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United States Government Accountability Office
Washington, DC 20548

June 30, 2011

The Honorable Carl Levin
Chairman
The Honorable John McCain
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Buck McKeon
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

*Subject: Military Uniforms: Issues Related to the Supply of Flame Resistant Fibers
for the Production of Military Uniforms*

Prior to Operation Enduring Freedom and Operation Iraqi Freedom, Department of Defense (DOD) personnel with flame resistant (FR) uniforms were mainly aviators, fuel handlers, and tank crews. With the growing prevalence of the improvised explosive device (IED) threat, all ground forces serving in Iraq and Afghanistan have been exposed to the possibility of fire-related injuries. The Ike Skelton National Defense Authorization Act for Fiscal Year 2011 extended to 2015 the authority to procure fire resistant¹ rayon fiber for the production of uniforms from certain foreign countries, provided by section 829 of the National Defense Authorization Act for Fiscal Year 2008 and originally set to expire in 2013.²

This letter formally transmits the enclosed briefing developed in response to the requirement in the Ike Skelton National Defense Authorization Act for Fiscal Year 2011 to report on the supply chain for FR fiber for the production of military uniforms. Specifically, the act required GAO to analyze several elements of the supply chain, including the current and anticipated sources of FR rayon fiber; actions DOD has taken to identify alternatives to FR rayon fiber; impediments to the use of

¹Although the act used the term "fire resistant," "flame resistant" is more generally accepted in industry and DOD.

²See Pub. L. No. 111-383, § 821(a) (2011) (H.R. 6523) (extending the authority provided by § 829 of the National Defense Authorization Act for Fiscal Year 2008, Pub. L. No. 110-181 (2008)).

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 30 JUN 2011		2. REPORT TYPE		3. DATES COVERED 00-00-2011 to 00-00-2011	
4. TITLE AND SUBTITLE Military Uniforms: Issues Related to the Supply of Flame Resistant Fibers for the Production of Military Uniforms				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Government Accountability Office, 441 G Street NW, Washington, DC, 20548				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 40	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

such alternatives; and the impediments posed to efficient procurement of FR rayon fiber by existing statutory or regulatory requirements; among others.³ On March 15, 2011, we provided a draft of the enclosed briefing to your offices to satisfy this requirement. Based on subsequent briefings to your offices, we updated the enclosed briefing by adding slide 28.

To conduct this work, we interviewed and analyzed data from a number of DOD and military service officials, as well as from representatives of companies that manufacture or use flame resistant fibers, and relevant officials from trade associations, academia, and testing facilities about sources of FR rayon and available alternatives to FR rayon. Additionally, we obtained DOD and industry views on relevant laws and regulations. We conducted this performance audit from February 2011 to June 2011 in accordance with generally accepted government auditing standards (GAGAS). These standards required that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

In summary, an Austrian-headquartered company is presently the only source used for FR rayon fiber to support the manufacturing of FR uniforms for DOD. However, the department has taken a number of steps over the past 5 years to identify alternative FR fabric blends. For example, the military services have sought fabric/garment submissions through sources sought notices, market surveys, or solicitations in 2006, 2007, 2009, and 2010 to explore available options and have tested a wide variety of FR fabrics. Based on our review of military service testing, it is unclear if FR rayon's flame resistant characteristics are better than all other alternatives. Further, some DOD and industry officials stated that FR rayon has several advantages, including improved comfort, moisture absorbency, and ability to be dyed, while others have stated that fabrics with FR rayon tend to be less durable than those using other FR fibers. With respect to legal requirements applying to the production and use of FR rayon fibers, immediately relevant to our assessment was the Berry Amendment,⁴ which generally prohibits the use of funds available to DOD for the procurement of certain items when not grown, reprocessed, reused, or produced in the United States, absent an exception.⁵ Two exceptions relevant to FR rayon fiber are the general availability exception under the Berry Amendment itself, which results in a domestic nonavailability determination (DNAD),⁶ and the exception unique to FR rayon provided by the authority found in section 829 of the National Defense Authorization Act for fiscal year 2008.⁷ DOD indicated that a DNAD issued in 2001 for rayon yarn for use in military clothing and textile items provides the basis for the waiver presently used for purchase of FR rayon for military uniforms.⁸

³For additional information on the eight elements of the requirement, see encl. I, slides 36-37.

⁴10 U.S.C. § 2533a.

⁵See § 2533a(a).

⁶See § 2533a(c); see also 48 C.F.R. § 225.7002-2(b).

⁷See Pub. L. No. 110-181, § 829(a), as amended by Pub. L. No. 111-383, § 821(a).

⁸See Under Secretary of Defense (AT&L), *Class Determination of Domestic Non-Availability for Rayon Yarn for Military Clothing and Textile Items* (July 20, 2001). DOD indicated that the authority provided by section 829 is not presently used, but nevertheless viewed it as valuable.

We are not making any recommendations in this report.

Enclosure I contains briefing slides that provide additional details regarding our findings. DOD did not provide written comments on this report. However, after reviewing a draft of this report, DOD officials agreed with its content and provided technical comments, which we incorporated where appropriate. Additionally, we provided information related to this briefing to industry and academic officials to ensure its technical accuracy. They generally agreed and provided technical comments which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees. We are also sending a copy to the Secretary of Defense. In addition, this report will be available at no charge on our Web site at <http://www.gao.gov/>.

