OFFICE OF THE UNDER SECRETARY FOR TECHNOLOGY

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

NATIONAL TECHNICAL INFORMATION SERVICE

FISCAL YEAR 2009

BUDGET SUBMISSION TO CONGRESS

Department of Commerce
Technology Administration
Office of the Under Secretary for Technology
BUDGET ESTIMATES, FISCAL YEAR 2009
CONGRESSIONAL SUBMISSION

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Exhibit 3

DEPARTMENT OF COMMERCE
Technology Administration
Budget Estimates, Fiscal Year 2009
Congressional Submission

EXECUTIVE SUMMARY

Public law 110-69, HR 2272 signed into public law on August 9, 2007; (121 Stat. 572) abolished the Technology Administration. It is no longer a bureau of the Department of Commerce. The Director of the National Institute of Standards and Technology (NIST) now reports directly to the Secretary of Commerce, and the National Technical Information Service reports to the Secretary through the Director of NIST.

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FY 2009 Annual Performance Plan
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY /
NATIONAL TECHNICAL INFORMATION SERVICE

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FY 2009 Annual Performance Plan

Mission

To promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

National Institute of Standards and Technology

NIST develops and disseminates measurement techniques, reference data, test methods, standards, and other infrastructural technologies and services required by U.S. industry to compete in the twenty-first century. In addition to its core measurement, testing, and standards functions, NIST also conducts extramural programs including the Hollings Manufacturing Extension Partnership (MEP) to help manufacturers adopt advanced manufacturing and management technologies and improve their overall competitiveness and the Baldrige National Quality Program to help U.S. businesses and other organizations improve the performance and quality of their operations by providing clear standards and benchmarks of quality.

National Technical Information Service

NTIS provides the American public with permanent and ready access to scientific, technical, and business research through the acquisition, organization, and preservation of data added to its permanent collection. NTIS collects, classifies, coordinates, integrates, records, and catalogs scientific and technical information from whatever sources, foreign and domestic, that may stimulate innovation and discovery and then disseminates that information to the public. In an effort to provide the American public with increased access to the vast collection of government information, NTIS utilizes advanced e-commerce channels, including providing downloads of any item in its collection that is in electronic format for a single low fee or at no charge if under five pages. NTIS also helps other Federal agencies interact with and better serve the information needs of their own constituents by providing information management services.

Corresponding DoC Strategic Goal and Objective / Outcome (NIST)

NIST Performance Outcome 1: Promote innovation, facilitate trade, and ensure public safety and security by strengthening the Nation's measurement and standards infrastructure.

Corresponding DOC Strategic Goal and Objective:

DoC Strategic Goal 2: Promote U.S. innovation and industrial competitiveness.

Performance Objective 2.1: Advance measurement science and standards that drive technological change.

Description of Performance Outcome:

As the National Measurement Institute for the United States, NIST is uniquely responsible for establishing and maintaining an efficient system that links the fundamental units of measurement to the measurement methods used by industry, universities, and other government agencies. The Nation's ability to innovate, and grow relies on a robust scientific and technical infrastructure – including the measurement science, standards, and technology provided by the NIST Laboratories. The NIST Laboratories perform research to develop the measurement tools, data, and models for advanced science and technology.

NIST has designed its performance evaluation system to accommodate the organization's unique mission and impact path as well as to respond to the intrinsic difficulty of measuring the results of investments in science and technology. Like other Federal science organizations, the primary output of NIST's laboratory research is scientific and technical knowledge, which is inherently difficult to measure directly and comprehensively. In addition, the outcomes from research often do not begin to accrue until several years after the research program has been completed, and the diffusion of benefits often affects broad segments of industry and society over long time periods. Given these challenges, the NIST Laboratory Program evaluates its performance using an appropriate mix of specific output tracking, peer review, and economic impact analyses. Together, these evaluation tools, combined with continual feedback from customers, provide NIST management and external stakeholders with a comprehensive picture of performance towards its long-term outcomes.

NIST Performance Outcome 2: Raise the productivity and competitiveness of small manufacturers.

Corresponding DOC Strategic Goal and Objective:

DoC Strategic Goal 1: Maximize U.S. competitiveness and enable economic growth for American industries, workers, and consumers.

Performance Objective 1.4: Position small manufacturers to compete in a global economy.

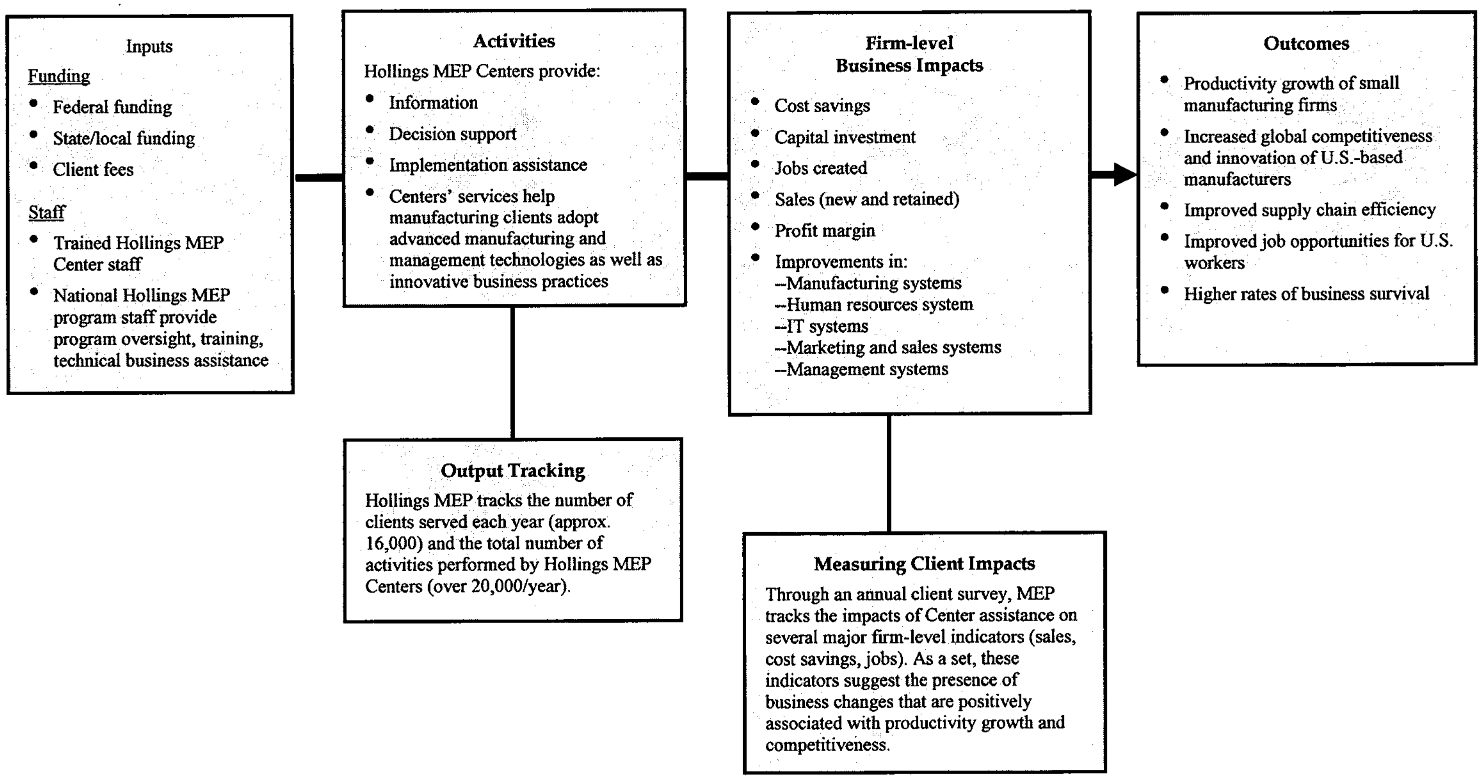
Description of Performance Outcome:

Operating under the authority of 15 U.S.C. 278k, Hollings MEP (MEP) is a federal-state-local partnership program that provides U.S. manufacturers with access to manufacturing technologies, resources, and expertise. Through MEP's network of manufacturing centers, linked to state, university, community college, and private sources of technology and expertise, NIST helps manufacturers adopt advanced manufacturing and management technologies as well as innovative business practices to position them to compete in the global economy.

The 2009 Budget will change MEP centers to a self-supporting basis, as intended in the program's original authorization. MEP centers provide manufacturers with consulting services that are also available from private entities. Given the reported benefits that MEP clients receive from the program, they have the profit incentive and means to cover the costs of these services through modestly increasing fees.

MEP's ultimate goal is to measurably improve the productivity and competitiveness of all its clients. The model below demonstrates the impact path (or value creation chain) of the MEP program from inputs such as appropriated funds and staff to end outcomes such as productivity improvements for the small manufacturing sector. In addition, the model also depicts how NIST measures the progress of the MEP program along its impact chain.

Hollings MEP's Impact Path and Evaluation Methods: Results-based Management for Advisory Services



Corresponding DoC Strategic Goal and Objective / Outcome (NTIS)

NTIS Performance Outcome 1: Increase public access to worldwide scientific and technical information through improved acquisition and dissemination activities.

Corresponding DOC Strategic Goal:

Strategic Goal 2: Promote U.S. innovation and industrial competitiveness.

Performance Objective 2.1: Advance measurement science and standards that drive technological change.

