SUPPLEMENTAL REPORT

Department of Commerce, Annual Budget Proposal, FY 2008

Annual Report on Technology Transfer: Approach and Plans, FY 2006 Activities and Achievements

U.S. Department of Commerce

Report prepared by:

Office of the Under Secretary for Technology Policy, Technology Administration;

National Institute of Standards and Technology, Technology Administration;

National Oceanic and Atmospheric Administration;

Institute for Telecommunication Sciences, National Telecommunications and Information Administration

In response to the:

Technology Transfer and Commercialization Act of 2000 (P.L. 106-404)

January 30, 2007

Foreword. This is the calendar year 2007 edition of a report series summarizing the technology transfer activities and achievements of the Department of Commerce's federal laboratories. This report responds to the statutory requirement for an annual "agency report on utilization" [15 U.S.C. Section 3710 (f)] under the revised federal-wide reporting process established by the Technology Transfer Commercialization Act of 2000 (P.L. 106-404). All federal agencies that direct one or more federal laboratories or conduct other activities under Section 207 and 209 of Title 35, United States Code are subject to the requirements of this statute.

At the Department of Commerce, technology transfer is a part of the mission and program activities of principally the National Institute of Standards and Technology (Technology Administration), the National Oceanic and Atmospheric Administration, and the Institute for Telecommunication Sciences (National Telecommunications and Information Administration). Accordingly, this report focuses on the activities of these three departmental agencies.

Each of the major sections of this report is organized to summarize the agency's technology transfer approaches and plans and to provide specific information about the activities and accomplishments for FY 2006 and several earlier comparative years. The report begins with a summary of this information for the Department of Commerce as a whole.

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This report has been organized and prepared by the Office of Technology Policy (Technology Administration), along with the joint participation of technology transfer personnel at the National Institute of Standards and Technology (Technology Administration), the National Oceanic and Atmospheric Administration, and the Institute for Telecommunication Sciences (National Telecommunications and Information Administration).

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I. DEPARTMENT OF COMMERCE OVERVIEW

Technology Transfer by the Department's Federal Laboratories – Summary of Approaches and FY 2006 Activities/Achievements

The Department of Commerce works in partnership with businesses, universities, communities, and workers to promote innovation and the Nation's overall competitiveness in the global economy. The Department pursues this objective through a host of policy and program activities directed at strengthening the nation's economic infrastructure, facilitating the development of cutting-edge science and technology, providing an information base, and managing national resources.

At the Department, research and development (R&D) in numerous areas of contemporary science and technology is conducted at the federal laboratories of the Technology Administration (the National Institute of Standards and Technology -- NIST), National Oceanic and Atmospheric Administration (various lab facilities across NOAA's bureaus), and the National Telecommunications and Information Administration (Institute for Telecommunication Research – ITS). Technology transfer is a key part of the program activities at each of these agencies' federal lab systems.[1]

■ Agency Missions and Channels for Technology Transfer

National Institute of Standards and Technology

NIST's mission is to develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the 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.

NIST's technology transfer activities are focused in general on the broad dissemination of research results to industry, rather than just creation of patents and associated licenses. Accordingly, NIST draws on a diverse group of mechanisms to transfer the knowledge and technologies that result from its laboratory research. Included are:

CRADAs,
Patents and licenses,
Technical publications,
Standard Reference Materials,
Standard Reference Data,

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[1] In reviewing the technology transfer plans and activity statistics provided by this report, it is important to recognize there are significant differences among the three agencies in the level of resources available to support R&D activities. For NIST, budget authority for R&D (including conduct of R&D and R&D facilities) in FY 2006 totaled an estimated $437 million. For NOAA, the corresponding figure for R&D budget authority in FY 2006 is $617 million. For ITS, the corresponding FY 2006 figure is $6 million

Calibration services,
Documentary standards
Conferences, workshops, and inquiries
Guest researchers and facilities users.

National Oceanic and Atmospheric Administration

NOAA's mission is to understand and predict changes in the Earth's environment and to conserve and manage coastal and marine resources to meet the Nation's economic, social, and environmental needs. This mission will be ever more critical in the 21st century as national needs intensify concerning climate change, freshwater supply, ecosystem management, and homeland security.

NOAA's broad approach to tech transfer involves direct transfer, licensing its intellectual property, and cooperative research relationships with industry. NOAA works with its laboratories according to each's expertise and ability to provide necessary resources. NOAA's principal tech transfer mechanisms are:

Public dissemination scientific/technical materials,
CRADAs,
Patents and licenses.

Institute for Telecommunication Sciences

ITS supports agency telecommunications objectives such as promoting advanced telecommunications and information infrastructure development in the United States, enhancing domestic competitiveness, improving foreign trade opportunities for U.S. telecommunications firms, and facilitating 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.

ITS engages in tech transfer and commercialization activities by encouraging and facilitating cooperative research with industry where it can directly benefit U.S. competitiveness and market opportunities. ITS' principal tech transfer mechanisms currently include:

CRADAs,
Patents and licenses,
Telecommunications analysis services.
Technical publications,
Development of telecommunications standards.

For a more detailed discussion, see the initial section of each of the agency chapters below.

■ Summary of Technology Transfer Activities and Achievements across the Department, FY 2006 and Recent Years

Selected Activity Measures

Collaborative Relationships for Research & Development

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **CRADA**s, total active in the FY [1]						
▪ Traditional CRADAs [2]	Department	141	92	67	80	149
	NIST	125	76	51	65	135
	NOAA	8	11	9	8	6
	ITS	6	5	7	7	8
▪ Non-traditional CRADAs [3]	Department	1,744	1,811	1,902	1,826	2,859
	NIST	1,687	1,577	1,590	1,553	2,353
	NOAA	0	0	0	0	0
	ITS	57	234	312	273	506
● **Other types of collaborative R&D relationships** [4]						
▪ Facility use agreements	NIST	391	511	590	588	639
▪ Guest scientists and engineers	NIST	1,300	1,300	1,700	2,15	2,114
▪ Collaborative standards contributions	ITS	3	2	11	11	16

CRADA = Cooperative Research and Development Agreement.

(1) "Active" = legally in force at any time during the FY. "Total active" is comprehensive of all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.

(3) CRADAs used for special purposes -- such as, material transfer or technical assistance that may result in protected information.

(4) For details on these types of R&D relationships see the respective agency's chapter later in this report.

Invention Disclosure and Patenting

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● New inventions disclosed in the FY [1]	Department	15	21	25	21	14
	NIST	14	16	23	19	10
	NOAA	1	5	2	1	4
	ITS	0	0	0	1	0
● Patent applications filed in the FY [2]	Department	20	8	12	12	5
	NIST	19	8	12	11	4
	NOAA	0	0	0	1	0
	ITS	1	0	0	0	1
● Patents issued in the FY	Department	23	11	12	10	7
	NIST	18	9	11	9	6
	NOAA	5	1	1	1	0
	ITS	0	1	0	0	1

(1) Inventions arising at the federal lab.

(2) Tally includes U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes provisional, continuation, duplicate foreign, and Paris Cooperation Treaty (PCT) applications.

Licensing -- Profile of Active Licenses

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
All licenses, number total active in FY [1]	Department	41	101	125	133	111
▪ **Invention licenses**, total active in FY	Department	41	101	125	133	111
- Patent licenses [2]	Department	41	101	30	33	36
	NIST	35	39	22	26	24
	NOAA	3	5	5	4	5
	ITS	3	57	3	3	7
- Material transfer licenses (inventions)		0	0	0	0	0
- Other invention licenses	Department	0	0	95	100	75
	NIST			0	100	75
	NOAA			0	0	0
	ITS			95	100	75
▪ **Other IP licenses**, total active in FY	Department	0	0	0	0	0
- Copyright licenses (fee bearing)						
- Material transfer licenses (non-inventions)						
- Other						

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

(1) "Active" = legally in force at any time during the FY.

(2) Patent license tally includes patent applications which are licensed.

Note: For simplicity, sub-departmental detail is suppressed in this table, where the appropriate disaggregated figures are straightforwardly evident from data listed in other rows.

Licensing Management

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Elapsed execution time**, [1] licenses granted in the FY						
▪ **Invention licenses**, average, months	NIST	5.4	3.4	*	1.0	6.0
	NOAA	8.0	5.0	*	*	7.0
	ITS	5.0	1.0	2.0	2.0	1.5
● **Licenses terminated for cause**, number in the FY						
▪ **Invention licenses**	NIST	3	1	0	1	0
	NOAA	0	0	0	0	0
	ITS	0	0	0	0	0

* No New licenses executed in the FY

For additional statistics on these metrics see the corresponding table the later agency chapters of this report.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)

Characteristics of Licenses Bearing Income

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **All income bearing licenses**, number	Department	39	37	23	25	30
▪ **Invention licenses**, income bearing	Department	39	37	23	25	30
- Patent licenses [1]	Department	39	37	23	25	30
	NIST	33	29	15	17	18
	NOAA	3	5	5	4	5
	ITS	3	3	3	4	7
▫ Exclusive/partially exclusive/ non-exclusive	Department	19/2/18	20/0/17	11/0/12	12/0/13	17/0/13
	NIST	18/2/13	19/0/10	10/0/5	11/0/6	16/0/2
	NOAA	1/0/2	1/0/4	1/0/4	1/0/3	1/0/4
	ITS	0/0/3	0/0/3	0/0/3	0/0/4	0/0/7
▪ **Other IP licenses**, income bearing			0	0	0	0
● **All royalty bearing licenses**, [2] number		36	34	23	25	30
▪ **Invention licenses**, royalty bearing		36	34	23	25	30
- Patent licenses [1]	Department	36	34	23	25	30
	NIST	33	29	15	17	18
	NOAA	3	5	5	4	5
	ITS	0	0	3	4	7
▪ **Other IP licenses**, royalty bearing		0	0	0	0	0

(1) Patent license tally includes patent applications which are licensed.

(2) Note that royalties are one component of total license income.

Note: For simplicity, sub-departmental detail is suppressed in this table, where the appropriate disaggregated figures are straightforwardly evident from data listed in other rows.

Income from Licensing

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Total income**, all licenses active in FY [1]		$164,622	$127,566	$203,289	$146,660	$194,393
▪ **Invention licenses**		$164,622	$127,566	$203,289	$146,660	$194,393
- Patent licenses [2]	Department	$164,622	$127,566	$203,289	$146,660	$194,393
	NIST	$89,750	$122,850	$144,828	$123,348	$156,793
	NOAA	$9,402	$4,716	$24,961	$16,100	$13,100
	ITS	$65,470	$0	$33,500	$7,212	$24,500
▪ **Other IP licenses**, total active in the FY		$0	$0	$0	$0	$0
● **Total Earned Royalty Income** [3]		$99,152	$127,566	$169,789	$139,448	$169,893
▪ **Invention licenses**		$99,152	$127,566	$169,789	$139,448	$169,893
- Patent licenses [2]	Department	$99,152	$127,566	$169,789	$139,448	$169,893
	NIST	$89,750	$122,850	$144,828	$123,348	$156,793
	NOAA	$9,402	$4,716	$24,961	$16,100	$13,100
	ITS	$0	$0	$0	$0	$0
▪ **Other IP licenses**, total active in the FY		$0	$0	$0	$0	$0

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee including patent costs.

(2) Patent license tally includes patent applications which are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or of units sold). Not a license issue fee or a minimum royalty.

Note: For simplicity, sub-departmental detail is suppressed in this table, where the appropriate disaggregated figures are straightforwardly evident from data listed in other rows.

Disposition of License Income

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● Income distributed [1]						
▪ Invention licenses	Department	$164,622	$127,566	$203,289	$146,660	$194,393
	NIST	$89,750	$122,850	$144,828	$123,348	$156,793
	NOAA	$9,402	$4,716	$24,961	$16,100	$13,100
	ITS	$65,470	$0	$33,500	$7,212	$24,500
- To inventor(s)	Department	$67,387 (41%)	$52,903 (41%)	$83,654 (41%)	$60,112 (41%)	$70,786 (36%)
	NIST	$45,650 (51%)	$51,773 (42%)	$54,134 (37%)	$48,148 (39%)	$47,536 (30%)
	NOAA	$696 (7%)	$1,130 (24%)	$11,070 (44%)	$8,400 (52%)	$7,500 (57%)
	ITS	$21,041 (32%)	$0 (0%)	$18,450 (55%)	$3,564 (49%)	$15,750 (64%)
- To other [2]	Department	$97,235 (59%)	$74,662 (59%)	$119,635 (59%)	$86,547 (59%)	$123,607 (64%)
	NIST	$44,100 (49%)	$71,076 (58%)	$90,694 (63%)	$75,199 (61%)	$109,257 (70%
	NOAA	$8,706 (93%)	$3,586 (76%)	$13,891 (56%)	$7,700 (48%)	$5,600 (43%)
	ITS	$44,429 (68%)	$0 (0%)	$15,050 (45%)	$3,648 (51%)	$8,750 (36%)

Invention licenses are the chief policy interest regarding disposition of income; content of table reflects this focus.

(1) Income includes royalties and other payments received during the FY.

(2) To internal purposes, in the case of each agency.

Other Important Mechanisms for Technology and Knowledge Transfer

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Standard Reference Materials (SRMs) available	NIST	1,353	1,214	1,211	1,246	1,302
Standard Reference Materials (SRMs) sold	NIST	30,996	29,527	30,490	32,163	31,195
Standard Reference Data (SRD) titles available	NIST	90	106	95	110	113
Number of items calibrated	NIST	2,924	3,459	3,373	3,145	3,026
Technical publications produced	NIST	2,236	1,918	2,074	2,070	1,960
Journal articles published	NOAA	529	626	419	397	444
Technical reports published	NOAA	363	245	300	226	148
Technical publications produced	ITS	17	20	17	19	8
Total number of hits, online publications	ITS	--	--	--	--	1,116,573

-- = Data not requested from agency in reports of prior years.

See the NIST, NOAA, and ITS chapters later in this report for definitions of these measures.

Further detail on the measures cited in the tables above, as well as additional activity statistics can be found in the individual agency chapters later in this report.

□ Illustrative Outcomes from Technology Transfer Cited by the Agencies

The following cases were selected and described by the agencies in their 2005 reports as examples of "downstream" outcomes resulting from agency technology transfer efforts:

Agency	Downstream Outcomes Listed
National Institute of Standards and Technology	▪ NIST RoboCrane® cuts aircraft maintenance costs. A revolutionary robotic platform developed by NIST, patented, and then licensed to the U.S. Technology Corporation has been adapted for the U.S. Air Force to address the critical, expensive, and nasty work of stripping old paint from large aircraft. The robot's work platform, which "floats" in mid air suspended by a web of computer-controlled cables, promises to drastically reduce paint-stripping time per airplane, cut costs and lessen incidents of operator stress and injury. The technology also is expected to be of use to the commercial aircraft industry. ▪ Quantum dot method rapidly identifies bacteria. A rapid method for detecting and identifying very small numbers of diverse bacteria, from anthrax to E. coli, has been developed by scientists from the National Cancer Institute (NCI) and NIST. The new method is more sensitive than conventional optical methods. It can count how many viruses are infecting a single bacteria cell and how many quantum dots are attached to a single virus. The work was funded by NIH, NCI, NIST, and the Center for Cancer Research. A joint patent application is being submitted. The work could lead to the development of handheld devices for accelerated identification of biological weapons and antibiotic-resistant or virulent strains of bacteria—situations where speed is essential.

Agency	Downstream Outcomes Listed
	▪ Structure of key enzyme in Plague bacterium found. Researchers at NIST have solved the structure of a key enzyme from the bacterium responsible for plague, finding that it has a highly unusual configuration. The results may shed light both on how the bacterium kills and on fundamental cell signaling processes. Plague bacterium is rated as a highest category biothreat agent by the Centers for Disease Control and Prevention and the National Institute of Allergy and Infectious Diseases. ▪ Bioactive cement scaffold may improve bone grafts. A new technology for implants that may improve construction or repair of bones in the face, skull and jaw, has been developed by researchers from the American Dental Association Foundation (ADAF) and NIST. The new technology provides a method for making scaffolds for bone tissue. The scaffold is seeded with a patient's own cells and is formed with a cement paste made of minerals also found in natural bone. NIST and the ADAF have conducted cooperative research on dental and medical materials since 1928. ADAF researchers focus on development of new dental materials, while NIST develops and disseminates infrastructural technologies and services required by the U.S. private sector and other non-profit and government partners. ▪ NIST method improves reliability of GPS clocks. The Global Positioning System (GPS) is more reliable today than it was several years ago. Widely used by the military, first responders, surveyors and even consumers, GPS is a navigation and positioning system consisting of ground-based monitors and a constellation of satellites that rely on atomic clocks. A statistical method, developed NIST, and tested and implemented with the help of several collaborators, has made the job of analyzing the accuracy and reliability of these satellite-borne time signals significantly faster and easier. The method will help ensure that GPS clocks produce accurate location and distance measurements and remain closely synchronized with official world time. ▪ 'Long' distances measured with picometer accuracy. A new laser-based method for measuring millimeter distances more accurately than ever before -- with an uncertainty of 10 picometers (trillionths of a meter) --has been developed and demonstrated by a physicist at the National Institute of Standards and Technology (NIST). This is akin to measuring the distance from New York to Los Angeles with an uncertainty of just 1 millimeter. The technique may have applications in nanotechnology, remote sensing and industries such as semiconductor fabrication. ▪ Tool tackles translucence and other color challenges. Plain old colors are passé. Complex visual effects, such as pearlescence, translucence, iridescence and glitter, help sell many products, including cars, cosmetics, pharmaceuticals and military hardware. A new instrument at NIST -- called a goniospectrometer -- makes comprehensive measurements of such appearance properties to help companies calibrate their own tools and control product quality. ▪ Advanced imaging facility watches fuel cells at work. Thanks to a