Should you or your staff have any questions concerning this report, please contact me at (202) 512-8365 or solisw@gao.gov. Key contributors to this report are listed in enclosure II. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report.

A handwritten signature in black ink, appearing to read 'W. Solis', with a long horizontal flourish extending to the right.

William Solis
Director
Defense Capabilities and Management

Enclosures - 2



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Enclosure I: Military Uniforms: Issues Related to the Supply of Flame Resistant Fibers for the Production of Military Uniforms

Briefing to the
Committees on Armed Services of the Senate and the House of Representatives

Updated June 2011

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- Introduction
 - Review Elements
 - Scope and Methodology
 - Background
 - Findings
 - Agency and Third Party Views
 - List of Department of Defense (DOD), Industry, and Other Organizations Contacted
 - Elements: Section 821(c) of the Ike Skelton National Defense Authorization Act for Fiscal Year 2011

- As the threat from Improvised Explosive Devices (IEDs) emerged during Operation Iraqi Freedom and continues today, numerous capabilities have been developed to protect the warfighter. These solutions include such items as armored vehicles, improved body armor, and flame resistant (FR) uniforms.
- A component used in many of the FR uniforms has been FR rayon, a material not produced domestically. Accordingly, DOD has been procuring FR rayon from foreign sources through a domestic nonavailability determination, a waiver of a legal requirement to use domestic sources.
- There has been debate about whether there are domestically available alternatives to FR rayon and whether DOD should be allowed to continue procuring foreign source FR rayon.
- In January 2011, the Ike Skelton National Defense Authorization Act for Fiscal Year 2011 extended a waiver provided by section 829 of the National Defense Authorization Act for Fiscal Year 2008, set to expire in 2013, to 2015.¹ The act also required GAO to assess issues related to the supply chain for fire resistant² fiber for the production of military uniforms. This briefing satisfies that requirement.

¹See Pub. L. No. 111-383, § 821(a) (2011) (H.R. 6523) (extending the authority provided by § 829 of the National Defense Authorization Act for Fiscal Year 2008, Pub. L. No. 110-181 (2008)).

²Although section 821 used the term "fire resistant," "flame resistant" is more generally accepted in industry and DOD.

In response to the requirements in the Ike Skelton National Defense Authorization Act for Fiscal Year 2011, this briefing addresses the following objectives:³

- (A) The current and anticipated sources of FR rayon fiber for the production of military uniforms.
- (B) The extent to which FR rayon fiber has unique properties that provide advantages for the production of military uniforms.
- (C) The extent to which the efficient procurement of FR rayon fiber for the production of military uniforms may be impeded by existing statutory or regulatory requirements.
- (D) The actions the Department of Defense has taken to identify alternatives to FR rayon fiber for the production of military uniforms.
- (E) The extent to which such alternatives provide an adequate substitute for FR rayon fiber for the production of military uniforms.
- (F) Any impediments to the use of such alternatives, and the actions the department has taken to overcome such impediments.

³For the complete language of the statute, see slides 36-37.

(G) The extent to which any uncertainty regarding the future availability of FR rayon fiber results in instability or inefficiency for elements of the U.S. textile industry that use FR rayon fiber, and the extent to which that instability or inefficiency results in less efficient business practices, impedes investment and innovation, and thereby results or may result in higher costs, delayed delivery, or a lower quality of product delivered to the government.

(H) The extent to which any modifications to existing law or regulation may be necessary to ensure the efficient acquisition of FR fiber or alternative FR products for the production of military uniforms.

- To determine current and future DOD plans for using FR fibers or flame retardants in military uniforms, and to analyze relevant federal laws and regulations, we collected data, as well as information on pertinent laws and regulations from DOD, military departments, and service components, and met with relevant officials.
- To determine current and future sources of FR fibers in military uniforms, to analyze the advantages of or impediments to using FR fibers (both rayon and alternatives) in military uniforms, to obtain perspectives on pertinent laws and regulations, and to determine the impact on the textile industry from uncertainty about the availability of FR rayon and any alternative fibers, we interviewed representatives from companies that manufacture or use FR rayon and alternative fibers, and relevant officials from trade associations, academia, and testing facilities.
- A list of DOD, industry, and other organizations we contacted can be found on slides 34 and 35.
- We conducted this performance audit from February 2011 to June 2011 in accordance with generally accepted government auditing standards (GAGAS).
- We provided information related to this briefing to DOD, industry, and academic officials to ensure its technical accuracy. They generally agreed and provided technical comments which we incorporated as appropriate.

