PROJECT ON NUCLEAR ISSUES SUMMER CONFERENCE
CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES
WASHINGTON, DISTRICT OF COLUMBIA
JULY 7 - 8, 2011

PRESENTATION ABSTRACTS

SESSION ONE: STATE CALCULATIONS ON ACQUIRING NUCLEAR WEAPONS

Red Lines in Coercive Nonproliferation
Daniel Altman, PhD Candidate, Political Science, Massachusetts Institute of Technology

We too often think about coercive demands solely in terms of how much is being asked of the other side. However, every demand must also set a red lines dividing compliance from noncompliance, and these red lines have important characteristics other than how much is demanded. This presentation will provide a set of five characteristics of red lines that enable a more structured discussion of coercive demands, briefly explain why each characteristic points to a vulnerability, and touch on how states exploit these vulnerabilities in red lines. More concretely, I will explain how these five properties of red lines have shaped coercive nonproliferation efforts towards Iran and North Korea.

The Cost of the Bomb: Security Trade-offs and Nuclear Forbearance
Gene Gerzhoy, PhD Candidate, International Relations, University of Chicago

Why have most states forsworn nuclear armament? Nuclear deterrence virtually guarantees a country's survival, yet among the dozens of states that pursued nuclear weapons, only nine currently possess them. This paper argues that nuclear abandonment results when the pursuit of nuclear weapons impedes a country's national security objectives. The paper proposes two mechanisms by which nuclear ambitions can hinder national security: (1) when the aspiring state is dependent for its survival on a great power patron determined to staunch nuclear proliferation, the proxy is vulnerable to coercion aimed at quashing its pursuit of nuclear weapons. (2) When states have a pressing need for investment in conventional weapons, the pursuit of nuclear arms produces unacceptable trade-offs, raising the opportunity cost of nuclear weapons development. The paper demonstrates the plausibility of these hypotheses using two historical case studies, and concludes by discussing the policy implications of its findings and avenues for future research.

Japan's Nuclear Hedging
Jithin George, Research Associate, National Maritime Foundation

Will Japan go nuclear? Most of the Japanese find it inconceivable given the strong anti nuclear sentiments learned through their dreaded experience in Hiroshima and Nagasaki. But on the contrary Japan's nuclear policy has remained strongly influenced by two major factors: Tokyo's determination to keep Japan's position under U.S. nuclear umbrella and U.S. security objectivities in East Asia. For Tokyo, there is a very serious problem resulting from keeping Japan protected by the U.S. nuclear shield. Tokyo has two simultaneous and antithetical objectives: the first is to keep Japan protected by the U.S. nuclear shield and the second is to oppose the existence of nuclear weapons. Argued by some to be

contradictory, a charge that Tokyo denies by saying that both objectives can be realized as the nuclear powers move toward disarmament, Tokyo attempts to maintain the first and promote the second, but only to the extent that the latter does not jeopardize the former. Suspicions and speculations have persisted that, given the right set (or wrong set) of international and domestic conditions, Japan might seriously consider the nuclear option. Japan is one of the most highly technologically advanced countries, relies heavily on nuclear power for its domestic energy consumption, and has vast stores of plutonium that can be used as nuclear weapons. If it ever crosses the Rubicon into the realm of the nuclear arms, there is near-universal recognition that the potential consequences would be enormous and unpredictable-and quite possibly extremely dangerous. This article evaluates Japan's experiences in nuclear hedging and tries to analyze the six possible scenarios which would force Japan to reconsider its anti nuclear stance. Given the vulnerable situation in East Asia and changing contours of U.S-Japan alliance, it is crucial to study the "push" factors involved in a Japanese nuclear hedging.