Agency	Downstream Outcomes Listed
	new and improved imaging instrument at NIST, scientists now can conduct detailed surveillance of water inside hydrogen fuel cells -- a piece of intelligence key to making the technology practical for powering automobiles. Better water management is fundamental to meeting targets for fuel cell performance, reliability and durability. Water is the by-product of the chemical process in fuel cells that strips electrons from hydrogen molecules to generate electricity. NIST's newly commissioned Neutron Imaging Facility can image water quantities smaller than 1 microgram (millionth of a gram), and details as small as 0.02 millimeter can be discerned in images. Even better spatial resolution is expected. Located at the NIST Center for Neutron Research (NCNR), the Neutron Imaging Facility research station is operated as a national user facility, open to scientists from industry, universities and government agencies. It is jointly funded by NIST, the Department of Energy and General Motors. ▪ Soft materials buckle up for measurement. NIST scientists have developed a new method to evaluate the mechanical properties of soft polymers and gels, such as those used in contact lenses and as tissue-engineering scaffolds. The new method uses "sensor films" with known properties to report the stiffness (or "modulus") of the soft substrates to which they are attached. This capability makes it possible to "map" spatial variations in rigidity in complex materials and devices. The new method may also be a powerful tool to test for flaws or weak regions in soft materials products. Another key aspect of the technique is its speed. The NIST team is working with industrial partners to harness this method as a high-throughput measurement tool for rapidly testing large numbers of soft polymer products. ▪ Microfluidic device tests fluid compatibility. The key to a great detergent, cosmetic, paint or other complex liquid product is pretty much the same: include components that mix well and don't have high levels of what scientists call "interfacial tension," a tendency to bead up and pull away from each other. To help industrial engineers improve their ability to systematically test new product formulations, NIST researchers have developed a microfluidic instrument that quickly measures interfacial tension. The device will be especially useful to test fresh interfaces for applications with scarce amounts of the fluids to be tested such as custom-synthesized materials from combinatorial chemistry. Funding for the research was provided by NIST, ICI/National Starch, and Proctor and Gamble. ▪ Quality standards issued for testing herbal products. NIST has issued the first suite of Standard Reference Materials (SRMs) in a planned series of reference materials for botanical dietary supplements. The dietary supplement industry has exploded in the past decade to about 29,000 products, with about 1,000 new products introduced each year, according to the Food and Drug Administration (FDA). NIST began working in 2001 with the FDA and the National Institutes of Health's Office of Dietary Supplements (NIH/ODS) on a series of SRMs of popular botanical dietary supplements. Products such as botanical supplements that have been derived from extracts of plant materials are challenging to analyze accurately because of their complex sample matrices. Manufacturers can use these materials for quality control, and researchers can use them to ensure that their laboratory analyses

Agency	Downstream Outcomes Listed
	of supplements are accurate. Future dietary supplement SRMs will include: Ginkgo biloba, saw palmetto, bitter orange, carrot extract, green tea, blueberries, cranberries, bilberries and St. John's wort. ▪ NIST SRM aids efforts to reduce cigarette fire risk. Cigarettes are the single largest igniters of fatal fires in the United States. Each year these fires cause about 700 to 800 deaths, 1,700 serious injuries and $400 million in direct property damage, according to the National Fire Protection Association. Several states, as well as Canada, have moved to reduce this toll by requiring that all cigarettes sold in their jurisdictions meet a new standard for low risk of igniting household furnishings. This year, NIST released Standard Reference Material (SRM) 1082 to help testing laboratories and cigarette manufacturers make accurate measurements required by the new regulations. ▪ Using 'minutiae' to match fingerprints can be accurate. A study by the National Institute of Standards and Technology (NIST) shows that computerized systems that match fingerprints using interoperable minutiae templates -- mathematical representations of a fingerprint image -- can be highly accurate as an alternative to the full fingerprint image. NIST conducted the study, called the Minutiae Interoperability Exchange Test (MINEX), to determine whether fingerprint system vendors could successfully use a recently approved standard for minutiae data rather than images of actual prints as the medium for exchanging data between different fingerprint matching systems. For many years, law enforcement agencies have used automated fingerprint matching devices. Increasingly, smart cards—which include biometric information such as fingerprints—are being used to improve security at borders and at federal facilities. The increased use and the desire to limit storage space needed on these cards is driving the use of minutiae rather than full images. MINEX was sponsored by the U.S. Departments of Homeland Security and Justice.
National Oceanic and Atmospheric Administration	▪ Precision airdrop system**.** Problems associated with aerial re-supply resulted in Department of Defense initiation of the Precision Airdrop System (PADS), a program to develop capability to airdrop ballistic parachute payloads accurately and safely from high altitude. Wind errors (forecast versus actual) are the largest contributors to the total error budget of a ballistic airdrop system, especially in mountainous terrain. The development team, comprised by the U.S. Army, Planning Systems Inc. (civilian contractor), and NOAA focused on reducing the wind error budget through the real-time measurement of winds over and near a planned drop zone using mature technologies. ▪ Air freezing index for construction industry. NOAA has developed an air freezing index (AFI) that was transferred to the U.S. construction industry for use in building frost protected shallow foundations (FPSF). The NOAA designers of the AFI received the 2006 NOAA Technology Transfer Award. ▪ Spot forecasts aid wildfire control**.** NOAA has issued nearly 3,000 spot forecasts for wildfires and over 7,000 for natural resource management. Covering relatively small geographic areas, these spot forecasts require NOAA meteorologists to apply micro and mesoscale knowledge about temperature, humidity trends, wind speed and direction, smoke dispersion, and expected rainfall and lightning,

Agency	Downstream Outcomes Listed
	usually for a 36-hour period. ▪ Aid to spacecraft launches and landings**.** When the space shuttle Discovery touched down, it was a triumph not only for NASA, but also for NOAA's National Weather Service Spaceflight Meteorology Group. NOAA has been an integral part of spaceflight since the space program began over 40 years ago. NOAA monitors and forecasts landing weather. ▪ First salt marsh ecosystem model**.** NOAA transferred a computer model of salt marsh restoration to Gulf of Maine coastal managers in 2006. MarshMD is the first salt marsh ecosystem model of its kind and resulted from a synthesis of original research and published scientific findings. ▪ Tsunami warning network expanded**.** NOAA deployed the first Deep-Ocean Assessment and Reporting of Tsunamis (DART) station in the Atlantic Ocean. The buoy station is located about 280 miles east-southeast of Cape Fear, North Carolina. NOAA also deployed DART stations in the Caribbean Sea and Gulf of Mexico. ▪ Tsunami preparedness materials**.** NOAA transferred preparedness materials and related tools to help communities in regions potentially affected by tsunamis. One such tool is "inundation mapping," which gives emergency managers graphical information to clarify the extent of potential coastal damage that may be caused by various tsunami/wave heights. ▪ Tsunami warning system**.** NOAA hosted several visitors from Indian Ocean nations in 2006 to provide the background and specific technological information regarding tsunami detection and reporting platforms as well as numerical modeling of tsunamis. NOAA also participated with the U.S. State Department Agency for International Development (USAID) in meetings in India, Indonesia, and Australia to assist Indian Ocean nations in developing a regional tsunami warning system. ▪ Hawaii first tsunami ready state**.** NOAA transferred Tsunami and storm information, data, and advice to Hawaii, helping it to become the first state of the United States to achieve the status of TsunamiReady and StormReady. ▪ Disneyland resort storm ready**.** NOAA's National Weather Service recently helped Disneyland Resort in California to become a StormReady community. The voluntary StormReady program provides communities with clear-cut advice from their local NOAA National Weather Service forecast offices. NOAA developed the StormReady program to help protect every American from hazardous weather. ▪ Gulf Coast storm tide information**.** The Gulf Coast was able to more frequently update storm tide information this past hurricane season (2006) thanks to technology upgrades implemented to the 23 National Water Level Observation Network (NWLON) stations along the Gulf Coast. The technology upgrades enable the near real time transmission of NWLON data to NOAA National Weather Service (NWS) forecasters, emergency responders, mariners, the public, and other users.

Agency	Downstream Outcomes Listed
	▪ Hazard mapping system to Mexican weather service**.** NOAA successfully transferred and implemented the Hazard Mapping System (HMS) for fire and smoke detection to the Servicio Meteorologico Nacional (National Weather Service of Mexico). HMS is an interactive tool to identify fires and associated smoke emissions in an operational environment. This state-of-the-art satellite data visualization and analysis system utilizes multiple geostationary and polar orbiting environmental satellites as input to automated fire or hotspot detection algorithms specifically designed for each sensor. ▪ Wind model to State of Florida**.** NOAA transferred a wind model to Florida for use in its CAT (Catastrophe) model. Florida's recently mandated annual hurricane insurance deductible is based on its catastrophe modeling system. ▪ Cutting-edge weather forecast model**.** NOAA has transferred an advanced weather forecast (WRF) model that predicts several types of extreme weather with substantially improved accuracy. The new model was created through a partnership between NOAA, the National Center for Atmospheric Research and more than 150 other organizations and universities in the United States and abroad. ▪ Greenhouse gas information to World Meteorological Organization**.** NOAA transferred its Annual Greenhouse Gas Index (AGGI) to the World Meteorological Organization (WMO) for inclusion in its annual Greenhouse Gas Bulletin. The AGGI is a benchmark measurement of gases in the atmosphere that affects the Earth's climate and provides a scientific basis for management and policy decisions by Government and industry. ▪ Debris flow warnings**.** NOAA's National Weather Service and Office of Oceanic and Atmospheric Research partnered with the U.S. Geological Survey to deliver life-saving watches and warnings for debris flow events. Once smoke clears from a wildfire, the danger is not over. Flash floods and debris flows can be one of the most hazardous consequences of rainfall on burned hill slopes. ▪ Advice on surface transportation weather**.** Three years ago, NOAA released its first report on improving surface transportation, safety and cost efficiency through improved weather information products. The report, "Weather Information for Surface Transportation," spurred a rapid expansion of interagency, intergovernmental and public-private efforts, all designed to enhance safety and mitigate economic impacts of transportation weather. This year's update of this report provides new data on the risks of transportation weather to America's safety, security, quality of life, and economic activity. ▪ CRADA signed with Boeing Aerospace**.** NOAA entered into a Cooperative Research and Development Agreement (CRADA) with Boeing Aerospace on October 6, 2005 (in FY 2006), to bring new satellite data sets into the Integrated Oceanic Observing System (IOOS), and to further coastal remote sensing. ▪ Coral reef warning system**.** NOAA expanded coverage for the NOAA Coral Reef Watch Satellite Bleaching Alert monitoring system from 6 Caribbean sites to a total of 24 sites throughout the U.S, and Caribbean. The expansion was made possible through collaborative efforts with NOAA, the World Bank, and the Global Environment

Agency	Downstream Outcomes Listed
	Facility. ▪ New Great Lakes weather observation platforms**.** More than a dozen new weather observation platforms deployed in the Great Lakes region by NOAA are providing valuable information directly to recreational and commercial boaters and to NOAA National Weather Service meteorologists issuing marine weather forecasts and life-saving warnings. NOAA's National Weather Service, National Ocean Service, and Great Lakes Environmental Research Laboratory joined forces to deploy 13 new coastal weather observation sites throughout the Great Lakes. These observation platforms now provide critical information on wind speed and direction, temperature and atmospheric pressure and are updated and broadcast every hour on the Internet for public consumption. ▪ Navigation information for Volvo ocean racers**.** NOAA helped to ensure safe navigation for the Volvo Ocean Race, an eight-month round the world sailing race covering 32,500 nautical miles over four oceans with port stops in nine countries. NOAA models provided near real-time sea surface currents, sea surface temperature, surface winds, and wave height and direction. ▪ Ozone forecasting tool for western U.S. The NOAA National Weather Service, in partnership with the Environmental Protection Agency, now provides experimental forecast guidance for ground-level ozone for the western half of the contiguous United States. This is in addition to the air quality forecast guidance currently prepared for the eastern half of the U.S. This new forecast guidance will provide accurate projections of ozone levels near the ground, linked to weather forecast models. NOAA National Weather Service forecast models are used to drive simulations of atmospheric chemical conditions using pollutant emissions and monitoring data provided by EPA. ▪ Sea Grant provides information to Gulf residents**.** In the wake of two of the worst natural disasters in our Nation's history, hurricanes Katrina and Rita, NOAA's Sea Grant is providing critical information to residents and business owners in communities affected by the storms. The Louisiana Sea Grant College Program has launched a Recovery Resources website. Also Sea Grant and NOAA's National Marine Fisheries Service are collaborating to place a Vietnamese-speaking Sea Grant extension agent in Mississippi to work on recovery efforts with the fishing industry. ▪ NEXRAD dual polarization modification**.** NOAA is leading a research and development effort on the dual polarization modification of the NEXRAD operational radar system. Improved radar data will improve support to severe weather warnings, flood and flash flood warnings, and general forecast services.
National Telecommunications and Information Administration -- Institute for Telecommunication Sciences	▪ Video quality metric – ITS has developed a superior method of measuring video quality objectively that closely predicts the quality that human viewers would perceive subjectively. The technology is covered by four patents owned by ITS/NTIA. The metric was adopted by ANSI as a U.S. national standard in FY 2003. It became an international standard in FY 2004, with approval by the International Telecommunication Union (ITU). ITS has targeted the method for

Agency	Downstream Outcomes Listed
	commercial development. In FY 2006, the metric earned substantial royalty income for the laboratory through commercial licenses. ▪ Table Mountain research. ITS' Table Mountain Field Site and Radio Quiet Zone supports fundamental research into the nature, interaction, and evaluation of telecommunication devices, systems, and services. Each year, private companies, universities, and other organizations conduct research at Table Mountain under Cooperative Research and Development Agreements (CRADAs).

See the agency chapters below for further details on these cases.

■ The Department's Performance Metrics for Technology Transfer

This year's annual report again provides a comprehensive set of statistics on the technology transfer activities of each of the department's agencies with federal lab operations. This information covers *cooperative research and development relationships*, *invention disclosure/patenting, licensing*, and *other technology transfer mechanisms employed by the labs*. There is also a new round of agency-selected case illustrations of downstream outcomes (e.g., commercially significant technologies, improved federal lab capabilities) resulting from these federal lab technology transfer activities.

The content and format of this year's performance report is consistent with guidelines issued for the annual performance reporting by the Office of Management and Budget in its July 2006 edition of Circular A-11. (OMB's guidelines are based on the performance reporting approach organized by the Interagency Working Group on Technology Transfer, which is coordinated by the Technology Administration at the Department of Commerce. This approach has been the basis for most all of the federal agencies reporting under the Technology Transfer and Commercialization Act over the last several years.)

All of the agencies continue to indicate that their overall technology transfer efforts involve a good deal more than cooperative R&D, patenting, and licensing. These "other" mechanisms include transfer through technical publications, development of industrial standards, other forms of public dissemination, and opportunities for guest scientists and engineers to participate in federal lab activities. Each of the agencies now includes yearly activity figures for such "other" mechanisms as they are a part of the agency's technology transfer effort.

Plans for technology transfer activities by the Department of Commerce's federal labs generally continue to emphasize the development of better metrics for program performance. In general, a stable framework for this annual reporting has now been established and is comprehensive of the main technology transfer mechanisms used by Department of Commerce federal labs. The Department continues, however, to evaluate the effectiveness of its technology transfer activities and will consider including additional metrics as need arises.

An appendix section at the end of each of the agency chapters below discusses the specific initiatives currently underway.

II. TECHNOLOGY ADMINISTRATION -- NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Technology Transfer at the Agency's Federal Laboratories – Approach and Plans, FY 2006

1. Agency Approach and Plans for Technology Transfer

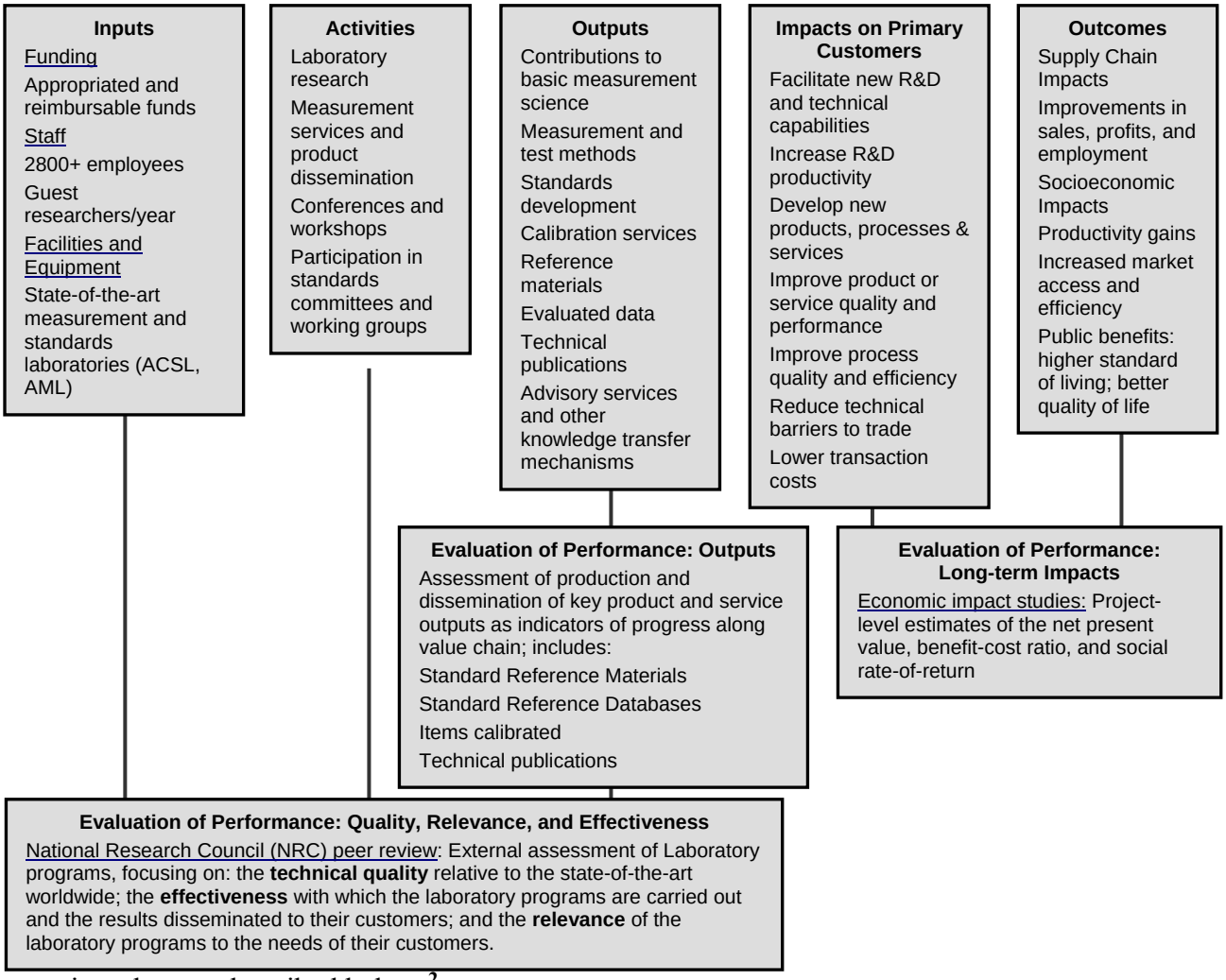
The National Institute of Standards and Technology (NIST) is an unusual federal agency. Its mission is broad: to promote U.S. innovation and industrial competitiveness by advancing measurement science and standards and technology in ways that enhance economic security and improve our quality of life.

