THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

The Honorable Howard P. "Buck" McKeon
Chairman
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515

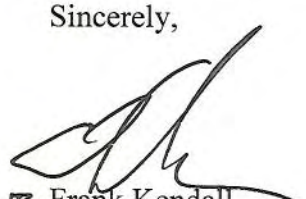
Dear Mr. Chairman:

Pursuant to section 843 of the Ike Skelton National Defense Authorization Act for Fiscal Year 2011 (Public Law 111-383), enclosed is the required report to Congress on the supply and demand for rare earth materials in defense applications. This report also addresses language contained in Senate Report 111-201, accompanying S. 3454, the Senate Committee on Armed Services' bill.

Seven of the 17 rare earth elements were found to meet the criteria established in Section 843. The report outlines a plan for assuring the long term availability of these materials.

A similar letter has been sent to the other congressional defense committees and other designated congressional committees.

Sincerely,



Frank Kendall
Acting

Enclosure:
As stated

cc:
The Honorable Adam Smith
Ranking Member

Report to Congress
Rare Earth Materials in Defense Applications

Under Secretary of Defense for Acquisition, Technology and Logistics

March 2012

Preparation of this report/study cost the Department of Defense a total of approximately $4,230 in Fiscal Years 2011 - 2012.
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Assessment of Rare Earth Materials Supply Chain

A. Introduction

This report is prepared pursuant to section 843 the Ike Skelton National Defense Authorization Act for Fiscal Year 2011 (Public Law 111-383) and Senate Report 111-201, accompanying S.3454, page 174. The Act requires the Secretary of Defense to submit a report to Congress on the supply and demand for rare earth materials in defense applications and Senate Report 111-201 requests discussion of national security issues related to rare earth materials in the defense supply chain.

B. Background on Rare Earths

The group of elements called the "rare earths" consists of 17 elements; 15 of these forming the chemical series called the lanthanides. Because of similar physical and chemical properties, scandium and yttrium are also considered to be rare earth elements (REEs). REEs are typically grouped into categories of "heavy" or "light." Light rare earths are those with lower atomic number, such as lanthanum or cerium. Heavy rare earths include terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, and yttrium. Despite the terminology "rare earths," some of these items are relatively abundant. Cerium is the 29th most abundant element in the Earth's crust and is three times as abundant as lead. Even the rarest REEs (such as thulium) are approximately 200 times more common in the Earth's crust than gold. However, all of the REEs (except for promethium) occur in low concentrations in the Earth's crust spread across various geographic regions.

The Department of Defense (DoD) uses products containing rare earths in a wide variety of applications throughout its defense operations. Indeed, rare earths are important components or inputs to a range of products, used both for commercial and defense purposes. Commercial applications dominate the market and consumption based on DoD procurement represents a small percentage of total U.S. consumption. DoD uses of products containing rare earths range from electronics and lighting to lasers, phosphors, and the strong permanent magnets contained primarily in computer hard drives as well as electric motors and actuators. Lack of supply for REEs would affect different products in different ways ranging from altering capabilities to requiring alternative technological solutions and, in some specific cases, preventing the production of particular products or models of a product. A lack of availability of these materials would also affect a wide variety of commercial products. As a result, manufacturers are seeking substitute materials and alternative technologies.

C. Congressionally Mandated Assessment Criteria

In section 843 of the National Defense Authorization Act (NDAA) for Fiscal Year 2011, Congress mandated that the Department assess which, if any, of the rare earth materials meet the following two criteria:

- Criterion 1: "The rare earth material is critical to the production, sustainment, or operation of significant United States military equipment."
- Criterion 2: "The rare earth material is subject to interruption of supply, based on actions or events outside the control of the government of the United States."

For each rare earth material that meets both criteria, section 843 requires a plan to ensure long-term availability, with a goal of establishing an assured source of supply of such material in critical defense applications by December 31, 2015.

Section 843 states that the plan shall include consideration of risk mitigation methods and states that sintered neodymium iron boron (NdFeB) magnets meet the criteria for inclusion in the plan.

D. Study Methodology

Organizations and individuals providing input and consultation in this assessment include those within DoD, the Department of Commerce, U.S. Geological Survey (USGS), U.S. Government Accountability Office (GAO), the U.S. Trade Representative, and the Department of Energy (DOE), as well as a myriad of rare earth subject matter experts and industry organizations.[1]

The Military Services provided input on the rare earth content of key applications and systems, any concerns they have regarding the related rare earth supply chains, and any vulnerability mitigation plans they have in place or would propose to DoD. Applicable studies conducted by DoD or other Federal agencies have been considered, and additional industry-Government assessments targeting the entire supply chain of specific defense applications have been conducted.

DoD organizations, other Federal departments and agencies, and a range of industry representatives were queried as to their judgments concerning which rare earth materials met the two section 843 criteria. These organizations were also asked to offer recommendations as to how to mitigate vulnerabilities for materials they identified as meeting the key criteria.

Information was also gathered through interviews, surveys, focus groups, case studies, and other Government and academic reports.

Data to determine the global supply of rare earths are based on best available public information. Sources included USGS, DoD, GAO, DOE, and a variety of recent Government reports and related information from the private sector.