Iran's Nuclear Strategy: Understanding Tehran's Acquisition Pathway
Patrick Disney, MA Candidate, International Relations, Yale University

The consensus among Western intelligence assessments states that Iran is not actively trying to obtain a nuclear weapon, though the option to do so remains open, and is amassing scientific and technological prowess that could potentially contribute to a nuclear weapon. Based on publicly available evidence, Iran's leaders appear to be ambivalent about weaponization and could be persuaded to pursue either a weapon or a purely civilian program depending on a wide array of factors. Past behavior -- particularly with regard to the nuclear program and other unconventional military acquisitions strategies -- indicate that Iran's leaders prefer to develop a wide variety of policy options for any given issue, and to delay as long as possible the need to choose among these options. The Iranian regime's past decision making behavior has been highly reactive and based in large part on forming consensus among diverse political factions. Therefore, with regard to nuclear weaponization, the regime is likely to delay its ultimate decision until some provocation changes its calculus. Such a provocation -- particularly if it involves an outside actor like the United States or Israel -- would allow a consensus position to emerge among Iran's otherwise divided political elite. This poses a serious problem for US policy makers whose primary goal is to block Iran's acquisition of nuclear weapons. Given that Iran's goal at present appears to be aimed at nuclear latency, not full weaponization, Washington's strategy could easily backfire. The practical consequence of America's misaligned strategy for dealing with Iran could actually be to encourage an Iranian push for a nuclear weapon.

SESSION TWO: U.S. – RUSSIA ENGAGEMENT ON NUCLEAR POLICY

Contextualizing and Engaging Russian Nuclear Policy
Alejandro Sueldo, JD Candidate, University of California at Berkeley

Drawing upon interviews with experts, this paper examines the role nuclear weapons play in Russia's foreign and defense policy, with particular focus on their relation to arms control, the U.S.-led ballistic missile system, Russian military reform, and the role of the U.S., NATO, Iran and China. The paper finds that Russia will for the foreseeable future continue to depend on its nuclear weapons for real and perceived status and security, and thus will be reluctant to engage in both further strategic arms reductions and talks on tactical nuclear arms control, particularly without greater clarity on the near-term U.S. political climate, and greater assurances that China will not jump to strategic parity and that

NATO missile defense will not threaten Russia. Furthermore, this paper finds that nuclear weapons will likely play a greater role in a reformed Russian military and that reductions of Russia's tactical nuclear weapons will largely depend on assurances regarding China intentions, greater transparency on U.S. prompt global strike, and efforts to revive talks on European conventional security. The paper is peppered with discussion on how to engage Russia nuclear policy on various fronts and concludes by examining latent challenges and promising opportunities to engaging Russia on nuclear issues.

Challenges in U.S.-Russia Non-Proliferation and Disarmament Initiatives

Kate Svyatets, PhD Candidate, International Relations, University of Southern California

Recently the United States and Russia have made a substantial progress in their cooperation on nuclear issues. The signing and ratification of the new START treaty has been a major success in the disarmament process, even though the problems of verification and accountability still persist. At the 2010 NATO-Russia Council summit, the presidents of Russia and the U.S. discussed future prospects of cooperation and potentially disputable issues, such as the missile defense plan in Europe and the Iranian nuclear issue. On the issue of Iran, they have been looking for a solution on the scale between engagement and coercion, to make sure that Iran complies with the international security and nonproliferation regimes. President Obama and President Medvedev seem to share a belief that this issue can only be resolved multilaterally, under the leadership of IAEA and the United Nations. In the last decade, the Iranian nuclear problem was a stumbling block between the U.S. and Russia, as Russia was aspiring to restore its great power status and nuclear leadership. The U.S. missile shield in Europe has been an equally problematic issue in U.S.-Russia relations and may undermine the implementation of the new START treaty. Russian experts have responded to the U.S. missile defense plan in Europe, as well as NATO's expansion, extremely negatively and described it as a radar system against Russia. American policymakers, on the contrary, have underscored that the system is not a threat to Russia's nuclear capabilities. Until recently, few attempts have been made to find a mutually acceptable solution. NATO experts have proposed an exchange of information, while Russia insists on a joint system. Latest suggestions to allow Russia's involvement in the missile defense system may help find a consensus.

From START to Finish?

