

Federal Laboratory Technology Transfer Fiscal Year 2007

**Summary Report to
the President and the Congress**

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January 2009



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FOREWORD

The Department of Commerce is pleased to present to the President and the Congress this Federal Laboratory Technology Transfer Report summarizing the achievements of Federal technology transfer and partnering programs of the Federal research and development agencies in fiscal year 2007. This report fulfills the requirement in 15 USC Sec 3710(g)(2) for an annual summary report on the use of technology transfer authorities established by the Technology Transfer Commercialization Act of 2000 (P.L. 106-404) and related legislation.

Technology transfer fosters the commercialization of government funded discoveries resulting from Federal laboratories' research and collaborative programs as an important part of the laboratories' mission. Today, Federal laboratories continue to reach out to industry, academic institutions, foundations, state and local governments, and international institutions through external collaborations and partnerships, leveraging Federal research and development as an engine to keep the United States a leader in technology and innovation and to stimulate economic growth. This report provides a summary of the results of Federal technology transfer in fiscal year 2007.

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CHAPTER 1

Overview of Federal Technology Transfer

Federal laboratories continue to actively partner with numerous and diverse non-federal organizations in industry, academia, the non-profit sector, State and local governments, and international organizations. These partnerships transform research into economic and social value using a variety of activities for evaluating, protecting, transferring, and monitoring Federal inventions. While focusing on critical national issues, Federal laboratories continue to develop many new technologies, products, and applications that solve many 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 can 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 and provides an overview of activities across agencies. This is the first year the summary report has been organized and prepared by the Department of Commerce (DOC) National Institute of Standards and Technology (NIST). An electronic version of this report is available on the internet at: <http://patapsco.nist.gov/ts/220/external/index.htm>. Previous editions of this report were prepared by DOC's former Technology Administration and are also available on the internet at: http://patapsco.nist.gov/ts/220/external/tech_transfer.htm.

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 science and technology endeavors.

Technology Transfer Principles and Approach

Federal laboratories collaborate with industry, academia, non-profit organizations, State and local governments, and international organizations to form partnerships and transfer rights to develop, refine, and use new technologies for the benefit of the public.

Although research results are often driven by a specific need, many economically viable advances might otherwise be overlooked or go unused without a dedicated effort by technology transfer offices. Technology transfer offices within the Federal laboratories assist by guiding the inventors and collaborators through the process to transfer innovations. A primary benefit of technology transfer is the contribution made to the public from new products, medical treatments, services, and innovations that reach the market, as well as the jobs created from cultivating and marketing these new goods. In addition to strengthening the regional and United States economies, successful partnerships provide additional benefits including:

- Stimulate the flow of ideas between government and other research sectors
- Create new businesses, especially small businesses
- Attract and retain talented innovators within the Federal laboratories
- Provide direct support to the mission of each agency
- Accelerate the development process and reduces costs for products and services to reach the marketplace
- Support further research by generating licensing revenue
- Create new products in health care, defense and security

Federal technology transfer offices typically rely on the following principal mechanisms:

▪ Cooperative Research and Development

Relationships for cooperative research and development between federal laboratories and outside partners are widely viewed as beneficial settings for technology transfer. Beyond the new know-how and technology that may result, these joint efforts can often confer a mutually advantageous leveraging of partners' resources and technical capabilities, as well as avenues for a partner to gain new competences and absorb 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 partners to work together on a R&D project. CRADAs were legislated by the Congress to encourage the Federal laboratories to participate in R&D partnerships for the purpose of advancing promising technologies toward commercialization. Some agencies have unique authority for cooperative R&D, such as NASA's use of Space Act Agreements.

▪ Intellectual Property Management

Invention Disclosure and Patenting

The protection of intellectual property is vital to driving additional investment and product development for early stage research products to reach their full commercial potential. Federal laboratory activities in the areas of invention disclosure and patenting

are often cited as indicators of the active management of intellectual assets and technical know-how.

Licensing

Licensing is one of the chief commercialization mechanisms to create incentives for industry to further develop leading edge technologies that will be put to use in the economy contributing to competitiveness and growth, rather than leaving them unused. Without the availability of licenses from the Federal Government to develop Government-owned technologies and inventions, those technologies would not be used or developed into products and services. The terms and conditions by which intellectual property is licensed are negotiated for each agreement and vary based on many factors including state of readiness for the technology to reach the market, the financial resources needed to develop the technology into a product ready for consumers, and projected market impact.

Other Mechanisms

There is a wide variety of types of technology transfer involving different purposes and tools appropriate for different situations. In addition to the mechanisms mentioned above, technology transfer offices use other mechanisms tailored to support the specific focus and mission of each Federal laboratory. Some of these technology transfer mechanisms include:

- Conferences, workshops, and inquiries
- Guest researchers and facilities users
- Outreach to trade and technical media
- Written information including technical publications, and reports to stakeholders
- Standard Reference Materials
- Standard Reference Data
- Documentary standards
- Material transfer licenses
- Calibration services
- Collaborative Research Agreements (e.g., MOUs, Clinical Trial Agreements)

CHAPTER 2

Performance in Fiscal Year 2007

Strengthening Performance Metrics

Each Federal research and development agency prepares and submits an annual report covering data on technology transfer 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 promote U.S. competitiveness. In addition, specific data is provided that demonstrates a level of utilization of the basic technology transfer authority including:

- number of patents filed
- number of patents received
- number of fully executed 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 below present a brief cross-agency summary of the numeric data on the utilization of technology transfer tools. It is evident from this numerical data that technology transfer tools and practices continue to be well used across the agencies. However, measuring the overall impact of technology transfer continues to be challenging. It remains far easier to assemble statistics on technology transfer activities than to quantify downstream benefits and the effectiveness of implemented programs because bringing inventions into practice involves many variables and factors. 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 that benefit the United States. Anecdotal evidence and success stories demonstrating 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 are but a few examples. Chapter 3 of this report provides a small sampling of the numerous positive impacts and outcomes of Federal technology transfer activities.

The Federal agencies jointly discuss and review new and better ways to improve both quantitative and qualitative measurements of performance, and other ways to disseminate and adopt best practices, through the Inter-agency Workgroup for Technology Transfer. Program-specific evaluations at each Federal laboratory can be found described in individual agency technology transfer reports.

The following tables give a summary of key data on technology transfer activities for FY 2003 – 2007. The total figures from all the agencies at the bottom of the tables indicate that CRADAs, licensing, and associated income generally increased between 2003 and 2007, whereas new inventions disclosed and patenting remained steady. These total

figures and trends represent a steady program, although there remains, as shown by the volume of CRADAs, licensing, patenting, and earned royalty income activities, a very active Federal technology transfer curriculum. The data was compiled from individual reports prepared by each agency.

In Table 1, traditional CRADAs refer to collaborative research and development by a federal laboratory and non-federal partners. Non-traditional CRADAs are used for special purposes such as material transfer or technical assistance that may result in protected information. In table 3, other IP licenses include copyrighted software (not including open source software licenses, which are also copyrighted software), open channel-web and noncommercial software licenses, biological materials, and other forms of intellectual property.

Table 1: Collaborative Relationships for Research and Development

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
DHS	DHS will begin compiling and reporting data in 2008					
DOC	• CRADAs , total active in the FY	1,903	1,969	1,904	3,008	2,778
	- New, executed in the FY	1,767	1,790	1,764	2,158	1,865
	▪ Traditional CRADAs, total active in the FY	92	67	80	149	154
	▪ Non-traditional CRADAs, total active in FY	1,811	1,902	1,826	2,859	2,624
	▪ Other collaborative R&D relationships	1,814	2,301	2,714	2,769	2,695
DOD	• CRADAs , total active in the FY	2,134	2,833	2,736	2,999	2,971
	- New, executed in the FY	630	786	679	705	641
	▪ Traditional CRADAs, total active in the FY	1,523	2,425	2,736	2,424	2,383
	▪ Non-traditional CRADAs, total active in FY	611	408	474	575	588
	▪ Other collaborative R&D relationships	0	0	0	0	0
DOE	• CRADAs , total active in the FY	661	610	644	631	697
	- New, executed in the FY	140	157	164	168	182
	▪ Traditional CRADAs, total active in the FY	661	610	644	631	697
	▪ 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	51	61	70	82	170
	- New, executed in the FY	12	16	21	38	112
	▪ Traditional CRADAs, total active in the FY	51	45	49	31	20
	▪ Non-traditional CRADAs, total active in FY	0	16	21	51	150
	▪ Other collaborative R&D relationships	0	0	0	0	0
DOT	• CRADAs , total active in the FY	96	0	57	59	36
	- New, executed in the FY	7	0	5	6	7
	▪ Traditional CRADAs, total active in the FY	96	0	55	59	36
	▪ Non-traditional CRADAs, total active in FY	0	0	2	0	0
	▪ Other collaborative R&D relationships	0	0	0	0	0
EPA	• CRADAs , total active in the FY	91	104	107	94	84
	- New, executed in the FY	39	23	33	16	18
	▪ Traditional CRADAs, total active in the FY	77	82	95	83	67
	▪ Non-traditional CRADAs, total active in FY	14	22	12	11	17
	▪ Other collaborative R&D relationships	0	0	0	0	0
HHS	• CRADAs , total active in the FY	427	220	215	164	285
	- New, executed in the FY	102	95	101	66	69
	▪ Traditional CRADAs, total active in the FY	254	119	117	92	206
	▪ Non-traditional CRADAs, total active in FY	173	101	98	72	79
	▪ Other collaborative R&D relationships	0	0	0	0	0

