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Industry Study**

**Final Report  
*Weapons Industry***



**The Industrial College of the Armed Forces**  
National Defense University  
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## WEAPONS 2009

**ABSTRACT:** With the new presidential administration, federal budget deficit, and its declared intention to withdraw from Iraq, the United States (U.S.) will decrease its military weapons expenditures in the future. More specifically, the Department of Defense (DOD) will move away from complex weapons systems to reinforce its core capabilities. As such, this study will concentrate on U.S. military core capabilities like the management of ammunition in theatre, critical nodes in propellant manufacturing, and the underutilization of non-lethal weapons. It will also offer suggestions on how the weapons industrial base can leverage its non-military sales market to overcome potential military spending shortfalls.

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## PLACES VISITED

### Domestic

Radford Army Ammunition Plant; Radford, VA  
Naval Surface Warfare Center Dahlgren; Dahlgren, VA  
Picatinny Arsenal; Picatinny Arsenal, NJ  
General Dynamics: Ordnance and Tactical Systems Scranton Operations; Scranton, PA  
FN Manufacturing, LLC; Columbia, SC  
Raytheon Company: Missile Systems; Tucson, AZ  
Nammo Talley; Mesa, AZ  
ATK: Integrated Weapon Systems; Mesa, AZ  
TASER International, Inc.; Scottsdale, AZ  
Dillon Aero Inc.; Scottsdale, AZ  
Lake City Army Ammunition Plant; Lake City, MO  
The Boeing Company; St. Louis, MO

### International

The International Institute for Strategic Studies (Asia) Ltd.; Singapore  
Ministry of Defense: Defense Industry and Systems Office; Singapore  
Singapore Technologies Kinetics Ltd.: Small Arms Manufacturing; Singapore  
Ministry of Defense: Defense Science and Technology Agency; Singapore  
Ministry of Defense: Industrial Affairs Office; Malaysia  
Boustead Shipping Agencies Sdn. Bhd.; Malaysia  
Aircraft Inspection, Repair, and Overhaul Depot; Malaysia  
American Malaysian Chamber of Commerce; Malaysia  
Samsung Techwin; South Korea  
Hyundai Rotem; South Korea  
Doosan DST; South Korea  
S&T Daewoo Co. LTD; South Korea  
Korean Ocean Research and Development Institute; South Korea  
Poongsan Corp. Ammunition Plant; South Korea

## INTRODUCTION

The end of the decade finds the United States (U.S.) domestic industrial base for weapons in transition. After almost eight years of increasing demand from the Department of Defense (DOD) for ammunition, explosives, small arms, missiles, and rockets, the industry is now awaiting a predicted downturn. The change in U.S. presidential administrations, a rapidly expanding budget deficit, and the declared intention of the U.S. to withdraw from Iraq by August of 2010 all point to a “topping-off” of weapons expenditure increases. The Obama administration has already announced the scaling back of the U.S. Army’s Future Combat System, significant reductions in Ballistic Missile Defense, and the end of supplemental spending bills for the wars in Iraq and Afghanistan and the Global War on Terrorism in general. Since Congress has the final say on weapons procurement, the Secretary of Defense’s proposed cuts to major weapons systems are not final until Congress concurs with DOD recommendations. In addition, the fifty year-old design of the M-16 rifle and its variants are showing their age and a new generation of automatic rifles is currently being readied for the U.S. Army’s Carbine Competition anticipated to be announced in the summer of 2009. As the U.S. plans to ramp-down in Iraq, the administration’s intention is to increase troop levels in Afghanistan; thus, any reductions in the volumes of munitions consumed there may be made-up elsewhere.

Overall, the last decade has brought to light a number of deficiencies in the production and management of conventional ammunition for U.S. forces. For example, the U.S. Army as the Single Manager for Conventional Ammunition (SMCA) has responsibility for all small arms ammunition for DOD. As has been repeatedly noted and sometimes addressed, the single nitrocellulose production facility, the Radford Army Ammunition Plant (RAAP), is an aged, decrepit, single point of failure for the Army, DOD, and the nation as a whole. Although a partial upgrade of the facility is underway, significant investment in the facility remains to be made. In addition, this study recommends that the management of the production, distribution, and logistics for small arms ammunition be reassigned to the Defense Logistics Agency (DLA) to improve its visibility, efficiency, and responsiveness. As noted, this is not an inconsequential change and sure to initiate debate within the ammunition community.

The U.S. defense industrial base is committed to not only supplying DOD, but also the international customer demand. Through Foreign Military Sales and direct commercial sales, U.S. defense contractors are providing our allies with state of the art defensive systems that promote interoperability and support coalition operations. The strict U.S. Government oversight on both is intended to prevent sophisticated weapons systems from falling into our adversaries’ hands.

Finally, a new focus for the weapons industry is the development of systems and devices designed to incapacitate, dissuade, or control persons and groups with less than lethal methods (addressed in Appendix C). More akin to devices used by police departments for crowd control, these non-lethal weapons (NLW) have found a role in the control of hostile populations when the use of deadly force is not warranted and would harm U.S. public image.

## THE INDUSTRY DEFINED

Although the weapons industry is highly regulated similar to the defense industrial base, it is much broader in scope and more difficult to define because it covers more than just military operations. To illustrate, the U.S. Defense Contract Management Agency (DCMA) defines its

defense industrial base (DIB) as “the world-wide organic and private sector industrial complex with capabilities to perform research and development, design, produce, and maintain *military weapons systems, subsystems, components, parts or provide other goods and services to meet military requirements*”<sup>1</sup>. The weapons industrial base, on the other hand, includes those areas outlined in DCMA’s DIB definition as well as the manufacturers, suppliers, and service providers of non-military weaponry. This sub-section of the weapons industry supports a diverse customer base that includes law enforcement, private security companies, sports enthusiasts, collectors, etc. Thus, companies in the weapons industry must offer a wider range of customized products and services to meet its more diverse customer demand. The importance of product and/or customer diversity is timely considering the recent economic crisis and concerns over ballooning federal debt/budget that will undoubtedly affect the defense industrial base faster than the weapons industry.

In a recent speech, Secretary of Defense Robert Gates stated that “this department [DOD] must consistently demonstrate the commitment and leadership to stop programs that significantly exceed their budget or which spend limited tax dollars to buy more capability than the nation needs”<sup>2</sup>. He further stated that:

every defense dollar spent to over-insure against a remote or diminishing risk – or, in effect, to ‘run up the score’ in a capability where the United States is already dominant – is a dollar not available to take care of our people, reset the force, win the wars we are in, and improve capabilities in areas where we are underinvested and potentially vulnerable<sup>3</sup>.

This statement suggests that DOD will be moving away from highly complex weapons systems of the future to focus instead on improving its core capabilities. As such, this study will concentrate on vulnerabilities in core U.S. military capabilities like the management of ammunition in theatre, critical nodes in propellant manufacturing, and the underutilization of non-lethal weapons. It will also offer suggestions on how the weapons industry can leverage its non-military sales market to overcome potential shortfalls from decreases in military spending.