Houston John Goodell, Captain, US Army Judge Advocate General; LLM Candidate, Georgetown University

The New START Treaty continues a long tradition of nuclear arms control between the United States and Russia that is a direct result of the Cold War arms race between both nations; however, while the treaty is beneficial in some ways, it is a vestige of successful past peace processes between both countries, an arcane tool that has become somewhat obviated by the modern realities of nuclear proliferation in the new millennium. The rise of nuclear states with links to terrorism, like North Korea, make the need more pressing for the United States to move away from bilateral treaties with Russia and focus efforts and resources on alternative means to create a more stable global picture. At some point, the United States, Russia, and the other members of the "nuclear club" are going to have to face a reality – whether or not to rid their countries of nuclear stockpiles completely in accordance with Article VI of the Non-Proliferation Treaty (NPT). With only the United States and Russia committing to treaties like New START, where an accurate accounting and decommissioning of nuclear weapons occurs, it seems less

likely that the other countries with nuclear weapons will ever disarm in accordance with Article VI of the NPT. If countries such as China, Pakistan and North Korea have no intention of complete nuclear disarmament, treaties like New START arguably serve less to reduce the nuclear stockpiles of the United States and Russia and more to keep the dialogue open between two nations that have already appeared willing to support transparency and a nuclear drawdown. While this is certainly a positive step in the movement toward greater nuclear disarmament, America – as the leader of the free world – does not need bilateral negotiations with Russia to encourage global nuclear arms reductions. American nuclear arms reduction unprompted by years of treaty negotiations would say as much, if not more, about America's commitment to the principles of the NPT, and it would have the added benefit of saving the American taxpayers billions. Ultimately, this presentation will examine the pros and cons of the New START Treaty as well as offer guidance regarding how the United States should proceed in the future with respect to nuclear arms control.

SESSION THREE: STRATEGIC STABILITY 1: KEY ISSUES FOR U.S. POLICYMAKERS

The US Extended Deterrence for South Korea and North Korea's unusual belligerence
Sungmin Cho, James Kelly Korean Studies Fellow, Pacific Forum CSIS

The Obama Administration's endeavors to achieve its long-term vision and the recent events on the Korean Peninsula have developed in opposite directions. On the global level, the Obama Administration has set the complete elimination of nuclear weapons as the long-term goal of the US policy while reducing the role of nuclear weapon. On the regional level, however, the US needs to assure its allies of extended deterrence including nuclear umbrella. On the Korean Peninsula, even worse, there has been growing public opinion in favor of increasing the role of nuclear weapon in South Korea facing the immediate and serious threat from North Korea. The idea of re-armament of South Korea with nuclear weapon is not feasible and strategically not helpful. Therefore, there is no doubt the US extended deterrence for South Korea should be further bolstered in face with North Korea's unusually emboldened belligerence. However further reinforcement of nuclear extended deterrence is no longer an option. The US is only able to maintain the current level of nuclear umbrella at best. Hence the reinforcement of the US extended deterrence should be realized through that of conventional extended deterrence. The US and ROK alliance, accordingly, need to consider Chinese perspective and try to engage with China while strictly focusing the coordinated efforts on deterring North Korea's provocations through conventional military measures. The reinforcement of the extended deterrence should not be regarded as the equivalent of abandoning dialogue or negotiation. At least, in order to provide some space for North Korea to leak out its stress from being deterred, dialogue and negotiation should not be abandoned. Therefore, the ultimate target of the US-ROK alliance's extended deterrence is limited to the hostile elements of the Kim Jong-il regime but engagement approach should be adopted targeting North Korean public in general.

Revisiting the Security/Insecurity Paradox in a Sino-American Context: The Challenge of a Bilateral Dialog on Strategic Stability
Jean-Loup Samaan, Lecturer, Sciences Po University

In its last *Nuclear Posture Review*, issued in 2010, the US government announced the pursuit of "*high-level, bilateral dialogues on strategic stability with both Russia and China which are aimed at fostering more stable, resilient, and transparent strategic relationships*" [NPR, 2010, p.X]. If this initiative toward

