

This page left intentionally blank

FOREWORD

The Department of Commerce is pleased to submit this fiscal year 2009 Technology Transfer Summary Report to the President and the Congress in accordance with 15 USC Sec 3710(g)(2) for an annual summary on the implementation of technology transfer authorities established by the Technology Transfer Commercialization Act of 2000 (P.L. 106-404) and similar legislation. This report highlights the achievements of Federal technology transfer and partnering programs of Federal research and development agencies.

Technology transfer is the use and commercialization of the results of Federal laboratory research and development and collaborative research programs. Effective technology transfer is an important part of each Federal laboratory's mission. Today, Federal laboratories reach out to industry, academic institutions, non-profit foundations, state and local governments, and international institutions through external collaborations and partnerships, thereby leveraging the Federal investment in research and development. An investment in Federal research and development serves as an important engine to maintain the United States' leadership in technology and innovation and stimulates economic growth through the development of new products and processes.

TABLE OF CONTENTS

CHAPTER 1	1
Scope.....	1
Technology Transfer Principles and Approach	1
CHAPTER 2	4
Strengthening Performance Metrics	4
CHAPTER 3	18
Department of Agriculture (USDA)	18
Department of Commerce (DOC)	20
Department of Defense (DoD).....	22
Department of Energy (DOE).....	25
Department of Health and Human Services (HHS).....	28
Department of Homeland Security (DHS)	30
Department of the Interior (DOI)	33
Department of Transportation (DOT).....	36
Department of Veterans Affairs (VA)	38
Environmental Protection Agency (EPA)	39
National Aeronautics and Space Administration (NASA)	41
CONCLUSION	43

LIST OF TABLES

Table 1: Collaborative Relationships for Research and Development	6
Table 2: Invention Disclosure and Patenting	9
Table 3: Profile of Active Licenses	12
Table 4: Characteristics of Income Bearing Licenses.....	15
Table 5: Income from Licensing (Dollars reported in thousands).....	16

This page intentionally left blank

CHAPTER 1

Overview of Federal Technology Transfer

Federal laboratories continuously partner with many non-federal organizations in industry, academia, the non-profit sector, as well as state and local governments. Through these partnerships, Federal agencies are better able to transform the results of their research into economic and social value. Agencies utilize a variety of authorities and agreements to evaluate, protect, transfer, and monitor the utilization and commercialization of technologies developed, in whole or in part, by Federal laboratories. While focusing on important national interests, Federal laboratories continue to develop many new technologies, products, and applications that solve some of our greatest challenges. By making these discoveries accessible to private, academic and other government entities, Federal research and development (R&D) provides expertise and resources resulting in viable products that give the United States a competitive edge in today's global market and improve the quality of life for all Americans.

This report summarizes information from individual reports prepared by each Federal agency conducting R&D within its laboratories. The Department of Commerce's (DOC) National Institute of Standards and Technology (NIST) prepared and organized this report. An electronic version of this report is available at: <http://www.nist.gov/tpo/publications/index.cfm>.

Scope

This report summarizes the technology transfer achievements of the eleven Federal agencies that have significant Federal laboratory operations:

- Department of Agriculture (USDA)
- Department of Commerce (DOC)
- Department of Defense (DoD)
- Department of Energy (DOE)
- Department of Health and Human Services (HHS)
- Department of Homeland Security (DHS)
- Department of the Interior (DOI)
- Department of Transportation (DOT)
- Department of Veterans Affairs (VA)
- Environmental Protection Agency (EPA)
- National Aeronautics and Space Administration (NASA)

All of these agencies have established programs for transferring the technology and intellectual property arising from their laboratory R&D endeavors.

Technology Transfer Principles and Approach

Promoting U.S. economic growth and creating jobs through the transfer and commercialization of Federally-developed technologies is a high priority for Federal laboratories and their technology transfer offices. Collaboration between Federal laboratories and non-federal

organizations allows greater access to research outcomes and plays an important role in the efficient and timely development of innovative technologies and new products. Efficient technology transfer activities ensure that taxpayer investments in cutting-edge and fundamental research and development significantly benefit the domestic economy through the transfer of rights to develop, refine, use and market new technologies for the benefit of the public. Since Federal research activities are often driven by a specific agency mission, many economically viable advancements might otherwise be overlooked, or otherwise go unused without dedicated efforts by Federal technology transfer offices to promote the dissemination and utilization of the results. Effective technology transfer promotes real economic growth through the development of new products, medical treatments, services, and other innovations that reach the market, and through the creation of the jobs resulting from the manufacture and marketing of these new goods. In addition to strengthening domestic and regional economies, successful partnerships with non-Federal entities provide additional benefits including:

- Stimulating the flow of ideas between the government and other research sectors
- Creating new businesses, especially small businesses
- Attracting and retaining talented scientific personnel within the Federal laboratories
- Providing support to the mission of each agency
- Accelerating the development and reducing the costs of products and services to reach the marketplace
- Supporting further research by generating licensing revenue
- Rewarding innovative accomplishments of Federal inventors through royalty sharing
- Creating a wide variety of new and efficient products in health care, defense, domestic security and many other sectors of the economy.

Federal technology transfer offices typically rely on the following principal mechanisms to facilitate the transfer of Federally-developed technologies.

▪ Cooperative Research and Development

Relationships for cooperative research and development between Federal laboratories and non-Federal collaborators are widely viewed as an effective and economical means of technology transfer and joint research. These efforts confer a mutually advantageous leveraging of Federal agency and collaborator resources and technical capabilities, as well as provide avenues for both the partner and the Federal laboratory to gain new competences and develop new skills.

One frequently used mechanism for establishing these joint relationships is the Cooperative Research and Development Agreement (CRADA). CRADAs are agreements between a Federal laboratory and one or more collaborators to work together on a R&D project with a defined scope of work. CRADAs allow Federal laboratories to participate in R&D partnerships for the purpose of developing and advancing promising new technologies toward commercialization. Many agencies have other specific authorities which also facilitate cooperative R&D.

▪ Intellectual Property Management

Invention Disclosure and Patenting

The protection of intellectual property can be vital to attracting the additional investment and product development resources necessary for early stage research products to be brought to their full commercial potential. Federal laboratory achievements in the areas of invention disclosures, general publications and patents obtained are often cited as metrics of the active management of intellectual assets and technical know-how by Federal agencies.

Licensing

Licensing is one of the primary mechanisms to create incentives for industry to further develop and commercialize leading edge technologies. Successful development and commercialization benefits the economy generally and contributes to competitiveness and economic growth. Without the ability to grant licenses to develop and commercialize government-owned technologies and inventions, many innovations would languish within laboratories and would not be further developed into products or services. The terms and conditions under which Federal intellectual property is licensed varies, based on many factors including the state of readiness for the market place, the financial resources needed to further develop the technology for consumer use, fields of use, projected market impact and other factors.

Other Commercialization Mechanisms

Other than licensing, there are a wide variety of technology transfer methods used by Federal agencies. Different mechanisms are used when licensing may not be necessary to efficiently or effectively transfer the technology. Some of the mechanisms used by Federal laboratories are tailored to support the specific focus, needs and mission of a particular Federal laboratory and/or a particular technology. Some of these other technology transfer mechanisms include:

- Presentations at conferences, workshops, and inquiries
- Utilization of guest researchers and facilities users
- Outreach to trade and technical media
- Technical publications and other reports
- Development of Standard Reference Materials
- Development of Standard Reference Data
- Development of documentary standards
- Material transfer licenses
- Calibration services
- Collaborative research agreements (e.g., Memoranda of Understanding (MOU), Clinical Trial Agreements)

CHAPTER 2

Performance in Fiscal Year 2009

Strengthening Performance Metrics

Each Federal research and development agency is required to prepare and submit an annual report of its technology transfer activities as described in 15 USC 3710(f). These reports include details on each agency's technology transfer program and plans to use technology transfer to advance the agency's mission and to promote U.S. competitiveness. In addition, specific data is required to measure the level of basic technology transfer, including:

- Number of patents filed
- Number of patents granted
- Number of licenses and details regarding the license
- Earned royalty income and other royalty statistical information
- Disposition of royalty income
- Number of licenses terminated for cause
- Discussion of other relevant parameters unique to the agency

The tables and charts below present a brief cross-agency summary of the utilization of the above technology transfer tools. Although the standard metrics required by statute continue to demonstrate robust use of these tools, they only address part of the full picture. It remains far easier to assemble statistics on technology transfer activities than to quantify actual downstream benefits and the effectiveness of the transfers because of the many variables and factors involved in commercializing nascent technologies. For example, knowledge gained from initial research may not make an immediate impact on the public, but may open new avenues for discoveries that lead to future products, medical treatments, and services. Technology distribution and use has evolved new mechanisms and Federal laboratories have embraced these approaches along with the more standard business model. Accelerating innovation requires multiple strategies and new metrics to evaluate progress. For example, open innovation demonstrates the value and potential for intellectual property outside the patent/license model. Open source software from Federal research has been proven to have a significant impact on US business without a measurable income stream to the laboratory and is not evident in the statistics presented here. Likewise, fellowships, post-doctoral appointments, and other on-going mechanisms for improving our research by training new scientists also result in knowledge and expertise moving from laboratories to businesses as well as universities.

To improve and develop better measures of the effectiveness of Federal technology transfer, the Federal Interagency Working Group on Technology Transfer (IWGTT) meets regularly and is attended by agency representatives and technology transfer experts from across the Federal government. The IWGTT serves as a broad forum to identify and discuss best practices, emerging concerns and trends through dialogue, interagency comparisons and sharing experience. Through the IWGTT, Federal agencies jointly discuss and review new and better means to improve both quantitative and qualitative measurements of technology transfer activities and means to improve dissemination of Federally-developed technologies.

Several groups have been looking closely at metrics for technology transfer. In 2009, the Government Accountability Office (GAO) conducted a study of the effectiveness of technology transfer at DOE laboratories. In general, the GAO noted that technology transfer was not consistently defined and is difficult to measure. The IWGTT is examining the GAO's findings and recommendations, as well as DOE's response, for technology transfer performance measures. The Interagency Workgroup on Innovation and Entrepreneurship has been examining, among other topics, commercialization of technology from Federal laboratories. The Department of Commerce Office of Innovation and Entrepreneurship has also commissioned a study to examine commercialization of Federal research. The findings and recommendations from these on-going studies are being followed by the IWGTT and will be reviewed, and reflected as appropriate, in future versions of this report.

Anecdotal evidence and success stories demonstrate the broad range of successful outcomes of technology transfer such as life-saving treatments, increased security or awareness about dangers and hazards, and new business start-ups. Chapter 3 of this report highlights a small sampling of the numerous positive impacts and outcomes of Federal technology transfer activities.

The following tables summarize the technology transfer activities compiled from each agency's report for a five-year period from fiscal year 2005 through fiscal year 2009. The total figures from the eleven agencies indicate that licenses, income bearing licenses, income from licenses, and earned royalty income generally trended upward over this period. However, invention disclosures, patent applications filed, and patents issued remained steady over the same period. The number of active CRADAs declined slightly in fiscal year 2008 but rebounded to new heights in 2009. Overall, these total figures and trends from the technology transfer activities of the Federal government represent a steady, mature program, as shown by the consistently high and relatively stable volume of CRADAs, licensing, patenting, and earned royalty income activities.

In Table 1, "Traditional CRADAs" refer to collaborative research and development by a Federal laboratory and non-Federal partners. "Non-traditional CRADAs" are used with non-Federal collaborators for special purposes such as material transfers, specialized equipment calibrations or other technical assistance which may produce information which needs to be protected from disclosure. In table 3, "other IP licenses" include licenses for copyrighted software (not including open source software licenses, which are also copyrighted software), open channel-web and noncommercial software, biological materials, and other forms of intellectual property.