## CURRENT CONDITION

### *All Roads Lead to Radford*

Performance within the American weapons industry while historically steady, recently demonstrated an ability and capacity to rapidly expand in order to meet growing requirements. As noted throughout this study, of greatest concern is the continued viability and vulnerability of the U.S. sole source of nitrocellulose, RAAP. Radford is the Achilles heel of the industry. As the sole domestic producer of nitrocellulose energetics, tracing virtually any munitions’ fabrication thread back to its component constituencies leads to Radford. The production of small, medium, and large caliber ammunition is all tied to this single point of failure. There is no domestic redundancy or substitute for the nitrocellulose produced at Radford. Further, unlike other single points of failure, Radford products are incorporated into a plethora of essential weapons and ammunition that the U.S. military relies upon.

Comprised of aging infrastructure, Radford has been incrementally improved as repairs were required enabling the plant to meet or exceed the defense requirements yet also providing a false sense of security—so far the band-aids have held. That said, it is important to note that

RAAP is literally one accident or intentional attack away from being unavailable. The consequences of this loss would be difficult, if not impossible in the near term, to overcome.

### ***Surging for War and Gliding to Peace***

Prior to September 11, 2001 (9/11) the U.S. weapons and ammunition industry was relatively stable. Weapons development and procurement was predicated on a range of anticipated contingencies up to and including high intensity conflict. Weapon systems, small arms, and ammunition of all types were produced in moderate amounts. Using the example of small arms ammunition, that is 5.56 mm to .50 caliber, is instructive of the industry's ability to surge in order to meet the demands posed by simultaneous wars in Afghanistan and Iraq. Prior to 2001 Alliant Techsystems (ATK) produced approximately 543 million (M) cartridges in 5.56mm, 7.62mm and .50 calibers at the Lake City Army Ammunition Plant (LCAAP), a government owned contractor operated (GOCO) facility. Since 9/11 production at the plant has almost tripled with calendar year 2008 production exceeding 1.3 billion rounds. To meet increasing demands posed by the ongoing wars and increased training of the force, production was ramped up with the consolidation of facilities, addition of personnel and refinement of manufacturing processes. All told, employment at LCAAP jumped from under 1000 to approximately 2500 in calendar year 2008.

Weapons production was similarly responsive to the needs of the services. Production and refurbishment of M-16 series rifles and carbines continued apace with Fabrique Nationale (FN) USA and Colt achieving record annual production totals. Additionally, variations of existing designs were introduced to the field. Notably, the M240B series medium machine gun receiver is now being fabricated from titanium; this is a direct result of requirements from the Afghanistan theater of operations for a lighter weapon. These are but a few examples of demonstrating the resiliency and responsiveness of the industry today.

### ***Small Arms Production***

Small arms in this study are defined as personal and crew served weapons ranging in caliber from 9mm to .50 caliber. Production of small arms remains steady, with weapons upgrades and replacements occurring as required by nearly eight years of use in continuous war. Anecdotal and empirical evidence suggests the industrial base remains resilient and responsive, with sufficient capacity to continue to meet the current demand and shift as required to develop new weapons. Maintenance of current government stocks has been the focus, though this is likely to shift once the existing contract for the Colt M-4 carbine expires and a new design is competed. Given discussions with leading small arms manufacturers such as Colt, Smith and Wesson, and FN/USA, all indications are that industry is prepared to meet the potential impending requirement with products and concepts ready to roll out if competition is offered.

### ***Foreign Industrial Base—A Study in Contrasts***

#### ***Small Arms***

Limited field surveys of weapons production were conducted in Singapore and Korea. These surveys provided an opportunity to contrast domestic weapons and ammunition

production with that found in modern foreign facilities. Tours were respectively conducted at Singapore Technologies Engineering (STE) and Daewoo industries. STE production and assembly facilities were not observed—though their products and production concepts were discussed with the STE’s management team.

STE products, particularly the SAR21 assault rifle represent the best of Singapore small arms development and fielding. The SAR21 is a modern, modular weapon constructed predominately of polymers and alloy materials and incorporates an optical and laser sighting system. Test fire of a demonstration model showed the weapon to function accurately and reliably by all who fired it. The weapon system appears to be well designed, robust and well suited to the operational environment of its intended use—of note, the weapon is produced in its entirety in Singapore and is wholly designed by ST Kinetics. Further, it is reportedly current issue to Singapore’s armed forces serving as a viable organically produced alternative to the previously issued M-16 series rifles. ST Kinetics reportedly also produces a full range of small arms ammunition for its light infantry weapons, though the component parts and raw materials are imported for assembly in Singapore.

Like Singapore, Korea possesses a highly capable small arms industry. Small arms production in this case resides with Daewoo industries. Daewoo’s current lines of production include a range of products from 9mm pistols to K11 assault rifles. A cursory tour of the Daewoo manufacturing facilities revealed a combination of mid-20th century machine tool production with some modern Computer Numerical Controlled (CNC) equipment. Given the limitations of our access it is difficult to accurately assess Daewoo’s capacity, though anecdotally it appears to be more than sufficient to meet South Korean military requirements as well as serving the needs of a larger global market. Of particular interest is Daewoo’s development of the K11 rifle, a combination of kinetic and area burst weapon mating a 5.56 kinetic platform with a 20mm burst weapon and comprehensive fire control and sensor package—it is remarkably similar in appearance and function to the U.S. Objective Individual Combat Weapon.

### ***Ammunition***

South Korean small arms ammunition production was observed at the Poongsan plant. The production facility was comprised of aging but very well maintained equipment organized to effectively produce a range of military and commercial grade small arms ammunition. Unlike Singapore, Poongsan produces ammunition from domestically (Korean) procured component parts and materials. Poongsan has sufficient capacity to provide for the South Korean armed forces and the larger market beyond Korea (including the U.S.). Poongsan’s ammunition production rivals that found in the U.S. both in quality and quantity, exceeding 1 billion (B) rounds per year—capacity in this case well exceeds Korean needs. While the facilities we observed appeared to be efficient and highly productive it was not possible to probe beyond the surface to identify any single point of failure issues like those we found with the nitro-cellulose production at RAAP. Poongsan appears to be responsive and adaptive not only to larger market demands but also to technological developments within the Korean defense establishment. An example of this can be seen in the production of the non-standard 20mm air bursting ammunition required by the K11 dual barrel weapon. According to Poongsan’s catalog, production includes all manner of small, medium and large caliber munitions and component parts, including single,

double and triple base propellants—in short a wholly organic production capability that is arguably more modern than our own.

### ***State of the Industry***

While the extent of the field survey was limited to Singapore and Korea, given what was observed there and in the U.S., it is apparent that the Weapons industry as a whole is resilient and capable of meeting the requirements of our armed forces. More often than not the difficulty lies in adequately defining requirements while being willing to embrace more than marginal iterative improvements in performance and simultaneously meeting current operational demands. As demonstrated by this brief survey of the development of emerging technology and manufacturing in the global production of rifles, side arms and ammunition, small arms development has been an iterative, sometimes cumulative evolutionary process. Achieving truly revolutionary results has escaped not only the U.S. but also other highly developed nation states, Germany not the least of these—with the fielding of the K11 air burst capable weapon system, South Korea may be among the first to break this trend. Brilliant designers, with refined engineering solutions providing increased lethality, efficiency and reliability are often thwarted by cost and schedule as seen in the examples of the HK G11K2 and the OICW. Overcoming the tyranny of risk represented by cost and schedule acquisition processes is perhaps only possible by embracing the unlikely. Seeking solutions which are on the edge of revolutionary, extreme evolutionary changes that capitalize on the best implementations of available technologies—if the field survey is any indication building weapons that leap ahead providing a decided battlefield advantage is becoming the realm of U.S. industrial competitors.

