4th Nuclear Stability Roundtable: “Strategic Stability and Global Change”

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Executive Summary

Objectives

This report is an analysis of the Fourth Nuclear Stability Roundtable, Strategic Stability and Global Change, held on March 12-13, 2002. It describes the presentations given at the workshop, key insights into today’s strategic stability environment, and identifies areas for future discussion, debate, research, and analysis in the nuclear security field.

History and Purpose

The Nuclear Stability Roundtable is co-sponsored by the Defense Threat Reduction Agency (DTRA), U.S. Department of State, U.S. Strategic Command, and Los Alamos National Laboratory. The Advanced Systems and Concepts Office of DTRA hosted this year’s roundtable. The goal of this year’s Nuclear Stability Roundtable Steering Committee was to stimulate discussion of how stability calculations should change in light of world events. Hence the title of this year’s conference was "Strategic Stability and Global Change". The roundtable sought to evaluate the pivotal developments in U.S. attitudes toward nuclear stability, as marked by the Administration's decision to withdraw from the ABM Treaty and its recently announced Nuclear Posture Review. The roundtable also served as a forum to discuss the sudden changes brought about by the terrorist attacks of September 11th, as well as more enduring issues, such as regional stability and conflict. Participants represented a wide array of expertise, from military operations research and modeling to the social sciences and policy-making community. Twenty presenters were selected from a pool of submitted abstracts to share their recent research on pressing stability issues. The presenters were assembled in the following panels:

- The Russia/China/U.S. Triangle,
- Implications of Missile Defense,
- Deterring the Threat of Rogue States,
- Regional Instability Between Nuclear States,
- New Analytic Techniques and Paradigms, and
- The Nuclear Posture Review.

Panelists’ presentations evoked much discussion among the participants and framed important issues such as:

- How relevant are Cold War concepts, models, and force postures in the post-Cold War Environment?
- What do we mean by nuclear strategic stability today?
- How do we plan for uncertainty, emerging threats, and strategic surprise?
- What new tools, models, and analytic frameworks are necessary to evaluate and influence new strategies?
- What is the future of the Offense-Defense relationship?
- How can we implement the Nuclear Posture Review and connect with the decision-makers?
As a result of the two-day session, participants had new concepts and tools to ponder and new areas of research and analysis on which to impart. Some of the key recommendations that resulted were:

- Continue to evaluate the applicability of stability concepts from the Cold War, such as deterrence, first-strike stability, and structuring our nuclear forces vis-à-vis Russia for their relevance in the post-Cold War security environment. Continue research and analysis of alternate concepts better suited to emerging threats, such as new nuclear powers, rogue states with WMD capabilities, terrorism, and strategic surprise.
- Recommend architectures for Missile Defense to the policy-makers. There is still time to influence the design of the system before deployment. Emphasize the relative costs and benefits of each system in terms of robustness, effectiveness, and the implications it will have on stability. Stability assessments must recognize the perceptions Russia, China, our allies, and rogue nations will have of Missile Defense and the impact these perceptions will have on their strategic direction and decisions.
- Continue with evaluations of the role of nuclear weapons in deterring, preempting, or responding to a WMD attack.
- Consider the findings of the 2001 Nuclear Posture Review and demonstrate methods and tools that when employed will help policy makers do “capabilities-based planning” and re-structuring of the Triad.
- Demonstrate the importance of addressing and reducing uncertainty to the extent possible in the decision-making process, and provide tools that will support the prevention or mitigation of a crisis under stressful conditions.
- Consider areas that were not debated in depth at the Nuclear Stability Roundtable, such as ensuring the safety and security of nuclear weapons in emerging nuclear states and incentives for non-proliferation. What role will these issues play in crafting a stable nuclear framework?
- Finally, consider the meaning of nuclear stability in today’s post-Cold War, post-9/11 world. What theories and concepts should we embrace?
Keynote Address: Ambassador Linton Brooks, Deputy Administrator, Defense Nuclear Nonproliferation, National Nuclear Security Agency

Background

Ambassador Brooks has several years experience in the nuclear nonproliferation arena. He framed the majority of the questions and issues that the roundtable discussed over the following two days. In his keynote address, he posed the question underlying the entire session: What do we mean by nuclear strategic stability today? In order to evaluate this question, he turned to the past, to see what nuclear stability had meant to the United States during the Cold War. In addition, he presented challenges to the assembled roundtable on how to analyze and plan for the shifting stability framework of the future.

Key Insights

In evaluating the question of if this conference had happened 20 years ago, what discussions would have occurred at the Nuclear Stability Roundtable, there would have been a common vision of nuclear stability, Ambassador Brooks noted. In addition:

- The discussions would have been almost exclusively about the U.S./USSR relationship, perhaps a brief mention of China, but not about regional actors and the rogue states.
- Two acknowledged components of stability existed:
  1) Crisis stability:
     - Both sides had the ability to absorb a first strike and still respond with devastating counterattack, so neither side had incentive for first strike, and this relationship was stable in crises.
  2) Arms control stability:
     - Neither side could achieve a great advantage from changing its forces, both knew that and therefore, there was no incentive to try.

Stability considerations did not influence force structure that much but stability considerations did help shape arms control, and arms control did deal with force structure.

- The result was START-I, with limits on particularly destabilizing systems, especially restrictions on "heavy" ICBMs, but less restrictive of SLBMs, and even less restrictive of bombers; for the U.S., this led to a more stabilizing posture.
- Some advocates of missile defenses existed but abrogating the ABM treaty was considered destabilizing.

Ambassador Brooks then looked to the future of nuclear weapons and strategic stability and emphasized that while some of the changes were hopeful, the future was anything but certain. On the hopeful side, he highlighted:

- Collapse of communism and demise of the USSR
- Removal of threat in Europe
The U.S. is the sole economic and military superpower – with unchallenged preeminence in conventional warfighting capability;
Democratization by fits and starts in the Russian Federation but it provides an environment for the strategic transformation of the bipolar relationship;

On the side of bad or worrying changes, he noted:
- India and Pakistan have nuclear weapons and represent the emerging threat of new nuclear powers;
- Rogue nations exist with suspect intent;
- Biological weapons may be used in asymmetric warfare, and how to use nuclear weapons against asymmetric threats is now a key issue;
- Well-organized non-state sponsored terrorism is a new threat; and
- We must plan for uncertainty and surprise.

Looking to the future with these realities in mind, Ambassador Brooks offered the following suggestions to the Roundtable:
- The era of "formal" East-West arms control probably is over: Deeper strategic cuts in the arsenal than we thought possible two years ago are acceptable today, but no “lock-in” of reductions can be allowed. The ability to reconstitute has to go along with unilateral reductions to provide a solution.
- There has been no great trauma in withdrawal from the ABM Treaty, despite gloomy forecasts by critics of missile defense;
- Highly MIRVed ICBMs are going away, and a lot of other traditional stability concerns are going away;
- The Chinese do not seem to focus on the same stability concerns we used to, and the emerging nuclear states do not seem to focus on them either;

In conclusion, Ambassador Brooks framed a number of other questions and issues for roundtable participants to ponder.
- What do we mean by strategic stability today?
- How should we structure of nuclear forces?
- How do we plan for strategic surprise?
- How relevant are the stability concepts of the Cold War?
- How can we encourage Russia to build up its deteriorating Early Warning System?
- What new concepts, tools, and methods of analysis can analysts contribute to policy?
Panel I: U.S./Russia/China Triangle

Introduction

The facilitator of Panel I was Dr. Thomas McIlvain, from the Arms Control Bureau of the Department of State. Panel members included the following:

- Dr. James Scouras, Consultant for the U.S. Department of State
  Post-Cold War Nuclear Events: Implications for a New Strategic Calculus

- Ms. Julia Gavrilov, Los Alamos National Laboratory
  Russian Reaction to U.S. Unilateralism in Nuclear Policy Issues

Background

The objective of the U.S./Russia/China panel was to examine the changing bilateral and trilateral relationships among these powers. Ms. Gavrilov presented views from Russia on the U.S. decision to unilaterally withdraw from the ABM treaty and predicted future impacts and trends in the relationship. Dr. Scouras addressed two basic questions

1) Are nuclear weapons still relevant?
2) Are nuclear deterrence and stability concepts still relevant?

Key findings

Dr. Scouras’ methodology for considering the role of nuclear weapons, deterrence and stability and their effect on force posturing was to evaluate nuclear events that have occurred since the collapse of the Soviet Union, with nuclear events defined as crises that have involved implicit or explicit nuclear threats or actions, or those in which the simple existence of nuclear weapons has played an important role.

The 1991 coup attempt in the Soviet Union, and Russia’s reaction to the launch of a Norwegian scientific rocket in 1995 were two nuclear events described by Dr. Scouras. These events, in addition to other instances in which nuclear weapons have played a role, offer some observations pertaining to the construction of the post-Cold War Strategic Framework.

- First, all situations mentioned ended without nuclear strikes.
- Second, these permutations in the strategic stability framework are "signs of instability," in that all situations involving Russia were one-sided and most involved a domestic crisis.

Post-Cold War Nuclear Events

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1991</td>
<td>Persian Gulf War</td>
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<tr>
<td>Aug 1991</td>
<td>Coup attempt against Gorbachev</td>
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<tr>
<td>May 1992</td>
<td>Armenia-Azerbaijan war</td>
</tr>
<tr>
<td>Oct 1993</td>
<td>Russian parliamentary crisis</td>
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<tr>
<td>1994</td>
<td>North Korean nuclear program</td>
</tr>
<tr>
<td>Jan 1995</td>
<td>Norwegian meteorological rocket launch</td>
</tr>
<tr>
<td>Mar 1996</td>
<td>Chinese missile launches near Taiwan</td>
</tr>
<tr>
<td>1998</td>
<td>Indian and Pakistani nuclear tests</td>
</tr>
<tr>
<td>Sept 2001</td>
<td>War on terrorism</td>
</tr>
<tr>
<td>2001</td>
<td>India-Pakistan political/military confrontation</td>
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The key lessons from these situations include:

- The need to broaden the strategic warning paradigm to consider the critical role played by the diverging views of Russian civilian political leadership and crisis leaders (i.e., the ministers vs. the general staff).
- Both sides should be alert to the dangers of mirror imaging, paying specific attention to the motivations for increased combat readiness.
- We should not count on getting or responding to strategic warning or tactical warning. During the Cold War, the threat of an attack without warning was inconceivable. This is no longer true for the post-Cold War world. Internal problems can now be a source for nuclear danger and the threshold for nuclear use in Russia is lower.
- We should expect to be surprised - we cannot anticipate every scenario that might lead to nuclear war. Examples of surprises that could have resulted in nuclear war include Korea, the Gulf War, and September 11th. So what are the implications for a post-Cold War Strategic Calculus?

With these situations as a backdrop and evaluative context, Dr. Scouras returned to his initial questions. First, are nuclear weapons still relevant? He argued that:

- Nuclear weapons define implicit rules, limits, and dangers even when they are not brandished or used;
- Nuclear weapons address conventional imbalances, (i.e., Israel), and can be used to deter non-nuclear WMD use; and
- We wish nuclear weapons were no longer relevant because of their inherent dangers and our conventional superiority.

The second question evaluated the utility of deterrence and first-strike stability as post-Cold War concepts. The utility of deterrence was addressed by looking at the ability to prevent crises from happening and lessen their intensity. Not all nations and acts can be deterred, but many can be deterred. Nuclear deterrence continues to be relied upon when other options do not exist or are impractical. However, the set of planning scenarios is for one big war and needs to shift to planning for a multistage war, including post-Cold War imperatives for evaluating deterrence. These imperatives included:

- Developing a set of planning scenarios by which to judge our capabilities;
- Undertaking a more sophisticated modeling for policy analysis;
- Establishing criteria for sufficiency.

