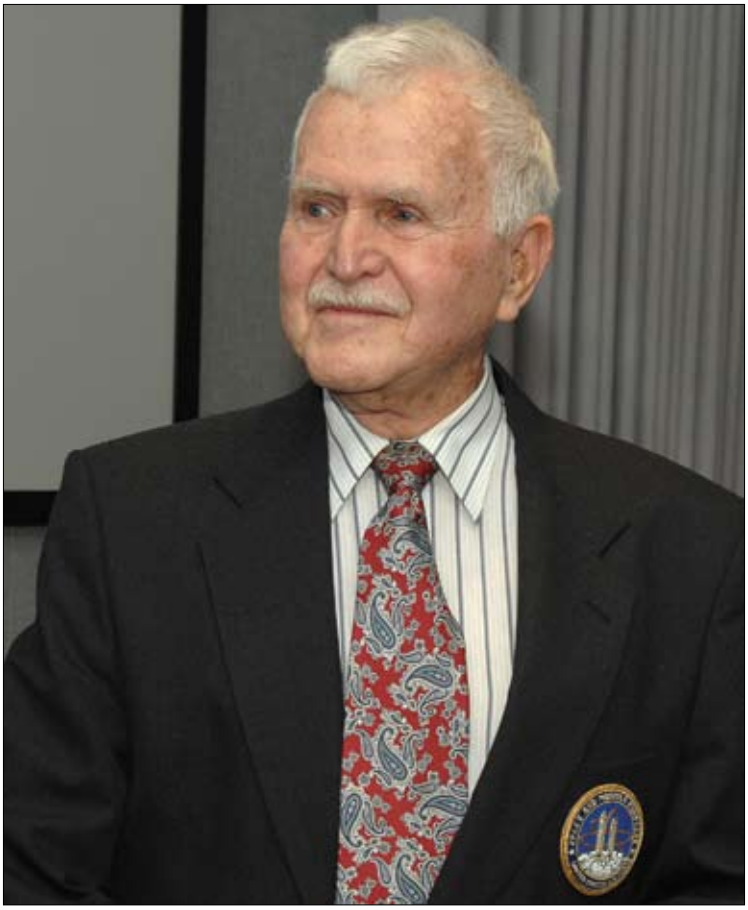

Figure 1. Col Francis "Joe" Hale, USAF, retired, 6 March 2008.

Sturdevant: Sir, when did you first become acquainted with the concept of a solid-propellant ICBM?

Hale: When Ed Hall joined the Thor program as its director, he had an extensive background as a propulsion man, both at Wright-Patterson AFB, Ohio and at WDD where he was the head of the rocket branch. He talked to me, and others, about the potential of solid propellants to respond with shorter response times and to be simpler. Although there were draw backs to liquid propellant motors, they did have the capability to deliver the large weights associated with the warheads available at that time and consequently the three major ballistic missiles were all liquid.

Even though Thor was being developed and built with production money, there was an accompanying amount of research and development money, which was not needed. So Ed Hall decided that he would give the money (I don't know how he did it) to the propulsion people at Wright-Patterson [AFB] to work on the problems associated with using solids, particularly in large missiles. Among the problems were the composition and casting of large motors, increasing the specific impulse, the ignition of the motors and maintenance of uniform burning without burning through the casing, control of the thrust vector, and shut down at the correct time. These were all problems that needed solving if there was to be a solid ICBM. The work went on in the background while Ed was running the Thor program.

Sturdevant: How important was Col Ed Hall to conception and acceptance of the Minuteman development program?

Hale: There would *not* have been a Minuteman program without Ed Hall. He developed the concept, which he originally named No-Man Minuteman, to overcome the disadvantages associated

with liquid propellant missiles then in development, namely cost, complexity, and delayed launch time.

At this time, Ed was no longer on the Thor program. Apparently he and General Bruce Medaris of Redstone Arsenal had an earlier history together; they were not fond of each other and apparently Medaris made his feelings known to General Bernard A. Shriever that Ed was not welcome at Huntsville, Alabama. I recall that was before Ed left the Thor program. I was sent to Alabama to work with the Army and Ed stayed in Los Angeles. I am convinced that Medaris had a lot to do with Ed being removed from Thor (replaced by Richard Jacobsen) and given a made-up job to study the "possibility of using solid upper stages along with liquid stages" and not to develop a solid ICBM system. My theory as to Medaris' or some other outside influence on Ed's removal is supported by the fact that when I went to Colonel [Charles H.] Terhune, [Schriever's deputy], and asked if I might go with Ed, I was told that I was needed on Thor and that there wasn't a significant job with Ed, that I would not be helping my career by going with him.

Figure 2. Col Edward N. Hall, ca. 1956.

However, Ed quickly decided that he was going to exploit the work that had been done to improve the solid rockets and develop a complete weapon system using solid motors.

Sturdevant: What advantages did the Minuteman have over the Atlas or Titan ICBMs?

Hale: The existing ICBM systems and the missiles themselves were complex and expensive with costs compounded by the number of people required to maintain and service them. People were expensive; every position that required 24 hour manning required five people to man it when allowances were made for normal shifts, leave, and sickness. These five people required supervisors and support people to pay, feed, and house them; the support people also needed support people and so on. Ed told me that when he passed the oil refineries in Torrance, California on his way to work each day, he was impressed by the lack of people present in the complex. His objective was to reduce the number of people required, thus the original name, No-Man Minuteman.

Ed also thought of the Minuteman missile as a "wooden missile" with no moving parts that required no maintenance, was cheap, so cheap that reliability was not a prime consideration. After all, our national policy, and rightly so, was to accept the first strike before responding. Thus our missiles were serving as targets for the enemy forces, which meant that the reliability of a destroyed missile was moot. However, there had to be enough functioning missiles remaining to respond. Thus the emphasis was on large numbers of inexpensive missiles with sufficient survivability and reliability to accomplish the mission and to serve as a deterrent. Since multiple missiles were needed to ensure the destruction of one of our silos, the enemy had to build and launch more missiles than there were targets. In fact, at one time Ed toyed with the idea of building empty silos and moving missiles in and out but rejected it as being more complicated and expensive than simply putting a missile in each silo. We joked about not building missiles, only targets.

I also would like to discuss the sizing of the missile. I used to give a talk entitled "The Non-Technical Aspects of the Minuteman Missile Design" that dealt with the details of how the external configuration was accomplished. Keep in mind that one of Ed Hall's major objectives was to keep the number of people associated with the system to a minimum. He wanted to move the missile on roads and highways without escort and without special permits or authorizations, which was not the case with the Atlas and Titan missiles. To do so placed limitations on the weight, diameter, and length of the missile transporter combination. As far as weight was concerned, the maximum allowable weight per axle for most states was 13,000 lbs. Consequently, seven axles, to include those of the tractor vehicle, would allow the missile-transporter to weigh 91,000 lbs. If the diameter of the transporter/missile combination was held to a maximum of 10 feet, warning vehicles fore and/or aft would not be required. Finally, it would be desirable to keep the overall length of the transporter below 100 feet to facilitate turning corners in passing through towns on the way from the assembly areas (manufacturing facilities) to the launch sites. This logic and

The existing ICBM systems and the missiles themselves were complex and expensive with costs compounded by the number of people required to maintain and service them. People were expensive; every position that required 24 hour manning required five people to man it when allowances were made for normal shifts, leave, and sickness.

conclusions were examined in detail and confirmed in a study that was conducted by Beech Aircraft in Wichita, [Kansas], as soon as money became available. I am not sure what we did to handle the movement of the rocket motors, which obviously contained explosives.

Sturdevant: What were your responsibilities as the first plans-and-programs officer for Minuteman ICBM development?

Hale: Prior to the day when Ed Hall tagged along with the other system directors to Washington and the Minuteman was approved by [General] Curtis LeMay and Don Quarles, there was no program nor program office. Once the program was approved, I somehow was transferred to work for Ed as his assistant (deputy); the details are fuzzy and unimportant. There was no deputy at that time; I don't think that there was even a position. Then I was officially designated as his deputy, a position I had become accustomed to.

Sturdevant: How and why did you become deputy program manager for Minuteman?

Hale: Originally, there were, I believe, only two captains working for Ed. After the Minuteman program was approved, we set up a standard organization with two branches (Missiles and Ground Support Equipment) with two lieutenant colonels as branch chiefs, Dick Hemsley and Frank Bagby; I was deputy director and was the junior lieutenant colonel of the three. At a later time before I left the program, Ed was transferred to Paris, [France], to the Mutual Weapons Development Team and Col Otto Glasser was appointed the director of WS-315A [Thor].

Otto was the director of the Atlas program and was not free to drop his program duties at that time and move to the Minuteman program. Otto was Minuteman director in name only and we did not see him for a considerable period of time. (I am not sure but I am under the impression that it was three months.) I called the three lieutenant colonels the "troika," and we ran the program until Otto moved into his office. Although I was the junior lieutenant colonel, with the approval of the other members of the troika and their input I represented the program as director, which is another story.

Figure 3. Full-scale tethered test of Minuteman I ICBM at Edwards AFB, California, 1960.

Sturdevant: I would like to hear that story, if you feel comfortable sharing it.