### **CHALLENGES**

Despite supplying weaponry for two major wars, the weapons industrial base faces unique challenges and it is the responsibility of the Federal Government to fix or at least mitigate their impact since DOD continues to rely heavily on the market. This study will concentrate on the following areas:

#### ***Conventional Ammunition Management***

The Secretary of the Army (SA) is responsible for the SMCA mission<sup>4</sup>. Yet, despite the intent of the single manager concept to eliminate overlap and duplication, there is redundancy in how SA and the DLA manage items – same processes, different items. That said, there is a strong argument that DLA could better support the ammunition by assuming the role of managing conventional ammunition and thereby creating efficiencies and program benefits.

#### ***Non-DOD Weapons and Munitions Sales***

With a budget request of over \$650 B, the defense looms large as a target of opportunity for anticipated funding cuts. A case can be made that adverse impact to the weapons industrial base can be mitigated by an increase in non-DOD weapons and munitions sales. Procurement and the closely related Research and Development (R&D) funding streams account for approximately \$200 B and these accounts could be considered “low hanging fruit” for cuts<sup>5</sup>.

Any cuts in procurement and R&D puts the strength of the weapons industrial base at risk. Increasing non-DOD or foreign weapons and arms sales may compensate for or mitigate the negative impact of declining defense budgets.

### *The State of the Propellant Industrial Base*

In the final accounting, it is not the tank, mortar, rifle, or pistol that is lethal, but the projectile delivered from the weapon. And as different as projectiles are, they are all linked by a single strategic commodity – propellant. All military propellants are a nitrocellulose-based chemical compound and today RAAP is the sole producer of nitrocellulose propellant. Without alternate sources or significant redundancy, this single production line of ammunition powder and rocket propellant for the U.S. is our Achilles’ heel.

### *Non-Lethal Weapon Policy Development*

DOD is dedicating increasingly more effort toward fielding NLWs that “incapacitate” while “minimizing fatalities” and “permanent injuries”<sup>6</sup>; however, while the technology to provide a system that operates somewhere between shout and shoot is rapidly advancing, the governing policies are lagging. DOD is faced with the challenges of incorporating NLWs into the warrior mentality, adequately funding such programs, providing training and education all while overseeing the on-going design efforts.

## OUTLOOK

The global weapons market consists of public and private companies and in some cases government owned producers who compete for a share of the lucrative market. In recent years, the global market has provided ample opportunity for companies to benefit from the needs of their own forces and from sales to foreign nations. When analyzed from the perspective of a national contribution to the entire market, five countries (U.S., Russia, Germany, France, and the United Kingdom [UK]) accounted for over 80% of the total value of arms sold during the 2003-2007 time period<sup>7</sup>. The U.S. led all countries in both the value of transfer agreements (\$24.8 B<sup>8</sup>) and the value of all arms deliveries (\$12.8 B<sup>9</sup>). The UK ranked third in both categories. From a corporate perspective, in 2006 the top 100 arms manufacturers sold \$315 B in products and services<sup>10</sup>. Forty-one companies located within the U.S. were among the top 100 and they accounted for 63% of all sales<sup>11</sup>. A group of Western European firms combined to account for another 29% of the total<sup>12</sup>. Compared to the previous year, real growth in the market was calculated to be 9.2%<sup>13</sup>.

The primary recipients for the major weapons developers were developing nations who took delivery of 64.7% of the total value of arms exported globally<sup>14</sup>. The following chart depicts the dollar value of U.S. defense products sales agreements within a given region and the largest buyer within the region during 2007<sup>15</sup>:

<b>Region</b>	<b>Total value in region</b>	<b>Top buyer in region</b>
Africa	\$10 M	Kenya (\$4 M)
American Republics	\$1.96 B	Canada (\$1.2 B)
Asia	\$4.67 B	Australia (2.9 B)
Near East	\$7.37 B	Egypt (\$1.7 B)
Europe	\$4.1 B	Turkey (\$2.1 B)

It is readily apparent where current U.S. arms export emphasis lies and not coincidentally the remainder of arms exporting nations are competing for a share in regions where cash has been plentiful and security needs have been a concern driven by the current fighting in Iraq and Afghanistan, Arab versus Israeli tensions, or fear of the destabilizing effects of an unpredictable Iran. Despite continuous conflict, African nations received very little in the way of U.S. military goods or services through 2007; with renewed interest causing stand up of a combatant commander command tasked with keeping tab of the continent's issues, which may lead to a future increase, particularly in the realm of training.

In the near term, there is considerable debate over how long the amount and annual growth of global arms sales can continue in tenuous economic times. A new administration in Washington, elected in part on the promise to withdraw troops from Iraq, will undoubtedly enact policies that may have a large impact on the types of systems, both new and existing, available to U.S. forces and for export through either the Pentagon's Foreign Military Sales or State Department's Direct Commercial Sales programs. Recent recommendations by the Secretary of Defense outlined the department's, and likely the administration's, thoughts on weapons program acquisition, sustainment, and active duty and civilian forces structure<sup>16</sup>. At present these are only recommendations and will have to clear the rather high hurdle of Congressional oversight, along with the appeals of manufacturers, before any real change is enacted.

However, all players in the defense industry will have to deal with an eventual reduction in available funds in DOD's wallet. From the major U.S. defense supplier's perspective, even if new major weapons systems are not sold to DOD in the coming years, major American defense contractors have a wide base of clients throughout the world requiring support, upgrades, and ordnance for the systems they have previously fielded<sup>17</sup>. While a diverse portfolio of systems and clients may be sufficient to prevent a catastrophic hard landing for leading firms, smaller suppliers in more narrowly defined product categories will have a more difficult time surviving. American industry has been placed in this situation any number of times in the past and indications are the same types of business strategies that allowed industry to weather previous storms will be counted on to see them through potential downturns in the coming years. Regardless of size, business have indicated they will attempt to cultivate new markets, expand from strictly military applications to civilian use, yet continue to research and develop some new products in order to not stagnate. Additionally, to remain competitive manufacturers will make changes within their own force structure. Voluntary retirements and lateral moves are the norm; however, one bonus of moving toward a lean structure is a versatile, agile, and cross-trained work force that will allow many companies to shift employees to operational product lines with greater ease than previously possible. In at least one case, human resource personnel indicated that enforcing existing personnel policies regarding work place behavior would be sufficient to trim employment rolls if reductions became necessary.