An essential part of NIST's work is to anticipate the future measurement and standards needs of U.S. industry. Fast-moving sectors like nanotechnology, biotechnology, homeland security, information technology, and advanced manufacturing need sophisticated technical support systems to flourish and grow. NIST's 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 (individual companies and consortia), universities, associations, and other government agencies.

NIST's technology transfer activities are designed to disseminate the Institute's measurements and standards research results broadly to industry and other customers. Leading-edge scientific and technical work requires multiple disciplines, high levels of collaboration among organizations and people with diverse capabilities, and highly specialized facilities and tools. For more than a century, the NIST laboratories have successfully collaborated with industry and universities to provide the measurement techniques and technical tools needed by America's innovators. NIST uses many mechanisms to collaborate with industry and to ensure that the resulting knowledge and infrastructural technologies are broadly disseminated.

The principal technology mechanisms employed for transfer of NIST's intellectual property and assets, in rough order of significance, are: informal research and development collaboration with colleagues from industry, academia and other government agencies; peer-reviewed publications; dissemination of Standard Reference Materials, Standard Reference Data, and Documentary Standards; participation in development of industry "road maps", organizing conferences and workshops; hosting U.S. and international Guest Researchers from industry, academia and other government agencies; Facility Use Agreements; CRADAs; and patents/licenses.

The set of outputs that NIST uses to transfer its measurement capabilities and technologies to customers includes standard reference materials, calibration services, and other products and



services that are described below.[2]

● Standard Reference Materials

Standard Reference Materials (SRMs) are one definitive source of measurement traceability in the United States. All measurements using SRMs can be traced to a common and recognized set of basic standards that provides the basis for compatibility of measurements among different laboratories. As economic exchange has become more global, customers increasingly use SRMs to achieve measurement quality and conformance to process requirements that address both national and international needs for commerce and trade. NIST produces and disseminates SRMs to a large and diverse group of customers, including private sector laboratories, universities, and

[2] NIST's authority to perform its technology/knowledge transfer activities does not rest solely in the Bayh-Dole Act, Stevenson-Wydler Act, Federal Technology Transfer Act (FTTA) and related legislation. It also resides in NIST's Organic Act (15 USC 272) and the Standard Reference Data Act (15 USC 290).

other federal agencies. NIST SRMs support industrial materials production and analysis, environmental analysis, health measurements, and basic measurements in science and metrology.

The number of SRMs available for sale -- currently over 1,300 -- illustrates the breadth of measurements supported by NIST. Over time, NIST expects slight growth in the number of SRMs available, given its current strategy of focusing on those SRMs that cannot be produced by secondary laboratories and which have broad and/or high downstream impact. In establishing its out-year projections, the NIST SRM Program monitors, among other things, trends in emerging technologies, new regulations that will depend on SRMs for enforcement, and the reference material needs of other federal agencies. Several microeconomic studies of NIST SRM programs have shown the technology transfer mechanisms built into these efforts to be effective with resulting high economic benefits delivered to industry.

● Calibration Services

The NIST laboratories provide physical measurement services for their customers, including calibration services, special tests, and measurement assurance programs (MAPs). Calibration services and special tests are characterizations of particular instruments, devices, and sets of standards with respect to international and national standards. MAPs are quality control programs for calibrating entire measurement systems. NIST's calibration services are designed to help the makers and users of precision instruments achieve the highest possible levels of measurement quality and productivity. The services constitute the highest order of calibration services available in the United States. NIST offers more than 500 different types of physical calibrations covering the following measurement areas: dimensional; mechanical, including flow, acoustic, and ultrasonic; thermodynamic; optical radiation; ionizing radiation; electromagnetic; and time and frequency.

Over the past several years, NIST has calibrated approximately 3,000 items annually. Over the next several years, NIST expects to realize a relatively high but slightly declining number of items calibrated. This is in keeping with a long-term trend, over the past several decades, of a decline in the number of items calibrated by NIST. Despite this overall trend, the number of calibrations in individual years may fluctuate slightly due to multi-year calibration cycles. NIST expects to provide fewer but more highly leveraged calibration services over time. NIST's strategy is driven by the need to effectively manage trends in demand from its major industry and government customers for these services. NIST is pursuing three strategies: (1) performing only those calibrations that require a direct connection to the national standards; (2) improving calibration accuracy in those areas where new industry demands are emerging; and (3) accrediting primary and secondary calibration laboratories to meet on-going industry needs. In FY 2006, the National Voluntary Laboratory Accreditation Program (NVLAP) accepted 6 new calibration laboratories into the program (bringing the total to 76) in fields ranging from dimensional metrology to optical and ionizing radiation. In FY 2006, NVLAP performed on-site assessments of 32 calibration laboratories. Through this overall approach, NIST efficiently leverages its primary calibration services to support a broader base of secondary calibrations conducted within the private sector. Several microeconomic studies of NIST calibration programs have shown the technology transfer mechanisms built into these efforts to be effective with resulting high economic benefits delivered to industry.

● Standard Reference Data

NIST produces and makes available (i.e., sells or distributes for free) many Standard Reference Data titles (SRDs). SRDs provide numeric data to scientists and engineers for use in technical problem solving, research, and development. These recommended values are based on data extracted from scientific and technical literature or on measurements done at NIST laboratories, which are then assessed for reliability and evaluated to select the preferred values. NIST's SRD databases cover many areas of science, including analytical chemistry, atomic and molecular physics, biotechnology, and materials sciences.

Historically, NIST has produced two new SRD titles per year. At the same time, NIST also provides numerous upgrades to existing databases. Each year, however, some database titles are eliminated from the NIST catalog. In FY 2006 there were 55 SRD databases for sale, including one new title – "Simulation of electron Spectra for Surface Analysis". One free online SRD database was also released on 2006: "NIST/TRC Ionic Liquids". Over time, NIST expects continued modest growth in the total number of SRD titles available.

● Technical Publications

NIST uses publications as a key mechanism to transfer the results of its work to the U.S. private sector and to other government agencies that need cutting-edge measurements and standards. Many of these publications appear in prestigious scientific journals and withstand peer review by the scientific community. Others appear in technological forums where measurement standards and technologies developed by NIST staff (at times in collaboration with private sector partners) are disseminated. Of the technical publications produced annually, approximately 80% are approved for external publication (such as in scientific journals), while the remaining 20% are NIST reports and special publications.

Over time, NIST expects a relatively constant level of high quality publications (2,000-2,300 per year) to be produced by its technical staff.

● Informative Collaborative Research, Guest Researchers, and Facilities Users

Each year hundreds of researchers visit NIST to participate in collaborative projects and/or to use NIST's research facilities. NIST makes its facilities available for limited periods of time to domestic and foreign guest researchers to collaborate with NIST staff on research and development projects of mutual interest or to transfer NIST techniques, procedures, and best practices. NIST also sponsors several formal collaboration programs with universities, among them JILA, an interdisciplinary institute for research and graduate education in the physical sciences, located on the main campus of the University of Colorado (CU) in Boulder, and operated jointly by CU and NIST; the Center for Advanced Research in Biotechnology (CARB), a joint collaboration with the University of Maryland Biotechnology Institute that conducts research and provides interdisciplinary training in fundamental problems at the forefront of biotechnology; and the Hollings Marine Laboratory (HML), a collaboration between NIST, NOAA, the South Carolina Department of Natural Resources, the Medical University of South Carolina, and the College of Charleston that conducts interdisciplinary scientific research for a better understanding of marine resources and environmental health. In 2006, NIST initiated new formal collaborations with the National Cancer Institute and the Food and Drug Administration in conjunction with the Nanotechnology characterization Laboratory, and with the University of Maryland and National Security Agency for the establishment of the Joint Quantum Institute.

● Conferences, Workshops, and Inquiries

NIST also transfers technology through the hosting of numerous conferences and workshops, as well as through answering inquiries. In FY 2006, NIST inquiries offices handled nearly 7,000 general inquiries. In addition, during FY 2006, NIST held 103 conferences with about 10,000 attendees.

● Participation in Documentary Standards Committees

Still another means by which NIST transfers technology is through staff participation in the activities of documentary standards developing organizations, which develop consensus standards on a host of technologies. NIST participation enables its scientists and engineers to bring NIST technology directly into a standard, which could involve test methods and procedures for protecting health, safety, and/or the environment, or specifications for performance or interoperability, or other aspects. During FY 06, 382 NIST staff members participated on 972 committees representing 98 standards developing organizations. NIST staff held 1324 memberships on these committees including 392 in ASTM International, 105 in the American National Standards Institute (ANSI), 49 in the Institute for Electrical and Electronic Engineers (IEEE), and 101 in the International Organization for Standardization (ISO).These activities are also reported by NIST to the Office of Management and Budget and to Congress as required by the National Technology Transfer and Advancement Act of 1995.

2. Performance in FY 2006: Activities and Achievements

The data below quantify the many ways through which NIST transfers knowledge and technology to the private sector.

In response to the reporting requirements of the Technology Transfer Commercialization Act of 2000 and other relevant legislation, data are provided for collaborative relationships for research and development (CRADAs and other kinds of relationships), invention disclosures and patenting, and licensing. In addition, in keeping with the previous discussion, data are also provided for some of the other technology transfer mechanisms utilized by the NIST laboratories: such as Standard Reference Materials available, technical publications produced, items calibrated, and guest researcher collaborations. A number of examples of downstream outcomes from NIST technology transfer activities are also provided.

■ Collaborative Relationships for Research & Development

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **CRADA**s, total active in the FY [1]	1,812	1,653	1,641	1,618	2,488
- New, executed in the FY	1,712	1,589	1,605	1,579	1,646
▪ Traditional CRADAs, [2] total active in the FY	*125	*76	*51	*65	135
- New, executed in the FY	25	12	15	26	74
▪ Non-traditional CRADAs, [3] total active in the FY	1,687	1,577	1,590	1,553	***2,353
- New, executed in the FY	**1,687	**1,577	**1,590	**1,553	***1,572
● **Other types of collaborative R&D relationships**					
▪ Facility use agreements, total in effect, end of FY [4]	391	511	590	588	639
- New, executed in the FY	62	308	239	280	283
▪ Guest scientists and engineers during the FY [5]	1,300a	1,300a	1,700	2,115	2114

CRADA = Cooperative Research and Development Agreement.

a = Figures are approximate.

* Includes CRADAs associated with all NIST programs, including Manufacturing Extension Partnership (MEP), Technology Services (TS), and the Director of Administration/Chief Financial Officer.

** "non-traditional" CRADAs protect the results (under CRADA authority) of calibrated items from disclosure for a period of five years after development. Such "non-traditional" CRADAs are issued (and terminate) on an annual basis.

(1) "Active" = legally in force at any time during the FY. "Total active" is comprehensive of all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.

(3) CRADAs used for special purposes -- such as, material transfer or technical assistance that may result in protected information.

(4) NIST authorizes individuals to use designated facilities. The numbers reported here represent the Facility Use Agreements in effect for the NIST Center for Neutron Research.

(5) "Guest scientists and engineers" includes foreign and domestic guest researchers, and researchers working at NIST under Intergovernmental Personnel Act (IPA) Agreements and CRADAs.

■ Invention Disclosure and Patenting

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● New inventions disclosed in the FY [1]	14	16	23	19	10
● Patent applications filed in the FY [2]	19	8	12	11	4
● Patents issued in the FY	18	9	11	9	6
● Active patents, end of the FY	207	190	161	154	132
● Patents purposely dropped (triaged) during the FY	13	15	26	14	24

(1) Inventions arising at the federal lab.

(2) Tally includes U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes provisional, continuation, duplicate foreign, and PCT applications.

■ Licensing

Profile of Active Licenses

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **All licenses**, number total active in the FY [1]	35	39	22	26	24
▫ New, executed in the FY	2	3	2	5	3
▪ **Invention licenses**, total active in the FY	35	39	22	26	24
▫ New, executed in the FY	2	3	2	5	3
- Patent licenses, [2] total active in FY	35	39	22	26	24
▫ New, executed in the FY	2	3	2	5	2
- Material transfer licenses (inventions), total active	0	0	0	0	24
▫ New, executed in the FY	0	0	0	0	3
- Other invention licenses, total active in the FY	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Copyright licenses (fee bearing)					
▫ New, executed in the FY					
- Material transfer licenses (non-inventions), total active					
▫ New, executed in the FY					
- Other, total active in the FY					
▫ New, executed in the FY					

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (hybrid licenses) are reported as patent licenses and not included in the count of copyright licenses.

(1) "Active" = legally in force at any time during the FY.

(2) Patent license tally includes patent applications which are licensed.

Licensing Management

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Elapsed execution time**, (1) licenses granted in the FY					
▪ **Invention licenses**					
▫ Average, months	5.4	3.4	**	1.0	6.0
▫ Minimum	2.5	1.0		1.0	1.0
▫ Maximum	5.0	10.0		1.0	13.0
- Patent licenses (2)					
▫ Average, months	5.4	3.4	**	1.0	6.0
▫ Minimum	2.5	1.0		1.0	1.0
▫ Maximum	5.0	10.0		1.0	13.0
● **Licenses terminated for cause, number in the FY**					
▪ **Invention licenses**	3	1	0	1	0
- Patent licenses (2)	*3	1	0	1	0

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.

* In addition to the 3 licenses cited here as terminated "for cause," 4 licenses were terminated by mutual agreement and 4 expired with the end of their original term.

** NIST processed no commercialization licenses in FY 2004.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)

(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2005
● **All income bearing licenses**, total number	33	29	15	17	18
▫ Exclusive	18	19	10	11	16
▫ Partially exclusive	2	0	0	0	0
▫ Non-exclusive	13	10	5	6	2
▪ **Invention licenses**, income bearing	33	29	15	17	18
▫ Exclusive	18	19	10	11	16
▫ Partially exclusive	2	0	0	0	0
▫ Non-exclusive	13	10	5	6	2
- Patent licenses, (1) income bearing	33	29	15	17	18
▫ Exclusive	18	19	10	11	16
▫ Partially exclusive	2	0	0	0	0
▫ Non-exclusive	13	10	5	6	2
▪ **Other IP licenses**, income bearing	0	0	0	0	0
▫ Exclusive					
▫ Partially exclusive					
▫ Non-exclusive					
- Copyright licenses (fee bearing)					
▫ Exclusive					
▫ Partially exclusive					
▫ Non-exclusive					
● **All royalty bearing licenses**, (2) total number	33	29	15	17	18
▪ **Invention lic**enses, royalty bearing	33	29	15	17	18
- Patent licenses, (1) royalty bearing	*33	29	15	17	18
▪ **Other IP licenses**, royalty bearing	0	0	0	0	0
- Copyright licenses (fee bearing)					

* Of the 35 licenses active in FY 2002 (see earlier table), two were royalty-free research licenses.

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee including patent costs.

(1) Patent license tally includes patent applications which are licensed.

(2) Note that royalties are one component of total license income.

Income from Licenses

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Total income**, all licenses active in FY [(1)]	$89,750	$122,850	$144,828	$123,348	$156,793
▪ **Invention licenses**	$89,750	$122,850	$144,828	$123,348	$156,793
- Patent licenses [(2)]	$89,750	$122,850	$144,828	$123,348	$156,793
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
- Copyright licenses					
● **Total Earned Royalty Income** (ERI) [(3)]	$89,750	$122,850	$144,828	$123,348	$156,793
▫ Median ERI	$2,300	n/a	n/a	*$2,500	$5,000
▫ Minimum ERI	$700	$960	$640	$640	$640
▫ Maximum ERI	$20,000	$35,000	$54,072	$45,000	$85,403
▫ ERI from top 1% of licenses	$20,000	$35,000	dw	dw	dw
▫ ERI from top 5% of licenses	$20,000	$35,000	dw	dw	dw
▫ ERI from top 20% of licenses	$50,000	$45,000	dw	dw	dw
▪ **Invention licenses**	$89,750	$122,850	$144,828	$123,348	$156,793
▫ Median ERI	$2,300	n/a	n/a	*$2,500	$5,000
▫ Minimum ERI	$700	$960	$640	$640	$640
▫ Maximum ERI	$20,000	$35,000	$54,072	$45,000	$85,403
▫ ERI from top 1% of licenses	$20,000	$35,000	dw	dw	dw
▫ ERI from top 5% of licenses	$20,000	$35,000	dw	dw	dw
▫ ERI from top 20% of licenses	$50,000	$45,000	dw	dw	dw
- Patent licenses [(2)]	$89,750	$122,850	$144,828	$123,348	$156,793
▫ Median ERI	$2,300	n/a	n/a	*$2,500	$5,000
▫ Minimum ERI	$700	$960	$640	$640	$640
▫ Maximum ERI	$20,000	$35,000	$54,072	$45,000	$85,403
▫ ERI from top 1% of licenses	$20,000	$35,000	dw	dw	dw
▫ ERI from top 5% of licenses	$20,000	$35,000	dw	dw	dw
▫ ERI from top 20% of licenses	$50,000	$45,000	dw	dw	dw
▪ **Other IP licenses**, total active in the FY	0	0	0	0	
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					
▫ ERI from top 20% of licenses					

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
- Copyright licenses					
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					
▫ ERI from top 20% of licenses					

n/a = Data not available from agency at time of this report.

dw = Data withheld to protect proprietary information.

* The distribution of NIST's annual license income is bimodal at the extremes. The median figure cited here is rather unrepresentative.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee including patent costs.

(2) Patent license tally includes patent applications which are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or of units sold). Not a license issue fee or a minimum royalty.

Disposition of License Income

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2005
● **Income distributed** (1)					
▪ **Invention licenses**, total distributed	$89,750	$122,850	$144,828	$123,348	$156,793
- To inventor(s)	$45,650 (51%)	$51,773 (42%)	$54,134 (37%)	$48,148 (39%)	$47,536 (30%)
- To other (3)	$44,100 (49%)	$71,076 (58%)	$90,694 (63%)	$75,199 (61%)	$109,257 (70%)
- Patent licenses, (2) total distributed	$89,750	$122,850	$144,828	$123,348	$156,793
- To inventor(s)	$45,650 (51%)	$51,773 (42%)	$54,134 (37%)	$48,148 (39%)	$47,536 (30%)
- To other (3)	$44,100 (49%)	$71,076 (58%)	$90,694 (63%)	$75,199 (61%)	$109,257 (70%)

Invention licenses are the chief policy interest regarding disposition of income; content of table reflects this focus.