- Prior to Operation Enduring Freedom and Operation Iraqi Freedom, DOD personnel with FR uniforms were mainly aviators, fuel handlers, and tank crews. In addition to DOD personnel, utility workers, firefighters, oil/gas industry workers, mechanics, and certain types of engineers also use FR uniforms. These personnel required FR uniforms because of their potential exposure to fire or other thermal energy.
- With the prevalence of the IED threat, all ground forces serving in Iraq and Afghanistan were exposed to the possibility of fire-related injuries. However, according to DOD officials, personnel raised concerns that existing FR uniforms were uncomfortable and not suited for the desert environment.
- In July 2006, the Army issued a notice seeking sources to gain information on industry capabilities for FR materials and subsequently evaluated 18 FR fabrics for future FR uniforms. The Army chose a fabric called *TenCate Defender™ M*—a blend of three different fibers, including FR rayon. According to the Army's Program Executive Office (PEO) Soldier, *TenCate Defender™ M* provided the best combination of flame resistance, durability, and breathability while also closely matching the non-FR uniform in texture and appearance. The Marine Corps also selected *TenCate Defender™ M* for its FR uniforms based on its own internal testing.

- In August 2007, the Army and Air Force jointly issued a solicitation to identify alternatives to *TenCate Defender™ M* based on concerns about the availability of FR rayon given a projected increase in demand from both services. According to Army officials, 26 proposals were evaluated, and two solutions were recommended—*TenCate Defender™ M* and a Nomex® and FR treated cotton-based blend called Abrams™ V. However, the Abrams™ V fabric had a different weave that did not match the Army's existing *TenCate Defender™ M* uniforms, creating variations in appearance that Army leadership found unacceptable. According to the officials, the Air Force agreed to purchase the Abrams™ V uniforms under the newly awarded contract to alleviate concerns about the availability of FR rayon to meet the Army's surge in FR uniform requirements. The officials stated that the Army, however, purchased only the minimum quantity of Abrams™ V uniforms required by the contract, electing instead to continue buying *TenCate Defender™ M* uniforms under its existing contract.
- Over the past 5 years, the military has sought fabric/garment submissions to explore and test a wide variety of fabrics. For example, the Army issued FR Army combat uniform sources sought notices⁴ or solicitations in July 2006, August 2007, and February 2010.

⁴A sources sought notice is a synopsis posted by a government agency that states they are seeking possible sources for a project. It is not a solicitation of offers.

- Most recently, the Army and Marine Corps have been testing FR fabrics as part of ongoing efforts to identify alternative fabrics with improved durability and equal FR capabilities.
- Currently, the Air Force uses Abrams™ V, a Nomex® and FR treated cotton-based blend fabric for its FR ground combat uniforms. However, the Air Force recently changed its wear policy for Afghanistan directing its personnel in that area of operation to wear the Army's Multicam® uniform, if available. Also known as the Operation Enduring Freedom Camouflage Pattern (OCP) uniform, it provides better camouflage in the Afghanistan environment and is constructed from an FR rayon-based fabric. Air Force officials told us that they are interested in the Army's ongoing study to select new ground combat uniforms and may consider adopting the same should it meet their needs.
- The Navy does not currently have a FR ground combat uniform. However, the Navy uses the Marine Corps FR uniform and Nomex® flight suits provided from the Marine Corps Systems Command and the Defense Logistics Agency (DLA), respectively. In addition, Navy personnel assigned to Army and Marine Corps units may wear the FR garment issued by those services when deployed.

Flame resistance in fabrics can be achieved in two ways:

(1) By using inherently FR materials and fibers. Flame resistance is the property of a material whereby flaming combustion is prevented, terminated, or inhibited following application of a flaming or nonflaming source of ignition with or without subsequent removal of the ignition source.⁵ For example, Nomex® is an inherently FR fiber.

(2) By using special treatments of fibers or fabrics. A flame retardant is a chemical used to impart flame resistance.⁶ For example, cotton blends are treated with a topical chemical application.⁷