Hale: My being the junior lieutenant colonel and acting as the director did not bother Dick Hemsley or Frank Bagby as they had enough on their plates, were enjoying their jobs, and had no desire to be the deputy director, which involved another set of problems. It did bother some other people, however, one of Terhune's assistants in particular, a somewhat senior colonel, who was not happy dealing with a junior officer such as me. After all of these years I am still under the impression that he complained to Terhune who apparently told him that since no one else had any problems with me, that he should accept me. The word got around that it was all right for me to represent the program in Glasser's absence. Incidentally, I was impressed by Otto Glasser's acceptance of the situation; he left me completely alone until he could devote full time to Minuteman. During this intervening period I do not recall a single conversation with him, which I think I appreciated even though it might have been nice to have had someone to talk with. However, I did have Dick and Frank; we got together often to bring up and discuss problems.

Figure 4. Minuteman I Launch.

Sturdevant: Can you describe the challenges—for example, financial, technical, managerial—that confronted the Minuteman program and how your team addressed them?

Hale: The first thing that we needed to do was to obtain the support and backing of others. Although the program had been approved in principle, there were still folks with doubts and many details to be worked out. I remember presenting the program to the Weapons System Evaluation Group (WSEG), a group of civilian consultants and advisors to the Department of Defense who had not had the opportunity to be briefed on Minuteman before its approval. I remember them as an interested, obviously competent, group of engineers and scientists who had many questions. I remember two questions in particular. The first had to do with the survivability of the missiles in the silos. I was asked what overpressure could be tolerated and I answered 200 pounds per square inch. (It has been a long time and that may not be the correct answer.) One of the members asked me if we were certain. I said "Of course not. But then the Russians could not be certain either or take the chance that we were wrong." Later in the program, there were instrumented tests of silos lined with square gin bottles to try to determine overpressures.

One other question from WSEG pertained to the warhead

yield since the allowable warhead weight for a solid was less than that for a liquid. I told them that it was estimated to be about 100 kilotons. That caused a bit of a stir since we were talking about 5 megatons for the liquid ICBMs and they thought it was too small. I told them that I had been at Eniwetok in 1958 for the three Sandstone tests as a member of the Blast Measurements Group and was greatly impressed by 20 kilotons and did not think that 100 kilotons was small. In any event, we received the blessing of WSEG.

As for the other challenges, we somehow met them; I don't remember exactly how, but we had no real problems. We had good contractors and good staff, and we met often to anticipate and forestall problems before they could grow out of control. I know that in the system office, we managed Boeing and the major problems and tried to leave the details to the supporting contractors.

Sturdevant: Were you still with the Minuteman program when the first tethered test was conducted in September 1959 and, if so, did you witness the test?

Hale: No, I had left WDD in the summer of 1959 to return to MIT for a doctor of science degree in aeronautics and astronautics. I had been selected to attend the Air War College as a lieutenant colonel but opted out for MIT.

As far as the "tethered" test is concerned, I believe you are talking about the launch of a partially loaded test missile from a silo, designed to burnout shortly after launch and fastened to a chain to prevent it from straying. It was an important test since a "hot" launch from a silo was essential to keeping the Minuteman simple. There were critics who did not think it was possible without escape vents, etcetera, and the diameter of the silo was a major factor in keeping the cost down.

We had some studies that indicated we could live with a silo diameter of less than 24 feet or so but, obviously, the smaller the better. Ed and I sat in his office one day to decide what the original test size should be. If launch was not possible, we would increase the diameter until it was. We needed a starting number. I recall Ed saying "How about doubling the diameter of the first stage?" which was 5.5 feet so that the hole diameter would be 11 feet. I was silent for awhile, a pregnant pause, until Ed asked what the problem was. I replied that I did not object per se but that I did not like odd numbers. Ed confessed that he did not either, so we went with 12 feet as the starting diameter. Over the years I wondered what the tests revealed, but the results were classified and I was at MIT. Then later, I asked someone working on Minuteman III or so, what the silo diameter was. He said "12 feet but I wish the guys who picked that number had gone larger as we have to work hard to stay that small."

Sturdevant: What was the status of the Minuteman ICBM when you left the program?

Hale: I do not remember exactly what the status was other than that the program was on schedule and progressing well.

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Dr. Rick W. Sturdevant (BA, History, University of Northern Iowa; MA, History, University of Northern Iowa; PhD, University of California, Santa Barbara) is deputy command historian, Headquarters Air Force Space Command (HQ AFSPC), Peterson AFB, Colorado. He joined the Air Force History and Museums Program in April 1984 as chief historian, Airlift Information Systems Division, Scott AFB, Illinois, and moved one year later to the Chidlaw Building near downtown Colorado Springs as chief historian, Space Communications Division (SPCD). When SPCD was inactivated in 1991, he moved to the HQ AFSPC history office and became deputy command historian in 1999.

An acknowledged expert in the field of military space history, Dr. Sturdevant appears frequently as a guest lecturer on space history topics and is author or co-author of chapters or essays in *Beyond the Ionosphere: Fifty Years of Satellite Communication* (1997); *Organizing for the Use of Space: Historical Perspectives on a Persistent Issue* (1995); *Golden Legacy, Boundless Future: Essays on the United States Air Force and the Rise of Aerospace Power* (2000); *Air Warfare: An International Encyclopedia* (2002); *To Reach the High Frontier: A History of US Launch Vehicles* (2002); *The Limitless Sky: Air Force Science and Technology Contributions to the Nation* (2004); *Encyclopedia of 20th-Century Technology* (2005); *Societal Impact of Space Flight* (2007); and *Harnessing the Heavens: National Defense through Space* (2008). His articles or book reviews have appeared in such journals as *Space Times*, *Journal of the British Interplanetary Society*, *Air & Space/Smithsonian*, *Quest: The History of Spaceflight Quarterly*, *Air Power History*, *High Frontier: The Journal for Space & Missile Professionals*, and *Journal of the West*. He sits on the editorial board of *Quest* and on the staff of *High Frontier*.

Dr. Sturdevant is an active member of the American Institute of Aeronautics and Astronautics (AIAA), American Astronautical Society (AAS), British Interplanetary Society (BIS), and Society for the History of Technology (SHOT). His professional honors include the Air Force Exemplary Civilian Service Award (1995-1999), the AAS President's Recognition Award (2005), and election as an AAS Fellow (2007).

Ballistic Missile Early Warning System – The British Perspective

Flt Lt David Andrew Smith, RAF
Operations Executive Officer
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Ten years ago, as a newly qualified junior officer, I received my first annual report. Today the only bit of that report I remember is the phrase 'with his degree in astrophysics Smith would be well suited to a tour at Fylingdales.' My first thought on reading this line was 'where on earth is Fylingdales?' Once I had discovered that Royal Air Force (RAF) Fylingdales was on the remote North Yorkshire Moors, my next thought was 'what had I done wrong to deserve such a recommendation?' I then proceeded to wriggle and connive to secure myself a posting somewhere, in fact anywhere, other than Fylingdales. Fast-forward 10 years and I now find myself as the operations executive officer for RAF Fylingdales.

Today, a brand new officer receiving a recommendation to be posted to RAF Fylingdales or the United Kingdom's (UK's) Space Operations Coordination Centre (SpOCC) should, unlike me 10 years ago, be thinking: 'excellent, I can get posted into a challenging job that will expand my horizons far more than many other jobs could.' In particular, the job of the operations executive officer is extremely challenging and you have to be an operator and a staff officer dealing with issues ranging from personnel through to operational test and evaluation, via international and inter-agency liaison.

Things have changed significantly in the last 10 years and, when offered a posting to RAF Fylingdales in 2007, I jumped at the chance. I am sure that most readers of this publication know that RAF Fylingdales is part of the Ballistic Missile Early Warning System (BMEWS). I am also sure that for most readers that is where the familiarity ends.

Figure 1. Spitfire over the Fylingdales Radar.

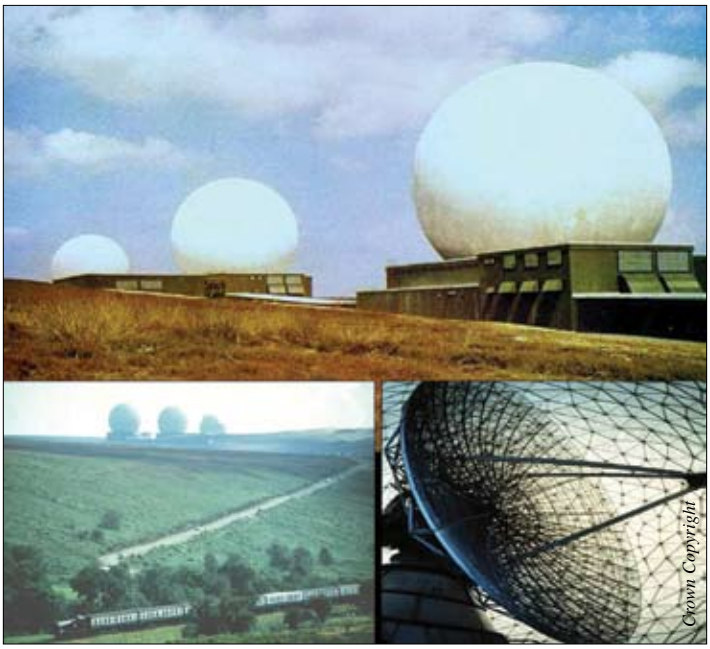

Figure 2. The Original Fylingdales Early Warning Radar.