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

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
NASA	● CRADAs, total active in the FY	0	0	1	1	1
	- New, executed in the FY	0	0	1	0	0
	▪ Traditional CRADAs, total active in the FY	0	0	1	1	1
	▪ Non-traditional CRADAs, total active in FY	0	0	0	0	0
	▪ Other collaborative R&D relationships	3,579 ^(*)	3,987	4,025	3,492	2,666
USDA	● CRADAs, total active in the FY	229 ^(*)	205	199	195	230
	- New, executed in the FY	55 ^(*)	44	55	57	69
	▪ Traditional CRADAs, total active in the FY	212 ^(*)	185	171	163	184
	▪ Non-traditional CRADAs, total active in FY	17 ^(*)	20	28	22	23
	▪ Other collaborative R&D relationships	2,769	1,166	5,028	3,477	4,084
VA	● CRADAs, total active in the FY	11 ^(*)	14	16	38	75
	- New, executed in the FY	8	5	3	24	44
	▪ Traditional CRADAs, total active in the FY	11 ^(*)	14	15	34	66
	▪ Non-traditional CRADAs, total active in FY	0	0	0	0	0
	▪ Other collaborative R&D relationships	0	0	0	0	0
TOTALS	● CRADAs, total active in the FY	5,603	6,016	5,949	7,271	7,327
	- New, executed in the FY	2,760	2,916	2,826	3,238	3,006
	▪ Traditional CRADAs, total active in the FY	2,316	2,937	3,319	3,036	3,117
	▪ Non-traditional CRADAs, total active in FY	2,626	2,469	2,461	3,590	3,481
	▪ Other collaborative R&D relationships	8,162	7,454	11,767	9,738	9,445

(*) Reflects data correction from FY 2003 Summary Report.

n/r = Data not reported.

Table 2: Invention Disclosure and Patenting

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
DHS	DHS will begin compiling and reporting data in 2008					
DOC	● New inventions disclosed in the FY	21	25	21	14	32
	● Patent applications filed in the FY	5	12	12	5	7
	● Patents issued in the FY	9	12	10	7	4
DOD	● New inventions disclosed in the FY	1,332	1,369	534	1,056	838
	● Patent applications filed in the FY	810	517	354	691	597
	● Patents issued in the FY	619	426	191	472	425
DOE	● New inventions disclosed in the FY	1,469	1,617	1,776	1,694	1,575
	● Patent applications filed in the FY	866	661	812	726	693
	● Patents issued in the FY	627	520	467	438	441
DOI	● New inventions disclosed in the FY	9	6	4	5	7
	● Patent applications filed in the FY	8	6	3	2	5
	● Patents issued in the FY	5	9	9	5	6
DOT	● New inventions disclosed in the FY	0	0	4	3	2
	● Patent applications filed in the FY	0	2	5	3	2
	● Patents issued in the FY	0	0	2	0	3
EPA	● New inventions disclosed in the FY	14	18	12	12	16
	● Patent applications filed in the FY	23	12	13	13	15
	● Patents issued in the FY	8	11	9	10	10
HHS	● New inventions disclosed in the FY	472	461	452	442	447
	● Patent applications filed in the FY	279	216	230	166	261
	● Patents issued in the FY	136	167	154	164	379
NASA	● New inventions disclosed in the FY	1,485 ^(*)	1,612	1,678	1,705	1,268
	● Patent applications filed in the FY	231 ^(*)	207	202	196	105
	● Patents issued in the FY	155 ^(*)	189	133	144	93
USDA	● New inventions disclosed in the FY	121	142	125	105	126
	● Patent applications filed in the FY	60	81	88	83	114
	● Patents issued in the FY	64	50	27	39	37

Table 2: Invention Disclosure and Patenting (continued)

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
VA	● New inventions disclosed in the FY	183	204	165	157	175
	● Patent applications filed in the FY	36	54	26	27	25
	● Patents issued in the FY	8	7	10	5	8
TOTALS	● New inventions disclosed in the FY	5,106	5,454	4,771	5,193	4,486
	● Patent applications filed in the FY	2,318	1,768	1,745	1,912	1,824
	● Patents issued in the FY	1,631	1,391	1,012	1,284	1,406

(*) Reflects data correction from FY 2003 Summary Report.

Table 3: Profile of Active Licenses

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
DHS	DHS will begin compiling and reporting data in 2008					
DOC	<ul style="list-style-type: none"> ● All licenses, number total active in the FY ▫ New, executed in the FY ▪ Invention licenses, total active in the FY ▫ New, executed in the FY ▪ Other IP licenses, total active in the FY 	101	125	133	111	217
		59	100	108	83	187
		101	125	133	111	222
		59	100	108	83	187
		0	0	0	0	0
DOD	<ul style="list-style-type: none"> ● All licenses, number total active in the FY ▫ New, executed in the FY ▪ Invention licenses, total active in the FY ▫ New, executed in the FY ▪ Other IP licenses, total active in the FY 	364	369	412	444	460
		49	60	60	56	67
		361	364	406	438	460
		49	60	60	56	67
		3	5	6	6	35
DOE	<ul style="list-style-type: none"> ● All licenses, number total active in the FY ▫ New, executed in the FY ▪ Invention licenses, total active in the FY ▫ New, executed in the FY ▪ Other IP licenses, total active in the FY 	3,687	4,345	5,677	5,916	5,842
		711	616	750	652	606
		1,223	1,362	1,535	1,420	1,354
		172	168	198	203	164
		2,464	2,983	4,142	4,496	4,488
DOI	<ul style="list-style-type: none"> ● All licenses, number total active in the FY ▫ New, executed in the FY ▪ Invention licenses, total active in the FY ▫ New, executed in the FY ▪ Other IP licenses, total active in the FY 	11	13	20	21	15
		1	3	5	1	1
		10	12	19	20	15
		1	3	5	1	0
		1	1	1	1	0
DOT	<ul style="list-style-type: none"> ● All licenses, number total active in the FY ▫ New, executed in the FY ▪ Invention licenses, total active in the FY ▫ New, executed in the FY ▪ Other IP licenses, total active in the FY 	0	1	5	5	5
		0	0	4	0	0
		0	1	5	5	1
		0	0	4	4	0
		0	0	0	0	0

Table 3: Profile of Active Licenses (continued)

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
EPA	● All licenses , number total active in the FY	32	38	39	35	38
	▫ New, executed in the FY	9	7	4	2	5
	▪ Invention licenses , total active in the FY	32	38	39	35	38
	▫ New, executed in the FY	9	7	4	2	5
	▪ Other IP licenses , total active in the FY	0	0	0	0	0
HHS	● All licenses , number total active in the FY	1,423 ^(*)	1,424	1,532	1,535	1,418
	▫ New, executed in the FY	230 ^(*)	288	349	290	293
	▪ Invention licenses , total active in the FY	1,350 ^(*)	1,173	1,237	1,213	915
	▫ New, executed in the FY	218 ^(*)	249	291	253	234
	▪ Other IP licenses , total active in the FY	82	251	295	322	460
NASA	● All licenses , number total active in the FY	521	861	1,338	1,675	1,883
	▫ New, executed in the FY	270 ^(*)	423	505	375	261
	▪ Invention licenses , total active in the FY	312 ^(*)	338	441	477	461
	▫ New, executed in the FY	71 ^(*)	107	129	73	28
	▪ Other IP licenses , total active in the FY	209 ^(*)	523	897	1,198	1,422
USDA	● All licenses , number total active in the FY	270	296	320	332	339
	▫ New, executed in the FY	27	29	33	25	25
	▪ Invention licenses , total active in the FY	270	296	320	332	339
	▫ New, executed in the FY	27	29	33	25	25
	▪ Other IP licenses , total active in the FY	0	0	0	0	0
VA	● All licenses , number total active in the FY	88	95	101	112	130
	▫ New, executed in the FY	7	9	6	11	18
	▪ Invention licenses , total active in the FY	88 ^(*)	95	101	112	130
	▫ New, executed in the FY	7	9	6	11	18
	▪ Other IP licenses , total active in the FY	12	12	0	0	0

Table 3: Profile of Active Licenses (continued)

	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
TOTALS • All licenses , number total active in the FY	6,497	7,567	9,577	10,186	10,347
▫ New, executed in the FY	1,363	1,535	1,824	1,495	1,463
▪ Invention licenses , total active in the FY	3,747	3,804	4,236	4,163	3,935
▫ New, executed in the FY	613	732	838	711	728
▪ Other IP licenses , total active in the FY	2,771	3,775	5,341	6,023	6,405

(*) Reflects data correction from FY 2003 Summary Report.

Table 4: Characteristics of Licensing Bearing Income

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
DHS	DHS will begin compiling and reporting data in 2008					
DOC	● All income bearing licenses , number	37	23	25	30	35
	▫ Exclusive	20	11	12	17	16
DOD	● All income bearing licenses , number	135	103	110	112	194
	▫ Exclusive	55	48	59	64	84
DOE	● All income bearing licenses , number	2,523	3,236	2,549	2,822	3,291
	▫ Exclusive	246	255	248	353	352
DOI	● All income bearing licenses , number	11	14	18	18	14
	▫ Exclusive	5	8	9	9	4
DOT	● All income bearing licenses , number	7 ^(*)	1	5	4	4
	▫ Exclusive	2 ^(*)	1	2	3	2
EPA	● All income bearing licenses , number	32	38	39	35	38
	▫ Exclusive	7	8	5	6	6
HHS	● All income bearing licenses , number	821	758	816	849	901
	▫ Exclusive	121	121	127	134	144
NASA	● All income bearing licenses , number	203 ^(*)	225	235	244	236
	▫ Exclusive	106 ^(*)	103	103	106	106
USDA	● All income bearing licenses , number	268	294	318	330	337
	▫ Exclusive	183	200	220	233	241
VA	● All income bearing licenses , number	67	74	82	93	115
	▫ Exclusive	8	9	14	24	44
TOTALS	● All income bearing licenses , number	3,969	4,797	4,267	4,597	5,181
	▫ Exclusive	698	767	810	950	1,000

(*) Reflects data correction from FY 2003 Summary Report.