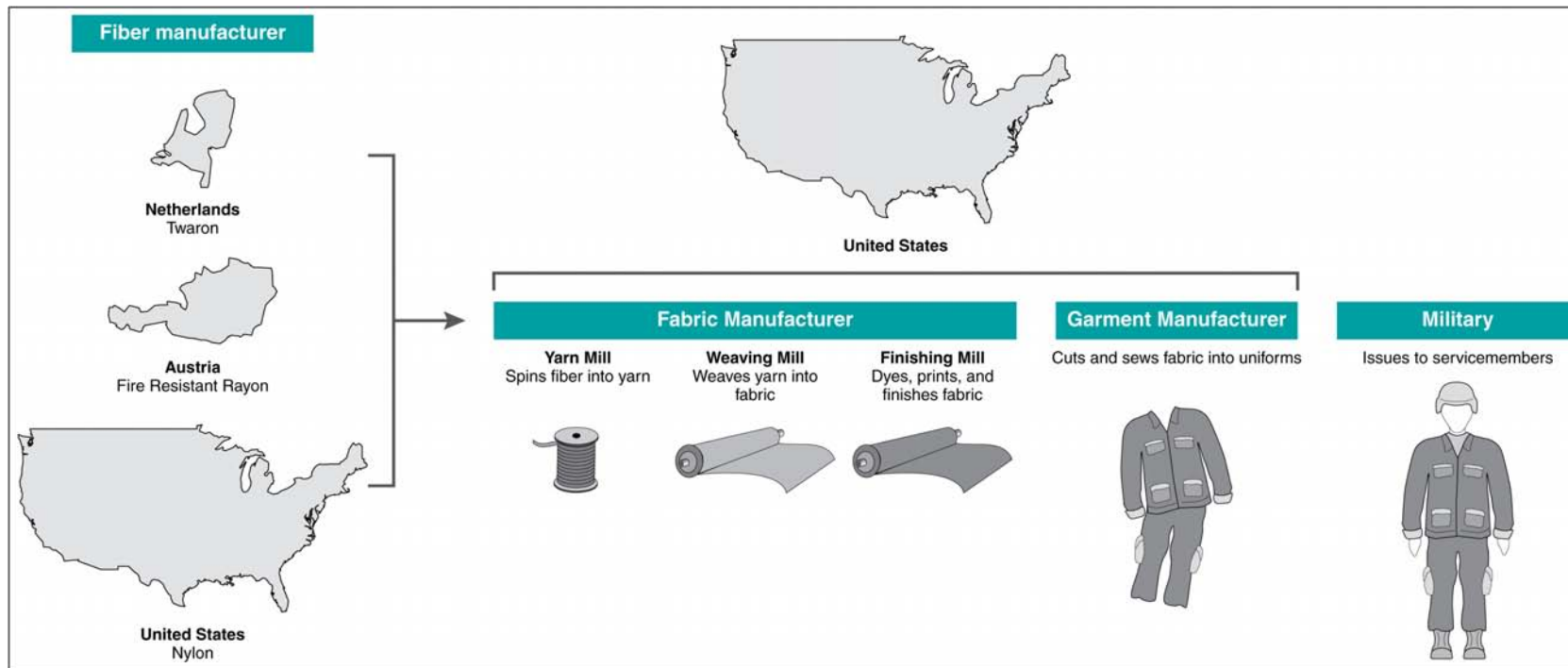
- FR fabrics can be produced from a single fiber (e.g., modacrylic) or from blends of two or more fibers. A variety of fibers may be used to create a fabric blend, including FR rayon, Nomex®, Twaron®, Kevlar®, FR cotton, polybenzimidazole (PBI), modacrylic, oxidized polyacrylonitrile (OPAN), and nylon, among others—each having its own unique properties.
- Blending of fibers is a common practice in industry to optimize the desired flame resistance and other properties, such as cost, durability, comfort, moisture absorbency, ability to be dyed, and fade resistance.

⁵ASTM D 4391, Terminology Related to the Burning Behavior of Textiles.

⁶ASTM D 4391, Terminology Related to the Burning Behavior of Textiles.

⁷During the finishing process, a treatment such as a flame retardant is applied to the fabric either before or after dyeing or printing but before the fabrics are cut and sewn into final products.

Figure 1: Supply Chain Flow Chart for *TenCate Defender™ M* Fabric



Source: GAO analysis of DOD and industry data.

A variety of laws, such as the Buy American Act, are designed to encourage federal agencies to purchase U.S. supplies and services, commonly referred to as domestic source restrictions. In addition, Congress has passed domestic source restrictions that apply only to particular federal agencies, such as the Berry Amendment, which applies only to DOD.

The Berry Amendment

- Generally, the Berry Amendment⁸ prohibits use of funds available to DOD for the procurement of certain items when such an item “is not grown, reprocessed, reused, or produced in the United States.”⁹
- A number of statutory and regulatory exceptions apply to the Berry Amendment,¹⁰ but two availability exceptions are the most relevant to this report:
 - o (1) The general availability exception under the Berry Amendment itself
 - DOD indicated that this exception provides the basis for the waiver presently used for FR rayon.
 - o (2) The exception specific to FR rayon provided by the authority found in section 829 of the National Defense Authorization Act (NDAA) for Fiscal Year 2008
 - DOD indicated that this authority is not presently used for FR rayon.

⁸10 U.S.C. § 2533a. Implementing regulations may be found in the Defense Federal Acquisition Regulations Supplement (DFARS). See 48 C.F.R. subpart 225.70.

⁹See § 2533a(a). For the list of covered items, see § 2533a(b) and DFARS § 225.7002-1(a).

¹⁰Notably, the prohibition does not apply to acquisitions at or below the simplified acquisition threshold. See § 2533a(h); see also DFARS § 225.7002-2(a).

The Exceptions to the Berry Amendment

- First, the availability exception under the Berry Amendment itself applies where certain officials determine that articles or items in satisfactory quality and sufficient quantity cannot be obtained from the domestic base “as and when needed at United States market prices.”¹¹ The relevant official issues a domestic nonavailability determination (DNAD).¹² On July 20, 2001, the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) issued a DNAD for rayon yarn for use in military clothing and textile items.¹³ In correspondence with members of Congress in 2009, the USD(AT&L) indicated that this DNAD covers the procurement of FR rayon.¹⁴

¹¹See § 2533a(c); see also DFARS § 225.7002-2(b). This authority may be exercised by the USD(AT&L), the Secretaries of the Army, Navy, and Air Force, and the Director of the Defense Logistics Agency. See DFARS § 225.7002-2(b)(1).

¹²See DFARS § 225.7002-2(b)(1), (2). The DNAD is to include an analysis of the alternatives that would not require a DNAD and a written certification “with specificity” by the requiring activity as to why these alternatives are unacceptable.

¹³See Under Secretary of Defense (AT&L), *Class Determination of Domestic Non-Availability for Rayon Yarn for Military Clothing and Textile Items* (July 20, 2001).