What is not clear are the U.S. government's intentions regarding propping industry up to avoid a hard landing. The industrial base is currently capable of supplying the needs of our forces at the present operational tempo. Some portions of the weapons industry are extremely active, while others admittedly have available surge capacity should demand increase for their wares. In either case, the pool of skilled labor is the linchpin and a prime consideration when discussing government policy toward industry. Should businesses resort to personnel layoffs in an already lean operation the trained, talented artisans who produce everything from energetics

to precision weapons will find work in other industries, but the defense industry will suffer, if not immediately in a depressed economy then certainly if or when demand rebounds.

## **GOVERNMENT GOALS AND ROLE**

As discussed, it is generally accepted that it is in the Nation's national strategic interest to maintain a viable defense industrial base capable of meeting both civil and defense weapons and munitions requirements. To that end, the U.S. requires highly-qualified weapons and munitions producers who are both well-established, to take advantage of their specialized expertise, and financially sound, to enable them to withstand the limitations that governmental practices and economic conditions may impose on them. In foreign countries, that strategic interest is also recognized, but may not always be based upon organic capabilities and capacity. Rather, having access to defense weaponry and munitions may involve reliance upon allies, such as the U.S., or it may involve the eventual establishment and maintenance of an organic defense industrial base with the capacity to provide the required or desired defense capabilities, as has been the case in recent years in countries with growing economies. In both the U.S. and foreign instances, however, the existence of clear government strategic goals and implementation policies is needed to create the conditions that allow such a viable defense industrial base to exist.

Assuming these strategic goals and implementation policies are in place, the first condition necessary is the existence of a legal environment that enables viable, continuous economic production based upon proprietary rights being guaranteed to the inventors and producers of goods and services. A second necessary condition involves some continuum of government spending dedicated to defense, in particular towards weapons and munitions production, as well as some standardized process by which that occurs, because often the government is the prime if not sole purchaser of defense-related products. Both a solid legal structure and a secure and continuous funding source are needed for any industry to survive, but this is especially relevant if commercial as well as defense applications are desired from production. To examine these conditions, we begin by briefly examining the current state of in the U.S. and three Asian nations visited (Singapore, Malaysia, and Korea). Recommended policy changes included in the conclusion will strengthen these conditions, given that government goals and implementation policies may vary over time, sometimes to the detriment of the conditions, themselves.

### ***Legal Issues***

As mentioned, a fundamental requirement for the establishment and maintenance of a solid manufacturing industrial base is an "accessible, sufficient and adequately-structured legal system that protects not only the safety of individuals, but also the rights of the parties who have entered into development or contractual arrangements that are critical to economic survival in industrial democracies"<sup>18</sup>. In the U.S., the federal government ensures this through patent and trade laws that guarantee intellectual property (IP) rights, and through trade and export agreements that work to provide a "level playing field" for domestic producers. Both types of legal regulations ensure that any invention or improvement to a product, such as a new method to produce energetics or discovery of a new chemical compound that improves the lethality of a projectile's impact, will provide value to the discoverer and/or producer, ensuring that the industry will be able to eke out enough revenue to sustain itself over time. Without these

protection mechanisms, a producer would lose the value of any intellectual asset developed and the incentive to stay in business<sup>19</sup>.

Similar issues face foreign producers, although they rely not only on domestic legal protections, but guaranteed government import restrictions and government production guarantees that insulate producers from competitive pressures. In more advanced countries, reliance on participation in international treaties, agreements, and conventions, such as the World Intellectual Property Organization (WIPO), the 1967 International Convention on Intellectual Property and the World Trade Organization's 1994 Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS).

Given the predominantly military applicability of their products, weapons and munitions producers (like other defense industries) face a unique set of legal standards in regards to their IP rights that at times may conflict with the needs of the federal government to a cost-effective product, because of national security requirements that restrict sales and limit production. In the U.S., munitions producers are prohibited from obtaining the full, free-market value of their products by Title 22 of the Code of Federal Regulations (22 C.F.R. §§ 120-130), commonly known as the International Traffic in Arms Regulations (ITAR), that prohibits "the transfer of information and material pertaining to defense and military-related technologies". For export of information or material that is not directly defense-related but could be dual-use for military and defense purposes, the Commerce Department's Bureau of Industry and Security (BIS) administers the Export Administration Regulations (EAR), and applies specific products to lists maintained under the terms of the Wassenaar Arrangement (WA) and the Missile Technology Control Regime (MTCR) that govern licensing requirements impacting U.S. defense industries.<sup>20</sup> Although of strategic importance to American national security, these legal restrictions negatively impact the health of the U.S. defense industrial base.

Other legal restrictions also impact the ability of defense industries to mitigate risks associated with weapons and munitions production, such as safety and environmental mandates that impact their ability to develop new production processes or modernize facilities, due to the prohibitive costs involved in meeting the requirements. This situation leads producers to sustain a higher risk profile than the one faced by commercial industrial producers, and requires the government to both pay for the increased risk through increased costs, and protect domestic defense suppliers by limiting competition from global competitors. Similar conditions exist in the three countries visited, including a predominance of direct government control over production, itself. Therefore, competition efficiencies are negatively impacted, including the defense industrial base's ability to maintain adequate capacity and provide innovative and efficient products in the future. Thus, we need to examine economic issues that represent another area where the government roles impact a viable defense industrial base.

### ***Economic Issues***

In the past, the U.S. military had been the main supplier of defense products, but "pressure from Congress, and an increasingly widespread belief in the superior efficiency and intrinsic virtue of the private sector combined to move the armed services...towards a virtually exclusive dependence on commercial arms suppliers"<sup>21</sup>. Thus, a viable U.S. defense industrial base now requires government spending. However, as the sole or main consumer of defense-related products, the U.S. government's uneven and sometimes unpredictable federal budgetary process also leads to economic inefficiencies that limit the U.S. defense industrial base from

providing the best value to the taxpayer. Over the last 20 years, the U.S. military budget has drastically increased, but under the two Clinton administrations in the 1990's, decreases in U.S. defense spending led to an enormous consolidation process within the U.S. defense industry that resulted in giants such as Boeing, Lockheed-Martin and Raytheon having hegemony over defense production, because smaller producers were unable to weather the downturn in government spending.

## **ESSAYS ON MAJOR ISSUES**

### **Essay1: Single Ammunitions Manager**

In this era of change and transformation we can assume there will be adjustments made to defense spending and defense missions. In looking across DOD there are duplicative roles and missions filled by both the Services and DLA. This essay is a recommendation that DLA assume the roles of the SMCA mission which are duplicative with DLA's mission.

#### ***Background***

“The early intent of the Single Manager concept was to eliminate overlap and duplication of production efforts among the Services”<sup>22</sup>. The SA is responsible for executing the SMCA mission within DOD<sup>23</sup> and the overall munitions production and item management function rests with the Program Executive Officer (PEO) Ammunition as the SMCA Executor,<sup>24</sup> Army Materiel Command (AMC) as the Executive Director for Conventional Ammunition (EDCA) functions<sup>25</sup> and finally, the Joint Munitions Command (JMC) is designated as the SMCA Field Operating Activity (FOA)<sup>26</sup>. The SMCA FOA is responsible for providing logistics and sustainment support to the SMCA Executor and the Military Services<sup>27</sup>.