(1) Income includes royalties and other payments received during the FY.

(2) Patent license tally includes patent applications which are licensed.

(3) NIST only in FY 2001-2004. In FY 2005, $1,500 to NIH and rest to NIST.

■ Other Performance Measures Deemed Important by the Agency

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Standard Reference Materials (SRMs) available [1]	1,353	1,214	1,211	1,246	1,302
Standard Reference Materials (SRMs) sold [2]	30,996	29,527	30,490	32,163	31,195
Standard Reference Data (SRD) titles available [3]	90	106	95	110	113
Number of items calibrated [4]	2,924	3,459	3,373	*3,145	3,026
Technical publications produced [5]	2,236	1,918	2,074	2,070	1,960

See Section I above for additional information about the measures listed here. See also the Department of Commerce's annual reports under the Government Performance and Results Act (GPRA) for detailed information about each of these measures, analysis of trends, and future-year performance projections http://www.osec.doc.gov/bmi/budget/FY2006APP.htm

(1) Direct and verifiable count of SRMs available to customers at the close of the fiscal year. The number of SRMs available for sale illustrates the breadth of measurements supported by NIST. Over time, NIST expects slight growth in the number of SRMs available.

(2) Direct and verifiable count of NIST SRM units sold during the fiscal year. In recent years, NIST had been expecting a continuing slight decline in the number of SRM units sold, as NIST made greater use of highly leveraged SRM services over time, including accreditation of Nationally Traceable Reference Material producers. However, in FY 2005, the number of SRMs sold increased. Some possible contributing factors include the implementation of new EPA regulations, environmental activities, increased in construction projects, and the availability of previously out-of-stock SRMs.

(3) Direct and verifiable count of SRD products developed and disseminated by NIST. NIST expects continued modest growth in the total number of SRD titles available. Of those titles currently available, about 50% are available for sale, and 50% are free online systems. Over time, a larger percentage of SRDs will be distributed via the Internet. New growth in online systems is anticipated for FY 2006 with the release of fee-based titles for the Internet.

(4) Direct and verifiable count of items calibrated by the NIST laboratories. Over the next several years, NIST expects to realize a relatively high but slightly declining number of items calibrated. This is in keeping with a long-term trend, over the past several decades, of a decline in the number of items calibrated by NIST. NIST expects to provide fewer but more highly leveraged calibration services over time.

(5) Annual number of technical publications generated by NIST's technical staff. The number is a direct count of the number of technical publications cleared for publication by the NIST Editorial Review Boards at the Gaithersburg and Boulder sites. Over time, NIST expects a relatively constant level of high quality publications (2,000-2,200 per year) produced by its technical staff. Of the publications produced annually, approximately 80% are approved for external publication (such as in scientific journals); the other 20% are NIST reports and special publications.

■ Outcomes from Technology Transfer

NIST develops and disseminates infrastructural technologies and services required by the U.S. private sector and other non-profit and government partners. The outputs of the NIST laboratories provide a foundation for industry in all stages of commerce -- research, development, testing, production, and marketing -- and in turn enable socioeconomic impacts, such as productivity gains, increased market access and efficiency, and improved quality of life. These impacts are long-term, accruing years after the original infrastructural technologies were developed by NIST (often in conjunction with industry partners).

The examples below show how NIST's various technology transfer mechanisms – CRADA's, Standard Reference Materials, joint research facilities, software, and documentary standards – have, over the long term, produced outcomes that significantly benefit consumers and improve the quality of life.

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• **NIST RoboCrane® cuts aircraft maintenance costs**. A revolutionary robotic platform developed by the National Institute of Standards and Technology (NIST), patented, and then licensed to the U.S. Technology Corporation has been adapted for the U.S. Air Force to address the critical, expensive, and nasty work of stripping old paint from large aircraft. The robot's work platform, which "floats" in mid air suspended by a web of computer-controlled cables, promises to drastically reduce paint-stripping time per airplane, cut costs and lessen incidents of operator stress and injury.

Air Force maintenance rules require that the coatings on large aircraft be stripped off and replaced every five to six years. The stripping process is difficult and hazardous, filling the air with toxic dust and vapors. The task is currently done by maintenance workers in hot, movement–inhibiting protective suits climbing on scaffolding erected around the airplane. Using the new "Aerial Multiaxis Platform" (AMP), a worker in a protected cab can operate the automated high-pressure blast nozzles of the paint-stripping machinery, moving easily around the aircraft suspended from the aircraft hanger's ceiling. This robotic approach allows the operator to guide several concurrent nozzles, vastly improving productivity over the conventional single nozzle, hands-on approach. The AMP uses NIST's RoboCrane® technology in which six hoist cables from three upper support points tautly support, stabilize, and maneuver the work platform. It eliminates the need for scaffolding and other ground-base equipment that is time consuming to set up and hinders other operations within the hanger.

The AMP was adapted for aircraft maintenance operations by NIST in partnership with the U.S. Technology Corporation, with sponsorship from the Air Force Research Laboratory (AFRL). According to AFRL's Manufacturing Technology program, the AMP dramatically improves the quality and productivity of the paint stripping operations—one third of the overall maintenance process. Tests demonstrate that a worker with the AMP can strip up to 10-20 square feet per minute. A single operator can comfortably work an entire eight hour shift rather than taking the frequent breaks needed with the current de-painting process. The AMP design reduces the process time to strip old paint from an aircraft by 40-50 percent, the equivalent of four to five days for a C-5 aircraft.

Two production AMP systems are being installed at the Air Force's Warner Robins Air Logistics Center in Georgia for C-130 coating removal. The technology also is expected to be of use to the commercial aircraft industry.

• **Quantum dot method rapidly identifies bacteria**. A rapid method for detecting and identifying very small numbers of diverse bacteria, from anthrax to E. coli, has been developed by scientists from the National Cancer Institute (NCI) and NIST. The work could lead to the development of handheld devices for accelerated identification of biological weapons and antibiotic-resistant or virulent strains of bacteria—situations where speed is essential.

Traditional ways of identifying infectious bacteria and their possible treatments can be time consuming and laborious, requiring the isolation and growth of the bacteria over many hours or even days. The new method speeds up the process by using fast-replicating viruses (called bacteriophages or phages) that infect specific bacteria of interest and are genetically engineered to bind to "quantum dots." Quantum dots are nanoscale semiconductor particles that give off stronger and more intense signals than conventional fluorescent tags and also are more stable when exposed to light. The method detects and identifies 10, or fewer, target bacterial cells per milliliter of sample in only about an hour.

The phages were genetically engineered to produce a specific protein on their surface. When these phages infect bacteria and reproduce, the bacteria burst and release many phage progeny attached to biotin (vitamin H), which is present in all living cells. The biotin-capped phages selectively attract specially treated quantum dots, which absorb light efficiently over a wide frequency range and re-emit it in a single color that depends on particle size. The resulting phage-quantum dot complexes can be detected and counted using microscopy, spectroscopy or flow cytometry, and the results used to identify the bacteria. The new method could be extended to identify multiple bacterial strains simultaneously by pairing different phages with quantum dots that have different emission colors.

The new method is more sensitive than conventional optical methods. It can count how many viruses are infecting a single bacteria cell and how many quantum dots are attached to a single virus. The work was funded by NIH, NCI, NIST, and the Center for Cancer Research. A joint patent application is being submitted.

• **Structure of key enzyme in Plague bacterium found**. Researchers at NIST have solved the structure of a key enzyme from the bacterium responsible for Plague, finding that it has a highly unusual configuration. The results may shed light both on how the bacterium kills and on fundamental cell signaling processes.

The NIST team determined the three-dimensional shape of Class IV adenylyl cyclase (AC), an enzyme found in Plague bacteria (Yersinia pestis) by purifying and crystallizing the protein and using X-ray crystallography at the Center for Advanced Research in Biotechnology to resolve its configuration. Adenylyl cyclase is a fundamental enzyme found in one form or another in organisms ranging from bacteria to mammals. It synthesizes cyclic AMP (cAMP), an important signaling molecule that in turn triggers a variety of cellular processes. Six distinct classes of AC are known, playing a wide variety of roles. AC-II is part of the anthrax bacterium's killing mechanism, for example, while AC-III triggers adrenaline release in humans. Shape plays an essential role in determining the biological function of a protein, but it's very difficult to determine for such large molecules. Three-dimensional structures are known for only two other forms of AC. The NIST experiments revealed that AC-IV has a shape completely different from

the other two known shapes. AC-IV folds into a rare form of a barrel-like shape previously seen in only three other unrelated proteins.

The purpose of AC-IV in plague is not well understood, but it may play a role in disrupting cell processes in the infected host. Plague is not as common as it was in the Middle Ages, when it killed millions, but the World Health Organization still logs about 1,000 to 3,000 cases a year, an average of 10 to 15 in the United States. It is rated as a highest category biothreat agent by the Centers for Disease Control and Prevention and the National Institute of Allergy and Infectious Diseases. Fundamental molecular data on this enzyme and its various forms may be critical to the development of defenses against plague and other pathogens, including Bacillus anthracis (Anthrax) and Bordetella pertussis (Whooping cough). Beyond that, structural and functional studies of AC-IV, with its unusual shape, may lead to deeper understanding of the cAMP signaling mechanism and other fundamental cellular processes.

• **Bioactive cement scaffold may improve bone grafts**. A new technology for implants that may improve construction or repair of bones in the face, skull and jaw, has been developed by researchers from the American Dental Association Foundation (ADAF) and the National Institute of Standards and Technology (NIST).

The new technology provides a method for making scaffolds for bone tissue. The scaffold is seeded with a patient's own cells and is formed with a cement paste made of minerals also found in natural bone. The paste is mixed with beads of a natural polymer (made from seaweed) filled with bone cells. The paste is shaped or injected into a bone cavity and then allowed to harden with the encapsulated cells dispersed throughout the structure. The natural polymer beads gradually dissolve when exposed to the body's fluids, creating a scaffold that is filled by the now released bone cells.

The cement, a calcium phosphate material, is strengthened by adding chitosan, a biopolymer extracted from crustacean shells. The implant is further reinforced to about the same strength as spongy natural bone by covering it with several layers of a biodegradable fiber mesh already used in clinical practice.

The researchers used mouse bone cells in their experiments, but in practice surgeons would use cells cultured from patient samples.

In addition to creating pores in the hardened cement, the natural polymer beads protect the cells during the 30 minutes required for the cement to harden. Future experiments will develop methods for improving the material's mechanical properties by using smaller encapsulating beads that biodegrade at a predictable rate.

NIST and the American Dental Association Foundation have conducted cooperative research on dental and medical materials since 1928. ADAF researchers focus on development of new dental materials, while

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NIST and the American Dental Association Foundation have conducted cooperative research on dental and medical materials since 1928. ADAF researchers focus on development of new dental materials, while NIST specializes in the development of improved technologies and methods for measuring materials properties.

The research was funded by the National Institute of Dental and Craniofacial Facial Research, NIST and ADAF.

• **NIST method improves reliability of GPS clocks**. The average user may not notice, but the Global Positioning System (GPS) is more reliable today than it was several years ago.

Widely used by the military, first responders, surveyors and even consumers, GPS is a navigation and positioning system consisting of ground-based monitors and a constellation of satellites that rely on atomic clocks. A statistical method, developed by the National Institute of Standards and Technology (NIST) and tested and implemented with the help of several collaborators, has made the job of analyzing the accuracy and reliability of these satellite-borne time signals significantly faster and easier. The method will help ensure that GPS clocks produce accurate location and distance measurements and remain closely synchronized with official world time.

The NIST method has been incorporated over the past few years into the GPS clock analysis software system managed by the Naval Research Laboratory (NRL). The satellite clocks—commercial devices based in part on research originally done at NIST—use the natural oscillations of rubidium atoms as "ticks," or frequency standards. The algorithm helps detect and correct GPS time and frequency anomalies. The algorithm also can be used to improve the control of other types of atomic clocks and has been incorporated into commercial software and instruments for various timing applications.

A GPS receiver pinpoints its location based on the distance to three or more GPS satellites at known locations in space. The distance is calculated from the time it takes for satellite radio signals to travel to the receiver. Thus, timing accuracy affects distance measurements. The NIST method makes a series of mathematical calculations to account for numerous measures of random "noise" fluctuations in clock operation simultaneously. This makes it easier to estimate many sources of error and identify the onset of instabilities in the clocks in minutes or hours rather than days. Adjustments then can be made promptly. The technique also could accelerate the evaluation of clocks during the process of building GPS satellites, where test time is at a premium.

• **'Long' distances measured with picometer accuracy**. A new laser-based method for measuring millimeter distances more accurately than ever before—with an uncertainty of 10 picometers (trillionths of a meter)—has been developed and demonstrated by a physicist at the National Institute of Standards and Technology (NIST). This is akin to measuring the distance from New York to Los Angeles with an uncertainty of just 1 millimeter. The technique may have applications in nanotechnology, remote sensing and industries such as semiconductor fabrication.

Laser light is typically used to measure distances by counting the number of wavelengths (the distance between successive peaks of the wave pattern) of light between two points. Because the wavelength is very short (633 nanometers for the red light most often used), the method is intrinsically very precise.

Modern problems in nanotechnology and device fabrication, however, require uncertainty far below 633 nm.

A more precise method involves measuring the frequency of laser light rather than the wavelength. The laser light is stored between two highly reflective mirrors, to create the optical analog of an organ pipe. The length of an organ pipe can be measured by driving the pipe with sound waves of a known frequency (pitch). The sound emitted by the pipe is loudest when it is driven at one of its "natural" frequencies, commonly called harmonics. When one or more of these frequencies is identified, the pipe length can be determined. In the NIST work, light is transmitted through both mirrors only when the frequency of the light matches a harmonic frequency. This frequency can be used to determine the distance between the mirrors.

While this approach has been used previously for the measurement of short distances (of the order of 1 micrometer), the new work extends it 25,000-fold by demonstrating a range of 25 millimeters. (Ultimately, the design should accommodate a range of up to 50 mm.) In addition, the NIST approach described in the paper excites two harmonics of the optical system, rather than one, a redundancy that increases the range while achieving picometer accuracy.

• **Tool tackles translucence and other color challenges**. Plain old colors are passé. Complex visual effects, such as pearlescence, translucence, iridescence and glitter, help sell many products, including cars, cosmetics, pharmaceuticals and military hardware. A new instrument at the National Institute of Standards and Technology (NIST) makes comprehensive measurements of such appearance properties to help companies calibrate their own tools and control product quality.

Exotic surfaces and coatings may look different depending on illumination or viewing angles, subtleties that cannot be accounted for by traditional characterization methods. Many consumers are familiar with automobile paints that appear to change color with viewing direction. The new NIST device, called a goniospectrometer, automatically measures the color of light reflected from a surface as well as its dependence on the directions of illumination and observation.

NIST already offers a heavily used calibration service making less sophisticated measurements with another instrument. The new goniospectrometer will provide more complete data on the reflection of light from a color surface, and will be used for calibrating similar instruments and for research on exotic-appearing materials and coatings. The work is part of a NIST effort to develop accurate measurement methods for reproduction and quality control of appearance attributes, including color matching, by determining the minimum set of illumination and viewing geometries needed to accurately characterize the perceived color.

The goniospectrometer, housed in a clean room, illuminates a sample with a range of wavelengths of visible light, every 5 nanometers (nm) from 360 nm to 780 nm, i.e. from the near ultraviolet/deep blue to red/infrared. The sample and detector are rotated around three axes, allowing illumination and viewing in any direction within a hemisphere around the sample (see graphic). The intensity of the reflected beam is measured at several hundred locations on a

sample surface. Based on these measurements, computer software assigns a numerical value to the color of the reflected light.

• **Advanced imaging facility watches fuel cells at work**. Thanks to a new and improved imaging instrument at NIST scientists now can conduct detailed surveillance of water inside hydrogen fuel cells—a piece of intelligence key to making the technology practical for powering automobiles.

With visualization powers 10 times better than those achieved previously, researchers can watch water being produced and removed inside the maze-like solid housing of fuel cells under a range of simulated operating conditions, from arctic cold to desert heat. This as-it-happens, inside view is essential because fuel-cell performance depends on a delicate. Too little—or too much—water can shut it down."

Better water management is fundamental to meeting targets for fuel cell performance, reliability and durability. Water is the by-product of the chemical process in fuel cells that strips electrons from hydrogen molecules to generate electricity. NIST's newly commissioned Neutron Imaging Facility can image water quantities smaller than 1 microgram (millionth of a gram), and details as small as 0.02 millimeter can be discerned in images. Even better spatial resolution is expected. The facility produces still images akin to CAT scans and movies recorded at a rate of up to 30 frames per second, or 30 times faster than the first-generation instrument that NIST built to demonstrate the usefulness of neutron imaging for fuel cell research.

Located at the NIST Center for Neutron Research (NCNR), the Neutron Imaging Facility research station is operated as a national user facility, open to scientists from industry, universities and government agencies. It is jointly funded by NIST, the Department of Energy and General Motors. Although the new facility has been optimized for fuel cell research, it has many potential applications, from evaluations of metal-casting techniques to non-destructive analysis of archeological artifacts.

• **Soft materials buckle up for measurement**. Buckling under pressure can be a good thing, say materials scientists at the National Institute of Standards and Technology (NIST). NIST scientists developed a new method to evaluate the mechanical properties of soft polymers and gels, such as those used in contact lenses and as tissue-engineering scaffolds. For such applications, stiffness is an indicator for key material performance qualities, such as comfort and durability, and it is important to controlling cell adhesion.

The new method uses "sensor films" with known properties to report the stiffness (or "modulus") of the soft substrates to which they are attached. Compressing the sample causes the sensor film to buckle, resulting in patterns of repeating ridge-like features, akin to corrugated cardboard. The ridge spacing is related to the modulus ratio between the film and the soft substrate. Since the mechanical properties of the sensor film was known, the researchers could calculate the stiffness of the soft material underneath.

The NIST the team focused on results achieved with model soft specimens, such as silicone polymer, and more challenging "hydrogel" specimens (networks of polymers swollen with water). In each case, the researchers tested "gradient" specimens that changed in their mechanical properties across the lengths of a sample. With the sensor film, they could track and measure changes in stiffness in the underlying materials.

This capability makes it possible to "map" spatial variations in rigidity in complex materials and devices. Accordingly, the new method may be a powerful tool to test for flaws or weak regions in soft materials products, the researchers suggest.