Table 1: Collaborative Relationships for Research and Development

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DHS	• CRADAs, total active in the FY	-	-	-	23	23
	- New, executed in the FY	-	-	-	8	6
	▪ Traditional CRADAs, total active in the FY	-	-	-	21	22
	▪ Non-traditional CRADAs, total active in FY	-	-	-	2	1
	▪ Other collaborative R&D relationships	-	-	-	3	5
DOC	• CRADAs, total active in the FY	1,906*	3,008 ⁺	2,778	2,390	2,386
	- New, executed in the FY	1,764	2,158	1,865	1,583	1,501
	▪ Traditional CRADAs, total active in the FY	80	149	154	131	77
	▪ Non-traditional CRADAs, total active in FY	1,826	2,859	2,624	2,259	2,309
	▪ Other collaborative R&D relationships	2,714	2,769	3,414*	3,476	3,608
DOD	• CRADAs, total active in the FY	3,210	2,999	2,971	2,596	2,870
	- New, executed in the FY	679	705	641	745	659
	▪ Traditional CRADAs, total active in the FY	2,736	2,424	2,383	1,993	2,247
	▪ Non-traditional CRADAs, total active in FY	474	575	588	603	622
	▪ Other collaborative R&D relationships	0	0	0	3	1
DOE	• CRADAs, total active in the FY	644	631	697	711	744
	- New, executed in the FY	164	168	182	178	176
	▪ Traditional CRADAs, total active in the FY	644	631	697	711	744
	▪ Non-traditional CRADAs, total active in FY	n/r	n/r	n/r	n/r	n/r
	▪ Other collaborative R&D relationships	0	0	0	0	0
DOI	• CRADAs, total active in the FY	70	82	170	170	248
	- New, executed in the FY	21	38	112	98	74
	▪ Traditional CRADAs, total active in the FY	49	31	20	33	36
	▪ Non-traditional CRADAs, total active in FY	21	51	150	137	212
	▪ Other collaborative R&D relationships	0	0	0	0	0
DOT	• CRADAs, total active in the FY	57	59	36	23	22
	- New, executed in the FY	5	6	7	6	7
	▪ Traditional CRADAs, total active in the FY	55	59	36	23	0
	▪ Non-traditional CRADAs, total active in FY	2	0	0	0	0
	▪ Other collaborative R&D relationships	0	0	0	0	2
EPA	• CRADAs, total active in the FY	107	94	84	112	155
	- New, executed in the FY	33	16	18	49	83
	▪ Traditional CRADAs, total active in the FY	95	83	67	74	51
	▪ Non-traditional CRADAs, total active in FY	12	11	17	38	104
	▪ Other collaborative R&D relationships	0	0	0	0	0

Table 1: Collaborative Relationships for Research and Development (continued)

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
HHS	● CRADAs, total active in the FY	215	164	284	453	457
	- New, executed in the FY	101	66	68	83	105
	▪ Traditional CRADAs, total active in the FY	117	92	206	295	284
	▪ Non-traditional CRADAs, total active in FY	98	72	79	158	173
	▪ Other collaborative R&D relationships	0	0	0	0	0
NASA	● CRADAs, total active in the FY	1	1	1	1	1
	- New, executed in the FY	1	0	0	1	0
	▪ Traditional CRADAs, total active in the FY	1	1	1	1	1
	▪ Non-traditional CRADAs, total active in FY	0	0	0	0	0
	▪ Other collaborative R&D relationships**	4,038*	3,509*	2,887*	2,750*	2,743
USDA	● CRADAs, total active in the FY	199	195	230	252	233
	- New, executed in the FY	55	57	69	76	72
	▪ Traditional CRADAs, total active in the FY	171	163	184	202	191
	▪ Non-traditional CRADAs, total active in FY	28	22	23	28	42
	▪ Other collaborative R&D relationships	5,028	3,477	4,084	5,466	9,960
VA	● CRADAs, total active in the FY	14	37*	82*	221*	606
	- New, executed in the FY	3	26*	52*	155*	423
	▪ Traditional CRADAs, total active in the FY	14	33	74*	207*	566
	▪ Non-traditional CRADAs, total active in FY	0	2	4	10	36
	▪ Other collaborative R&D relationships	0	0	0	0	0
TOTALS	● CRADAs, total active in the FY	5,947	7,268	7,326	6,923	7,733
	- New, executed in the FY	2,826	3,238	3,009	2,961	3,106
	▪ Traditional CRADAs, total active in the FY	3,962	3,666	3,819	3,664	4,219
	▪ Non-traditional CRADAs, total active in FY	2,461	3,592	3,485	3,235	3,499
	▪ Other collaborative R&D relationships	11,767	9,738	10,164	11,411	16,319

-DHS began compiling and reporting data in 2008.

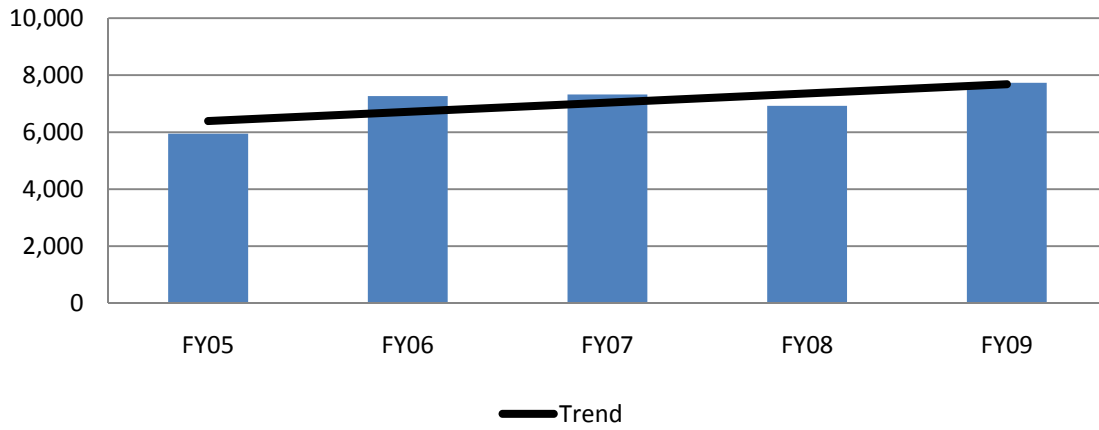
n/r = Data not reported.

* updated to reflect corrected data.

** Limited use of CRADA authority; NASA often employs Space Act Agreements instead.

+ The sharp increase in CRADAs beginning in FY 2006 is primarily due to a change in how DOC counts non-traditional CRADAs associated with calibrations. This number reduces after FY 2006 due to DOC discontinuation of telecommunication services analysis CRADAs.

Total Active CRADAs



Total New, Executed CRADAs

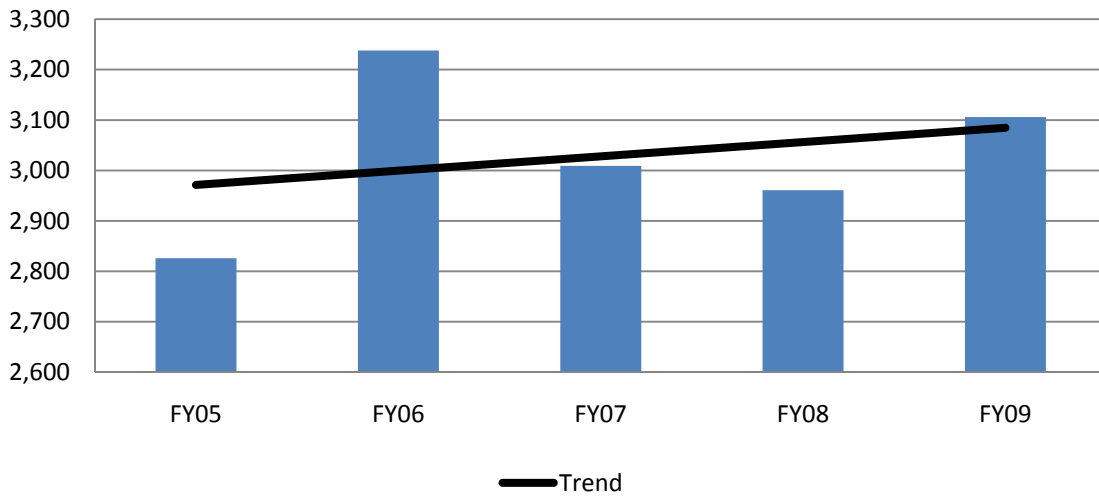


Table 2: Invention Disclosure and Patenting

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DHS	● New inventions disclosed in the FY	-	-	-	10	32
	● Patent applications filed in the FY	-	-	-	0	2
	● Patents issued in the FY	-	-	-	1	2
DOC	● New inventions disclosed in the FY	21	14	32	40	40
	● Patent applications filed in the FY	12	5	8	21	19
	● Patents issued in the FY	10	7	3	2	7
DOD	● New inventions disclosed in the FY	534	1,056	838	1,018	831
	● Patent applications filed in the FY	354	691	597	590	690
	● Patents issued in the FY	191	472	425	462	404
DOE	● New inventions disclosed in the FY	1,776	1,694	1,575	1,460	1,439
	● Patent applications filed in the FY	812	726	693	904	919
	● Patents issued in the FY	467	438	441	370	520
DOI	● New inventions disclosed in the FY	4	5	7	7	4
	● Patent applications filed in the FY	3	2	5	7	8
	● Patents issued in the FY	9	5	6	1	4
DOT	● New inventions disclosed in the FY	4	3	2	3	3
	● Patent applications filed in the FY	5	3	2	0	1
	● Patents issued in the FY	2	0	3	2	1
EPA	● New inventions disclosed in the FY	12	12	16	9	8
	● Patent applications filed in the FY	13	13	15	6	3
	● Patents issued in the FY	9	10	10	4	9
HHS	● New inventions disclosed in the FY	452	442	447	437	389
	● Patent applications filed in the FY	230	166	261	164	156
	● Patents issued in the FY	154	164	379	278	397
NASA	● New inventions disclosed in the FY	1,682*	1,713*	1,487*+	1,297*	1,373
	● Patent applications filed in the FY	209*	219*	193*	166*	128
	● Patents issued in the FY	139*	146*	108*	135*	114
USDA	● New inventions disclosed in the FY	125	105	126	133	153
	● Patent applications filed in the FY	88	83	114	123	117
	● Patents issued in the FY	27	39	37	30	21

Table 2: Invention Disclosure and Patenting (continued)

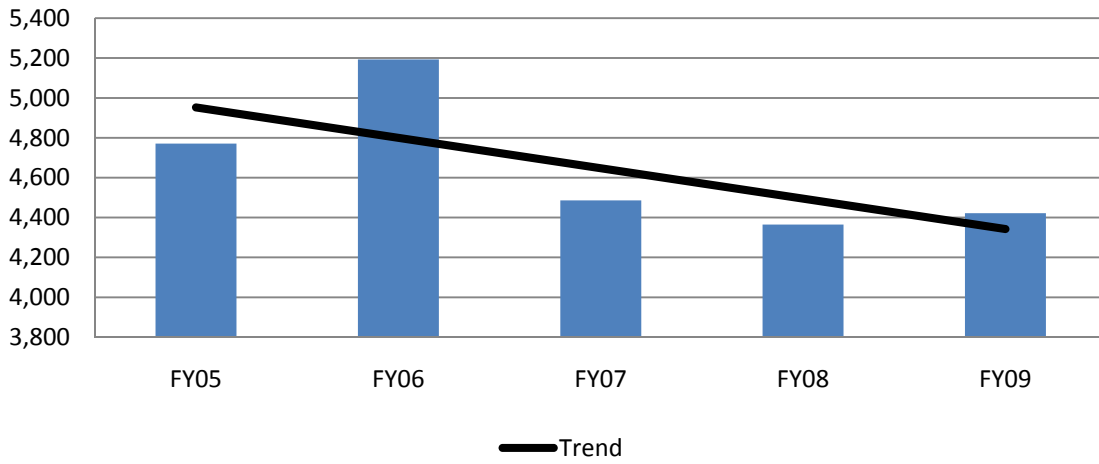
		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
VA	● New inventions disclosed in the FY	165	157	175	164	150
	● Patent applications filed in the FY	26	27	25	13	37
	● Patents issued in the FY	10	5	8	10	15
TOTALS	● New inventions disclosed in the FY	4,771	5,193	4,486	4,365	4,422
	● Patent applications filed in the FY	1,745	1,912	1,825	1,938	2,080
	● Patents issued in the FY	1,012	1,284	1,405	1,272	1,494

- DHS began compiling and reporting data in 2008.

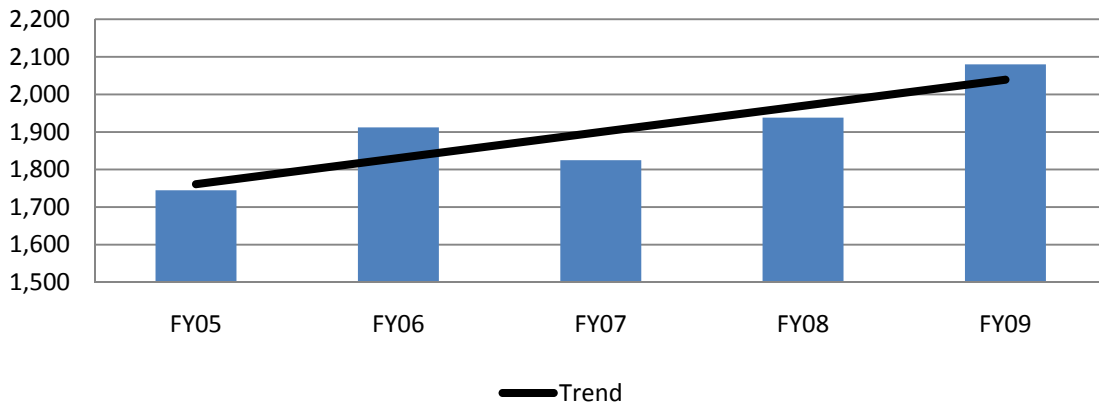
* updated to reflect corrected data

⁺ The reduction in invention disclosures at NASA beginning in FY 2007 were associated with a greater emphasis on the engineering challenges associated with a new “Vision for Space Exploration” and budget reductions in the fundamental science fields.