¹⁴See Letter from the Honorable Ashton Carter, USD(AT&L) to the Honorable Lynn A. Westmoreland (July 28, 2009); Letter from the Honorable Ashton Carter, USD(AT&L) to the Honorable Lindsey Graham (Aug. 19, 2009); Letter from the Honorable Ashton Carter, USD(AT&L) to the Honorable Jim Webb (Aug. 19, 2009).

- Second, the exception found in section 829 of the NDAA for FY 2008 provides the authority to procure FR rayon fiber from certain foreign countries, following necessary determinations.¹⁵
 - o To use the authority, the Secretary of Defense must determine either that (1) FR rayon fiber for uniform production is unavailable from sources within the national technology and industrial base; or (2) Procuring FR rayon fiber manufactured from suppliers within the national technology and industrial base would result in sole-source contracts or subcontracts that are not in the best interests of the government or consistent with the objectives of competition in contracting.¹⁶
 - o Although the authority was to expire on January 28, 2013, section 821(a) of the Ike Skelton NDAA for FY 2011 provided an extension until January 1, 2015.¹⁷
 - o In his 2009 correspondence, the USD(AT&L) suggested that DOD has not issued a determination pursuant to section 829 because it is relying instead on the 2001 DNAD for rayon yarn.¹⁸

¹⁵See Pub. L. No. 110-181, § 829(a) (2008), as amended by Pub. L. No. 111-383, § 821(a) (2011).

¹⁶See § 829(a)(1), (2). Specifically, the second determination makes reference to the objectives of 10 U.S.C. § 2304. The Secretary of Defense must submit a copy to Congress within 30 days of making a determination under the authority. See Pub. L. No. 110-181, § 829(b).

¹⁷See Pub. L. No. 111-383, § 821(a) (H.R. 6523).

¹⁸See Letter from the Honorable Ashton Carter, USD(AT&L) to the Honorable Lynn A. Westmoreland (July 28, 2009).

The Buy American Act

- The Buy American Act restricts the acquisition of articles manufactured outside the United States and articles manufactured domestically but substantially all from articles, materials, or supplies from foreign sources.¹⁹
 - o An exception can be made based on a determination that (1) acquisition of domestic articles is “inconsistent with the public interest,” (2) their cost is “unreasonable,” or (3) items are not made domestically in sufficient and reasonably available quantities and are not of a satisfactory quality, among other circumstances.²⁰
 - o Under DOD implementing regulations, a manufactured end product is considered domestic if it is manufactured in the United States and if the cost of its components from the U.S. and qualifying countries exceeds 50 percent of the cost of all components.²¹

¹⁹See 41 U.S.C. § 8302(a)(1). The Buy American Act, previously codified at 41 U.S.C. § 10a, was moved to § 8302 as part of the reorganization of Title 41 by Pub. L. No. 111-350 (2011).

²⁰See 41 U.S.C. § 8302(a)(1), (a)(2)(B) (reorganized from 41 U.S.C. § 10a(a)).

²¹See DFARS § 225.101(a). The list of qualifying countries includes Austria and the Netherlands. See DFARS § 225.003(10). Qualifying countries are those with reciprocal defense procurement memoranda of understanding or international agreements. *See id.*

(A) The current and anticipated sources of FR rayon fiber for the production of military uniforms.

- Currently, there is only one source of FR rayon fibers to support the manufacturing of FR uniforms for the Department of Defense—an Austrian-headquartered company, Lenzing.
- Other types of FR rayon fibers are produced by other companies in Finland, China, and Japan, but these fibers are used for nonwoven products, such as FR fibers for mattresses and cannot be used to make uniforms, according to an industry official.
- No U.S. source currently exists for the production of FR rayon. According to several industry officials, it is unlikely that the U.S. textile industry will develop any FR rayon production given the costs to build and maintain environmentally compliant manufacturing facilities, uncertain demand from DOD, and a limited commercial market.

(B) The extent to which FR rayon fiber has unique properties that provide advantages for the production of military uniforms.

- Based on our review of military service testing, it is unclear if FR rayon's flame resistant characteristics are better than all other alternatives. Some tests indicate that fabric blends with FR rayon provide better protection; however, other tests show that fabrics without FR rayon may perform as well or better than those with FR rayon. According to Army and Marine Corps officials, fabric blends containing FR rayon have met FR test requirements.
- However, DOD and industry officials stated that FR rayon has several advantages such as improved comfort, moisture absorbency, and ability to be dyed.
- On the other hand, according to DOD and industry officials, FR rayon tends to be less durable than other FR fibers. To mitigate this weakness, FR rayon can be blended with other fibers to produce a fabric with increased durability. For example, *TenCate Defender™ M* is a fabric blend that combines FR rayon with a para-aramid fiber (such as Twaron®) and nylon to improve durability.

(C) The extent to which the efficient procurement of FR rayon fiber for the production of military uniforms may be impeded by existing statutory or regulatory requirements.

We discussed statutory or regulatory requirements that might apply to the production of FR rayon with industry representatives and DOD officials to determine which one(s) they view as potentially affecting the procurement of FR rayon for the production of military uniforms. In addition to asking generally about potential impediments, we specifically discussed the following:

- the Berry Amendment,
- environmental laws and regulations,
- the Buy American Act, and
- workplace safety laws and regulations.