Another key aspect of the technique is its speed. The NIST team is working with industrial partners to harness this method as a high-throughput measurement tool for rapidly testing large numbers of soft polymer products.

• **Microfluidic device tests fluid compatibility**. The key to a great party is inviting guests who mix well and don't instill tension among their fellow revelers. The key to a great detergent, cosmetic, paint or other complex liquid product is pretty much the same—include components that mix well and don't have high levels of what scientists call "interfacial tension," a tendency to bead up and pull away from each other.

To help industrial engineers improve their ability to systematically test new product formulations, researchers at the National Institute of Standards and Technology (NIST) have developed a microfluidic instrument that quickly measures interfacial tension.

The instrument is relatively simple and includes a series of channels ranging from 700 micrometers to 50 micrometers wide. Fluids are pumped toward a "T" intersection where drops of one liquid are pinched off and flow along a "river" of the second liquid. As the spherical drops flow through constriction points in the channel, they speed up and elongate. The degree to which the drops stretch out depends on the interfacial tension between the two fluids. High levels of tension exert more pressure on the drops, keeping them more nearly spherical.

Just as the mood of a party goes through stages, the tension between newly mixed liquids can change over time, and the device tracks these changes as the drops move downstream through the channel. A camera captures 100 pictures per second to record the changes, and an algorithm analyzes the data and produces a measurement in approximately 1 second.

The device will be especially useful to test fresh interfaces for applications with scarce amounts of the fluids to be tested such as custom-synthesized materials from combinatorial chemistry.

Funding for the research was provided by NIST, ICI/National Starch, and Proctor and Gamble.

• **Quality standards issued for testing herbal products**. The National Institute of Standards and Technology (NIST) has issued the first suite of Standard Reference Materials (SRMs) in a planned series of reference materials for botanical dietary supplements.

The dietary supplement industry has exploded in the past decade to about 29,000 products, with about 1,000 new products introduced each year, according to the Food and Drug Administration (FDA). In 2001 NIST began working with the FDA and the National Institutes of Health's Office of Dietary Supplements (NIH/ODS) on a series of SRMs of popular botanical dietary supplements. Manufacturers can use these materials for quality control, and researchers can use them to ensure that their laboratory analyses of supplements are accurate. Products such as botanical supplements that have been derived from extracts of plant materials are challenging to analyze accurately because of their complex sample matrices.

The new NIST reference materials were designed primarily for quality control of supplements containing ephedra, a plant once widely used in herbal weight-loss products. Ephedra products were pulled from the market by the FDA in 2004 after being linked to cardiovascular problems, but the new test materials remain valuable both to assure that new products are not adulterated

with ephedra and because they also can be used to improve several other key measurements in other botanical supplements, including concentrations of potentially toxic heavy metals.

The new reference materials represent several different forms of ephedra and include powdered plant material (SRM 3240), a ground solid oral dosage form (SRM 3243), and a protein powder (SRM 3244). The materials are certified for their concentrations of the ephedrine alkaloids and potentially toxic elements (including arsenic, cadmium, lead and mercury). SRM 3243 also provides certified values for synephrine (a compound in some of the "ephedra-free" weight-loss products) and caffeine. SRM 3244 adds values for caffeine, theobromin, theophylline, and nutrients including fat, protein, carbohydrate, individual fatty acids and amino acids, vitamins and nutritive elements.

Future dietary supplement SRMs will include: Ginkgo biloba, saw palmetto, bitter orange, carrot extract, green tea, blueberries, cranberries, bilberries and St. John's wort.

• **NIST SRM aids efforts to reduce cigarette fire risk**. Cigarettes are the single largest igniters of fatal fires in the United States. Each year these fires cause about 700 to 800 deaths, 1,700 serious injuries and $400 million in direct property damage, according to the National Fire Protection Association. Several states, as well as Canada, have moved to reduce this toll by requiring that all cigarettes sold in their jurisdictions meet a new standard for low risk of igniting household furnishings. This year, the National Institute of Standards and Technology (NIST) released Standard Reference Material (SRM) 1082 to help testing laboratories and cigarette manufacturers make accurate measurements required by the new regulations. The SRM consists of 10 packs of uniform cigarettes especially produced with the required low risk of ignition.

The regulations in New York, California, Vermont and Canada all use an ASTM standard, which was originally developed by NIST as part of the Fire Safe Cigarette Act of 1990. (ASTM standard E2187-04, “Standard Test Method for Measuring the Ignition Strength of a Cigarette.”) All have adopted the 2004 New York State pass/fail criterion that no more than 25 percent of 40 tested cigarettes burn their full length when placed on 10 layers of standard filter paper.

NIST developed SRM 1082 at the request of cigarette companies, the New York State Office of Fire Prevention and Control (OFPC), and Health Canada. Extensive testing by NIST, the National Research Council of Canada and Kidde-Fenwal Inc. established that SRM 1082, manufactured for NIST by Philip Morris USA, is compatible with the New York State pass/fail criterion.

Approximately 20 laboratories are or will be performing testing of commercial cigarettes for compliance using the ASTM standard. Comparative measurements between SRM 1082 and commercial cigarettes should enable testing laboratories to assure clients that their measurements are accurate and do not vary over time. Cigarette companies also are expected to use the SRM to check their products’ ignition properties prior to certification testing. More information about SRM 1082, including purchase data, can be found at https://srmors.nist.gov/view_detail.cfm?srm=1082.

• **Using ‘minutiae’ to match fingerprints can be accurate**. A study by the National Institute of Standards and Technology (NIST) shows that computerized systems that match fingerprints using interoperable minutiae templates—mathematical representations of a fingerprint image—can be highly accurate as an alternative to the full fingerprint image. NIST conducted the study, called the Minutiae Interoperability Exchange Test (MINEX), to determine whether fingerprint

system vendors could successfully use a recently approved standard for minutiae data rather than images of actual prints as the medium for exchanging data between different fingerprint matching systems.

Minutiae templates are a fraction of the size of fingerprint images, require less storage memory and can be transmitted electronically faster than images. However, the techniques used by vendors to convert fingerprint images to minutiae are generally proprietary and their systems do not work with each other.

For many years, law enforcement agencies have used automated fingerprint matching devices. Increasingly, smart cards—which include biometric information such as fingerprints—are being used to improve security at borders and at federal facilities. The increased use and the desire to limit storage space needed on these cards is driving the use of minutiae rather than full images.

Fourteen fingerprint vendors from around the world participated in MINEX. Performance depended largely on how many fingerprints from an individual were being matched. Systems using two index fingers were accurate more than 98 percent of the time. For single-index finger matching, the systems produced more accurate results with images than with standard minutia templates. However, systems using images and two fingers had the highest rates of accuracy, 99.8 percent. Results of the test are available at http://fingerprint.nist.gov/minex04/.

MINEX was sponsored by the U.S. Departments of Homeland Security and Justice. The test was not conducted to recommend or endorse any products or equipment.

Appendix:

Progress in Improving the Agency's Performance Metrics for Tech Transfer

The additional activity metrics included by NIST in FY 2002, 2003, and 2004 -- notably, for non-traditional CRADAs to cover NIST calibration services; greater detail on licenses and license income; workshops, conferences, and publications; and participation by NIST staff in documentary standards committees -- are now well integrated into the annual report process. The present array of metrics covers the wide variety of mechanisms that NIST employs for technology transfer.

NIST continues, however, to evaluate the effectiveness of its technology transfer activities and will consider including additional metrics as need may arise.

III. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Technology Transfer at the Agency's Federal Laboratories – Approach and Plans, FY 2006 Activities/Achievements

1. Agency Approach and Plans for Technology Transfer

NOAA's mission 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 climate change, freshwater supply, ecosystem management, and homeland security.

NOAA is one of the nation's premier scientific agencies. NOAA science and technology impact the daily lives of the nation's citizens and have a significant effect on the national economy. For example, about one-third of the U.S. economy (approximately $3 trillion) is weather sensitive -- such as agriculture, energy, construction, travel, and transportation. Weather data and forecasts play a critical role -- and are transferred to industry and the public through the media, internet, and NOAA Weather Radio. Governments and the public use weather warnings to save lives and prevent destruction of property. Television weathercasters and many weather related firms use weather data and forecasts in their daily operations. Industry uses NOAA data in home construction and design, crop selection, disease control, and fuel delivery and supply. Additionally, industry has applied weather data for deciding such things as automobile fuel delivery system design, the best time to market umbrellas, and even for when the conditions would be best for the mating of honeybees. Increasingly accurate and longer range weather forecasts depend on an ongoing program of research and development.

Research by NOAA's federal laboratories is aimed at assisting NOAA's operational components. NOAA's research is directed at such topic areas as weather forecasting, solar emission forecasting, estimating fish stocks, predicting water resources, warning of tsunamis, and charting ocean bottom topography. The results of such research are transferred to NOAA's operational components to improve prediction, management, and other mission activities.

NOAA's web page at www.noaa.gov details the voluminous amount of research and technology data made available to the public in the form of information products and services, such as weather and climate forecast data, El Nino prediction and monitoring, tides and currents, satellite imagery and direct readout, fishery statistics and information on protected species, air quality, state of the coasts, beach temperatures, and nautical charts, as well as extensive databases on climate, oceans, ice, atmosphere, geophysics, and the sun.

NOAA's primary technology transfer mechanism has historically been the open dissemination of scientific and technical information to individuals, industry, government, and universities. This means of transfer is consistent with the agency's mission and scientific tradition and has been found to be more efficient and economical than transfer through patenting and licensing. Even

so, NOAA continues, where advantageous, to transfer intellectual property through licenses and CRADAs -- including to industry to benefit the competitiveness of U.S. companies.

In FY 2006, NOAA conducted an extensive technology transfer program through applications of meteorological and oceanographic technologies and information, and through open dissemination to individuals, industry, government, and universities. In addition, NOAA provided daily weather forecasts and warnings through the media and NOAA Weather Radio. NOAA technology is transferred through presentations at scientific meetings, publication in peer-reviewed scientific journals, and through NOAA scientific and technical publications. For example, the NOAA laboratories in Boulder, Colorado published 444 articles in scientific journals and 148 papers in NOAA Tech Reports. NOAA Weather Radio has been integrated into the nation's homeland security efforts and will be used to alert citizens to take precautions in response to chemical or nuclear spills and terrorist attacks. The system, called the all-hazards alert system, reaches more than 97 percent of U.S. territory on a 24/7 basis, through broadcasts in the 50 states and in U.S. territories.

NOAA collaborates with other federal research agencies on science and technology development matters of joint interest. For example, NOAA and the Environmental Protection Agency (EPA) team to provide new experimental air quality forecast guidance that enables state and local agencies to issue more accurate and geographically specific air quality warnings to the public. The annual cost of poor air quality to the U.S. from air pollution-related illnesses has been estimated at $150 billion.

Furthermore, to ensure that the United States benefits from and fully exploits scientific research and technology developed abroad, NOAA collaborates and shares information with organizations in countries throughout the world. Through these international relationships, technology is transferred into NOAA for the eventual benefit of U.S. industry and public users. For instance, the understanding and forecasting of global phenomena that occur in the atmosphere, oceans, and on the sun require worldwide collaboration and information sharing. This is accomplished through formal agreements with individual countries and participation in international organizations, such as the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC), and the International Astronomical Union (IAU). NOAA also participates in international scientific programs and shares technology and scientific data, such as in the Global Earth Observation System. This effort involves nearly 50 other countries, the European Commission, and 29 international organizations. NOAA also provides technical assistance and training to individuals from other countries, and participates in a visiting scientist program. In addition, environmental data is shared through NOAA participation in the World Data Center program.

In the future, NOAA will continue to direct its technology transfer and international collaboration activities toward four mission goals: 1. protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management; 2. understand climate variability and change to enhance society's ability to plan and respond; 3. serve society's needs for weather and water information; and 4. support the Nation's commerce with information for safe, efficient, and environmentally-sound transportation.

2. Performance in FY 2006: Activities and Achievements

■ Collaborative Relationships for Research & Development

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **CRADA**s, total active in the FY [1]	10	11	9	8	6
- New, executed in the FY	1	0	0	0	0
▪ Traditional CRADAs, [2] total active in the FY	10	11	9	8	6
- New, executed in the FY	1	0	0	0	0
▪ Non-traditional CRADAs, [3] total active in the FY	0	0	0	0	0
- New, executed in the FY	0	0	0	0	0
● **Other types of collaborative R&D relationships**	0	0	0	0	0

CRADA = Cooperative Research and Development Agreement.

(1) "Active" = legally in force at any time during the FY. "Total active" is comprehensive of all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.

(3) CRADAs used for special purposes -- such as, material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● New inventions disclosed in the FY [1]	1	5	2	1	4
● Patent applications filed in the FY [2]	0	0	0	0	0
● Patents issued in the FY	5	1	1	1	0

(1) Inventions arising at the federal lab.

(2) Tally includes U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes provisional, continuation, duplicate foreign, and PCT applications.

■ Licensing

Profile of Active Licenses

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **All licenses**, number total active in the FY [1]	3	5	5	4	5
▫ New, executed in the FY	1	2	0	0	1
▪ **Invention licenses**, total active in the FY	3	5	5	4	5
▫ New, executed in the FY	1	2	0	0	1
- Patent licenses, [2] total active in FY	3	5	5	4	5
▫ New, executed in the FY	1	2	0	0	1
- Material transfer licenses (inventions), total active	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Other invention licenses, total active in the FY	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Copyright licenses (fee bearing)					
▫ New, executed in the FY					
- Material transfer licenses (non-inventions), total active					
▫ New, executed in the FY					
- Other, total active in the FY					
▫ New, executed in the FY					

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (hybrid licenses) are reported as patent licenses and are not included in the count of copyright licenses.

(1) "Active" = legally in force at any time during the FY.

(2) Patent license tally includes patent applications which are licensed.

Licensing Management

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Elapsed execution time**, (1) licenses granted in the FY					
▪ **Invention licenses**					
▫ Average , months	*8.0	**	**	**	*7.0
▫ Minimum					
▫ Maximum					
- Patent licenses (2)					
▫ Average , months	*8.0	**	**	**	*7.0
▫ Minimum					
▫ Maximum					
● **Licenses terminated for cause, number in the FY**					
▪ Invention licenses	0	0	0	0	0
- Patent licenses (2)	0	0	0	0	0

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a sub-class.

* Only a single new license was executed in FY 2001 and 2002. Thus, there is no range of execution times to report.

** No new licenses were executed in FY 2004 or FY 2005.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)

(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **All income bearing licenses**, total number	3	5	5	4	5
▫ Exclusive	1	1	1	1	1
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	2	4	4	3	4
▪ **Invention licenses**, income bearing	3	5	5	4	5
▫ Exclusive	1	1	1	1	1
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	2	4	4	3	4
- Patent licenses, (1) income bearing	3	5	5	4	5
▫ Exclusive	1	1	1	1	1
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	2	4	4	3	4
▪ **Other IP licenses**, income bearing	0	0	0	0	0
▫ Exclusive					
▫ Partially exclusive					
▫ Non-exclusive					
- Copyright licenses (fee bearing)					
▫ Exclusive					
▫ Partially exclusive					
▫ Non-exclusive					
● **All royalty bearing licenses**, (2) total number	3	5	5	4	5
▪ **Invention licenses**, royalty bearing	3	5	5	4	5
- Patent licenses, (1) royalty bearing	3	5	5	4	5
▪ **Other IP licenses**, royalty bearing	0	0	0	0	0
- Copyright licenses (fee bearing)					

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee including patent costs.

(1) Patent license tally includes patent applications which are licensed.

(2) Note that royalties are one component of total license income.

Income from Licenses

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Total income**, all licenses active in the FY [1]	$9,402	$4,716	$24,961	$16,100	$13,100
▪ **Invention licenses**	$9,402	$4,716	$24,961	$16,100	$13,100
- Patent licenses [2]	$9,402	$4,716	$24,961	$16,100	$13,100
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
- Copyright licenses					
● **Total Earned Royalty Income** (ERI) [3]	$9,402	$4,716	$24,961	$16,100	$13,100
▫ Median ERI	$1,333	$696	$1,923	$1,000	$1,000
▫ Minimum ERI	$100	$100	$116	$100	$100
▫ Maximum ERI	$7,969	$1,920	$21,000	$9,000	$5,000
▫ ERI from top 1% of licenses	$7,969	$1,920	$21,000	$9,000	$5,000
▫ ERI from top 5% of licenses	$7,969	$1,920	$21,000	$9,000	$5,000
▫ ERI from top 20% of licenses	$7,969	$1,920	$21,000	$9,000	$5,000
▪ **Invention licenses**	$9,402	$4,716	$24,961	$16,100	$13,100
▫ Median ERI	$1,333	$696	$1,923	$1,000	$1,000
▫ Minimum ERI	$100	$100	$116	$100	$100
▫ Maximum ERI	$7,969	$1,920	$21,000	$9,000	$5,000
▫ ERI from top 1% of licenses	$7,969	$1,920	$21,000	$9,000	$5,000
▫ ERI from top 5% of licenses	$7,969	$1,920	$21,000	$9,000	$5,000
▫ ERI from top 20% of licenses	$7,969	$1,920	$21,000	$9,000	$5,000
- Patent licenses [2]	$9,402	$4,716	$24,961	$16,100	$13,100
▫ Median ERI	$1,333	$696	$1,923	$1,000	$1,000
▫ Minimum ERI	$100	$100	$116	$100	$100
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▫ ERI from top 20% of licenses	$7,969	$1,920	$21,000	$9,000	$5,000
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
▫ ERI from top 20% of licenses					
- Copyright licenses					
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					
▫ ERI from top 20% of licenses					

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee including patent costs.

(2) Patent license tally includes patent applications which are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or of units sold). Not a license issue fee or a minimum royalty.

Disposition of License Income

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● Income distributed [1]					
▪ Invention licenses, total distributed	$9,402	$4,716	$24,961	$16,100	$13,100
- To inventor(s)	$696 (7%)	$1,130 (24%)	$11,070 (44%)	$8,400 (52%)	$7,500 (57%)
- To other	$8,706 (93%)	$3,586 (76%)	$13,891 (56%)	$7,700 (48%)	$5,600 (43%)
- Patent licenses, [2] total distributed	$9,402	$4,716	$24,961	$16,100	$13,100
- To inventor(s)	$696 (7%)	$1,130 (24%)	$11,070 (44%)	$8,400 (52%)	$7,500 (57%)
- To other	$8,706 (93%)	$3,586 (76%)	$13,891 (56%)	$7,700 (48%)	$5,600 (43%)

Invention licenses are the chief policy interest regarding disposition of income; content of table reflects this focus.