Description of Performance Outcome:

The National Technical Information Service (NTIS) operates a central clearinghouse of scientific and technical information that is useful to U.S. business and industry. Without appropriated funds, NTIS collects scientific and technical information; catalogs, abstracts, indexes, and permanently archives the information; disseminates products in the forms and formats most useful to its customers; develops electronic and other new media to disseminate information; and provides information processing services to other Federal agencies. NTIS's revenue comes from (1) the sale of technical reports to business and industry, schools and universities, state and local government offices, and the public at large; and (2) services to Federal agencies that help them communicate more effectively with their employees and constituents. NTIS promotes the development and application of science and technology by providing technologically advanced global e-commerce channels for dissemination of its specialized information to business, industry, government, and the public. The NTIS bibliographic database is available via the Internet free of charge. Users can download full text documents for free or for a nominal fee depending on document length and can purchase the same documents in a variety of physical media formats.

PART Summary

NIST

- **NIST Laboratory Program** – the 2003 PART assessment of the NIST Laboratories for the FY 2005 budget cycle found the Laboratories "effective."

NIST Laboratory Program	Year	Score	2007 Funding Actual	2008 Funding Estimate	2009 Funding Request
	2003	Effective	662.4	808.2	787.5
Open recommendations and discussion of how PART and other performance information influenced the FY 2009 budget request; 1. Investing in research in key technologies to support new measurement requirements, important for the U.S. economic and scientific infrastructure, in such areas as nanotechnology, enabling the hydrogen economy, and quantum science. The President's American Competitiveness Initiative (ACI) includes several initiatives for further development of essential technologies, including bioscience, optical communications and computing, and nanotechnology. 2. Investing in facility improvements at NIST Labs to sustain the program's strong research capability. The ACI includes facility improvement-related initiatives that address NIST's most pressing facility aging and obsolescence issues. NIST is engaged in a long-range facility modernization program to make repairs and upgrades to its physical plant. The ACI also includes substantial increases for the NIST Center for Neutron Research, as well as for NIST Boulder and JILA facilities.					
Hollings Manufacturing Extension Partnership	**Year**	**Score**	**2007 Funding Estimate**	**2008 Funding Estimate**	**2009 Funding Request**
	2002	Moderately Effective	107.3	91.6	4
Open recommendations and discussion of how PART and other performance information influenced the FY 2009 budget request; 1. Change MEP centers to a self-supporting basis, as intended in the program's original authorization.					

NTIS: A PART assessment for NTIS has not been conducted.

* Dollars shown in millions

Priorities/Management Challenges

NIST: Strategic Priorities for FY 2009
Based on long-term strategic planning efforts and an analysis of the most pressing needs related to the coming fiscal year, NIST senior leadership identified several key priorities in support of the Secretary's Policy Agenda for FY 2009.

- **Competitiveness and Innovation: Use the President's American Competitiveness Initiative to help the United States to drive and take advantage of the increased pace of technological change.** The American Competitiveness Initiative (ACI) proposal will double funding for NIST's core programs over the next 10 years and thus increase Federal investment in critical research to ensure that the U.S. continues to lead the world in opportunity and innovation. NIST will continue to conduct high-priority research, identify technical measurement barriers to innovation, and transfer technical knowledge developed to the private sector as part of efforts to drive this initiative. Next-generation measurement and standards needs require NIST to focus its long-term research efforts on specific interdisciplinary technology areas where inadequate technical infrastructure is a barrier to innovation, commercialization, and public benefit, in particular in such areas as nanotechnology, enabling the hydrogen economy, and quantum science.

- **Trade: Maximize the value of free trade agreements and advance the interests of American business in key developing markets.** NIST will foster more efficient transactions in the domestic and global marketplace through more effective development and use of standards. As NIST expands its research efforts with the private sector and other government agencies, it will work to improve the ways in which standards are used to support U.S. innovation and industrial competitiveness. Additionally, as part of the Department's Standards Initiative, NIST will continue to implement recommendations from the Department's May 2004 report, "Standards and Competitiveness: Coordinating for Results, Removing Standards-Related Trade Barriers Through Effective Collaboration." NIST will work to more effectively represent U.S. interests in selected areas of global standards and develop a more strategic approach for NIST's involvement in the standards process, including international standards affecting trade.

- **China: Promote U.S. trade and economic interests in our relations with China.** NIST will engage China in the formal international standards and measurement systems to minimize the need for China to develop its own unique national standards. In addition, NIST will establish cooperative efforts with China in targeted science and technology areas, addressing metrology and related standards needs of both the U.S. and China, with an emphasis on standards developed through an open, transparent, consensus process. In the process, NIST will build crucial peer-to-peer contacts to provide early understanding of Chinese strategic objectives in the standards and metrology arenas, thereby enabling an appropriate U.S. response. In collaboration with other agencies of the Department, NIST will support access to Chinese markets for U.S. companies by working to identify and remove potential technical barriers to trade, posed either by planned regulations, proposed standards, or conformity assessment activities.

- **Gulf Coast Recovery: Assist in the rebuilding of the Gulf Coast economy and place the region on a path to become stronger than it was before the 2005 hurricane season.** NIST will continue to recommend improvements to building and infrastructure standards for cost effectively reducing the loss of life and property damage due to natural and man-made hazards. These recommendations are based on NIST's expertise in developing the scientific basis required to enable technology innovations, improve prediction capabilities, and improve codes and standards. In particular, NIST will focus its efforts on disaster resilient structures and communities.

- **Environmental Stewardship: Advance market-driven, scientifically sound environmental stewardship.** NIST will continue its efforts to improve the accuracy and reliability of global climate change predictions and data by providing the necessary measurement science and standards. The ability to predict climate change rests on the accuracy of atmospheric measurements and on knowledge of basic properties of atmospheric constituents. Working in collaboration with other agencies, NIST will address critical gaps in climate change science that are limiting long-term climate policy decision-making.

- **Improve NIST's Facilities and Infrastructure:** As science and technology advances, the need for more sophisticated and demanding measurement science and standards grows. NIST can develop and provide these challenging capabilities and services only in environmentally stable and safe research and measurement laboratories. Many NIST laboratory facilities are decades old and are no longer capable of providing the stable research environment needed to efficiently conduct the advanced measurement research in many crucial areas including nanotechnology and quantum science. To fulfill its mission requirements, NIST must invest in a new high-performance laboratory at its Boulder site as well as critical improvements in its Gaithersburg facilities, including the expansion of the NIST Center for Neutron Research.

NTIS: Strategic Priorities for FY 2009

NTIS' priority is to contribute successfully to the Department of Commerce's strategic goal of promoting U.S. innovation and industrial competitiveness through improved productivity, quality, dissemination, and efficiency of research. To that end, NTIS is committed to increasing the number of updated items it makes available, increasing the number of information products disseminated annually and enhancing customer satisfaction.

Target and Performance Summary Table (with brief measure descriptions)

NIST Performance Outcome 1: Promote innovation, facilitate trade, and ensure public safety and security by strengthening the Nation's measurement and standards infrastructure

Measure 1A: Qualitative assessment and review of technical quality and merit using peer review	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Actual	FY 2008 Target	FY 2009 Target
	Completed	Completed	Completed	Complete	Complete	Complete

Description: Beginning in FY 2007, the NRC conducted an assessment process where half of the NIST Laboratories will be reviewed each year. The assessment process focuses on the quality, relevance, and technical merit of the NIST Laboratories Program to ensure it is developing and promoting the infrastructure tools and measurement standards needed by industry, academia, and other government agencies.

Comments on Changes to Targets: Citation impact remains consistently above average for the past 26 years (1981-2006).

Relevant Program Change(s):	Title:	Exhibit 13 Page #:
N/A	N/A	

Measure 1B: Citation impact of NIST-authored publications	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Actual	FY 2008 Target	FY 2009 Target
	New	New	New	>1.1	>1.1	>1.1

Description: This measure demonstrates that NIST consistently produces relevant scientific and technical publications. Citation impact reflects the utility and relevance of NIST research and is outcome-oriented. The measure represents NIST's "relative citation impact" which is the average citation rate per NIST publication relative to Thomson's Scientific baseline citation rate number for a large group of peer scientific and technical organizations.

Comments on Changes to Targets: FY 2008 and 2009 Targets: Citation impact remains consistently above average for the past 26 years (1981-2006). This measure, which was discontinued in FY 2004 to reduce the overall number of NIST performance measures, was reestablished as a NIST GPRA measure beginning in FY 2007.

Relevant Program Change(s):	Title:	Exhibit 13 Page #:
N/A	N/A	

Measure 1C: Peer-reviewed technical publications	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Actual	FY 2008 Target	FY 2009 Target
	1,070	1,148	1,163	1,272	1,100	1,150

Description: This measure reflects the quality and demand for NIST publications providing measurements and standards to those in industry, academia, and government agencies. As of FY 2007, this reflects a direct count of NIST technical manuscripts that have been published in an elite body of influential scientific peer-reviewed journals as compiled in the *Web of Science®* bibliographic database maintained by Thomson Scientific.

Comments on Changes to Targets: The FY 2009 target aims for an increase in the number of peer-reviewed technical publications as NIST's research results from new and expanded programs funded under the American Competitiveness Initiative (ACI) in FY 2007. NIST estimates that the impact of the ACI funding increase will lag by a minimum of two years due to the time needed for research, writing, journal peer review, and publication processes. While NIST expects to produce an increase in the number of peer-reviewed technical publications over the next ten years, to help drive the ACI targets, estimates may need to be adjusted based on the actual ACI funding for NIST and trend data from FY 2007 and FY 2008.