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

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
DHS	DHS will begin compiling and reporting data in 2008					
DOC	• Total income , all licenses active in FY	\$128	\$203	\$147	\$194	\$225
	▪ Invention licenses	\$128	\$203	\$147	\$194	\$225
	▪ Other IP licenses , total active in the FY	\$0	\$0	\$0	\$0	\$0
	• Total Earned Royalty Income , (ERI)	\$128	\$170	\$139	\$170	\$217
DOD	• Total income , all licenses active in FY	\$9,966	\$9,204	\$10,650	\$10,963	\$14,246
	▪ Invention licenses	\$9,966	\$9,199	\$10,637	\$10,961	\$14,240
	▪ Other IP licenses , total active in the FY	\$0	\$5	\$13	\$2	\$6
	• Total Earned Royalty Income , (ERI)	n/a	n/a	n/a	n/a	n/a
DOE	• Total income , all licenses active in FY	\$25,805	\$27,252	\$27,382	\$35,572	\$39,165
	▪ Invention licenses	\$23,670	\$23,321	\$24,226	\$32,211	\$34,933
	▪ Other IP licenses , total active in the FY	\$2,136	\$3,931	\$3,156	\$3,362	\$4,233
	• Total Earned Royalty Income , (ERI)	\$6,612	\$10,882	\$12,443	\$18,332	\$18,759
DOI	• Total income , all licenses active in FY	\$41	\$48	\$71	\$47	\$57
	▪ Invention licenses	\$41	\$48	\$71	\$47	\$57
	▪ Other IP licenses , total active in the FY	n/a	n/a	n/a	n/a	n/a
	• Total Earned Royalty Income , (ERI)	\$41	\$45	\$68	\$46	\$57
DOT	• Total income , all licenses active in FY	\$0	\$0	\$37	\$22	\$34
	▪ Invention licenses	\$0	\$0	\$22	\$22	\$34
	▪ Other IP licenses , total active in the FY	\$0	\$0	\$15	\$0	\$0
	• Total Earned Royalty Income , (ERI)	\$0	\$0	\$22	\$22	\$34
EPA	• Total income , all licenses active in FY	\$908	\$762	\$666	\$632	\$544
	▪ Invention licenses	\$908	\$762	\$666	\$632	\$544
	▪ Other IP licenses , total active in the FY	\$0	\$0	\$0	\$0	\$0
	• Total Earned Royalty Income , (ERI)	\$677 ^(*)	\$205	\$34	\$29	\$107
HHS	• Total income , all licenses active in FY	\$55,199	\$56,479	\$98,542	\$83,097	\$88,799
	▪ Invention licenses	\$54,571	\$56,170	\$96,485	\$82,187	\$67,108
	▪ Other IP licenses , total active in the FY	\$628	\$309	\$2,057	\$909	\$19,128
	• Total Earned Royalty Income , (ERI)	\$58,782 ^(*)	\$39,456	\$76,695	\$63,250	\$70,743

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

		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
NASA	• Total income , all licenses active in FY	\$2,799 ^(*)	\$3,124	\$3,935	\$4,862	\$2,912
	▪ Invention licenses	\$1,694 ^(*)	\$3,036	\$3,935	\$4,726	\$2,912
	▪ Other IP licenses , total active in the FY	\$5 ^(*)	\$89	n/a	\$136	n/a
	• Total Earned Royalty Income, (ERI)	\$234 ^(*)	\$929	\$1,333	\$2,162	\$1,352
USDA	• Total income , all licenses active in FY	\$2,291	\$2,164	\$3,315	\$3,162	\$3,588
	▪ Invention licenses	\$2,291	\$2,164	\$3,315	\$3,162	\$3,588
	▪ Other IP licenses , total active in the FY	\$0	\$0	\$0	\$0	\$0
	• Total Earned Royalty Income, (ERI)	\$1,561	\$1,427	\$2,089	\$2,337	\$2,682
VA	• Total income , all licenses active in FY	\$153	\$279	\$117	\$138	\$358
	▪ Invention licenses	\$153	\$279	\$117	\$138	\$358
	▪ 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	\$97,290	\$99,211	\$144,640	\$138,243	\$149,894
	▪ Invention licenses	\$93,422	\$73,269	\$115,313	\$107,714	\$123,965
	▪ Other IP licenses , total active in the FY	\$2,769	\$4,334	\$5,226	\$4,409	\$23,367
	• Total Earned Royalty Income, (ERI)	\$47,591	\$53,113	\$92,801	\$86,326	\$93,917

(*) Reflects data correction from FY 2003 Summary Report.

n/a = Data not available from agency.

CHAPTER 3

Outcomes and Impact of Technology Transfer Activities

Individual success stories cut across industrial sectors and demonstrate the broad reach of technology transfer into the lives of American citizens. Incorporated within these success stories are examples of new and innovative approaches and best practices. Agencies continue to review, discuss, and refine these practices to that improve and strengthen the overall technology transfer process across the Federal government. The cases provided below are provided as 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

Beginning in FY 2006, the ARS Office of Technology Transfer expanded its services to include Animal Plant Health Inspection Service (APHIS) Wildlife Services (WS). APHIS is responsible for protecting and promoting U.S. agricultural health, administering the Animal Welfare Act, and carrying out wildlife damage management activities.

More information about USDA technology transfer please visit:

ARS: <http://www.ars.usda.gov/partnering>

Forest Service: <http://www.fs.fed.us>

• Novel Sweetener Reaches Market

ARS researchers at the USDA/ARS Bioproducts and Biocatalysis Research Unit at the National Center for Agricultural Utilization Research (NCAUR), in Peoria, IL, are working in partnership with Cargill on the use of enzymes to convert sugar and corn syrup to value-added complex carbohydrates. Using ARS-developed methods to produce and characterize novel carbohydrate products from agricultural materials, ARS and Cargill surveyed more than 100 microbial isolates from culture collections and natural isolations. This research led to the discovery of a novel low-glycemic index sweetener, called Xtend™ sucromalt. The new product provides food and beverage customers with a natural and slow release carbohydrate syrup. This fully digestible, low glycemic syrup provides natural sweetness for products such as nutritional beverages and bars, cereals, ice cream, jams and jellies, and yogurts. The product is named sucromalt because it is derived from a combination of sucrose (cane or beet sugar) and maltose (corn sugar).

This technology was transferred through a Cooperative Research and Development Agreement (CRADA), in which ARS provided facilities and expert scientific contributions to the production and characterization of novel carbohydrate materials and related enzyme systems and Cargill tested and developed applications. ARS identified microbial strains and Cargill developed the commercial product. Cargill has licensed ARS's background technology and has filed patent applications for the use of low-glycemic sweeteners in food and beverage compositions.

Cargill is commercially producing Xtend™ sucromalt as a food ingredient, rather than a finished food product, for use in such products as the recently-introduced energy drink Fuelosophy (currently in Whole Foods stores across the Midwest), and the products marketed under their Glucerna™ trade name for diabetics and others who need or desire to follow a low-glycemic index diet. The Glucerna products, which include cereal, shakes and snack bars, are now available in stores across the country.

Cargill's sucromalt provides food and beverage customers with a natural and slow release carbohydrate syrup. The slow and complete digestibility of sucromalt makes it unique among other sweeteners. In food and beverages, sucromalt releases its carbohydrates into the bloodstream slowly, resulting in a muted blood sugar response and a 'sustained energy' release versus the 'fast energy' release and higher glycemic response of sugar. Sucromalt offers manufacturers and consumers health benefits over traditional sweeteners, while still providing a satisfying, sweet taste. It is 70% as sweet as sugar. Food industry studies predict sales of low glycemic index products in the United States to grow at a rate of 45.7% through 2011, when the market is expected to reach \$1.8 billion per annum.

The Low Glycemic Index Sweetener Team of Gregory Cote, Timothy Leathers, Melinda Nunnally, and Sheila Maroney (Midwest Area, Peoria, IL), Ting Carlson and Anton Woo (Cargill, Inc) won a 2007 Superior Effort ARS Technology Transfer Award for this work.

- **Slick New Method Protects Ready-to-Eat Meat Products**

Listeria monocytogenes is a well documented foodborne bacterial pathogen responsible for severe illness in humans and costly product recalls. It is a particular problem in ready-to-eat (RTE) foods such as hams, roast beef, turkey breast, and frankfurters. In recent years, 1.2-2.4 billion dollars have been lost in recalls of these products. Previous post processing methods can reduce the presence of *Listeria* by 90 to 99.9%, but these methods may have a negative impact on flavor, or add to production costs and processing time.

To overcome these problems, a team of USDA/ARS researchers at the Eastern Regional Research Center (ERRC) in Wyndmoor, PA developed a new process called the Sprayed Lethality in Container intervention delivery method or SLIC. SLIC sprays fluid containing a food-grade antimicrobial chemical into packages immediately prior to inserting the food product. A vacuum is used to seal the container uniformly, which distributes the antimicrobial across the product surface and allows for contact time throughout shelf life. The SLIC process successfully inhibits outgrowth of *Listeria*

monocytogenes during extended refrigerated storage, resulting in a 99.999% reduction of *Listeria* within 24 hours at 4°C. Equally important, the RTE product has no reduction in taste quality. Because of its effectiveness and safety, SLIC has achieved Food Safety and Inspection Service (FSIS) regulatory status.