So where is RAF Fylingdales and what does it do? RAF Fylingdales is located within the North Yorkshire Moors National Park between the towns of Pickering and Whitby. The first missile warning radar was placed on Fylingdales Moor in 1963 as a result of a 1960 Memorandum of Understanding between the UK and the US.

The system operated successfully until it was replaced in 1991 by the AN/FPS-123 (land-based radar) housed within the Solid State Phased Array Radar building. With three faces providing 360-degree coverage, Fylingdales is unique within the BMEWS. The third face was originally required to provide warning of submarine-launched ballistic missiles originating from the North Atlantic.

In September 2007, in accordance with the UK's agreement to support US missile defense activities, the AN/FPS-123 was replaced by the AN/FPS-132 system. Although externally indistinguishable from the AN/FPS-123, the latest radar is a completely new system and a step change from 'the Legacy', as the old system is called by the operations crews. As well as delivering a system that is capable of fulfilling the missile warning and space surveillance missions, the capability to support missile defense was added. Whilst the US paid for the capital costs of the radar equipment, the UK is responsible for its operation and maintenance; the total annual cost to the UK of running RAF Fylingdales is around £20 million per annum.

Another unique aspect of RAF Fylingdales is its dual com-

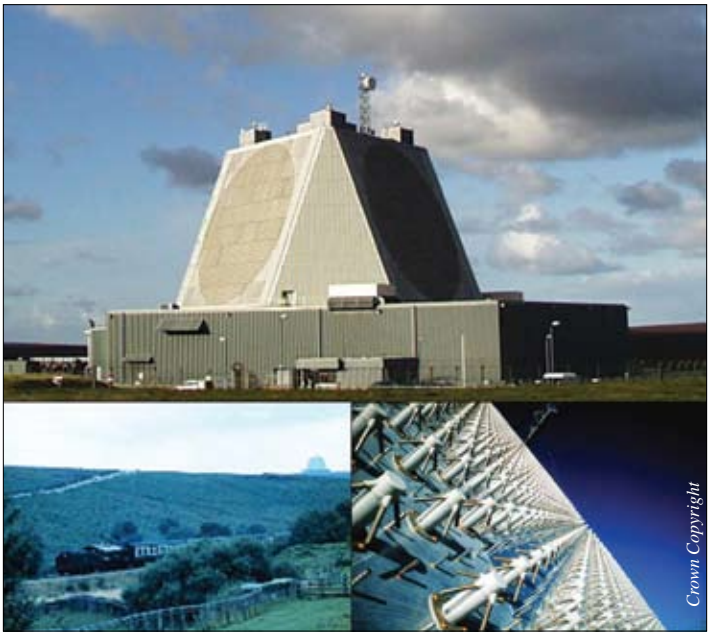

Figure 3. The Solid State Phased Array Building.

mand and control chain. Fylingdales is a RAF station manned and operated by RAF personnel performing both US and UK missions. The US missions are missile warning for the continental US, contributing to the space surveillance network and, when directed, supporting missile defense. The UK missions are missile warning for the UK, space surveillance in support of UK interests, and acting as a fallback facility for the UK SpOCC. At the tactical level, the station reports jointly to both the UK SpOCC and the US Joint Space Operations Centre. Administratively the station is commanded by the RAF's Headquarters Air Command, but for the organise, train, and equip functions the station reports jointly to both RAF's Air Command and the US Air Force's 21st Space Wing. Due to our unique status, both command formations have an equal vote and the radar cannot be released for any activities until both UK and US command and control agencies concur.

This joint command structure creates many opportunities for the exchange of best practice and there are regular meetings between the various UK and US command and operational staffs. However, there is an issue of scale: Air Force Space Command (AFSPC) is approximately 40,000 personnel strong, which is roughly the size of the entire RAF. As a result, the RAF broadly tends to adopt US space doctrine unless there is an overwhelming need to address a UK-specific national requirement. This is actually extremely positive because UK and US personnel can easily relate to each other doctrinally and, in practice, we have an excellent two-way flow of ideas.

In order to simultaneously support all of the UK and US missions, a RAF Fylingdales operations crew consists of five personnel, supported by two military communications personnel, a civilian space track analyst and five civilian engineering staff. The operations crew consist of a crew commander, a crew chief, a console supervisor, a missile warning console operator (MWCO) and a space surveillance console operator (SSCO). In a missile warning scenario, the MWCO will pass data to the US using voice communications, the SSCO will do the same to the UK SpOCC and both operators will be supervised by the console supervisor. The crew commander is responsible for site report declarations, system management, and overall crew management. The crew chief acts as the crew commander's deputy and is also responsible for the management of all communications and, when required, producing satellite warning outputs.

One of the greatest strengths of the station is the invaluable support provided by the civilian staff many of whom have years of BMEWS experience. In particular, the SERCO space track analysts are an invaluable resource and provide the UK with the capability to conduct our own analysis. The individuals are extremely knowledgeable and, in most cases, have decades of experience.

The RAF does not have a specialist space career field to fulfil these roles and officers at RAF Fylingdales are predominately drawn from the aerospace battle management career field; enlisted personnel are drawn from the aerospace operator career field. The RAF is diversifying the personnel who can be posted to Fylingdales and an air traffic control officer recently qualified as a crew commander. Due to their diverse backgrounds, personnel posted to Fylingdales undergo a 10-week training course; this is the equivalent to initial qualification training, unit qualification training, and re-qualification training under the US system. Upon successful completion of the course, personnel are declared combat ready and join one of the five operational crews.

Figure 4. The Legacy Operations Room.

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One of the biggest space issues for the RAF is recognising, training, and nurturing space-aware personnel and recently there has been significant movement towards developing a space cadre. This space cadre is unlikely to become a separate career field, rather it will be a group of specialists from disparate fields who could be called upon to meet the unique requirements of space operations.

Figure 5. The Upgraded Operations Room.

To conduct the training, Fylingdales has a training section filled by formally qualified instructors and is more akin to the schoolhouse at Vandenberg AFB, California than the kind of training section which would be found at a USAF-manned BMEWS site. The training staff also administers and monitors crew continuation training. The station also has its own dedicated evaluation staff who, in the interests of impartiality, belong to support squadron rather than operations squadron. As personnel at Fylingdales belong to the RAF, we have our own training and evaluation procedure to follow. Whilst the style and rationale of the training may differ from that provided within the US, the required output standard has been agreed by both the UK and the US, and is reviewed and monitored by both parties on a regular basis.

One of the biggest space issues for the RAF is recognising, training, and nurturing space-aware personnel and recently there has been significant movement towards developing a space cadre. This space cadre is unlikely to become a separate career field, rather it will be a group of specialists from disparate fields who could be called upon to meet the unique requirements of space operations. The RAF's aspiration would be for a career manager, when looking to fill a particular post, to be able to search a database to identify suitable candidates. At present, this is not something that can be accomplished when looking to fill space-related posts.

As part of our drive to improve the visibility and operational experience of the RAF's space professionals, the previously-mentioned SpOCC was recently established. The SpOCC was created by re-brigading the UK Missile Warning Centre at RAF High Wycombe together with the Space Information Office that was formerly based at Fylingdales. The new organization is based in a newly refurbished facility at RAF High Wycombe and is now the single RAF point of contact for operational space issues. The SpOCC can provide data on space weather, global positioning system predictions, space surveillance data, and other intelligence information. Functionally, the aspiration is for the SpOCC to fulfil many of the same roles as the Joint Space Operations Center (JSPOC); however, the total strength of the SpOCC is only 15 officers and Airmen at present, so a great deal of expectation management has been required. Currently, the SpOCC is working hard to solidify its customer base and is beginning to establish connections with the JSPOC.

To return to my first annual report, I would have to say that it was correct and that I am well suited to a tour at Fylingdales. I have found that, rather than the dull, dead-end posting that I dreaded 10 years ago, I have worked in an extremely busy and challenging environment. In fact, Fylingdales is an extremely popular posting and for some positions there is even a waiting list. To summarize, the RAF has an extremely professional cadre of space professionals who are well trained and motivated, and deliver outstanding results. Put another way, we may be much smaller than AFSPC, but we are perfectly formed!

Flt Lt David Andrew Smith, RAF (BSc[Hons], Physics with Astrophysics, University of Kent at Canterbury, PGDip, Communications Systems Engineering, University of Kent at Canterbury, MSc, Aerospace Systems Engineering, Kingston University) is currently the operations executive officer at Royal Air Force Fylingdales. He is the deputy commander for operations squadron and is responsible for the day to day operational output of the unit and the effective management of the operational crews.

After commissioning into the Royal Air Force as an aerospace battle management officer in 1997, he held a succession of operational air defence posts including a tour as an combat ready instructor. Following successful completion of the Aerosystems Course at RAF Cranwell, Flight Lieutenant Smith served as a trials officer with the Air Warfare Centre. Prior to taking up his current post, he was air warfare instructor with the Air Warfare Centre at RAF Cranwell conducting both undergraduate and postgraduate instruction. He was the specialist instructor in space operations and lectured on space situational awareness, defensive counter space, and offensive counter space subjects.