Relevant Program Change(s): $136.8M Increase	**Title:** Laboratories and Technical Programs					**Exhibit 13 Page #:** ***NIST-23, 28, 36, 44***
Measure 1D: Standard Reference Materials sold	**FY 2004 Actual**	**FY 2005 Actual**	**FY 2006 Actual**	**FY 2007 Actual**	**FY 2008 Target**	**FY 2009 Target**
	30,490	32,163	31,195	32,614	31,000	31,000
Description: Standard Reference Materials are the definitive source of measurement traceability in the United States. SRMs are certified in the NIST Laboratories for their specific chemical and material properties. Customers use SRMs to achieve measurement quality and conformance to process requirements that address both national and international needs for commerce and trade and public safety and health. This measure represents a direct count of the number of SRM units sold to customers in industry, academia, and other government agencies.						
Comments on Changes to Targets: The FY 2008 and FY 2009 target aims for a modest increase to 31,000 SRM units disseminated annually based on the restoration of key SRMs to inventory, but may be revised based on the trends indicated by FY 2007 and FY 2008 outcomes. NIST predicts that the number of SRM units sold will start to increase in the out years as a result of NIST research associated with new and expanded programs funded under the American Competitiveness Initiative (ACI) in FY 2007.						
Relevant Program Change(s): $136.8M Increase	**Title:** Laboratories and Technical Programs					**Exhibit 13 Page #:** ***NIST-23, 28, 36, 44***
Measure 1E: NIST-maintained datasets downloaded	**FY 2004 Actual**	**FY 2005 Actual**	**FY 2006 Actual**	**FY 2007 Actual**	**FY 2008 Target**	**FY 2009 Target**
	73,601,352	93,305,136	94,371,001	130M	140M	140M
Description: NIST's online data systems are heavily used by industry, academia, other government agencies, and the general public and represent another method NIST uses to deliver its measurements and standards tools, data, and information. This measure is a direct count of the annual number of downloads of NIST-maintained data.						
Comments on Changes to Targets: FY 2008 and FY 2009 targets were revised to include all NIST datasets downloaded from www.nist.gov, www.time.gov, and other websites for a more comprehensive measure. While over time NIST expects a consistent level of online data dissemination, it is difficult to develop long-term target estimates without additional trend data, and FY 2008 and FY 2009 targets may need to be adjusted.						
Relevant Program Change(s): N/A	**Title:** Laboratories and Technical Programs					**Exhibit 13 Page #:** ***NIST-23, 28, 36, 44***
Measure 1F: Number of calibration tests performed	**FY 2004 Actual**	**FY 2005 Actual**	**FY 2006 Actual**	**FY 2007 Actual**	**FY 2008 Target**	**FY 2009 Target**
	12,503	12,849	13,127	27,489	12,000	12,000
Description: Beginning in FY 2007 these targets were revised to measure the number of calibration tests performed versus the number of items calibrated to better demonstrate the calibration output.						
Comments on Changes to Targets: The conversion of research results into robust, deliverable measurement services typically takes at least three additional years. Consequently, the number of calibration tests as impacted by the American Competitiveness Initiative (ACI) funded work is expected to increase in the out years. The FY 2009 target aims for consistent number of calibration tests performed, but may be revised based on the trend indicated by FY 2007 and FY 2008 outcomes.						
Relevant Program Change(s): $136.8M Increase	**Title:** Laboratories and Technical Programs					**Exhibit 13 Page #:** ***NIST-23, 28, 36, 44***

NIST Performance Outcome 2: Raise the productivity and competitiveness of small manufacturers.

Measure 2A: Number of clients served by MEP Centers receiving Federal funding	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Target	FY 2008 Target	FY 2009 Target
	16,090	16,448	28,004	21,237	14,500	0

Description: This measure represents the annual number of new and repeat clients served by MEP Centers who received training, technical, and business assistance ranging from informational seminars and training classes to in-depth technical assistance typically beginning with the implementation of lean enterprise concepts and progressing to strategic re-positioning and access to new markets.

Relevant Program Change(s):	Title:	Exhibit 13 Page #:
N/A	N/A	

Measure	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Target	FY 2008 Target	FY 2009 Target
Measure 2B: Increased sales attributed to MEP Centers receiving Federal funding	$1,889M	$2,842M	$3.1B	$762M	$630M	$0M
Measure 2C: Capital investment attributed to MEP Centers receiving Federal funding	$941M	$2,248M	$1.65B	$955M	$485M	$0M
Measure 2D: Cost savings attributed to MEP Centers receiving Federal funding	$721M	$1,304M	$1.1B	$521M	$330M	$0M

Description: This measure indicates the changes that are positively associated with productivity growth and competitiveness, which are the two factors that are crucial for American manufacturers to manage and succeed in the rapidly changing manufacturing environment. Data is collected through an annual survey of clients receiving services from MEP Centers.

Comments on Changes to Targets: FY 2008 and FY 2009 targets are based on an appropriation of $91.6M and $4M respectively. The orderly end of Federal funding for the MEP program will be initiated in FY 2009, therefore performance targets for FY 2009 are not applicable. FY 2007 targets were revised based on an appropriation of $104.7M versus $46.3M requested in the President's Budget.

Relevant Program Change(s):	Title:	Exhibit 13 Page #:
N/A	N/A	

NTIS Performance Outcome 1: Increase public access to worldwide scientific and technical information through improved acquisition and dissemination activities.						
Measure 1A: Number of Updated Items Available (Annual)	**FY 2004 Actual**	**FY 2005 Actual**	**FY 2006 Actual**	**FY 2007 Actual**	**FY 2008 Target**	**FY 2009 Target**
	553,235	658,138	673,807	744,322	725,000	745,000
Description: The number of items available for sale to the public from NTIS includes scientific, technical, and engineering information products added to the permanent collection, as well as items made available through online electronic subscriptions.						
Comments on Changes to Targets: The FY 2008 and FY 2009 targets have been increased to reflect increases in expected activity, as demonstrated in the FY 2007 actual data.						
Relevant Program Change(s): N/A	**Title:** N/A				**Exhibit 13 Page #:**	
Measure 1B: Number of Information Products Disseminated (Annual)	**FY 2004 Actual**	**FY 2005 Actual**	**FY 2006 Actual**	**FY 2007 Actual**	**FY 2008 Target**	**FY 2009 Target**
	25,476,424	26,772,015	30,616,338	32,027,113	32,100,000	32,850,000
Description: This measure represents information disseminated and includes compact discs, diskettes, tapes, online subscriptions, Web site pages, as well as traditional paper and microfiche products.						
Comments on Changes to Targets: FY 2008 target has been increased to reflect increases in expected dissemination activity, as demonstrated in the FY 2007 actual data.						
Relevant Program Change(s): N/A	**Title:** N/A				**Exhibit 13 Page #:**	
Measure 1C: Customer Satisfaction	**FY 2004 Actual**	**FY 2005 Actual**	**FY 2006 Actual**	**FY 2007 Actual**	**FY 2008 Target**	**FY 2009 Target**
	96%	98%	98%	98%	95% - 98%	95% - 98%
Description: This measure represents the percentage of NTIS customers that are satisfied with the quality of their order, the ease of order placement, and the timely processing of that order. NTIS's continual efforts to maintain and possibly improve this very high rate of customer satisfaction are essential to the success of NTIS's performance and mission to collect and disseminate scientific and business-related information.						
Comments on Changes to Targets:						
Relevant Program Change(s): N/A	**Title:** N/A				**Exhibit 13 Page #:**	

FY 2009 Program Changes

The FY 2009 budget request reflects the challenges facing the Nation's technological infrastructure and the resources needed to directly contribute to the Department's strategic goal to promote U.S. innovation and industrial competitiveness by advancing measurement science and standards that drive technological change and to maximize U.S. competitiveness and enable economic growth for American industries, workers, and consumers by raising the productivity and competitiveness of small manufacturers.