New Inventions Disclosed



Patent Applications Filed



Patents Issued

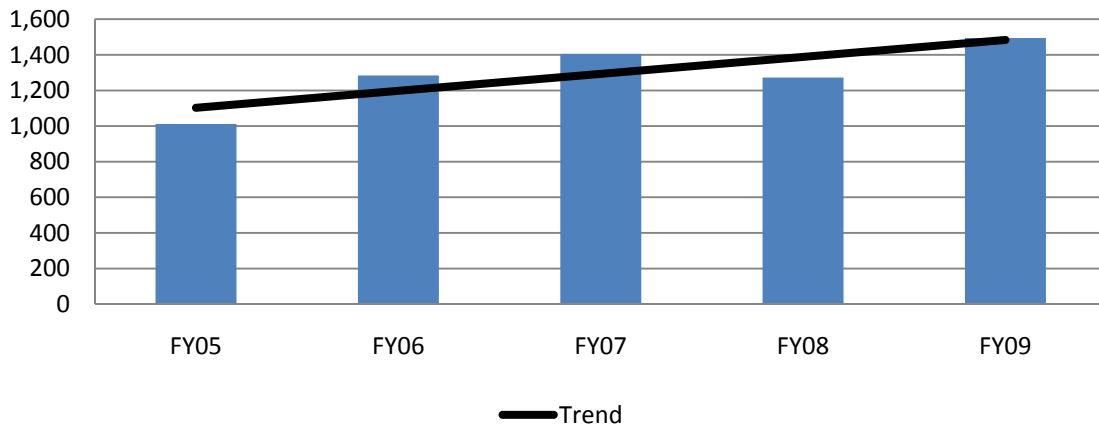


Table 3: Profile of Active Licenses

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DHS	● All licenses , number total active in the FY	-	-	-	18	63
	▫ New, executed in the FY	-	-	-	0	45
	▪ Invention licenses , total active in the FY	-	-	-	0	0
	▫ New, executed in the FY	-	-	-	0	0
	▪ Other IP licenses , total active in the FY	-	-	-	18	63
DOC	● All licenses , number total active in the FY	133	111	222	29	40
	▫ New, executed in the FY	108	83	187	2	12
	▪ Invention licenses , total active in the FY	133	111	222	29	40
	▫ New, executed in the FY	108	83	187	2	11
	▪ Other IP licenses , total active in the FY	0	0	0	0	0
DOD	● All licenses , number total active in the FY	412	444	495	365	432
	▫ New, executed in the FY	60	56	67	52	57
	▪ Invention licenses , total active in the FY	406	438	460	351	386
	▫ New, executed in the FY	60	56	67	52	57
	▪ Other IP licenses , total active in the FY	6	6	35	14	46
DOE	● All licenses , number total active in the FY	5,677	5,916	5,842	6,196	5,752
	▫ New, executed in the FY	750	652	606	685	455
	▪ Invention licenses , total active in the FY	1,535	1,420	1,354	1,418	1,452
	▫ New, executed in the FY	198	203	164	177	139
	▪ Other IP licenses , total active in the FY	4,142	4,496	4,488	4,748	4,300
DOI	● All licenses , number total active in the FY	20	21	15	19	21
	▫ New, executed in the FY	5	1	1	1	4
	▪ Invention licenses , total active in the FY	19	20	15	18	18
	▫ New, executed in the FY	5	1	0	1	3
	▪ Other IP licenses , total active in the FY	1	1	0	1	1

Table 3: Profile of Active Licenses (continued)

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DOT	• All licenses , number total active in the FY	5	5	5	5	2
	▫ New, executed in the FY	4	0	0	0	0
	▪ Invention licenses , total active in the FY	5	5	1	5	3
	▫ New, executed in the FY	4	4	0	0	0
	▪ Other IP licenses , total active in the FY	0	0	0	0	0
EPA	• All licenses , number total active in the FY	39	35	38	37	40
	▫ New, executed in the FY	4	2	5	2	3
	▪ Invention licenses , total active in the FY	39	35	38	37	40
	▫ New, executed in the FY	4	2	5	2	3
	▪ Other IP licenses , total active in the FY	0	0	0	0	0
HHS	• All licenses , number total active in the FY	1,532	1,535	1,418	1,675	1,584
	▫ New, executed in the FY	349	290	293	277	221
	▪ Invention licenses , total active in the FY	1,237	1,213	915	1,376	1,304
	▫ New, executed in the FY	291	253	234	233	198
	▪ Other IP licenses , total active in the FY	295	322	460	352	327
NASA	• All licenses , number total active in the FY	1,340*	1,680*	2,035*	2,337*	2,497
	▫ New, executed in the FY	506*	375	413*	347*	418
	▪ Invention licenses , total active in the FY	443*	482*	474*	486*	504
	▫ New, executed in the FY	130*	73	43*	50*	67
	▪ Other IP licenses ¹ , total active in the FY	897	1,198	1,561*	1,851*	1993
USDA	• All licenses , number total active in the FY	320	332	339	328	316
	▫ New, executed in the FY	33	25	25	28	25
	▪ Invention licenses , total active in the FY	320	332	339	328	316
	▫ New, executed in the FY	33	25	25	28	21
	▪ Other IP licenses , total active in the FY	0	0	0	0	0
VA	• All licenses , number total active in the FY	101	112	130	153	163
	▫ New, executed in the FY	6	11	18	23	10
	▪ Invention licenses , total active in the FY	101	112	130	153	163
	▫ New, executed in the FY	6	11	18	23	10
	▪ Other IP licenses , total active in the FY	0	0	0	0	0

Table 3: Profile of Active Licenses (continued)

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
TOTALS	• All licenses , number total active in the FY	9,577	10,186	10,352	11,098	10,913
	▫ New, executed in the FY	1,824	1,495	1,463	1,377	1,250
	▪ Invention licenses , total active in the FY	4,236	4,163	3,935	4,172	4,226
	▫ New, executed in the FY	838	711	728	544	509
	▪ Other IP licenses , total active in the FY	5,341	6,023	6,405	6,972	6,730

- DHS began compiling and reporting data in 2008.

1 NASA “Other IP licenses” refer to copyrights, most of which arise out of JPL.

* updated to reflect corrected data.

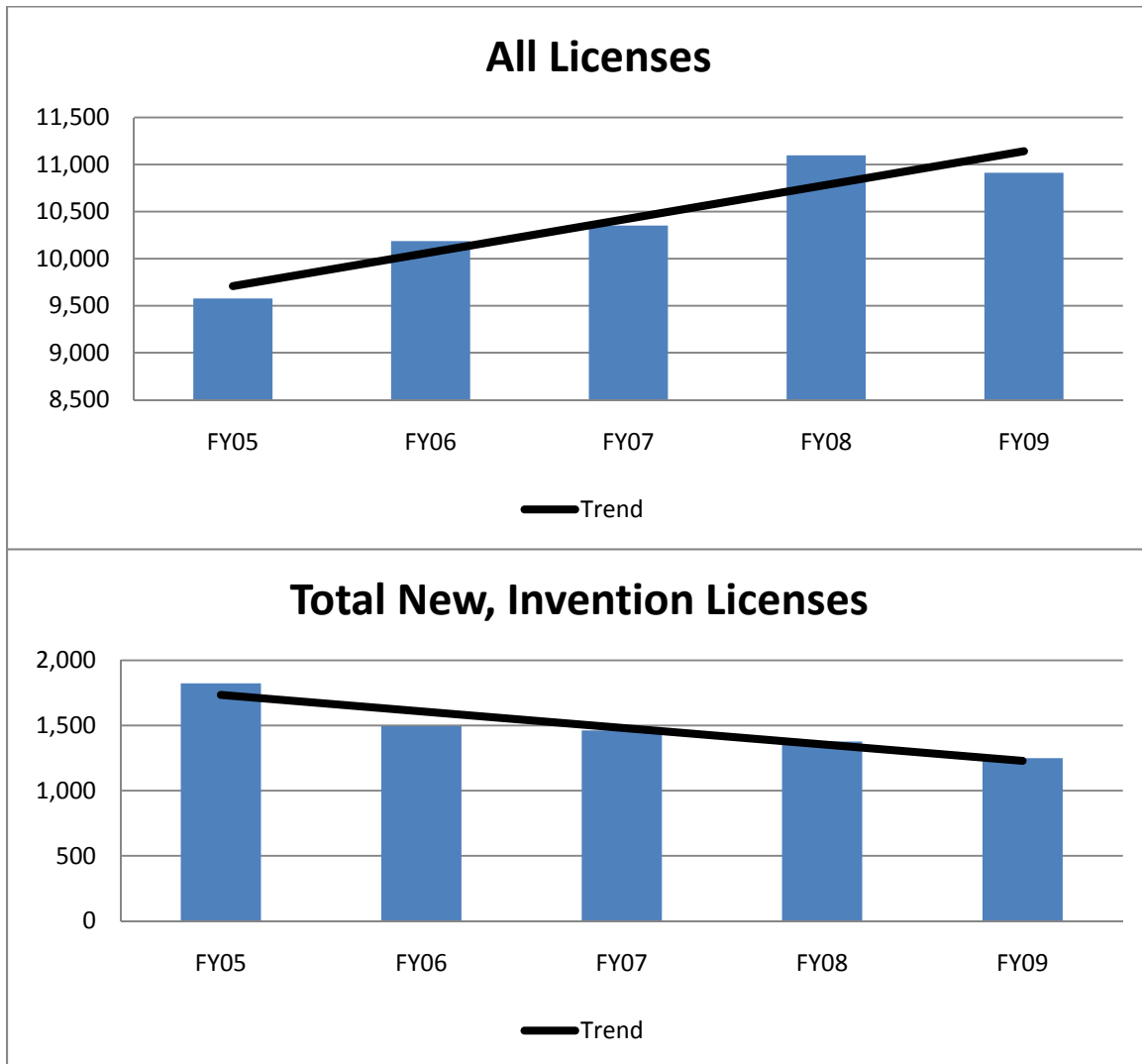


Table 4: Characteristics of Income Bearing Licenses

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
DHS	● All income bearing licenses, number	-	-	-	0	0
	▫ Exclusive	-	-	-	0	0
DOC	● All income bearing licenses, number	25	30	35	25	27
	▫ Exclusive	12	17	16	14	15
DOD	● All income bearing licenses, number	110	112	194	210	227
	▫ Exclusive	59	64	84	70	78
DOE	● All income bearing licenses, number	2,549	2,822	3,291	4,397	3,339
	▫ Exclusive	248	353	352	372	411
DOI	● All income bearing licenses, number	18	18	14	16	18
	▫ Exclusive	9	9	4	5	4
DOT	● All income bearing licenses, number	5	4	4	4	3
	▫ Exclusive	2	3	2	1	3
EPA	● All income bearing licenses, number	39	35	38	37	40
	▫ Exclusive	5	6	6	7	8
HHS	● All income bearing licenses, number	816	849	901	1,057	899
	▫ Exclusive	127	134	144	149	111
NASA	● All income bearing licenses, number	238*	251*	253*	265*	263
	▫ Exclusive	105*	110*	113*	119*	119
USDA	● All income bearing licenses, number	318	330	337	313	314
	▫ Exclusive	220	233	241	223	222
VA	● All income bearing licenses, number	82	93	115	138*	144
	▫ Exclusive	14	24	44	61	64
TOTALS	● All income bearing licenses, number	4,197	4,537	5,165	6,444	5,274
	▫ Exclusive	799	949	999	1,014	1,035

- DHS began compiling and reporting data in 2008.

* updated to reflect corrected data.

