

Public Interest Report

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NEW FAS PRESIDENT

Charles D. Ferguson returns to FAS as its new president. No stranger to the organization, Ferguson worked as a nuclear arms control analyst and the director of the Nuclear Policy Project from 1998 - 2000. Read his letter to learn about the exciting new programs and research projects being introduced to FAS. More on page 2...

THE DEVELOPMENT OF *IMMUNE ATTACK (IA) 2.0*

Director of the Educational Technologies Program Melanie Stegman shows how video games teach intuitively. In August 2010, Stegman plans to release *Immune Attack 2.0*. Learn all about the progression from the first version of the video game to the latest release. *Immune Attack* has been downloaded more than 8000 times, with over 500 teachers registering to evaluate it. More on page 4...

BUILDING INSPECTOR *SECOND LIFE* TRAINING PILOT

Lindsey Marburger, program manager for the Earth Systems Program, explains how a new module in a virtual world can train building inspectors and code officials to inspect structures built with structural insulated panels (SIPS). An interactive virtual training course can prepare the shortage of skilled workers to design, construct, retrofit, and inspect buildings. More on page 6...

About FAS

The Federation of American Scientists (FAS), founded on 8 December 1945 as the Federation of Atomic Scientists by Manhattan Project scientists, works to ensure that advances in science are used to build a secure, rewarding, environmentally sustainable future for all people by conducting research and advocacy on science public policy issues. Current weapons nonproliferation issues range from nuclear disarmament to biological and chemical weapons control to monitoring conventional arms sales and space policy. FAS also promotes learning technologies and limits on government secrecy. FAS is a tax-exempt, tax-deductible 501(c)(3) organization.

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PRESIDENT'S MESSAGE

New Opportunities



I feel deeply honored to serve as the new president of FAS. I am also very pleased to return to FAS. From 1998 to 2000, I worked as a nuclear arms control analyst and the director of the Nuclear Policy Project. I am especially grateful to FAS members and readers of the PIR for your support of FAS during the leadership transition. We should all wish the greatest success for the previous FAS president Henry Kelly in his new position as Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy. Please also join me in thanking Ivan Oelrich for keeping FAS on course as acting president during the transition.

Exciting opportunities abound for FAS in all program areas. In recent months, the Strategic Security Program has performed critical analysis of the Obama administration's nuclear security agenda. Dr. Oelrich, vice president of the program, and Hans Kristensen, director of the Nuclear Information Project, have written several Web blogs and given numerous news media interviews. I invite readers to visit fas.org to follow their insightful analysis. The forthcoming issue of the PIR, set for publication soon after the conclusion of the Non-Proliferation Treaty Review Conference at the end of May, will showcase FAS's work in reducing nuclear dangers. FAS has benefited from having research associate Alicia Godsberg based in New York in months leading up to and during the conference. Check out her Web blog on fas.org.

Presently worth highlighting is the proposal by Dr. Oelrich and research associate Ivanka Barzashka. In the April Issue Brief "The Twenty Percent Solution: Breaking the Iranian Stalemate," published on fas.org,

they argue for accepting the terms of Iran's fuel exchange proposal. The fuel swap was proposed last fall as a means to have Iran ship low enriched uranium out of the country in exchange for fuel for the Tehran Research Reactor. This reactor was supplied by the United States during the reign of Shah Reza Pahlavi. It had been converted to use uranium fuel composed of 19.75 percent uranium-235, an enrichment level just below the 20 percent dividing line between low and high enriched. While any high-enriched uranium is in principle useful for making nuclear weapons, the higher the enrichment level the greater is the usefulness for weapons. Weapons grade uranium is considered to be 90 percent or greater. By Iran enriching up to 20 percent, it will have reduced by more than half the amount of time needed to reach weapons grade levels. The essence of Barzashka and Oelrich's proposal is to take away reasons for Iran to enrich to the 20 percent level.

But because the United States and Iran have yet to agree to the terms of the fuel swap, Iran has already proceeded to enrich some uranium to 20 percent. The fundamental difference in the two sides' positions lies in where the fuel exchange would take place. The United States prefers that Iran send the low enriched uranium (LEU) out of the country as soon as possible while waiting for delivery of the reactor's fuel rods. In contrast, Iran does not want to ship the LEU until the fuel rods have been delivered. Nonetheless, Tehran has offered to send the LEU to Kish Island, which is part of Iran. The International Atomic Energy Agency could monitor the material on the island. While the two sides have to date not budged publicly on their proposals, Iran continues to gain experience in

enriching to higher levels. The window of opportunity remains brief especially since the United States is working with allies on the United Nations Security Council to enact more sanctions. While sanctions have yet to dissuade Iran from enriching uranium, further sanctions may close the door to a sensible solution to delay Iran's weapons capability and at the same time give Iran a means to become more transparent about its nuclear program. Greater transparency is a necessary condition for Iran to assure the international community that it intends to only have a peaceful nuclear program.

The Strategic Security Program also continues to provide analytic services that are not matched by other non-governmental organizations. In particular, Steve Aftergood, director of the Government Secrecy Project, has, for more than 20 years, served as the leading analyst in assessing the implications of secrecy policies for the nation's security and the public's access to government. Moreover, Matt Schroeder, the manager of the Arms Sales Monitoring Project, has continued to shine a spotlight on the illicit arms trade and has offered guidance on achieving greater transparency, accountability, and restraint in the legal arms trade. This PIR issue includes analysis by Matt Buongiorno on two programs that funneled large quantities of weapons into Iraqi arsenals and the problems that occurred due to the lack of stringent accountability procedures of other U.S. arms transfer programs. Problems with record keeping and accountability may have failed to prevent the diversion of U.S. weapons.

Biosecurity is growing in importance for the United States and other nations. In recognition of this vital policy area, FAS has recently created the Biosecurity Program, which builds on the decades long work that FAS has done. Former FAS biosecurity analysts are presently shaping policy inside the government.