Russia has been one of the pillars of US nuclear policy to mitigate the risks of conventional escalation and to control arms race since the 60s, the mention of China represents a substantial change and proves the shift in US planners' perception regarding Chinese arsenal. In other words, Beijing is no longer seen as a large North Korea to be defended against but as a small Russia to be deterred.Although the policy developments of this US-China dialog on strategic stability have so far been modest, its emergence leads to central issues for both practitioners and scholars of international security. In that perspective, this presentation will examine the way this initiative could shape a security-insecurity paradox between both countries. According to the paradox, strategic stability, meaning a low likelihood that conventional war will escalate to the nuclear level, reduces the danger of launching a conventional war but in lowering the potential costs of conventional conflict, it also makes the outbreak of such violence more likely. To that aim, the first section describes how the Cold War analogy of "strategic stability" is not yet relevant if considering current Chinese nuclear capabilities (whether compared to Russian ones or to American ones) but it illustrates Washington's firm belief concerning the mid- to long term trends in the Chinese arsenal (second-strike capabilities, number of warheads, range of submarine-launched ballistic missiles, and so forth). In the second section, I explain that on the short term, this dialog is also needed because of the simultaneous rise of Chinese conventional capabilities (the much-discussed A2/AD capabilities) and US countermeasures (Air Force's and Navy's AirSea Battle Concept, funding for a new long-range bomber) that render the outcome of a US-China confrontation extremely uncertain and eventually increase the risks of nuclear escalation by accident. Noteworthy, most of the 'worst-case scenarios' available in the public domain and describing such a contingency in the Taiwan Strait fail to address the nuclear issue as a key factor of both actors' behaviour. As a result, having made the case for a Sino-American dialog on strategic stability, the third and last section will conclude with some of the current issues that hinder the likelihood of such project, among others Chinese concerns over American overwhelmingly superior conventional deterrent.

Why We Should Study Developing Nuclear Earth Penetrators – And Why They are Actually Stabilizing
Elbridge Colby, Research Analyst, Center for Naval Analyses

With the ratification of the New START Treaty and the associated political commitments made by the Administration and Congress to modernize U.S. nuclear deterrent capabilities, attention is beginning to shift towards the shape of the future arsenal. Many questions remain: about the threats which we need to deter, about what we need to hold at risk in order to deter effectively, and about the size and nature of the arsenal needed to meet those requirements. One of the most pressing questions is what the United States can and should do about the growing ability of its most plausible state adversaries, including North Korea and Iran, to locate their most valued assets underground in facilities effectively immune from missile, air, or naval attack. What is essentially undisputed is that potential adversaries such as North Korea and Iran are increasingly able to locate or move their most valued assets to underground depths beyond the effective reach of U.S. action (assuming that the most deeply buried facilities would be reserved primarily for the most important assets). This is because current U.S. earth penetration capabilities are insufficient to hold such facilities at risk. While the U.S. fields conventional earth penetrators, "many of the more important strategic hard and deeply buried targets are beyond the reach of conventional explosive penetrating weapons and can be held at risk of destruction only with nuclear weapons," as the 2005 National Academy panel reported. U.S. nuclear earth penetrator capabilities, on the other hand, are also limited, and U.S. Government officials have made clear that current U.S. nuclear weapons cannot penetrate to the depths required to hold at risk the most important HDBTs.

Session Four: Strategic Stability 2: South Asia Dynamics

The Evolution of Strategic Instability in South Asia

Vipin Narang, Assistant Professor, Massachusetts Institute of Technology

Thirteen years after India and Pakistan tested nuclear weapons, stability between the two historic adversaries is at an all-time low. This talk explores the drivers of both India's and Pakistan's nuclear postures and highlights the increasing instability emerging on the Subcontinent as a result of the coupling of Pakistan's nuclear posture to India's conventional posture, which is itself coupled to the perceived mass casualty terrorist threat to India emanating from Pakistan. Pakistan's first use posture against India's attempt to develop 'proactive strategy' conventional retaliatory options have placed the Subcontinent on the brink of a catastrophic conflict should another mass casualty terrorist attack, backed by a perceived Pakistani hand, occur against India. This talk analyzes this dynamic and offers some possible pathways to re-establish strategic stability between India and Pakistan.