The relevance of first strike stability was then examined. Dr. Scouras argued that first strike stability is a useful concept today only in the context of a crisis. Despite this, it remains true that striking first is vastly superior to striking second, albeit vastly inferior to no war. Additionally, defenses may exacerbate first-strike instability and this could give rise to preemption as a more important element of nuclear strategy.

In answer to the third question, "Should we structure and posture our nuclear forces to deter attack from Russia?" Dr. Scouras presented some opposing arguments:
Ms. Gavrilov’s research on Russia contributed much to increasing the participants’ knowledge of Russian perceptions. Ms. Gavrilov began her presentation by discussing President Bush’s decision on December 13, 2001 to withdraw from the ABM Treaty (“Treaty on Limitation of Anti-Ballistic Missiles System”) with the intent to develop and deploy a National Missile Defense system. Ms. Gavrilov argued that:

- This U.S. action to withdraw from the ABM Treaty was a manifestation of Washington’s increasingly unilateralist trend and an indicator of U.S. reliance on its status as an economic and military superpower.
- On the Russian viewpoint, Russians believe that Russia’s willingness to cooperate on issues of arms control and, more recently, on the War on Terrorism, is not being reciprocated by the U.S.

Ms. Gavrilov argued that Moscow regarded the ABM Treaty as a cornerstone of strategic stability. Thirty-two international disarmament and nuclear non-proliferation treaties are linked to it, among them SALT I, SALT II, START I, and START II. The ABM treaty has served as a basis on which arms control has operated for the past 30 years. The removal of this element is ultimately destabilizing and could cause the collapse of the entire structure not to mention creating a legal vacuum for arms control.

Russian reactions to the U.S. ABM Treaty withdrawal announcement were varied:

- Initially, Russia’s official reaction was calm and restrained despite Russian President Vladimir Putin's calling the move “a mistake.”
- Some of the Russian ruling elite claimed that Bush’s decision was humiliating for Moscow and detrimental to Russia’s interests.
  - Injury to Russia was exacerbated, in their view, by President Putin’s support of the U.S.’s global campaign against terrorism.

The objective of Ms. Gavrilov’s research was to consider Russia’s possible responses to the changed strategic security factors based on sets of underlying factors, including internal factors (i.e., industrial development and economic health, criminal activities and corruption, and separatist movements in the Russian Federation) and regional security concerns affecting the constitution of Russia’s armed forces (i.e., NATO expansion and local conflicts in the Caucasus and Central Asia). Global issues also factor into Russian
analysis due to their implications for shifts in the strategic balance. Finally, the future role and perceived effectiveness of the principle of nuclear deterrence; Russia’s weakening international status, and the U.S.’s growing unilateralism in the nuclear realm all will affect Russia’s strategic direction.

Ms. Gavrilov presented definitions of the concepts of nuclear deterrence and strategic stability and then analyzed the Russian view of the expected shift of advantage in these areas in favor of the United States.

- Strategic stability to be measured by approximate parity of nuclear arsenals. Presently, the U.S. and Russian nuclear arsenals maintain rough parity, however in 10-15 years, Russia’s forces will shrink drastically due to the process of natural aging, the struggling economy and prevailing popular sentiments will not support the defense appropriations necessary to replace the aging warheads
- The U.S. will have deployed a NMD system and the U.S. economy will most likely be able to support an overwhelming nuclear force.

Ms. Gavrilov argued that the implication of the shifting central balance would prompt the U.S. to take unilateral steps in the nuclear sphere; these are foreshadowed already by U.S. withdrawal from the ABM Treaty, decision to stockpile rather than eliminate the nuclear warheads subject to reduction, and resistance to new binding arms control agreements. In addition, a deployed NMD coupled with overwhelming nuclear forces could give the U.S. a sense of assured protection and make it more aggressive and reckless in international policy or more inclined to solve problems by force.

For the future disposition of Russian Forces, Ms. Gavrilov predicted:
- Russia will continue to rely on nuclear deterrence; however, it will be minimal nuclear deterrence.
  - Factors that will shape this force include: the traditional makeup of the strategic nuclear force (SNF), military reform to attempt to create something resembling the American Triad, and considerations of economic realities and regional threats.

Ms. Gavrilov argued against Russian military reform emulating the U.S. Triad model. That model, she observed, is incompatible with Russia’s military-technical and geostrategic specifics. The revised structure would leave Russia highly vulnerable to potential counterforce strikes. She emphasized the importance of land-based missile forces to the Russian deterrent and suggested that a forced economic downsizing of the Russian arsenal should come at the expense of the strategic aviation and only then land-based strategic forces.

Multiple regional and internal threats affect Russia’s strategic calculus. Economic pressures have had deleterious effects on Russian conventional forces, and increased Russia's incentive to preserve the Strategic Nuclear Forces currently in place. Ms. Gavrilov concluded that the Russian decision to accept a peaceful, non-aggressive role in the international arena is due to the multiple threats Moscow is facing. However, Russia should maintain its nuclear force for protection against other nuclear threats and other
national interests in a crisis situation. The force composition should be optimally composed, reliable, and affordable.

**Discussion and areas for future consideration**

The discussion following Dr. Scouras' presentation raised some interesting questions.

- How can we make nuclear weapons non-useable?
- How can we deter rogue states, Russia, and China from using nuclear weapons?
- Another participant cited Samuel Huntingdon's reference to Russia as a "torn country" caught between wanting to "Westernize" versus its traditional insularity and wanting to challenge the West. Participants concurred that it is crucial to consider Russia on a deeper level.
- Another participant addressed the issue of Russia as a nuclear factor in strategic affairs, arguing that there is strong evidence that Russia is moving down the strategic track (mid-90s) towards nuclear weapons to compensate for its conventional inferiority. This track could include a new family of more "useable, clean, and tactical" nuclear weapons that could be used near or possibly even on Russian soil.

One participant questioned the findings of Ms. Gavrilov’s research, positing that the Russians were not perturbed by the U.S. unilateral withdrawal from the ABM Treaty because the ABM Treaty only became a “cornerstone” in the late 1980s after the Soviet economy began to decline, President Reagan proposed the Strategic Defense Initiative, and the Russian elite were persuaded that the nuclear forces were not affordable.
Panel II: The Russia/China/U.S. Triangle - continued

Introduction

The facilitator for Panel II was Mr. Tom Neary, Director of the Nuclear Center at SAIC. The panelists included the following:

- Dr. Victor Utgoff, Institute for Defense Analyses
  *Game Theory Examination of Stability*

- Dr. Brad Roberts, Institute for Defense Analyses
  *China-U.S. Nuclear Relations: What relationship Best Serves U.S. Interests?*

- Dr. Greg Canavan, Los Alamos National Laboratory
  *Game Theoretic Analysis of Trilateral Engagements*

Background

Panel II's objectives were the same as Panel I's: to evaluate the changing dynamics of the bilateral and trilateral relationships between and among the U.S., Russia, and China. Dr. Utgoff showed how a game theoretic model could be used to examine a potential nuclear conflict between the U.S. and China over Taiwan. Dr. Roberts also focused on the U.S. relationship with China, identifying the chief U.S. options for shaping a strategic relationship with Beijing. Finally, Dr. Canavan looked at the interaction between the players in terms of the number and levels of forces, the effect of high value targets, and the introduction of defenses into a trilateral dynamic.

Key Insights

Dr. Utgoff's presentation demonstrated the ability of game theory analysis and simulation to derive Nash Equilibrium Strategies. In the illustrative U.S.-China-Taiwan game, players seek to balance the value of winning Taiwan versus the cost of fighting for it. The game's key components included:

- The conflict begins with Taiwan declaring independence from China
- A decision tree model depicts the strategies of each player
- Multiple chances exist in the decision tree for protagonists to strike and retaliate with different numbers of warheads; each has opportunities to back down or escalate
- A payoff function is used for calculations, based on two terms:
  1) The damage suffered from the nuclear attacks each side might chose to make, and
  2) The relative value of Taiwan to each.
- The payoff function is given by:

\[ e^{-Amk} - 1 \pm \nu_t \]
Panel II: U.S./Russia/China Triangle

Where:
- A is the number of warheads received.
- m is the fraction of warheads that hit.
- k is a constant proportional to the reciprocal of the number of targets that would have to be struck to destroy the entire value of the country.
- \( v_t \) is the value of Taiwan, added or subtracted as necessary.

- U.S. missile defense affects the escalation dynamic: Chinese missile vulnerability could become a future issue, requiring China to acquire mobile missiles.
- U.S. missile defenses may give Taiwan the confidence to stand up against PRC.

The proposition being tested by this game was the possibility of the PRC being able to "bluff us out" with their first-strike capability. Dr. Utgoff demonstrated the value of this method of analysis in looking at this potential future conflict but also presented some of the models limitations, namely:
- Rationality is assumed,
- Limited ways in which to employ nuclear weapons on both sides,
- Limited number of strike scenarios, and
- Other equilibriums are possible.

Dr. Roberts also examined the potential for conflict between China and the United States over Taiwan. His analysis was set within the larger context of U.S. decisions to pursue missile defense and the options that the U.S. consequently is facing in its future strategic relationship with China. What relationship best serves U.S. interests? Dr. Roberts presented three options:
- Tolerate Chinese capability to strike the U.S.: observe PRC build-up without fielding countervailing defenses;
- Trump Chinese strike capability: reorient the defense away from a limited one focused on rogues to something more capable; or
- Hedge against Chinese strike capability: tolerate it for the moment but only under certain conditions (which appears to be fairly close to the Administration's posture).

After laying out these options, Dr. Roberts outlined the structure of his study. First, he reviewed the history of the U.S.-PRC nuclear relationship and determined that the U.S. and China had fundamentally different views of history. Secondly, he explored the facets of the currently problem, namely:
- What role might nuclear weapons play in a conflict over Taiwan?
- What does the debate about the desired political relationship imply for the nuclear relationship?
- How can the perspectives of U.S. friends and allies inform U.S. thinking?
Panel II: U.S./Russia/China Triangle

- How might a view of the nature of the nuclear peace among the major powers generally inform thinking about the U.S.-PRC dimension?

Dr. Roberts’s scenario analyzing the role of nuclear weapons in a Taiwan contingency offers insights into the escalation dynamic:

- How it starts matters.
- Taiwan is an independent factor: it has the ability to defend, attack, and coerce.
- The PRC de-escalation capacity is uncertain because survival of the regime may be at stake.
- The U.S. has escalation strength but it is not certain it will be exercised in the escalation situation.
- The PRC could escalate despite the high risk but is more likely to prolong the conflict. It is very unlikely that the endgame will “spasm.”

These escalation insights contribute to U.S. views on the potential use of nuclear weapons in a conflict over Taiwan. Some additional findings from Dr. Roberts’ research were that defenses could shift the deterrence calculus in ways favorable to the U.S. In terms of options for the political relationship, he concluded that the partner versus competitor debate is more about what we must accept than what we desire. In relation to the theme of perceptions, which surfaced often during the roundtable, Dr. Roberts asked: What political goals are being signaled by the U.S.? U.S. decisions, like the deployment of BMD, and the maintenance of continued numerical superiority in offensive weapons, coupled with the growing U.S. conventional edge, all send competitor rather than partner signals to China. Dr. Roberts’ final insights were a cost, benefit, and risk analysis of the trump, tolerate, and hedge options: all situations have costs, benefits, and risks, and mandate that some trade-offs will be necessary.