The ERRC researchers entered into a Cooperative Research and Development Agreement (CRADA) with a major meat-processing company to evaluate SLIC on RTE ham products. The results of the studies, conducted as part of the CRADA, were published in a peer-reviewed publication. A second CRADA with the same cooperator is evaluating SLIC on other RTE meat and poultry products. A third CRADA, with another industrial partner was recently signed to further develop SLIC for RTE meats and poultry. This new industrial partner intends to collaborate with the other food processors to ensure that SLIC is broadly available and adopted.

The technology has already had a great impact on the processing of RTE food products. One company is now using SLIC on four different production lines for hams and frankfurters, with a production capacity of 2.7 million pounds per year. Another processor is using SLIC to treat 19 million pounds a year of RTE chicken, turkey, and beef products. A third company is in the process of testing SLIC on 13 of its ham production lines, with an approximate production capacity of 176.5 million pounds per year, nine of its sliced luncheon meat production lines, with the approximate production capacity of 33 million pounds per year, and 10 of its frankfurter production lines with approximate annual production capacity of 150 million pounds. It is estimated that the average production cost of RTE foods using SLIC is reduced from 2-3 cents per pound to 0.2 to 0.9 cents per pound. This results in cost savings of about \$1 to 2 million per year for large processing plants. More importantly, consumers are being better protected from products potentially contaminated with *Listeria monocytogenes*.

John Luchansky and Neil Goldberg (Microbial Food Safety Research Unit, North Atlantic Area, Wyndmoor, PA) and Alas Oser (Industry partner) won a 2007 Superior Effort ARS Technology Transfer Award for this work.

Forest Service

- **New Technology For the Fermentation of Hemicellulosic Sugars to Biofuels**
USDA Forest Service researchers from the Institute for Microbial and Biochemical Technology, at the USDA Forest Products Laboratory (FPL), in Madison, WI, have found an improved method of producing biofuels from hemicellulose – a compound that is common in paper, pulp and agricultural processing waste streams. The Forest Service team developed genetically engineered yeast strains for the improved production of xylitol and ethanol from hemicellulosic sugars. To approach this goal, the Madison researchers obtained the complete genomic sequence of the xylose fermenting yeast, *Pichia stipitis*, through collaboration with the Department of Energy Joint Genome Institute (JGI) and worked with the USDA/ARS National Center for Agricultural Utilization Research (NCAUR) in Peoria, IL, which provided valuable culture collection services and collaborated in gene expression analysis. The Forest Service team used the

information gathered from their research partners to conduct large-scale assessments of gene expression. They also developed efficient genetic transformation technology that would enable them to engineer the target yeast organism. The researchers assessed which genes and other genetic factors could be rate limiting to the overall fermentation and then altered the expression of those genes to improve the desired metabolic activities. To do this they had to know which of about 200 different genes contribute most to xylose utilization and ethanol production. Generally no one gene determines a complex trait of this sort. Instead, various genes need to be regulated in a concerted manner to achieve optimal metabolic activity. Multiple gene expression in a stable manner is essential for commercial development.

The new technology was transferred through major presentations at number of conferences that focus on biotechnology for renewable fuels and through publications in a number of peer reviewed journals such as *Applied and Environmental Microbiology*, *Nature Biotechnology* and *Applied Microbiology and Biotechnology*. Potential beneficiaries include companies in the pulp and paper industry that are interested in producing ethanol from pulp waste streams, and companies in the grain ethanol processing industry that are interested in making better, more economical use of cellulosic and hemicellulosic agricultural residues.

However, the ultimate beneficiary of this technology will be the public because commercialization will provide many new jobs in rural areas while providing a sustainable, clean-burning fuel for transportation. In 2006, the grain ethanol industry supported the creation of 160,000 new jobs while producing 5 billion gallons of ethanol from grain. The President's goal of producing 35 billion gallons of ethanol per year by 2017 can only be met if a substantial fraction of that total is derived from cellulose and hemicellulose.

Department of Commerce (DOC)

At the Department Commerce, R&D in numerous areas of contemporary science and technology is conducted at the National Institute of Standards and Technology (NIST), National Oceanic and Atmospheric Administration (NOAA), and the Institute for Telecommunication Sciences within the National Telecommunications and Information Administration (ITS).

More information about the DOC technology transfer is available on these 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 our quality of life. NIST laboratories develop and disseminate measurement techniques, reference data, test methods, standards, and other infrastructural technologies and services 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 (and consortia), universities, associations, and other government agencies.

- **Making Robotic Movement of Goods More 'Pallet-able'**

Under a cooperative research and development agreement (CRADA) with Transbotics, a Charlotte, N.C., automatic guided vehicle (AGV) manufacturer, NIST has developed advanced sensor processing and modeling algorithms to help robot forklifts verify the location and orientation of pallets laden with goods.

The experimental system utilizes two onboard, single scan-line Laser Detection and Ranging (LADAR) devices to negotiate obstacles and home in on warehouse pallets. LADAR is an optical technology which measures properties of scattered laser light to find range and other information about a distant target. One LADAR device, located at the base of the AGV, is used as a safety sensor to detect obstacles such as humans in the forklift's path. It also can be used to scan inside a truck's cargo area to detect the presence of a pallet or define distances from the forklift to the truck's inside walls.

The other sensor, called the Panner, is a panning laser ranger mounted on a rotating motor at the top front of the AGV. The Panner acquires many scan lines of range data that allows the scene in front of the device to be reconstructed in various visual formats such as a pseudo-colored coded image (where colors indicate relative proximity to an object) or a 3-dimensional data point "cloud." A computer model is then derived from the data with the output sent immediately to the AGV's control center. This allows the robot forklift to maneuver, load and unload pallets, verify the remaining space within the truck being loaded, and track the number of pallets still needing handling.

Transbotics is planning to implement the NIST pallet verification software on one of its AGVs for use in real manufacturing situations.

- **NIST Helps the Blind See**

A recently completed licensing agreement for two novel NIST technologies may help bring affordable graphic reading systems for the blind and visually impaired to market. The two systems bring electronic images to life in the same way that Braille makes words readable.

ELIA Life Technology Inc. of New York, N.Y., licensed for commercialization both the tactile graphic display device and fingertip graphic reader developed by NIST researchers. The former, first introduced as a prototype in 2002, allows a person to feel a

succession of images on a reusable surface by raising some 3,600 small pins (actuator points) into a pattern that can be locked in place, read by touch and then reset to display the next graphic in line. Each image—from scanned illustrations, Web pages, electronic books or other sources—is sent electronically to the reader where special software determines how to create a matching tactile display.

An array of about 100 small, very closely spaced (1/10 of a millimeter apart) actuator points set against a user's fingertip is the key to the more recently created "tactile graphic display for localized sensory stimulation." To "view" a computer graphic with this technology, a blind or visually impaired person moves a device-tipped finger across a surface like a computer mouse to scan an image in computer memory. The computer sends a signal to the display device and moves the actuators against the skin to "translate" the pattern, replicating the sensation of the finger moving over the pattern being displayed. With further development, the technology could possibly be used to make fingertip tactile graphics practical for virtual reality systems or give a detailed sense of touch to robotic control (teleoperation) and space suit gloves.

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.

• New Tsunami Warning Stations Deployed

The launch of the first Deep-ocean Assessment and Reporting of Tsunamis (DART®) stations in the Indian Ocean in December 2006 marked an important milestone toward the goal of early detection and real-time reporting of tsunamis in the open ocean. Launched just a few weeks short of the second anniversary of the 2004 Boxing Day tsunami in Indonesia, the DART® stations bring important tsunami wave data to the region. One of the realities of the 2004 event was that the lack of real-time data made it very difficult to detect and warn of such an event. The DART® system was developed by NOAA Pacific Marine Environmental Laboratory, in Seattle, Washington, and is operated by the NOAA National Data Buoy Center, within the National Weather Service Office of Operational Systems. The stations consist of a bottom pressure sensor that is anchored to the seafloor and a companion moored surface buoy. An acoustic link transmits data from the bottom pressure sensor to the surface buoy. Then satellite links relay the data to ground stations. The result is tsunami detection that is communicated to forecasters in real-time. The new DART® station will equip Indian Ocean countries with additional information to determine if and when to issue tsunami warnings. Thailand is responsible for the deployment and long-term maintenance as per a recently signed Memorandum of Agreement with NOAA. NOAA is also providing the region with technical leadership in building an end-to-end system by improving communications systems, establishing modeling and forecasting capabilities, building resilient communities, providing expertise in building regional and national operations centers,

and training technical officials on various aspects of tsunami and multi-hazard warning operations. NOAA and the University of Washington trained tsunami warning and preparedness officials. The initial class included 31 participants from India, Indonesia, Thailand, Sri Lanka, and the Maldives.

The United States and Indonesia also launched a second DART® station in the Indian Ocean. The deployment was funded under a US Agency for International Development program (USAID) to make strategic investments in support of the Indian Ocean Tsunami Warning System (IOTWS). Using technology developed by NOAA, the Australian Bureau of Meteorology deployed its first Deep-ocean Assessment and Reporting of Tsunami buoy station. The DART® station is in the southeast Tasman Sea some 1,200 kilometers from Tasmania.

Tsunamis: <http://www.noaa.gov/tsunamis.html>

Real-time DART® Data: <http://www.ndbc.noaa.gov/dart.shtml>

National Telecommunications and Information Administration—Institute for Telecommunication Sciences

The Institute for Telecommunication Sciences (ITS) is the chief research and engineering arm of the National Telecommunications and Information Administration (NTIA).

ITS supports such NTIA telecommunications objectives as promotion of advanced telecommunications and information infrastructure development in the United States, enhancement of domestic competitiveness, improvement of foreign trade opportunities for United States telecommunications firms, and facilitation of more efficient and effective use of the radio spectrum. ITS also serves as a principal federal resource for solving the telecommunications concerns of other federal agencies, state and local governments, private corporations and associations, and international organizations.