Table 5: Income from Licensing (Dollars reported in thousands)

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2008
DHS	● Total income , all licenses active in FY	-	-	-	\$0	\$0
	▪ Invention licenses	-	-	-	\$0	\$0
	▪ Other IP licenses , total active in the FY	-	-	-	\$0	\$0
	● Total Earned Royalty Income, (ERI)	-	-	-	\$0	\$0
DOC	● Total income , all licenses active in FY	\$147	\$194	\$225	\$293	\$336
	▪ Invention licenses	\$147	\$194	\$225	\$293	\$336
	▪ Other IP licenses , total active in the FY	\$0	\$0	\$0	\$0	\$0
	● Total Earned Royalty Income, (ERI)	\$139	\$170	\$217	\$293	\$336
DOD	● Total income , all licenses active in FY	\$10,650	\$10,963	\$14,246	\$16,057	\$16,439
	▪ Invention licenses	\$10,637	\$10,961	\$14,240	\$16,048	\$16,165
	▪ Other IP licenses , total active in the FY	\$13	\$2	\$6	\$9	\$274
	● Total Earned Royalty Income, (ERI)	n/a	n/a	n/a	n/a	n/a
DOE	● Total income , all licenses active in FY	\$27,382	\$35,572	\$39,165	\$49,318	\$43,496
	▪ Invention licenses	\$24,226	\$32,211	\$34,933	\$43,108	\$40,238
	▪ Other IP licenses , total active in the FY	\$3,156	\$3,362	\$4,233	\$6,210	\$3,258
	● Total Earned Royalty Income, (ERI)	\$12,443	\$18,332	\$18,759	\$31,718	\$28,901
DOI	● Total income , all licenses active in FY	\$71	\$47	\$57	\$79	\$89
	▪ Invention licenses	\$71	\$47	\$57	\$79	\$89
	▪ Other IP licenses , total active in the FY	n/a	n/a	n/a	n/a	n/a
	● Total Earned Royalty Income, (ERI)	\$68	\$46	\$57	\$79	\$89
DOT	● Total income , all licenses active in FY	\$37	\$22	\$34	\$18	\$44
	▪ Invention licenses	\$22	\$22	\$34	\$18	\$44
	▪ Other IP licenses , total active in the FY	\$15	\$0	\$0	\$0	0
	● Total Earned Royalty Income, (ERI)	\$22	\$22	\$34	\$9	\$34
EPA	● Total income , all licenses active in FY	\$666	\$632	\$544	\$1,038	\$849
	▪ Invention licenses	\$666	\$632	\$544	\$1,038	\$849
	▪ Other IP licenses , total active in the FY	\$0	\$0	\$0	\$0	\$0
	● Total Earned Royalty Income, (ERI)	\$34	\$29	\$107	\$571	\$255
HHS	● Total income , all licenses active in FY	\$98,542	\$83,097	\$88,799	\$97,609	\$85,059
	▪ Invention licenses	\$96,485	\$82,187	\$67,108	\$94,712	\$83,041
	▪ Other IP licenses , total active in the FY	\$2,057	\$909	\$19,128	\$2,897	\$998
	● Total Earned Royalty Income, (ERI)	\$76,695	\$63,250	\$70,743	\$80,805	\$77,251

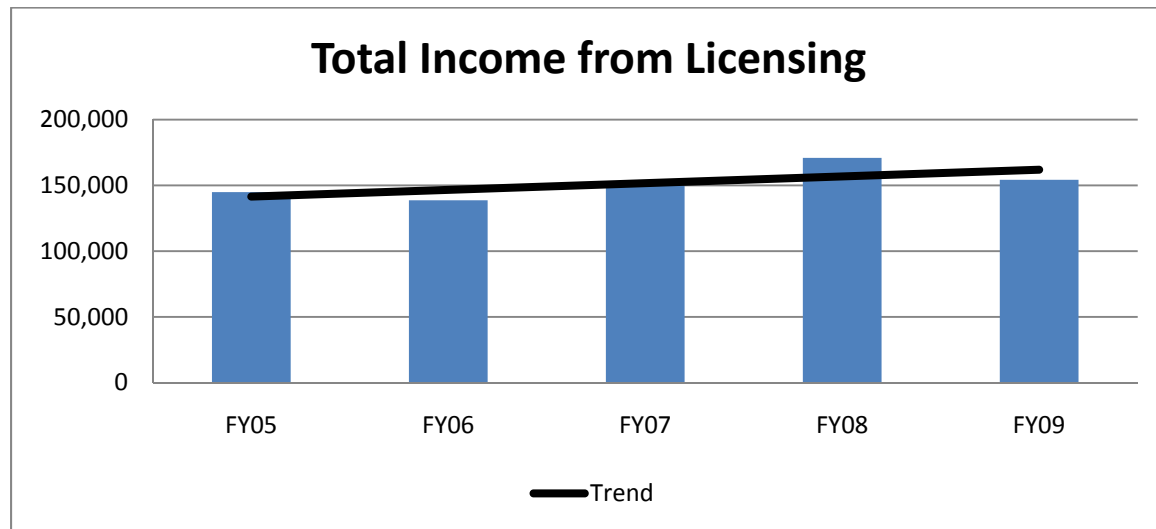
Table 5: Income from Licensing (Dollars reported in thousands) (continued)

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
NASA	● Total income , all licenses active in FY	\$3,930*	\$4,862	\$3,689*	\$4,223*	\$2,388
	▪ Invention licenses	\$3,930*	\$4,726	\$3,689*	\$4,183*	\$2,374
	▪ Other IP licenses , total active in the FY	n/a	\$136	n/a	\$40*	\$14
	● Total Earned Royalty Income, (ERI)	\$1,331*	\$2,178*	\$1,520*	\$1,711*	\$719
USDA	● Total income , all licenses active in FY	\$3,315	\$3,162	\$3,588	\$3,953	\$5,376
	▪ Invention licenses	\$3,315	\$3,162	\$3,588	\$3,953	\$5,318
	▪ Other IP licenses , total active in the FY	\$0	\$0	\$0	\$0	\$0
	● Total Earned Royalty Income, (ERI)	\$2,089	\$2,337	\$2,682	\$3,010	\$4,422
VA	● Total income , all licenses active in FY	\$117	\$138	\$358	\$141	\$202
	▪ Invention licenses	\$117	\$138	\$358	\$141	\$202
	▪ Other IP licenses , total active in the FY	n/a	n/a	n/a	n/a	n/a
	● Total Earned Royalty Income, (ERI)	n/a	n/a	n/a	n/a	n/a
TOTAL	● Total income , all licenses active in FY	\$144,862	\$138,689	\$149,928	\$170,901	\$154,278
	▪ Invention licenses	\$139,621	\$134,280	\$123,999	\$161,785	\$148,656
	▪ Other IP licenses , total active in the FY	\$5,241	\$4,409	\$23,367	\$9,116	\$4,544
	● Total Earned Royalty Income, (ERI)	\$92,823	\$86,348	\$93,951	\$117,644	\$112,007

- DHS began compiling and reporting data in 2008.

n/a = Data not available from agency.

* updated to reflect corrected data.



CHAPTER 3

Outcomes and Impact of Technology Transfer Activities

Reports of the successful commercialization of Federally-developed technologies cut across industrial sectors and demonstrate the broad reach of technology transfer into the lives of American citizens. The cases provided below are examples of the downstream outcomes arising from technology transfer activities.

Department of Agriculture (USDA)

The Agriculture Research Service (ARS) conducts research to develop and transfer solutions to agricultural problems of high national priority to:

- ensure a high-quality, safe, abundant food supply;
- assess the nutritional needs of Americans;
- sustain a competitive agricultural economy;
- enhance U.S. natural resources and the environment; and to
- provide economic opportunities for rural citizens, communities, and society as a whole

ARS promotes adoption of agricultural research results in a manner that supports local/regional economic development. Traditionally, innovation and small business development have been critical to the nation's global competitiveness and in achieving sustainable local/regional economic development. To help meet these challenges and enhance partnering with small businesses, ARS initiated an Agricultural Technology Innovation Partnership (ATIP) program to facilitate adoption of ARS research outcomes by private sector companies for commercial production of goods and services.

More information about USDA technology transfer: ARS: <http://www.ars.usda.gov/partnering> and the Forest Service: <http://www.fs.fed.us>

• CrispTek – An Early Success of the ATIP

In April 2008, CrispTek, LCC of Columbia, MD acquired the exclusive license right to the ARS patent (US 6,224,921) in an effort to commercialize ARS's low oil-uptake batter technology. Researchers at the Mid South Area's Food Processing and Sensory Quality Unit in New Orleans, LA, developed the technology. Support for this startup company was provided, in part, by the Maryland Technology Development Corporation (TEDCO), using their Maryland Technology Transfer Fund. TEDCO was the inaugural Partner of the ATIP program. ATIP was envisioned to assist business and research partners of ARS by providing complementary business assets (business development teams, financial resources, manufacturing consultants, etc.). Because of TEDCO's involvement, CrispTek rolled out its first product, ChoiceBatter in June 2009, and it is currently available through their website, www.ChoiceBatter.com, and at over 300 retail stores across the U.S. Fried foods coated with the product are low in fat, gluten-free and Kosher- pareve. The development meets the need of healthier foods and thus will have an impact on the health and well being of US consumers. A follow-up CRADA between ARS and CrispTek is underway to study the effects of solvents on the textural and sensory properties of the batters. In

late 2009, CrispTek entered into agreement with two major food distributors. This research is part of Quality and Utilization of Agricultural Products, an ARS national program (#306).

- **World-wide Soybean Crop Modeling**

ARS scientists at the Beltsville Area's Crops Systems and Global Change Laboratory in Beltsville, MD, developed a soybean crop model GLYCIM to pinpoint the best agronomic practices for maximizing soybean production within the US. They are now improving GLYCIM performance under a range of conditions around the world. ARS researchers have now partnered with Drs. S. B. Lokhandle and V.M. Salokhe (Asian Institute of Technology in Pathumthani, Thailand) to develop 504 cultivation and yield scenarios for two key soybean production areas in northern Thailand. GLYCIM results also indicated that it is critical for farmers to use optimal planting dates to achieve high yields at these sites. Yield losses in delayed planting simulations averaged around 30 percent. These results further support GLYCIM's use as a comprehensive mechanistic model for predicting soybean growth, development and yield across a range of agricultural systems. This research is part of *Crop Production*, an ARS national program (#305).

- **Rift Valley Fever Outbreak Early-Warning Team**

Rift Valley fever (RVF) is a viral disease of domestic animals and humans that occurs throughout sub-Saharan Africa. RVF has global implications because of its expanding range. RVF causes severe infections in domestic animals, resulting in mortality as high as 80 percent, and produces very serious human disease and death. ARS researchers at the South Atlantic Area's Center for Medical, Agricultural, and Veterinary Entomology in Gainesville, FL, discovered that disease outbreaks are episodic, and are closely linked to global and regional climate variability. This discovery is based on a study of an RVF outbreak that occurred in 1997-1998 in the Horn of Africa. This outbreak involved five countries with a loss of approximately 100,000 domestic animals, approximately 90,000 human infections. The World Organization for Animal Health estimated economic losses from trade restrictions of more than \$100 million. To directly address the threat of globalization of RVF, ARS scientists and personnel from multiple U.S. and international agencies, developed a highly innovative and effective method to forecast RVF outbreaks. This method is based on measurements of global climate conditions that determine the local and regional ecological conditions that cause the emergence of the virus in Africa. This novel and important technology has been effectively transferred to international, regional, and local agriculture and public health agencies in endemic countries and in countries at potential risk of this serious and deadly disease. This research is part of *Veterinary, Medical, and Urban Entomology*, an ARS national program (#104).

Department of Commerce (DOC)

At the Department Commerce, R&D in numerous areas of science and technology is conducted at the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and the Institute for Telecommunication Sciences (ITS) within the National Telecommunications and Information Administration (NTIA). More information about DOC technology transfer is available on the following websites:

NIST: <http://patapsco.nist.gov/ts/220/external/index.htm> ; NOAA: <http://www.noaa.gov/>

ITS: http://www.its.bldrdoc.gov/programs/tech_transfer/

National Institute of Standards and Technology

NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST laboratories develop and disseminate measurement techniques, reference data, test methods, standards, and other technologies that support U.S. industry, scientific research, and the activities of many federal agencies. In carrying out its mission, NIST works directly with industry partners, academia, associations, and other government agencies.

- **NIST Teams with Carl Zeiss Inc. on Nanomanufacturing**

Researchers at NIST and Carl Zeiss, Inc. are improving nanoscale measurement accuracy to help manufacturing industries. Via a CRADA, NIST and Carl Zeiss researchers tested Orion, the first commercial helium ion microscope, at NIST's Advanced Measurement Laboratory (AML).

“What we are learning goes directly back to the manufacturers to improve their products, which allows NIST and industry to obtain the most precise measurements possible,” explains Michael Postek, Chief of the Precision Engineering Division. “We are transferring NIST technology and sharing our research with the semiconductor industry trade organization, SEMATECH.” Carl Zeiss recently unveiled its new Orion Plus, incorporating many of NIST's design suggestions including a better helium cooling system.

- **Femtomolar Optical Tweezers**

NIST has licensed a patented “optical tweezers” technique for detecting and measuring very small concentrations of a biological substance, such as a virus on a surface. NIST has issued a non-exclusive license for the technology to Haemonetics, a global health care company that provides blood management technologies for hospitals and blood/plasma collection agencies. The licensed technology was patented (patent #5,620,857), as a result of research conducted under the NIST BioSensor Consortium.

National Oceanic and Atmospheric Administration

The mission of the National Oceanic and Atmospheric Administration (NOAA) is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet the Nation's economic, social, and environmental needs. This mission will

become ever more critical in the 21st century as national needs intensify concerning global warming, freshwater supply, ecosystem management, and homeland security.