Reader's Rebuttal

Space Assurance for the 21st Century

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This article responds to various articles presented in the November 2008 issue of *High Frontier* that address analytical frameworks for delivering space protection or assurance. It argues for a new strategic framework—that the foundations of assuring national space capabilities should be based on four pillars: global engagement, awareness, deterrence and defense, and responsive infrastructure.

Four Pillars of Space Assurance

The complete mix of civil, military, and national and multinational commercial space capabilities are important enablers for successful 21st century militaries, economies, information transfer, diplomatic communication and collaboration. Given their importance, capabilities presented by US and friendly space systems must be protected so they can continue for the short and long term. Protecting space systems must also involve more than just deterring, defending against and defeating adversaries seeking to neutralize, disable, or destroy them; we must encourage the global space community to operate in a manner conducive to safe space operations by all members. This strategy must also be flexible enough to address orbital debris issues and other matters such as spectrum management, safe spacelift, and deorbit operations.

In crafting a new strategy to protect US and friendly space capabilities, one should distill the various deterrence, protection, and assurance frameworks that have been presented in recent years to their essential elements.

In 2006, General Kevin P. Chilton, then commander of Air Force Space Command, posited a "new triad" for *strategic deterrence* consisting "of offensive capabilities, defensive capabilities, and a responsive defense infrastructure, all enabled by persistent global command and control, intelligence and planning systems …"[1] Later, as commander, United States Strategic Command, the general stated the foundations for this new triad arose out of the 2001 Nuclear Posture Review. In other forums the general has argued the importance of securing the space domain and the need to improve space situational awareness capabilities to satisfy that need. He has argued: "We must—and we will—be prepared to deter, dissuade, and if necessary, defeat any adversary that seeks to deny us the ultimate high ground of space."[2]

In another framework, Maj Carl M. Jones, USAF, argues the triad for *space protection* should consist of space situational awareness (SSA), offensive counterspace, and joint warfighting space.[3]

Mr. Samuel Black of The Henry L. Stimson Center, suggested in the November 2008 issue of *High Frontier* there is still yet another three-component construct (triad?) to achieve space assurance, one consisting of effective diplomacy, defensive measures to make satellites harder to attack, and offensive hedges.[4] Mr. Black places great trust and reliance on "space diplomacy" to achieve "assurance." His approach retains defense tasks but discounts offensive hedge components (in space, but not other retaliatory schemes).[5]

Mr. Black's top-level formulation of the objectives of a space strategy as "space assurance" is compelling. He argues, "A space assurance strategy strives to ensure that the president, US armed forces, and US citizens, allies and friends can call upon space assets when needed."[6] The space assurance strategic formulation appears to apply whether the threats come from adversaries; well-meaning, space-faring states, or just the environment. General Chilton and Major Jones both stress the importance of SSA and responsive military capabilities to securing US access to the space domain. However, their deterrence frameworks for strategic defense and space protection need to be augmented with Black's diplomatic measures. This would provide a more comprehensive approach to accomplishing strategic space assurance objectives and respond to threats that arise from more than state or non-state actors.

Considering the various formulations posed by Chilton, Jones, and Black, it seems a comprehensive strategy to assure US and friendly space systems that space capabilities must depend on four elements, or pillars: global engagement, space situational awareness, deterrence and defense, and responsive infrastructure.

Global Engagement

The United States' approach to securing and protecting the space domain has been and will continue to be rooted in rational policy making and international law. US law and policy place great emphasis on diplomacy and international engagement; it is a centuries-old practice that has secured borders, enhanced commerce, and resolved disputes. Assuming adversaries (and friends) pay heed to customary and treaty-based provisions of international law, the approach affords members of the global space community some measure of confidence they can all have assured access to space.

Some acts in space are prohibited (e.g., no weapons of mass destruction [WMD] on orbit), but there are relatively few restrictions on the use of space for military or other purposes.

With minimal international law restrictions, smart decision making is needed to operate safely and securely in this environment. The complete span of international legal, policy, diplomacy and international engagement implications should therefore be fully considered when planning for and executing space assurance activities. The United States has done this for decades; it has applied experience and wisdom to address threats posed by anti-satellite (ASAT) systems and other activities in space.

According to Dr. Nancy Gallagher, with the Center for International and Security Studies at Maryland, mutual informal reciprocal ASAT restraint was exercised by the United States and Soviet Union through the mid-1970s. The US strategic calculus through that time was that the "US gained both relative and absolute advantages from vulnerable satellites." US capabilities were more advanced than those of the USSR, and those capabilities were more important to the US than the Soviet satellite capabilities were to the USSR. US policy makers determined that space systems primary uses also stabilized deterrence and supported arms control policy ends.[7] They believed a vigorous US anti-satellite program would more likely stimulate Soviet anti-satellite efforts than dissuade or deter them. So developing and retaining a rudimentary ASAT capability only served as a "deterrent, hedge, bargaining chip, and/or domestic compromise."[8]

Eventually, Dr. Gallagher observes, the informal restraint became increasingly untenable. There was military pressure and support for developing ASAT technology, to prepare to fight in a contested domain, as some believed that eventually space technology would evolve and satellites would become vulnerable to direct attack and inadvertent interference. Politically, a further imperative to develop the technology was based on the fear that the other side wanted "space for war-fighting, not deterrence."[9] Dr. Gallagher argues technology developments eventually outran the political attempts to control ASAT weapons and negotiate a formal ban.[10] Ambiguity over a definition of a space weapon also made such arms control efforts impractical or extremely difficult to achieve.[11] Eventually, the United States and Soviet Union both developed ASAT capabilities.

The Soviets developed and deployed its own ASAT, a co-orbital shotgun-type, non-nuclear system during the 1970s and 1980s. The Soviet ASAT used a "hot-metal kill" weapon which involved setting off an explosion in the vicinity of a target satellite; this explosion produced a spherical cloud of shredded metal expanding in all directions. The use of a high-explosive warhead, as opposed to nuclear, circumvented the proscriptions against nuclear and WMD devices contained in the Outer Space Treaty.[12] By 1986 the Soviets had performed some twenty tests of the system.[13] The USSR developed other ASAT capabilities, or potential capabilities, including direct ascent and ground-based laser weapons. Direct ascent weapons were said to include the Galosh anti-ballistic missile and even intercontinental ballistic missiles outfitted with nuclear warheads to destroy US satellites beyond low earth orbit, even to geosynchronous orbits. Two ground-based lasers at the USSR's Sary Shagan missile test center were described as capable of space missions.[14]

The initial US operational ASAT system was Project 437. It used a nuclear-tipped weapon launched on a Thor missile. The Project 437 system was declared operational in 1964; it was deactivated in 1975. When considering the effects of nuclear explosions on friendly satellites and Project 437's inability to deal with the "threat" from the increasing number of Soviet satellites, US policymakers directed research into non-nuclear ASAT options.[15] During the early 1980s the US responded to the Soviet co-orbital, non-nuclear system with an F-15 launched ASAT interceptor program. Senior congressional leaders argued that significant debris arose from testing the system, so funding for this program was dramatically constrained and a moratorium on tests was imposed in 1985.[16] Congress was also unconvinced of the system's deterrent value; some suggest these congressional leaders may have also been influenced by a Soviet initiative to ban weapons in space and a new moratorium on testing by the Soviets of their ASAT system. The F-15 ASAT program was canceled in 1988.[17]

The informal, pragmatic and mutual USSR/Russian/US moratorium on on-orbit ASAT tests held firm for many years, but a new and rising competitor in the space community, the Peoples Republic of China (PRC), swept away this balance with its 2007 intercept.

The *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 1967,* or the *Outer Space Treaty* as the treaty is informally known, forms the basis for much of international space law. The treaty was entered into during a period of time where US policy makers observed the space domain offered unique benefits for both the military and political dimensions of the Cold War security strategy. Space provided high priority access for reconnaissance satellites to see behind the iron curtain for threat assessment, arms, early warning, and other purposes. Developing space scientific and communications satellites could also demonstrate US leadership in sharing the benefits of "peaceful space technology."[18] There were other pragmatic reason for agreeing to the Outer Space Treaty—space could not be controlled then through military means. Initially, intelligence satellites orbited the earth too high to intercept or "shoot down," and their use could only be precluded through other means.[19]

The Outer Space Treaty provides that international law applies to space (including Article 51 of the United Nations Charter confirming national right to self-defense and, also importantly, the laws of armed conflict);[20] space is not subject to national appropriation; it is to be used for peaceful purposes with due regard for all; nations may not station or orbit in space or on celestial bodies (including the moon) any objects carrying nuclear weapons or any other WMD; and the stationing of troops or creation of military installations on the moon and other celestial bodies is prohibited. As a signatory to the Outer Space Treaty, the United States supported freedom of access to space by all space venturing powers, agreeing to treaty language that provides: "Outer space … shall be free for exploration and use by all States without discrimination of any kind.…"[21]

Treaties, conventions, and agreements help regularize space activities and, as such, help protect the capabilities of the systems that have been or are about to be placed on orbit. Bi-lateral and multi-lateral arms control treaties preserve some of the sanctuary aspects of space by prohibiting "interference" with "national technical means" (such as missile warning and reconnaissance satellites) used to verify treaty compliance. Confidence-building procedures have improved opportunities for transparency between potential adversaries, perhaps improving dialogue that can prevent a dispute from evolving into armed conflict or to

Violations of treaties and other agreements should nominally be responded to through economic means and diplomatic consultation and, if necessary, other sanctions, assuming a nation or some part of the global community agree to them.

a nuclear catastrophe. Other treaties and conventions address frequency spectrum management.[22]

Engagement has been helpful, though problematic; there is an element of risk in relying solely on it to assure access to space capabilities. Enforcement mechanisms for violating treaties and agreements relating to space are rather limited. There are no specific enforcement mechanisms in place to address violations of the Outer Space Treaty, and this increases the risk of depending on such documents and handshakes to protect or assure access to space. Violations of treaties and other agreements should nominally be responded to through economic means and diplomatic consultation and, if necessary, other sanctions, assuming a nation or some part of the global community agree to them.