#### ***SMCA Responsibilities***

The SMCA, in collaboration and in partnership with the Military Services and, executes duties in the following areas: joint development and distribution of joint conventional ammunition policies and procedures (JCAPPS), research, development, test and evaluation (RDT&E), transition, production base, acquisition, supply, maintenance, demilitarization, disposal, quality assurance, technical data, configuration management control, transportation, handling, safety, security, financial management, resource planning, resource programming, resource budgeting, resource execution, implementing regulations, regulation assessment, personnel training, unit training, and security assistance<sup>28</sup>.

We would like to note here that the SMCA has been relegated as a general manager of the storage, issue, and transportation of all munitions but does not truly manage all munitions as each Service reserves the right to contract for, and produce, munitions they consider unique to their Service.

Service “rights” to produce Service specific munitions has a serious impact on the ability of the SMCA to manage the overall stockpile and cross level munitions supplies to support combat efforts as one Service cannot send munitions in support of another, a feat a true DOD agency such as DLA can successfully accomplish by simply managing the entire munitions stockpile at the national level.

## *Defense Logistics Agency*

DLA is no stranger to the Single Manager concept as DLA manages fuel and food at the national level and serves as the single point of contact for Commanders in the field. “At the wholesale level the Single Manager was concerned with net requirements, procurement, production, storage, distribution, disposal, transportation, cataloging, inspection, maintenance, and standardization”<sup>29</sup>. With the exception of production, transportation, and maintenance, these responsibilities are performed by DLA today.

Is there duplication in the missions performed by the SMCA and DLA today? Yes, AMC’s JMC, as the SMCA FOA, and DLA perform many of the same functions. To name a few: joint development and distribution of joint procedures, item transition, acquisition, supply, demilitarization, disposal, quality assurance, technical data, some transportation, handling, safety, implementing regulations, and regulation assessment. With the exception of JMC’s SMCA FOA role, AMC typically performs functions such as these for the Army alone. DLA, on the other hand, performs these functions as core competencies for all Services, for all Combatant Commands, and for all Foreign Military Sales Customers for all classes of supply they manage. Today DLA does not manage the same items as the SMCA; however these same mission functions are applied to different items DLA manages such as fuels managed by DLA’s Defense Energy Support Center (DESC).

DESC is one of four Inventory Control Points of DLA and is the DOD’s Executive Agent for all bulk petroleum: diesel and gasoline, jet fuel, ship propulsion, and missile fuel<sup>30</sup>. DLA manages the fuel supply chain at the national level meaning the Services and Combatant Commands do not need to procure, transport, and store massive amounts of fuel or commit resources and personnel to the fuel supply chain other than when they are ready to consume it, similar to JMC and munitions. The Services and Combatant Commands develop and refine fuel requirements and the supply chain is managed by DESC to the point of consumption. Managing a supply chain at the national level saves the Department both money and resources and gives a true picture of total demand history.

Demand history, in the case of munitions expenditures, coupled with routine collaboration with the customer, is the key component in accurate forecasting and resource planning. Demand plan accuracy ensures funding is allocated to preferred stocks and help prevent the impact of being out of stock and back orders.

DLA managing supply chains at the national level reduces the need for Service personnel to serve in positions as Item and Inventory Managers, as Buyers, as Contracting Officers, as Quality Assurance Representatives, as Contract Administrators, as Attorneys, etc.

In any acquisition strategy the goal is stability; a steady pipe line of support. Therefore, redundancy is key; multiple suppliers, multiple prime vendors, multiple routes, contingency support contracts, etc. especially in a volatile areas where the demand can be unpredictable and inconsistent<sup>31</sup>. DLA procurement options allow flexibility and competition in logistics opening doors for industry to provide solutions through partnership and mitigating risk to the Department as a whole.

Today munitions are planned by each Service based on targets that are allocated to them through Combatant Command’s Operational Plans. Each Service then provides their munitions requirements to the SMCA which is then translated into contracts and production at government or commercial munitions producers. Each Service request for munitions is often laden with

surplus “safety” cushion that could mean an addition of 10 – 20% more munitions than the mission calls for. The “safety” cushion could be greatly reduced or even eliminated if DLA were to manage all munitions, not just munitions relegated to the SMCA for overall management as the safety cushion would be spread across all Services.

In transferring conventional ammunition management to DLA, benefits and efficiencies might be gained through DLA’s extensive experience in jointly managing commodities. DLA’s policies, procedures, acquisition strategies, and systems are all built around supporting all Services, all Combatant Commands, and all Foreign Military Sales Customers which enables cross leveling of supplies if or when needed.

In moving overall munitions management to DLA, some policy and procedural changes would have to occur and it may take some time for benefits to be realized. Efficiencies might be gained due to the benefits of consolidating munitions into DLA’s robust and maturing Enterprise Resource Planning (ERP) information technology system and may also be gained through DLA’s culture of leveraging acquisition strategies to increase competition within the industrial base and with DLA’s experience in managing fuel and food at the national level. DLA successfully performs these missions for all Services which are DLA’s core competencies daily.

### ***Rumor Control***

During the Weapons Industry site visits and briefings from guest speakers, the question of DLA’s ability to perform these functions was received with concerns. The first concern being DLA’s cost recovery rate. The rate is simply the combination of the cost of the item and DLA’s cost of doing business. AMC is subject to the same costs and one could argue DLA costs may be less because overall commodity management is their core competency.

The second concern was a possible violation of Title 10 authority. DLA is currently managing fuel and food at the national level with no violation of Title 10 authority. The core competencies performed by DLA today are the focus of this essay. Performing these specific duties for conventional ammunition items would not violate Title 10 authority.

Hazardous Materials (HAZMAT) was a third topic of concern. DLA currently manages many hazardous materials. DLA’s current HAZMAT policies and procedures could be expanded to include proper handling, storage, and transportation of conventional ammunition.

### ***Conclusion***

DLA performing the mission of the SMCA would eliminate duplications in the missions performed by the SMCA and DLA today, specifically in the areas of joint development and distribution of joint procedures, item transition, acquisition, supply, demilitarization, disposal, quality assurance, technical data, some transportation, handling, safety, implementing regulations, and regulation assessment.

Should DLA assume the role of managing conventional ammunition at the national level? Yes, DLA efficiently and effectively manages all supply items at the national level today. In order for DLA to manage conventional ammunition, policy and procedure changes would be required. For example, hazardous materials policies could be expanded to include proper handling, storage, and transportation of conventional ammunition.

Will benefits be realized or efficiencies gained by transferring conventional ammunition management to DLA? Due to the many policy and procedural changes that would have to occur

at DLA to make this change, the answer is “probably”. Efficiencies might be gained after consolidating conventional ammunition into DLA’s ERP information technology system and through DLA’s culture of leveraging acquisition strategies to increase competition within the industrial base and with DLA’s experience in managing fuel and food at the national level. Without further detailed analysis it is impossible to truly answer this question, but DLA successfully performs these missions which are DLA’s core competencies daily.