China, India, and Cruise Missiles

Kalyan M. Kemburi , MA candidate, Monterey institute of International Studies

The last two decades have witnessed the rise of cruise missiles as a coercive political tool and a versatile military weapon. Several incidents stand testimony to this development. Important among them are: the advent and success of U.S' 'cruise-missile diplomacy' beginning in the 1990s; the failure of coalition missile defenses during the 2003 Operation Iraqi Freedom against the Iraqi cruise missile attacks; and Hezbollah's successful attack against an Israeli naval vessel in 2006 with an antiship cruise missile (ASCM). Compared with other air delivery systems—aircraft and ballistic missiles—cruise missiles have certain unique technical characteristics: operational flexibility, precision strikes, ability to penetrate air defenses, and affordability in development and deployment. These capabilities attracted military establishments' world over including China and India. This presentation endeavors to demonstrate how increasingly cruise missiles would affect the strategic calculus between China and India and why this influence warrants the two countries to include this weapon system in any strategic discussion and assessment. Through an evaluation of various technical, operational, and doctrinal aspects related to cruise missiles, this presentation identifies three capabilities that these missiles would endow China and India: strengthen nuclear deterrence; negate effectiveness of missile defenses; and provide conventional strike options for counterforce operations and strategic targeting. The second objective of this presentation involves a discussion of why CBMs associated with cruise missiles are difficult to implement and verify.

Session Five: Examining the Legal Instruments of Nonproliferation and Arms Control

Superpower Collusion and the Nuclear Nonproliferation Treaty

Jane Vaynman, PhD Candidate, International Relations, Harvard University

I will present a formal model of the origins and stability of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). In the model, the treaty arises from a shift in the superpowers' perceptions of the consequences of proliferation. Growing worries over the autonomy nuclear weapons provide to other states lead the superpowers to collude in order to preserve the nuclear oligopoly and their influence over their respective clients. The treaty is enforced by the superpowers' threat of sanction or abandonment and their clients' fears of being "left out in the cold." We test three predictions of the

model, showing that the superpowers did collude extensively in the design of the treaty, in pressuring other states to sign the NPT, and in responding to violations of the treaty.

Disarmament Under the NPT: Article VI in the 21st Century

Paul Kiernan, LL.M. Candidate, Energy & Environmental Law, The George Washington University Law School

This presentation will introduce the NPT, posit an interpretation of Article VI, and summarize the implications of this interpretation for recent and longstanding nonproliferation initiatives, U.S. security guarantees, and U.S. strategy going forward. It will also subject this interpretation to legal analysis under relevant principles of international law, before concluding with a final, overarching policy rationale for accepting meaningful reductions in the U.S. nuclear arsenal. Henry Kissinger once asked, "What in the name of God is strategic superiority? What is the significance of it, politically, militarily, operationally, *at these levels of numbers*? What do you do with it?" I argue that the U.S. should exchange it for durable security gain. Even though strategic superiority can still increase the reluctance of potential adversaries to initiate nuclear or other violent conflict, and can still achieve actual victory in nuclear or other conflict, it is equally true that when the number of nuclear weapons deployed rises high enough, victory in nuclear conflict ceases to carry much meaning. Thus, the size and characteristics of a nuclear arsenal matter: appropriate limits can preserve victory in some real sense, and they can prevent deterrence from breaking down. Of course, deterrence and victory still require *ab initio* a lower number of nuclear weapons controlled by hostile entities. The overarching objective is strategic superiority at numbers that both preserve deterrence and avoid nuclear holocaust. Depending on geopolitical realities, and leaving specific numbers for planners, at a minimum, partial disarmament steps should serve both victory and deterrence better than an equal measure of arms build-up or improvement. Perhaps coordinated, calculated reductions can take us back to an insistence on tiny details, which can drive stability just as it did during the Cold War. If so, then Article VI, properly understood, makes it easier for states to find it in their interests to observe the NPT. In closing, it is important to observe that the interpretation of Article VI espoused here should not negatively impact the thrust of Shultz, Perry, Kissinger, and Nunn's proposal, for the simple reason that both are realistic, pragmatic, and carefully wrought. Indeed, a trajectory of partial disarmament steps and reductions is most of what these statesmen seek. Moreover, their "vision" of zero nuclear weapons is better understood as a vehicle for lessening present danger than as a short-term objective.