In the past decade, FAS also has led in the development of learning technologies

that employ computer games and virtual worlds. Like the Biosecurity Program, the Learning Technologies Project has placed former FAS project personnel in the government. Building on the Learning Technologies Project's record of accomplishment, Dr. Melanie Stegman, the director of the Educational Technologies Program, is examining the efficacy of the computer game *Immune Attack* in teaching immunology without prior exposure to lectures or textual lessons about the subject. The potential of this technology to transform teaching of science appears limitless.

While Dr. Kelly served as president, FAS began groundbreaking projects on building technologies and energy efficiency. Similar to the biosecurity and learning technolo-

FAS is proud of its members, many of whom are the science and policy leaders in improving national and international security. Seeking to reach out to and educate the next generation of leaders and to involve this generation in learning about science and security, FAS in April began Students for International Security (SIS). Initiated by James Wright, manager of Development and Membership Services, SIS welcomes students of all majors in joining a dialogue about how to improve the security of all nations. FAS invites members who are part of faculty at colleges and universities to become faculty advisers to SIS and those who are students to take part in this new initiative. To learn more, please visit fas.org or contact Mr. Wright.

“Seeking to reach out to and educate the next generation of leaders and to involve this generation in learning about science and security...”

gies areas, a measure of FAS's success has been the relatively large number of former staff now serving in the government helping the nation to develop more efficient buildings, save energy use, and deploy more renewable energy technologies. Using the existing Building Technology Project as the nucleus, FAS announced officially on Earth Day that it has created the Earth Systems Program. This program examines the linkages between human actions and natural resource sustainability especially concerning energy, land, water, and food. The objective is to identify more effective government and corporate policies to protect the earth's systems and enhance human security.

I hope readers are as excited as I am about the future of FAS. Please stay tuned to future transformations of the PIR and the organization as a whole. I welcome readers' advice on how to make FAS a center for excellence.



FAS

Building on Success – Development of *Immune Attack (IA) 2.0*.

By Melanie Ann Stegman, Director of the Educational Technologies Program

In May 2008, the Federation of American Scientists released *Immune Attack 1.0*. The game was downloaded more than 8000 times, with over 500 teachers registering to evaluate it. Surveys of teachers and students indicated that the game was engaging and created an interest in biology. This evaluation provided a measure of how well the students understood the core concepts of cell biology, chemistry and nanotechnology after playing the game. The data is being used to build additional game levels that include more details of cellular function and protein interaction.

The development of *Immune Attack 2.0* began with the creation of the Science Advisory Group, a group of scientists from many fields recruited because of their interest in science education. A list of core concepts in cell biology, chemistry, and nanotechnology was developed and used to redesign the game.

The Science Advisory Group (SAG)

While the National Science Foundation (NSF), the National Institutes of Health (NIH), and the Wellcome Trust encourage their investigators to engage in public outreach, most scientists are too busy. The optimal outreach strategy is one that will get the most information out of scientists in the least amount of their time. The Science Advisory Group is comprised of 20 scientists from many disciplines — biochemists, structural biologists, metabolism experts, and geneticists.

The Game Outline Builds *Immune Attack 2.0*

A game outline was written that reads like a short review article on an immunological process. This document was sent to scientists for critique, like a peer-reviewed manuscript for a journal. The outline consolidated comments made by many of the scientists.

The existence of one document allowed for collaboration by many scientists from various fields. *Immune Attack* will eventually

speak more generally to cell biology, molecular interactions and topics more broad than immunology or neurology alone. Most importantly, the game world must be accurate, which requires the combined efforts of scientists from fields as specialized as neurology and nanotechnology.

The game outline is written in plain English with footnotes that contain the molecular science details and discussion. The game programmer, Escape Hatch Entertainment, reads the outline and requests changes to make the game more fun to play. A new component of the game includes the possibility of complement proteins binding to the hull of the Microbot and eventually piercing it. After adding this element to the game outline, a SAG member volunteered to design a “hull covering” for the Microbot that would keep proteins from sticking. The game outline allows scientists to provide input from the earliest stages of development, which allows for the integration of molecular science into the game.

Engaging Students in Molecular Science Research

In August 2010, FAS will launch *Immune Attack 2.0* and an online version of the new Mission Intelligence (MI) Database. The Microbot in *Immune Attack 2.0* will contain the MI database, which will consist of index cards with names and images of a cell or molecule encountered during gameplay, along with other relevant data. The cards will also provide references to additional information sources and links to laboratories of scientists who work on the topic.

The online database will allow students to see the molecules they encounter in the game and follow links to papers written by scientists who work on the objects. Students will also be able to add their own index cards to the online MI database and vote for the cards that are most informative and best referenced.

The scientists who work on the topics will be able to vote as well. FAS hopes to create an environment where scientists, teachers and students converse about molecular science. After all, the topic of discussion will be the same, the vocabulary will be common among the three groups, and the stage will be set for a student to ask, “How do you know that...?”

If you are interested in evaluating *Immune Attack* in your classroom, please register at <http://www.FAS.org/immuneattack>.

Pictures Teach Intuitively

Here are two screen shots from *Immune Attack*. They are from the same point in the game — the top picture from *Immune Attack 1.0* (released May 2008) and the bottom from *Immune Attack 2.0* (scheduled for release in August 2010).

Figure 1.

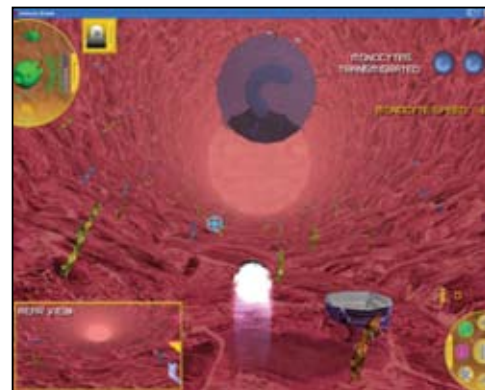


Figure 1. Monocyte Transmigration in *Immune Attack 1.0*. A blue Monocyte cell travels down the vein with yellow and brown proteins sticking out of the Monocyte and out of the cells that make the round vein walls. There is only one cell in the vein and the vein walls are red. These three aspects of the game are inaccurate. Proteins should not be visible at the micrometer scale; there should be many more cells crowded into the vein; and the walls of the vein would not be red (or blue) if we were actually inside the vein. Only the red blood cells would have color.