Dr. Canavan combined the bipolar dynamics and evaluated the effect of introducing a third actor into the strategic stability calculus. His Game Theoretic Analysis of Trilateral Engagements is a tool to assess the implications of introducing high-value targets and defenses into a trilateral nuclear scenario. He began by explaining that although stability is not a factor that is considered in game theory, the game itself is valuable in its ability to demonstrate costs and benefits to each side, and the effects that the introduction of various factors can have on a scenario.
Panel II: U.S./Russia/China Triangle

The game is a decision tree. The process involves:

- Identifying which side makes choices;
- The enumeration of payoffs for each side in the game;
- Assessing the first and second strike costs and the costs of inaction; and
- The first node is the most critical, because the choice there determines whether to compete at later nodes. It is possible to figure out the disposition of forces and behaviors to see which side will move first.

When two sides with START-level forces are introduced to a third side with smaller forces and the primary targets are military in nature, then the relationship between the bilateral forces will remain stable, but the dyad will have an incentive to strike at the smaller player, while the smaller player will simultaneously have incentives for preemption of the larger sides’ forces. However, the introduction of high value targets, such as cities, reduces all three players’ incentives for action and the trilateral dynamic remains stable. Dr. Canavan’s model demonstrated that large defenses have no impact on the incentive to strike and generally there is no loss of stability.

On a policy level, this game has applications to our future posturing. For example, our relationship with Russia is considered stable and insensitive to offensive reduction and the introduction of defenses. The PRC dynamic differs in that perceived stability in this case is a factor of the targets. U.S. reluctance to incur damage to U.S. cities allows the PRC a means to compensate for a disparity in nuclear arsenals by targeting high-value assets and thereby achieving stability through a smaller version of Mutual Assured Destruction.

Another interesting facet of the trilateral engagement game was the trading of offenses for defenses and the possibility that this could remove missiles from trilateral interactions altogether. Dr. Canavan offered some interesting observations on game theory:

- Although it is difficult to know each side’s cost and objective, cost minimization produces Nash equilibria that will be adequate for bi and trilateral interactions with and without defenses.
- Uncoordinated attempts to avoid preemption might often be the cause of it.
- Dr. Canavan also noted that the role of uncertainty in this game is critical.
Discussion and areas for future consideration

Roundtable participants were intrigued by the value that games could add to analysis of nuclear stability. One participant queried Dr. Canavan about the extent to which you can assign value to either side’s susceptibility to brinkmanship. This question was important particularly in light of Dr. Roberts’ exercise to see if China could “bluff-out” the United States. Dr. Canavan explained that preferences, values, and brinkmanship are often reflected in the parameters of the game but are highly dependent on other factors as well. He highlighted the value of looking back at previous events, such as the Cuban Missile Crisis, to evaluate the equilibrium solutions reached during the games. This connection highlighted the complementarities of various analytic tools and models, like Dr. Scouras’ historical empirical analysis and Dr. Utgoff and Canavan’s games to help craft a more comprehensive stability framework.

The discussion over Dr. Roberts’ research left participants with a sense that Ambassador Brooks earlier comments about the future may be correct: it is not necessarily an arms race instability relationship within the triangle anymore. The relationship is definitely not static and the Offense-Defense Relationship is evolving. In thinking about our relationships with both Russia and China, participants wondered if it:

- Is in our best interest to preserve or negate their respective deterrents?

Another result of the discussion following the U.S./Russia/China Triangle Panels was:

- How does the “shadow effect” of nuclear weapons in regional conflicts factor into strategic deterrence?

This question highlighted the role that nuclear weapons can play in the stages prior to crisis escalation and warranted further examination.
Panel III: Missile Defense Implications

Introduction

Mr. Patrick McKenna, of the Strategic Studies and Analysis Branch, Force Assessments Division, of the United States Central Command moderated the third panel. The panelists evaluating the implications of missile defense where:

- Dr. Jerome Bracken, Consultant to the U.S. Department of State  
  *Layered Defense Architectures: Effectiveness, Stability, and Robustness*

- Dr. Kerry Kartchner, U.S. Department of State  
  *The Offense-Defense Relationship*

- Dr. Robert Powell, University of California at Berkeley  
  *Nuclear Deterrence Theory and National Missile Defense*

Background

The objective of the missile defense panel was to examine new tools for assessing the stability impacts of a deployed system, recommend architectures, and analyze the changing nature of the offense-defense relationship. Panelists covered a broad spectrum of missile defense issues and provoked much discussion and debate from roundtable participants.

Key Insights

Dr. Bracken presented *Layered Defense Architectures: Effectiveness, Stability and Robustness* as an option for a missile defense architecture. His presentation considered the views of Russia and China and the perceived impact on their deterrents. Dr. Bracken noted that to achieve a high level of effectiveness with a single layer, a missile defense system would require a high number of interceptors. This high number could in turn be perceived as compromising the deterrent of Russia or China. The advantage of a layered interceptor system is its ability to achieve specified goals of defense effectiveness without large numbers.

Dr. Bracken presented four alternate defense employment doctrines, each with different attacker and defender information, which in turn has an impact on the level of effectiveness. The four doctrines include:

- Known Allocation of Interceptors (Point Defense)
- Random Subtractive Defense (Area Defense)
- Reallocated Preferential Defense (Point Defense)
- Adaptive Preferential Defense (Area Defense)
After an examination of the programs of the Missile Defense Agency and the current deployment plan, Dr. Bracken moved on to describe several layered defense architectures. He highlighted:

- The system requirements
  - Effective;
  - Robust; and
  - Stable.
- The deleterious effect that discrimination problems can have on a system,
  - Particularly the discrimination problem that the Midcourse Defense Segment (MDS) may have.

Dr. Bracken advocated the Exoatmospheric/Endoatmospheric Interceptor (E2I), because of its ability to mitigate discrimination problems and serve as a final layer of defense against many targets. He also presented a work-around to the Russian and Chinese stability concerns by recommending a combination of a boost-phase defense and a ground-based defense.

His conclusion was that layered ground-based architectures with two kinds of interceptors could be both effective and robust with respect to discrimination and failure of a layer. However, the number of interceptors required could still be substantial if the threat is 20 RVs from the East and West and we have to engage every cluster. This could be problematic for the Russian and Chinese deterrent forces.

Mr. Kerry Kartchner addressed the key assumptions of the offense-defense relationship and the need to rethink the assumptions. In addition, he sought to provide alternative models for the future of the offense-defense relationship.

Mr. Kartchner first looked at some key assumptions of the Offense-Dominant Model that are now open to question:

- Deploying missile defenses will provoke an arms-race;
- Missile defense would increase first-strike incentives in a crisis;
- Defenses are technically infeasible and cost-ineffective;
- Offenses alone are sufficient for deterrence; and
- Strict limits on ABM systems are a necessary precondition for further offensive arms reductions.
Mr. Kartchner pointed out that it is unlikely that missile defenses will provoke an arms race with Russia. However, other situations such as U.S.-China, U.S.-North Korea, and China-India-Pakistan could be impacted. He also pointed out that missile defenses are unlikely to undermine crisis stability and could actually be beneficial in terms of buying time for a peaceful resolution. The technology and cost of missile defense are currently feasible and relatively cost effective. Mr. Kartchner also suggested that deterrence based on the threat of offensive retaliation may no longer be sufficient and he recommended the rehabilitation of concepts like damage limitation and reward through such means as détente, trade, and foreign aid. He cited instances of deterrence failures and scenarios in which deterrence will not be applicable to emphasize the need for new constructs. In addition, he argued that limits on the ABM systems are not a necessary precondition for further arms control since other factors are driving force reductions now. To fill the current gap, he suggested alternate models:

- **Offense-Dominance:**
  - The Offense-Dominance model remains the same as it was during the Cold War: that strategic offensive weapons are cheaper, easier to build, more reliable, and more effective than defenses particularly because defenses are still considered destabilizing and could provoke a regional arms race and because defensive countermeasures will continue to accord primacy to offenses.

- **No Relationship:**
  - The No Relationship model posits that no relationship exists between offenses and defenses due to differing roles and objectives. Offenses are mature, defenses are under development, and defenses will not be integrated into the SIOP.

- **Ad Hoc:**
  - The Ad Hoc model offers a trade for offensive weapons in order to be accorded greater rights to deploy defenses. It calls for a “new grand compromise” and is a relationship based on expediency. The relationship is political, ad hoc, and based on factors unrelated to the nature of the weapons themselves.

- **Defense-Dominance:**
  - The Defense-Dominance model portrays defensive technology as mature, reliable, and affordable. It places more emphasis on damage limitation in military, diplomatic, and political strategies and scenarios and is designed to allow defenses to fulfill missions previously assigned to offenses.

Mr. Kartchner asserted that traditional models and assumptions are in transition. He made a case for the disaggregated offense-defense relationship. He also claimed that the models are not necessarily mutually exclusive, they could represent points along a continuum in the transitional process from an offense dominant to defense dominated situation.
Mr. Kartchner also offered some areas for future study to the Roundtable. He suggested the need for:

- A better understanding of major nodes and milestones in the transitional process;
- An examination of the roles, missions, and objectives for defense forces because the Administration has made no decisions on architectures, interceptors, etc.;
- Rehabilitation of the approach of using Damage Limitation as a Measure of Effectiveness; and
- Analysis of the offense-defense operational trade-offs as a precondition for arms control.

Dr. Powell presented his game theoretic model of brinkmanship, *Nuclear Deterrence Theory and National Missile Defense*. His model analyzes the effects of proliferation and National Missile Defense (NMD) on crisis stability. His presentation evaluated the potential impact of NMD on America’s freedom to pursue its interests in regional conflicts with states that have acquired nuclear capabilities. His research provided four major findings:

- Acquisition of nuclear weapons is likely to give the regime of a small nuclear state – whether a rogue or not – the ability to deter the United States from trying to overthrow that regime. This moreover is likely to be the case even if the United States deploys an NMD unless that system is virtually flawless.
- The relative stability between the United States and the Soviet Union during the second half of the Cold War provides a poor guide to the stability of a crisis between new nuclear states or between the United States and a new nuclear state.
- NMD would give the United States somewhat more freedom of action and make a rogue more likely to back down in a crisis.
- Unless highly effective, NMD is likely to elevate the probability of a nuclear attack on the United States. This increased probability results from the United States’ willingness to press a crisis harder with NMD.

**Discussion and Areas for Future Research**

Dr. Bracken’s presentation was valuable in its attempt to identify effective, stable, and robust alternatives for missile defenses, particularly since the Administration has not yet selected an architecture for deployment. Participants at the roundtable were intrigued by Dr. Bracken’s concepts and also considered the question, “What other missile defense architectures could be deployed?” One participant noted that the scientific challenge of missile defense has mainly been conquered. The next step is to implement the technology while maintaining strategic stability.

Mr. Kartchner’s presentation argued that there is potential value in rehabilitating certain older concepts and constructs like Damage Limitation. Additionally, what are the cost and benefits of offense/defense tradeoffs? One participant queried the role that the emergence of new technologies such as information operations plays in the effectiveness of deterrence. Participants also pondered the future of the offense-defense relationship if space-based laser became a part of defense. Would that open the U.S. to attacks or sabotage on satellites, and would that be a stable condition? Mr. Kartchner agreed that
Panel III: Missile Defense Implications

space-based lasers could not be deployed in the near term and said, hopefully, that by that point in the future, the evolving strategic relationships would be mature enough to avoid this.