(1) Income includes royalties and other payments received during the FY.

(2) Patent license tally includes patent applications which are licensed.

■ Other Performance Measures Deemed Important by the Agency

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Journal articles published	529	626	419	397	444
Technical reports published	363	245	300	226	148

Represents publications by NOAA laboratories in Boulder, Colorado.

■ Outcomes from Technology Transfer

For this year's annual report, the cases described below are provided as examples of the downstream outcomes being achieved by NOAA technology transfer efforts:

• Precision airdrop system. Problems associated with aerial re-supply resulted in Department of Defense initiation of the Precision Airdrop System (PADS), a program to develop capability to airdrop ballistic parachute payloads accurately and safely from high altitude. Wind errors (forecast versus actual) are the largest contributors to the total error budget of a ballistic airdrop system, especially in mountainous terrain. The development team, comprised by the U.S. Army, Planning Systems Inc. (civilian contractor), and NOAA focused on reducing the wind error budget through the real-time measurement of winds over and near a planned drop zone using mature technologies. The developed, fully-operational PADS was transferred to nations in NATO (Sweden, Spain, Belgium, Norway), the Middle East (Saudi Arabia, India, and Israel), and Pacific (Australia, Japan, and Singapore), and it now serves domestic, civilian, and military applications. NOAA tailored the Local Analysis and Prediction System (LAPS), along with its components and interfaces, to operate within the PADS software architecture on the PADS laptop-computer, in its unique operating environment. LAPS components were tailored and applied to accomplish two mission-critical processes: 1) an analysis using the full physics and dynamics of real-time wind data and high-resolution forecast fields from a weather center to produce an accurate analyses of 3-D winds and density; and 2) a short-range forecast using parametric time-tendencies from weather-center forecast fields to produce an accurate 0-1 hour forecast of 3D-wind and density at the planned time of airdrop. These winds and densities are further processed by the PADS payload-descent simulator to produce the Computed Air Release Point (CARP) executed by the airdrop aircrew.

• **Air freezing index for construction industry**. NOAA developed an air freezing index (AFI) that was transferred to the U.S. construction industry for use in building frost protected shallow foundations (FPSF). Home builders can now construct a frost protected shallow foundation (FPSF), which is a practical alternative to deeper and more costly foundations that are less environmentally friendly. The Index produces significant savings to homeowners and the environment. The NOAA designers of the AFI received the 2006 NOAA Technology Transfer Award.

FPSF construction is directly reliant upon the AFI and incorporates strategically placed insulation to raise the frost depth around a building. At the construction site, the AFI is used to determine the required footing depth and the amount of insulation needed to protect a building foundation from frost heave.

This technology transfer has resulted in the following quantified savings to homeowners & the environment:

Construction Cost Savings:

a) Conventional deep foundations not needed: depths now 16 inches vs. several feet in severe climates
b) Minimizes site disturbance; more environmentally friendly
c) Building savings: 1.1 – 3.8% of total home cost

d) Projected Annual Construction Savings to U.S. homeowners: $300 million

Energy Savings:

a) Added insulation protects foundation from frost heave
b) Added insulation also saves on home heating cost
c) Amount of insulation determined by the AFI
d) Projected annual energy savings to the US homeowners: 590 megawatts; Equivalent to saving 8.6 million gallons of gasoline

Builders can interpolate the statistic from maps provided by NOAA: http://www.ncdc.noaa.gov/oa/fpsf/fpsfmaps.html.

Three main web sites that can also be searched for further information on the AFI:

-NOAA http://www.ncdc.noaa.gov/oa/fpsf/

-ASCE http://www.techstreet.com/cgi-bin/detail?product_id=946635

-NAHB http://www.nahb.org/fileUpload_details.aspx?contentTypeID=7&contentID=434

• **Spot forecasts aid wildfire control.** NOAA has issued nearly 3,000 spot forecasts for wildfires and over 7,000 for natural resource management. For example, the Sawtooth fire near California 's Yucca Valley recently burned over 60,000 acres, demolishing 50 homes and causing one fatality. NOAA's San Diego forecast office provided two spot forecasts on July 10 and another three on July 11 to aid firefighters in successfully battling this blaze. Covering relatively small geographic areas, these spot forecasts require NOAA meteorologists to apply micro and mesoscale knowledge about temperature, humidity trends, wind speed and direction, smoke dispersion, and expected rainfall and lightning, usually for a 36-hour period. (http://fire.boi.noaa.gov)

• **Aid to spacecraft launches and landings.** When the space shuttle Discovery touched down, it was a triumph not only for NASA, but also for NOAA's National Weather Service Spaceflight Meteorology Group. NOAA has been an integral part of spaceflight since the space program began over 40 years ago. NOAA monitors and forecasts landing weather. NASA will not launch a space shuttle unless, should an emergency arise, there is a safe place to land shortly after take-off. That means forecasting weather conditions at U.S. landing sites in Florida, California, New Mexico, and also sites in France and Spain. NOAA also issues a key weather forecast for the critical end-of-mission shuttle landing decision by NASA's Mission Control. NOAA examines a range of weather parameters. For example, the cloud ceiling must be at least 8,000 feet, visibility must be five miles or greater, and crosswinds must be 15 knots or less. Precipitation should be at least 30 miles away for scheduled landings, and 20 miles away for launch abort landings. At times, the sky is beautiful in Florida yet the space shuttle does not fly. That is because the emergency landing site weather does not fit parameters required to ensure a safe landing in a launch emergency. Collaborating with Houston Mission Control and Moscow Control Center, NOAA also provides forecasts for worldwide Soyuz landing sites. Should astronauts and cosmonauts ever need to make an emergency escape from the space station on the Soyuz, these forecasts would be vital. (www.srh.noaa.gov/smg)

• **First salt marsh ecosystem model.** NOAA transferred a computer model of salt marsh restoration to Gulf of Maine coastal managers in 2006. MarshMD is the first salt marsh ecosystem model of its kind and resulted from a synthesis of original research and published

scientific findings. The model was distributed to coastal managers through CDs and workshops. MarshMD integrates components that simulate plant biomass production, marsh elevation dynamics, tidal hydrology, and plant succession. The Office of Intellectual Property at the University of New Hampshire is investigating market opportunities. This investigation includes documentation of intellectual property status and a comprehensive market analysis.

• **Tsunami warning network expanded.** NOAA deployed the first Deep-Ocean Assessment and Reporting of Tsunamis (DART) station in the Atlantic Ocean. The buoy station is located about 280 miles east-southeast of Cape Fear, North Carolina. NOAA also deployed DART stations in the Caribbean Sea and Gulf of Mexico. These new DART stations are part of the U.S. tsunami warning system expansion project and also contribute the ongoing effort to maintain and improve capabilities for the early detection and real-time reporting of tsunamis in the open ocean. Ten DART stations maintained by the U.S. are already operational in the Pacific Ocean. (For further information see www.tsunami.noaa.gov .)

• **Tsunami preparedness materials.** NOAA transferred preparedness materials and related tools to help communities in regions potentially affected by tsunamis. One such tool is "inundation mapping," which gives emergency managers graphical information to clarify the extent of potential coastal damage that may be caused by various tsunami/wave heights. In the U.S., there are 512 coastal communities that can gain from protection planning using 75 tsunami inundation maps. NOAA's West Coast/Alaska Tsunami Warning Center in Palmer, Alaska transferred tsunami information bulletins to coastal populations and emergency management officials in California, Oregon, Washington, Alaska and the province of British Columbia. The Pacific Tsunami Warning Center in Hawaii transfers materials to most countries in the Pacific Basin as well as to Hawaii and all other U.S. interests in the Pacific outside of Alaska and the U.S. West Coast.

• **Tsunami warning system.** NOAA hosted several visitors from Indian Ocean nations in 2006 to provide the background and specific technological information regarding tsunami detection and reporting platforms as well as numerical modeling of tsunamis. NOAA also participated with the U.S. State Department Agency for International Development (USAID) in meetings in India, Indonesia, and Australia to assist Indian Ocean nations in developing a regional tsunami warning system.

• **Hawaii becomes the first tsunami ready state.** NOAA transferred Tsunami and storm information, data, and advice to Hawaii, helping it to become the first state of the United States to achieve the status of TsunamiReady and StormReady. Through these programs, Hawaii is better prepared to help protect the lives and property of its residents and visitors during severe weather events. The TsunamiReady and StormReady programs are voluntary, and provide communities with the information they need through a partnership between the local NOAA National Weather Service offices and state, county, and local emergency managers. StormReady currently has more than 990 StormReady status communities in 48 states and TsunamiReady has 20 TsunamiReady status communities in 6 states.

• **Disneyland resort storm ready.** NOAA's National Weather Service recently helped Disneyland Resort in California to become a StormReady community. The voluntary StormReady program provides communities with clear-cut advice from their local NOAA National Weather Service forecast offices. NOAA developed the StormReady program to help protect every American from hazardous weather. StormReady helps communities improve

communications and safety resources needed to save lives -- before, during, and after a weather event. High winds, heavy rain, flooding, and thunderstorms are likely to affect the southern California region. Disneyland has set up its own emergency operations center with 24-hour warning capabilities. Along with the Walt Disney World Resort in Florida, the Disneyland Resort joins more than 1,070 StormReady communities throughout the United States and is one of 18 such communities in California

● **Gulf Coast storm tide information.** The Gulf Coast was able to more frequently update storm tide information this past hurricane season (2006) thanks to technology upgrades implemented to the 23 National Water Level Observation Network (NWLON) stations along the Gulf Coast. The technology upgrades enable the near real time transmission of NWLON data to NOAA National Weather Service (NWS) forecasters, emergency responders, mariners, the public, and other users. The upgrades allow NWLON stations to transmit their data every six minutes over the NOAA geostationary satellites, making the data available within minutes on the internet at: http://tidesonline.nos.noaa.gov Prior to the technology upgrades, NWLON stations provided data every sixty minutes. NOAA has also worked with state governments and other partners along the Gulf Coast to almost double its water level observing capacity in that region. NOAA now receives, analyzes, and disseminates data from water level stations operated to NWLON standards by the Texas Coastal Ocean Observing Network and through Tampa Bay and Houston-Galveston Physical Oceanographic Real Time Systems. Having access to observed storm tide heights can improve NWS storm surge forecast accuracy, enable emergency responders to make critical evacuation decisions, and provide mariners with critical water depth information.

• Hazard mapping system to Mexican weather service. NOAA successfully transfered and implemented the Hazard Mapping System (HMS) for fire and smoke detection to the Servicio Meteorologico Nacional (National Weather Service of Mexico). HMS is an interactive tool to identify fires and associated smoke emissions in an operational environment. This state-of-the-art satellite data visualization and analysis system utilizes multiple geostationary and polar orbiting environmental satellites as input to automated fire or hotspot detection algorithms specifically designed for each sensor.

Analysts apply quality control procedures for the automated fire detections by eliminating those that are deemed to be false and adding hotspots that the algorithms have not detected via a thorough examination of real time satellite imagery. The HMS also allows analysts to denote fires that are producing smoke emissions. These fire locations are in turn used as input to a smoke trajectory model developed by NOAA and run to provide a forecast of smoke emissions and dispersion through 48 hours. By using the HMS, the Mexican weather service can better support their Forestry Service and civil emergency responders. The output of the HMS -- including both fire detectors and smoke plume outlines as well as auxiliary data layers such as land cover -- is available via a WebGIS page at http://www.firedetect.noaa.gov/viewer.htm . The fire and smoke analyses are also made available to users in several standard formats via the Internet at http://gp16.ssd.nesdis.noaa.gov/FIRE/fire.html. A more detailed description of the system is located at http://www.ssd.noaa.gov/PS/FIRE/hms.html.

• **Wind model to State of Florida.** NOAA transferred a wind model to the State of Florida for use in its CAT (Catastrophe) model. Florida's recently mandated annual hurricane insurance deductible is based on its catastrophe modeling system.

• **Cutting-edge weather forecast model.** NOAA has transferred an advanced weather forecast (WRF) model that predicts several types of extreme weather with substantially improved accuracy. The high-resolution WRF model is the first to serve as both the backbone of the nation's public weather forecasts and as a tool for cutting-edge weather research. The new model was created through a partnership between NOAA, the National Center for Atmospheric Research and more than 150 other organizations and universities in the United States and abroad. The U.S. Air Force Weather Agency has used WRF for several areas of operations around the world. The new model is being adopted by the national weather agencies of Taiwan, South Korea, China and India. The model's research-oriented version has been transferred to approximately 4,000 people in 77 countries to study a wide range of weather problems.

• **Greenhouse gas information to World Meteorological Organization.** NOAA transferred its Annual Greenhouse Gas Index (AGGI) to the World Meteorological Organization (WMO) for inclusion in its annual Greenhouse Gas Bulletin. The AGGI is a benchmark measurement of gases in the atmosphere that affects the Earth's climate and provides a scientific basis for management and policy decisions by Government and industry. NOAA's AGGI is a recently developed index that provides an easily understood and scientifically unambiguous point of comparison for tracking annual changes in levels of atmospheric greenhouse gases. This year's AGGI reflects an increase in carbon dioxide (CO2) and nitrous oxide (N2O), but a leveling off of methane (CH4), and a decline in two chlorofluorocarbons (CFCs), gases that help cause the Antarctic ozone hole. Overall, the AGGI shows a continuing, steady rise in the amount of heat-trapping gases in the atmosphere. (See the following for the WMO Greenhouse Gas Bulletin:

www.wmo.int/web/arep/gaw/ghg/ghg-bulletin-en-03-06.pdf.)

• **Debris flow warnings.** NOAA's National Weather Service and Office of Oceanic and Atmospheric Research partnered with the U.S. Geological Survey to deliver life-saving watches and warnings for debris flow events. Once smoke clears from a wildfire, the danger is not over. Flash floods and debris flows can be one of the most hazardous consequences of rainfall on burned hill slopes. The powerful force of rushing water, soil, and rock, both within the burned area and downstream, can cause injury or death and destroy culverts, bridges, roadways, and structures. Sixteen people, for example, were killed on Christmas Day 2003 when a debris flow hit recently burned hill slopes in San Bernardino County. Nearly $1 billion was spent to clean up and repair roadways following this event. Many areas in southern California are prone to wildfires in close proximity to housing developments, and heavy precipitation in these areas has resulted in flash floods and debris flows. These warnings are key to safety in the region.

• **Advice on surface transportation weather.** Three years ago, NOAA released its first report on improving surface transportation, safety and cost efficiency through improved weather information products. The report, "Weather Information for Surface Transportation," spurred a rapid expansion of interagency, intergovernmental and public-private efforts, all designed to enhance safety and mitigate economic impacts of transportation weather. This year's update of this report provides new data on the risks of transportation weather to America's safety, security, quality of life, and economic activity. Acting on the information provided by NOAA, some roadway freight lines have equipped their trucks to receive NOAA Public Alert Radio broadcasts and some automobile manufacturers offer the capability as an option. The updated report also includes weather information for railway, marine and airport ground operations, pipeline systems -- as well as the impact of weather on traffic congestion.

• **CRADA signed with Boeing Aerospace.** NOAA entered into a CRADA agreement with Boeing Aerospace on October 6, 2005 (in FY 2006), to bring new satellite data sets into the Integrated Oceanic Observing System (IOOS), and to further coastal remote sensing. The title of the agreement is "A State of the Art Earth Science Information System." This CRADA funds a graduate student to undertake applied research and development to determine water levels in Chesapeake Bay using satellite-derived altimetry data. The work is performed at the University of Maryland and the NOAA Cooperative Institute for Climate Studies (co-located at the University).

• **Coral reef warning system.** NOAA expanded coverage for the NOAA Coral Reef Watch Satellite Bleaching Alert monitoring system from 6 Caribbean sites to a total of 24 sites throughout the U.S, and Caribbean. The expansion was made possible through collaborative efforts with NOAA, the World Bank, and the Global Environment Facility. The warning system will give local officials advance warning that a bleaching event is about to occur. With this advance notice, officials can take measures to prevent human activity, such as diving, boating and recreational fishing, from adding to the stress of higher ocean temperature already affecting the coral reefs. Preliminary data summaries, as well as maps of coral bleaching and thermal stress are posted on the web at: http://coralreefwatch.noaa.gov/caribbean2005.

• **New Great Lakes weather observation platforms.** More than a dozen new weather observation platforms deployed in the Great Lakes region by NOAA are providing valuable information directly to recreational and commercial boaters and to NOAA National Weather Service meteorologists issuing marine weather forecasts and life-saving warnings. NOAA's National Weather Service, National Ocean Service, and Great Lakes Environmental Research Laboratory joined forces to deploy 13 new coastal weather observation sites throughout the Great Lakes. These observation platforms now provide critical information on wind speed and direction, temperature and atmospheric pressure and are updated and broadcast every hour on the Internet for public consumption. Boaters use the information to avoid perilous situations on the water, and NOAA forecasters incorporate the data with other factors to improve weather and marine forecasts. Information from these platforms are improving wind and wave forecasts, assisting in the response to coastal hazards, strengthening coastal resource management and improving the safety of marine commerce and recreation in the Great Lakes. Mariners on the Great Lakes are very weather dependent, not only for their own safety but also for protecting their commercial investments. Each year, nearly 200 million tons of cargo, mostly iron ore, limestone and coal, are shipped over the Great Lakes' sometimes treacherous waters, which also are home to large recreational and commercial fisheries.

• **Navigation information for Volvo ocean racers.** NOAA helped to ensure safe navigation for the Volvo Ocean Race, an eight-month round the world sailing race covering 32,500 nautical miles over four oceans with port stops in nine countries. NOAA models provided near real-time sea surface currents, sea surface temperature, surface winds, and wave height and direction. NOAA provided graphics for every leg of the race and multiple regions within each leg, information that Volvo's race meteorologist used to provide forecasts for the racers. SARSAT, an instrument package flown aboard NOAA environmental satellites, provided life-saving capability to the racers. Each crew carries an Emergency Position Indicating Radio Beacon (EPIRB) as part of the SARSAT system. (See: www.sarsat.noaa.gov)

• **Ozone forecasting tool for western U.S.** The NOAA National Weather Service, in partnership with the Environmental Protection Agency, now provides experimental forecast guidance for ground-level ozone for the western half of the contiguous United States -- a total of 17 states from the Plains to the Pacific Coast. This is in addition to the air quality forecast guidance currently prepared for the eastern half of the U.S. This new forecast guidance will provide accurate projections of ozone levels near the ground, linked to weather forecast models.