Figure 2.



Figure 2. Monocyte Transmigration in *Immune Attack 2.0*.

Through conversation with teachers, the game programmer, and the Scientific Advisory Group, the presentation of cells and proteins have been reconfigured in the forthcoming release *Immune Attack 2.0*. The three main changes affect the presentation of scale, molecular/cellular crowding, and color.

Scale. In figure 1, the player saw the whole cell with proteins sticking out. Now, in figure 2, either proteins or cells are displayed. To make this juxtaposition less confusing, there are two views of the action: in the bottom left corner is the view through the cell-sized Microbot, while the main screen is the view from the protein-sized Nanobot.

Color. While the red walls of the arteries and the veins in *Immune Attack 1.0* [figure 1] convey the idea of the bloodstream to players, if we were actually inside the vein, only the red blood cells would have color. The walls of the blood vessels would be beige. In *Immune Attack 2.0*, the red color has been removed from the vein walls. Currently, we are experimenting with textures for the walls, using scanning electron microscope images for reference. Altering the vein walls gives *Immune Attack 2.0* a less familiar, more exciting feeling of exploring a strange fantastic world. This is one example of how introducing more scientifically accurate images and actions can make the game more exciting.

Crowding. Finally, with *Immune Attack 2.0*, players will be required to contribute to the formation of the game view, so the difference between reality (crowded) and the game (lots of open space) will be clear. For example, the many cells that should be crowding the area have been *removed by the player*, by scanning them and then clicking "Mission Relevant View."

FAS

Learning By Doing

By Melanie Ann Stegman, Director of the Educational Technologies Program

Immune Attack teaches students about specific molecular processes during game play. But, like many video games, *Immune Attack* also inspires players to create their own games based on the same world and premise.

FAS joined Dr. Kevin Clark, an associate professor at George Mason University, and Mr. Rick Kelsey, former STEM coordinator at McKinley Technology High School in Washington, DC, in a technology program for high school students.

Immune Attack was used to inspire students to create their own video games about the molecular world and as a tool to determine whether students developed an interest in the science being discussed. McKinley students learned to make video games using a program called Game Maker. Students in two other classrooms also created their own 3D images.

What kind of games did they develop? What kinds of objects did they model?

The students from McKinley created games about gene regulation and inter-neuronal signaling. Some students also designed neurons, their myelin sheath, and motor proteins carrying cargo to the end of axons as 3D Models.

The program kicked off with a 30-minute introduction to basic neurology. The students listened to how ion channels allow an electrical impulse to travel from the cell body to the end of the axon, and how Myelin helps increase the speed of the electrical impulse. They heard how receptors on the cell body receive chemical signals and certain combinations of those signals can cause the electrical impulse to start. They were also introduced to how chemical signals can alter gene expression.

Following each presentation and lecture, the McKinley Game Maker students asked about 20 minutes of intense questions. And while the 3D modeling students also asked many questions, their models clearly showed that they had done a lot of independent research.

These high school students learned to listen to a subject matter expert and then design a video game based on the scientific presentation. The students were engaged and curious, resulting in creative assignments.

The process of developing a video game provided a perfect environment for teaching molecular biology. The students' questions focused on very specific situations in order to accurately design their own game. This focus made it easier to discuss unfamiliar objects and molecular processes.

At the beginning of the program, students decorated their computer desktop backgrounds with images of popular singers, blockbuster movies, and animation characters. Toward the end, wallpaper of electron microscope scans of arteries filled with red blood cells started to replace the traditional pop art.

While a few students were not interested in learning about game development or molecular biology, it was clear that the students who were interested in game programming and 3D model building were very motivated to learn the molecular biology.

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Edutopia, the Web site of The George Lucas Educational Foundation, contains an archive of continually updated best practices, from classroom tips to recommendations for districtwide change. Two videos feature the students of McKinley Technical High School and Dr. Clark using *Immune Attack*. The videos were made by Edutopia to demonstrate some best practices in STEM education.

<http://www.edutopia.org/digital-generation-game-design-video>

<http://www.edutopia.org/digital-generation-profile-justin-video>

To learn more about FAS's research, please visit: <http://www.fas.org/immuneattack/>

Building Inspector *Second Life* Training Pilot

By Lindsey Marburger, Program Manager for the Earth Systems Program

The FAS Building Technologies Project, in collaboration with experts from the Structural Insulated Panel Association (SIPA), created a module in the *Second Life* virtual world to train building inspectors and code officials to inspect a structure built with structural insulated panels (SIPS), a type of panelized high performance building system used for flooring, roofing, and walls.

The American Recovery and Reinvestment Act of 2009 appropriated \$53 billion to education and training for the new “green” economy. The federal government also appropriated more than \$30 million to weatherize existing homes. Despite a downturn in new home sales, energy efficient houses continue to grow their market penetration rate. Residential energy use accounts for more than 20 percent of all energy use in the United States. Through federal investments in weatherization, energy efficiency retrofits, and energy efficiency and renewable energy tax incentives, there is now an opportunity to retrofit homes to use fewer fossil fuels, save money, and reduce carbon output.

One barrier to meet new residential energy efficiency goals is the shortage of skilled workers to design, construct, retrofit, and inspect these buildings. If properly utilized, the Recovery Act funding can train tens of thousands of workers to design with, construct with, and inspect buildings made with the latest energy efficient materials and technologies.