		Accompanying GPRA		Base		Increase/ Decrease		Exhibit 13 Page for Detailed Discussion
	Name of Program	**APP Page #**	**Performance Measure**	**FTE**	**Amount ($M)**	**FTE**	**Amount ($M)**	
National Institute of Standards and Technology	**NIST Laboratories**	Page 10 Page 11 Page 11	Measure 1C: Peer-reviewed technical publications. Measure 1D: Standard reference materials (SRMs) sold. Measure 1F: Number of Calibration tests performed.	**2,797**	**$650.7**	***189***	**$136.8**	*NIST-23, 28, 36, 44*
	Hollings Manufacturing Extension Partnership	N/A	N/A	**67**	**$89.6**	**-48**	**-$85.6**	
National Technical Information Service	**National Technical Information Service**	N/A	N/A	**150**	**$42.0**	**0**	**$0**	

Resource Requirements Summary

NIST Laboratory Performance Outcome 1: Promote innovation, facilitate trade, ensure public safety and security, and help create jobs by strengthening the Nation's measurement and standards infrastructure

	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Actual	FY 2008 Estimate	FY 2009 Base	Increase/ Decrease	FY 2009 Estimate
Total Funding	576.8	621.6	762.4	662.4	808.6	650.7	136.8	787.5
IT Funding	63.1	65.6	65.9	73.0	75.2	75.2	0.6	75.8
FTE	2,672	2,503	2,550	2,566	2,797	2,797	189	2,986

NIST Hollings MEP Performance Goal 2: Raise the productivity and competitiveness of small manufacturers

	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Actual	FY 2008 Estimate	FY 2009 Base	Increase/ Decrease	FY 2009 Estimate
Total Funding	46.9	102.7	111.9	107.3	91.6	89.6	-85.6	4.0
IT Funding	1.5	1.0	1.0	0.5	0.5	0.5	-0.5	0.0
FTE	68	71	67	67	67	67	-48	19

NTIS Performance Outcome 1: Increase public access to world wide scientific and technical information through improved acquisition and dissemination activities

	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Actual	FY 2008 Estimate	FY 2009 Base	Increase/ Decrease	FY 2009 Estimate
Total Funding	19.2	15.9	27.2	27.9	50.4	42.0	0.0	42.0
IT Funding	5.4	3.5	3.9	3.2	4.1	3.9	0.0	3.9
FTE	165	157	144	131	150	150	0	150

Grand Total	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Actual	FY 2008 Estimate	FY 2009 Base	Increase/ Decrease	FY 2009 Estimate
Total Funding	830.1	878.5	973.9	890.9	1021.0	853.4	-13.7	839.7
IT Funding	72.1	72.3	72.3	78.2	81.4	79.6	0.1	79.7
FTE	3,109	2,938	2,896	2,891	3,130	3,080	103	3,183

* Funding amounts reflect total obligations

** Dollars shown in millions

*** Grand total includes funding and FTEs associated with the Advanced Technology Program/Technology Innovation Program and Hollings Manufacturing Extension Partnership..

Data Validation and Verification

NIST's Management and Organization Division conducts an annual review of its quantitative performance data to ensure that it is complete and accurate. During this process, Management and Organization discusses the data with appropriate offices to assess results relative to forecasts and to understand long-term trends and drivers of performance. Management and Organization also reviews the verification and validation procedures used by the offices that provide the source data and verifies that the source data itself is identical to or consistent with the reported data.

The table below summarizes the data validation and verification processes for each organization in the Technology Administration.

Performance Measure	Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
NIST Measure 1a: Qualitative assessment and review of technical quality and merit using peer review	On-site interviews and discussions with NIST management and research staff by independent external scientific and technical experts, managed by the NRC.	Beginning in FY 2007, the NRC conducted an assessment process where half of the NIST Laboratories will be reviewed each year.	NRC	Oversight of laboratory-specific expert review panels provided by the NRC.	Data are qualitative in nature	None
NIST Measure 1b: Citation impact of NIST-authored publications	Thomson Scientific, formerly the Institute for Scientific Information (ISI)	Ongoing	NIST	Data represents NIST's "relative citation impact" - that is, the average citation rate per NIST publication relative to Thomson's Scientific's baseline citation rate number for all scientific and technical organizations. Internal controls include verification and review by NIST Information Services Division and the NIST Program Office.	Factors such as self-citations, citation circles, and multiple authorship may affect the reliability of any data of this nature. However, even with such factors citation frequency analyses is broadly recognized as an indicator of the importance or utility of a publication.	None
NIST Measure 1c: Peer-reviewed technical publications	*Web of Science®* bibliographic database compiled by Thomson Scientific.	Ongoing	NIST	Publication data is collected by Thomson Scientific. Data represents analysis performed by NIST's Information Services Division.	Output only	None

Performance Measure	Data Source	Frequency	Data Storage	Internal Control Procedures	Data Limitations	Actions to be Taken
NIST Measure 1d: Standard Reference Materials (SRMs) sold NIST Measure 1e: NIST-maintained datasets downloaded NIST Measure 1f: Number of calibration tests performed	NIST Technology Services	Ongoing	NIST Technology Services	Data represents direct and verifiable counts. Internal controls include verification and review by NIST Technology Services and the Measurement Services and Advisory Group.	Data provide information on output levels only. NIST measure 2b reflects the number of users accessing these datasets; it does not reflect unique users or capture how the data was used.	None
NIST Measure 2a: Number of clients served by MEP Centers receiving Federal funding NIST Measure 2b: Increased sales attributed to MEP Centers receiving Federal funding NIST Measure 2c: Capital investment attributed to MEP Centers receiving Federal funding NIST Measure 2d: Cost savings attributed to MEP Centers receiving Federal funding	The client impact survey is administered by a private firm, Synovate, located in Arlington Heights, IL.	The survey is conducted four times per year, and clients are selected based on when they completed the first project with a MEP Center in the previous year. This process is used to reduce respondent burden, raise overall response rates, and improve data quality. Clients are asked to estimate how the group of MEP-provided services over the previous two years has affected their business performance in the 12-month period prior to the survey.	Survey data is sent directly to MEP for analysis. MEP reviews and stores survey data received from Synovate.	Internal controls include verification and significant review of the Synovate data by MEP staff. Criteria are in place for identifying outliers in the data. Centers verify the outlier and if necessary, the data are revised based on the Center review.	As with similar survey instruments, sources of uncertainty include variation in interpretation of specific questions; in the estimation techniques used in response to specific questions; in the quality of industry data; missing values; and other common survey problems. Synovate uses standard survey techniques to clean the data, ensure accuracy and reliability, and improve the response rate.	None
NTIS Measure 1a: Number of Updated Items Available (Annual)	NTIS operates and maintains internal systems for collecting acquisition statistics.	Data is available daily. Reports are produced monthly.	All data is stored within NTIS systems.	NTIS' accounting and budget offices analyze and report performance data to management. Data verification is provided through regular internal independent auditor reporting.	Output Only	None
NTIS Measure 1b: Number of Information Products Disseminated (Annual)	A modified commercial order processing system and a standard Web analysis software package used by industry.	Internal management activity reports are produced daily, summaries are produced monthly.	All data is stored within NTIS systems.	NTIS' accounting and budget offices analyze and report performance data to management. Data verification is provided through regular internal independent auditor reporting.	Output Only	None
NTIS Measure 1c: Customer Satisfaction	A modified commercial order processing system.	Internal management activity reports are produced daily, summaries are produced monthly.	All information is stored within NTIS systems.	NTIS accounting and budget offices analyze and report performance data to management. Data verification is provided through regular internal and independent auditor reporting.	None	None

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Department of Commerce
Technology Administration
Office of the Under Secretary for Technology
Salaries and Expenses
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations
2008 Currently Available	0	0	$93	$93
plus: 2008 unobligated balance	0	0	0	0
2009 Adjustments to base:				
less: Nonrecurring Technology Administration base reduction	0	0	(93)	(93)
2009 Base Request	0	0	0	0
plus: 2009 Program change	0	0	0	0
2009 Estimate	0	0	0	0

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Comparison by activity/subactivity:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Under Secretary for Technology											
Under Secretary for Technology	Pos./BA	7	$2,020	0	$93	0	0	0	0	0	0
	FTE/Obl.	7	1,931	0	93	0	0	0	0	0	0
TOTALS	Pos./BA	7	2,020	0	93	0	0	0	0	0	0
	FTE/Obl.	7	1,931	0	93	0	0	0	0	0	0
Adjustments for:											
Nonrecurring Technology Administration base reduction			0		0		0		0		0
Unobligated balance, start of year			0		0		0		0		0
Unobligated balance, end of year			0		0		0		0		0
Unobligated balance expiring			89		0		0		0		0
Budget Authority			2,020		93		0		0		0
Financing from transfers:											
Transfers to other accounts (+)			0		0		0		0		0
Appropriation			2,020		93		0		0		0

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Exhibit 8

Department of Commerce
Technology Administration
Office of the Under Secretary for Technology
Salaries and Expenses
ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	Perm. Pos.	FTE	Amount
Adjustment:			
Nonrecurring decrease for termination of the Technology Administration..............	0	0	($93)
Total, Adjustments to base..	0	0	(93)

Exhibit 9

Department of Commerce
Technology Administration
Office of the Under Secretary for Technology
Salaries and Expenses
JUSTIFICATION OF ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	FTE	Amount
Adjustment:		
Nonrecurring decrease for termination of the Technology Administration	(0)	$(93)

The Technology Administration was terminated in FY 2008. The policy activities of the Under Secretary of Technology were elevated to the office of the Secretary of Commerce.

Exhibit 10

Department of Commerce
Technology Administration
Office of the Under Secretary for Technology
Salaries and Expenses
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Activity: Under Secretary for Technology
Subactivity: Under Secretary for Technology

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Under Secretary for Technology	Pos./BA	7	$2,020	0	$93	0	0	0	0	0	0
	FTE/Obl.	7	1,931	0	93	0	0	0	0	0	0

Department of Commerce
Technology Administration
Salaries and Expenses
JUSTIFICATION OF PROGRAM AND PERFORMANCE
OFFICE OF THE UNDER SECRETARY FOR TECHNOLOGY
Congressional Submission

Base Program
Technology Administration - Abolished

Public law 110-69, HR 2272 signed into public law on August 9, 2007; (121 Stat. 572) abolished the Technology Administration. It is no longer a bureau of the Department of Commerce and ceases to exist.