The PRC is a signatory to the Outer Space Treaty, but this did not prevent it from executing the ASAT intercept that left thousands of pieces of space debris on orbit, many of which will be creating a hazard to low earth orbiting space systems for well over a hundred years. The PRC initially denied its involvement in the event. The former chairman of the Joint Chiefs of Staff, General Peter Pace, "commented that China's senior military leaders still refuse to disclose any details about their recent test."[23] The Chinese test was "part of a broader effort to mature direct-ascent ASAT capability and to develop a spectrum of counterspace capabilities."[24]

Interestingly, the PRC has argued for years for a new treaty for the Prevention of an Arms Race in Outer Space (PAROS) that would ban or eliminate space-based weapons.[25] The Outer Space Treaty does not by its terms prohibit tests of the type performed by the PRC, nor does the proposed new treaty. The Outer Space Treaty does, however, provide in Article IX for consultation "[i]f a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space … would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space…, it shall undertake appropriate international consultations before proceeding…."[26] The PRC undertook no such consultations. The unfortunate consequence of PRC ASAT intercept is that it has forced the International Space Station and others operating in low earth orbit to expend precious propellant resources to execute maneuvers to avoid the debris left behind.

Still, there is considerable global interest in continued negotiation of space weaponization issues.[27] Some space arms control proponents clamor for the "negotiation of a code of conduct between space-faring nations to prevent incidents and dangerous military activities in space. Key activities to be covered under such a code of conduct include avoiding collisions and dangerous maneuvers in space; creating special caution and safety areas around satellites; developing safer traffic management practices; prohibiting antisatellite tests in space; providing reassurance through information exchanges, transparency and notification measures; and adopting more stringent space debris mitigation measures."[28]

It remains to be seen whether these on-going efforts will ever result in an agreement with terms that further enhance US national space assurance and other policy interests. Nevertheless, diplomacy has been and will continue to be a vital component of the US strategy to secure space systems.

Awareness

The challenge to protect US space assets does not begin and end dealing with hostile state and non-state actors. Mankind's destruction of the space environment itself also poses significant threats. The creation of orbital debris is a risk significantly exacerbated by 50-plus years of unsafe or irresponsible design and operation of space systems. The number of man-made objects and space debris being tracked by the US Air Force are growing at an alarming rate. Velocities for space objects are significant, so even small objects, some as small as a paint chip, can impart significant damage to space systems they impact. The Hubbell Space Telescope looks a bit like a stop sign shot-up by locals on an old country road. Liquid propellant tanks, if left unvented, can explode years after a satellite's last operation, throwing thousands of objects into its satellite's or upper stage's orbital plane. These threats must be monitored.

SSA, the ability to monitor and predict threats in space, is essential to mission success and protection of space assets.[29] According to Joint Publication 3-14, *Joint Doctrine for Space Operations:*

> Situational awareness is fundamental to the ability to conduct the space control mission. It requires: robust space surveillance for continual awareness of orbiting objects; real-time search and targeting-quality information; threat detection, identification, and location; predictive intelligence analysis of foreign space capability and intent in a geopolitical context; and a global reporting capability for friendly space systems.[30]

SSA enables a space power to "detect, identify, assess, and track space objects and events to support space operations. The awareness is also critical to space support operations, such as placing satellites in orbit,"[31] or performing anomaly or recovery operations.

A key component of establishing SSA is space surveillance. Space-faring nations can use their awareness to avoid space hazards, or advise other nations on their dangers and perhaps on the means and ways to avoid producing them. Space surveillance is the "observation of space and of the activities occurring in space."[32] Surveillance tasks are accomplished through a variety ground and space-based radar and electro-optical sensors. Surveillance enables deterrence and defense activities against man-made and environmental threats. It provides "continual

awareness of orbiting objects; real-time search and targeting-quality information; threat detection, identification, and location; predictive intelligence analysis of foreign space capability and intent in a geopolitical context; and a global reporting capability for friendly space systems."[33]

In support of efforts to enhance global understanding of the space debris challenge, the US has been working to expand efforts to provide orbital data through the Commercial and Foreign Entities program. "The Air Force operates the world's most capable space surveillance network, and commercial and other satellite operators have long relied on the service for information in order to reduce the chances of collisions with other spacecraft or orbital debris."[34] The SSA issue is important enough that commercial satellite operators are laying the "groundwork" for a process by which they "can share data previously deemed competition sensitive to avoid costly mishaps."[35]

The ability to differentiate between purposeful attacks and natural environmental hazards reduces potential for misperception or miscalculation. Furthermore, effective deterrence and defense (another pillar of achieving space assurance, discussed below) is strengthened if SSA can show the nature and origins of any attempted attack or threat to a system's space, terrestrial, or communications links.[36]

Deterrence and Defense

Space-based capabilities (precision navigation and timing, battlefield and battlespace characterization, missile warning and defense, weather, communications, intelligence, surveillance, and reconnaissance) enable the US and its allies to efficiently and effectively reach out, shape, support and control events in any part of the globe. Unfortunately, taking down these same space capabilities offers a means by which adversaries can eliminate this significant asymmetric advantage. The strategic deterrence logic of the past does not fully apply to new threats, and we cannot wholly depend on current capabilities, or the pillars of engagement and awareness, to deter them.

According to Austin Long in RAND's *Deterrence from Cold War to Long War*, "A widely used definition of deterrence is the manipulation of an adversary's estimation of the cost/benefit calculation of taking a given action."[37] A deterrence strategy seeks to "persuade an adversary by the threat of force (and other measures) not to pursue an undesirable course of action."[38] Deterrence has failed throughout strategic history—"because the object of deterring measures fails to notice them, does not find the measures credible, or is pursuing an agenda sufficiently important enough to its interests that it is prepared to ignore the deterrence attempt."[39] So deterrence policies and approaches are not enough—defenses must also be deployed. The deterrence and defense concepts are inexorably linked to each other. "Defenses offer protection, while deterrence threatens punishment. Defenses can succeed whether the enemy believes in them or not."[40]

Deterrence worked throughout the Cold War; the Soviet Union was powerful but it was also an intensely rational adversary (albeit hobbled with economic inefficiency inherent in its imposed Marxist-Leninist theologies). It was also open to and reciprocated US diplomatic engagement overtures. In contrast, new adversaries and their rogue leaders often are now more risk prone, or perhaps deliberately reckless. They know full-well the importance of space capabilities to military and economic success. These leaders see that attacking and disrupting US space capabilities presents a significant opportunity to deny US national objectives, to retain or expand their power, and to compensate for their own lack of conventional strength. Further, attacks on space systems can be performed through terrorist proxies, through third parties, or through covert acts that offer the perpetrators plausible deniability for damage inflicted.

As observed by retired Congressman Terry Everett (R-AL), in a Fall 2007 article written for *Strategic Studies Quarterly*:

> … In the past few years, we have seen a handful of global positioning system (GPS) and increasing numbers of satellite communications (SATCOM) jamming incidents. In the early stages of Operation Iraqi Freedom , US forces encountered a GPS jamming situation. In this case, precision munitions were used to hit these jamming sources, which allowed our forces to quickly resume operations. We have seen several SATCOM jamming incidents, including Iranian jamming of a US satellite from Cuba in July 2003; ongoing jamming by Iran against PanAmSat Corporation, Asia Satellite Telecommunications Co. Ltd., Arab Satellite Communications Organization, and Eutelsat S.A. from June 1997 to July 2005; and Libyan jamming of two international SATCOM systems in December 2005. Last fall it was reported that a Chinese ground based laser illuminated a National Reconnaissance Office intelligence-gathering satellite. What is most troubling is that these attacks are coming during a period of widespread use of GPS, satellite communications, and space-based imagery.
>
> …[T]here is a spectrum of potential threat capabilities looming on the horizon to include electronic jamming, low-power laser blinding, high-energy lasers, microsatellites, direct-ascent ASATs, cyber attacks, physical attacks to ground stations, and possibly even a nuclear explosion. These threats can target satellites in orbit; their communications links to and from the ground; and their ground-based command, control, and receive stations. All produce the same general result—they render our space capabilities temporarily or permanently useless. Many of these antisatellite technologies exist today, and many are dual-use in nature, including a microsatellite that could be used as an experimental spacecraft or, with a simple command, could shadow or collide with another satellite.
>
> Space is no longer a sanctuary. Those who wish to challenge America's role in the world increasingly recognized the strategic importance of space and are more willing to deny us freedom of action in space by employing a wide range of methods."[41]

The contemporary, emerging threat to space capabilities posed by hostile states and non-state actors and by the space environment is fundamentally different from that experienced during the Cold War. It demands a different approach to deterrence and new tools for defense. Deterring or eliminating these threats will be difficult. There are no mutual understandings or reliable lines of communication with some adversaries.