The training of construction industry professionals has changed little over the past decades, with current training and certification programs failing to take advantage of new learning tools. Two components



comprise current training practices: a field-based demonstration and a classroom-based instructional course, which consists of reading, lectures, and a question-and-answer period with the instructor.

With field-based instruction, building inspectors or code officials are brought to a site and shown what to look for when inspecting a building, and the steps and materials necessary to properly complete the inspection. The interactive experience of looking at a building with an expert instructor and going through the inspection process is an essential aspect of training and a superior method of learning how to apply the codes and concepts learned in the classroom.

Classroom-based instruction emphasizes the memorization of facts, codes, and concepts, and assesses knowledge through a multiple-choice exam.

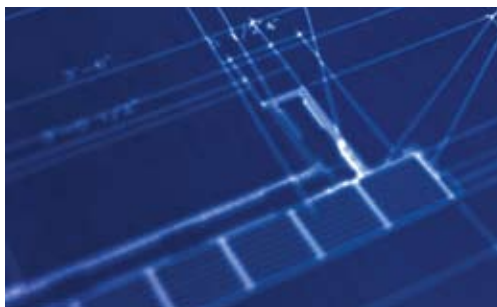
The introduction of new technology has been limited to online courses where students read code sections, then answer problem solving questions based on the relevant code; and instructor-led webinars for students to ask questions of the instructor or cover content from the classroom curriculum. There is little opportunity for students to practice inspection skills, to undertake scenario-based learning by solving code violation issues or other problems in the field, or to integrate knowledge of specific codes and concepts with the act of inspecting a building site.

To meet this curriculum void, training must include hands-on, scenario-based learning tools that allow the user to visually explore content in an interactive environment. The building industry needs tools that have the following capabilities: easy access; flexible learning pace; an interactive environment that can be manipulated by relatively inexperienced users; the ability to select and modify learning objectives; and the ability to replicate intricate structural and architectural details and model the physical assets of a building, such as energy flows and duct tightness.

The FAS pilot program explores the use of virtual learning technologies to ease the adoption of advanced building systems and technologies. One objective of the virtual training module is to prove the concept rather than assess the training capabilities of virtual worlds on a large scale. The module inte-

grates written descriptions, training activities and guides, CAD drawings of structural details, media aids, and supporting documentation and informational materials.

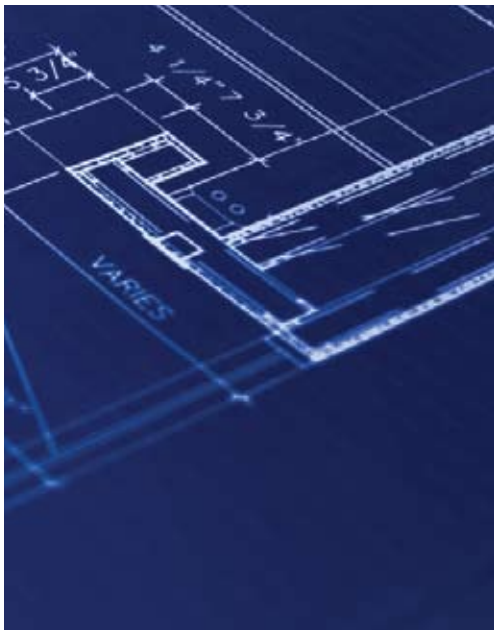
Within *Second Life* the training module consists of three main scenes. The first scene includes an introduction and orientation area



where users practice moving within *Second Life* and learn that SIPs are an energy efficient material which, when properly installed, create a tight building envelope that requires minimal heating and cooling. SIP manufacturers and installers note that building inspectors frequently do not know what proper SIP installation should look like, are unfamiliar with the recent addition of SIPs to the International Residential Code (IRC), and are unsure of how to inspect SIP houses for adherence to structural and architectural plans. A presentation and several animated, linked models demonstrate SIP composition, physical properties, and construction techniques.

The second scene, the Training House, is a virtual demonstration house that illustrates multiple phases of SIP construction — from laying the foundation and framing doors and windows to exterior cladding and roofing.

Based on the architectural and structural drawings of an existing SIP house and CAD drawings of building details provided by SIPA, the virtual house demonstrates 20 key details or features that an inspector must look for when inspecting a house. Special attention has been paid to details, such as corner joints,



where installation or construction mistakes are frequent. This scene is highly interactive, allowing users to visualize how SIP construction should look; click on a detail to learn more about it, the applicable codes, and the detail's role in creating a tight, energy efficient building envelope; compare the house to a set of detailed plans; and walk through the process of inspecting a house with the assistance of the Training House Guide.

The final scene, the Assessment House, allows users to assess their knowledge of proper SIP construction and energy efficiency concepts. The assessment scene contains a house identical to the Training House with 10 common mistakes added to the building's construction. In *Second Life*, users answer multiple-choice style questions to test understanding of construction

issues, such as what specific mistake was made, and conceptual comprehension, such as why that particular mistake impacts the tightness of the building envelope.

The capabilities of this virtual world training module demonstrate its utility for training building inspectors, and all building industry professionals. This advanced learning technology not only fills key voids in the current training curriculum, but can also replace current training practices. Instead of going to a physical classroom or actual building site, an expert instructor can walk through the virtual site with a class and create different scenarios within the scene for students to solve, while guiding students through the process of inspecting a building.

Students can also independently utilize the virtual training module and the corresponding Web 2.0 technologies to practice inspecting buildings, prepare for the written and physical inspection aspects of their certification, and gain in-depth knowledge of technologies, materials, and key concepts.

Virtual worlds and training modules, if widely implemented, are capable of improving industry-wide training and education. To train and certify a high skilled "green" workforce to create a substantively more efficient, more sustainable, and more affordable housing stock, improvement must be made to training methodology, tools, and scale.