Department of Defense (DoD)

The purpose of the Office of Technology Transition is to ensure, to the maximum extent practicable, that 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.

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/sci_tech/3t/transition/tech_tran/

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

<http://www.mda.mil/mdalink/html/transfer.html>

<http://www.nsa.gov/techtrans/index.cfm>
<http://www.jfcom.mil/about/industry.htm>

- **Advancements in Real Time Biological Pathogen Detection Technology**

The Naval Research Lab (NRL) has executed several CRADAs and a patent license with a startup company, Sword Diagnostics, Inc, to develop a real time biological pathogen detection technology. In this partnered effort, NRL is providing expertise in laser physics, spectroscopy and analytical software coupled with their swept wavelength optical detector invention and their patented OASISTM software. This will enable the design and fabrication of a prototype instrument. Sword will incorporate their knowledge in applied microbiology to develop the critical analysis criteria for the instrument. The first technology trials are for use in meat packing plants.

Because the detection of dangerous microbiological organism has taken on new urgency in the fields of food safety and homeland security, the end product could have real public benefit by filling this growing global need for rapid pathogen detection. Sword Diagnostics will focus initially on applications in the \$1.6 billion food safety testing market. The first commercial product is targeted for the meat packing industry where there have been repeated instances of recalls of more than a million pounds of hamburger for potential E. coli contamination. The company's "real time" field system will identify pathogens in a matter of minutes, whereas the current state-of-the-art lab tests take almost two days. In a later version of the product, the company plans to develop a test for prions to detect "Mad Cow" disease.

Sword Diagnostics will commercialize a potential "breakthrough" diagnostic system based on the combination of a novel NRL laser based analytical instrument with patented NRL software. If successful, the revolutionary new system, based on two NRL patent applications and two issued patents would scan swabbed samples from the combination blood, tissue, and fecal matter typical of a beef slaughterhouse floor and, by comparing the data with identifying data in a pathogen library, could allow the detection and identification of as little as a single bacterial. It also has the potential for real time detection of bioterrorism agents such as anthrax. The New Jersey Technology Counsel selected Sword Diagnostics for its award for the NJ startup company with the "Most Innovative Product/Service." Most importantly, company researchers testing a simplified version of the detector found a way to make a product that could be for sale in less than a year.

- **New Vein Viewer Technology**

Scientists from the Air Force Research Laboratory (AFRL) Materials and Manufacturing Directorate have invented, developed, patented and licensed a breakthrough medical technology, a Vein Viewing device that can be used to see beneath the skin and through body sections to show the vasculature, the network of blood veins in the body, in a broad range of lighting conditions. According to military medical personnel, the most pressing need on the battlefield is the ability to insert an intravenous needle into a wounded soldier to administer life sustaining fluids or medication, especially during the first, most critical hour after the wound occurs. However, the prompt insertion of an IV can be difficult or

nearly impossible under low ambient lighting or nighttime conditions. Conventional methods for finding a patient's veins rely on tactile and visual cues, a stab and guess process that requires available visible light to work. Experts in the medical imaging community struggled to discover an effective way to rapidly access veins in low light level conditions for several decades. Due to the technology's potential for a broad range of civilian medical uses, the lab established a CRADA with InfraRed Imaging Systems (IRIS) Inc., of Columbus, Ohio, to manufacture and market the technology. IRIS has gone on to further develop the technology and create a product, the IRIS Vascular Viewer, for commercial release.

The vein viewer technology provides both the Air Force and the medical community with the solution to the need for a reliable and accurate method of viewing a patient's veins, rapidly and accurately in conditions where the lighting is less than optimal..

- **Advancements in Intelligent Search and Retrieval Tool**

The Army Communications – Electronics RD&E Center worked with Austin Info Systems to produce a commercially available intelligent search and retrieval tool known as the Open Source Automated Link Analysis Tool (OSALAT). The Internet has proved to be an extraordinary information source, but, at the same time, can quickly become information overload for intelligence analysts. The challenge is to find relevant and timely data for mission planning. OSALAT provides an intelligent search agent to find relevant documents; organize the results for easy review; supports gathering information from external sources; extracts information from the overall collection; displays findings in graphical and textual reports; and contributes to the dissemination of information. The comprehensive nature of OSALAT allows the automating of information analysts' business processes that are currently handled manually

Retrieval of documents does not guarantee useful data and useful intelligence may not be found in those documents. OSALAT extracts information from documents using several state-of-the-art processes and artificial intelligence algorithms to provide extraction capabilities that "learn from their own errors," supports identification of relationships between them and also collects this information on a case-wide basis. Through these capabilities, OSALAT provides cross-document intelligence gathering, which is being used extensively by the U.S. Army today. The company has been selected as one of the 50 fastest growing small businesses in Austin, TX, four years in a row.

Department of Energy (DOE)

Technology partnering is an active and significant component of DOE's overall mission, particularly in areas associated with its scientific, engineering and related technical activities. Technology transfer is carried out at all 17 of DOE's national laboratories and at 5 other DOE research and/or production facilities, as authorized through provisions in DOE's management and operating (M&O) contracts.

As required by the Energy Policy Act of 2005, for the first time, the energy secretary appointed a technology transfer coordinator to be the principal advisor on all matters

relating to technology transfer and commercialization. To assist the Coordinator and to allow for continuity and uniformity in technology transfer throughout the DOE complex, a Technology Transfer Policy Board was established, made up of senior career representatives of the major organizations within the agency.

DOE has recently promulgated its guiding principals for technology transfer at DOE facilities. They emphasize that technology transfer requires the direct involvement of the facility where the technology arose or will be further developed; that facilities must ensure fairness of opportunity, promote domestic economic interests, prevent inappropriate competition with the private sector and protect national security in partnering transactions; and affirm that it is the policy of DOE that commercialization transactions involve partners with substantial business plans to further develop and deploy the technology as expeditiously as possible. They further state that DOE facilities should promote access by small businesses, including entrepreneurs, to accelerate commercialization of new technologies arising at the Facilities. Of greatest significance, they point out that royalties and equity interests received as a result of licensing transactions are not the measure of success and should not be the centerpiece for negotiation of any partnering transaction.

More information about the DOE technology transfer program can be found at: http://www.science.doe.gov/Technology_Transfer/overview.htm

- **Newest Radiation Detectors in Development**

Development and commercialization of a new generation of multiplicity shift registers, devices used to better detect plutonium and other radioactive materials, are now underway. Under a cooperative research and development agreement, Los Alamos National Laboratory (LANL) and Canberra Albuquerque Inc. will develop the new benchtop or handheld devices, which have the potential for use in homeland security applications domestically and abroad.

These instruments, first developed by the LANL more than 15 years ago, count and analyze pulse streams generated by neutron detectors to quantify radioactive materials. They are currently used by the International Atomic Energy Agency (IAEA) to ensure that radioactive materials are not lost, stolen, or used for military purposes.

According to LANL researcher and principal investigator Matt Newell, the new multiplicity shift registers are needed because existing devices are nearly 10 years old and becoming incompatible with other detection technology used by the IAEA.

“We were contacted by people who use the current technology, asking us to do some new development,” Newell said. “Many of the parts used to make the current shift registers are obsolete or becoming obsolete.”

Under the recently-signed agreement, Canberra Albuquerque will fund the development of a new multiplicity shift register, which can continuously store neutron measurements automatically without an operator present, for use in remote or unattended operations. In

addition, the company will validate the use of a handheld, battery-operated multiplicity shift register already developed by Newell and his team. Both devices will be faster, easier to use, compatible with new measurement instrumentation, and designed in accordance with IAEA guidelines.

The LANL and Canberra expect testing and commercialization to take approximately two years, after which Canberra Albuquerque intends to manufacture the instruments at its Albuquerque facilities.

“Our collaboration with Los Alamos National Laboratory is vital to Canberra's work extending the boundaries of neutron-counting technology,” said Dr. Markku Koskelo, Vice President of Special Projects. “Together we have built a roadmap for the next generation of shift registers.”

LANL is managed and operated under contract to the DOE National Nuclear Security Administration by the Los Alamos National Security, LLC (formed by the University of California, Bechtel, BWX Technologies, and Washington Group International).

• **Burying Global Warming with SEQUIRE™ Well Finding Technology**
SEQUIRE™ Well-Finding Technology was developed by DOE National Energy Technology Laboratory (NETL) researchers Richard Hammack and Garret Veloski in partnership with Apogee Scientific, Inc. (Englewood, Colorado), Fugro Airborne Surveys (Mississauga, Ontario), and LaSen, Inc. (Las Cruces, New Mexico).

By way of background, geologic sequestration stores the greenhouse gas CO₂ in geologic formations, such as depleted oil and gas reservoirs, and is an important step towards curbing emissions of greenhouse gases. Those formations must subsequently be evaluated to make sure they are properly sealed and suitable for the task. SEQUIRE™ locates wells quickly and efficiently, allowing researchers to pinpoint the most reliable reservoirs to help curb emissions of greenhouse gases, and thus constitutes a major breakthrough in carbon sequestration efforts.

If you have ever re-used jars to can your own vegetables, this approach will sound familiar. Oil and gas are trapped under ground and under pressure for millions of years until engineers extract these hydrocarbons to feed our energy needs. What remains are reusable containers capable of indefinitely storing the byproduct of our fossil fuel use, CO₂. While this sounds easy enough, the caprock (think lid) of the hydrocarbon cans was punctured in 1859 and today is now perforated with millions of wells. If the holes can be patched and the wells made into air-tight vessels once again, depleted hydrocarbon reservoirs would be the perfect place for CO₂ storage. In many cases, however, the abandoned wells leak. Cement that was used to plug the wells degrades over time or was never made completely air tight to begin with. Improperly plugged wells would release the CO₂ stored in the reservoirs and such wells are considered among the greatest threats to such carbon storage.