Ms. Angela Evens, Defense Logistics Agency / COL Thomas Schorr, U.S. Army

## **Essay 2: Weapons/Munitions Sales (Non-DoD)**

The U.S. is in the midst of an economic crisis and bogged down in two wars in the Middle East. The national debt is skyrocketing and deficit spending has reached thresholds never before encountered in U.S. history. With a budget request of over \$650 B for FY2010, the DOD is by far the government’s largest non-discretionary account. Health and Human Services, at \$79 B, is a distant second<sup>32</sup>. This budget disparity is enormous. As attempts are made to set funding priorities, control spending, reduce the deficit and reduce the national debt, the defense budget looms large as a target of opportunity for funding cuts. A case can be made that adverse impact to the weapons industrial base will be mitigated by an increase in Non-DOD weapons/munitions sales.

### ***DOD Budget Breakdown***

DOD expenditures fall into five categories as follows: Operations and Maintenance (O&M), Military Personnel, Procurement, R&D, and Other (Overseas Contingency)<sup>33</sup>. The O&M and Military Personnel requirements together absorb about 60% of DOD’s base budget or about \$320 B<sup>34</sup>. The procurement account funds the production of weapons systems and other equipment at about \$120 B. The R&D account funds the development and testing of new weapons systems and other equipment at about \$80 B. Procurement of weapons/munitions is closely linked to procurement of weapon systems.

Procurement and R&D budgets could be considered the ‘low hanging fruit’<sup>35</sup>. Procurement is known for cost overruns and schedule slippages and R&D spending does not offer immediate payoff on investment<sup>36</sup>. Surprisingly, funding for R&D has remained consistent during previous downturns<sup>37</sup>. The expectation is that R&D spending will again remain consistent during this downturn. The percentage of the defense budget allocated to procurement has decreased about 7% since the late 1980s. This downward trend is expected to continue or possibly accelerate. To maintain the industrial base workforce and associated capability, the decreased U.S. spending will need to be offset. Based on the above historical data, the procurement budget could experience a reduction of 7% in FY2010 and similar amounts in future years. Increasing non-DOD or foreign weapons/arms sales may be able to compensate for or mitigate the negative impact of declining defense budgets. What follows is a snapshot of the global weapons market and the U.S. laws governing arms exports

### ***A Closer Look at the U.S. Laws Applicable to the Global Weapons Market***

Weapons made in the U.S. that are subsequently exported, are governed by three U.S. laws: (1). The Arms Export Control Act (AECA) of 1976 (22 U.S.C. 2778); (2) The Foreign Assistance Act (FAA) of 1961; and (3) the Export Administration Act of 1979 Reauthorization (EAA).

The AECA is administered by the State Department and governs the procedures and purposes for which military equipment/weapons may be sold or transferred (self-defense, internal security and UN [United Nations] operations only). The International Traffic in Arms Regulations (ITAR) implements this law. The FAA is also administered by the State Department and addresses economic and military assistance to foreign governments and bars military aid or arms if patterns of human rights abuse exist or if nuclear weapons are being pursued<sup>38</sup>.

The EAA is administered by the Commerce Department and governs shipments of dual-use goods (technology and information) with both military and civilian applications. The Export Administration Regulations (EAR), which is similar to the ITAR, implements this law and guides sales activities of Commerce Department personnel and exporters. The EAR contain the Commerce Control List (CCL), which includes technologies useful for the production of ballistic missiles, ingredients which could be used to make chemical weapons, certain computers, shotguns and police equipment. Companies wishing to export these items must obtain an export license from the Commerce Department<sup>39</sup>.

### ***Two Types: Foreign Military Sales and Direct Commercial Sales***

There are five principle means by which the U.S. exports weapons and military services abroad. They are foreign military sales (FMS), direct commercial sales (DCS), leases of equipment, transfers of excess defense articles (EDA) and emergency drawdown of weaponry<sup>40</sup>.

FMS are essentially government to government negotiated foreign sales. In addition to procuring weapons, the Pentagon usually contracts to deliver the goods, provide training in the operation and maintenance of the weapon, supply spare parts and give performance assurances<sup>41</sup>. The military articles being sold through this program can come from either Pentagon stocks or new production. In the latter case, the Defense Department contracts with U.S. arms manufacturers to actually build the weapons and, in some cases, provide related services<sup>42</sup>. But the Pentagon takes care of all of the paperwork.

DCS are negotiated by U.S. companies and foreign buyers, without the involvement of the Pentagon. These sales must be approved by the State Department's Office of Defense Trade Controls through the provision of an export license. They are subject to the same congressional notification procedure as FMS.

In general, the choice of whether to use the government-to-government channel or to deal directly with the arms manufacturer is up to the purchasing country. The Pentagon is technically neutral about which method foreign governments use to make their purchases, although there are some weapons systems that the Pentagon will not permit the industry to sell directly. The commercial route is usually quicker, sometimes cheaper and always

entails less government oversight than FMS. In addition, the State Department is much less transparent about DCS than the Pentagon is about FMS<sup>43</sup>.

As a result, there is very little data maintained on U.S. commercial direct arms sales<sup>44</sup>. Based on export license data from the State Department, DCS of lower technology items has surged to \$96 B, up from \$58 B in 2005<sup>45</sup>. Foreign sales are credited with helping to keep production lines like the F-16 open at Lockheed Martin and the C-17 open at Boeing<sup>46</sup>. For Lockheed Martin this represented \$6.3 B in revenue in 2007 or 15% of total sales, up from \$4.8 B in 2001<sup>47</sup>. This trend is a clear demonstration that foreign sales can mitigate downturns in defense procurement.

The U.S. is the largest arms supplier in the world, with FMS sales agreements in 2008 at \$32 B, up from \$10 B in 2005<sup>48</sup>. The U.S. was responsible for over 45% of all weapons transferred globally in 2007<sup>49</sup>. In addition to arms, this includes ammunition, training, and support services<sup>50</sup>. The value of all arms transfer agreements worldwide, to both developed and developing nations, in 2007 was nearly \$60 B. The number of U.S. arms clients, various states and territories, grew from 123 in 2001 to 174 in 2008. At times, the U.S. has been strategic in its approach to these sales. Countries that were previously barred and ineligible to import weapons were subsequently approved, if they supported our national interests (viz., war against terror, counter-drug policies, or similar)<sup>51</sup>. Other top arms suppliers include Russia (\$24.9 B in agreements in 2007), UK (\$10.4 B in agreements in 2007), and China (\$3.8 B in agreements in 2007)<sup>52</sup>. Figure 1 in Appendix A lists the top seven arms suppliers.

Most of the growth in foreign arms sales is among developing nations, which account for 67% of the value of all transfer agreements worldwide<sup>53</sup>. Developing nations include all countries except the U.S., Russia, European nations, Canada, Japan, Australia, and New Zealand<sup>54</sup>. The top arms recipients under DOD's FMS program include: Pakistan, Saudi Arabia, Israel, Iraq, Korea, United Arab Emirates (UAE), Kuwait, Egypt, Columbia, Singapore, and Jordan<sup>55</sup>. Figure 2 in Appendix B lists the top 25 arms recipients in the developing world<sup>56</sup>. Hence there are plenty of foreign arms business opportunities for the U.S. weapons industrial base to pursue and to use to offset projected U.S. procurement expenditure shortfalls. For example, in 2008, international sales accounted for 70% of Raytheon's total sales<sup>57</sup>. Other opportunities could include expanding efforts in the weapons upgrade and weapons servicing area. Although foreign arms sales are a lucrative business, it is not without problems.