FAS

Small Arms in Iraq Vulnerable to Theft and Diversion

By Matt Buongiorno, Scoville Fellow, FAS Arms Sales Monitoring Project and Nuclear Information Project

The Iraq Relief and Reconstruction Fund (IRRF), later succeeded by the Iraq Security Forces Fund (ISFF), was established as a train-and-equip program charged with quickly delivering weaponry to the Iraq Security Force (ISF) and related Iraqi entities. While the ad hoc program succeeded in funneling large quantities of weapons into Iraqi arsenals, it lacked the stringent accountability procedures of other U.S. arms transfer programs and, consequently, may have failed to prevent the diversion of U.S. weapons, as explained in the Spring 2008 edition of the Public Interest Report.¹ This article updates and expands upon the 2008 article, drawing on documents obtained under the Freedom of Information Act, reports from the Department of Defense (DOD), and media accounts. The article begins with a brief summary of the two programs and problems with record keeping and accountability identified by the Defense Department and the Government Accountability Office. Instances of possible diversion reported in U.S. government documents and media accounts are then briefly examined. The article then provides an in-depth look at the steps the U.S. has taken to improve accountability, and evaluates the extensiveness of these efforts.

Background

Shortly after the U.S. invaded Iraq and disbanded its army, the administration of President George W. Bush concluded that

the key to stabilizing the country and eventually withdrawing U.S. forces was the rapid creation of self-sufficient and effective Iraqi Security Forces (ISF).² Two programs were subsequently established: the Iraq Relief and Reconstruction Fund (IRRF) and the Iraq Security Forces Fund (ISFF). IRRF was established to provide support reconstruction, rehabilitation, relief, and security in Iraq. Some of the nearly \$19 billion appropriated through this program was used to purchase arms and ammunition for the Iraqi Security Forces.³ In 2005, Congress appropriated \$5.2 billion for Iraq Security Forces Fund.⁴ The funding was to be used “to provide equipment; supplies; services; training; and facility and infrastructure repair, renovation, and construction for the Iraq Security Forces.”⁵ Notably, both funds, and the train-and-equip programs they supported, fell outside of the U.S.’s traditional security assistance framework.

“These programs lacked the stringent accountability procedures common in traditional security assistance programs, resulting in problems with record keeping and accountability.”

These programs lacked the stringent accountability procedures common in traditional security assistance programs, resulting in problems with record keeping and accountabil-

ity. In 2006, the Special Inspector General for Iraq Reconstruction (SIGIR) found that “only about 10,000 of over 370,000 IRRF-funded weapons, or about 2.7%, may have been registered in the DOD Registry of the Small Arms Serialization Program.”⁶ The U.S. Government Accountability Office (GAO) identified similar problems in a 2007

report. According to the GAO, the electronic spreadsheets used to record Iraqi forces’ receipt, storage, and distribution of equipment (known as property books) failed to account for some 190,000 weapons⁷ as a result of sporadic recording of weapon serial numbers, failure to collect and store hand receipts, and confusion regarding what rules applied to weapons procured through the train-and-equip programs.

While traditional security assistance programs have explicit procedures for “storing, protecting, transporting, and registering small arms and other sensitive items transferred to foreign governments,”⁸ U.S. forces in Iraq often lacked this guidance. As a result, they “did not maintain a centralized record of all equipment distributed to the ISF, and did not consistently collect supporting documents that confirm the dates the equipment was received, the quantities of equipment delivered, or the Iraqi units receiving the equipment,” according to the GAO.⁹

Defense Department Inspector General reports from both July 2008 and December 2008 suggest that accountability procedures and recording standards for captured enemy weapons needed improvement.¹⁰ In the July report the Inspector General wrote that the U.S. military had not “clearly defined procedures for the accountability, control, and final disposition of weapons captured by U.S. forces, to include recording captured weapons serial numbers.”¹¹ In the follow-up report from December 2008, the Inspector General observed that “[t]housands of captured weapons were in storage at the Taji [National Army Depot] and the [Kirkush Military Training Base] Location Command. These weapons had not had their serial numbers recorded and had not been



inspected for serviceability and placement into the Iraqi military weapons inventory.”¹²

Reports of theft, loss and diversion of U.S.-funded weapons from the Iraqi Security Forces highlight the danger posed by these shortcomings in stockpile security and accountability. The DOD reported that in some cases U.S. firearms originally provided to the ISF found their way into the hands of insurgents, terrorists, and criminals in Turkey.¹³ Further, American military commanders reportedly told the New York Times that Iraqi security guards were suspected of stealing hundreds of weapons in about ten major thefts at arms depots at Taji and Abu Ghraib, and Iraqis sympathetic to insurgents would infiltrate warehouse crews, sometimes resulting in missing guns.¹⁴ While it is not clear what, if any, direct links there are between the stolen and diverted weapons and the record keeping and accountability shortcomings identified by the GAO and the Defense Department, these cases none-

theless underscore the need for stringent accountability standards that are universally and robustly applied.

U.S. Corrective Action

Recognizing the dangers associated with poorly secured and managed weapons, the U.S. government has taken several important steps to improve stockpile security and accountability procedures for U.S.-origin and U.S.-funded weapons transferred to Iraq. Efforts by the U.S. military to address the shortcomings identified by the Special Inspector General and the GAO began even before the reports were published. For example, by the time that the Special Inspector General published its October 2006 report, the military had established a process for “...accurately issu[ing] weapons by quantity and serial number listing.”¹⁵

In 2008 the U.S. Congress passed legislation requiring stricter regulations and guidelines for future arms transfers to Iraq. Section 1228 of Public Law 110-181, which was enacted in January 2008, requires the

establishment of a Registration and Monitoring System to include:

(1) the registration of the serial numbers of all small arms to be provided to the

Government to Iraq or to other groups, organizations, citizens, or residents of Iraq;

(2) a program of end-use monitoring of all lethal defense articles provided to such individuals or entities; and

(3) a detailed record of the origin, shipping, and distribution of all defense articles transferred under the Iraq Security Forces

“Efforts by the US military to address the shortcomings identified by the Special Inspector General and the GAO began even before the reports were published.”