Exhibit 16

Department of Commerce
Technology Administration
Office of the Under Secretary for Technology
Salaries and Expenses
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
11	Personnel compensation					
11.1	Full-time permanent	$870	$76	0	0	0
11.3	Other than full-time permanent	0	0	0	0	0
11.5	Other personnel compensation	1	0	0	0	0
11.9	Total personnel compensation	871	76	0	0	0
12.1	Civilian personnel benefits	226	17	0	0	0
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	24	0	0	0	0
22	Transportation of things	1	0	0	0	0
23.1	Rental payments to GSA	193	0	0	0	0
23.2	Rental payments to others	0	0	0	0	0
23.3	Communications, utilities, and miscellaneous charges	5	0	0	0	0
24	Printing and reproduction	8	0	0	0	0
25.1	Advisory and assistance services	0	0	0	0	0
25.2	Other services	40	0	0	0	0
25.3	Purchases of goods and services from government accounts	550	0	0	0	0
25.7	Operation and maintenance of equipment	1	0	0	0	0
26	Supplies and materials	10	0	0	0	0
31	Equipment	2	0	0	0	0
41	Grants, subsidies, and contributions	0	0	0	0	0
42	Insurance claims and indemnities	0	0	0	0	0
43	Interest and Dividends	0	0	0	0	0
99	Total Obligations	1,931	93	0	0	0

	Object Class	2007 Estimate	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
99	Total Obligations	1,931	93	0	0	0
	Plus: Unobligated Balance, end-of-year proposed two-year authority	0	0	0	0	0
	Less: Unobligated Balance, proposed two-year authority	0	0	0	0	0
	Plus Unobligated Balance Expiring	89	0	0	0	0
	Total Budget Authority	2,020	93	0	0	0

Personnel Data

	2007 Estimate	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
Full-time equivalent employment:					
Full-time permanent	7	0	0	0	0
Other than full-time permanent	0	0	0	0	0
Total	7	0	0	0	0
Authorized Positions:					
Full-time permanent	7	0	0	0	0
Other than full-time permanent	0	0	0	0	0
Total	7	0	0	0	0

Exhibit 33

Department of Commerce
Technology Administration
Office of the Under Secretary for Technology
Salaries and Expenses
APPROPRIATION LANGUAGE AND CODE CITATIONS

Public law 110-69, HR 2272 signed into public law on August 9, 2007; (121 Stat. 572) abolished the Technology Administration. It is no longer a bureau of the Department of Commerce and has been statutorily abolished.

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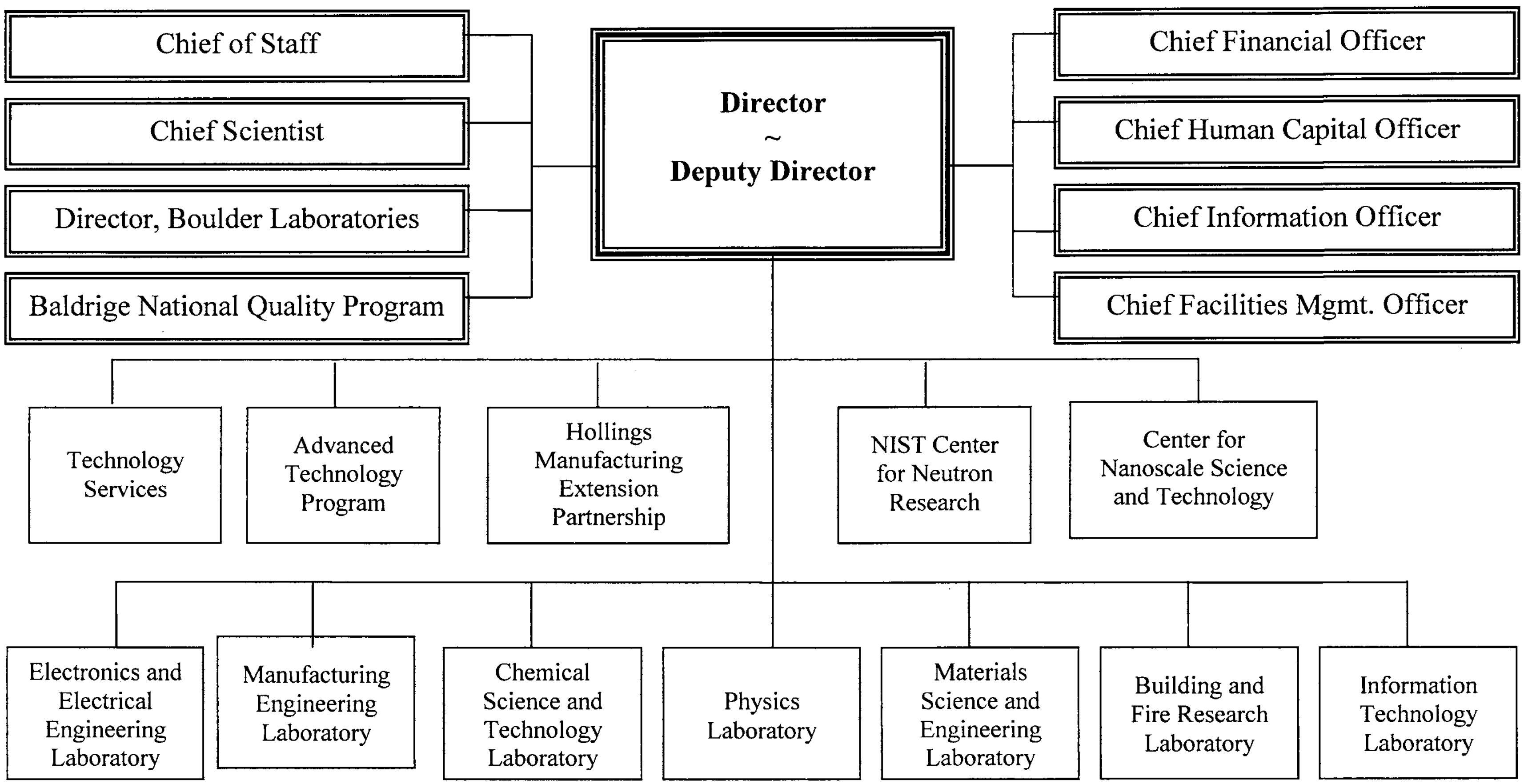
Department of Commerce
National Institute of Standards and Technology
BUDGET ESTIMATES, FISCAL YEAR 2009
CONGRESSIONAL SUBMISSION

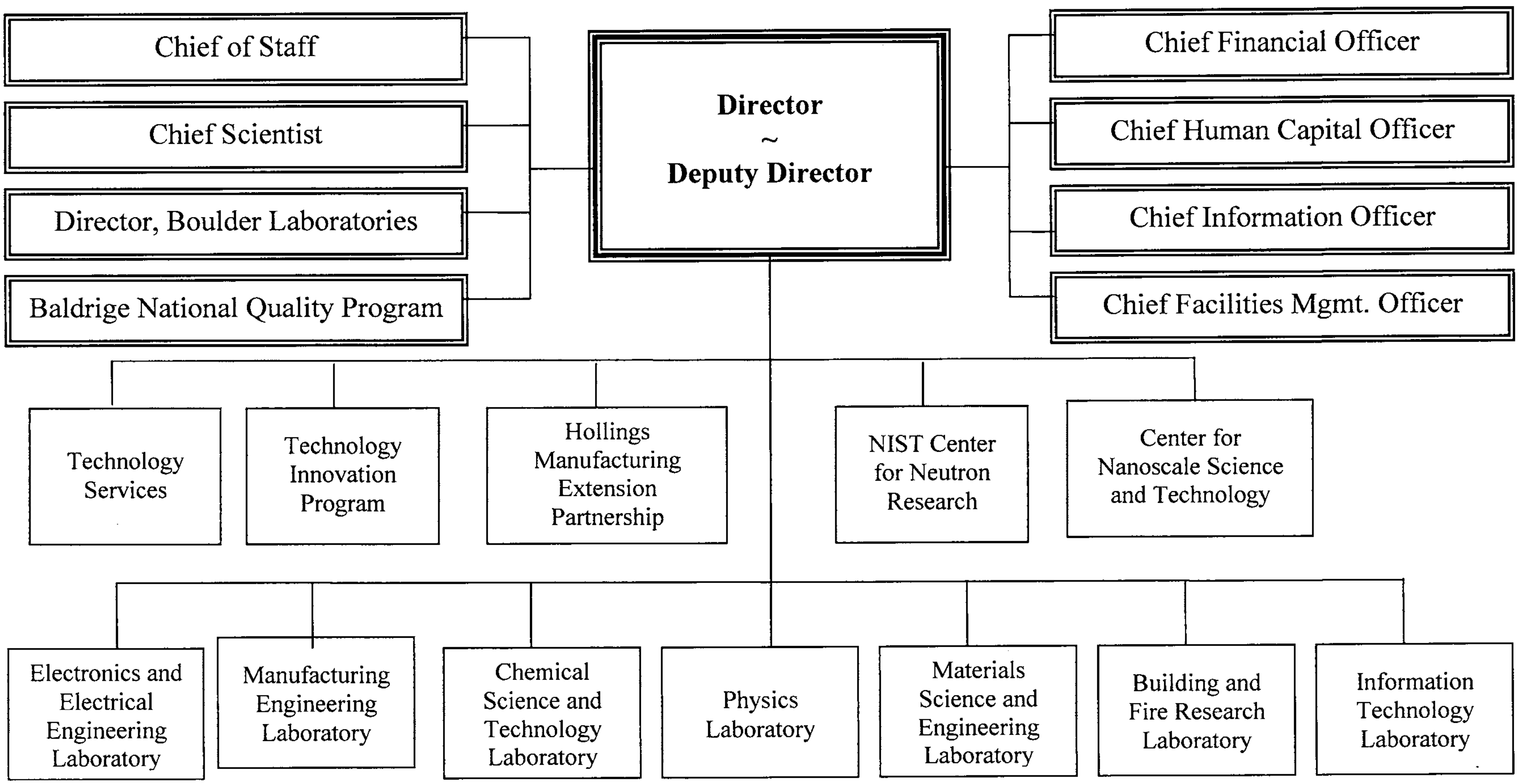
Table of Contents

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology



Current Structure

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology



Proposed Structure

DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
Budget Estimates, FY 2009
Congressional Budget Submission

INTRODUCTION

"One of the great engines of our growing economy is our Nation's capacity to innovate. Through America's investments in science and technology, we have revolutionized our economy and changed the world for the better."