### ***Problems With Foreign Weapons Sales***

Although the U.S. weapons industry has tremendous capability, much care should be taken to ensure that the right weapons don't end up in the wrong hands. As indicated, FMS is a government to government transaction. In spite of the checks and balances, U.S. provided weapons may be found in some of the wrong places. For example there are tens of thousands of assault rifles and other firearms that are unaccounted for in Afghanistan<sup>58</sup>. Inventory controls have been inadequate. Care should also be taken to ensure that foreign weapons sales don't spiral out of control and lead to regional or other instability. These are specific areas that require some attention.

### *The Way Forward*

Although there has been significant consolidation in the U.S. weapons industrial base, U.S. companies like Boeing, Lockheed Martin, Northrop Grumman, and Raytheon are well positioned to increase their market share. The industry, with support from the U.S. Government, should step up efforts to court developing nations. U.S. export policy should be reviewed and changes made as appropriate.

### *Conclusion/Recommendations*

Foreign Military Sales and Direct Commercial Sales are viable avenues for offsetting declines in the defense budget. The size of the international market is growing as more countries enter. Some U.S. weapons suppliers are already taking advantage of the increased opportunities. Increased efforts will be needed to backfill for DOD's reduced procurement budgets.

Mr. Willis Williams, Dept. of Navy

### **Essay 3: Propellant Industrial Base**

Ammunition is essential to U.S. fighting forces. Not only is it required for the conduct of ongoing combat operations, but it is also consumed in the constant training of war-fighters needed to develop and maintain the skills to fight and win. Ensuring sufficient supplies of safe, reliable, and effective ammunition is vital for the U.S. to maintain and apply its military tool of national power. The manufacture of nitrocellulose, the primary ingredient of ammunition propellants and explosives, is among the most critical capabilities in the military industrial base. Today, there is a single source in North America for the nitrocellulose used in ammunition, RAAP.

This paper provides an assessment of nitrocellulose production capability within the U.S. ammunition industrial base. It first assesses RAAP's performance in meeting production requirements and identifies the critical issues affecting production. It then reviews the Joint Munitions Command's strategy and plans for maintaining, improving, and securing nitrocellulose production capability, along with potential alternatives for redundant sources of supply. Finally, it provides recommendations to ensure the U.S. has access to the nitrocellulose it needs to meet its ammunition and explosives requirements.

### ***RAAP Nitrocellulose Production Performance and Challenges***

On the surface, ammunition production may not appear to be a technically critical capability, but it absolutely is. It requires exacting production and quality standards. "Ammunition is a unique commodity that requires technical production accuracy to the nearest details and superior quality levels for the safety of its users. The complex processes associated with creating quality ammunition components and end-items require specific technical skill and capability"<sup>59</sup>. As a key element in ammunition, the manufacture of nitrocellulose is no exception.

In addition to ensuring rigorous technical requirements, the U.S. requires secure sources for the production of ammunition and its components. To manage the acquisition of ammunition

across the military services, the Army has consolidated responsibilities within the Joint Munitions and Lethality (JM&L) Life Cycle Management Command (LCMC), which is assigned as the DOD SMCA. Within JM&L, the Program Executive Officer (PEO) Ammunition has established Program Manager, Joint Services (PMJS) for managing the responsibilities of the SMCA. The vision of PMJS is “to be the systems expert on the integration and execution of Joint Service munitions, industrial base and demilitarization programs”<sup>60</sup>. PMJS has determined that the manufacture of nitrocellulose is central to the ammunition industry, and must have a domestic source.

RAAP is the sole North American producer of nitrocellulose. In its assessment of the National Technological Industrial Base (NTIB), PMJS has identified nitrocellulose production as a ‘single point failure’ common to all domestic manufacturing of ammunition (excluding non-DOD ammunition), with no alternative commercial producers in the U.S. or Canada<sup>61</sup>. RAAP is a GOCO. In 1941, RAAP began production of nitrocellulose, propellants, and explosives under the operation of the Hercules Powder Company<sup>62</sup>. ATK Energetic Systems (AES), part of Alliant Techsystems, has operated the plant under contract since 1995<sup>63</sup>.

Even with RAAP as the only U.S. source, research for this paper has not identified any shortfalls of nitrocellulose that have impeded manufacture of propellants and explosives for the U.S. military’s ammunition needs. By this measure, the nitrocellulose industrial base is a success. However, there are risks inherent in a single provider of critical material that is manufactured under highly hazardous chemical processes. A prolonged break in nitrocellulose production would threaten availability of ammunition products that are vital to U.S. forces.

RAAP has experienced numerous, short-term issues that have stopped nitrocellulose production. The plant experienced seventy production failures in 2008<sup>64</sup>. Much of the infrastructure is at or past its designed useful life<sup>65</sup>. Breaks in water and wastewater pipes, compressed air and electrical lines, and the acid processing plant are the leading causes of stopping production. Acid plant failures, in particular, affect production and increase the cost of nitrocellulose manufacture. Like most of the ammunition industrial base, RAAP’s infrastructure has degraded due to cyclical funding of ammunition procurement since World War II. Numerous studies on the ammunition base, including RAAP, have concluded the base is obsolete, lacks efficiency, and requires modernization<sup>66</sup>.

### ***Strategies for Improving RAAP Nitrocellulose Production***

As the organization responsible for ammunition acquisition, PEO Ammunition has responded to the challenges facing the industrial base by developing the *Single Manager for Conventional Ammunition (SMCA) Industrial Base Strategic Plan (IBSP): 2015* to “provide strategic guidance and establish a management framework to posture the ammunition production and logistics supply chain to effectively and efficiently respond to the Joint Warfighter’s current and future conventional ammunition requirements”<sup>67</sup>. The document provides a guiding set of goals and objectives for ensuring the ammunition industrial base, and includes strategies specific to each of the government owned facilities. The strategies address implementation plans and resourcing by process.

For RAAP, there are a number of improvements defined. Specifically related to nitrocellulose production are: 1) Construct and commission a new nitric acid/sulfuric acid and nitrocellulose production capability; and 2) Acid area tank farm modernization. Other improvement plans focus on reducing facility footprint, increasing energy efficiency, and more

automated production facilities that will reduce the risk of nitrocellulose production interruptions<sup>68</sup>.

The 2015 IBSP is an update to previous versions, and the strategic plans it contains have begun to materialize in modernization actions at RAAP. To date, 26 improvement projects have been initiated at RAAP, with total funding provided from fiscal year 2005 to 2008 of \$273 M. Additionally, \$430 M is planned from fiscal years 2009 to 2015, and \$230 M in 2016<sup>69</sup>. The contractor has also made investments to overcome recurring production challenges. Since assuming control in 1995, ATK has invested more than \$50 M in RAAP<sup>70</sup>.

However, the benefits of the government investments will take time to materialize and will require following through with the planned funding. There is risk of changes to planned resources and priorities that could jeopardize modernization efforts at RAAP, particularly with a new administration and the 2009 financial crisis. The well-defined plans PEO Ammunition assembled will assist in justifying the continued investment and balance some of the risk.