One final question was posed to Dr. Powell about his findings on NMD: if the U.S. continues with robust offenses while going on to build defenses, will China be placed in a “use it or lose it” situation? This question requires further analysis and is one that was touched upon in various degrees when considering the impact of offensive and defensive systems on our strategic relationship with China.
Panel IV: Deterring Rogue State Threats

Introduction
Dr. Jeffrey Milstein, a scientific advisor in the Advanced Systems Concept Office of DTRA acted as the facilitator for the rogue threat panel. This panel comprised:

- Dr. Michael Simon, SPARTA, Inc.
  *Rogue State Response to NMD: The Regional Context*

- Dr. Brent Sterling, DFI, International
  *Using "Red-lines" to Enhance Deterrence of Rogue States*

- Mr. Forrest Waller, SAIC
  *The Utility of Nuclear Weapons Against BW/CW Threats*

Background
The objective of this panel was to highlight the emerging threat of rogue states and to analyze how deterrence could be applied. The panel considered the goals of rogue states, how they are influenced by regional and external factors, and how they may respond to structured incentives and disincentives. The panel asked how do nuclear weapons affect rogue states? What impact will a deployed missile defense have on the decisions of rogue states? Is there a role for nuclear weapons in deterring the use of a biological or chemical weapon? And finally, what type of deterrent communication with rogue states would be most effective in deterring attack: “calculated ambiguity” or definitive “red-lines?”

Key Insights
In his presentation, *Rogue State Response to NMD: The Regional Context*, Dr. Simon focused on the following questions: "Will NMD Deployment make rogue states more or less likely to acquire nuclear weapons? “How will NMD affect the likelihood and severity of conventional war?” Dr. Simon claimed that the inquiry should be conducted in the *regional context* that rogue states actually inhabit. The methodology for his analysis was a game-theoretic model of regional conflict, both with and without NMD deployment. The findings were:

- NMD deployment would make rogue state nuclear acquisition less likely, but regional conflict more likely and more severe.
- Rogue states are particularly susceptible to the impact of NMD deployment.
The regional context that Dr. Simon presented was one in which rogue states were not seeking major power status. Rogues generally have regional rivals (e.g., North Korea vs. South Korea and Iraq vs. Saudi Arabia and Israel). Disputes with the U.S. often stem from a U.S. friendship with the rogue states’ regional rival (e.g., U.S. and South Korean friendship). The claim within this regional context is that the most likely impact on rogue state behavior of NMD deployment is a change in the rogue's behavior regarding its regional rival.

The game theoretic approach assumes:
- Decision-makers will attempt to maximize their expected utility; and
- Each state is Soft, Hard or Rogue type, which describes their preferences for various outcomes.

The substantive conclusions from the game-theoretic model included:
- In a technologically asymmetric dyad, NMD decreases the likelihood of regional states’ acquisition of nuclear weapons; but
- NMD increases both the likelihood and severity of regional conflicts that involve that regional state and its regional rivals.
- More broadly, U.S. NMD removes an enemy's nuclear bargaining advantage but does not change its goals.
  - The enemy will not go away, but will shift methods in pursuit of its goals; and
  - In a regional rivalry, this means increased likelihood and severity of conventional conflict.
- One implication is that protecting our friends with NMD would make them more likely to provoke their rivals. This too increases the likelihood and severity of conventional conflict.

Dr. Sterling presented the concept of deterrence "red-lines.” He discussed the two schools of thought that have developed on deterrence:
- One builds on the certainty of the deterrent message of retaliation as the key to effective deterrence; and
The other school favors the projection into an opponent's mind of uncertainty as to the attainability of his objectives as the key to effective deterrence. Ambiguity maximizes the opponent’s uncertainty regarding the consequences of the U.S. reaction.

Dr. Sterling argued that while actual attempts at establishing deterrence always fall between these two views, the relative emphasis on certainty/uncertainty might depend on the nature of the adversary.

Dr. Sterling discussed the difficulties involved in applying deterrence dynamics models to rogue states. Conveying deterrent threats to rogue states effectively is often difficult given asymmetry between the U.S. and the target county in terms of the intensity of the interests involved, the capabilities of each actor, the strategic cultures of the actors, and the political systems.

Dr. Sterling emphasized two fundamental components that exist with deterrence red-lines:

1) **Composition**:  
   - Red-lines only apply to those activities that, if pursued, could prompt significant U.S. military response.  
   - There are four basic types of red-lines: direct aggression, indirect aggression, use of certain weapons, or acquisition and supply of certain weapons.  
   - Specificity and prioritization of the red-lines must be considered:  
     - Specific red-lines are vulnerable to “salami tactics”; and  
     - There is a risk of the weakest red-line being attacked first, which would be deleterious to the credibility of the overall deterrent threat.

2) **Articulation** to the adversary  
   - Consider the source, message, timing, and implementation.

Dr. Sterling presented three situational types of deterrence: General (non-crisis), Intermediate (crisis situation), and Intra-War (during hostilities). He stressed the importance of delineating red-lines clearly during non-crisis situations, due to the loss of credibility and difficulty in conveying the message in the later two stages. “Definitive consequences” will also enhance effectiveness. Dr. Sterling presented this calculus:

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**Applying Deterrence Dynamics Model to Rogue States**

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<tr>
<th>Phase A: Threat from Target State</th>
<th>Phase B: Message Filters</th>
<th>Phase C: Target Reaction</th>
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<td>Requirement</td>
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<td>Target Perception</td>
<td>X* (US)</td>
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Conveying deterrent threats to rogue states effectively is difficult given asymmetry between US and target in terms of (1) intensity of interests, (2) capabilities, (3) strategic cultures, and (4) political systems.
Dr. Sterling then presented some notional red-lines for use with Rogue states:
- No attacks of any kind on the U.S. homeland;
- No attacks on U.S. allies, friends, or forward–based forces;
- No use of WMD against U.S. forces or allies; and
- No transfer of WMD to terrorists.

He argued that these red-lines are critical components of effective deterrence. He also claimed that precedent is an essential component as well. If a rogue successfully challenges a red-line, the credibility of future red-lines for both the offender and other deterrent targets will be compromised. Restoring the U.S. deterrent credibility after such a failure would be difficult and costly.

Mr. Waller presented *The Utility of Nuclear Weapons against BW/CW Threats*. His findings were lessons learned from counterproliferation games conducted over the period of 1995-2002. The purpose of the four games on which he based his results was to determine the how participants evaluated the utility of U.S. nuclear options to deter or defend against rogue state/non-actors armed with WMD. The games were future-oriented with the adversaries mainly coming from the “arc of instability”: North Africa to Northeast Asia. The game was deliberately structured to make it difficult for the players - with collapsing policy, geographic options and timing - to avoid considering the use of nuclear weapons as a possible solution to their problem.

The first game involved adversary use of lethal BW in the United States with significant U.S. civilian casualties in order to hamper embarkation of U.S. forces into the theater. Another game scenario involved persistent adversary CBW uses in a series of domestic and regional crises to contest U.S. access to the region. A third game posited a Middle East/Near East counterterrorism scenario with an international terrorist group attempting to acquire nuclear and biological weapons. Finally, the fourth game involved the U.S. defense of a regional ally, with the introduction of several NBC agents.

The key findings from the games were:
- Since 9/11 the U.S. experts’ perspectives on the utility of nuclear weapons has changed.
- Prior to 9/11, almost all the groups were reluctant to even discuss a nuclear response. However, after 9/11 all groups discussed the nuclear responses seriously.
Mr. Waller asked the question, “What does this mean?” Is it a result of a traumatic event or is there actually a paradigm shift occurring? Mr. Waller also presented other findings that suggest that the idea is gaining support that nuclear weapons may have a practical niche utility against WMD threats. Against lethal BW, particularly any contagious agent, some game participants found the nuclear option to be practical and relatively acceptable. Against less potent WMD, such as CW, they found the nuclear option unnecessary and unacceptable. However, whether seen as useful or not, the nuclear option was not a preferred option for any set of players, even after 9/11. Mr. Waller inferred that nuclear weapons only have niche utility for deterring rogue states. There are isolated instances when we would use them. The U.S. is unwilling to bluff about the use of nuclear weapons and opportunities to deter rogues are limited to circumstances when nuclear options are viable (i.e., lethal BW). He found that the players preferred deterrence through denial, not punishment. Significantly, Mr. Waller found that players insisted that sets of standards or questions had to be met or answered for them to decide that the U.S. nuclear option was viable. In most regional conflict cases, he inferred, the nuclear option will fail to pass this test or meet these standards.

**Discussion and areas of future consideration**

At the close of his presentation, Mr. Waller presented several questions to the Roundtable. He explained that in the post-9/11 world, some nuclear options are on the table, but barely. He asked the Roundtable, “Do U.S. plans reflect the change?” He wondered whether the war on terrorism and the Department of Defense’s massive transformation would cause the perception of the utility of nuclear weapons to grow or to decline.

Some other questions were posed about Dr. Simon’s theories on deterring rogue states. One participant asked if Mr. Simon’s theories could be applied to Iraq with a resultant change in Saddam Hussein’s behavior. Dr. Simon argued that it would apply because the regional implications of the U.S.’s friendship with Israel would suggest that the United States would become involved in an Israeli/Iraqi contingency, thereby decreasing incentives for Iraq to acquire nuclear weapons. Other participants questioned Dr. Simon’s finding that NMD could potentially make U.S. allies more aggressive. They argued that historically, extended deterrence has not caused that phenomenon to occur and that it would take a major shift for this result to happen.

Another debate emerged over the articulation of deterrence red-lines. Although “calculated ambiguity” is considered effective, many nations perceive the United States as a “paper tiger.” Alternatively, “clearly-delineated” red-lines pose a risk because the consequences could allow for the protagonist to perform a cost/benefit analysis while challenging the credibility of the United States.
Panel V: Instability Between Emerging Nuclear States

Introduction

Dr. Robert Batcher of the U.S. Department of State introduced the panel entitled *Regional Instabilities between Nuclear States*. The panelists for this session included:

- Mr. Robert Mosher, U.S. Department of State
  *A Battlefield and Combat History Survey of the Indo-Pakistani Wars of 1965 and 1971 and other Confrontations*

- Dr. Rodney Jones, Policy Architects International
  *Conventional Military Asymmetry and Regional Stability Among Emerging Nuclear States*

- Dr. Daniel Geller, University of Mississippi
  *Multi-Causality and War Between Emerging Nuclear States*

Background

This panel’s goal was to use different analytic tools and models of analysis to evaluate the threats and risks of nuclear war that emerging nuclear states pose in regions, like South Asia, that have many other kinds of instabilities, and where the emerging nuclear states also have a history of longstanding rivalry and recurring conventional warfare. To them, nuclear deterrence is a novelty and may be thought of almost like a game. If so, deep regional tensions or misperceptions could cause inadvertent escalation, ultimately resulting in a nuclear exchange. Dr. Mosher presents the history of India and Pakistan’s past conventional conflicts. Dr. Jones’ analysis looks at the trend towards more severe conventional military asymmetries between the two states and the role that nuclear weapons play in their respective military doctrines. Finally, Dr. Geller analyzes the impact of multiple factors that can cause a dyad, particularly one with a nuclear capability, to resort to war or to escalate.

Key Insights

Dr. Robert Mosher presented *Conflict in South Asia, A Historical Review of the Wars of India and Pakistan*. His historical analysis provided insight into the tactics, terrain, and strategy that affected the strategic calculus of both India and Pakistan during their 1965 and 1971 conventional wars. The lessons learned from past battles highlight:

- The lack of strategic depth between the two nations in the principal areas of past operations, particularly adjacent to or in Kashmir; and
- Factors that influence their calculus in the decision to escalate or back down in a conflict.

From Dr. Mosher’s historical analysis, it is apparent that:
Panel V: Regional Instabilities Between Nuclear States

- Low level skirmishes in Kashmir are a festering source of tension; and
- Skirmishes like the Kargil incident demonstrate the potential that events could spin out of control and quickly move from a conventional skirmish to a nuclear exchange.