Twice daily, NOAA supercomputers produce ground-level ozone forecasts, which are available on NOAA's National Weather Service (www.nws.noaa.gov/aq) and EPA data servers (http://airnow.gov/index.cfm?action=airnow.main). Hour-by-hour ozone forecasts, through midnight of the following day, are available online, providing information for the onset, severity and duration of poor air quality for more than 290 million people from coast to coast. This product also serves as a tool that local and state air quality forecasters can use when creating daily air quality outlooks and issuing poor air alerts. Air quality forecasts can help Americans reduce their exposure to ozone pollution, which is a special concern for children and people with asthma and other lung diseases. This new experimental guidance expands coverage westward to the Pacific Ocean and will enable additional state and local agencies to issue enhanced and more geographically specific ozone-based air quality warnings to the public. States included in this experimental expansion are Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming, and the remaining western portions of Kansas, Nebraska, North Dakota, Oklahoma, South Dakota and Texas. The eastern parts of these states were included in last year's expansion into the central U.S.

• **Sea Grant provides information to Gulf residents.** In the wake of two of the worst natural disasters in our Nation's history, hurricanes Katrina and Rita, NOAA's Sea Grant is providing critical information to residents and business owners in communities affected by the storms. The Louisiana Sea Grant College Program has launched a Recovery Resources website at \ The site offers information on wetlands, seafood and water quality to ports, economic impacts and rebuilding concerns. Experts in a variety of fields provide the best current information, and updates are made as new data become available. Also Sea Grant and NOAA's National Marine Fisheries Service are collaborating to place a Vietnamese-speaking Sea Grant extension agent in Mississippi to work on recovery efforts with the fishing industry. The agent assists the Asian communities in the affected areas in understanding hurricane relief programs, including NOAA Fisheries disaster programs that may be implemented. The agent also collaborates with NOAA Fisheries, Pascagoula Laboratory to communicate with Asian fishers in the Gulf Region. In the wake of Hurricane Katrina, *vibrio vulnificus*, a naturally occurring marine bacterium that can cause serious infections in humans, could become an even greater danger. California and Georgia Sea Grant have developed a vibrio informational website at http://safeoysters.org. The site includes information about how the disease impacts shellfish and its threat to humans through skin wounds.

• **NEXRAD dual polarization modification.** NOAA is leading a research and development effort on the dual polarization modification of the NEXRAD operational radar system. Improved radar data will improve support to severe weather warnings, flood and flash flood warnings, and general forecast services. The NEXRAD tri-agencies (Departments of Commerce, Defense, and Transportation) have determined that adding Dual Polarization capability to the WSR-88D radar would provide mission benefits including improved hail detection for severe thunderstorm warnings, improved rainfall estimation for flood and flash flood warnings, rain/snow

discrimination for winter weather warnings and advisories, icing conditions for air and ground transportation, data retrieval from areas of partial beam blockage to improve services in mountainous terrain, and removal of non-weather artifacts such as birds and ground clutter to improve overall data quality for algorithms and numerical model input. The Dual Polarization modification to NEXRAD will improve precipitation estimates and will have a national economic benefit of $690 million a year as a result of improvements in flash flood warnings.

Appendix:

A. Progress in Improving the Agency's Performance Metrics for Tech Transfer

In future reports, the agency will list mission-related data that addresses NOAA's primary technology transfer mechanism, which is the open dissemination of its products and services. Presentations at scientific meetings, collaborative research (other than CRADAs), visiting scientists, data exchange agreements, numbers of data requests received by NOAA's environmental data centers, and external agency studies are being investigated as metrics for reporting this aspect of NOAA's technology transfer activities. Annual figures for the number of publications in scientific journals and NOAA technical reports are already included.

B. Information on Other Agency Technology Transfer Activities

Data and Resources Available on NOAA Web Pages

NOAA makes available on its web pages large amounts of information and data for transfer to a wide variety of users. Some of the new or updated web pages are as follows:

• Hurricane Katrina web site. This Website offers a comprehensive look at the historic storm, providing details on the development of the storm, its power, and destruction. The site also details NOAA's multi-faceted response to the storm's aftermath, including floods, testing fisheries, clearing waterways, and identifying and cleaning up oil spills. In addition, there are dozens of photos and satellite images that capture Hurricane Katrina's march into the Gulf of Mexico and its subsequent landfall on the U.S. Gulf Coast. Although Katrina will be recorded as the most destructive storm in terms of economic losses, it did not exceed the human losses in storms such as the Galveston Hurricane of 1900, which killed as many as 6,000-12,000 people, and led to almost complete destruction of coastal Galveston. Estimates from the insurance industry as of late August 2006, have reached approximately $60 billion in insured losses (including flood damage) from Katrina. The storm could cost the Gulf Coast states as much as an additional $120 billion. (See www.katrina.noaa.gov).

• **Critical Gulf coast storm information site.** NOAA has instituted C-SIDE, a comprehensive Gulf Coast Storm Information Center, providing direct linkage to local, state and federal information as it pertains to severe weather preparation and monitoring across the Gulf of Mexico coastal region. (C-Side stands for Coastal Studies, Information and Data for the Ecosystem.) The site includes recommendations for home preparation and evacuation as well as time-sensitive data, weather products, and storm surge information. Post-storm assessments on the ecosystem, response and recovery products, environmental data and information, and remotely sensed data and imagery for affected areas are available for response and recovery efforts. C-Side fills the need to provide potentially life-saving information in hazardous circumstances, especially when coastal demographics have changed a great deal over the past 25 years, and there has been an influx of people unfamiliar with the threat of tropical events. (http://ecowatch.ncddc.noaa.gov/c-side).

• **Coast Pilot Disaster Impact website.** NOAA has established a special Coast Pilot Disaster Impact website to help speed the recovery efforts of 21 significant port facilities in Texas, Louisiana and Mississippi impacted by Hurricanes Katrina and Rita. The Coast Pilot Disaster Impact website is http://www.nauticalcharts.noaa.gov/nsd/cpgulf/cpgulf.htm. The purpose of the

Coast Pilot Disaster Impact website is to help facilitate the recovery efforts by providing a resource for port facility managers to send critical information to NOAA's Coast Survey. The information received will be promptly evaluated and posted on the website where mariners can quickly access the most current information available regarding the impacted ports. The website will remain active until all impacted ports have fully recovered. The website data will include information on: pilotage, channel, side and approach depths, anchorages locations, obstruction hazards, bridge information, storage and supply facility information, overhead or surface bottom cabling, small craft facilities, status of wreck removals, and wharf information. NOAA publishes books covering the entire United States coast. These books contain important information about port facilities, channel depths, and hazards to navigation. This information is often drastically altered by a disaster such as a hurricane and it changes again as the port recovers. The website will make these changes available rapidly online.

• **Coastwatch program serves east coast.** NOAA has opened the East Coast Node of its CoastWatch program. This will broaden the availability of environmental data for the Atlantic Ocean collected by the agency's geostationary and polar-orbiting satellites. The East Coast Node, part of a network of other CoastWatch offices around the country, gathers data, including sea surface temperature, ocean surface winds, and chlorophyll-a levels and posts the information on the Internet. Scientists, resource managers and fishermen use the data to forecast atmospheric events, predict harmful algal blooms, and study fish and marine mammal distribution, along the eastern seaboard of the United States. See: http://coastwatch.chesapeakebay.noaa.gov

• **New version of nowCOAST planning tool.** In a continuing effort to improve maritime safety and commerce through the monitoring of physical changes in weather, oceanographic, and river conditions, NOAA has launched an updated version of the popular nowCOAST Web portal. nowCOAST is a planning aid for commercial and recreational mariners, coastal managers, emergency responders, marine educators, and researchers to discover and display real-time coastal information. By aggregating a wide variety of this information in one location and providing access and visualization in an easy-to-use manner, nowCOAST serves as a unique and powerful tool for the marine community to visualize environmental conditions via the Internet. The new version of nowCOAST allows users to view real-time surface observations on-the-map along with the latest GOES satellite cloud imagery, and NOAA National Weather Service weather radar images. The GOES imagery is updated every half hour and the weather radar mosaic is updated every 15 minutes. nowCOAST uses Geographic Information System technology allowing users to overlay other datasets and NOAA forecast products with these on-map displays to get a detailed picture of present conditions from the top of the watershed to the ocean. nowCOAST's on-map display of real-time surface meteorological and oceanographic observations includes hourly updated data from federal and regional observing networks on land and water. In addition to these new data, nowCOAST includes geo-referenced hyperlinks to observations from river and water quality observing networks, coastal Web-cams, as well as NOAA marine and weather forecasts and forecast guidance from NOAA weather, ocean, estuarine, and river computer prediction models. NowCOAST includes an interface to accommodate both novice and experienced GIS users to allow both to quickly view real-time environmental conditions for any U.S coastal area. Users can access information via four pull down menus or use standard GIS tools such as zooming in and out to change map scale; and overlaying different types of observations or forecasts for comparison purposes. By combining these capabilities, nowCOAST provides a rapid way to discover and view a wide range of real-

time coastal observational and NOAA forecast information. The nowCOAST Web portal allows users to specify particular areas of interest and provides both on-map display of environmental conditions and direct access to Web pages displaying observational and forecast information. nowCOAST web page: http://nowcoast.noaa.gov.

● **New marine science web portal.** NOAA and "Immersion Presents" launched oceanslive.org, a marine science portal that offers live video and special content to educate people of all ages about the ocean, including national marine sanctuaries. "Immersion Presents" is an after-school science education program founded by ocean explorer Robert Ballard. In addition to watching live video from research expeditions, the portal's visitors can learn more about oceanography, marine life, conservation and preservation, marine research technologies, and the nation's maritime heritage. To complement the video broadcasts, the portal offers lesson plans, videos, puzzles and games based on the marine environment. The portal's first live telepresence broadcast on July 17 focused on a research expedition to the wreck of the Civil War ironclad the USS Monitor, located off the North Carolina coast. The expedition is a collaborative effort between the Institute for Exploration and the NOAA Monitor National Marine Sanctuary to generate a digital photographic mosaic of the ship's hull and surrounding wreckage. Live programming was fed via Internet to sites across the country, and also was converted for broadcast through the oceanslive.org portal.

• **Climate models available.** NOAA has developed timely, state-of-art model simulations of past, present, and future climates. NOAA prepared over 7,000 years of climate simulations and enabled open access to the data sets. This output is easily available through the Internet. A large amount of data has been shipped to the repository of the Department of Energy's Program for Climate Model Diagnosis and Intercomparison (PCMDI); the information is also available locally from a dedicated NOAA Web portal. Over 1200 users have downloaded data from NOAA; 293 users have accessed the PCMDI site. Over 20,000 gigabytes of data (enough to completely fill the disks of 200 PCs) have been distributed. A broad cross section of international and national researchers has been served by these actions.

• **Weather radar viewer.** Data from NOAA's Weather Surveillance Radar 1988 Doppler (WSR-88D), generally known as NEXRAD, are in high demand globally by both the public and private sectors. To provide better support to these end users, NOAA has developed visualization tools for browsing and displaying these data. The NOAA Interactive Weather Radar Viewer and Data Exporter loads WSR-88D S-band volume scan data, known as Level-II, and derived products, known as Level-III, into an OPEN GIS compliant environment. The application is launched via Java Web Start and runs on the client machine while accessing these data remotely from the NOAA archive or in near real time from other servers. The NOAA Interactive Weather Radar Viewer provides tools for custom data overlays, animations and basic queries. The export of images and movies is provided in multiple formats that support the "blending" of radar data with other types of data. The Data Exporter allows for data export in both vector polygon and raster formats. Instructions for using the Radar Data Viewer and Exporter can be found at the following web page: (http://www.ncdc.noaa.gov/oa/radar/jnx/index.html). A tutorial is also available at: (http://www.ncdc.noaa.gov/oa/radar/jnx/jnxv-basics.php).

• **Users of Scientific Graphics toolkit and ncBrowse increase.** These Java-based tools, developed by NOAA, which more easily visualize oceanographic (and other) data for both Web-based and desktop applications had increased users in 2006. The Scientific Graphics Toolkit (SGT) is designed to aid developers in producing scientific graphics applications. SGT Beans

can be used with several Java integrated development environments (NetBeans, JBuilder, etc.) and provides a graphical environment to configure and develop SGT applications. The number of users increased to over 11,000 from 77 countries, including users from Australia, France, Germany, Italy, Japan, Poland, Russian Federation, South Africa, Switzerland, and the United Kingdom . ncBrowse is a general purpose Java desktop application designed to enable users to interactively browse and visualize data from netCDF files and OPeNDAP resources. netCDF is a file format commonly used by the oceanographic community to store both observations and model results. The number of ncBrowse users has increased to over 9,300 from 74 countries, including Australia, Canada, France, Germany, Japan, Norway, Poland, Russian Federation, Sweden, and the United Kingdom.

• **Web-based access to distributed data sets**. At the end of FY 2006, the number of users of the NOAA-developed Live Access Server (LAS) is estimated to have increased to 50-75 systems. LAS is used by other Federal Agencies (NASA, Navy, DOE); internationally, in support of major collaborations (Global Ocean Data Assimilation Experiment, GODAE; Hybrid Coordinate Ocean Model, HYCOM; and the International Pacific Research Center, IPRC); and at individual ocean research institutions in Japan, France, Germany, Italy, and other nations.

Information Transfer Through Outreach and Education

NOAA also transfers large amounts of information through outreach efforts and through education of the public, teachers, and students. Education is also an important way of stimulating students to become future meteorologists, oceanographers, and fishery scientists.

● NOAA transfers hurricane awareness information. NOAA's Hurricane Awareness Tour came to a successful conclusion in Tampa, Fla., delivering its message of the need for hurricane preparedness to thousands of visitors and media audiences. Other stops were in Brownsville and Beaumont, Texas; Mobile, Ala.; and West Palm Beach, Fla. Max Mayfield, director of the NOAA National Hurricane Center, emphasized the importance of an individual hurricane plan. People who have a hurricane plan, and execute that plan, fare much better than those that do not. Each person needs to take individual responsibility and make preparations. The NOAA National Weather Service forecast offices arranged the event with local governments, emergency managers, FEMA, schools, the public and the media in a team effort to increase hurricane awareness and encourage preparedness in this vulnerable area of the nation. Educating the public is an ongoing NOAA mission.

● **Science On a Sphere.** Science On a Sphere expanded its availability to the general public and to many different student groups by providing public demonstrations to these audiences at its Planet Theater which is part of the Earth System Research Laboratory in Boulder, Colorado. In addition to installing Science On a Sphere at six more museums and science centers, emphasis was placed on expanding the content to be shown on the sphere. Five major content categories were developed and descriptions were written for each data set within the category. The five categories are land, atmosphere, ocean, model and simulation and solar system. NOAA’s Office of Education provided a grant to help pay for the hardware pieces required to build a Science On a Sphere system plus the integration and installation of the total system. As a result, four facilities installed this technology in FY06: The Tech Museum of Innovation in San Jose, CA; the Science Museum of Minnesota in St. Paul, MN; the Bishop Museum in Honolulu, HI; and the Maryland Science Center in Baltimore, MD. In addition to these museums and science

center, Science On a Sphere technology was also transferred to the Thunder Bay National Marine Sanctuary in Alpena, MI and the NASA Goddard Space Flight Center in Greenbelt, MD. A key NOAA contribution to these technology transfers is to provide rich data sets to be shown on the sphere that will help teach audiences about planetary science. Examples are: near real time weather data showing developing hurricanes and typhoons, ocean simulations such as El Nino, and visualizations showing global climate change possibilities. NOAA's ultimate goal is to increase public understanding of the environment and earth system processes.

● NOAA teaches teachers about Gulf of Mexico coral reefs. The Flower Garden Banks National Marine Sanctuary staff invited educators from around the country to get out of their classrooms and into the Gulf of Mexico for a five day educators' underwater exploration workshop, "Down Under, Out Yonder." NOAA manages the sanctuary, which partners with the non-profit Gulf of Mexico Foundation to organize this popular annual event. The workshops offer teachers firsthand experience with exploration and research. The teachers get hands-on training, and they get to interact with educators from around the country. They exchange ideas that result in new classroom dynamics. During the classroom session, the participants are given a crash course in coral reef biology and ecology. They use those new skills during a three-day cruise to the sanctuary, hosted by the foundation. While underwater, teachers will count fish and other animals and conduct general observations on the coral reef environment. SCUBA diving is done from a 100-foot converted oil and gas crew boat equipped for diving. Flower Garden Banks National Marine Sanctuary: http://flowergarden.noaa.gov. Gulf of Mexico Foundation: http://www.gulfmex.org

● NOAA trains students for careers in meteorology and oceanography. Students from colleges and universities in 36 states and Puerto Rico spent their summer in NOAA laboratories as part of the Hollings Scholarship Program. The scholarship program was named after former Senator Ernest F. Hollings of South Carolina, a strong supporter of science education. NOAA provides hands-on training and experience to encourage the 110 undergraduates to pursue studies in the fields of Oceanography and Meteorology. The NOAA program consists of a series of workshops where the students are engaged in a wide variety of projects, including conducting fisheries surveys, engineering remotely operated underwater vehicles, studying the carbon flux in marine waters, forecasting sea breeze and lightning, monitoring tornado processes, analyzing storm data, identifying acoustic signatures of marine mammals, evaluating sea bass habitat, and participating in studies of the Antarctic climate. The NOAA Hollings scholarship program increases students' knowledge of oceanic and atmospheric science, fosters multidisciplinary training opportunities, prepares students for public service careers with NOAA, prepares students for careers as teachers and educators in oceanic and atmospheric science, and increases public understanding and support for stewardship of the ocean and atmosphere.