Joint Publication 3-14 talks to the possibility of employing negation measures against adversary party space systems;[42] but these components probably would not be employed tit-for-tat. A retaliatory deterrence strategy for the US has little credibility if directed at adversary space assets since the United States "… is the most space-reliant country today. Threatening to attack

adversary satellites in response to attacks on our own may prove fruitless if the adversary in question does not leverage significant military, diplomatic and economic power through such systems.…"[43]

Of course, deterrence strategies that include threats of retaliation cannot be reasonably employed as a strategy against long-standing allies and friends who also engage in the space domain. Global engagement strategies appear better equipped to deal with such communities; and SSA tools should help provide the information needed to deal with threats posed by their systems. Deterrence may be unsuccessful in dealing with irrational non-state actors (e.g., terrorists), and it will not protect satellite systems against threats posed by space debris; so fielding SSA tools and satellite defense capabilities is also very important in responding to these threats. Deterrence could be achieved by denying adversaries the specific benefits of attacking US satellite systems. There are a number of defensive measures that can be undertaken and they lend credibility to any US response to an attack. Importantly, defensive measures can also enable survival of an environmental event or conjunction with space debris. This could be accomplished by installing passive defenses on satellites, such as hardening against electromagnetic pulse attacks (radiation hardening), taking measures to make jamming more difficult (link encryption, increased signal strength, adaptive waveforms), and using ablative shielding. These measures could help satellites both withstand and defend against attacks and survive space debris impacts and other hazards in the environment.[44]

Similarly, using a defensive strategy that spreads the risk of attacks against satellite systems (by infusing redundancy into the systems with multiple platforms, or sharing capabilities on allied or friendly space systems) could convince a rational adversary that his attacks would fail. "International cooperation can complicate adversary plans and intentions, and creates more stakeholders in the orderly use of the space environment. Deterrence can be greatly reinforced if an adversary has to contend not only with a US response, but with an international response also."[45]

If deterrence fails, a "punishment strategy" could be exercised. Absolute flexibility should be maintained by the US in the way it wields its "deterrence by punishment instrument (if it chooses to wield it at all)." The full range of diplomatic, information, military, and economic instruments of national power could be considered and employed and these are not limited to offensive or defensive counterspace or space control activities. Preparing to employ these instruments "would signal to any adversary considering US space systems as a legitimate target that the US has the means and resolve to respond if it so chooses."[46]

Responsive Infrastructure

The US government and industrial/commercial base must be able to "develop and accelerate programs for rapid launch of satellites, to reconstitute lost systems or bolster constellations in times of crisis."[47] Assuming the first three of the four pillars of space assurance fail, a responsive infrastructure will enable an agile space community to effectively respond to threats and a changed space environment, and assure access to capabilities presented through the space domain.

Spacelift delivers satellites, payloads, and material into space. Spacelift operations are conducted to deploy, sustain, or augment satellite constellations. "During periods of increased tension or conflict," the US must be able to "launch and deploy new or replacement space assets and capabilities necessary to maintain, augment, or add to the operational capability of space systems to achieve national security objectives. This requires responsive, affordable launch capabilities and infrastructure."[48]

Similarly, to assure continued access, satellite operations must be conducted to "maneuver, configure, and sustain on-orbit capabilities, and to activate on-orbit spares.… [S]atellite operations are executed through a host of dedicated and common-user networks."[49] So the various networks must be more fully integrated to ensure the survivability of space resources.

"Reconstitution refers to plans and operations for replenishing space capability in the event of their loss."[50] This could require repositioning surviving assets and augmentation by a variety of capabilities and replacement of lost assets. These spacelift, satellite operations, and reconstitution concepts are being explored in the ongoing Operationally Responsive Space program and other activities throughout the national security space community.

Concluding Thoughts

A space assurance strategy which focuses on four mutually supportive elements or pillars is better equipped to respond to man-made and environmental threats to space systems. Global engagement leverages long-standing approaches to securing and protecting the space domain through recognized international law and policy. SSA enables monitoring and prediction of threats in space. Essential to mission success and protection of space assets, SSA allows a policy maker or commander to differentiate between purposeful attacks and natural environmental hazards; this reduces the potential for misperception or miscalculation. Deterrence policies and approaches are not enough; a variety of defenses are needed to respond to man-made and environmental threats. Finally, a robust infrastructure enables space powers to provide agile responses to changes in the space environment, to threats, and to the viability of their space systems. These four pillars will enable US and friendly space systems to continue to perform their missions for the short and long term.

Notes:

[1] Air Force Link, "Space Command focuses on tailoring mission with new triad," www.af.mil/news/story.asp?id=123025319, 17 August 2006. This proposal was contained in a speech made to the 9th Annual Space and Missile Defense Conference and Exhibition, Huntsville, AL.

[2] In the review, the DoD significantly expanded thinking on the range of strategic deterrent capabilities to include not only the strike elements of the old triad, which consisted of nuclear-armed intercontinental ballistic missiles, submarine-launched ballistic missiles, and strategic bombers, but also conventional and nonkinetic offensive strike and defensive capabilities. See Janet A. St. Laurent, Letter to Terry Everett, "Military Transformation: Actions Needed by DOD to More Clearly Identify New Triad Spending and Develop a Long-term Investment Approach," Government Accountability Office, GAO-05-962R Military Transformation, 4 August 2005, 1-2.

"The New Triad now emphasizes the integration of offensive capabilities, both nuclear and conventional; defensive capabilities; and a responsive defense infrastructure, all enabled by intelligence, planning, and global command and control (C2)." General Kevin P. Chilton, commander, United States Strategic commander, Statement before the Strategic Forces Subcommittee, House Armed Services Committee on United States Strategic Command, 27 February 2008, 5. The 2001 Nuclear Posture Review triad construct has also been rolled-out to explain the need, policy and organization for missile defense. In recognition of new global missile threats, in 2002 President George W. Bush issued National Security Presidential Directive No. 23 which declared the United States must make progress in fielding a new triad composed of long-range conventional and nuclear strike capabilities, missile defenses, and a robust industrial and research development infrastructure. See National Security Presidential Directive 23, 2002; "2007 Air Force Space Command Strategic Intent," April 2007, http://www.afspc.af.mil/shared/media/document/AFD-070412-128.pdf. See also William L. Shelton, "Realizing the Unthinkable: AFSPC Influence Yesterday, Today, and Tomorrow," *High Frontier* 3, no. 4 (August 2007) 17.

[3] Maj Carl M. Jones, USAF, "The Space Triad: Organizing for an Effective MilSpace Deterrent Strategy," Air Command and Staff College, AU/ACSC/4209/AY2006, April, 2006, 9-12. According to Jones, SSA would provide "… insight into our own space capabilities and more importantly the adversary's. SSA provides the ability to maintain and track status of space objects and the solar and terrestrial environment.… OCS is the ability to plan, target, execute and assess operations to deny, disrupt, degrade, deceive, destroy and or/or negate an adversary's use of space services and capabilities that threaten US/Allied forces or interests.… JWS calls for affordable, rapidly developed and launched satellites, in sufficient numbers, to be employed in direct support of a Joint Force commander. Sufficient numbers of assets must be available to replenish lost capabilities on demand and in order to be tailored and responsive to theater commanders' needs, JWS capabilities must be interoperable with the entire range of systems they are augmenting and/or replacing.… All three of these elements operate individually to provide capabilities that may or may not deter an enemy from attacking the US's space capability."

[4] Samuel Black, "Components of a Space Assurance Strategy," *High Frontier* 5, no. 1 (November 2008): 16-18.

[5] Ibid.

[6] Ibid.

[7] Nancy Gallagher, "US Space Security Policy," presented to the Conference on Security and Cooperation in South Asia, A Global Perspective, 8-10 October 2007, 5.

[8] Ibid.

[9] Ibid.

[10] Ibid.

[11] Terry Everett, "Arguing for a Comprehensive Space Protection Strategy," *Strategic Studies Quarterly*, Fall 2007, 32-33. The Representative argues: "Some believe a space weapon is purely a weapons system based in space that collides with another space object or intercepts a missile traveling through space. However, I would argue, the damage caused by a ground-based high energy laser is just as sever for a target satellite as the damage caused by a physical on-orbit collision. The key difference is the latter may create unacceptable debris field, posing further risks to satellites.

"It is the ambiguity in definition that makes arms-control measures which ban space weapons difficult to implement and nearly impossible to enforce. This is compounded by the fact that satellites have tremendous dual-use value, making it very difficult to distinguish a nonweapon space system from a weapon space system. Any satellite could be maneuvered in such a way as to collide with a target satellite. Any ballistic missile, with sufficient orbital ephemeris data and software changes, could be used to target a satellite."

[12] Matthew Mowthorpe, *The Militarization and Weaponization of Space* (Lexington Books, 2004) 117.

[13] William R. Van Cleave, *Fortress USSR* (Hoover Institute Press, 1986) 24-31. Citing the *US Air Force FY 85 Report* (Arlington, Virginia: Air Force Office of Public Affairs, 1985) 40.

[14] Ibid., 26, citing DoD, *Soviet Military Power 1985*, 56.