President George W. Bush
February 2, 2006
American Competitiveness Initiative, Leading the World in Innovation

NIST's mission– to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards and technology in ways that enhance economic security and improve our quality of life– only hints at the true scope of the Institute's real-world impact. Virtually every segment of the economy–transportation, computers, banking, food processing, health care, communications–depends every day on NIST research, products, and services.

Today's most sophisticated technologies come in deceptively simple packages...cell phones smaller than your hand that also play music and video…medical kits that instantly analyze a patient sample and provide yes or no answers to diagnose specific conditions or diseases…clothing that is much more resistant to stains but looks and feels just like its much less durable predecessors…computers and telecommunications systems that appear effortlessly to serve up amateur videos on every possible topic and from every possible country.

These and many other technologies that most people take for granted every day depend on a vast and constantly expanding technical support system–an innovation infrastructure–that allows today's laboratory curiosities to become tomorrow's necessities. The Department of Commerce's (DoC) National Institute of Standards and Technology works to continually improve and maintain this support system, which includes measurement methods, data, standards, calibrations, access to state-of-the-art scientific facilities, and an array of other programs and services. In the process, NIST ensures that U.S. companies have the scientific and technical tools they need to create new, innovative products and to get those products to market as quickly as possible to help enhance the Nation's economic competitiveness.

Leadership in innovation is much more than a point of national pride. It is the key to our high standard of living and the source of future jobs. As scientific progress accelerates, opening the way to emerging technologies with once-unimaginable possibilities, the United States faces increasingly stiff competition from the rest of the world. Industrial nations and emerging economies alike are engaged in a high stakes race to develop the "next big thing" that will result in new, market-creating, value added next generation technologies that will revolutionize everyday life.

The United States still leads the pack, but improvements are required across the entire innovation spectrum, from mind to market, from discovery to application. The Nation's key strategic assets must be better leveraged. These include the U.S. university system, the primary performer of basic research and source of new scientists and engineers, and the Nation's fiercely competitive manufacturing and service industries that altogether account for 28 percent of global economic output.

In short, changing conditions and global trends in the new century demand continuous improvement in how our Nation develops, refines, and applies new technologies. This can be called an economy-wide "innovation imperative."

President Bush's American Competitiveness Initiative (ACI) announced in February 2006 aims to launch "a new era of American innovation." A critical element of the ACI is a doubling of funding over ten years for NIST laboratory programs and facilities along with the National Science Foundation and the Department of Energy Office of Science. NIST is positioned at the intersection of academia–which generates most fundamental scientific discoveries – and industry–which turns discoveries into products and services. NIST develops leading-edge measurements, tests, and other infrastructural tools that are essential in the drive to continuously improve innovation performance at all levels: in individual laboratories and companies, in whole industry sectors, and throughout the entire economy. In many instances, NIST work in measurement science is the critical path to discovery and innovations.

While companies strive to make their latest products and services as easy to use and as simple for consumers as possible, the underlying knowledge and technology base that makes this possible is certainly not simple. Consider the web of fiber optic networks that makes broadband communication–from long distance telephone, to cable television, to high-speed internet–possible. The system includes dozens of independent networks, tens of thousands of connections and millions of miles of optical fibers, each fiber capable of carrying hundreds of separate signals simultaneously. Yet, despite its already mind boggling complexity, this fiber optic system that our economy depends on may soon suffer with the same kind of traffic congestion currently clogging highways around many major metropolitan areas.

To prevent this, communications manufacturers and service companies need faster, more accurate ways to measure the quality of optical signals, data analysis tools to diagnose transmission problems, and nanoscale monitoring systems for ultra fast microchips that use light instead of electrons to store and process information. NIST is uniquely positioned to help meet these challenges. NIST has the right combination of world class scientists and engineers, outstanding scientific facilities, and strong ties with both the industrial and service sectors to provide the tools needed to realize next-generation optical technologies.

Medicine is facing a similar complexity explosion. As the project to decode the 3 billion "letters" of the human genome has demonstrated, the frontiers of medicine have moved in the last few decades from often qualitative assessments to increasingly quantitative measures down to the level of individual biological molecules. As a result, medical researchers skilled in the biological sciences are increasingly finding that they need to integrate physical scientists, and their quantitative measurement skills into their research teams.

And just as a systems engineer might study an entire fiber optic network from its individual components to its overall efficiency, life science researchers are beginning to treat medical and biological research problems with a "systems approach" long used in engineering and the physical sciences. Life sciences researchers are attempting to fully integrate what they know at the nano and microscale of molecules, DNA, and proteins with the macroscale problems of disease and other medical problems experienced by patients. Again, NIST, with its interdisciplinary research staff and expertise in creating groundbreaking new measurement methods and standards, can provide the tools needed to advance the field. The payoff will be faster development of new drugs, more personalized medicine, and better prediction, diagnosis, and understanding of disease. This approach leverages NIST's core competencies.

Similar opportunities exist for NIST to undertake the equally complex measurement challenges involved in safely exploiting the promise of nanotechnologies or transforming the field of computer modeling and visualization to a truly quantitative, predictive science.

To accomplish all of these goals and to meet the challenges of the ACI, NIST must continue to update and expand its own laboratory facilities. Consequently, this budget also includes a third year funding request for the continued construction of an extension to NIST facilities at its laboratory in Boulder, CO (Building 1) to provide new high performance space; an expansion of facilities and capacity to train future U.S. scientists in cutting edge atomic, molecular, and optical physics at JILA–NIST's world renowned joint institute with the University of Colorado at Boulder; as well as funding for the third year of a program to expand and upgrade NIST's Center for Neutron Research–the Nation's leading facility of its kind and a critical research tool for more than 2,200 researchers annually who work in nanotechnology, advanced materials, biotechnology, and other fields.

For more than 100 years, NIST research has been critical to our Nation's current and future competitiveness. Cell phones, the Internet, air bags, the global positioning system, all of these now common technologies and many more were made possible in part by NIST efforts to continually improve the Nation's measurement and innovation infrastructure. Nanotechnologies, automotive hydrogen fuel cells, quantum computers, DNA lab-on-a-chip devices—NIST is working now on the measurement tools, data, and standards needed for these and many other yet to be imagined products that will define our future. The critical new initiatives requested in this FY 2009 budget, especially those funds targeted for critical new initiative efforts, will help NIST work with industry and academia to build a strong future for all Americans.

Strategic Environment: Conditions and Assumptions

NIST lays the foundation for the innovation, economic growth, and quality of life that Americans have come to expect. NIST technology, measurements, and standards help U.S. industry invent and manufacture superior products reliably, provide critical services, ensure a fair marketplace for consumers and businesses, and promote acceptance of U.S. products in foreign markets. As manufacturing, service sector, and national priorities change, NIST responds to the Nation's most critical and emerging needs.

In February 2007, NIST issued a new report, *An Assessment of the United States Measurement System: Addressing Measurement Barriers to Accelerate Innovation.* This report is the product of a NIST-led survey and analysis of measurement-related needs for supporting innovation across 11 industrial sectors and technology areas. These needs ranged from materials to software and from building and construction to nanotechnology. In all, more than 1,000 people in industry, academia and government participated in the study.

The assessment identified more than 700 scientific and technical measurement challenges facing U.S. industry today. Examples of the measurement challenges identified included the need for versatile, high-accuracy methods to measure the three-dimensional geometry of manufactured products and the need for tools for measuring the properties of nanodevices and materials. The report calls on the public and private sectors to address those challenges by crafting a "strategic, long-term approach" designed to sustain U.S. innovation at a world-leading pace. NIST will play a critical, central role in that effort. NIST will use the assessment to focus and prioritize its research and collaborative efforts on overcoming the most significant measurement-related barriers to U.S. innovation and industrial competitiveness.

In addition to its core measurement and standards functions, NIST manages the Baldrige National Quality Program to help U.S. businesses and other organizations to achieve organizational performance excellence by providing clear standards and benchmarks of quality. By helping U.S. organizations adopt practices for continually improving their performance, this program also promotes innovation.

To do its job well, NIST must not only have world class scientists, engineers, and facilities -- it must also operate at technology's cutting edge five, ten or even fifteen years ahead of industry's need for new measurement or quality control tools. In the course of pursuing frontier research, NIST scientists have received three Nobel Prizes in Physics since 1997, a National Medal of Science, a MacArthur Foundation "genius" grant and numerous appointments to prestigious bodies such as the National Academies of Sciences and Engineering. In the words of NIST Nobel Laureate William Phillips, "NIST has a responsibility to *lead* measurement so that we are not solving today's problems tomorrow. We have a responsibility to solve tomorrow's problems today."