- **HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) Model**

The HYSPLIT model is a powerful and useful analytical tool that helps explain how, where, and when chemicals and materials are atmospherically transported, dispersed, and deposited. HYSPLIT was developed and is continuously updated by NOAA's Air Resources Laboratory and is used by NOAA's National Weather Service through the National Centers for Environmental Prediction and at local Weather Forecast Offices. The number of registered users has increased dramatically to include government, commercial, and university personnel, both in the United States and from many foreign nations. These users implement the model for emergency response operations, such as tracking and forecasting the release of radioactive material, volcanic ash, and wildfire smoke, as part of research efforts addressing sources of pollutants, and by glider pilots and balloonists for recreational purposes. At the local/regional level, field forecasters regularly respond to requests for dispersion forecasts from state and local emergency managers. At the national level, the model is often applied to needs from the aviation industry and air quality regulators. Internationally, NOAA responds through its participation with the World Meteorological Organization and the International Atomic Energy Agency by providing dispersion model forecasts in the event of a large scale nuclear incident. Also internationally, NOAA maintains one of the nine Volcanic Ash Advisory Centers around the world supporting the International Civil Aviation Organization; the NOAA VAAC response is based upon HYSPLIT model simulations.

National Telecommunications & Information Administration/Institute for Telecommunication Sciences

ITS supports telecommunications objectives such as promotion of advanced telecommunications and information infrastructure development in the United States, enhancement of domestic competitiveness, improvement of foreign trade opportunities for U.S. telecommunications firms, and facilitation of more efficient and effective use of the radio spectrum.

- **Table Mountain Research**

The Table Mountain Field Site and Radio Quiet Zone supports fundamental research into the nature, interaction, and evaluation of telecommunication devices, systems, and services. Each year, private companies and other organizations conduct research there under CRADAs. The University of Colorado's Research and Engineering Center for Unmanned Vehicles has for 3 years conducted measurements of the performance of ad hoc wireless networks with both ground-based and airborne terminals at Table Mountain. In FY 2009, several companies performed antenna, lidar/GPS, and other testing at the Table Mountain turntable facility under a CRADA. Lockheed Martin Coherent Technologies is in its 10th year of performing field-testing and characterization of components, subsystems, and systems for eye-safe coherent laser radar, which has benefited NTIA and the Department of Defense.

Department of Defense (DoD)

The purpose of the DoD Office of Technology Transition is to ensure, to the maximum extent practicable, technology developed for national security purposes is integrated into the private sector of the United States in order to enhance national technology and industrial base, reinvestment and conversion activities.

DoD is unique in applying the principles, practices, and tools of technology transfer in the execution of its mission. DoD funds and develops mission focused technology, and technology transfer statutory authorities enable it to promote and facilitate the commercialization of that technology for both military and civilian purposes. Concurrently, DoD is a technology buyer as it strives to purchase new technology embodied in products and systems to meet the challenges faced by our warfighters. In many instances technology transfer and technology transition are becoming a seamless path to fielding new technology critical to responding to the new and dynamic threats of asymmetric warfare, the global war on terrorism, and the ever expanding role of civil assistance and disaster recovery worldwide. In the 1980's when much of the technology transfer legislation was enacted, the Federal Government, including DoD, was the principle funding source for R&D. Consequently, technology transfer was viewed as a "spin out" to the marketplace, a stimulus to the domestic economy, and a return on investment for taxpayer funded R&D. Today, the majority of U.S. R&D is industry funded. This shift in funding has led to a greater emphasis on technology transfer as a collaborative effort between DoD labs and their partners in industry, academia, and state and local government.

Each of the Military Services, Defense Agencies, and Office of the Secretary of Defense (OSD) maintain technology transfer websites to inform the public and make available general information.

The websites are:

<http://www.acq.osd.mil/ott/techtransit>

<http://www.arl.army.mil/main/Main/default.cfm?Action=6>

<http://www.onr.navy.mil/en/Science-Technology/Directorates/Transition/Technology-Transfer-T2.aspx>

<http://www.wpafb.af.mil/library/factsheets/factsheet.asp?id=6026>

http://www.mda.mil/business/tech_apps.html

<http://www.jfcom.mil/about/industry.htm>

The following examples describe some of DoD's successful approaches to technology transfer:

- **Decontamination Technology**

The Army Edgewood Chemical and Biological Center, through a CRADA with Strategic Technology Enterprise, Inc., was able to deliver a breakthrough decontamination technology of modified vaporized hydrogen peroxide effective against CB agents. They worked with the company to develop prototype delivery systems that were successfully field tested in decontaminating actual aircraft, sensitive equipment, and building interiors. The DoD Chemical and Biological Defense Program is funding the transition to a new DoD acquisition program established to field this capability.

- **DoD Labs Working Outside the Fence**

Many DoD labs recognize technology transfer is not just the ability to use different mechanisms to share technology with others but it also provides the labs with opportunities to build long term relationships with state and local governments, universities, and businesses in their geographic area. In fostering these relationships, the labs have worked with these other entities as they create collaborative work environments that include technology parks, business incubators, and research, development, test and evaluation (RDT&E) facilities.

The Naval Air Warfare Training Systems Division actively participates in a not-for-profit National Center for Simulation that includes all the military services, NASA Kennedy Space Flight Center, the University of Central Florida, and over 300 modeling and simulation companies. In addition, the Naval Center shares spaces and engages in a number of project collaborations in two “Partnership Buildings” adjacent to but outside of the Navy’s installation. In these partnership buildings, the Navy is working side-by-side with the National Institute of Justice and their Federal Law Enforcement Training Center, the Marine Corps Program Managers for Training Systems, and the University of Central Florida. Through these collaborative relationships with other Government Activities, academia, and leading edge companies, the military, and the law enforcement community can realize significant benefits in the fast moving dynamics of software development.

The Air Force Research Laboratory Sensors Directorate initiated a collaborative relationship several years ago that brings together state and local economic development interests in Dayton, Ohio. Three Ohio universities (Ohio State University, Wright State University, and the University of Dayton), and a number of small and large businesses are partnering in what can best be described as a hands-on-business incubator. This activity is the Institute for Development and Commercialization of Advanced Sensors Technology (IDCAST). IDCAST provides a collaborative environment to foster research, development, and commercialization of remote sensing and chemical, biological, radioactive, nuclear, and explosive sensor technologies. With the facilities and equipment at IDCAST, collaborative teams from industry (over 30 companies), academia (now six Ohio universities), and several Federal Labs, specific projects are undertaken to develop and mature promising technologies that have both military and commercial applications. Prototyping, test and evaluation, product engineering, and scale-up to manufacturing, all benefit from this collaborative work space. Technologies are being adapted for wide area airborne sensor technology for video monitoring of large areas, use of sensors for improved water quality monitoring, a commercial product that would enable highly accurate breast cancer surgery, and a different adaptation of the cancer cell detection technology that enables real-time quality control of microcircuit manufacturing.

- **DoD Labs focus on Energy:**

Energy supply and consumption has a critical impact on DoD’s ability to execute its mission. As a consequence, DoD (as well as several other agencies, academia, and the private sector) focus significant resources on seeking better energy solutions. In several instances, technology transfer

is playing a critical role advancing DoD's capability to deal with some of these complex energy related issues.

The Navy Surface Warfare Center, Carderock, has executed several CRADAs with companies to assess and develop technologies that can exploit the power generation capabilities of ocean currents. In one case, the Navy is working jointly with CRADA partners to identify commercial technologies and assess technical issues related to materials selection, platform hydrodynamics, machinery noise, propulsion efficiency, cables for electric power transmission, mooring large ocean systems, system control, installation, survivability, and life cycle analysis. The effort is focused on an area identified as the Florida Current. It is projected that harnessing four percent of just one cross section of the current, could potentially extract one to two thousand megawatts of power. Under a second CRADA, Carderock is working with a company that has developed two scaled prototype models of open center turbines to capture the flow energy available in ocean currents and tides. The collaboration includes analysis using Carderock computational fluid dynamics capabilities and expertise, model development and testing, full scale engineering design analysis, and engineering support during first article development and installation

The Army Corps of Engineers Engineering Research and Development Center (ERDC) Construction engineering Research Laboratory (CERL) entered into a CRADA with Vehicle Projects, Inc. and Burlington Northern Santa Fe Railway to conduct developmental and operational test and evaluation of the Nation's first hydrogen fuel cell locomotive. To assist this effort, the Defense Logistics Agency cost shared with Burlington Northern in building a full scale prototype of this new engine. The locomotive uses a fuel cell that combines hydrogen and oxygen to produce electricity with water and heat as by products. The generated electricity either powers the engine or is stored in batteries. It was built in Topeka, Kansas, and is undergoing testing at the Transportation Technology Center, Inc. at Pueblo, Colorado. It will proceed from there to operational testing at two rail yards in Los Angeles. Once the prototype proves successful, it will be moved to a military installation to test and evaluate its capability to serve as a backup power generation source.

The Air Force Research Laboratory Propulsion Directorate has been working in both near term and long term work with others in Government, industry, and academia to develop and evaluate alternative fuels for use in military and civilian aircraft. Through the use of Material Transfer Agreements (MTAs), the Air Force has evaluated fuels provided by both large and small companies beginning in FY2007, and based on the results of these efforts, some first generation alternative fuels have been commercialized and certified for use by military aircraft. Collaboration has included Military Services, several Federal Agencies (NASA, NIST, EPA, FAA), and the Departments of Energy and Agriculture.

Department of Energy (DOE)

The Department of Energy's seventeen national laboratories and several of its facilities conduct much of its fundamental and applied research, and they license to and collaborate with industry and academia to develop and commercialize a wide spectrum of products and processes for commercial use. Technology partnering has been an important focus for DOE technology transfer, and it is a significant means for DOE laboratories and facilities to engage Federal, private and academic entities in arrangements to advance the process of technology development and commercialization. These arrangements leverage capabilities of DOE's top notch scientists and world-class facilities, including national user facilities, computational facilities, and science laboratories, with industrial research and production facilities.

The Department oversees the construction and operation of some of the Nation's most advanced research and development user facilities, located at national laboratories and universities. These state-of-the-art facilities are shared with the science community worldwide and offer some technologies and instrumentation that are available nowhere else. These facilities include particle and nuclear physics accelerators, synchrotron light sources, neutron scattering facilities, genome sequencing facilities, supercomputers, and high-speed computer networks. In the 2009 fiscal year, these facilities were used by more than 21,000 researchers from universities, national laboratories, private industry, and other federal science agencies.

In an effort to enhance technology transfer activities and facilitating access to its facilities, the Department recently appointed its first full-time Technology Transfer Coordinator who is working with the Laboratories to streamline and increase efforts to partner with industry. The Coordinator is also teaming with others to identify and implement new and innovative ways to accelerate the time-to-market for innovations arising at the laboratories.

The Department launched a new single-entry web presence for all the DOE laboratories conducting technology transfer: <http://technologytransfer.energy.gov>. This website goes beyond simply providing information on technology transfer arrangements at DOE. It provides searching capabilities across multiple databases to help identify laboratories and investigators who have capabilities in a searcher's desired subject matter, including contact information to ease and increase the potential for partnering and licensing laboratory technologies. Combined with direct access to laboratory and laboratory technology transfer websites, information on partnering with DOE laboratories, and additional access to related web resources to enhance collaborative opportunities and success of licensed technologies, the searching capabilities provide a vast and easy-to-use resource for individuals, small and large businesses, and any potential collaborator or licensee.

- **American Corn Continues to Feed U.S. Industries**

Researchers at the Department of Energy's Pacific Northwest National Laboratory, in partnership with trade groups, private industry, and universities, have been able to expand their initial technology development of a robust catalytic process that converts plant sugars from corn

fiber into a portfolio of catalysts and methods that make it more feasible economically for chemical producers to “go green.”

Many everyday items from food to liquid detergents and cosmetics contain the petroleum-based additive known as propylene glycol (PG). The additive, however, can also be made from plant byproducts. Funded by DOE's Office of Energy Efficiency and Renewable Energy, PNNL researchers developed a chemical catalyst that converts a plant-based compound into the additive, and Archer Daniels Midland (ADM), an agricultural processing company, has developed additional processes to clean out impurities. The highly efficient process generates the additive from plant byproducts inexpensive enough to compete with propylene glycol derived from oil. The company has now completed construction of the first full-scale plant to make propylene glycol from renewable sources. The Decatur, Illinois plant is designed to produce up to 25 percent of the propylene glycol needed in the United States every year.

- **Software improves U.S. manufacturing -- and National Laboratory capabilities**

Many manufacturers run their equipment 24 hours a day, 7 days a week. Equipment failure in any phase of the operation can produce a ripple effect that translates into significant losses in time and productivity for the manufacturer, which results in more costly products for consumers. With its diverse manufacturing lines, Proctor & Gamble (P&G) was motivated to find a system that would help them maximize the uptime of their various operations.