[15] Matthew Mowthorpe, *The Militarization,* 111-112.

[16] Ibid., 116-117

[17] Ibid.

[18] Nancy Gallagher, "US Space Security Policy," p. 3.

[19] Ibid.

[20] See Professor P. J. Blount's wonderful analysis in "Limits on Space Weapons: Incorporating the Law of War into the Corpus Juris Spatialis," presented at the Colloquium on International Space Law, International Astronautical Congress, Glasgow, Scotland, IAC-08-E8.3.5, 29 September - 3 October 2008.

[21] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies* (Outer Space Treaty), Article I. The treaty states in pertinent part: *Article I* - The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind. Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies. There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation. * * * * * *Article III* - States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding. *Article IV* - States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.…

[22] Founded in 1865, the International Telecommunications Union (ITU) plays an important role in global management of the international radio frequency-spectrum and satellite orbits, important components of any space-related activities. It has developed legally binding Worldwide Agreements and Standards for more than 100 years: the Radio Regulations and the ITU-R recommendations, reports and handbooks. See Valery Timofeev, International Telecommucations Union: Space-related Activities, briefing to the 28th United Nations Inter-Agency Meeting on Outer Space Activities, Geneva, Switzerland, 16-18 January 2008. The document cites the Constitution of the International Telecommunications Union, Article 12 providing that the ITU purpose is "To ensure rational, equitable, efficient and economical use of the radio frequency spectrum by all radiocommunication services—including those using the geostationary satellite orbit or other satellite orbits—and to carry out studies on radiocommunications matters."

[23] Terry Everett, "Arguing for a Comprehensive," 22, citing Bill Gertz, "China Mum on Pace Query on Anti-Satellite System," *Washington Times*, 6 April 2007.

[24] Ibid.

[25] Prevention of space weaponization is a major theme of the Prevention of an Arms Race in Outer Space (PAROS) treaty discussions within the UN Conference on Disarmament (CD).

[26] The Outer Space Treaty, Article IX, provides, in pertinent part: In the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment.

[27] Dr. Michael Rance, Presentation to AIAA Space 2007, AIAA 2007-6061, 2. Dr. Rance, a United Kingdom missile defense and space policy expert and leader argues: There is no formal definition of "weaponization of space" or "space weapons", but some have tried. Michael Krepon and Michael Katz-

Hyman propose this (citation omitted): "terrestrially based devices specifically designed and flight-tested to physically attack, impair, or destroy objects in space, or space-based devices designed and flight-tested to attack, impair, or destroy objects in space or on earth." Bruce DeBlois (citation omitted) suggests something similar: "A space weapon is that which is built with destructive intent to be used in a terrestrial-to-space, space-to-space or space-to-terrestrial capacity."… I recognize that alternatives exist, usually depending on which side of the debate the definer sits. Contention focuses on whether ground-based weapons should be included.… Some definitions include as a space weapon a defensive interceptor such as THAAD or Aegis SM-3 when the planned interception is OUTSIDE the atmosphere, but exclude the use of Patriot PAC-3 and THAAD when the planned interception is WITHIN the atmosphere. This is a particular issue for THAAD which has both an exo- and an endo-atmospheric capability. There is no consensus [on the definition].

[28] Ibid., 4.

[29] Space Foundation, "Space Situational Awareness—Panel Focus at Strategic Space and Defense 2008, http://www.spacefoundation.org/news/story.php?id=599, 22 September 2008. The User Expert Group of ESA SSA requirement study preliminarily defined Space Situational Awareness (SSA) "as a comprehensive knowledge of the population of space objects, of existing threats/risks, and of the space environment. Luca del Monte, "A European approach to Space Situational Awareness, Fourth European Space Weather Week, Brussels, 5-9 November 2007, 2. According to Luca del Monte: The User Expert Group of the ESA SSA requirements study concluded that SSA is the understanding and maintained awareness of (a) the Earth orbital population, (b) the space environment, and (c) possible threats. "(a) Earth orbital population. Detection and/or tracking of man-made objects (e.g., US SSN Catalog, comprising spacecraft, rocket bodies, mission-related objects, and fragments); identification and characterization of detected objects (e.g., launching nation, owner, operator, object status, and function); determination of orbit state and covariance information; identification of spacecraft maneuvers; determination of spacecraft attitude; determination of antenna/instrument pointing. "(b) Space environment—Detection and/or tracking natural objects (e.g., near-Earth objects [NEO]); detect and understand man-made, induced environment; detect and understand interferences; forecast space weather and its effects; predict the natural particulate environment and its effects (meteoroids). "(c) Possible threats—Predict and assess the risk to humans and property on ground and in air space due to re-entries; detect and assess adversary use or preparations for adversary use of or upon space systems (e.g., ground- or space-based); detect on-orbit explosions and release events (accidental or intentional); predict and/or detect on-orbit collisions (accidental or intentional); predict and/or detect permanent or temporary disruption of mission and/or service capabilities."

[30] Joint Publication 3-14, *Joint Doctrine for Space Operations*, 9 August 2002, IV-6.

[31] Ibid.

[32] Ibid.

[33] Ibid.

[34] Turner Brinton, "US Air Force Declined to Help Intelsat with Satellite Maneuver," *Space News*, 8 December 2008, 1

[35] Ibid., 4.

[36] See John B. Sheldon, "Space Power and Deterrence: Are We Serious?," *Marshall Institute Policy Outlook,* November 2008, 3-4.

[37] Austin Long, *Deterrence from Cold War to Long War*, RAND, 2008, 7.

[38] John B. Sheldon, "Space Power and Deterrence," 1

[39] Ibid.

[40] Robert Butterworth, "Fight for Space Assets, Don't Just Deter," *Marshall Institute Policy Outlook*, November 2008, 1.

[41] Terry Everett, "Arguing for a Comprehensive," 23-24, citing: Jim Garamone, "CENTCOM Charts Operation Iraqi Freedom Progress," American Forces Press Service, 25 March 2003; Maj Gen William L. Shelton, commander, 14th Air Force, "Update on Space Operations" (briefing, Air Force Association National Symposium on Space, Beverly Hills, CA, 17 November 2006; Warren Ferster and Colin Clark, "NRO Confirms Chinese Laser Test Illuminated US Spacecraft," *Space News*, 2 October 2006, 10; and Office of the Secretary of Defense, *Military Power of the People's Republic of China 2007, Annual Report to Congress* (Washington, DC: Department of Defense, 2007).

[42] Joint Publication 3-14, *Joint Doctrine for Space,* IV-7. Negation includes "Measures to deceive, disrupt, deny, degrade, or destroy an adversary's space capabilities. Negation can include action against the ground, link, or space segments of an adversary's space system." The US National Space Policy also states: "… the United States will … deny, if necessary, adversaries the use of space capabilities hostile to US national interests." See Fact Sheet on US National Space Policy, National Security Presidential Directive No. 49, 31 August 2006, 1-2.

[43] John B. Sheldon, "Space Power and Deterrence," 3-4.

[44] Ibid.

[45] Ibid.

[46] Ibid.

[47] Ibid., 3.

[48] Joint Publication 3-14, *Joint Doctrine for Space,* IV-10.

[49] Ibid.

[50] Ibid.

Col James D. Rendleman, USAF, retired (BS, Chemistry, University of North Carolina—Chapel Hill; MBA and MPA, Golden Gate University; JD, Whittier College School of Law; LLM, University of San Diego School of Law). Mr. Rendleman was commissioned a second lieutenant through the Reserve Officers Training Corps at the University of North Carolina—Chapel Hill. He has held a wide variety of science and technology, engineering, management, and policy positions within Air Force laboratories, the space acquisition community, Headquarters, Air Force Space Command, the Air Staff, and the National Reconnaissance Office, working to improve national and coalition space; missile; command, and control; and intelligence capabilities.