The solution? Find and check every abandoned well to ensure that all potential leak points are sealed. And that's no small task. Over time, many wells have become buried. In some cases, parking lots have even been built over them.

SEQUIRE™ provides a speedy way to locate the wells, which are spread over miles, so that ground teams can more efficiently evaluate them. SEQUIRE™ deploys helicopters loaded with magnetic and methane sensors to locate lost wells—a search that stretches over hundreds of square kilometers. It saves time, is cost-effective, and is the only commercially available well-finding technology for large areas. SEQUIRE™ was recognized by *R&D Magazine* with a 2007 R&D 100 award.

- **Cadmium Telluride (CdTe) Photovoltaic (PV) Technology**

In February 2007, the National Renewable Energy Laboratory (NREL) and PrimeStar Solar, Inc. signed an \$870,000 Cooperative Research and Development Agreement (CRADA) to transition NREL's leading cadmium telluride (CdTe) photovoltaic (PV) technology to commercial module production. This technology, developed at NREL, produces the world record CdTe PV cell efficiency of 16.5 percent.

In addition to technology transfer, the CRADA provides PrimeStar Solar with ready access to NREL's world-class photovoltaic scientists and state-of-the-art equipment. PrimeStar Solar has leased a 16,000 square foot facility near NREL in Golden, Colorado, to develop a pilot plant. Initial CdTe processing equipment has been delivered from PrimeStar's assembly facility in Michigan.

PrimeStar Solar secured seed capital in excess of \$6M from individual investors and a global investment bank to help fund a portion of the initial scale-up work. The company plans to rapidly scale up low-cost CdTe PV module production.

NREL has been researching, developing, and helping to commercialize CdTe technology for several years. In 2003, NREL researchers shared an R&D 100 Award with First Solar for developing a high-rate vapor deposition technology that deposits a thin, uniform layer of CdTe or cadmium sulfide over a glass substrate in less than 40 seconds. This technology revolutionized thin-film, PV module production.

NREL's CdTe PV technology research and development supports the U.S. Department of Energy's (DOE) Solar America Initiative. This initiative strives to make solar energy cost-competitive with conventional forms of electricity by 2015. The strategy pursues complementary activities in research and development, and in market transformation. The goals are to reduce costs through research and development, and to eliminate market barriers through deployment. It also supports NREL's mission to develop renewable energy and energy efficiency technologies and practices, advance related science and engineering, and transfer knowledge and innovations to address the nation's energy and environmental goals.

NREL is managed and operated under contract to the DOE Office of Energy Efficiency and Renewable Energy (EERE) by the Midwest Research Institute and the Battelle Memorial Institute.

Department of Health and Human Services (HHS)

The National Institutes of Health (NIH) has as its mission the conduct and support of biomedical research to improve the public health. The Office of Technology Transfer (OTT), Office of the Director, NIH, 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.

Therefore, NIH has developed a new method for measuring technology transfer outcomes that focuses on the manner and extent to which technologies developed in NIH laboratories and transferred to commercial partners are meeting the NIH mission of improving the public health. NIH conducted ten case studies using this method. These case studies are a part of a series. The full ten case studies are available at:

http://www.ott.nih.gov/about_nih/success_stories.html#pdfLink

For more information about the HHS technology transfer program please visit:

CDC: <http://www.cdc.gov/od/science/techTran>

FDA: <http://www.fda.gov/oc/ofacs/partnership/techtran/default.htm>

NIH: http://www.ott.nih.gov/about_nih/success_stories.html

- **Potential New Treatment For Delayed Cerebral Vasospasm**

The NIH Office of Technology Transfer completed a license agreement for the development of sodium nitrite as a potential treatment for delayed cerebral vasospasm. Delayed cerebral vasospasm is an orphan drug indication and a currently unmet medical need with no treatment yet proven in controlled trials to improve outcome following subarachnoid hemorrhage (SAH) through a prevention or reversal of vasospastic arterial narrowing.

Development of such a new treatment based upon sodium nitrite would be considered an important development in low cost patient care. Non-traumatic aneurysmal subarachnoid hemorrhage (SAH) today afflicts an estimated 28,000 people in the U.S. annually (incidence approximately 10 cases per 100,000 persons), which represents almost 5-10% of all strokes and increases with age. Approximately 25% of patients die from the immediate hemorrhage or as a consequence of secondary complications, and 50% of those patients who survive become seriously disabled. Bleeding may result in brain damage, decreased cerebral perfusion, brain shift and herniation and hydrocephalus. Patients who survive the initial event are at risk of secondary complications for the next three weeks, notably aneurysmal rebleeding and cerebral vasospasm (delayed ischemia

can occur as early as day one and as late as day 40 following the initial bleed). The estimated lifetime cost for annual cases of patients hospitalized with aneurysmal SAH in the U.S. is \$1.75 billion dollars.

- **New Therapeutic Cancer Vaccine Against Solid Tumors**

The NIH Office of Technology Transfer completed a license agreement to provide access to a pox virus vector delivery system, modified vaccinia virus Ankara (MVA), which will be an essential part of a new cancer vaccine against a wide range of solid cancer tumors, including those found with renal, colorectal and prostate cancer. This cancer vaccine, now in mid-to-late clinical trials, has been used in about approximately 900 patients to date. Using a proprietary cancer antigen, the vaccine has been safe and well tolerated so far and has induced an anti-tumor immune response in the majority of patients. The strongest immune responders have also tended to show the greatest clinical benefit.

Therapeutic cancer vaccines such as this coax a person's immune system into recognizing and destroying malignant cells without harming normal cells. Worldwide cancer vaccine revenues are estimated by some analysts to reach approximately \$6 billion by 2010. With ongoing development in renal, colorectal and prostate cancer, this product may well address markets that currently exceed \$8 billion based on annual sales of existing cancer treatments, thus potentially providing substantial public health benefits to cancer patients.

Department of Homeland Security (DHS)

DHS officially established the Office of Research and Technology Applications (ORTA) in February 2008.

For more information, please visit:

http://www.dhs.gov/xnews/releases/press_release_0219.shtm

- **Field Tests of a Prototype Shoe Screening Device at Atlantic City International Airport**

During the week of July 28, 2008 TSL field tested a prototype shoe scanning device under a Cooperative Research and Development Agreement (CRADA) between the South Jersey Transportation Authority (SJTA) and the Department of Homeland Security. Passengers in the baggage claim at Atlantic City International Airport were asked if they would like to help DHS test a new technology to improve and expedite security screening. This testing was the first under this new CRADA signed on July 15 in ceremony that included: Mr. Bart Mueller, Executive Director of SJTA; Dr. Susan Hallowell, Director of the TSL; Mr. Brad Buswell, Deputy Under Secretary of the DHS Science and Technology Directorate; Mr. Ron Facciponti, Transportation Security Administration (TSA) Federal Security Director for Atlantic City International Airport. The CRADA will allow the TSL to work in partnership with the SJTA to develop, test, and evaluate security technology prototypes, procedures, and processes in an operational environment. While the initial focus is aviation, this agreement will allow field testing of security technology at sea ports, rail facilities, and highways.

Department of the Interior (DOI)

The United States Geological Survey

The United States Geological Survey (USGS) is a bureau of the Department of the Interior. 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/contacts.html>

- **Expanding Coalbed Methane (CBM) Technology**

From 2000-2005, the USGS collaborated with the State of Louisiana and numerous small private energy firms to leverage drilling costs and share scientific information to identify domestic gas sources in coal reserves in previously unknown and/or untested areas. Follow-up partnerships are now testing and comparing USGS's bio-assay technology with similar technologies from the private sector to identify cost-effective biochemical techniques that will allow the bioconversion of coal to methane. Meanwhile, other USGS research teams are working with U.S. companies and federal partners to develop the water-quality information required by state regulators that would permit the reuse of coal-bed methane ground water, thereby supporting the growth of new water reuse systems and companies.

- **Developing Mineral and Anthropogenic Waste Information**

In 2007, a USGS licensed technology was used by a company that subsequently became a USGS licensee to successfully complete a six week mineral identification survey in the Bismarck Sea. During the six week trial, the licensee and its client gathered information on 1,200-line kilometers of ocean floor, and generated 830,000 induced polarization resistivity measurements that were sampled simultaneously at four to seven depths. The technology verified the fact that the paleo channels the company was mining on land could be mapped along, and beneath, the seafloor. It identified the existence of similar mineral profiles, of interest to the company, that had not previously been tested for and established a vertical distribution for such minerals to a depth of 20 meters, suggesting that mineral resources were also present beneath the test zone.

The technology is now being used in environmentally sensitive urban offshore areas where anthropogenic waste (such as sewage outfalls, garbage-barge dumps, and industrial waste that contains significant metal content) pose navigational and environmental problems that impact human health and ecosystem balance. Offshore regions in the 200 mile-wide U.S. Exclusive Economic Zone equate to more than 3 million square miles of land beneath the water-sediment interface that have not been scientifically mapped, categorized, or explored; this zone holds the potential for significant economic benefits to the nation as well as for the private sector.

Bureau of Reclamation

The Bureau of Reclamation (Reclamation), is responsible for water and hydropower deliveries for Reclamation projects throughout the 17 Western states. Reclamation manages several research programs that provide advanced solutions to a broad range of water and power management issues. The research results serve to improve Reclamation water management practices, increase water supply, and ensure cost-effective power generation operations to benefit Reclamation's stakeholders.

The Reclamation Research and Development (R&D) programs that participate in federal technology transfer legislative activities are the Science and Technology Program, the Colorado River Basin Salinity Control Program, and the Operations and Maintenance Program.