The Department of Energy's Accelerated Strategic Computing Initiative (ASCI) was developed to ensure the safety, reliability and performance of the U.S. nuclear stockpile without testing a single weapon, by modeling a nuclear weapon from start to finish. The ASCI program pushed the boundaries of simulation through advances in both high performance computers and the codes to run on them. The DOE's Los Alamos National Laboratory and P&G collaborated under a Cooperative Research and Development Agreement for mutually-beneficial results. The Los Alamos scientists obtained real world data to validate and verify statistical models while P&G received state-of-the-art simulations of their manufacturing lines on which to base maintenance decisions. Using this new capability, P&G reported that it was able to increase plant productivity by 44 percent, cut controllable costs by more than 30 percent, improve equipment reliability between 30 and 40 percent and reduce line changeover time from hours to minutes. It has been reported to have saved P&G more than a billion dollars in manufacturing costs.

- **Ultra-thin film solar technology poised to heat things up**

Solexant is creating cost-effective solar cells that are comparatively simpler to manufacture and use less material and energy than conventional solar cells. Working with scientists from the DOE's Lawrence Berkeley National Laboratory, the San Jose-based company is improving on this thin-film technology first developed at the National Lab. Solexant has been operating a pilot plant in California, and is nearing completion of a full-scale plant in Oregon capable of manufacturing 100 MW of solar cells per year.

While thin film technologies have the potential to bring the cost of solar power down, they are typically made of polymers that are less efficient than conventional silicon solar cells and

vulnerable to the environment. This challenge led Solexant to invest in nanocrystal materials developed at the National Laboratory, leading both to an increase in their solar efficiency and the creation of durable ultrathin-film solar cells. The flexibility of these films allows them to be produced using a low-cost, high-throughput roll-to-roll production technique, much like newspaper printing. Solexant's development efforts have reduced the cost of manufacturing the solar cells to about half that for conventional photovoltaics, putting solar energy closer to parity with fossil fuels on a dollar-per-watt basis.

Department of Health and Human Services (HHS)

Research at the Department of Health and Human Services is conducted by the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), and the National Institutes of Health (NIH).

The NIH has as its mission the conduct and support of biomedical research to improve the public health. The NIH Office of Technology Transfer (OTT) is responsible for identifying, evaluating, protecting and marketing technologies derived in NIH intramural laboratories. OTT transfers these technologies through licenses to the private sector, where they can be further developed into products used in the prevention, diagnosis, or treatment of disease.

Effectively measuring the public health outcomes that result from such technologies is challenging and complex. Traditionally, efforts to measure the effect of technology transfer activities focus on outputs such as the number of patents and licenses or the amount of royalties generated. However, this approach does not depict the full scope of activities and may, in fact, distort the importance of ensuring that novel biomedical inventions are commercialized.

NIH has created a Product Showcase (<http://www.ott.nih.gov/products/showcase/default.aspx>) that displays products from its intramural research program utilized every day to detect, treat or prevent disease or assist researchers as they continue to explore ways to develop newer and more effective health care products and procedures. The Showcase includes products that are now or have been on the market. Some are FDA-approved and many do not necessitate FDA approval.

For more information about the HHS technology transfer program please visit:
CDC: <http://www.cdc.gov/od/science/techTran>; NIH: <http://www.ott.nih.gov/> and
FDA: <http://www.fda.gov/ScienceResearch/CollaborativeOpportunities/default.htm>

- **Prostate Cancer Immunotherapy**

While the research and development required to bring a cancer treatment to market is long and expensive, the benefit for patients is incalculable. Dr. Jeffrey Schlom, Chief of the Laboratory of Tumor Immunology and Biology at the NIH National Cancer Institute, led the scientific team that developed PROSTVAC, a prostate cancer immunotherapy that triggers the patient's own immune system to attack prostate cancer cells. An exclusive patent license was granted to Bavarian Nordic to further develop the technology. The company recently released encouraging clinical data at the American Society for Clinical Oncology Annual Meeting. Phase 2 clinical trials demonstrated an improved survival of 8.5 months, on average. In contrast, the only approved treatment currently available for advanced prostate cancer is a form of chemotherapy, which extends survival by an average of only 2.4 months.

- **Rapid quantitative assay to detect all known Interferon-Alpha subtypes and allotypic variants**

Different forms of IFN mRNA transcripts and proteins are induced at different levels in response to a variety of physiological and pharmacological stimuli. The detection of the

individual forms has utility not only in the research laboratory, but also potentially to monitor vaccine efficacy, autoimmune disease, chronic infections, or tumor therapy. Because the 12 human IFN- α genes share a high degree of sequence homology, their individual transcripts are extremely difficult to quantify using conventional methods. By overcoming this technological hurdle, this highly sensitive and specific quantitative real-time PCR assay provides a tool for better determining which IFN- α mRNAs responds to a particular treatment and to what extent, both in cell culture and in vivo, allowing to differentiate between several IFN- α transcripts in one single assay. A kit of primer/probe sets complementary to the coding sequence avoids spurious detection of degraded mRNA and enhances the correlation between the IFN- α subtype that is measured by the assay of the invention and the protein that is actually expressed.

- **Technology for the Detection of HIV**

The 2008 Report on the global AIDS epidemic found that since 1981, HIV caused an estimated 25 million deaths worldwide. Despite the success of antiretroviral drugs to slow the rate of AIDS deaths, HIV still remains a challenging public health problem. As of 2007, about 33 million people in the world were living with AIDS. There is a strong need for improved diagnostics to provide more rapid and sensitive identification of the virus. New HIV infections occur faster than people can be treated. Recognizing the most recent infections at the individual level would allow for prevention programs to target those areas more effectively, and in turn, slow the HIV infection rate dramatically.

Dr. Bharat Parekh of the CDC has lead a team to develop unique tests that not only detect HIV-1, but also identify how recently a person has been infected with HIV-1; this allows for identification of HIV infection hot spots. Specifically, he developed novel peptides that can detect all HIV-1 strains for incidence estimation. Initially, the product used the BED peptide, a synthetic protein. However, synthetic production was difficult and prevented widespread use of the test. As a result, CDC scientists created a unique multi-subtype recombinant protein developed from HIV-1 that could identify all strains of HIV-1. Unlike the synthetic peptide, the new protein can be expressed and purified from *E. coli*, which greatly simplifies the production process while enabling production of substantially larger quantities of protein.

Dr. Parekh used invention reports to disclose his inventions to the CDC Technology Transfer Office. This resulted in licenses to companies in the United States, Ireland, India, and China. Dr. Parekh provided these companies with information and biological materials to replicate the tests. His laboratory members trained key scientists from the companies in a hands-on approach to ensure a successful transfer of technology. CDC staff worked closely with company personnel to ensure consistency of the test kits developed for all the testing assays.

Dr. Parekh's efforts led to ground breaking assessments of new infection rates in the United States and South Africa. His tests have been used in many countries including: Brazil, India, China, Thailand, Botswana, and more. Currently, he is transferring new technologies to the companies for newer improved test kits. The result of this technology transfer will lead to better detection and surveillance of HIV, thereby indicating where prevention programs should be implemented.

Department of Homeland Security (DHS)

The DHS's Office of Research and Technology Applications (ORTA) is housed in the Science and Technology Directorate. The ORTA is responsible for developing and instituting policies to facilitate technology transfer in accordance with 15 USC 3710 throughout DHS and its laboratories. The ORTA's responsibilities include:

- Standardizing and approving DHS Cooperative Research and Development Agreements (CRADAs), licensing, and other technology transfer agreements;
- Preparing application assessments for selected research and development projects in which the DHS Laboratory is involved and may have commercial application;
- Providing and disseminating information on Federally owned or originated technologies which have potential application to State and local governments and private industry;
- Preparing and providing an annual report to Congress and the President through submission to the National Institute of Standards and Technologies (NIST);
- Developing training programs on technology transfer and intellectual property for DHS employees; and
- Establishing an intellectual property program for DHS to track and prosecute patents and other intellectual property, and to develop a royalty and rewards policy.

The DHS has laboratories with varying capabilities throughout the United States. With the exception of the Coast Guard Research and Development Center, the DHS laboratories listed are within the Science and Technology Directorate. Data included in this report was provided by:

- Chemical Security Analysis Center (CSAC)
- Coast Guard Research and Development Center
- Environmental Measurements Laboratory (EML)
- National Biological Analysis and Countermeasures Center (NBACC)
- Plum Island Animal Disease Center (PIADC)
- Transportation Security Laboratory (TSL)
- Federal Law Enforcement Training Center (FLETC).

For more information on DHS laboratories and their capabilities, visit the website at <http://www.dhs.gov/xres/labs/>

• **Avatar Based Interview Simulator**

In 2008, the FLETC Behavioral Science Division was pursuing an avenue to increase opportunities for students to practice different types of interviews without increasing curriculum time, or instructor resources. Students currently receive classroom instruction followed by practical exercises with role players. The U.S. Army's multi-million dollar investment in virtual human simulations that train soldiers in cultural awareness and tactical questioning techniques has been a great success. This same technology is now working for FLETC. The FLETC is leveraging the technology to develop an interview simulator capability specific to DHS law enforcement interview training requirements. The first prototype simulator was delivered to FLETC's Glynco location in February 2009.

The ability to demonstrate verbal and non-verbal cues and indicators with a simulator will no doubt increase the capacity of our officers to detect deceptive behavior, elicit truthful statements through rapport building techniques, and help diffuse dangerous situations. Students will be able to practice on the simulator and be better prepared for live scenarios. This will allow instructors to use the live scenario time to focus on training students for the more difficult type interviews they may encounter.

- **Advanced Use of Force Training System (AUFTS)**

The research laboratory at the Naval Air Warfare Center Training Systems Division (NAWCTSD) used the latest in virtual avatars, speech recognition and weapon firing simulations to prototype the next generation of a virtual use-of-force training system. Current commercially available use-of-force training systems do not allow full interaction or give trainees the ability to verbally interact with the suspect.

This AUFTS allows the trainee to fully interact with the suspect. The suspect avatar responds to verbal commands with voice and engagement depending on the level of compliance, in a similar manner as a live use-of-force lab. In addition to improved interaction capabilities, the instructors have the ability to alter the level of compliance of the on-screen characters and can also alter features such as time of day, weather, and ethnicity of characters. This capability ensures that scenarios and outcomes are not the same regardless of how many times a student practices.

In addition, the portable AUFTS can be used in exported training programs due to the short set-up time that is required. Currently, the FLETC's Artesia, NM, training facility is exploring the opportunity to test the system in export programs. If expanded to other programs, this application may be able to enhance FLETC's mission to support state, local and tribal law enforcement training, and particularly, the mission of the Rural Policing Institute. In January 2010, FLETC and NAWCTSD received the Southeast Region, Federal Laboratory Consortium's Partnership award for their cooperative efforts with the AUFTS.

Exit Lane Breach Control System

South Jersey Transportation Authority (SJTA) and the Atlantic City International Airport (ACY) located in Atlantic City, New Jersey, have acquired the local TSA Federal Security Director approval of the Eagle I and Eagle II Exit Lane Breach Control System for unmanned protection of the secure areas beyond an exit lane. As the Transportation Security Officer (TSO) force has developed greater expertise and considering the increase of passenger travel, the demand for screener readiness at the checkpoints has increased dramatically. The Transportation Security Laboratory/SJTA CRADA is in operation as ACY investigates utilizing technologies to provide reductions in cost and resource allocations.

Airport Exit Lanes provide for one way travel of arriving passengers to leave a secured area of an airport or terminal. Exit Lanes have been the source of security breaches of the secured areas beyond the security checkpoints by the intrusion of human and threat objects that could,

and do, present a security threat potential. While detection of a security breach is essential, risk mitigation of the intrusion is also an objective of security authorities. If a breach of the Exit Lane occurs, appropriate responses could include the following: the airport or terminal will be closed, passengers and employees will be evacuated, arriving flights will be prevented from deplaning passengers and security forces will be deployed to conduct sweeps of the affected area. Only upon completion of the sweeps can the evacuated personnel be re-screened by TSA and allowed to re-enter the airport, or terminal. The delay caused by a breach can cost hundreds of thousands to hundreds of millions of dollars, depending on the size of the airport.

Monitoring of Exit Lanes by posting security personnel at the public side of the exit lane has two main purposes; (1) to protect against intrusion and/or introduction of humans and objects (threat and non-threat), and (2) to illustrate active security measures to the public, but also as a deterrence to those that might attempt illegal entry. Utilizing the TSL/SJTA CRADA, the underlying objective of both the TSL and the SJTA ACY was to work with the TSA at ACY to deploy a system or technology that can be unmanned during normal operations while maintaining a high degree of security beyond the security checkpoint. As configured, the system achieved this level of operational compliance, in a single portal configuration and as an aggregate system configuration and approach.