EXECUTIVE SUMMARY

NIST Goals and Focus of the FY 2009 Budget Request

American Competitiveness Initiative

NIST is a unique and essential asset in the Nation's scientific R&D enterprise. To maximize its effectiveness, NIST selects major research initiatives that are highly leveraged to provide the greatest possible return to the American taxpayer on the investment of NIST resources. NIST's FY 2009 Scientific and Technical Research and Services (STRS) and Construction of Research Facilities (CRF) appropriations budget request of $634 million is an integral component of the President's 10-year American Competitiveness Initiative (ACI), which proposes doubling the support over the coming decade for high-payoff physical science research in the National Institute of Standards and Technology (NIST), the National Science Foundation, and the Department of Energy Office of Science. Excluding earmarks and unrequested grants enacted in the FY 2008 Omnibus bill, this budget request reflects a 22.0 percent increase over FY 2008 for STRS and CRF. The FY 2009 budget for NIST applies its core competencies to strategic areas that are critically important to the Nation's future economic and physical security and are among the Administration's top R&D priorities.

Elimination of the Advanced Technology Program and creation of the Technology Innovation Program, and Discontinuation of the Hollings Manufacturing Extension Partnership Program (MEP)

On August 9, 2007, the President signed Public Law 110-69, the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science (COMPETES) Act. The Act eliminates NIST's Advanced Technology Program (ATP), but allows for continued support for previous and pending ATP awards. The same statute creates the Technology Innovation Program (TIP). Under the statute, TIP can provide assistance for proposed technologies with strong potential to address critical national needs by transforming the Nation's capacity to deal with major societal challenges that are not currently being adequately addressed, and generate substantial benefits to the Nation that extend significantly beyond the direct return to the applicant.

The Administration's FY 2009 budget continues investing in basic research through mechanisms such as the American Competitiveness Initiative (ACI). The FY 2009 budget request continues the ACI as NIST's highest priority for the nation. As a result, no funds are requested for TIP in FY 2009. Anticipated prior-year recoveries will be sufficient to phase out the program.

Additionally, the FY 2009 budget also discontinues Federal funding for the MEP. Funds are requested for the orderly discontinuation of the program. MEP Centers will change to a self-supporting basis, as intended in the program's original authorization.

Summary of FY 2009 Proposed Budget Request

To carry out its mission, NIST requests a total budget of $638 million, including 2,905 permanent positions (3,033 FTE). This budget request includes program changes totaling $-18.1 million and 119 permanent positions (103 FTE), which includes increases of $71.1 million for STRS, $61.7 million for CRF and decreases of $150.8 million for ITS.

The FY 2009 budget request for the Construction of Research Facilities appropriation totals $99 million, and 61 permanent positions (60 FTE). It funds the final phase of construction of the Building 1 Extension in Boulder (+$43,538,000) while providing funding for a limited expansion of the laboratories at JILA, a joint institute of the University of Colorado and NIST (+$13,000,000). The FY 2009 request also includes an increase of $5,151,000 for Safety, Capacity, Maintenance, and Major Repairs (SCMMR) to address the backlog of major repair work and to forestall more costly emergency repairs in the future.

The FY 2009 budget request for the Scientific and Technical Research and Services appropriation totals $535 million and 2,136 permanent positions (2,147 FTE), and includes the following major initiative components for the ACI:

1. NIST Center for Neutron Research (NCNR) Expansion and Reliability Improvements	$2,000,000	6 permanent positions	4 FTE
2. Environment, Health and Safety Measurements & Standards for Nanotechnology	$12,000,000	31 permanent positions	23 FTE
3. Measurements and Standards to Accelerate Innovation in the Biosciences	$10,000,000	25 permanent positions	19 FTE
4. Quantum Information Science/Enabling Innovation through Quantum Science	$7,000,000	22 permanent positions	16 FTE
5. Enabling Nanotechnology from Discovery to Manufacture	$7,000,000	18 permanent positions	13 FTE
6. Measurements and Standards for the Climate Change Science Program	$5,000,000	20 permanent positions	15 FTE
7. Innovations in Measurement Science	$3,000,000	12 permanent positions	9 FTE
8. National Earthquake Hazard Reduction Program Initiative	$3,250,000	3 permanent positions	2 FTE
9. Disaster Resilient Structures and Communities	$4,000,000	5 permanent positions	4 FTE
10. Cyber Security	$5,000,000	16 permanent positions	12 FTE
11. Going at Light Speed: Optical Communications and Computing	$5,840,000	25 permanent positions	18 FTE
12. Enabling the Hydrogen Economy	$4,000,000	13 permanent positions	10 FTE
13. Biometrics: Identifying Friend or Foe	$2,000,000	4 permanent positions	3 FTE
14. Manufacturing Innovation through Supply Chain Integration	$1,000,000	3 permanent positions	2 FTE

The FY 2009 budget request for the Industrial Technology Services appropriation totals $4 million, no permanent positions, and 47 FTE. The $4 million funds the orderly end of Federal funding for the Hollings Manufacturing Extension Partnership program. The FY 2009 budget does not request funds for the Technology Innovation Program.

FY 2009 Budget in Support of the American Competitiveness Initiative (ACI)

The FY 2009 budget request for NIST provides the Nation with essential tools to enable continued innovation and economic vitality. It strongly supports the Administration's goal to promote U.S. innovation and industrial competitiveness. The initiatives under CRF and STRS highlighted below are the Administration's ACI priorities in this FY 2009 request.

Construction of Research Facilities (CRF)

1. Building 1 Extension (B1E) - Providing the Tools of Science to Support Sustained Scientific Advancement and Innovation (+$43,538,000)

This initiative is the final year of funding for the phased construction of the Building 1 extension (B1E) in Boulder aimed at providing new high-performance laboratory space with stringent control of temperature, vibration, humidity, and air cleanliness. The FY 2008 appropriation provides $23.6 million of construction and major renovation funding for the B1E project. With the requested funding in FY 2009, NIST will finish construction, increasing the level of the laboratory space in B1E to achieve required performance. The improved space will enable NIST to support scientific discovery and technical development of transformational technology in homeland security, telecommunications, nanotechnology, precision timing, hydrogen energy sources, precision electrical standards, biotechnology, applications of lasers, electromagnetic interference testing, quantum computing and quantum communications, and other national needs.

2. JILA Expansion - Preparing the Next Generation of Physicists (+$13,000,000)

NIST proposes to expand the laboratories at JILA, a joint institute of the University of Colorado and NIST of the highest class, in which the two institutions have forged important scientific advances together since the early 1960's. JILA currently houses the laboratories of three Nobel laureates, two MacArthur Genius prize winners, seven members of the National Academy of Sciences, and five members of the Academy of Arts and Sciences. The working relationship between JILA and NIST is mutually beneficial, and many of NIST's top researchers hold faculty appointments with the University.

JILA is an international leader in Atomic, Molecular, and Optical (AMO) science -- a field that the National Academy of Sciences says is "key to training our best scientists, engineers and technical professionals." NIST is the lead Federal agency in AMO science, accounting for almost 40 percent of all Federal funds for research in this area.[1] The additional space made available through this two year expansion initiative will enable NIST to support scientific discovery and develop radically new tools of science that will push the frontiers of science in all fields. The JILA expansion will increase the capacity to train the next generation of AMO scientists at JILA by 33 percent and the Nation's capacity to train AMO scientists by 10 percent[2]. Current facility space is inadequate and constrains the number of researchers who can work in this field. The government's return on investment in expanding JILA will be increased since the cost will be shared between NIST ($22.5 million over two years) and the University of Colorado which will contribute $5 million in direct funding in addition to valuable in-kind contributions, including the land, utilities infrastructure such as electricity, chilled water and steam, and other services. The proposed funding continues an existing "institutional award" made to maintain the long-term partnership between NIST and JILA. Detailed analysis showed conclusively that expanding on existing space was the most cost-effective approach.

3. Safety, Capacity, Maintenance, and Major Repairs (SCMMR) (+$5,151,000)

This initiative provides additional base funding in support of NIST's Safety, Capacity, Maintenance, and Major Repairs (SCMMR) program to facilitate the reduction of the deferred maintenance backlog. A 2004 report from consultants Hanscomb, Faithful and Gould (HF&G) reported that, based upon a business case analysis, the annual SCMMR allowance should be at least three percent of the building replacement value of NIST facilities. This increase will over time help decrease the deferred maintenance backlog of safety, capacity, maintenance, and major repairs.

Scientific and Technical Research and Services (STRS)

1. NIST Center for Neutron Research (NCNR) Expansion and Reliability Improvements (+6 Permanent Positions, +4 FTE, +$2,000,000)

This initiative request is the third fiscal year of funding increases required in the five year project for the NCNR expansion. The NCNR is the Nation's leading neutron research facility, and serves more scientists and engineers than all other U.S. facilities combined. NIST has begun construction of the expanded instrument hall (called a Guide Hall) and the required support and utility buildings for the new cold source, instruments, and experimental activities. A prototype liquid hydrogen cold source, with twice the neutron output as the current cold source, has been constructed and successfully tested at NIST. In consultation with the national

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[1] National Research Council (2005). Controlling the Quantum World of Atoms, Molecules, and Photons: An Interim Report

[2] American Institute of Physics, Ph.Ds by Subfield; http://www.aip.org/statistics/trends/highlite/emp/figure15.htm

research community, NIST developed concept proposals for the five neutron scattering instruments and associated guide tubes. The NCNR expansion will provide capabilities that are not presently available in the United States. The requested FY 2009 funding will support the next phase of the NCNR expansion: initiate installation, testing, and commissioning of the new neutron instruments that promise to bring new neutron measurement capability to U.S. researchers, exceeding current capabilities by up to a factor of 100.