Dr. Rodney Jones of Policy Architects International built on these factors in his presentation, *Military Asymmetry and Instability in Emerging Nuclear States: India and Pakistan*. Dr. Jones emphasized certain conditions necessary for strategic deterrent stability between emerging nuclear rivals:

- High nuclear threshold;
- Strong conventional defenses;
- Secure Second Strike Capability;
- Robust C^4I;
- Rough parity in size and defense space;
- Neither side falling behind the other’s first strike edge (perhaps through the implementation of a good early warning system); and
- Allies to fill gaps and generate uncertainty in the mind of the stronger on behalf of the side that is weaker.

Dr. Jones argued that the actual situation in South Asia is a clear contrast to the desirable conditions for nuclear stability between emerging nuclear state rivals. India’s conventional forces are burgeoning, while Pakistan’s are falling behind. Pakistan’s nuclear second-strike capability is dubious. There is intense political conflict over Kashmir and a high risk that low-intensity warfare in Kashmir could escalate to major conventional and then nuclear war. The C^4I is fragile and likely to contribute to nuclear instability during a military crisis or conventional war.

The methodology of his research employed trend comparisons of defense expenditures, quantitative levels of conventional combat equipment, and qualitative measures of combat capability in the air, ground and naval services on both sides. By examining such factors as defense budgets and burdens for both India and Pakistan, the composition of India and Pakistan's air forces, ground forces, naval forces, space and air surveillance capabilities, Dr. Jones was able to summarize both India's and Pakistan’s conventional modernization trends and to depict the growing conventional military imbalance.

He noted that India’s conventional military modernization was slow but steady. Despite a large domestic research and development establishment, India is import-dependent for most first-line equipment. India has acquired a ground force maneuverability advantage in the breadth and depth of its capabilities. India has some blue water naval ambitions, and its air and ground forces are potent compared to Pakistan’s. Russia is India’s main supplier of weapons with some weapons coming from Europe and Israel. Pakistan’s modernization is technologically slower, lacks variety, and lags India's in sophistication. China is Islamabad’s main supplier of equipment with some aircraft coming from Europe. Pakistan's ground and air forces are falling behind India in surveillance and connectivity and the air force is increasingly vulnerable to preemptive conventional air
attack. These factors contribute to the Pakistani incentive to rely on unconventional warfare.

Dr. Jones’ highlighted some policy implications based on his analysis:

- Due to the instability rising from the growing conventional military imbalance, Pakistan’s nuclear threshold is dropping;
- Pakistan is highly dependent on China and its unconventional warfare incentives are growing.

The question Dr. Jones posed was “Is conventional rebalancing possible?” This is vital to consider if US policymakers are serious about the avoidance of nuclear war in that region, but rebalancing needs to be done in a practical way. It should focus on raising the nuclear threshold and increasing the time available to prevent military crises running out of control.

Dr. Daniel Geller of the University of Mississippi built on Dr. Jones and Dr. Mosher’s presentations, taking into account the historical factors, conventional asymmetry, and new risks of nuclear conflict. His presentation, *Multi-Causality and War Between Emerging Nuclear States*, looked at how certain structural factors change the likelihood of warfare, what these variables look like in South Asia, and what implications they have in that region for managing the risks of nuclear war.

The conflict between India and Pakistan is shaped by multiple structural factors that increase the probability of violent interaction. The key variables are:

- Contiguity;
- Democratic vs. Authoritarian Political Systems;
- Unequal or uneven Economic Development;
- Unequal Capability Balance;
- Nuclear Brinkmanship; and
- Enduring Rivalry.

Applying these factors to India and Pakistan demonstrated that geographic contiguity has created a security dilemma for both nations as evidenced in the three wars over Kashmir, and their physical proximity decreases the requirement of military reach. The absence of democratic political systems on both sides of the equation adds instability as well. Nonviolent norms and shared institutions provided by common political systems would constrain leaders from escalating a crisis. The lack of advanced economic systems in the India-Pakistan relationship also contributes to instability, since low levels of international trade and development provide no disincentive to use war as a foreign policy option.

Dr. Geller presented four scenarios for the outbreak of nuclear war between India and Pakistan:

- Escalation from conventional war;
- Crisis-generated preemptive attack;
- Preventative war; and
• Accidental or unauthorized use of nuclear weapons because of failed command and control.

The final causal factor was enduring rivalry between the nations. Dr. Geller’s research showed that the probability of a dispute escalating into a war is eight times higher for an enduring rivalry than for a non-rival dyad. Dr. Geller’s conclusion was that the conflict between India and Pakistan is shaped by multiple structural factors that increase the probability of violent interaction. These forces are weighted heavily towards war and may supercede the deterrent effect of nuclear weapons.

Discussion and Areas for Future Consideration

Participants were impressed by the severity of the instability between these regional rivals. One participant questioned, “How can we raise the nuclear threshold between these two nations?” Another participant was concerned by the growing asymmetry in the militaries of the two countries and wondered if the most significant asymmetry was in surveillance and early warning.

Another issue that warrants future consideration is the impact of the current "war against terrorism" on the regional nuclear dynamic between India and Pakistan.

Finally, will the possession of nuclear weapons by this dyad increase or decrease the likelihood of use? Is the existence of nuclear weapons in this case purely for last resort or could they be used strategically and tactically to actually wage a nuclear war?
Panel VI: New Analytic Techniques and Paradigms

Introduction
Mr. Larry Sanders, a Scientific Advisor for the Advanced Systems Concepts Office of DTRA facilitated the last unclassified panel on *New Analytic Techniques and Paradigms*. The panelists for this session were:

- Dr. Robert Lempert, Evolving Logic
  *Ensuring Robustness in a Deeply Uncertain World*

- Dr. David McGarvey
  *Balancing Today’s Strategic Stability and Control Problems*

- Dr. Sean O’Brien
  *Analyzing Complex Threats for Operations and Readiness*

Background

The panelists for this session presented new analytic techniques and paradigms to address the shifting security framework. Dr. Lempert addressed the meaning of robustness to the new stability construct. He attempted to complement decision-making processes under stress. Dr. McGarvey analyzed the future of the strategic stability framework. Finally, Dr. O’Brien presented a novel tool for forecasting instabilities that could potentially destabilize the global environment.

Key Insights

Dr. Lempert addressed the concept of robustness in his presentation. He highlighted the need to prepare for and respond to surprise and the importance of decision-making under deep uncertainty. He sought to develop analytic tools for generating strategic scenarios. He described the failure of current analytic tools to bridge the gap in approaches to deep uncertainty. Currently, analysts typically use methods that ignore uncertainty, consider a small number of scenarios, and use probabilities to optimize expected utility. Decision-makers typically seek strategies that exceed some performance threshold or 'satisfice' over the criteria and are robust against failures. Dr. Lempert demonstrated that the Robust Adaptive Planning (RAP) model combines traditional analytic and narrative approaches to support robust, adaptive planning with analytic reasoning over multiple views of the future.

In order to craft an analytic approach to robust strategies:

- It is first necessary to identify candidate strategies;
- Compare strategies across all plausible scenarios;
- Select strategies robust over scenarios and values; and
- Discover and examine failure modes for candidate strategies.
Then based on analysis, decision makers can consider a means for hedging. It is then possible to iterate using the new candidate strategy set. This process is the analytic underlay of the process that decision-makers go through. Scenario generators address four types of factors:

- Exogenous;
- Policy levers;
- Metrics; and
- Relationships.

Dr. Lempert discussed utilizing RAP with the Multiple Engagements of Strategic Arsenals with Stability Measures (MESA/SM) model, developed by Los Alamos National Laboratory. MESA/SM examines strategic force planning and stability in multipolar scenarios. It analyzes force structure problems with hierarchical optimization, and generates multiple damage and stability outputs. Dr. Lempert’s computer assisted reasoning approach factors in a measure of relative "regret" in order to evaluate strategies. This approach allows decision-makers to analytically evaluate a variety of strategies for robustness and to detect strategies with poor outcomes near solutions with acceptable outcomes.

One critical caveat that Dr. Lempert pointed out was that MESA does not consider the effects of uncertainty on force planning within the model. This presents a challenge to the analysts to expand the role of uncertainty in modeling, since coping with surprise and deep uncertainties are among the most stressing challenges facing military planners.

Dr. David McGarvey, presented *Balancing Today’s Strategic Stability and Control Problems*. His presentation also pondered the future of the strategic framework. Dr. McGarvey defined the concept of “Nuclear Strategic Stability” as a set of conditions in which the risk is lowered that nuclear weapons will be used anywhere in the world. His research methodology:

- Identified major concerns today in maintaining strategic stability,
- Discussed the fundamentals of maintaining stability and control,
- Proposed some guidelines for the evaluation of force postures,
- Applied these guidelines to an illustrative example, and
- Provided observations

Today’s concerns about maintaining strategic stability are multiple and diverse. Dr. McGarvey identified the stability of coalitions, the management of arms competition, the control of proliferation, and political crisis and escalation control as the most pressing of these concerns. He also acknowledged nuclear force crisis and escalation control as key problems. Specifically, he noted that the stability framework could be altered under true or false tactical warning of an attack, under authorized or unauthorized attack, or under real or perceived force generation. Dr. McGarvey then presented some stability and control fundamentals that are essential to the construct of a new strategic framework and must factor into our notion of what stability means today. He argued that time lags can make an otherwise stable system fail and that insufficient resources can also cause a
nominally stable system to fail. Finally, coupling is important because attempts to correct one mode of imbalance within the system may exacerbate another.

In line with Ambassador Brooks’ challenge, Dr. McGarvey proposed new guidelines for U.S. nuclear force posture design and analyses. These included maximum use of non-nuclear forces, the use of Non-Strategic Nuclear Weapons (NSNW) instead of strategic weapons when possible, and decreased dependence on prompt launch. In addition, he recommended that the U.S. shift its focus to denying the enemy achievement of their objectives. He also advocated taking measures to reduce civilian damage, and at all stages retain some forces for possible later use. Finally, he argued that nuclear force posture and plans for use should be based on a carefully developed spectrum of conflict contingencies. From this suggestion stemmed a critical question, “What is today’s set of contingencies, if any, for planning tomorrow’s nuclear forces?”

To illustrate his points, Dr. McGarvey looked at two U.S. and Russian nuclear force postures: the first was a baseline nuclear force with the U.S. at 2,220 warheads based on the 2001 Nuclear Posture Review and the Russian Federation at 1,500 warheads. The second posture was deep cuts and de-alerting with both the U.S. and the Russian Federation at 1,000 warheads. Dr. McGarvey observed the implications of both postures in light of a crisis contingency in the Taiwan straits. Within this context, he posed a question to the group. He asked, “Would more, or less, capable NSNW, strategic offensive and/or defensive forces affect escalation or coalition control? Or are all nuclear forces politically equal?”

Dr. McGarvey then presented factors other than the nuclear balance that affect strategic stability including:
- The role of missile defenses;
- The capabilities of non-nuclear and non-strategic nuclear forces;
- Limitations on, transparency of, and verifiability of deployed forces;
- Weapons stockpiles and weapons production infrastructures; and
- Tactical warning and response systems.