The Berry Amendment

DOD and military service officials suggested that the Berry Amendment was not an impediment, due to the availability of a Berry Amendment waiver.

- However, several military service officials recognized the need to seek entirely domestic solutions if a waiver no longer existed.
- In fact, officials from one service indicated that their ultimate goal is to find an entirely domestic solution that does not depend on a waiver.

Industry representatives similarly expressed the view that the Berry Amendment was not an impediment, due to use of a waiver. However, there were mixed views on how a waiver impacts innovation.

- Several suggested that the absence of a waiver would preclude the use of FR rayon, limiting their choice of fibers, and constraining their ability to develop FR solutions that meet desired characteristics (e.g., flame resistance, durability, comfort, etc.).
- Others suggested that a waiver limits innovation by encouraging use of FR rayon as opposed to developing alternative solutions.
- Representatives from one company expressed concern that DOD might not consider alternatives from a foreign source where a waiver does not already exist.

Although some industry representatives and DOD officials correctly identified a DNAD under the Berry Amendment itself as the waiver presently used for FR rayon, others appear to believe that DOD relied to some extent on the authority provided by section 829 of the NDAA for 2008.

Environmental Laws and Regulations

- Industry representatives stated that environmental laws impacted the production of FR rayon in the United States by raising the costs to build and maintain manufacturing facilities, but they did not identify any specific laws or regulations that posed impediments.²²
- Most industry representatives stated that the cost to comply with environmental laws and regulations was just one factor that industry would have considered in a business decision to open a domestic FR rayon production plant. For example, several representatives and officials noted that environmental regulations existed in Austria, where at least one firm has found it cost effective to continue FR rayon production and expand plant capacity. Industry officials cited other business factors that would have to be considered, including:
 - o whether DOD's demand for FR rayon alone is sufficient and predictable to support a business case for new plant construction; and
 - o the likelihood that a new start U.S. rayon production plant will be able to recapture a sufficient share of the commercial rayon fiber market to produce a positive return on investment, recover its initial start-up costs, and make a profit.

²²Representatives from one industry manufacturer mentioned the Clean Air Act and Clean Water Act generally, without reference to specific provisions.

The Buy American Act

- DOD officials did not view the Buy American Act as an impediment, since the act is generally less restrictive than the Berry Amendment. They confirmed that FR uniforms are generally manufactured in the United States using materials from domestic or qualifying country sources, which would likely make them compliant with the Buy American Act.

Workplace Safety Laws and Regulations

- Industry representatives and DOD officials did not identify any workplace safety or labor legal regimes as an impediment to efficient procurement.

(D) The actions the Department of Defense has taken to identify alternatives to FR rayon fiber for the production of military uniforms.

- The Department of Defense has taken actions since 2006 to identify alternative FR fibers for military uniforms, including maintaining contact with industry organizations through site visits and Industry Day events; conducting a market survey; issuing sources sought notices; and testing fabric blends to gain information about the latest improvements in FR fabric blends.
- FR fabrics are currently being tested by the services to identify alternative FR fabrics or to improve flame protection, durability, laundering reaction, comfort, and price. Just over half of the fabrics currently being tested contain FR rayon fibers; alternative fibers are being tested in fabric blends as well, including domestically produced fibers such as meta-aramids (e.g., Nomex®), modacrylic, PBI, and FR-treated cotton.
 - o For example, the Army is currently testing fabrics in an attempt to qualify more than one fabric for use in the production of its future FR uniforms. Of the 52 samples submitted for review by industry, 39 samples contained FR rayon, while 12 samples did not contain FR rayon fibers.²³

²³One fabric blend submitted to the Army did not include a description of the fiber content.

- o The Marine Corps is currently field testing five fabrics from approximately 100 industry proposals in an effort to identify a more durable uniform fabric that provides the same level of flame resistance. Four of these five fabric blends contain FR rayon.
- o In 2008, in response to an urgent operational need request for flame resistant ground combat equipment in U.S. Central Command's area of operation, the Air Force tested 26 FR fabric blends. Of the 26 samples tested, 14 contained FR rayon, while 12 did not contain FR rayon. The Air Force chose the Abrams V® fabric, a domestically produced blend of nylon, cotton, and Nomex®.

- o In 2010, the Navy Clothing and Textile Research Facility (NCTRF) conducted a market survey to determine the availability of cost-effective FR materials for use in military clothing and equipment.
 - Of the 33 industry submissions, the Navy determined that 11 of the samples met the requirements of the market survey, of which 9 did not contain FR rayon.
 - Testing results in the market survey were limited by considering only flame resistance and cost, with no specified end product. The resulting market study report recommended more extensive flame and physical property testing for materials with potential application to specific end items to determine if they meet specified requirements particular to the item.
 - The list of cost-effective FR materials identified as meeting the requirements of the Navy's market survey have been provided to each service to determine if there are potential applications of the tested samples to current or developmental items.