Negotiating Divorce: Withdrawing from Arms Control Treaties

Thomas Schafbuch, JD Candidate, Syracuse University College of Law; MPA Candidate, Syracuse University

Russia has the right to withdraw from New START if it is in "good faith." History shows that Russia exaggerates the perceived threat of missile defense and its willingness to withdraw from arms control treaties and disrupt future arms control deals over missile defense. Russia threatened to withdraw from START if missile defense systems were pursued. The United States withdrew from the ABM treaty and started researching and developing missile defense systems. Russia did not withdraw from START, but signed a new arms control treaty, The Moscow Treaty. Russian military elites have essentially given three responses to missile defense: 1) it is a threat to Russia's strategic nuclear arsenal; 2) Russia can develop missiles that can penetrate any missile defense shield; and 3) Missile defense does not pose any threat to Russia's national security interests. While the 1st point is heard more frequently in the West,

the other two points are made by current policy through Russian language press or media. It would be difficult for Russia to withdraw from New START in good faith if government officials were espousing all three arguments concurrently. Finally, future arms control treaties should not have conditional withdrawal clauses, like the NPT, unless they are backed by credible enforcement mechanisms. While conditional withdrawals are well intentioned to deter withdrawal, they end up challenging the legitimacy of a treaty regime if a withdrawing party cannot be punished (e.g. North Korea). Furthermore, attaching a strict or conditional withdrawal clause may prevent parties from entering negotiations from the onset and prevent future nonproliferation and disarmament efforts if a party fears it cannot contract out of an agreement. In sum, arms control negotiators will need to conceptualize stronger enforcement mechanisms before attaching conditions on withdrawals in nuclear arms control treaties.

SESSION SIX: PREVENTING PROLIFERATION WHILE MEETING NUCLEAR ENERGY DEMANDS

The Next Generation of 123 Agreements
Laura Berzak, Congressional Fellow, Office of U.S. Senator Kent Conrad

Governed by language in the Atomic Energy Act of 1954, "123 Agreements" lay the framework for civilian nuclear cooperation between the United States and another entity, and is a necessary condition for such cooperation. 123 agreements must meet a series of criteria in order to be concluded. The United States currently has agreements with roughly 27 entities, ranging from Australia and Euratom to India and Russia. Such Agreements can be economically and diplomatically beneficial. However, they can also be fraught with proliferation concerns and political challenges. These concerns and challenges have changed over the decades and raise the question of whether the framework for nuclear cooperation developed nearly 60 years ago is suited for today's challenges. This seminar will describe the basis for "123 Agreements", what is included in such an Agreement, and how an Agreement is concluded. Potential benefits and pitfalls of these Agreements will be discussed with specific examples drawn, in particular, from Agreements with the UAE, Russia, and India. These examples will be compared to potential Agreements with Jordan and Vietnam, coupled with a discussion of possible changes to the legislating language that could be applied to guide future Agreements.

Transnational Networks and Nonproliferation: Strengthening the Multilateral Nuclear Export Control Regime
Michael M. Lieberman, Associate, International Department, Steptoe & Johnson LLP, Washington D.C.; Fellow, Truman National Security Project

This presentation will offer a developing theoretical framework of the role transnational regulatory and enforcement networks play in preventing the proliferation of sensitive nuclear technology. As developers and enforcers of domestic and international laws to combat proliferation, these networks are vital to combating their criminal doppelgangers, the illicit procurement networks exemplified by A.Q. Khan and known to be used by nuclear aspirants such as Iran, North Korea and Syria.

Countering Proliferation Finance: An Essential But Undervalued Component of the Nonproliferation Regime
Javier Serrat, Scoville Fellow, James Martin Center for Nonproliferation Studies, Washington, D.C.