Dr. McGarvey’s presentation again highlighted the multiple theories and factors that must be considered in evaluating and constructing strategic stability today. His presentation demonstrated that while it is necessary to preserve and propagate the positive relationship with Russia, it is also essential to preserve the deterrent value and escalation dominance of the United States in a crisis contingency. He argued that the strategic forces of the United States cast an important shadow and must be factored into logistical planning. In addition, the maintenance of strategic forces is critical to prepare for a scenario in which we would be caught off-guard by an adversary.
Dr. O’Brien of the Center for Army Analysis (CAA) presented *Analyzing Complex Threats for Operations and Readiness (ACTOR)*. ACTOR was developed to provide decision-makers with tools and models to give them insights into where, when, and to what extent country instabilities might challenge our national security interests and to enable contingency planning. The ACTOR model identifies, evaluates and then forecasts country macro-structural factors associated with different levels of intensity of country instability. For example, Dr. O’Brien presented collected data on GDP per Capita, Trade Openness, Religious and Ethnic Diversity and caloric intake, which contribute to environments likely to undermine national stability. These indicators help to gauge how the county will absorb shocks to its system and indicate if a situation could spark a conflict. Indices of instability are used to judge intensity levels of instability. The index places a country’s portfolio of macro-structural factor in historical context, applies algorithms and then forecasts the expected level of intensity. Instability levels can be high, moderate or low/none and are classified on a scale of one through four with four being war, three is violent crisis, two is a crisis and one is no conflict.

The Fuzzy Analysis of Statistical Evidence (FASE) analyzes the relationships between macro-structural factors and historical occurrences of instability. It is a non-linear, non-parametric, machine-learning algorithm developed by CAA specifically for ACTOR-related applications. Dr. O’Brien demonstrated through a split sample validation technique the ability of FASE to generate competent predictions. The model is trained with data from 1975-1999 to examine how structural variables have been associated with various levels of instability during that period. Using historical observations as a baseline, it is then possible to forecast each structural factor over the period FY2000-2015. Given the patterns that were uncovered during the training phase, and based on forecasted structural factors, an algorithm is then instructed to assign probability that a certain level of instability will occur in each year for a country during the 15 year time frame.

Dr. O’Brien gave a summary of ACTOR forecasts:
- The model forecasted that the world would become more unstable until the year 2007
- After the year 2007, improvements will occur.
• In particular, poor standards of living, ethnic tensions, and a long history of instability will continue to inhibit stable polities in Africa and South Asia. The forecasts also examine the intensity of instability in countries with nuclear capabilities:
  • Pakistan and Iraq were areas of high intensity;
  • China, North Korea, Russia, and Libya were moderate intensity;
  • India, Iran, and Israel initially were areas of high intensity but are forecasted to improve to moderate intensity.

Dr. O’Brien mentioned that additional layers could be added to the model to include things like environmental factors. ACTOR is a relevant tool for policy makers because it provides an analytical approach for developing long-term, global forecasts of country instability; it is amenable to scenario development and “what if” drills, and can provide assistance to strategic planners. Currently, the ACTOR methodology is being extended to forecast Militarized Inter-State Disputes (MIDs). The goal is to be able to generate long-term forecasts to be used as targets for systematic monitoring in real-time, which could aid in early warning and more nuanced predictions.

Discussion and Areas for Future Consideration

On Dr. McGarvey’s presentation, one participant observed that if we intend to generate a force of NSNW to constrain China, it is critical that we can communicate that we have this capability. Russia for instance, may not have the tactical warning or collection capability to effectively identify the direction in which we are moving with our forces. An ambiguous signal could pose a problem to our relationships with friendly nations and the credibility of the threat to adversaries of the future.

Another participant surmised that the Chinese might not distinguish between the types of forces that are being regenerated. There is an inherent sensitivity in designing capabilities and it is necessary for policy-makers to be attuned to re-alerting, validation, and verification dynamics as well.

Participants also engaged in debates about the necessity for an integrated assessment. Several models and analyses exist with results that are spread. Therefore, an examination of historical data will complement and validate other analytical tools and models. In addition, how can uncertainty be captured in the parameters of the analyses to craft strategies for the near term or ten years in the future that will be robust?
What do we mean by strategic stability today?

Ambassador Brooks began the conference with the question, “What do we mean by strategic nuclear stability today?” Are concepts such as deterrence and first-strike, which were once key considerations of our stability framework, still relevant? Participants and presenters examined the validity of these constructs in the post Cold-War environment and found them in need of revision. The new direction of the U.S.-Russian relationship, in particular, suggests the U.S. nuclear force structure that was primarily geared towards deterring Russia may not be well suited to preventing an attack from a rogue nation, a sub-national terrorist organization, or an emerging threat. The roundtable advanced the theme of rehabilitating damage limitation as a measure of effectiveness and also suggested the possible need to disaggregate the offense-defense relationship. How should the U.S. approach its strategic relationship with China? Trump, tolerate, and hedge options were suggested, but ultimately policy-makers must decide if it is within the U.S. interest to preserve or negate the Chinese deterrent, be it through a regeneration of offensive forces or a defensive build-up.

Several definitions of stability were placed on the table. Some were cast in traditional terms. Others tried to highlight scientific and technical nuances. In dealing with rogue states, some participants even questioned if stability was the ultimate goal or if it was better to instill in them a fear of devastating U.S. reprisals and make them feel the full weight of instabilities. Some recommended in light of lingering uncertainty and the prospects for surprise, that flexibility or “elasticity” on both tactical and strategic levels would better serve U.S. interests in the post Cold-War world.

How should we structure U.S. nuclear forces?

The 2001 Nuclear Posture Review posits that the United States is in a new era of “multiple potential opponents, sources of conflict, and unprecedented challenges.” The stated objectives are to assure, dissuade, deter, and defeat these challenges. The new NPR calls for nuclear based planning that will be capabilities-based, allow for greater flexibility for a range of contingencies, and facilitate unilateral reductions that will preserve flexibility yet allow for greater transparency in our relations with Russia and other global actors.

The forces under these criteria will include active defenses and non-nuclear capabilities with an increased dependence on command, control, intelligence and adaptive planning – aspects typically not addressed in traditional modeling. Ambassador Brooks challenged the roundtable participants to “catch-up” and help influence this new policy. Presenters evaluated force levels and the impact of reductions on stability and also demonstrated some new tools and methodologies that could bear more directly on these broader issues in the future.
Implications of missile defense

Missile defenses figured prominently in Roundtable discussions, whether in the context of their impact on the U.S.-Russia-China triangle, specific conflict scenarios (e.g., China-Taiwan), or allied/rogue state behavior. A variety of approaches were applied to the subject as well, including complex modeling and game theory. Some of these approaches yielded counter-intuitive propositions, such as an increased severity of regional warfare as well as the increased possibility of attacks on the United States once national missile defenses were deployed. Participants were challenged to compare such modeling results with empirical data.

While no consensus was reached on the most appropriate method of analyzing missile defense implications for stability, some approaches appeared to be quite germane to the policymaking dimensions of the issue. One model, for example, demonstrated that a layered defense might be a viable option for solving stability concerns vis-à-vis Russia and China by allowing for effectiveness and robustness with a smaller number of interceptors.

How do we plan for strategic surprise and deal with emerging threats?

September 11th has drastically altered the strategic calculus of the United States. Being able to forecast the certainty of attack, as manifested in the tactical warning of the Cold War, is a thing of the past. Policy-makers now realize that it is crucial to factor uncertainty into the offense and defense calculation. Participants advocated flexibility of response as a way to work around this challenge. Others presented new tools and methods that would help forecast regional instabilities, highlighting areas of the world that could present challenges to U.S. interests and potentially support better contingency planning.

What new concepts, tools, and methods can stability analysts contribute to policy?

The Roundtable depicted the transitional nature of the stability community today. Based on the presentations made, that community faces numerous challenges. Among them is adapting traditional gaming and modeling approaches to post-Cold War and post-September 11th realities. Greater collaboration among disciplines is another major challenge. The Roundtable’s mix of modeling and empirical analyses, for example, underscored the unique strengths and contributions of each approach. Yet, the synergistic effects of combining multiple disciplines could be more widely demonstrated. A challenge for all stability disciplines is to make their products more relevant to today’s policymakers, who appear to have moved well beyond traditional attitudes toward deterrence, offense-defense dynamics, and military planning. Senior-level policymakers attending the Roundtable issued a very specific challenge to stability analysts in this regard. The Roundtable thus offers these analysts an important opportunity for reflection and redirection.
What did we miss?

At the outset of the Roundtable, Ambassador Brooks mentioned the necessity of giving incentives to Russia to repair its deteriorating early warning system. Although the roundtable covered many topics, safety and security of nuclear weapons and nuclear weapons complexes was not explored in great detail. Some mention was made of the need to provide incentives for non-proliferation in a post arms-control world, but this issue still leaves room for exploration. Terrorist use of a radiological or nuclear device was also not a focus of the Roundtable participants.
Agenda
Fourth Nuclear Stability Roundtable: “Strategic Stability and Global Change”

March 12-13, 2002
DTRA Threat Reduction Support Center, Springfield, Virginia

Agenda

Tuesday, March 12, 2002

8:00-8:30 Check-in

8:30-8:45 Welcome and Opening Remarks

   Dr. Charles Gallaway
   Director, Advanced Systems and Concepts Office, DTRA

   Ms. Karin L. Look
   Deputy Assistant Secretary of State for Strategic and Technology Affairs

   Dr. Lewis Dunn, Conference Chair
   Senior Vice President, Science Applications International Corporation (SAIC)

8:45-9:15 Keynote Address

   Ambassador Linton Brooks
   Deputy Administrator, Defense Nuclear Nonproliferation
   National Nuclear Security Agency

Session 1 – Russia/China/U.S. Triangle

9:15-9:45 Post-Cold War Nuclear Events: Implications for a New Strategic Calculus
   Dr. James Scouras, Consultant to U.S. Department of State

9:45-10:15 Russian Reaction to U.S. Unilateralism in Nuclear Policy Issues
   Ms. Julia Gavrilov, Los Alamos National Laboratory

10:15-10:30 Break

Session 2 – Russia/China/U.S. Triangle - continued

10:30-11:00 Game Theory Examination of Stability
   Dr. Victor Utgoff, Institute for Defense Analyses

11:00-11:30 China-U.S. Nuclear Relations: What Relationship Best Serves U.S. Interest?
   Dr. Brad Roberts, Institute for Defense Analyses

11:30-12:00 Game Theoretic Analysis of Trilateral Engagements
   Dr. Greg Canavan, Los Alamos National Laboratory

12:00-1:00 Lunch

Session 3 – Missile Defense Implications

1:00-1:30 Layered Defense Architectures: Effectiveness, Stability and Robustness
   Dr. Jerome Bracken, Consultant to U.S. Department of State

1:30-2:00 The Offense Defense Relationship
   Dr. Kerry Kartchner, U.S. Department of State

2:00-2:30 Nuclear Deterrence Theory and National Missile Defense
   Dr. Robert Powell, University of California at Berkeley

2:30-2:45 Break
Agenda

**Tuesday, March 12, 2002 continued**

**Session 4 – Deterring Rogue State Threats**

<table>
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| 2:45-3:15 | Rogue State Response to NMD: The Regional Context  
Dr. Michael Simon, SPARTA, Inc. |
| 3:15-3:45 | Using “Red-Lines” to Enhance Deterrence of Rogue States  
Dr. Brent Sterling, DFI International |
| 3:45-4:15 | The Utility of Nuclear Weapons Against BW/CW Threats  
Mr. Forrest Waller, SAIC |
| 4:15-5:00 | Discussion: Summary of Day One -- Dr. Lewis Dunn |
| 5:00 | Adjourn |

**Wednesday, March 13, 2002**

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**Session 5 – Instability Between Emerging Nuclear States**