Fund or any other security assistance program to such entities or individuals.¹⁶

The Registration and Monitoring System required by Congress applies to all five avenues or programs through which arms are transferred to Iraq.¹⁷

To assess the status of stockpile security and accountability in Iraq, the Defense Department dispatched a Munitions Assessment Team (MAT) on two separate occasions: September-October 2007 and April-May 2008. The team conducted inspections on a number of supply depots, warehouses, and ports of entry, studied the extensiveness of accountability procedures, and made recommendations for further improvements.

Below is a brief summary of the stockpile security and accountability measures implemented by the State and Defense Departments, and assessed by the Munitions Assessment Teams. These measures can be divided into three categories of safeguards mandated by Congress: Weapon Serialization, End-Use Monitoring, and Recording the Origin, Shipping, and Distribution of Defense Articles.

Weapon Serialization

Recording the serial numbers of weapons prior to transfer facilitates in-transit and post-shipment security and end-use monitoring, and helps investigators to identify the points in the transfer chain in which the weapons are lost, stolen or diverted.

A memorandum from August 2008 obtained by the Federation of American Scientists under the Freedom of Information Act outlines DOD's new and rigorous Iraqi weapon serialization program, which began in 2006.¹⁸ Electronic lists of serial numbers are recorded and sent to the intended recipi-

ent in Iraq prior to shipment of weapons so that the recipient knows the types and quantities of weapons that are to be delivered. Upon receipt of the shipment, the end-user can then match the electronic submission against the actual shipment to determine whether all weapons arrived (serial numbers are also posted on the inside and outside of shipping containers).¹⁹ Serial numbers of weapons exported through FMS are provided to the DOD Component Registry,²⁰ and the Component Registry then transfers this data to a central DOD Registry as part of a monthly electronic file transfer.²¹ These detailed guidelines help fulfill the serialization program's objectives, to "ensure continuous visibility over all small arms by serial number from the contractor to the depot; in storage; in-transit to requisitioners; in post, camp, and station custody; in the hands of users; during turn-ins; in renovation; and during disposal/demilitarization,"²² and to "provide law enforcement and investigative agencies with the identification of the last accountable activity having specific serial numbered weapons when those weapons are found missing or stolen."²³

Part of the Munitions Assessment Team's task was to assess implementation of the new weapon serialization program by performing manual checks at weapons depots. During an inspection of Taji National Army Depot, three different types of weapons were selected for auditing. A physical count of the weapons revealed discrepancies between the number of weapons in the depot and the number recorded in the depot's inventory database. According to the team's report, there were weapons in the depot for which there was no corresponding entry in the database, including 16,841 more AK-47 rifles in storage than there were in the warehouse records.²⁴ Further, the team was

unable to locate all of the weapons in the depot because of the "disorganized manner in which the weapons were physically stored."²⁵

However, a follow-up assessment conducted several months later revealed significant improvements at the Taji National Army Depot. Of the serial numbers of the 463 pistols and rifles checked by the Munitions Assessment Team, only eight were incorrectly entered or missing from the depot's inventory spreadsheet. This discrepancy rate is comparable to the overall rate of 1.75 percent for the 915 weapons cumulatively checked by the Munitions Inspection Team during the assessment.²⁶

In addition to issuing arms by serial number, "the Iraqi Army is issuing U.S.-supplied M16A4 and M4 rifles to individual soldiers using biometric technology, including fingerprints, photographs, and iris scans..."²⁷ and has established harsh penalties for Iraqi personnel who fail to adequately safeguard their weapons. During a February 12, 2009 hearing on accountability measures in Afghanistan, Principle Deputy Inspector General Thomas Gimble noted that "on the Iraqi side... if you lost a weapon, such as a Glock, they actually fine people about a year's salary."²⁸ This observation is corroborated by a 2008 memorandum issued by the Iraq Ministry of the Interior. The memorandum established "rigid fines for the loss of any weapon or ammunition...rang[ing] from 100,000 Iraqi dinars for a bayonet, to 5,000,000 Iraqi dinars for a pistol, to 15,000,000 Iraqi dinars for a machine gun."²⁹ However, it is not clear how frequently and in what context the fines are levied.

Finally, an important step in a successful and long-term stockpile security and



accountability in Iraq is the establishment by the ISF of its own weapon serialization program, part of what the DOD refers to as Iraqi logistics sustainability. In 2006 the Special Inspector General for Iraq Reconstruction (SIGIR) issued a report citing progress in building “effective logistics capabilities within the Iraqi Army” and the transition of these capabilities to the Iraqi Ministry Defense and the Iraqi Army.³⁰ For example, the Iraqi Army has devised its own indigenous system of property books that includes all weapons issued to its soldiers and is currently working on tracking and recording weapons that were distributed prior to the establishment of property books. A DOD report reveals that as of October 2007 approximately 85 percent of four Iraqi Army Divisions assessed by the US military “were accounting for weapons by serial number.”³¹

As illustrated above, DOD has taken several important steps to address the problems with record keeping identified by

the Government Accountability Office and the Special Inspector General. The more frequent and accurate recording of serial numbers and deployment of assessment teams to check the records has fostered a level of accountability that had not previously existed in Iraq.³² Moreover, that the Iraqi Security Forces and related Iraqi entities are now establishing their own record keeping and monitoring systems is encouraging.