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>

- **Chlorine Resistant Membrane**

Reclamation researchers, in collaboration with University of Denver (DU) and Separations Systems Technologies (SST) have discovered new polyamide membrane technology that can potentially revolutionize the desalination membrane industry. This membrane technology has demonstrated equal or better ability to purify water without being degraded by chlorine. Chlorination is required upstream of the desalination membrane in order to control microorganisms that biofoul and clog the membrane. In addition, chlorine has typically been added to many source waters to prevent water-borne diseases. A high performance, chlorine-resistant membrane that resists chlorine degradation has been a long-sought capability by the desalination industry, and would also be a tool that would modernize and lower the cost of operating desalting plants.

Initial tests of the new polyamide membranes constructed on flat sheets were conducted at SST. From SST, the most successful new polyamide membranes were transferred to Reclamation's Water Quality Improvement Center (WQIC) in Yuma, AZ to verify how these membranes would react in actual field test situations. Water flux and salt rejection comparisons for a standard polyamide membrane and new polyamide membranes were monitored beginning in August 2005 at the WQIC. Currently, about 50% of the new

polyamide membranes have completed long-term testing. Several of the new polyamide membranes tested indicated a superior degree of chlorine resistance.

Currently, long-term testing of new polyamide membranes is done on flat sheets rather than actual spiral-wound membranes. The next step is to run long-term tests using a number of 2” diameter by 40” long spiral-wound membranes in carefully designed experiments to establish industry standard engineering data. Reclamation is currently seeking industry partners to cooperate in further testing and commercializing these new chlorine resistant membranes.

Department of Transportation (DOT)

The 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 innovations from the research and development (R&D) programs to fulfill the key goals of the Department: safety, mobility, global connectivity, environmental stewardship, security, and organizational excellence. Technology Transfer is carried out in all of laboratories in the Department. They include 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 (Volpe Center). Beginning 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>

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

Volpe National Transportation Systems Center

- **Global Maritime Domain Awareness Tool Serving 40 Countries**

Harvard University’s Kennedy School’s Ash Institute for Democratic Governance and Innovation announced the Global Maritime Domain Awareness Program as a winner of the prestigious 2008 Innovations in American Government Awards for its efforts in enhancing levels of safety and economic stability on the global seas. Developed by the Volpe Center of the U.S. DOT’s Research and Innovative Technology Administration, the program provides an unprecedented level of visibility into transit and port activity. The movements of more than 10,000 vessels from over 40 nations are tracked and updated in real-time. Called a “wiki on the waves,” the program fosters an unparalleled level of cooperation among participating nations.

The Volpe MSSIS Team Members awarded for this work were Kam Chin, McCharles Craven, Bryan Long, Daniel Nim, Dave Phinny, Brendon Providence, and Henry Wychorski.

William J. Hughes Technical Center

- **Localizer to Improve Margin of Safety at Airports All Over the Country**

Steven Edwards, a member of the FAA's Navigational Aids unit at the Dallas/Fort Worth International Airport developed the Localizer Cable Fault Analyzer. This unique electronic device can quickly troubleshoot problems in an instrument landing system's (ILS) antenna array. The ILS provides precise source and height guidance to an aircraft approaching a runway. The system is made up of a localizer antenna array, with several pairs of directional antennas beyond the end of the runway. All antennas must be functioning properly for the transmitted signal to be correct in the aircraft and for the system to work properly. Any antenna problem can result in an unsafe condition during the final approach.

The analyzer will catch an antenna cable fault and memorize the antenna that has the fault. The device is connected to the ILS equipment, enabling technicians to quickly identify and repair the malfunctioning antenna, greatly reducing the amount of time the ILS is out of service. The analyzer immediately pinpoints the faulty antenna, saving hours of troubleshooting and repair time.

The Air Traffic Control Association awarded Steven Edwards the Airway Transportation Systems Specialist of the Year. The Localizer was featured at the World's Best Technologies Exposition.

Turner-Fairbank Highway Research Center

- **Traffic Signal Timing - ACS-Lite**

Adaptive Control Software Lite (ACS-Lite) is a low cost signal timing optimization system that dynamically adjusts signal timing to meet current traffic demands. ACS-Lite was developed through a public private partnership between FHWA, Siemens, The University of Arizona, Purdue University, Siemens/Eagle, Econolite, Quixote/Peek and McCain Traffic.

Traditional traffic signal timing is designed by sampling traffic demand during peak periods and designing signal timing to meet those demands. Most local traffic agencies do not commit sufficient resources to evaluate and retime traffic signals on the recommended frequency of 3 to 5 years. As communities grow and traffic demands change due to schools opening and closing, seasonal shifts, special events and a host of other sources, congestion and delays are frequently the result. ACS-Lite is a technology solution that allows signal timing to address changes in demand and adjust signal timing appropriately.

As part of ACS-Lite testing, researchers conducted a before-and-after traffic study on State Route 70 in Manatee County, FL, to assess the benefits of the software. Specifically, the study focused on collecting data on traffic volumes at eight intersections between Caruso Road to the east and U.S. 301 to the west, performing "floating car" travel time and delay studies, and conducting statistical analyses on traffic volume, speed

and travel time, and delay data. The floating car methodology involves performing travel time runs using a test vehicle driven at an average speed through the arterial, allowing vehicular speed to be dictated by the platoon speed, not the posted speed limits. Travel time measurements begin when the test vehicle passes the stop line at the first intersection and end when the vehicle passes the stop line at the last intersection in the section or arterial being evaluated.

The result indicated that the total travel time, stopped delay, number of stops, and fuel consumption decreased during the "after" study period when the ACS-Lite software was in effect. In addition to a 9 percent reduction in network traffic volumes between the "before" and "after" study periods, the researchers also reported a 12 percent reduction in travel time, 28 percent reduction in travel time delay, attributing a significant portion of the gains to the ACS-Lite software. <http://www.oti.dot.gov/tst/practices/acslite.htm>

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

- **New System For Living Organ Transplants**

One of VA's most successful licenses this year was a new system that enables living organ transplants. The technology was licensed to TransMedics, a medical device company. The technology entails a warm blood perfusion technology, the Organ Care System which is designed to maintain organs in a functioning state outside the human body to optimize their health and to allow clinical evaluation. This could potentially increase organ availability and improve outcomes for the growing population of patients with end stage organ failure in need of a transplant, bridging the widening gap between the number of organs available and the number of recipients awaiting transplants. This technology is currently available in European Union, throughout Asia and is expected to enter clinical trials in 2008 for use in heart transplants in the US.

- **Solution For Tissue Preservation**

Another invention that VA licenses is a solution for tissue preservation. In particular, the GALA solution is an aqueous salt solution for the preservation of venous and arterial grafts prior to transplantation during Cardiac By-Pass Surgery. The GALA solution is the only solution that has been shown to fully preserve the endothelium of vascular conduits for up to 72 hours, insuring the implantation of fully viable conduits during

coronary artery and peripheral artery revascularization. The GALA solution has been used in more than 2500 consecutive patients (both in cardiac and peripheral vascular surgery) with superb clinical results.

Environmental Protection Agency (EPA)

EPA's Federal Technology Transfer Act (FTTA) Program was established to promote collaboration between private and federal research. EPA offers exceptional opportunities to develop and commercialize new technologies. Through the authority given to EPA by the Federal Technology Transfer Act, 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.

For more information please visit:

<http://www.epa.gov/osp/ftta.htm>

- **Successful Aerobic In situ Bioremediation of MTBE/BTEX Contamination Using BioLuxing Technology and Solid Oxygen Source Pellets**

The U.S. EPA and Foremost Environmental Solutions of Denver, CO, teamed up under a Cooperative Research and Development Agreement (CRADA) to successfully demonstrate how the company's patented "BioLuxing" technology could aerobically biodegrade benzene, toluene, ethylbenzene, and xylene (BTEX) and methyl tertiary-butyl ether (MTBE) in situ more effectively by adding EPA's patented solid oxygen source (SOS) pellets in Foremost's treatment slurry. The objective of study was to determine the most effective and efficient method of providing oxygen to the aerobic treatment zone with BioLuxing. The demonstration showed that SOS met the oxygen demands for up to 22 months without additional activities. With typical mechanical problems, compressed air was about 70% effective when compared to SOS.

The patented and trademarked BioLuxing technology is a process in which Bioremediation is enhanced by creating a Luxurious in situ environment for the selected microbes (bacteria) that will degrade the contaminants. By fracturing with the porous pellets, two major cleanup advantages are developed: preferential pathways to direct the contaminants into the designed treatment zones are created; and the reactive sheets contain a porous microbial matrix which will slowly release nutrients (and oxygen when SOS is included) and can accommodate exceptionally large volumes of microbes. This provides an ideal "microbial growth and working environment" for Bioaugmentation of selected additional microbes or Biostimulation of the naturally occurring indigenous microorganisms. Each sub-surface fracture, (a ½ inch thick and 30-40 feet in diameter sheet) is a "BioLux" and each stack of BioLuxes (normally includes two to five, spaced about 2-4 feet apart, between 15-40 feet below ground surface [bgs]) is referred to as a "BioNet."

The project included seven BioNets on the Flathead Indian Reservation near Ronan, Montana. The MTBE plume from a retail gasoline station was contaminating about 15 acres of farmland and threatening Native American-owned surface waters. The BioNets contained a selected variety of slurry mixtures of: (1) sand or Isolite, (small porous ceramic pellets) as a fracture material/proppant, which created bioremediation zones and facilitated inoculation and also allowed attachment of the bacteria; (2) a zone for addition of oxygen by aeration or SOS; (3) enhanced porosity/permeability of the subsurface; (4) selected aerobic bacteria known to degrade MTBE; and (5) a proprietary nutrient mix. Bioaugmentation results indicated that 12 months after inoculation, the reductions of MTBE in the groundwater samples were as high as 85 percent where optimum conditions were created for biodegradation, when the slurry injections included Isolite inoculated with the selected microbes, nutrients, and the SOS pellets. The use of SOS stimulates as much, or more reduction as the use of oxygen as supplied air, when available, at various flow rates. In the test BioNet used for Biostimulation where Isolite was inoculated only with nutrients and provided with air, no reductions were noted for the first four months. Additionally, the barrier installed around the gasoline station for treatment did not cause disruption to service and the station achieved its most profitable day during the clean up. Further licensing opportunities for EPA's SOS technology are under discussion.