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| 8:15-8:45 | A Battlefield and Combat History Survey of the Indo-Pakistani Wars of 1965 and 1971 and other Confrontations  
Mr. Robert Mosher, U.S. Department of State |
| 8:45-9:15 | Conventional Military Asymmetry and Regional Stability Among Emerging Nuclear States  
Dr. Rodney Jones, Policy Architects International |
| 9:15-9:45 | Multi-Causality and War Between Emerging Nuclear States  
Dr. Daniel Geller, University of Mississippi |
| 9:45-10:00 | Break |

**Session 6 – New Analytic Techniques and Paradigms**

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| 10:00-10:30 | Ensuring Robustness in a Deeply Uncertain World  
Dr. Robert Lempert, Evolving Logic |
| 10:30-11:00 | Balancing Today’s Strategic Stability and Control Problems  
Dr. David McGarvey, Consultant to U.S. Department of State |
| 11:00-11:30 | Analyzing Complex Threats for Operations and Readiness (ACTOR)  
Dr. Sean O’ Brien, Center for Army Analysis |
| 11:30-12:00 | Discussion: Summary of Morning Session -- Dr. Lewis Dunn |
| 12:00-1:00 | Lunch |

The classified portion of the roundtable begins here

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<th>Time</th>
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| 1:15-2:15 | The Nuclear Posture Review: Classified Overview  
Mr. Tom Scheber  
Special Assistant to the Deputy Assistant Secretary of Defense for Forces Policy |

**Session 7 – Classified Presentations**

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| 2:15-2:45 | Stability Assessment of the 2001 Nuclear Posture Review Strategies  
Mr. Dennis Powell, Los Alamos National Laboratory |
| 2:45-3:15 | Lessons Learned Regarding Rogue State WMD Deterrence: A Survey of Deterrence Framework Analysis  
Mr. Greg Weaver, SAIC |
| 3:15-3:30 | Break |
| 3:30-5:00 | Summary and Discussion -- Dr. Lewis Dunn |
**Agenda**

<p>| 5:00 | Roundtable Adjourns |</p>
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Session 1 – Russia/China/U.S. Triangle

Post-Cold War Nuclear Events: Implications for a New Strategic Calculus
Dr. James Scouras, Consultant to U.S. Department of State

Abstract: One particularly important and oft-cited, but little-examined, source of difficulty in engaging and resolving post-Cold War strategic issues is that Cold War methods of analysis and measures of effectiveness are of uncertain relevance in this new era. While it is relatively easy, however, to assail “Cold-War thinking,” it is not so easy to develop new, more relevant, analytical approaches. The challenge is to define a methodology—a strategic calculus—that can be employed to evaluate the contribution of strategic forces to U.S. national security. Developing a strategic calculus relevant to the post-Cold War is an ambitious undertaking; this analysis attempts only the first steps. In particular it addresses the most basic questions: 1) Are nuclear weapons still relevant? And 2) Are nuclear deterrence and stability still relevant concepts, and how should we assess the contribution of strategic forces to underwriting them? The analysis focuses on the post-Cold War experience with crises that have involved implicit or explicit nuclear threats or actions, or those in which the simple existence of nuclear weapons has played an important role.

Russian Reaction to U.S. Unilateralism in Nuclear Policy Issues
Ms. Julia Gavrilov, Los Alamos National Laboratory

Abstract: On December 13, 2001, President Bush announced the U.S. decision to withdraw from the “Treaty on Limitation of Anti-Ballistic Missiles System” with the intent to develop and deploy a National Missile Defense system. Russia had warned previously that the destruction of this “cornerstone of strategic stability would lead to collapse of the complex and fragile structure of disarmament agreements concluded over the last 30 years,” would greatly undermine Russia’s national interests, and bring about destabilization, increased tension and arms race. Yet Russia’s reaction has been surprising soft, taking no concrete actions thus far. This paper explores the possible, realistic and not so realistic steps that Russia might take in the future in response to Washington’s unilateral withdrawal from the ABM Treaty.
Session 2 – Russia/China/U.S. Triangle – continued

Game Theory Examination of Stability
Dr. Victor Utgoff, Institute for Defense Analyses

Abstract: This presentation provides a transparent examination employing game theory to look at a potential nuclear confrontation between the U.S. opportunities to escalate the conflict or back down. It uses a simple payoff function that includes two terms - the damage suffered from the nuclear attacks each side might choose to make and the relative value of Taiwan to each. It solves for all possible extended strategies for playing the game that are Nash equilibria. The important characteristics of these sets of strategy equilibria are explained. Finally, it shows the sets of strategy solutions and how their important characteristics change as key parameters are varied such as the relative amounts of damage each can impose on the other with nuclear forces, the strength of their respective attachments to Taiwan, and whether or not the U.S. has missile defenses of various presumed levels of effectiveness. Comment is also made on how one might interpret the results of this examination in light of the fact that people and groups are not generally thought to behave according to the prescriptions of game theory.

China-U.S. Nuclear Relations: What Relationship Best Serves U.S. Interest?
Dr. Brad Roberts, Institute for Defense Analyses

Abstract: Coming to terms with the China - U.S. nuclear relationship is essential in the debate over how to construct a new deterrence framework that meets the requirements of security and stability in the post-Cold War era. China clearly knows what it wants in its nuclear relationship with the United States—some mutual vulnerability so that it is not again subject to what it considers nuclear blackmail, especially over Taiwan—and will modernize its forces to meet whatever missile defense challenge the U.S. poses in a way that it has survivable second strike. Arguing from first principles rather than expedients of cost or political constraints, what type of offense/defense relationship best serves the interests of the United States? The study identifies three basic U.S. strategy options: trump, tolerate, or hedge. In order to inform the U.S. choice, this study investigates four questions. First, what role might nuclear weapons play in the processes of escalation and de-escalation of a Taiwan confrontation? Second, how might an interest in shaping a constructive political relationship with China inform U.S. thinking about the necessary nuclear relationship? What might the interests of U.S. friends and allies suggest? And how might U.S. interests in general peace and stability among the major nuclear powers influence its thinking
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about the bilateral U.S.-PRC aspect? The study concludes with an elaboration of benefits, costs, and risks of each of the three basic strategy options.

Game Theoretic Analysis of Trilateral Engagements
Dr. Greg Canavan, Los Alamos National Laboratory

Abstract: Previous analyses have shown that the introduction of a third side with small offensive forces into the interaction between two sides with START-level forces leaves the interaction between the large sides essentially bilateral and stable. However, both see a strong incentive to strike the small side at low force levels. If targeting of higher value targets is included and the large sides strongly prefer survival of their high value targets, those incentives are reduced or eliminated. If the small side can hold a sufficient number of high value targets at risk with its limited number of weapons, the large side’s strike incentives are eliminated, which eliminates the small side’s incentive to preempt. The basis for the balance between the small and large sides then becomes essentially the same as that between the large sides on a smaller scale. The addition of modest defenses by one of the large sides has no impact on their bilateral interaction, which remains stable. The allocation of a small fraction of those defenses to the small side would not impact stability between them, but the allocation of a large fraction would give the large side an incentive to strike. However, as the number of defenses allocated approached the number of small side missiles from below, the small side would see an incentive to preempt, which acts as a barrier to further deployment. It resembles the barrier to deployment of large defenses in the bilateral interaction between two large forces, which arises from the same incentives. Incorporating the targeting of high value targets reduces strike incentives and maintains stability, although it does so at the price of the large defended side’s ability to deter untoward action by the small side. Trading offenses for defenses in both interactions could remove missiles from trilateral interactions altogether.

Session 3 – Missile Defense Implications

Layered Defense Architectures: Effectiveness, Stability and Robustness
Dr. Jerome Bracken, Consultant to U.S. Department of State

Abstract: To achieve high missile defense effectiveness with a single layer may require firing a large salvo at each reentry vehicle (RV). For instance, if there is a threat of 20 RVs, the interceptor requirement may be on the order of 100. If defenses are designed to thwart rogue nations with high effectiveness, the number of interceptors required may be perceived as compromising the deterrent of Russia and/or China. Layered defenses can achieve specified effectiveness goals with significantly fewer interceptors than are required by a single layer. For any defense, doctrines with different attacker and defender information can result in widely varying effectiveness outcomes. Layered defense architectures can differ
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substantially in effectiveness, stability and robustness. Detection of a cluster of objects by layers and by individual interceptors, and classification of RVs and decoys by interceptors, can strongly affect results. The paper presents a layered defense example. It compares four defense doctrines. It reviews the scope of the programs of the Missile Defense Agency and of the current deployment plan. It describes comprehensive layered defense architectures and reviews several more limited schemes. An attempt is made to identify effective, stable and robust alternatives. The paper investigates how differing assumptions about decoy discrimination by layers affect overall defense performance.

The Offense-Defense Relationship
Dr. Kerry Kartchner, U.S. Department of State

Abstract: Throughout the Cold War, offensive strategic forces and deterrence strategies that relied almost exclusively on punitive retaliation were the dominant and preferred means of underwriting strategic stability. This “cult of the offensive” was based on four key premises, whose continued relevance or viability are now subject to question. The potential now exists for a new offense-defense relationship to arise, but the character of this relationship is not yet clear. This presentation explores four potential futures for the offense-defense relations: (1) no change from the present offense-dominance; (2) a disaggregated, or non-relationship where both serve distinct roles and have no effect on the other; (3) offensive forces as strictly bargaining chips to be bartered away for greater rights to deploy missile defenses (the converse of the Cold War relationship where ABM systems were strictly considered as bargaining chips to trade away for limits on offensive forces); and, (4) the emergence of a defense-dominant relationship, reversing the preeminent Cold War dynamic.

Nuclear Deterrence Theory and National Missile Defense
Dr. Robert Powell, University of California at Berkeley

Abstract: In a brinkmanship crisis, each state continually faces a choice between giving in to its adversary or pressing the crisis forward thereby raising the risk that events will spiral out of control through accident or inadvertence. The crisis continues until one of the states finds the risk too high and acquiesces or events do go out of control. This paper presents a game theoretic model of brinkmanship and uses it to analyze the effects of proliferation and National Missile Defense (NMD) on crisis stability. The analysis shows first that the spread of nuclear weapons is likely to give the regime of a small nuclear state – whether a rogue or not – the ability to deter the United States from using its conventional superiority to overthrow the regime. This moreover is likely to be the case even if the United States deploys an NMD unless that system is virtually perfect. Second, over a wide range of issues, NMD would give the United States more freedom of action and make a rogue more likely to back down in a crisis. But, third, NMD is likely
to raise the probability of a nuclear attack on the United States unless, once again, that system is extremely effective.

Session 4 – Deterring Rogue State Threats

Rogue State Response to NMD: The Regional Context
Dr. Michael Simon, SPARTA, Inc.

Abstract: How will rogue states respond to U.S. deployment of NMD? Will NMD make rogue states more likely to acquire nuclear weapons, or will it convince them that such deployment is futile? How will NMD affect the likelihood of conventional war? Heavy debate exists on all of these questions. Much of this work, however, ignores the important regional context that rogue states inhabit. While rogue states (such as Iraq or North Korea) may see the U.S. as an enemy, most of their foreign policy behavior is centered on regional rivals (such as with Iran and South Korea, respectively). Thus whether or not rogue states will choose to acquire nuclear weapons is largely a regional matter. Rogue states – almost by definition – are not states that are attempting to achieve major power status and become rivals of the U.S. in the traditional sense. What is relevant to rogue states is the extent to which the U.S. can and will intervene in their regional conflicts. The game-theoretic model examines the impact of NMD deployment on rogue state behavior and regional conflict. For tractability, the model focuses only on asymmetric regional rivalries. Results suggest that NMD deployment will make nuclear acquisition less likely, but regional conflict more likely and more severe. The model suggests that NMD is particularly influential at altering the behavior of rogue states.