End-Use Monitoring

End-use monitoring (EUM) promotes compliance with U.S. requirements for, and restrictions on, the storage, transfer and use of exported weapons, and facilitates detection of violations of these restrictions.³³

Several steps have been taken to strengthen end-use monitoring in Iraq. In an interview with the FAS, an official from the Defense Security Cooperation Agency (DSCA) noted that “U.S. personnel assigned to the SCO are required to observe and report any

potential misuse or illegal transfer of U.S.-origin defense articles,”³⁴ and must conduct “physical security inspections of at least one Iraqi weapons storage facility quarterly as security conditions and force protection posture allow.”³⁵ In compliance with the Iraq Golden Sentry End-Use-Monitoring Standard Operating Procedure,³⁶ Multi-National Security Transition Command-Iraq (MNSTC-I) “accomplished seven site visits in 2008, [and that] during these visits [they] inspected site security; reviewed location property books; conducted 100% serial number inventories; and reviewed unit inventory and control procedures.”³⁷ Finally, DSCA conducts Compliance Assessment Visits (CAVs) under Golden Sentry to “assess the [Security Cooperation Organization’s] compliance with the monitoring responsibilities and Iraq’s compliance with the transfer agreements of the defense articles received from the [U.S. government].”³⁸

Commercial arms exports to Iraq are also subjected to end-use monitoring. According to a 2008 document obtained by the FAS under the Freedom of Information Act, the State Department conducts post-shipment verification of all lethal defense articles exported to Iraq through the U.S. Embassy in Baghdad. While the verification requirements are not described in detail, they appear to include consultation with all consignees and end-users.³⁹

Recording the Origin, Shipping, and Distribution of Defense Articles

Also important are strong controls on the transport and distribution of exported weapons. According to the Defense Department, “The main objective of a chain of custody is to ensure that arms and ammunition are tracked through the process between procurement and delivery to the ultimate recipient and that the arms and ammunition received by the ultimate recipient are in the same condition, type, and count as originally shipped.”⁴⁰

In its July 2008 report, the Defense Department’s Inspector General observes that “U.S. forces did not always maintain an unbroken chain of custody for the accountability and control of U.S.-controlled arms and ammunition before formal handover to the ISF,”⁴¹ though the report offers no further insight or details. The same report mentions that there were problems with the chain of custody in deliveries to Taji National Depot and to Baghdad Police College.⁴²

The U.S. military has taken several steps to address these problems. For example, it requires munitions to be delivered through U.S.-controlled ports in Iraq.⁴³ Improvements in weapon serialization also help U.S. authorities to track small arms as they move through the transfer chain.

Each of these efforts strengthens the chain of custody, and allows for more accurate recording of weapons’ origin, shipping, and distribution. Equally as significant is the increased use of the Foreign Military Sales Program for small arms exports to Iraq. The FMS program has a clearly defined and robust set of transit controls for small arms and other sensitive weapons. These controls include the use of the Transportation Command’s (USTRANSCOM) Global Transportation Network (GTN), a “web-based tool used to...locate materiel anywhere in the world in a seamless, near-real-time capability.”⁴⁴

Conclusion

The problems identified in the 2007 GAO report highlight the importance of well-established, concrete guidelines detailed, robust, and universally applicable record keeping, stockpile security and end-use monitoring requirements for small arms and light weapons transfers originating in the U.S. or funded with U.S. foreign aid. Fortunately, the U.S. government has taken several steps to improve accountability in arms transfers to Iraq, as summarized above.

These efforts are significant not only because they will undoubtedly reduce the vulnerability of Iraqi small arms and light weapons to theft, loss, and diversion, but also because they serve as an example for current and future train-and-equip programs.

In Afghanistan, for example, the U.S. is encountering record keeping and accountability problems similar to those in Iraq. As was the case in Iraq, Combined Security Transition Command-Afghanistan (CSTC-A) – the command responsible for implementing the development of the Afghan National Security Force (ANSF)⁴⁵ – had not issued “instructions or procedures governing the

accountability, control, and physical security of Arms, Ammunition, and Explosives the U.S. is supplying to ANSF,”⁴⁶ Similarly, the Government Accountability Office found that “lapses in weapons accountability occurred throughout the supply chain, including when the weapons were obtained, transported to Afghanistan and stored at two central storage depots in Kabul” and that the U.S. military “did not maintain complete records for an estimate 87,000 – or about 36 percent – of the 242,000 weapons Defense procured and shipped to Afghanistan for ANSF.”⁴⁷ U.S. military officials and policymakers should draw on the various lessons from Iraq when addressing these problems.

Finally, there are numerous smaller U.S. government programs and authorities through which the international transfer of small arms and other sensitive items are arranged or funded, many of which lack the transparency of the larger, more established programs such as Foreign Military Sales. U.S. policymakers should thoroughly examine the policies and procedures applied to transfers of small arms arranged or funded through these smaller programs, and if lax controls are discovered, establish safeguards that are at least as robust as those being implemented in Iraq.

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Footnotes

1 Katarzyna Bzdak, 'Ad Hoc Equipping Scheme Contributed to Diversion of Small Arms', *FAS Public Interest Report*, Spring 2008, pp. 6-10.

2 Jeremy Sharp, 'Iraq's New Security Forces: The Challenge of Sectarian and Ethnic Influences', (CRS Report, March 2005), p. 1.

3 Department of Defense Inspector General, SPO-2008-001: *Assessment of the Accountability of Arms and Ammunition Provided to the Security Forces of Iraq*, July 2008, p. 2.

4 Sharp, *Iraq's New Security Forces*, p. 2.

5 Department of Defense Inspector General, D-2008-026: *Management of the Iraqi Security Forces Fund in Southwest Asia – Phase III*, November 2007, p. i.

6 Special Inspector General for Iraq Reconstruction, SIGIR-06-033: *Iraqi Security Forces: Weapons Provided by the U.S. Department of Defense Using the Iraq Relief and Reconstruction Fund*, October 2006, p. 9.

7 Government Accountability Office, GAO-07-711: *Stabilizing Iraq: DOD Cannot Ensure that U.S. Funded Equipment Has Reached Iraqi Security Forces*, July 2007, p. 1.