- o The extent to which DOD will evaluate non-Berry Amendment compliant²⁴ sources was uncertain. For example:
 - An Army sources sought notice in 2006 provided that Berry Amendment noncompliance did not exclude items from consideration. In comparison, a sources sought notice from 2010 does not explicitly address Berry Amendment compliance.
 - Army and Marine Corps officials stated that Berry Amendment compliance does not prevent them from evaluating and burn testing the noncompliant materials.
 - o However, representatives from one manufacturer indicated that their submission in response to the 2010 Army sources sought notice was not evaluated because their product was noncompliant with the Berry Amendment. According to the representatives, without an opportunity to demonstrate the capabilities of their material, they would be unlikely to obtain an exception to the Berry Amendment or have sufficient information to develop a business case for developing domestic production. The Department of the Army responded to the submission and indicated the Army was unable to consider it, characterizing Berry Amendment compliance as mandatory for that review of sources.
 - Navy officials stated that they would evaluate noncompliant materials to determine if they meet or exceed current warfighter requirements.
 - However, Air Force officials stated that they would not request, review, or test flame resistant materials that are not Berry Amendment compliant and that they do not have a mechanism in place to obtain information about materials that are noncompliant.

²⁴ We use the term “non-Berry Amendment compliant” or “noncompliant” to refer to materials that are covered by the restriction but are not of domestic origin and do not fall under any exception or waiver.

(E) The extent to which such alternatives provide an adequate substitute for FR rayon fiber for the production of military uniforms.

- Alternatives to FR rayon fibers exist; however, in evaluating FR fabrics for use in uniforms there are many factors to consider beyond flame resistance.
- The services have identified a number of performance measures used to evaluate FR fabrics. The measures include flame protection, durability, laundering, comfort, and cost.
- According to DOD and industry representatives, individual fibers should not be considered alone in assessing their suitability for FR uniforms. Rather, FR fabrics are generally blends of multiple fibers, each providing its own advantages as well as capabilities to offset the disadvantages of others.
- The services are using or are considering a number of alternatives to FR rayon, for example:
 - o The Navy and Air Force use Nomex® in their flight suits and the Airman Battle Ensemble, and the Army uses Nomex® in its Improved Combat Vehicle Crewmen's Coverall.
 - o The Army and Marine Corps are considering fabric blends containing FR-treated cotton as a potential alternative.
 - o The Marine Corps uses PBI fibers in its balaclava (a protective covering for the head), and modacrylic fiber in its T-shirt and the knitted section of its combat shirt. Currently, the Army is testing fabric blends that include PBI fibers.

(F) Any impediments to the use of such alternatives, and the actions the department has taken to overcome such impediments.

- Service officials identified some impediments to the use of Nomex®, including:
 - Higher relative cost of Nomex®.
 - Long lead time for Nomex®.
 - To address concerns regarding the Nomex® supply chain, in February 2008 DLA conducted an industrial base analysis for the supply of Nomex®. The study found that the raw material lead times, production capacity, and other factors were constraining the supply of Nomex®. DOD invested in the supply of Nomex® through the WarStopper Program.²⁵
- Army officials stated that fabric blends containing FR-treated cotton, while a potential alternative, requires special finishing equipment and expertise to cure the fabric, which most textile finishing plants do not have.
- According to Marine Corps officials, PBI is difficult to dye and may not be cost effective compared to alternatives given its relatively higher cost.

²⁵DLA established a "WarStopper" program to ensure sufficient wartime surge capacity for critical items. It took preemptive steps, such as establishing surge contracts and investing funds in equipment and facilities, to ensure that these items would be available in sufficient quantities during contingency operations.

(G) The extent to which any uncertainty regarding the future availability of FR rayon fiber results in instability or inefficiency for elements of the U.S. textile industry that use FR rayon fiber, and the extent to which that instability or inefficiency results in less efficient business practices, impedes investment and innovation, and thereby results or may result in higher costs, delayed delivery, or a lower quality of product delivered to the government.

- We spoke with representatives from nine industry manufacturers as well as representatives from industry trade associations, academia, and testing facilities regarding their role or perspective with regard to the production, supply, and use of FR fibers in military uniforms. According to industry representatives:
 - o The uncertainty of the future availability of FR rayon inhibits investment and innovation. For example, if a waiver ceases to exist, industry representatives expressed a risk averseness to invest in large capital and/or R&D to develop products that involve rayon. However, representatives from one manufacturer indicated that the uncertainty of FR rayon availability may not necessarily inhibit capital investments because equipment used to process FR rayon can also be used to process alternatives to FR rayon.
 - o Cutting off the supply of FR rayon would be detrimental. For example, representatives from one manufacturer indicated a restriction on foreign sources of FR rayon would severely impact the current production of certain FR uniforms, and in the long run would dissuade companies we spoke with from making investment decisions to support further research and development of FR rayon-based fabrics. Industry representatives were uncertain about what specific impact this might have on cost, delivery, or quality of product delivered to the government.
 - o No concerns were raised regarding the current production capacity to supply FR rayon.

(H) The extent to which any modifications to existing law or regulation may be necessary to ensure the efficient acquisition of FR fiber or alternative FR products for the production of military uniforms.