● NOAA promoting ocean science through school milk carton campaign. NOAA carried out an outreach and education effort to reach K-12 students in St. Louis, Missouri by placing ocean science awareness messages on side panels of school milk cartons in 450 schools, reaching about 240,000 students. The cartons were distributed to schools served by Prairie Farms Dairy, in conjunction with Blue Ridge Paper Products Inc. The milk cartons were complemented by NOAA posters distributed to the schools. The milk carton campaign allows NOAA to promote an informal education effort that could be used nationwide. The carton's panels ask a variety of ocean and weather related trivia questions and supplies answers. They also direct readers to the NOAA home page, which has a link to a page describing NOAA, its education resources, and

age-appropriate information. NOAA offers resources on its Web site for teachers to use, such as curriculum ideas and teaching kits on weather, climate change, earth science, the oceans and coasts, fish and marine mammals, navigation, and earth-monitoring satellites. NOAA: http://www.noaa.gov. NOAA Education: http://www.education.noaa.gov

● NOAA provides experience and knowledge through science camps. Sixty-five seventh and eighth graders from 32 Seattle schools experienced science firsthand as they addressed complex environmental issues by learning to interpret information, conduct investigations and report outcomes to a broad audience. NOAA scientists helped develop lesson plans in areas such as water sampling, marine mammal tagging, and photo-identification of humpback whales. Meeting Washington State middle-school science standards, the curriculum also taught students how data from ocean buoys help predict El Niño events. The activities also attracted assistance from 10 teachers and 11 high school and undergraduate interns.
http://www.nwfsc.noaa.gov/sciencecamp.cfm

● NOAA teaches through telepresence. Telepresence capability, a growing resource for environmental interests and NOAA, opened a world of virtual exploration as live underwater images from the Monterey Bay National Marine Sanctuary were beamed to visitors at the Aquarium of the Pacific in Long Beach, California. Action from the depths of the sanctuary allowed viewers to become submerged in an underwater kelp forest filled with rockfish, red-hued anemones, and perhaps a sea lion or two. The demonstration introduced plans for a "Follow That Fish!" educational exhibit that will highlight ongoing acoustic telemetry research being conducted at national marine sanctuaries by the Pfleger Institute of Environmental Research to learn about fish behavior. Development of the exhibit begins summer 2006, with completion expected by early 2007. The telepresence capability is fully interactive, allowing a viewer, for instance, to talk directly with a diver in Monterey Bay

● NOAA offers educational discovery kit on non-point source pollution. A new online educational product, The Nonpoint Source Pollution Discovery Kit, is now available online (http://oceanservice.noaa.gov/education/kits/pollution/welcome.html). The kit explains the history of pollution, the differences between point and nonpoint source pollution, types of pollutants, and how scientists monitor, assess and control nonpoint source pollution. This online educational product is one of five Web-based Discovery Kits from NOAA. The kit makes complex science more accessible to students. The kits are written in plain language and a student-friendly style, with ample use of multimedia features to visually illustrate difficult concepts. They are designed for the high school level, but can be easily adapted for middle school and even college undergraduate levels. The Discovery Kits, are part of the NOAA Education Discovery Center. The center also includes Discovery Stories, which are comprehensive case studies, and the Discovery Classroom, a growing library of lesson plans designed for use in the classroom. The Discovery Center is available at: http://oceanservice.noaa.gov/education. The Nonpoint Source Pollution Discovery Kit joins four other Discovery Kits (on corals, tides and water levels, geodesy, and estuaries). It also complements the two existing Discovery Stories covering lion fish and the recovery of Alaska's Prince William Sound after the Exxon Valdez oil spill.

Other Tech Transfer Activities

● NOAA's system for operational rainfall products, the Microwave Surface and Precipitation Products System (MSPPS), has been updated with improved algorithms. Some components or data sets from MSPPS have been delivered to Japan and European Countries, including the UK Meteorological Office and the European Center for Medium-range Weather Forecasting (ECMWF).

● The Satellite Climate Studies Branch, co-located with the Cooperative Institute at the University of Maryland, hosted guest scientist Doug Ramers from the University of Evansville. He collaborated with NOAA scientist Christopher Brown to predict various ocean habitats with a neural network.

● NOAA hosted four graduate students from the Cooperative Remote Sensing Science & Tech. Center in New York. These students are pursuing projects on satellite remote sensing, in College Park, Maryland

● NOAA scientist Jeffrey Key (Cooperative Institute for Meteorological Satellite Studies, CIMSS, in Madison, Wisconsin) visited the Kongsberg Satellite Services facility in Tromsø, Norway, to deliver a system there that generates real-time polar wind observations from data received in Svalbard, Norway from the Moderate Resolution Imaging Spectroradiometer **(**MODIS**)** satellite.

IV. NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION -- INSTITUTE FOR TELECOMMUNICATION SCIENCES

Technology Transfer at the Agency's Federal Laboratories – Approach and Plans, FY 2006 Activities/Achievements

I. Agency Approach and Plans for Technology Transfer

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 U.S. 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.

ITS uses three principal means for achieving technology transfer: cooperative research and development, technical publications, and leadership and technical contributions in the development of telecommunications standards.

Cooperative research and development. Cooperative research and development agreements (CRADAs), based upon the Federal Technology Transfer Act (FTTA) of 1986, are a principal means through which ITS aids the private sector. The FTTA provides the legal basis for and encourages shared use of government facilities and resources with the private sector in advanced telecommunications technologies.

These partnerships aid in the commercialization of new products and service as well as enhance the capabilities of ITS laboratories. They also provide insights into industry's needs for productivity growth and competitiveness enabling ITS to adjust the focus and direction of its programs for effectiveness and value.

In FY 2006, ITS participated in technology transfer and commercialization efforts by fostering cooperative telecommunications research with industry where benefits can directly facilitate U.S. competitiveness and market opportunities. These efforts will continue in future years. ITS also participated – as it has for a number of years – in CRADAs with private sector organizations to design, develop, test, and evaluate advanced telecommunication concepts. The private industry partner benefits through such cooperative relationships, as does the Institute, as it is able to undertake research in commercially important areas that it would not otherwise be able to do.

To date, major contributions to personal communication services (PCS), local multipoint distribution service (LMDS), ultrawideband (UWB), Broadband over Power Line (BPL) technologies have been achieved through CRADAs. These have aided U.S. efforts to rapidly introduce new socially beneficial, communications technologies. More recently, CRADAs in the

areas of objective audio and video quality and advanced antennas for wireless systems have allowed ITS to contribute to the development of new products and services.

In addition, ITS plans to continue using patents to secure intellectual property rights in laboratory innovations with commercial promise. ITS plans to advance its mission and benefit the competitiveness of U.S. industry by pursuing opportunities to commercially license patents to CRADA partners and other interested parties. As an example, ITS is targeting software implementing a video quality metric for commercial development. This software incorporates technology covered by three patents. Evaluation software was requested by 201 parties in FY 2006 for testing purposes and five commercial licensing agreements are currently being negotiated with corporations.

Technical publications. Publication has, historically, been the means through which ITS has transferred research results to other researchers, the commercial sector, and government agencies. Many of these publications – both internal reports and monographs and external, peer reviewed, scientific journal articles – have become standard references in several telecommunications areas.

Technical publication remains at present a principal means for ITS' technology transfer. Most of these technical publications are released only after going through an internal peer review process managed by the ITS Editorial Review Board (ERB). Of the publications released through the ERB process in recent years, approximately one half were approved for external publication in the scientific literature.

Development of telecommunication standards. This third principal means of ITS technology transfer directly addresses improvement of U.S. competitiveness in telecommunications. For several decades, ITS has provided leadership and technical contributions to organizations, both national and international, responsible for developing telecommunication standards. For example, a plurality of the technical recommendations of the International Telecommunication Union (ITU – a treaty organization) are based on research conducted at ITS. Also, key national quality of service standards developed under the American National Standards Institute (ANSI) T1 committee for video, audio, and digital data incorporate research results obtained at ITS.

ITS continues to chair numerous committees and working groups in the ITU, ANSI T1, and other telecommunication standards organizations, providing technical leadership that is trusted by the commercial sector participants. ITS' technical inputs are relied upon as technically advanced and sound, and unbiased by commercial interests.

In FY 2006, ITS continued its technical leadership and contributions to communications standards for public safety, particularly for first responders. ITS' primary area of contribution has been interoperability standards and testing procedures. ITS' objective video quality measurement method has been made a national standard by ANSI. ITS' method was also the best performing metric in comparison testing by the ITU with other methods from around the world.

II. Performance in FY 2006: Activities and Achievements

■ Collaborative Relationships for Research & Development

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **CRADA**s, total active in the FY [1]	63	239	319	280	514
- New, executed in the FY	6	178	185	185	512
▪ Traditional CRADAs, [2] total active in the FY	6	5	7	7	8
- New, executed in the FY	0	0	3	5	6
▪ Non-traditional CRADAs, [3, 4] total active in FY	57	234	312	273	506
- New, executed in the FY	6	178	182	180	506
● Other types of collaborative R&D relationships					
▪ Collaborative standards contributions, [5] total active in FY	3	2	11	11	16
- New, executed in the FY	0	1	0	0	5

CRADA = Cooperative Research and Development Agreement.

(1) "Active" = legally in force at any time during the FY. "Total active" is comprehensive of all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.

(3) CRADAs used for special purposes, such as material transfer or technical assistance that may result in protected information. (For example, CRADAs for Video Quality Software Evaluation.)

(4) ITS' Telecommunications Analysis Services (TA Services) is Internet accessible through Web-based electronic CRADAs. TA Services provides analysis support to private industry and public agencies in the areas of wireless system design and evaluation, and site selection. The service is provided on a cost-reimbursable basis, 24 hours a day/7 days a week throughout the year. TA Services currently reaches numerous government and private sector users across the nation, providing the latest versions of ITS-developed telecommunications models, databases, and tools. Use of the CRADA makes TA Services available to users in a short time and on a cost reimbursable basis. Additionally, CRADA partners provide useful evaluations of the ITS software used. This information aids ITS to improve existing software tools for wireless system design and analysis and to develop new ones – benefiting both ITS' own research capabilities and the resources that outside users can draw upon. The CRADA agreement also allows ITS to gain valuable insights from users' feedback about the rapidly changing needs of industry and government in telecommunications technology.

(5) ITS works with industry, through a number of standards fora, to apply research results to the development of telecommunication performance standards and guidelines. In FY 2004, ITS worked collaboratively with the International Telecommunication Union, the Telecommunications Industry Association, the Alliance for Telecommunications Industry Solutions, and various Federal Public Safety groups to interpret and analyze standards and regulations.

Invention Disclosure and Patenting

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● New inventions disclosed in the FY [1]	0	0	0	1	0
● Patent applications filed in the FY [2]	1	0	0	0	1
● Patents issued in the FY	0	1	0	0	1
● Active patents, end of the FY	6	6	6	6	8

(1) Inventions arising at the federal lab.

(2) Tally includes U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes provisional, continuation, duplicate foreign, and PCT applications.

■ Licensing

Profile of Active Licenses

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **All licenses**, number total active in the FY [1]	3	57	98	103	82
▫ New, executed in the FY	2	54	98	100	79
▪ **Invention licenses**, total active in the FY	3	57	98	103	82
▫ New, executed in the FY	2	54	98	100	79
- Patent licenses, [2] total active in FY	3	57	3	3	7
▫ New, executed in the FY	2	54	3	0	4
- Material transfer licenses (inventions), total active	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Other invention licenses, [3] total active in the FY	0	0	95	100	75
▫ New, executed in the FY	0	0	95	100	75
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Copyright licenses (fee bearing)					
▫ New, executed in the FY					
- Material transfer licenses (non-inventions), total active					
▫ New, executed in the FY					
- Other, total active in the FY					
▫ New, executed in the FY					

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (hybrid licenses) are reported as patent licenses and not included in the count of copyright licenses.

(1) "Active" = legally in force at any time during the FY.

(2) Patent license tally includes patent applications which are licensed.

(3) International copyright licenses (non fee bearing) for VQM technology

Licensing Management

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Elapsed execution time**, (1) licenses granted in the FY					
▪ **Invention licenses**					
▫ Average, months	5.0*	1.0	2.0	2.0	1.5
▫ Minimum		1.0	1.0	1.0	1.0
▫ Maximum		1.0	3.0	3.9	2.0
- Patent licenses (2)					
▫ Average, months	5.0*	1.0	2.0	2.0	1.5
▫ Minimum		1.0	1.0	1.0	1.0
▫ Maximum		1.0	3.0	3.0	3.0
● **Licenses terminated for cause**, number in the FY					
▪ **Invention licenses**	0	0	0	0	0
- Patent licenses (2)	0	0	0	0	0

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a sub-class.

* Only a single new license was executed in FY 2002. Therefore, there are no distributional statistics for elapsed execution time to report.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)

(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **All income bearing licenses**, total number	3	3	3	4	7
▫ Exclusive	0	0	0	0	0
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	3	3	3	4	7
▪ **Invention licenses**, income bearing	3	3	3	4	7
▫ Exclusive	0	0	0	0	0
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	3	3	3	4	7
- Patent licenses, (1) income bearing	3	3	3	4	7
▫ Exclusive	0	0	0	0	0
▫ Partially exclusive	0	0	0	0	0

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
▫ Non-exclusive	3	3	3	4	7
▪ **Other IP licenses**, income bearing	0	0	0	0	0
▫ Exclusive ▫ Partially exclusive ▫ Non-exclusive					
- Copyright licenses (fee bearing)	0	0	0	0	0
▫ Exclusive ▫ Partially exclusive ▫ Non-exclusive					
● **All royalty bearing licenses**, (2) total number	0	0	3	4	7
▪ **Invention licenses**, royalty bearing	0	0	3	4	7
- Patent licenses, (1) royalty bearing	0	0	3	4	7
▪ **Other IP licenses**, royalty bearing	0	0	0	0	0
- Copyright licenses (fee bearing)					

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee including patent costs.

(1) Patent license tally includes patent applications which are licensed.

(2) Note that royalties are one component of total license income.

Income from Licenses

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Total income, all licenses active in the FY** (1)	$65,470	$0	$33,500	$7,212	$24,500
▪ **Invention licenses**	$65,470	$0	$33,500	$7,212	$24,500
- Patent licenses (2)	$65,470	$0	$33,500	$7,212	$24,500
▪ Other IP licenses, all active licenses in FY	$0	$0	$0	$0	$0
- Copyright licenses					
● **Total Earned Royalty Income** (ERI) (3)	$0	$0	$0	$0	$0
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					
▫ ERI from top 20% of licenses					

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
▪ Invention licenses	$0	$0	$0	$0	$0
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					
▫ ERI from top 20% of licenses					
- Patent licenses (2)	$0	$0	$0	$0	$0
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					
▫ ERI from top 20% of licenses					
▪ **Other IP licenses**, total active in the FY	$0	$0	$0	$0	$0
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					
▫ ERI from top 20% of licenses					
- Copyright licenses					
▫ Median ERI					
▫ Minimum ERI					
▫ Maximum ERI					
▫ ERI from top 1% of licenses					
▫ ERI from top 5% of licenses					
▫ ERI from top 20% of licenses					

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee including patent costs.

(2) Patent license tally includes patent applications which are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or of units sold). Not a license issue fee or a minimum royalty.

Disposition of License Income

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● **Income distributed** (1)					
▪ **Invention licenses**, total distributed	$65,470	$0	$33,500	$7,212	$24,500
- To inventor(s)	$21,041 (32%)	$0	$18,450 (55%)	$3,564 (49%)	$15,750 (64%)
- To other (3)	$44,429 (68%)	$0	$15,050 (45%)	$3,648 (51%)	$8,750 (36%)
- Patent licenses, (2) total distributed	$65,470	$0	$33,500	$7,212	$24,500
- To inventor(s)	$21,041 (32%)	$0	$18,450 (55%)	$3,564 (49%)	$15,750 (64%)
- To other (3)	$44,429 (68%)	$0	$15,050 (45%)	$3,648 (51%)	$8,750 (36%)

Invention licenses are the chief policy interest regarding disposition of income; the content of this table reflects this focus.

(1) Income includes royalties and other payments received during the FY.
(2) Patent license tally includes patent applications which are licensed.
(3) To ITS/NTIA

■ Other Performance Measures Deemed Important by the Agency

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Technical publications produced	17	20	17	19	8
Total number of hits on ITS online publications	--	--	--	--	--

-- = Data not requested from agency in reports for prior years.

See "Technical Publications" above in the first section of this report for additional information on this topic.

■ Outcomes from Technology Transfer

For this year's annual report, the cases described below are provided as examples of the downstream outcomes being achieved by ITS technology transfer efforts:

• **Video quality metric**. ITS has developed a superior method of measuring video quality objectively that closely predicts the quality that human viewers would perceive subjectively. The technology is covered by four patents owned by ITS/NTIA. In FY 2003, the ITS method was adopted by the ANSI as a U.S. national standard. In addition, the ITU tested a number of proposed video quality metrics from around the world and found the ITS method superior. ITS' method became an international standard in 2004, as approved by the ITU. Also in FY 2004, the Federal Laboratory Consortium presented ITS with an award for its efforts to disseminate this technology both nationally and internationally. ITS filed another patent on a new version of the video quality metric in FY 2006. ITS also received a registered trademark for the video quality metric logo in FY 2006.

ITS has targeted this technology for commercial development. In FY 2006, the video quality metric earned thousands in royalty income for the laboratory. To date, seven commercial licenses and two CRADAs have been negotiated with U.S. corporations with royalty and CRADA funding exceeding $100,000. Five new royalty bearing licenses are currently being negotiated. More than 200 copies of software implementing the method were requested in FY06 for purposes of evaluation.

• **Table Mountain research**. The Table Mountain Field Site and Radio Quiet Zone supports fundamental research into the nature, interaction, and evaluation of telecommunication devices, systems, and services. Each year, private companies, universities, and other organizations conduct research at Table Mountain under Cooperative Research and Development Agreements (CRADAs). Brief descriptions of some of these recent CRADAs follow.

For the past two years the University of Colorado's Research and Engineering Center for Unmanned Vehicles has conducted measurements of the performance of ad hoc wireless networks with both ground-based and airborne terminals at Table Mountain. In FY 2006, a small local company known as Johnson's Jobs performed antenna testing at the Table Mountain turntable facility under a CRADA. Another small company, RF Metrics, performed research under a CRADA entitled "A Study of the Use of a New Antenna Pattern Collection

• **Technique for Radar Emissions**." Lockheed Martin Coherent Technologies is currently in the middle of a year-long CRADA to perform field-testing and characterization of components, subsystems, and systems for an eyesafe, coherent laser radar.

Appendix:

A. Progress in Improving the Agency's Performance Metrics for Tech Transfer

ITS' annual performance reporting has been revised to conform to the Department of Commerce guidelines. Starting in 2003, ITS added a new metric under the "Other Performance Measures" category: number of publications approved through the Editorial Review Board (ERB) process. While not perfect, this metric provides a useful, working indicator of the number of quality publications released to the public. In 2004, ITS added another measure, participation on standards committees. In 2006, ITS added another metric; one that more directly provides an indication of ultimate benefit to the public. The new metric is the total number of hits on the publications listed on the "ITS Online Documents."