The nuclear Non-Proliferation Treaty lies at the core of a much wider and expanding normative construct characterized ever more by ad hoc arrangements, and where economic instruments such as targeted financial sanctions have gained in importance. However, UNSCRs 1540 (2004) and 1803 (2009) accentuated the need to impede proliferators' access to the international financial system. The somewhat abstract formulations of the financial provisions in these Security Council resolutions, and the lack of harmonized international policies to implement them, bring to the fore the work of the Financial Action Task Force. Originally created to combat money laundering, the task force expanded its mandate to include counter terrorist financing. The task force created a set of norms, known as the 40+9 Recommendations, which quickly became the global standard for fighting money laundering and terrorist financing, mainly due to the creation of regional bodies that adopted the guidelines. FATF has a minuscule budget and no enforcement mechanism. Nevertheless, a peer review process that evaluates compliance with the guidelines acts as a powerful tool of persuasion to ensure implementation. Since 2007, FATF has been assisting members in interpreting UNSC resolutions related to WMD proliferation, particularly sanctions resolutions against Iran and North Korea. More recently, the task force has undertaken an in-depth study of the modalities of proliferation finance with the purpose of establishing standards for a more effective implementation of the financial provisions in UNSCR 1540. There are multiple aspects to this effort, including definitional issues, financial intelligence, prosecutorial arrangements between states, and the role of the financial institutions.
Understanding the financial nodes of WMD procurement and supply networks is essential to the ability to map out and disrupt illicit networks, and, ultimately, prevent the acquisition of WMD by both states and non-state actors. The Financial Action Task Force has a key role to play in developing a solid platform for harmonized standards in countering proliferation finance and implementing the financial provisions of UN Security Council resolutions. Furthermore, the enforcement of global proliferation finance countermeasures through FATF's peer review process could motivate a discussion on innovative mechanisms for the enforcement of nonproliferation obligations.

SESSION SEVEN: TECHNOLOGICAL TOOLS SUPPORTING ARMS CONTROL AND NONPROLIFERATION

Nuclear Ionization Quenching Measurement in a Dual-Phase Argon Detector

Michael Foxe, PhD Candidate, Nuclear Engineering, Pennsylvania State University

Antineutrino reactor monitoring is a technology capable of tracking the power and isotopic content of a nuclear reactor over time. This ability to monitor nuclear reactors has the potential to be a major benefit in the secure expansion of nuclear power technology both in the U.S. and around the world. It has been proposed that the use of a dual-phase argon detector may be very well suited for detection of the coherent neutrino scatter (CNS) interaction, which has a potential to increase the efficiency of the detectors for monitoring nuclear reactors. In these detectors, a neutrino scatters off of the target nucleus; the resulting nuclear recoil ionizes the surrounding medium. This ionization is detected and the recoil energy can be inferred. One unfortunate characteristic of these noble liquid detectors, along with many other detector media, is that nuclear recoils produce less observable ionization than electronic recoils of equal energy. The ratio between the observable energy from nuclear recoils to electronic recoils of equal energy is referred to as the nuclear ionization quench factor. The nuclear ionization quench factor depends on both the detector medium as well as the energy of the recoil and for this reason, must be measured directly. We present the current capabilities of antineutrino reactor

monitoring detectors along with our progress in measuring the nuclear ionization quench factor in liquid argon.

Monte Carlo Modeling of Non-Destructive Gamma Ray Spectrum Analysis for Spent Fuel Material Accountancy Application

Sarah Williams, Former Scoville Fellow, Project Coordinator, Center for Science, Technology and Security Policy, American Association for the Advancement of Science