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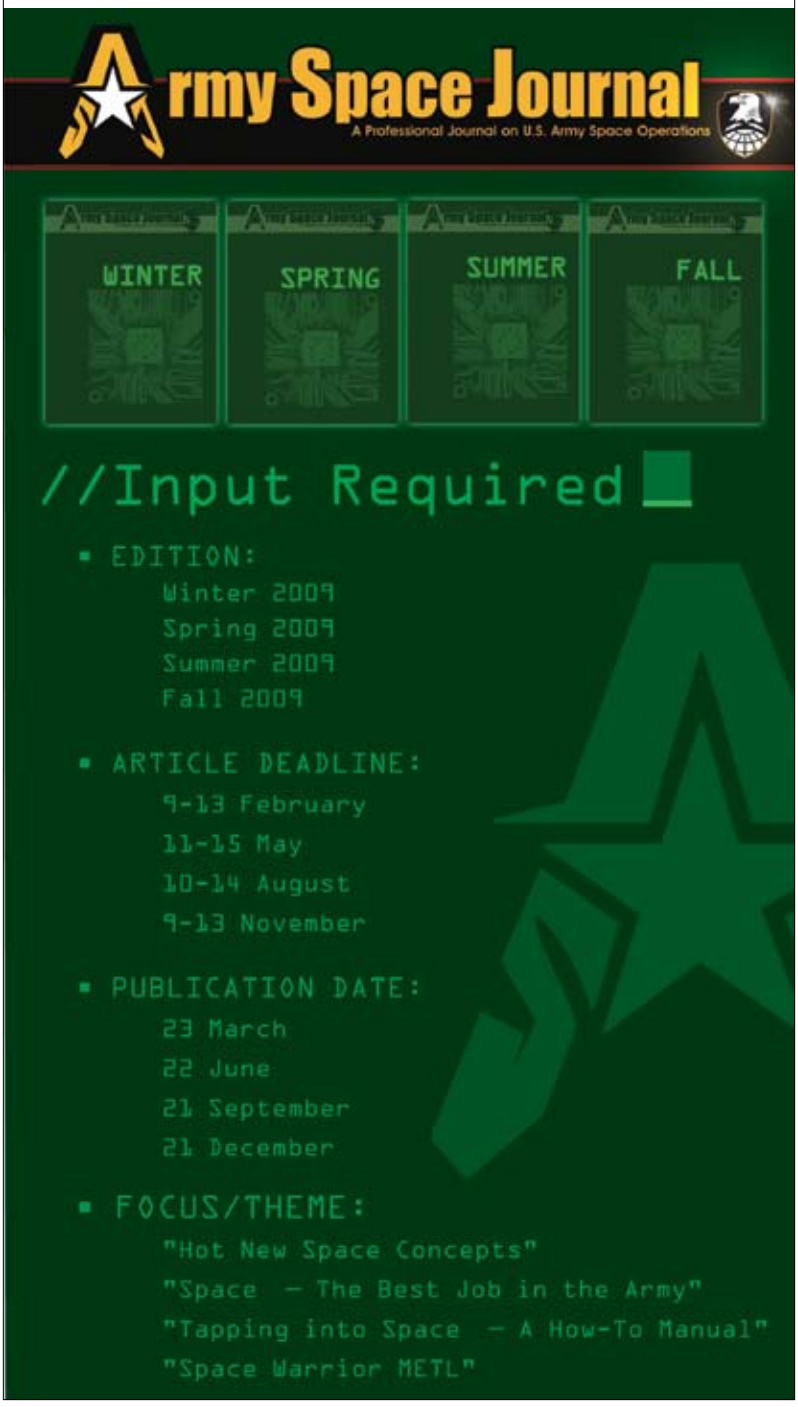
Mr. Rendleman has been awarded the Legion of Merit, Air Force Meritorious Service Medal with three oak leaf clusters, and Air Force Commendation Medal. He is a graduate of Reserve Component Advanced Joint Professional Military Education, Joint Forces Staff College; and Air War College, Air Command and Staff College, and Squadron Officers' School.

A Collaborative Effort

The Air Force Space Command *High Frontier Journal* and *Army Space Journal* are entering into a collaborative effort for 2009. Because audiences of both publications share a common interest in how space issues impact the national security environment, the editors of both publications have agreed to create an article exchange program in order to share ideas across their respective communities. Please note the themes and article deadlines for the *Army Space Journal* below. To submit articles and article concepts for these editions, contact the *Army Space Journal* editorial staff at space.journal@us.army.mil. The intent is to broaden perspectives through information and idea sharing.



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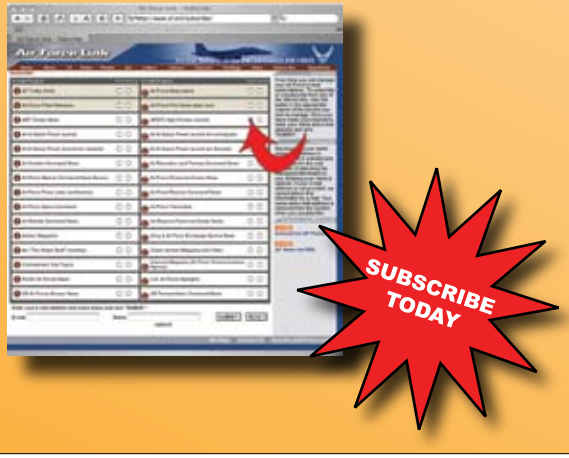


Book Review

Bomb Scare: The History and Future of Nuclear Weapons

Bomb Scare: The History and Future of Nuclear Weapons. By Joseph Cirincione. New York: Columbia University Press, 2007. Figures. Tables. Glossary. Notes. Index. Pp. xvi, 206. $27.95 Hardcover ISBN: 0231135106; $18.95 Paperback ISBN: 0231135114.

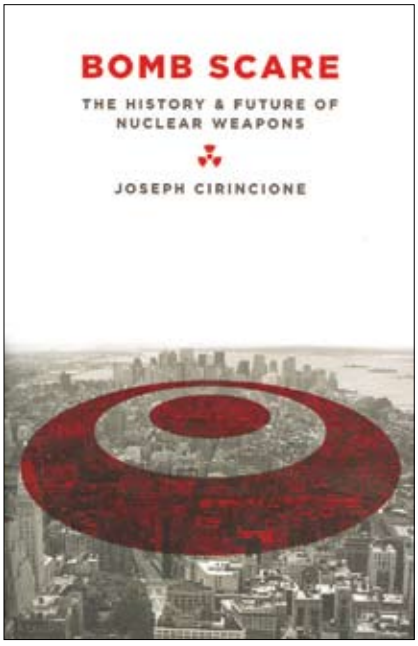
For over six decades now, humanity has coped with the legacy from those fateful August days in 1945 when Hiroshima and Nagasaki lay devastated beneath atomic clouds. In fact, a few weeks before those events, University of Chicago physicist and Nobel laureate James Franck formed a committee to consider the implications of nuclear weaponry. A report bearing his name identified the rationing of nuclear materials as the simplest way to control nuclear technology, thereby preventing an unlimited arms race. The Franck report recommended, as a matter of "long-range national policy rather than military expediency," that the United States seek an agreement for "effective international control of the means of nuclear warfare" (p. 16). That recommendation led to formation of a United Nations commission in 1946 and, with almost 100 nations as original signatories, the Treaty on Non-Proliferation of Nuclear Weapons in 1970.

In *Bomb Scare*, Joseph Cirincione, a seasoned weapons expert and current Ploughshares Fund president, reviews the history and theory of nuclear weapons from the atomic discoveries of the 1930s to the terrorist threat of the early 21st century. Surprisingly comprehensive for such a slender volume, *Bomb Scare* juxtaposes Cold War nuclear stockpiling among a handful of nations and the rise of a nuclear nonproliferation regime among more than 180 countries. Cirincione outlines with remarkable clarity five reasons why nations acquire, or decide not to acquire, nuclear weapons: security, prestige, domestic politics, technology, and economics. Using that framework, he analyzes what drove particular countries toward acquiring nuclear weapons, while others opted not to acquire them.

Today's nuclear world, according to Cirincione, is far less dangerous than during the Cold War. We certainly face very serious dangers, but the "threat of a global thermonuclear war is now near zero" (p. 85). Cirincione takes comfort in knowing US and Russian nuclear weapons decreased by 61 percent between 1986 and 2006. If we no longer worry about the fate of the earth, he nonetheless finds reason to worry about the fate of our cities. Fissile material in the hands of messianic or apocalyptic terrorist groups is worrisome, because they have little or no fear of the retaliation that deters nations from using nuclear weapons. Moreover, risk of extremists obtaining bomb-grade nuclear material or an intact warhead, especially from Russia or Pakistan, has increased. The threat of nuclear terrorism, coupled with evidence of a collapsing nonproliferation regime, prompted President George W. Bush to set a fundamentally new course for US nuclear policy.

After the attacks of 11 September 2001, the Bush administration chose to abandon the old internationalist policy of managing proliferation and adopt a more action-oriented strategy of preventing nuclear proliferation. Prevention, however, was limited to states or groups hostile to the US; in other words, President Bush distinguished between "bad proliferation" and "good proliferation" (p. 114). American power, instead of multilateral treaties, became the primary means of stopping bad proliferation. Cirincione identifies "three pillars" in the Bush administration's anti-proliferation policy: traditional nonproliferation agreements; counter-proliferation (including anti-missile systems and military action); and consequence management (responding if weapons of mass destruction were used). He compares positives and negatives of this new policy and concludes the best chance for future success lies in "a comprehensive strategy that combines the best elements of the US-centric, force-based approach with the traditional multilateral, treaty-based approach" (p. 123).

An insightful primer on nuclear proliferation and efforts to control it, *Bomb Scare* develops kernels of the author's wisdom into substantial food for thought. He suggests, for example, that policies should follow two guiding principles: focus the greatest government resources on the most serious threats; and minimize proliferation drivers, while maximizing proliferation barriers. As one of the experts who contributed to *Universal Compliance: A Strategy for Nuclear Security*, a 2005 Carnegie Endowment report, Cirincione concurs with its recommendation that the "new strategic aim of nonproliferation policy should be to achieve *universal compliance* with the norms and rules of a *toughened* nuclear nonproliferation regime" (p. 136). In describing what that new strategy might look like, he admits the three most difficult proliferation problems confronting us are terrorism, the spread of technology for reprocessing spent nuclear fuel rods, and the emergence of new weapon states. Solving these problems, and thereby reducing the risks from nuclear weapons, he concludes, cannot be done one country at a time—it must be global.



Reviewed by Dr. Rick W. Sturdevant, Deputy Command Historian, HQ Air Force Space Command.

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