- **EPA CRADA Partnerships Demonstrate Arsenic Removal in Drinking Water**

Arsenic is a widely distributed, naturally-occurring semi-metal that is found in ground water in locations throughout the United States. Long-term exposure to arsenic has been linked to adverse health effects, including cancers of the bladder, lungs, skin, kidneys, and liver.

In January, 2001, when the U.S. Environmental Protection Agency (EPA, or Agency) announced the final standard for arsenic in drinking water, the EPA Administrator pledged financial and technical support for small drinking water system owners and operators to reduce their costs with implementing and meeting the new standards.

Over the next several years, EPA conducted two rounds of demonstrations of technologies for removing arsenic from drinking water. In order to assist each community water system with choosing the most appropriate arsenic removal technology for its specific needs, EPA partnered with municipalities and equipment producers through Cooperative Research and Development Agreements (CRADAs). This allowed the Agency to demonstrate new technologies where their effectiveness could be demonstrated on-site.

Demonstrations typically follow a set procedure. First, new water treatment equipment, matched to the characteristics of the water source, is installed. This new equipment is operated by the local systems managers while EPA-contracted scientists monitor water samples weekly. EPA used the results from this and similar projects to demonstrate new methods, tailored to community water conditions, for arsenic removal from drinking water.

The expected outcomes of the demonstration projects include widely communicating the benefits and accessibility of the latest, most cost-effective technologies for removing arsenic from drinking water. The results of this effort will assist small communities with selecting the most appropriate and cost-effective technology for use at their sites. In addition, residents will benefit by having arsenic levels in their drinking water reduced to levels that comply with the new EPA standard.

Details about these demonstration projects can be found at this Web site:

<http://www.epa.gov/ORD/NRMRL/arsenic>

- **CRADA Technology Cleans Water with Recycled Catalyst**

EPA is inventing and supporting technologies that eliminate arsenic from drinking water. As an added benefit, removal of arsenic with a recycled catalyst enhances the sustainability of the metals removal process, and reuses equipment that would otherwise be discarded. MAR Systems is commercializing a patent pending process developed under a Cooperative Research and Development Agreement (CRADA) with the US Environmental Protection Agency at their National Risk Management Research Laboratory, Cincinnati, Ohio. The process removes metal contaminants from water and industrial fluid waste streams through its Sorbster™ brand of products. The product uses recycled material – a spent catalyst which was historically disposed of as a non-hazardous waste – to extract hazardous metals such as arsenic, mercury, selenium and uranium from water. In addition to providing a leading edge technology in meeting the stringent demands of EPA drinking water standards announced in January, 2001, the process will establish a new standard in cost, simplicity and reliability. This is a significant commercial advantage over competitive approaches.

The process is based on the reuse of the spent catalyst from the Claus Process, a final polishing step for light hydrocarbons (including natural gas) to remove trace amounts of sulfur. Based on initial tests, impregnation of the alumina with sulfur promotes the absorption of heavy metals. The spent catalyst absorbs heavy metals at a rate that is ten times faster than pre-existing processes, thus making it the only product suitable for treatment at the tap, while saving 70%-85% on cost and minimizing waste. In addition to the reuse of the catalysts, MAR can also manufacture sulfur impregnated alumina to meet production needs. As a result, Sorbster™ is expected to be a competitive technology for the removal of arsenic from drinking water (estimated at \$4 billion domestically in 2006) and from industrial waste water (estimated at \$15 billion domestically in 2006).

Analytical work at Ohio University is planned to qualify the catalyst for mass production by utilizing their ‘quick catalyst screening’ procedure. Analytical research and initial pilot plants have proven Sorbster’s effectiveness. Second generation pilot plants are operational at Ohio locations to remove arsenic from drinking water that exhibit >15 ppb arsenic levels and to define media adsorption capacity. Also, the research and development efforts of the MAR system’s drinking water technology will directly apply to the emerging needs of other aqueous waste streams. The 2006 revision to the Arsenic drinking water regulation established a new threshold for aqueous streams that may come into contact with ground water or other sources of potable water.

In addition to drinking water, the Sorbster™ product line is being tested to reduce mercury emissions to the environment. In March, 2005, EPA issued the Clean Air Mercury Rule, which creates performance standards and establishes permanent, declining caps on mercury emissions. The products show promise in removing metal contaminants from gaseous streams, including coal-fired electrical generators and industrial incinerators. A pilot plant has been established to remove mercury from an industrial effluent containing >5ppb mercury.

With energy prices soaring, developing countries relying more heavily on coal-based energy, and national and international regulations stressing the removal of mercury from the air and arsenic from the water, means of achieving standards outlined in these regulations will become more valuable internationally. Thus the relatively inexpensive and overwhelmingly effective MAR System process could take a large share of an expanding global market.

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. The organization responsible for technology transfer within NASA is the Innovative Partnerships Program (IPP). With offices at HQ and all ten of NASA's field centers, IPP seeks to develop technology to meet NASA's needs through partnerships with industry, academia, government agencies, and national laboratories, and facilitates intellectual property protection and transfer out of NASA developed technology for commercial application and broad public benefit.

Each year, NASA documents some notable successes from technology transfer efforts in the annual Spinoff publication. It is available online at <http://www.sti.nasa.gov/spinoff>, and hard copies are available upon request. More than 1,600 spinoff successes have been documented in the publication and are all 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 the public understand how NASA technologies are present in and contributing to the quality and safety of their everyday life.

More information about the NASA Innovative Partnership Program can be found at: <http://www.ipp.nasa.gov>; <http://www.sti.nasa.gov/spinoff>; <http://www.nasa.gov/city>.

- **NASA Invention of the Year Controls Noise and Vibration**

Developed at NASA's Langley Research Center, the Macro-Fiber Composite (MFC) is designed to control vibration, noise, and deflections in composite structural beams and panels. Smart Material Corporation specializes in the development of piezo composite components, and licensed the MFC technology from Langley in 2002. To date, Smart Material Corporation has sold MFCs to over 120 customers, including such industry giants as Volkswagen, Toyota, Honda, BMW, General Electric, and the tennis company, HEAD. The company estimates that its customers have filed at least 100 patents for their various unique uses of the technology. In addition, the company's product portfolio has grown to include piezo ceramic fibers and fiber composites, piezo ceramic actuators and

sensors, and test equipment for these products. It also offers a compact, lightweight power system for MFC testing and validation. Consumer applications already on the market include piezoelectric systems as part of audio speakers, phonograph cartridges and microphones, and recreational products requiring vibration control, such as skis, snowboards, baseball bats, hockey sticks, and tennis racquets.

- **Noninvasive Test Detects Cardiovascular Disease**

At NASA's Jet Propulsion Laboratory (JPL), NASA-developed Video Imaging Communication and Retrieval (VICAR) software laid the groundwork for analyzing images of all kinds. A project seeking to use imaging technology for health care diagnosis began when the imaging team considered using the VICAR software to analyze X-ray images of soft tissue. With marginal success using X-rays, the team applied the same methodology to ultrasound imagery, which was already digitally formatted. The new approach proved successful for assessing amounts of plaque build-up and arterial wall thickness, direct predictors of heart disease, and the result was a noninvasive diagnostic system with the ability to accurately predict heart health.

Medical Technologies International Inc. (MTI) further developed and then submitted the technology to a vigorous review process at the FDA, which cleared the software for public use. The software, patented under the name Prowin, is being used in MTI's patented ArterioVision, a carotid intima-media thickness (CIMT) test that uses ultrasound image-capturing and analysis software to noninvasively identify the risk for the major cause of heart attack and strokes: atherosclerosis. ArterioVision provides a direct measurement of atherosclerosis by safely and painlessly measuring the thickness of the first two layers of the carotid artery wall using an ultrasound procedure and advanced image-analysis software. The technology is now in use in all 50 states and in many countries throughout the world.

- **Sensor Network Provides Environmental Data**

The National Biocomputation Center, a joint partnership between the Stanford University School of Medicine's Department of Surgery and NASA's Ames Research Center, is the test bed for much of NASA's research in telemedicine, the remote delivery of medical care. In early 2005, researchers at the National Biocomputation Center formed a spinoff company, Intelesense Technologies, to use the telemedicine sensors to provide integrated global monitoring systems. Intelesense uses the systems to better understand how environments and people are linked, monitor and protect natural resources, predict and adapt to environmental changes, provide for sustainable development, reduce the costs and impacts of natural disasters, and provide an effective and intelligent response to such disasters. Current projects range from protecting the environment to tracking emerging infectious diseases like avian influenza (bird flu) and helping people from around the world connect and interact with each other to better understand their environment and themselves.

Conclusion

Technology transfer is an active and essential mission of Federal laboratories, using our nation's innovation and investment in science and technology to 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 CRADAs, licensing, and associated income generally increased between 2002 and 2007, whereas new inventions disclosed and patenting remained steady. Federal research is a complex process that provides the opportunity for new ideas and innovations to be successfully marketed to serve citizens. The success stories in this report provide examples of how society benefits from technology transfer activities across the Federal laboratories. As knowledge advances and the needs of the economy change, Federal laboratories will continue to play a role in keeping America in the forefront of innovation and supporting our economy by aiding in the transfer and commercialization of knowledge.