The material demand computation methodology included: (1) determining overall demand for a material in a baseline year; (2) partitioning demand among several different applications; (3) using economic data associated with each military application to compute the fraction of demand that is defense and to estimate growth factors; (4) applying fraction and growth factors to compute defense demands by application and year; and (5) aggregating data to get total defense demand for material in each year.

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[1] More than 80 organizations and subject matter experts were contacted for information for this report.

E. Key NDAA 2011 Section 843 Findings

Summarized below are findings from a case study on sintered neodymium iron boron (NdFeB) and samarium cobalt (SmCo) rare earth-based magnet supply chains:

1. NdFeB Magnets

- NdFeB magnets are typically comprised of 31-percent neodymium, 4-percent dysprosium, and 65-percent iron.
- DoD-related applications consume approximately 175 tons per year (almost exclusively as components of final products, far removed from direct DoD acquisition).
- Rare earth assessment notes no U.S. production and identifies concerns about foreign supply reliability.
- However, a post-assessment announcement by Hitachi indicates U.S. production by April 2013 will reach 500 tons per year.

2. SmCo Magnets

- SmCo magnets are typically comprised of 36-percent samarium and 64-percent cobalt.
- U.S. production meets defense industrial base consumption.
- Average U.S. defense demand is significantly smaller than for NdFeB magnets.
- SmCo can be used as a substitute for NdFeB in some applications.
- SmCo is less powerful than NdFeB but maintains magnetic properties at higher temperatures.

F. Forecast of U.S. Supply vs. Key Defense Consumption – 2013

	Supply	Consumption	Surplus	Deficit
Dysprosium	7	7	0	
Erbium	1.2	1.14	0.056	
Europium	21	11	10	
Gadolinium	42	4	38	
Neodymium	2,232	110	2,122	
Praseodymium	824	14	810	
Yttrium	26	119		93

Rare earth materials are widely used within the U.S. defense industrial base. Markets for rare earth materials are dominated by commercial end-uses, and the defense industrial base represents a small fraction of overall U.S. consumption. The seven rare earth elements in the preceding table are those which are the most prevalent among defense consumption for the purposes of procurement. The assessment determined that by 2013 U.S production could satisfy the level of consumption required to meet defense procurement needs, with the exception of yttrium (estimates based on model using 2010 data). Since 2010, both expected DoD demand, and, more significantly, actual U.S. commercial demand have decreased significantly. As importantly, the U.S. and global market has responded to market conditions with new investments, corporate restructuring, and technical advances. All are trending positive for a market capable of meeting future U.S. Government demand. It is anticipated the domestic supply of REEs and rare-earth-containing products will continue to grow between now and 2015, and it will be possible for manufacturers within the defense industrial base to obtain some rare-earth-containing products from reliable foreign sources of supply. Despite the many positive developments that indicate an increasingly diverse and robust domestic and global supply chain for rare earth materials, the Department will continue to monitor these supply chains and take actions as indicated in the following sections.

G. DoD's Recommended Plans to Assure Supplies of Rare Earth Materials

The DoD plan for ensuring the long-term availability of rare earth materials applies a multi-pronged approach. The following options could be used in conjunction with existing DoD Defense Production Act Title I authorities (e.g., priority claim on U.S. supplies and foreign supplies that are imported into the United States):

- DoD will engage in continuous, rigorous monitoring of markets and production levels;

- DoD will undertake recurring reviews of defense industrial base materials supply chains;

- DoD will make preparations for the possible need to establish buffer stocks that are contractor-owned, U.S. Government-subsidized but not implemented unless certain predetermined marked indicators are met; and

- DoD will make preparations for the possible need to establish contingency measures to obtain vendor-managed inventories when pre-determined market and/or supply chain indicators occur.

In addition to the elements of supply assurances in the plan above, the following methods will be considered during implementation of the DoD plan, as outlined in section 843:

- Assessment of available financing to industry, universities and not-for profits;

- Assessment of Defense Production Act benefits;

- Assessment of research and development funding for alternatives and substitutions; and

- Assessment of foreign trade practices with relevant U.S. Government components.

H. Conclusions

Rare earth materials are widely used within the defense industrial base. However, such end uses represent a small fraction of U.S. consumption. As a result, when looked at in isolation, the growing U.S. supply of these materials is increasingly capable of meeting the consumption of the defense industrial base. Over the past year, there have been a number of positive developments with regard to both supply and demand within the rare earth materials markets. Reactions to market forces have resulted in positive developments, such as prices decreasing by half from their peak levels in July 2011, increased investment and domestic supply of rare earth materials, corporate restructuring within the supply chain, and lower forecasts for non-Chinese consumption. By 2015, the Department believes this will help to stabilize overall markets and improve the availability of rare earth materials.

The Department remains committed to pursuing a three-pronged approach to this important issue: diversification of supply, pursuit of substitutes, and a focus on reclamation of waste as part of a larger U.S. Government recycling effort. In addition to the many positive developments that indicate an increasingly diverse and robust domestic and global supply chain for rare earth materials, the Department will continue to monitor these supply chains, prepare possible contingency plans for ensuring their availability, and implement such plans as appropriate.