### ***Strategies for Ensuring Redundant Nitrocellulose Production***

Assuming the Army fully implements the planned improvements to RAAP, the plant is still a single point of failure for NC production. To address this problem, the Army leadership must also develop alternatives for redundant or standby production capability. In general, there are three options to ensure availability of nitrocellulose: (1) Produce a war reserve or safety stockpile of nitrocellulose; (2) Develop an alternate manufacturing line at RAAP or other government location; and (3) Develop an alternate commercial source of nitrocellulose.

Discussion with ATK indicates RAAP has some excess capacity that could be used to produce a safety stockpile, while still producing the normal requirement. The major concern will be safety and storage space. Storing large quantities of nitrocellulose will introduce explosion hazards and adequate space may not be available. An explosion of this stock could damage the already fragile base infrastructure and facilities, and thus negatively affect nitrocellulose production. Therefore, the storage location would need to be located a safe distance from any from any critical infrastructure. This option would be the least expensive of the three.

The next option is to develop a second government source; however, this would incur significant cost, likely to be in the billions of dollars<sup>71</sup>. There are also the challenges with plant location and environmental impact. The nature of working with nitrocellulose requires large space away from populated areas (RAAP is over 6,000 acres)<sup>72</sup>. The manufacturing process requires large amounts of water, and emits high levels of nitrates, which could make obtaining operating permits difficult. The benefit of access to production from one facility if the other is off-line or damaged comes at the added cost of maintaining two facilities and the continuing cost of overcapacity, which runs counter to a business tenet in the IBSP – right sizing of the industrial base for operating efficiencies<sup>73</sup>. In addition, a second source would not obviate the need for modernization of RAAP. PMJS would need to identify significant risk to existing nitrocellulose facilities to warrant spending resources on establishing a second source.

Another approach is to privatize the nitrocellulose facilities at RAAP. Private ownership would incentivize investment in modernization and technology for an economic return on investment, and eliminate the need for government-appropriated funds. A potential difficulty is liability for existing environmental issues, although this may be overcome if the government leased the land to the company. Privatization would support the tenets of the IBSP by having industrial base support costs included as fully burdened costs of production<sup>74</sup>.

Along similar line, the military could turn to other commercial industry to provide nitrocellulose. Many U.S. chemical companies make products that are either similar to nitrocellulose or that contain nitrocellulose (for example, some paints, varnish removers, Compound W™ Wart Remover, lacquers, plastics, golf balls, syringes, piano keys, wound dressings, magician's flash paper, early movie film, and nail polish). Chemical companies, such as DuPont (previously an explosive manufacturer) and Dow Chemical, have facilities and processes similar to those found at RAAP, and could be contracted to serve as an alternate or emergency source of nitrocellulose. Implementing this option may yield lower costs, since the companies already have some of the required equipment and trained personnel. However, the major challenges associated with this option will be securing the required environmental compliance permits and implementing the appropriate safety measures at the company's site.

### ***Recommendations***

The DOD should support and fully fund the PEO Ammunition plan for modernization at RAAP. This will achieve the goal of ensuring a reliable source of nitrocellulose that meets the production capacity needs of the military. PMJS indicates executing the plan for RAAP will provide the following benefits: (1) Significant risk reduction to supply of acids and nitrocellulose; (2) Increased product quality & yield; (3) Total modernization will result in a ~\$30 M annual return on investment; (4) Reduced risk of catastrophic failures; and (5) Reduced Equipment 'Down-Time'.

This well-developed plan balances the needs of the military, long-term industrial base sustainment, supply chain risk, and affordability. With the government plant modernization efforts under way and planned for ammunition, including nitrocellulose production, the National Defense Industrial Association has reprioritized issues other than ammunition manufacturing as the most critical within its armaments division, stating that the ammunition "industrial base is evolving from at-risk to modernizing, but the plans must be executed"<sup>75</sup>.

In parallel with executing the IBSP, PMJS should take the following actions: 1) Conduct a assessment and business case analysis for privatizing RAAP. Private industry would have a profit incentive to make modernization and process improvements. If the assessment favors private industry, existing modernization plans could be adapted for transition. Ongoing IBSP investments in RAAP would still benefit the government, as recoupment of these costs would not have to be included in prices charged by a new private owner; 2) Build a strategic reserve/safety stock of nitrocellulose; 3) Conduct a risk analysis and business case analysis for the creation of an alternate source of nitrocellulose. The analysis should consider a range of alternatives from do nothing and emergency contracting, to a fully redundant production facility.

### ***Conclusion***

Nitrocellulose is a key component in the propellants used in the manufacture of ammunition. As the only domestic manufacturer of nitrocellulose, RAAP has for decades met the nation's needs, but its aging infrastructure and facilities risk production stops that may result in ammunition shortfalls for the military. PEO Ammunition has defined and begun execution of a strategic plan for investing in the modernization of the ammunition industrial base, including RAAP. DOD should provide full funding for the plan's investments supporting the manufacture of nitrocellulose. PMJS should assess the costs, benefits and risks of privatizing the facilities at

RAAP so that profit provides an incentive for ongoing process and facility sustainment and improvement. In addition, PMJS should take steps to establish a safety stock of nitrocellulose and investigate other alternative for a redundant source to ensure access to this critical material in the event of catastrophic disaster at RAAP. Executing and improving upon on the initiatives put in place by PEO Ammunition will ensure the U.S. has access to the nitrocellulose needed to produce the ammunition and explosive ‘tools’ of national defense.

Mr. David Chipman, Dept. of Navy  
COL Kenneth Deal, U.S. Army / Col Charles Westgate, U.S. Air Force

## CONCLUSION

The weapons industry is complex and is integral to the defense industrial complex. Whether they are arms (rifles, small cannons, pistols), munitions (ammunition, rockets, guidance systems) or ordnance (artillery shells, bombs, mines) or an emerging category of less-than-lethal weapons they are key to every major weapons platform in the inventory. Every ship, aircraft, tank, and artillery piece use some sort of projectile to make contact with and destroy an enemy target. Additionally the individual soldier carries personal weapons and crew served rockets, mortars, or grenades into battle. The production, modernization and innovation of munitions and ordnance are strategically important in peace and war.

The current wars in Iraq and Afghanistan have demonstrated that the industry is relatively healthy. Industry has kept up with demand for munitions and ordnance. Companies have ramped up production, hired new skilled and unskilled labor, expanded factory space, entered into cooperative multi company arrangements and developed innovative measures to increase productivity. However, while wartime requirements have generated growth and prosperity for the weapons industrial base, the inevitable defense spending reduction places the industrial base at risk if it experiences a “hard landing”. Shortfalls in government purchasing and international sales will make it difficult for companies to recoup their long term infrastructure investments and could drive some out of business altogether. While this study group does not advocate the government protectionism or subsidies for defense industry at large, there is a cogent argument to be made for keeping national weapon companies solvent and functioning for long term strategic security. In short, we should not abdicate our strategic flexibility by outsourcing critical weapons design and manufacturing to overseas companies. Furthermore, selected key and critical functions of the industrial base must be modernized to ensure they remain functional through the post Iraq and Afghanistan war period.

## ENDNOTES

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