- Some industry representatives suggested that any Berry Amendment waiver for FR rayon should be further extended or made permanent, to provide certainty for the supply chain and promote investment by fabric manufacturers.
 - Some of those who recognized that section 829 was not the basis of the present waiver nevertheless suggested that extension or permanence of the section 829 waiver would provide some degree of certainty to companies in the supply chain.²⁶
 - Some expressed concern that the DOD might cease to use the DNAD.
- In 2009 correspondence with members of Congress, the USD(AT&L) suggested that the authority to procure under section 829 might provide an exception to the Berry Amendment if a single domestic source for FR rayon appeared, while the DNAD availability exception would not. As such, DOD viewed the authority under section 829 as valuable, even though it is not presently used, and therefore appeared to favor continuing availability.
- Industry representatives and DOD officials identified no necessary modifications to environmental or workplace safety laws or regulations.

²⁶The waiver for para-aramid fibers and yarns (e.g., Twaron® and Kevlar®) was cited as an example of a statutory waiver, used by DOD, that contained no sunset provision. This waiver, which originally appeared as an authority to procure articles containing para-aramids from foreign sources under § 807 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999, Pub. L. No. 105-261 (1998), has since been implemented in the DFARS as a Berry Amendment exception. See DFARS § 225.7002-2(m)(2).

- DOD did not provide written comments on this report. However, after reviewing a draft of this report, DOD officials agreed with its content and provided technical comments, which we incorporated where appropriate.
- Similarly, we sent relevant portions of the draft report to each of the industry and academic organizations we included in this engagement for their review and comment. Generally, these officials agreed with the material presented and some provided technical comments, which we incorporated where appropriate. However, officials from one organization expressed concerns that their views were not fully captured in our characterizations of industry perspectives. They provided additional information and views, which we incorporated into the briefing as appropriate.

List of DOD, Industry and Other Organizations Contacted

We collected data from officials from the following DOD, industry, and other organizations:

- Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
- Defense Logistics Agency
 - Troop Support
- Army, PEO Soldier, Army Natick Soldier Research, Development and Engineering Center
- Navy, Naval Facilities Engineering Command, Naval Aviation Command, Naval Clothing and Textile Research Facility
- Marine Corps, Marine Corps System Command
- Air Force, Aircrew Performance Branch
- Special Operations Command
 - Army, Special Operations Command
 - Naval Special Warfare
 - Marine Corps, Special Operations Command
 - Air Force, Special Operations Command
- Industry Associations
 - National Textile Association
 - American Apparel and Footwear Association

List of DOD, Industry and Other Organizations Contacted (continued)

- Industry
 - o Atlantic Thread and Supply Company, Inc.
 - o Lenzing Group
 - o Dupont
 - o Inman Mills
 - o Patton Boggs, LLP (Representing Teijin Aramid)
 - o Tencate Protective Fabrics
 - o Milliken & Company
 - o PBI Performance Products, Inc.
 - o GSL, Inc.

- Academia
 - o Clemson University, Clemson Apparel Research
 - o North Carolina State University, Textile Protection and Comfort Center

Elements: Section 821(c) of the Ike Skelton NDAA for Fiscal Year 2011

Section 821(c): Report required

(1) In General. Not later than March 15, 2011, the Comptroller General of the United States shall submit to the Committees on Armed Services of the Senate and the House of Representatives a report on the supply chain for fire resistant fiber for the production of military uniforms.

(2) Elements. The report required by paragraph (1) shall include, at a minimum, an analysis of the following:

(A) The current and anticipated sources of fire resistant rayon fiber for the production of military uniforms.

(B) The extent to which fire resistant rayon fiber has unique properties that provide advantages for the production of military uniforms.

(C) The extent to which the efficient procurement of fire resistant rayon fiber for the production of military uniforms is impeded by existing statutory or regulatory requirements.

(D) The actions the Department of Defense has taken to identify alternatives to fire resistant rayon fiber for the production of military uniforms.

(E) The extent to which such alternatives provide an adequate substitute for fire resistant rayon fiber for the production of military uniforms.

**Elements: Section 821(c) of the Ike Skelton
NDAA for Fiscal Year 2011 (continued)**

(F) The impediments to the use of such alternatives, and the actions the Department has taken to overcome such impediments.

(G) The extent to which uncertainty regarding the future availability of fire resistant rayon fiber results in instability or inefficiency for elements of the United States textile industry that use fire resistant rayon fiber, and the extent to which that instability or inefficiency results in less efficient business practices, impedes investment and innovation, and thereby results or may result in higher costs, delayed delivery, or a lower quality of product delivered to the Government.

(H) The extent to which any modifications to existing law or regulation may be necessary to ensure the efficient acquisition of fire resistant fiber or alternative fire resistant products for the production of military uniforms.

Pub. L. No. 111-383, § 821(c) (2011).

Enclosure II: GAO Contact and Staff Acknowledgements

GAO contact

William Solis, (202) 512-8365 or solisw@gao.gov

Staff Acknowledgements

In addition to the contact named above, key contributors to this report include Cary Russell, Assistant Director; Larry Junek, Assistant Director; Usman Ahmad; Marquita Campbell; Laura Czohara; James Lackey; Tobin McMurdie; Elizabeth Morris; Richard Powelson; Mike Shaughnessy; Amie Steele; and Delia Zee.

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