Using “Red Lines” to Enhance Deterrence of Rogue States
Dr. Brent Sterling, DFI International

Abstract: The articulation of “red lines” – thresholds whose violation would precipitate a military response – is often suggested as a “magic bullet” to shape adversary perceptions of when the U.S. would commit to force to deter rogue states with chemical and biological weapons (CBW). This presentation, building on past work at DFI, explores the virtue of red lines. In particular, it offers some thoughts on when and how to employ red lines. The briefing considers the relative advantages of particular variants such as prohibitions on certain actions, prohibitions on using particular weapons, or setting distinct threshold levels for either of the first two variants; antecedent conditions that enhance or undermine the potential effectiveness of red lines; and the complication of employing multiple red lines for rogue states and the potential need to diversify specific warnings among particular adversaries. Any discussion of using red lines would be incomplete without consideration of how to communicate a credible threat to the adversary. The key challenge is for the U.S. to convey serious consequences for defiance without sacrificing tactical flexibility that would come from
specifying the precise means of response. Ultimately, properly employed red lines offer the potential to bolster U.S. deterrence, but only if used in the right manner.

**The Utility of Nuclear Weapons for Deterring BW/CW Threats**
Mr. Forrest Waller, SAIC

**Abstract:** This presentation describes a series of unclassified games and simulations whose purpose was to explore the utility of U.S. nuclear weapons in notional conflicts involving chemical and biological weapons. The games and simulations began in the mid-1990s and continue today in various forms. The games were designed to put participants in situations of increasingly destructive adversary use of CBW while simultaneously narrowing U.S. options for response. In so doing, the games tested the participants’ perception of the utility of nuclear weapons in achieving U.S. political-military objectives. Participants in the games were serving and former civilian officials of the United States Government and included individuals with experience serving on the National Security Council Staff; senior officials of the Departments of Defense, State and Energy; Congressional staff; and senior military officers. Their service spanned several presidential administrations. This presentation will describe the game series, its objectives, and outcomes. It will also draw distinctions between professional groups and their reasoning processes when they considered recommending the use of nuclear weapons.

**Session 5- Instability Between Emerging Nuclear States**

**A Battlefield and Combat History Survey of the Indo-Pakistani Wars of 1965 and 1971 and other Confrontations**
Mr. Robert Mosher, U.S. Department

**Abstract:** This presentation examines how the conventional forces of the two South Asian states have fared in combat against each other, looking especially for insights into the likely outcome of possible future conflicts. In addition, a parallel examination is conducted of the operational theater and how its terrain has affected past outcomes and may influence future conflicts. This analysis draws on a number of Indian and Pakistani sources, as well as accounts and analysis from neutral observers.
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Conventional Military Asymmetry and Regional Stability Among Emerging Nuclear States
Dr. Rodney Jones, Policy Architects International

Abstract: The dynamics of conventional military interaction between pairs of emerging nuclear states which are adversaries and located outside the traditional U.S. nuclear umbrellas for Europe and East Asia represent uncharted territory and may pose difficult or even unprecedented foreign and security policy questions. Strategic deterrence theory principles of the Cold War may or may not be applicable to regional conflicts between emerging nuclear state adversaries. This paper examines the growing disparity of conventional force capabilities between India and Pakistan. It raises questions about the degree to which existing conventional defense capabilities will withstand, or are likely to break down under, the increasing stress of confrontations between these two states over Kashmir and terrorism. Based on qualitative and quantitative measures of differential conventional force modernization, this analysis provides one approach to assessing the degree of the military and crisis instability to be expected between asymmetrically endowed nuclear-armed states. It thus provides a window into the conditions under which pairs of emerging nuclear adversaries may experience a collapse of deterrence and escalation to nuclear use. These issues in turn raise fundamental policy questions regarding the preparedness of the United States and the international community to deal with the consequences of nuclear use in densely populated environments adjacent to regions of vital importance to U.S. and allied national security, such as the Gulf and East Asia.

Multi-Causality and War Between Emerging Nuclear States
Dr. Daniel Geller, University of Mississippi

Abstract: Explanatory knowledge resides at the apex of the processes of science. In recent decades, the empirical identification of the factors and forces which move nations into conflict has constituted a basic goal in the scientific study of war. However, few attempts have been made to construct empirically grounded explanations of violent international conflict. There is a growing recognition of the complexity of war, and this has led to discussion among social scientists of a process termed "multiple conjunctural causality" in which events are the product of the intersection of several factors and where a given event can occur through several different causal paths. In this study I provide an empirically derived explanation of conflict between new nuclear states based on the mechanism of multiple conjunctural causality. It is concluded that the conjunction of structural forces is heavily weighted toward war, and that the presence of nuclear weapons will have little effect in deterring future conflict.
Session 6 – New Analytic Techniques and Paradigms

Ensuring Robustness in a Deeply Uncertain World
Dr. Robert Lempert, Evolving Logic

Abstract: An important concern of strategic forces planners and warfighters has been assessing the capabilities and implications of force structures and doctrines over a range of stressing conditions. The game-theoretic and optimization frameworks on which such assessments rely have traditionally been unable to address the challenge of surprise and uncertainty. This presentation will apply newly developed Robust Adaptive Planning (RAP) methods to the Los Alamos National Laboratory’s Multiple Engagement of Strategic Arsenals with Stability Metrics (MESA/SM) model. LANL developed MESA/SM to examine strategic force planning and stability in multi-polar (including bi-polar) scenarios. MESA/SM has been embedded in the robust adaptive planning software environment and examined its implications over a very wide range of scenarios. In particular, we examine the stability of a range of offensive and defensive force structures, alert rates, and withhold strategies over a very wide range of scenarios, including different combinations of adversaries, as well as different objective functions, force structures, and doctrines used by those adversaries. We assess which strategies are most robust against these scenarios. These results will not only be interesting in and of themselves, but will demonstrate an exciting new method for assessing force structures and doctrines under conditions of deep uncertainty.

Balancing Today’s Strategic Stability and Control Problems
Dr. David McGarvey, Consultant to U.S. Department of State

Abstract: Systems may fail if they have either excessive or inadequate inherent stability relative to the active controls available to restore equilibrium, if control response times are too sluggish relative to system dynamics, or if attempts to correct one mode of disequilibrium exacerbate another. Designing to deal with only benign disequilibriums, or only with one or two modes of disequilibrium at a time can lead to disastrous failure. The post-Cold War world provides many challenging strategic nuclear stability problems. As Russian Federation forces decline, Chinese forces grow, and the acquisition of weapons of mass destruction by nations with unresolved regional disputes continues, the United States must configure its offensive and defensive forces and undertake other initiatives to balance many forms of stability and control. These include crisis and escalation control, the stability of coalitions, management of arms competition, and control of proliferation. These must all be dealt with, as well as problems inherited from the Cold War such as stability under conditions of false warning, unauthorized attack, or real or perceived force generation. Stability and control must be
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maintained not only “one problem at a time” but also, potentially, under the stressing conditions of multiple challenges brought on, say, by a regional conflict or other major events. Focusing on just one or a well chosen few of these stability problems can lead to “obvious” solutions which exacerbate other problems. The trick is getting the balance right among all of them.

Analyzing Complex Threats for Operations and Readiness (ACTOR)
Dr. Sean O’Brien, Center for Army Analysis

Abstract: Military planners, defense analysts, diplomats, and legislators need better tools and models to provide them with better insights into where, when, and to what extent country instabilities might challenge national security interests so they can anticipate, plan, and budget for these possible occurrences in advance. This study draws upon the state strength literature, uses recently developed data-mining tools and draws upon an extensive database that includes annually aggregated data covering political, economic, and socio-cultural domains for some 159 countries over the period 1975-1999 to forecast the likelihood that countries throughout the world will experience a certain level of intensity of instability over the period 2001-2015. The study uses a pattern classification algorithm—Fuzzy Analysis of Statistical Evidence (FASE)—developed by Chen (2000) on behalf of the U.S. Army to identify and analyze the relationships between country macro-structural factors and historical occurrences of instability. A split-sample validation design is used to evaluate the ability of FASE to generate competent predictions, using the standard performance metrics overall accuracy, recall, and precision. The results demonstrate the potential capability of the model to accurately forecast not just the occurrence, but also the level of intensity of country instability six years in advance with about 80% overall accuracy. The forecasts generated through the year 2015 suggest that South Asia and East Africa will continue to harbor highly unstable states. However, most of the states expected to improve their prospects for greater stability are also located in these regions.

(U) The Nuclear Posture Review: Classified Overview
Mr. Tom Scheber, Special Assistant to the Deputy Assistant Secretary of Defense for Forces Policy,

(Unclassified) Abstract: The Department of Defense has outlined in the Quadrennial Defense Review (September 2001) a general approach to transform military strategy. The Nuclear Posture Review (December 2001) provided an additional level of detail for the transformation of the existing deterrence strategy to a broader-based strategy that addresses the new defense policy goals. The new strategy outlined in the Nuclear Posture Review is fundamentally different from that of the past and is much more complex. The past strategy was threat-based and dependent on offensive strategic nuclear forces and mutual vulnerability to
ballistic missiles; it will be replaced by a new, capabilities-based strategy. The capabilities-based force will be characterized by a significantly reduced arsenal of offensive strategic nuclear weapons that will be part of a “New Triad.” Improvements in intelligence, planning, and command and control also will be required to provide flexibility and to integrate the capabilities of the New Triad. This new framework will present new challenges and opportunities for the analytic community. New stability concepts, models and metrics will need to be developed to guide the development of the New Triad and to measure its effectiveness. Many details regarding new capabilities, planning systems, and employment concepts remain to be developed. The analytic community will need to play a significant role to provide insight to the national leadership during this time of innovation and transition. This presentation will provide an overview of the new strategy and will outline briefly the challenges associated with the New Triad concept for stability analysis.

(U) Stability Assessment of the 2001 Nuclear Posture
Mr. Dennis Powell, Los Alamos National Laboratory

(Unclassified) Abstract: The status of strategic nuclear forces is changing for both Russia and the U.S. For the U.S., the 2001 Nuclear Posture Review (NPR) has established initial directions for the future of U.S. strategic policy. Many factors affecting the U.S. strategic posture and capabilities are addressed, although strategic stability gets little mention in the NPR. The relative stability of the U.S. with respect to other nuclear-capable nations is still of interest, especially given reduced nuclear warhead levels and the expected introduction of missile defenses. The decision to unilaterally reduce to 1,700-2,200 deployed warheads was influenced by the analysis of several force level and strategy combinations. Using classified sources for U.S. and threat capabilities, the force levels and strategies used for the NPR are evaluated with respect to well-known metrics of stability. Using these scenarios as a baseline, limited ballistic missile defense is added to the U.S. strategic force and its effect on stability is examined. This analysis is intended to provide a preview of the stability implications of mutual strategic warhead reductions up to the year 2015.

(U) Lessons Learned Regarding Rogue State WMD Deterrence: A Survey Framework Analysis
Mr. Greg Weaver, SAIC

(Unclassified) Abstract: This presentation draws out a set of “lessons learned” from WMD deterrence calculus assessments of three rogue states: Iraq, Iran, and North Korea. These studies were performed in support of USCENTCOM, USPACOM, and OSD/Policy under DTRA sponsorship. The presentation will outline the key lessons learned from these detailed and rigorous assessments of the perceived benefits and costs of various forms of WMD use by these three
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adversaries. Each lesson learned will be examined to determine its source or cause, its relevance to other potential deterrence situations, and the potential U.S. actions that could be taken to address it. The presentation will conclude with a summary of key potential U.S. actions that could enhance deterrence of rogue state WMD use based on these analyses.