The 2010 Nuclear Security Summit, held in April of last year, was the largest gathering of heads of state in the United States since the end of World War II. Leaders from 47 countries met to discuss the need for a coordinated effort to secure nuclear material and prevent nuclear terrorism around the globe. The Nuclear Security Summit was intended to be meeting with a focused, narrow agenda that sought to address one piece of President Obama's Prague Agenda—securing the world's vulnerable nuclear material in four years. Summit participants agreed on a work plan and communiqué, documents that contain sweeping statements about achieving universality of relevant international treaties and conventions and global cooperative efforts to prevent nuclear smuggling. While such documents are important from a diplomatic perspective, and can be looked upon as proof that the countries in attendance publicly endorsed the overall goals set forth by the summit, their broad language does not lend them to measurement. The summit did not leave the public without information with which to evaluate past and future efforts of participant countries. 29 countries issued public national statements that included specific national commitments, ranging from additional donations to the IAEA Nuclear Security Fund to improvements in national legal structures and technical support for detection efforts. These commitments, 54 in total, provide a basis by which we can measure the success of the summit process and encourage movement forward. The April 2011 report, "The 2010 Nuclear Security Summit: A Status Update" highlighted progress that has been made on each of the 54 commitments. The report sought not to place judgment on countries for not having completed certain commitments, but to provide an unbiased look at what progress had been made to date. The results were quite promising: countries completed approximately 60 percent of their national commitments within a year of the summit. An additional 30 percent of commitments were in progress at the time the report was released. This presentation will investigate what might be applicable from the report's methodology for future commitment tracking and to encourage further investments in nuclear material security. The report turned out to be a classic example of doing something that might seem too obvious to be novel, only to realize upon completion that your product is the only one in the game. Knowing what countries have been able to achieve and where there have been lapses is essential if the Nuclear Security Summit process is to continue beyond its next iteration in Seoul in 2012. Now that we have an independent source for what initiatives countries have successfully completed, we might be able to glean a better understanding of the geographic distribution of various levels of security. This will be valuable information for the drafters of summit documents in the future, and might allow for more efficient allocation of resources from donor countries. While such knowledge will not necessarily precipitate technical developments that will facilitate monitoring, detection, or material security in the future, understanding gaps in success might hint at where technical developments could make the most difference.

A Proof-of-Concept Game Theoretic Model for Optimal Inspection Strategy Determination

Rebecca Ward, Graduate Student, Nuclear Engineering and Radiation, University of Texas at Austin

A simple formulation of a two-person, zero-sum game between a proliferator, attempting to minimize detection probability, and an inspector, attempting to maximize detection probability, is presented in this work. The attacker chooses the rate of material diversion, while the inspector chooses the safeguarding strategy from a discrete set of options, governed by a budget constraint. In order to assess the relative success of different defense strategies and the effect of budget limitations, the game theoretic model needs to be populated with detection probabilities for different safeguarding-diversion strategy pairs. These values were generated using an elementary discrete event simulator, extending a previously developed insider theft methodology [Durán 2010]. The game theoretic model serves as an optimization tool to select the optimal outcome from a set of detection probabilities generated by the discrete event simulator. The goal of this presentation is to demonstrate the utility of game theory in analyzing state-level threat scenarios and selecting appropriate defense strategies within budget constraints. A simple game theory model was developed using the GAMS modeling language, and solved using the CPLEX solver. Due to the limited scope of the model, it was possible to validate model results by comparison to direct enumeration of strategy outcomes. A sensitivity analysis was conducted to examine the effect of varying budget and background detection parameters on optimal safeguarding strategy. The background detection probability is a proxy used to represent all other safeguarding activities not explicitly modeled. The model also computed and output the total detection probability for each scenario. While this value has little absolute meaning, given that it rests upon arbitrary assumptions for individual event detection probabilities, it may provide insight when viewed in a relative sense. Finally, this paper demonstrates the viability of coupling a discrete event simulator to a game theoretic model to make practical use of game theoretic techniques in evaluating inspection resource allocation strategies. As expected, the model results indicated that as the defender budget increased, the overall detection probability increased accordingly; however, the defender's budget had only a minimal effect on the diversion strategy chosen by the attacker. Instead, the background detection probability had the greatest impact on the attacker's chosen rate of diversion. This observation– that attacker strategy is largely dependent on the baseline safeguarding activities not explicitly modeled– has relevance in terms of the addition of an element to an existing safeguarding regime. The proof-of-concept model presented here indicates that game theory may be useful in nonproliferation analysis to provide unique insights into optimal inspector and proliferator strategies and the incremental benefit of additional inspection resources