8 Government Accountability Office, GAO-07-711, p. 6.

9 Ibid, p. 8.

10 Department of Defense Inspector General, SPO-2008-001: *Assessment of the Accountability of Arms and Ammunition provided to the Security Forces of Iraq*, July 2008, p.15. See also: Department of Defense Inspector General, SPO-2009-002: *Report on the Assessment of Arms, Ammunition, and Explosives Accountability and Control; Security Assistance; and Logistics for the Iraqi Security Forces*, December 18, 2008, p. 39.

11 Furthermore, the July 2008 DOD report shows captured weapons stored at Taji National Depot in what appears to be a disorganized pile. See Department of Defense Inspector General, SPO-2008-001, p. 15.

12 Department of Defense Inspector General, SPO-2009-002, p. 39. The report recommended that the U.S. military establish procedures for the accountability, control, and final disposition of weapons captured by U.S. forces (to include recording captured weapons' serial numbers), but provides no further detail on the progress of the implementation of this recommendation. See Ibid, p. 9.

13 Department of Defense Inspector General, SPO-2008-001, p. i.

14 Eric Schmitt and Ginger Thompson, 'Broken Supply Channel Sent Arms for Iraq Astray', *The New York Times*, November 7, 2007. More recently, Jamal Yousef, who was recently extradited to the U.S. for allegedly conspiring in 2008 to supply military-grade weapons to the Columbian guerilla group known as FARC, reportedly claimed that weapons offered to US informants had been stolen from Iraq. Publicly available documents on the case provide little insight into the veracity of Yousef's alleged claims, however. See: United States District Court Southern District of New York, United States of America v. Jamal Yousef, S3 08 Cr. 1213, p. 3.

15 Special Inspector General for Iraq Reconstruction, SIGIR-06-033, p. 23.

16 See Section 1228 of Public Law 110-181.

17 The five programs through which arms are transferred to Iraq are (1) the Iraqi Security Forces Fund (ISFF), managed primarily by Multi-National Force-Iraq (MNF-I); (2) Foreign Military Sales (FMS), managed by the Defense Security Cooperation Agency (DSCA) under the DOD; (3) Secretary of Defense's authority to Support Military Operations to Combat Terrorism, managed by Special Operations Command Central (SOCCENT); (4) the Foreign Excess Personal Property (FEPP) program, managed by the Deputy Under Secretary of Defense (DUSD) for Logistics and Material Readiness; and (5)

Direct Commercial Sales (DCS), managed by the Department of State. See: Jeffrey Wieringa, 'Compliance with Section 1228 of the National Defense Authorization Act for Fiscal Year 2008', (DSCA, July 2008), pp. 2-3. This document was retrieved by FAS using FOIA.

18 Department of Defense Inspector General, SPO-2008-001, p. iv.

19 Defense Security Cooperation Agency, *Memorandum for the Record: Foreign Military Sales Program Compliance with Section 1228 of the FY08 National Defense Authorization Act*, August 2008, p. 3. This document was retrieved by FAS using FOIA.

20 Defense Security Cooperation Agency, *Foreign Military Sales Program Compliance with Section 1228*, p. 2.

21 Ibid.

22 Department of Defense Inspector General, SPO-2008-001, p. 86.

23 Ibid.

24 Ibid, p. 39.

25 Ibid.

26 Department of Defense Inspector General, SPO-2009-002, pp. 35-36.

27 Department of Defense Inspector General, SPO-2008-001, p. iv.

28 News Conference, 'Training and Equipping Afghan Security Forces: Unaccounted Weapons and Strategic Challenges', *Federal News Service*, February 12, 2009.

29 Department of Defense, SPO-2009-002, p. 11.

30 Special Inspector General for Iraq Reconstruction, SIGIR-06-032: *Iraqi Security Forces: Review of Plans to Implement Logistics Capabilities*, October 2006, p. ii.

31 Department of Defense Inspector General, SPO-2008-001, p. 47.

32 Government Accountability Office, GAO-07-711, p. 1.

33 According to the Security Assistance Management Manual (SAMM), U.S. end-use monitoring programs “scrutinize[e] the purchaser’s use of defense articles and services to ensure their use is in compliance with the agreements under which they were provided.” See: ‘Chapter 8: End-Use Monitoring’, Security Assistance Management Manual (DSCA, October 2003), p. 323.

34 Interview with End-Use Monitoring (EUM) Program Management official in the Defense Security Cooperation Agency, November 2009.

35 Ibid.

36 The Iraq Golden Sentry End-Use-Monitoring Standard Operating Procedure (SOP), which were signed into force on September 12, 2008, “delineates responsibilities, required procedures, inspection requirements, and visit procedures.” See: MNSTC-I Response to the DODIG ‘Assessment of Arms, Ammunition, and Explosives Accountability and Control; Security Assistance; and Sustainment for the Iraqi security Forces’, October 2008, p. 5.

37 Ibid.

38 Interview with End-Use Monitoring (EUM) Program Management official in the Defense Security Cooperation Agency, November 2009.

39 Frank Ruggiero, ‘Background 1228 Policy Changes’, (State Department, August 2009), p. 2.

40 Department of Defense Inspector General, SPO-2008-001, p. 27.

41 Ibid, p. vii.

42 Ibid, pp. 30-31.

43 Interview with End-Use Monitoring (EUM) Program Management official in the Defense Security Cooperation Agency, November 2009.

44 Defense Security Cooperation Agency, *Foreign Military Sales Program Compliance with Section 1228*, p.2

45 Combined Security Transition Command-Afghanistan, “CSTC-A Mission” (2009), retrieved from http://www.cstc-a.com/index.php?option=com_content&view=article&id=124&Itemid=1 on September 30, 2009.

46 Department of Defense, SPO-2009-001: *Assessment of Arms, Ammunition, and Explosives Control and Accountability; Security Assistance; and Sustainment for the Afghan National Security Forces*, October 2008, p. ii.

47 Government Accountability Office, GAO-09-366T: *Corrective Actions Are Needed to Address Serious Accountability Concerns about Weapons Provided to Afghan National Security Forces*, February 2009, p. 3.

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