- **Thumbprint Quality Control Kit (TQC)**

The Transportation Security Laboratory developed the TQC for use as a training aid for screeners, Transportation Security Officers (TSOs). The TQC kit allows for training TSOs to test for trace amounts of explosives. Trace amounts of explosives are blended into a non-toxic modeling clay matrix. The training instructor then places his/her thumb into the clay and makes a thumbprint impression on a test article. The exact location on the test article is unknown to the screener. The screener then collects a trace sample from the test article and analyzes the sample in an ETD (Explosive Trace Detection) analyzer. If the screener follows standard operating procedures for correct sample collection, then the ETD is expected to alarm. If no alarm is produced, then the screener is given further training on correct sampling techniques. To aid in demonstrating the location of the thumbprint impression in failed sampling attempts, a fluorescent dye is incorporated in the clay that can be visualized only under a “black” light. It is invisible in ordinary room light.

TSL has successfully transitioned this product to the Operational and Technical Training Branch of the Transportation Security Administration (TSA). The TQC kit is now included as part of the screener training kit that also includes mock IEDs and other bulk training materials. The TQC is a tremendous asset for both the TSO workforce and the TSA managers/supervisors, with benefits such as enhanced security and higher efficiency rate.

Department of the Interior (DOI)

The United States Geological Survey

The United States Geological Survey (USGS) is a bureau of DOI. The mission of the USGS is to serve the nation by providing reliable scientific information to describe and understand the Earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect our quality of life.

Since delivery of science information is a primary purpose of the agency, technology transfer activities with the public sector and the private sector, including academia and non-profits, typically support the collection and transference of scientific data (knowledge dissemination). The USGS cooperates with its public and private collaborators to help them maintain necessary services, better understand the environmental consequences of their commercial and non-commercial activities, and to develop new products and services.

For more information please visit: <http://www.usgs.gov/tech-transfer/index.html>

- **CRADA to Improve Earthquake Hazard Assessments**

The Pacific Gas and Electric Company (PG&E), a publicly regulated utility providing service within California, is engaged in a long-term, multi-element, action-based seismic risk management program to reduce the impact of future earthquakes on the performance of their gas and electric systems, and to maintain acceptable levels of customer service. To further this program, PG&E and the USGS have been involved in a series of CRADAs since 1992.

In 2009, the USGS and PG&E extended their CRADA for five years. In this period, PG&E seeks (1) the development and rapid application of data, methods, and technologies that improve earthquake hazard assessments in the regions where its electric power and natural gas facilities, service centers, and office buildings are located and where its customers live and work; and (2) the improvement of emergency response to earthquake occurrence by incorporating real-time earthquake hazard information.

The USGS Earthquake Program, under the auspices of the National Earthquakes Hazards Reduction Program, includes a broad range of applied earthquake hazards research, data compilation and archiving, and distribution of earthquake information products and services. The PG&E CRADA complements the USGS Earthquake Program, and is carried out using the capabilities of five USGS Science Centers (Earthquake, Geology and Geophysics, Pacific Coastal and Marine, California Water, and Geologic Hazards).

- **Invention to Protect Plants from Harsh Conditions**

The USGS co-owns a patent with Montana State University (MSU) entitled “Use of Endophytic Fungi to Treat Plants” that teaches methods of protecting plants from harsh environmental conditions such as drought and extreme heat (U.S. Patent No. 7,232,565 B2, issued June 19, 2007). This is accomplished by inoculating a target plant with endophytic fungi isolated from

Curvularia species grass found in geothermal zones of the Lassen Volcanic and Yellowstone National Parks. The extracted fungi, a microorganism, may be inoculated into plants, plant parts, seedlings, or seeds. These microorganisms are too small to see, even with electron microscopes, but are believed to occupy the intercellular spaces of plant tissues. Within host plants, they seem to produce bioactive substances and, possibly in concert with the plant's genome, help such plants adapt to harsh external conditions. Inoculated plants demonstrate asymptomatic stress tolerance and enhanced plant growth.

Additional benefits conferred by such treatments to plants are protection from metals and metal ions (that can harm or kill plants) and from abnormal pH (both acidic and alkaline). The potential for the invention is significant for both crop plants and other plants, particularly in light of the possibility of harm to plant life caused by climate change. In addition to other agricultural uses, these microorganisms may ultimately be shown to be beneficial in medical and industrial applications. The invention is currently exclusively licensed by MSU to a U.S. company that is seeking patent protection in Europe, Brazil, and China, in addition to the U.S.

Bureau of Reclamation

The Bureau of Reclamation (Reclamation) is responsible for water and hydropower deliveries throughout the 17 Western states. Reclamation's stated mission is to "manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public." In support of this mission, Reclamation operates 348 reservoirs and 58 hydroelectric plants, making it the nation's largest wholesale water supplier and the second producer of hydroelectric power in the West. Reclamation conducts and sponsors research in the following four mission-related focus areas:

- Water & Power Infrastructure Reliability & Safety
- Water Delivery Reliability
- Reservoir & River Operations Decision Support
- Water Supply Technologies

Reclamation research solutions should demonstrate mission relevancy by improving Reclamation water management practices, increasing water supply, and/or ensuring cost-effective power generation operations that benefit Reclamation's project managers and stakeholders, western water community, other federal agencies, non-federal sector and the general public.

The broad scope of some of Reclamation research solutions can be viewed from the link: <http://www.usbr.gov/research/science-and-tech/research/results/index.html>

- **Catch Cups – Landscape irrigation tool and guide used to conserve urban water**

Reclamation's Upper Colorado Regional (UCR) Office in Salt Lake City, Utah has developed inexpensive, easy-to-use, self-supporting catch cups (U.S. patent no. 6,779,399), an associated simple, one-page pamphlet and instructional video for homeowners, a full length manual for landscape professionals, and individual county watering schedules for each county in Utah. The

catch cups and related information are intended to help homeowners irrigate their lawns correctly and reduce over watering. Reclamation has a non-exclusive license agreement with Utah State University and has currently sold over 7,000 catch cups to irrigation professionals throughout the U.S. and has improved irrigation efficiency results in lower water bills, improved landscape health, reduced water pollution and reduced fertilizer use. The catch cups measure the amount of water collected across an irrigated area. Water measurements are used to evaluate sprinkler performance so that sprinkler systems may be adjusted to apply the optimal amount of water.

- **Flexible Magnetic Flux Probe – A new inexpensive, light, and thin probe improves generator rotor diagnostics accuracy and reduces maintenance costs**

Reclamation's Hydropower Technical Services Group has developed and patented (#6466009) an inexpensive, small, flat, flexible magnetic flux probe that can detect deteriorating insulation in large scale spinning electrical generators. Reclamation has a non-exclusive license agreement with Iris Power LP and currently over 40 probes have been sold in the U.S. that have improved generator reliability and reduced maintenance costs. The probe consists of a thin, flexible pickup coil on the back side with an electrostatic shield on the front side. The pickup coil, which is used to measure the magnetic flux, is composed of printed circuit board traces etched onto a flexible substrate. The flexible substrate is very light and thin allowing easy installation into the air-gap. If the probe would happen to come loose during generator operation, the flexible substrate would not damage the generator. This probe provides for consistent and uniform electrical and magnetic characteristics thus eliminating the need for calibration.

Department of Transportation (DOT)

The U.S. Department of Transportation (DOT) is the federal steward of the nation's transportation system. DOT is made up of many transportation agencies and programs, all of which seek to apply innovation from the research and development (R&D) programs to fulfill the key goals of the Department: safety, livable communities, state of good repair, economic competitiveness, and environmental sustainability. Technology transfer is carried out in the following DOT laboratories: the Federal Aviation Administration's (FAA) William J. Hughes Technical Center, the Federal Highway Administration's (FHWA) Turner-Fairbank Highway Research Center, and the Research and Innovative Technology Administration's (RITA) Volpe National Transportation Systems Center. In 2004 the Research and Innovative Technology Administration was charged with the coordination of technology transfer efforts across the Department.

For more information about the DOT technology transfer please visit:

FAA http://faa.gov/about/office_org/headquarters_offices/ato/tc/initiatives/ttp

FHWA <http://www.fhwa.dot.gov/everydaycounts/>

RITA <http://www.volpe.dot.gov/ourwork/techtrns.html>

• SafeTrip-21 Transportation Safety Technologies Take Manhattan

The Volpe National Transportation Systems Center has launched a bold new intelligent transportation systems (ITS) initiative dubbed SafeTrip-21 (Safe and Efficient Travel Through Innovation and Partnerships for the 21st Century). SafeTrip-21 builds on DOT's IntellidriveSM research and leverages technologies currently in wide use, such as cellular phones, GPS, Wifi, Bluetooth, and the Internet, to accelerate the advance of safety and mobility applications. The Volpe Center will assess applications to improve automobile travel and public transit convenience, as well as commercial vehicle safety and productivity. In June 2008, the Volpe Center entered into a cooperative agreement with the California Department of Transportation (Caltrans), establishing the inaugural SafeTrip-21 field test site in the San Francisco Bay area. In this 12-month field test beginning December 2008, travelers received transportation information and transmitted their own transportation data, creating a real-time, dynamic, wireless data mesh of information. SafeTrip-21 technologies were unveiled at the 15th ITS World Congress in New York City in November 2008. An MTA bus and two rental vehicles were equipped to demonstrate applications for both drivers and transit riders. Also, key driver and pedestrian applications were showcased at a special "integrated show," which included technologies developed worldwide. Three new SafeTrip-21 partners were announced at the World Congress:

- iCone deploys active road cones to increase roadway safety using radar to measure traffic speed
- Parking Carma fields a mobile web enabled parking application that allows travelers to find, reserve, and pay for a parking space at a participating "smart" parking lot
- I-95 Corridor Coalition uses vehicle probe data to make it much easier for I-95 travelers to get information about traffic backups, construction information, and other delays.

- **Building the Bridge of the Future**

Rather than demanding expensive new equipment or materials, these revolutionary new bridges can be built using readily available materials and common construction equipment, without the need for highly skilled workers. What's new is that the bridges use geosynthetic reinforced soil (GRS) technology for abutments. Instead of a conventional bridge abutment, GRS technology employs the low-tech approach of alternating layers of compacted local soil and sheets of geotextile fabric reinforcement to provide support for the bridge. The technology produces bridges that are extremely durable, while simultaneously saving money. Compared to standard bridge construction, transportation agencies can cut their costs by 25 to 50 percent.

Researchers at the U.S. Forest Service and the Colorado Department of Transportation (CDOT) pioneered the early development of the technology. FHWA then worked with CDOT to further refine it. FHWA has built and tested several full-scale GRS structures at its Turner-Fairbank Highway Research Center in McLean, Virginia. FHWA provided guidance and abutment design plans to Defiance County, Ohio, to build the Bowman Road Bridge using GRS technology. This was the county's first time using the technology to build bridge abutments. Defiance County realized a cost savings of nearly 25 percent and built the bridge in 6 weeks, shaving 2 weeks off the construction time for a conventional bridge. Since that initial project, 13 more bridges have been built in Defiance County using GRS, with similar successful results. Other Ohio counties and several States also are interested in using the technology. In summer 2008, Warren County, Ohio, built both a temporary bridge and a permanent bridge on GRS abutments. Morgan County, Ohio, meanwhile, has used GRS to replace a failed bridge abutment.

As more State and local agencies learn about the potential savings in time and money that GRS offers, FHWA's next step is to develop design and construction guidelines on using GRS technology for highways, with a primary focus on bridge abutment applications.

- **Diverging Diamond Interchanges Expected to Improve Safety**

FHWA researchers have evaluated alternative intersection designs that offer to improve intersection safety while meeting the challenges of increasing capacity, decreasing congestion, and minimizing the cost of new infrastructure. Among these alternative designs is the diverging diamond interchange (DDI). Using the DDI, arterial traffic approaching the interchange crosses over to the left side of the arterial roadway. Vehicles can then turn left onto limited-access ramps entering a highway without having to stop and without conflicting with through traffic. Eliminating crossing conflicts between vehicles turning left onto the highway and opposing arterial traffic offers potential safety benefits.

The design also offers operational and cost benefits. The Missouri Department of Transportation estimates that a proposed DDI in Kansas City would cost half as much as retrofitting a conventional diamond interchange. Traffic modeling also suggests that upon completion the proposed DDI would be operating at only 60 percent of its traffic capacity, while the conventional diamond interchange option would be operating at 95 percent of capacity. FHWA researchers are monitoring plans to construct DDIs in Kansas City and other locations so that their actual safety and operational performance can be documented.

Department of Veterans Affairs (VA)

The mission of VA's Technology Transfer Program (TTP) is to serve veterans and the American public by commercializing worthy discoveries made by VA employees in furtherance of VA's research mission. This requires a program that educates inventors concerning their rights and obligations, rigorously evaluates all inventions, obtains patents, and assists in the commercialization of new products. It also requires consistent policies that govern the necessary relationships between investigator (i.e., inventor), academic partners, local VA medical centers, VHA-affiliated non-profit corporations, industry and the Department of Commerce.

More information is available on the VA's Technology Transfer Program website:
http://www.research.va.gov/programs/tech_transfer/default.cfm

- **Screening Tools for Discovery of Novel Anabolic Agents**

Current drugs for treating muscle atrophy possess limited efficacy or safety due to the fact that their mechanism of action is not specific. There is a need in the medical community for more specific treatments for muscle atrophy, as well as a need in the pharmaceutical industry for improved screening assays for identifying compounds with more specific anabolic properties.

One of VA's licenses this year was an invention that permits screening for new drugs that could be employed for increasing the size, strength and function of muscle in debilitated or elderly patients. The technology is non-exclusively licensed to Wyeth Pharmaceutical. The company has interest in using the cell line of the invention as a drug development tool for anabolic agents.

This invention has the potential for being important in preventing or reversing muscle loss and providing tools for rapid screening of candidate drugs that promote muscle growth and will possibly benefit not only veterans but the general public.

- **Compositions and Methods for Treating Diabetes, Obesity and Alzheimer's Disease**

A large market opportunity exists for novel therapeutic treatment options for type 2 diabetes, obesity and Alzheimer's disease. This year, the VA has licensed a suite of technologies that employ the use of Cyclo-Z for: the prevention and/or treatment of type 2 diabetes; body weight reduction in diabetes-associated obesity and for Alzheimer's disease.

The inventions are exclusively licensed with the Preventative Nutrient Company. The company is a research based drug development company focusing on products for diabetes, obesity and Alzheimer's treatment and management

These inventions can help the development of new therapeutic treatment regimes for these diseases and ultimately improve the care and quality of life for veterans and others by helping to prevent and/or treat these diseases.

Environmental Protection Agency (EPA)

EPA's Federal Technology Transfer Act Program was established to promote collaboration between private and federal research. EPA offers exceptional opportunities to develop and commercialize new technologies. EPA facilitates the transfer of new technologies to the marketplace while protecting intellectual property rights of all parties.

Partners in the FTTA Program will have the benefit of collaborating with world class EPA scientists involved in leading-edge research. Collaboration enhances the quality of research projects and helps move the environmental technologies into the marketplace more quickly, resulting in better protection of human health and the environment.

Highlights of several outcomes of the Agency's technology transfer activities are provided below. For more information please visit: <http://www.epa.gov/osp/ftta.htm>

- **Hybrid Vehicle Technology as part of the EPA National Clean Diesel Campaign's Clean Ports USA Program**

In April 2009, EPA and its industry partners offered a preview of a leading edge, pollution-saving truck for transferring cargo containers at the Society of Automotive Engineers World congress in Detroit, Michigan. The special cargo mover, called a series hydraulic hybrid yard hostler, moved from the exhibition into field testing at port terminals in the United States. Hostlers are large, off-road vehicles used to transfer cargo containers at marine ports, rail yards, warehouses and distribution centers. The trucks spend about half of their time idling and contribute to air pollution generated in ports throughout the world.

EPA and its partners have applied EPA's patented series hydraulic hybrid vehicle (HHV) technology to the heavy-duty truck as part of the EPA National Clean Diesel Campaign's Clean Ports USA program. EPA's unique series HHV power train efficiently recovers, stores and reuses braking power while significantly reducing idling and optimizing engine operation to use less fuel and reduce air pollution. HHV technology has been demonstrated and field tested in a number of vehicles, including package delivery vehicles and reuse trucks. EPA believes this vehicle design can improve the efficiency of the yard hostler operation by 50-60 percent.

Several EPA programs, including the National Clean Diesel Campaign and its Clean Ports USA, Clean Automotive Technology, Office of International Affairs, and EPA Region 2 (New York and New Jersey) collaborated on this project. Industry technical partners include APM Terminals, Parker-Hannifin, Kalmar Industries, FEV Inc., R. H. Sheppard Co Inc., and Webasto. Additional support was provided by the Port Authority of New York and the New Jersey Department of Environmental Protection. By developing cost-effective technologies, the Clean Automotive Technology Program also encourages manufacturers to produce cleaner and more fuel-efficient vehicles. Fleet owners benefit by being able to recoup the initial hybrid system costs through lower operating costs within a few years. More information about the program and EPA technologies can be found at <http://www.epa.gov/otaq/technology>.

- **EPA ToxCast™ Program**

EPA initially launched ToxCast™ in 2007 to develop a cost-effective approach for prioritizing the toxicity testing of large numbers of chemicals in a short period of time. Using data from state-of-the-art high throughput screening (HTS) bioassays developed in the pharmaceutical industry, ToxCast™ is building computational models to forecast the potential human toxicity of chemicals.

With the launch of ToxCast™, EPA announced collaborative opportunities for facilitating and expanding the development of ToxCast™. The response to the announcement has been overwhelming. In Phase 1 of the ToxCast™ program alone, EPA executed over 20 agreements to expand the high-throughput bioassay data results available on more than 300 well-characterized chemicals (primarily pesticides) in over 400 HTS endpoints. These endpoints include biochemical assays of protein function, cell-based transcriptional reporter assays, multi-cell interaction assays, transcriptomics on primary cell cultures, and developmental assays in zebrafish embryos.

Almost all of the compounds examined in Phase 1 of ToxCast™ have been tested in traditional toxicology tests, including developmental toxicity, multi-generational studies, and sub-chronic and chronic rodent bioassays. ToxRefDB, a relational database created to house this information, will contain nearly \$1B worth of toxicity studies in animals when completed. These ToxCast™ signatures will be defined and evaluated by their ability to predict outcomes from existing mammalian toxicity testing, and identify toxicity pathways that are relevant to human health effects.

The second phase of ToxCast™ will screen additional compounds representing broader chemical structure and use classes, in order to evaluate the predictive bioactivity signatures developed in Phase I. Following successful conclusion of Phases I and II, ToxCast™ will provide EPA regulatory programs an efficient tool for rapidly and efficiently screening compounds and prioritizing further toxicity testing.

National Aeronautics and Space Administration (NASA)

Since its creation in 1958, NASA has been charged with disseminating the results of its research broadly for public benefit. Beginning in FY 2011, the organization responsible for technology transfer within NASA, the Innovative Partnerships Program (IPP), is being merged into the newly created Office of Chief Technologist. With offices at HQ and all ten of NASA's Centers, IPP seeks to develop technology to meet NASA's needs through technology development partnerships with industry, academia, government agencies, and national laboratories; IPP also facilitates intellectual property protection and transfer out of NASA developed technology for commercial application and other public benefit. For these purposes, NASA Centers also facilitate collaborations with state and local government economic development agencies. Under the auspices of the Office of Chief Technologist, NASA will continue to seek dual use technology development partnerships and transfer out NASA technology for commercial application and other public benefit. In addition, under the Office of the Chief Technologist, NASA will continue to exercise its Prize Authority for the purpose of inviting and encouraging citizen inventors to create and demonstrate technologies targeted to some of NASA's, and the Nation's, greatest challenges.

Each year, NASA documents some notable successes from its technology transfer efforts in NASA's annual Spinoff Magazine publication. The magazine is available online at <http://www.sti.nasa.gov/spinoff>, and hard copies are available on request. To date, 1,712 spinoff successes have been documented in the publication, all of which searchable by keyword on the website. In addition, NASA has established a website called NASA@Home, NASA City, located at <http://www.nasa.gov/city> which helps to make the public aware of NASA's contributions to the quality and safety of everyday life. NASA participates with several other federal agencies in highlighting technologies available for licensing for commercial and research applications; details on this and other initiatives are available on the Office of Chief Technologist web site: <http://www.nasa.gov/offices/oct/home/index.html>. More information about the NASA Innovative Partnerships Program can be found at: <http://www.sti.nasa.gov/spinoff>; <http://www.nasa.gov/city>

- **Image-Capture Devices Extend Medicine's Reach**

On the International Space Station, diagnosing an injury can be problematic; bulky medical imaging devices like X-ray or MRI machines are too large and heavy for costly transportation into space. The ISS does, however, have a much smaller ultrasound machine. Johnson Space Center, Henry Ford Hospital in Detroit, and Houston-based Wyle Laboratories collaborated on NASA's Advanced Diagnostic Ultrasound in Microgravity (ADUM) experiment, which developed revolutionary medical ultrasound diagnostic techniques for long-distance use. Mediphan, a Canadian company with U.S. operations in Springfield, NJ, drew on NASA expertise to create frame-grabber and data archiving technology that enables ultrasound users with minimal training to send diagnostic-quality ultrasound images and video to medical professionals via the Internet in near-real time—allowing patients as varied as professional athletes, Olympians, and mountain climbers to receive medical attention as soon as it is needed. More than 345 musculoskeletal ultrasound examinations have been performed on these patients so far, a number of these with remote guidance.

- **Robots Save Soldiers' Lives Overseas**

Marshall Space Flight Center mobile communications platform designs for future lunar missions led to improvements to fleets of tactical robots now being deployed by the U.S. Army. The Multi-function Agile Remote Control Robot (MARCbot) helps soldiers search out and identify improvised explosive devices. NASA used the MARCbot to test its mobile communications platform, and in working with it made the robot faster while adding capabilities—upgrading to a digital camera, encrypting the controllers and video transmission, as well as increasing the robot's range and adding communications abilities. NASA engineers also simplified the design, providing more plug-and-play sensors and replacing some of the complex electronics with more trouble-free, low-cost components. Applied Geo Technologies Inc., a tribally-owned corporation in Choctaw, Mississippi, was given the task of manufacturing the modified robots. The company is now producing 40 units per month, 300 of which have already been deployed overseas.

- **Air Purifiers Eliminate Pathogens, Preserve Food**

NASA-funded researchers produced an ethylene reduction device for a plant growth unit designed for cultivating crops in space. KES Science and Technology Inc., a Kennesaw, Georgia-based company specializing in sustaining perishable foods, licensed the ethylene scrubbing technology. KES partnered with Akida Holdings of Jacksonville, Florida, which now markets the NASA-developed technology as AiroCide. According to the company, it is the only air purifier that completely destroys airborne bacteria, mold, fungi, mycotoxins, viruses, volatile organic compounds (like ethylene), and odors. The devices have no filters that need changing and produce no harmful byproducts, such as the ozone created by some filtration systems. The technology is now featured in a line of refrigerators that preserve freshness and reduce food waste, and AiroCide units have been deployed to remote regions of the world where harsh environments and underdeveloped infrastructure complicate food storage and distribution. In the health care arena, the technology has been incorporated into doctors' clinics, operating rooms, neonatal wards, and waiting areas.

- **Tensile Fabrics Enhance Architecture Around the World**

Using a remarkable fabric originally developed to protect Apollo astronauts as part of their spacesuits, Birdair Inc. of Amherst, New York, has crafted robust, safe, environmentally friendly, and architecturally stunning tensile membrane roofs for over 900 landmark structures around the world. The material is pound-for-pound stronger than steel, lightweight, energy-efficient thanks to its ability to let in natural light while reflecting heat, and cost-effective due to its durability and low maintenance characteristics. Travelers in airports, sports fans at stadiums, and shoppers in malls have all experienced the benefits of the Teflon-coated fiberglass fabric that has enabled Birdair to grow from a small company established in its founder's kitchen in 1956 to a multimillion-dollar specialty contractor today. Among the recent structures that feature Birdair's NASA-derived roof technology are the new Dallas Cowboys' stadium and three of the four primary stadiums for the 2010 World Cup in South Africa.

CONCLUSION

Technology transfer is an active and essential mission of Federal laboratories. By leveraging our nation's innovative nature and investing in science and technology, we strengthen our economy and American competitiveness in world markets. This report details the results of technology partnering activities cultivated in the Federal sector.

The statistical data provided in this report indicate that over the five-year span from 2005 through 2009, collaborations at Federal labs using CRADAs show a flat to slightly upward trend for both new and active CRADAs. Although the number of new inventions reported demonstrates a declining trend, new patent applications and issued patents actually show an increase over the same time period. The number of "other" licenses shows an upward trend in contrast to standard invention licensing which shows a decline. The net impact on total licensing shows the income from licensing trend as relatively flat.

These numbers, however, do not tell the whole story. Federal laboratories transfer many technologies through a variety of mechanisms not reflected by these numbers and charts. A number of studies and workgroups are underway to evaluate technology transfer and appropriate metrics to accurately describe and measure the role of Federal research in supporting our over-all economic well-being.

The success stories in this report provide examples of how society benefits from technology transfer activities across the Federal laboratories. As technology advances and the needs of the economy change, Federal laboratories will continue to play a vital role in keeping America in the forefront of innovation. Federal research continues to support our economic and international competitiveness by successfully transferring and facilitating commercialization of Federally created technologies.