2. Environment, Health and Safety Measurements & Standards for Nanotechnology – Enabling the Safe Exploitation of Nanotechnology (+31 Permanent Positions, +23 FTE, +$12, 000,000, including a + $4,000,000 transfer to the Working Capital Fund)

Hundreds of nanotechnology products are already in the marketplace and the potential for growth is tremendous. The National Science Foundation is predicting $1 trillion dollars in revenue from nanotechnology to the world's economy by 2015. Industry is increasingly finding that the unknown environment, health, and safety (EHS) risks associated with nanotechnology is a threat to innovation and competitiveness. Therefore, it is critical that potentially dangerous nanomaterials be identified before they can harm the public. It is also critical that the next breakthrough technology or new cancer cure not be halted by unsubstantiated fears of adverse health effects. Otherwise, industrial innovation will suffer in an uncertain regulatory, liability, and investment environment. There is no measurement infrastructure currently in place to assess the EHS impacts, if any, that these materials pose. The National Nanotechnology Initiative working group on EHS has called on NIST to lead in developing metrologies needed to determine any EHS effects of nanomaterials.

With this increase, NIST will launch a coordinated effort for leveraging nanotechnology expertise and resources across its laboratories and facilities to develop analytical methods for quantifying the type and amount of nanomaterials in biological materials, the environment, and the workplace. Accurate and validated protocols and reference materials will be developed to define the uses and limitations of major analytical methods. Metrologies to enable the understanding of EHS properties of nanomaterials will be developed, including techniques for standardizing assessment of nanoparticle size and size distribution, shape, structure, and surface area, and characterizing nanoparticle chemical composition, purity, and heterogeneity. It is only through such standardization and characterization that understanding and prediction of nanoparticle and nanomaterial EHS impact will be realized.

3. Measurements and Standards to Accelerate Innovation in the Biosciences (+25 Permanent Positions, +19 FTE, +$10,000,000, including a $2,200,000 transfer to the Working Capital Fund)

The enhanced understanding of complex biological systems is a national scientific priority. While tremendous Federal and industry investment in the biosciences has dramatically increased our understanding of the complexity of living systems (e.g., the Human Genome Project), concurrent investments in bioscience physical measurement capabilities have not kept pace. The lack of an advanced quantitative and traceable bioscience physical measurement infrastructure capable of handling the complexity of biological systems and the molecular interactions that define them is stifling the Nation's ability to capitalize on its investment in the life sciences. There is no measurement infrastructure that assures that the data collected are accurate, comparable, easily used, or correctly interpreted by the life sciences community. The recent National Academies report, *Cancer Biomarkers: The Promises and Challenges of Improving Detection and Treatment*, highlights NIST and the need for the creation of standards for biomarker discovery, validation, and usage. Provision of new measurement tools requires a combination of complex physical and information science expertise that lies outside the traditional life sciences community. Enhanced bioscience physical measurement capabilities dramatically impact the biotechnology and pharmaceutical industries by decreasing both the time and cost associated with drug development. This is done by increasing efficiency in the drug development process through the early identification of potential problems with candidate drugs before they enter the more costly pre-clinical and clinical trial stages of development.

With this increase, NIST will apply physical and chemical science expertise in microfluidics, microarrays, cellular imaging, and single molecule measurements to develop quantitative measurement technologies and standards necessary for a traceable measurement infrastructure that can address the current barriers to the measurement and modeling of biological systems. NIST will continue to collaborate closely with the National Institutes of Health and industry to ensure that the NIST biosciences measurement program addresses the highest priority measurement barriers of the life science community.

4. Quantum Information Science/Enabling Innovation through Quantum Science (+22 Permanent Positions, +16 FTE, +$7,000,000, including a +$1,100,000 transfer to the Working Capital Fund)

Quantum-based experiments led to many of the technological advances that defined the last century. Advances in quantum mechanics have enabled everyday devices such as computers, cell phones, and even laser scanners found at the checkout counter of every grocery store. Yet the quantum realm holds more surprises, and more possibilities. The exploitation of quantum behavior for innovative leaps in technology requires overcoming barriers to creating the devices that will constitute future quantum technologies. NIST will enhance its Nobel-prize winning work by pushing the limits of scientific understanding in the quantum realm, and building advanced tools and techniques to exploit the full potential of quantum phenomena.

The FY 2009 request enables NIST to build on and exploit the research accomplishments supported by previously appropriated funds. For instance, NIST demonstrated simple quantum logic operations in FY 2005 and FY 2006, the basis for a quantum processor, using neutral atoms and trapped ions. NIST also demonstrated single photon sources and detectors, the basis of quantum communication system. FY 2007 funding enabled NIST to develop quantum components and early applications of quantum information science, specifically the demonstration of a complete quantum communication system operating at speeds high enough for practical use. All of the FY 2005, 2006, 2007, and 2008 efforts are ongoing, and the FY 2009 request allows NIST to continue to exploit these past accomplishments.

5. Enabling Nanotechnology from Discovery to Manufacture (+18 Permanent Positions,+13 FTE, +$7,000,000, including a +$2,000,000 transfer to the Working Capital Fund)

Emergent breakthroughs in nanotechnology promise to spur economic growth and development in the early 21st century by increasing the value of existing products, enabling new products, and fostering the growth of high-tech jobs in the U.S. economy. By 2015, sales of nanotechnology-related products are predicted to exceed $1 trillion, with far-reaching effects in many industries.[3] These predictions will only be realized if our Nation can cost-effectively incorporate innovative nanotechnologies into the advanced manufacturing of products and devices. Moving from fundamental discoveries to valuable and marketable devices and products depends upon a measurement infrastructure that allows industry sectors to accurately and reliably differentiate among innovative solutions at the nanoscale.

NIST will continue to build the Nation's nanoscale measurement infrastructure that will nurture and ensure U.S. leadership in the production and use of nanotechnology. Specifically, NIST will construct additional tools for the characterization of nanostructures through advances in materials science, modeling, simulation, and three dimensional imaging. Furthermore, NIST will partner with industry to provide the necessary measurements and standards to enable the development of ultimate CMOS (complementary metal oxide semiconductor) and thereby continue the rapid increase in the delivered value of semiconductor devices, allowing U.S. semiconductor manufacturers to keep pace in the competitive nanotechnology era.

6. Measurements and Standards for the Climate Change Science Program (+20 Permanent Positions, + 15 FTE, +$5,000,000, including a + $1,000,000 transfer to the Working Capital Fund)

For more than a decade, the United States has invested heavily in scientific activities related to climate change. In February 2002, the U.S. Climate Change Science Program (CCSP) was launched as a collaborative interagency program, designed to improve the government-wide management of climate science and climate-related technology development. Among the top priorities in the 10 year strategic plan produced by the CCSP were better methods for understanding the impact of aerosols on global warming and calibrating satellites used for understanding the current state of Earth's atmosphere. NIST will develop the necessary measurement science and standards to improve the accuracy of climate change predictions, providing policymakers with accurate information about the advantages and consequences of various policy options.

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[3] *M.C. Roco and W.S. Bainbridge, eds., 2001, "Societal Implications of Nanoscience and Nanotechnology", Springer, pp. 3-4.*

7. **Innovations in Measurement Science (+12 Permanent Positions, + 9 FTE, +$3,000,000, including a +$500,000 transfer to the Working Capital Fund)**

The NIST Innovations in Measurement Science Program is one of NIST's primary mechanisms for keeping pace with the measurement requirements needed for innovation in U.S. industry. This program is used to advance NIST's capabilities in the core measurement science areas underpinning technology innovation. Just as industry must innovate to survive in a competitive environment, NIST must develop innovative approaches to measurement challenges. NIST uses this program to anticipate industry needs and develop the measurement science needed by the next generation of technology. The increased funding would mean more and faster measurement innovation to meet emerging industry needs.

8. **National Earthquake Hazard Reduction Program Initiative (+3 Permanent Positions, + 2 FTE, +$3,250,000)**

There are close to $8.6 trillion of structures and 75 million people located in urban areas of moderate to high earthquake risk. National Research Council studies estimate that a single large earthquake in the U.S., like the one that struck Kobe, Japan, in 1995, could cause damage of $100 to $200 billion. This initiative will fund research for advanced mitigation technologies and create guidelines for the rehabilitation of existing structures. The funds requested helps implement Public Law 108-360, the National Earthquake Hazards Reduction Program (NEHRP). Public Law 108-360 created the Interagency Coordinating Committee on Earthquake Hazards Reduction and designated NIST as the lead agency for the effort.

9. **Disaster Resilient Structures and Communities (+ 5 Permanent Positions, + 4 FTE, +$4,000,000)**

Despite significant progress in disaster-related science and technology, natural and technological disasters in the United States are responsible for an estimated $52 billion in average annual costs in terms of lives lost, disruption of commerce and financial networks, properties destroyed, and the cost of mobilizing emergency response personnel and equipment. Natural hazards–including extreme winds (hurricanes, tornadoes, windstorms) and storm surge, wildland fires, earthquakes, and tsunamis–are a continuing and significant threat to U.S. communities. Human activities that are accidental, criminal, or terrorist can lead to disastrous community losses as well. A single event such as a major earthquake or hurricane could potentially cause $80 billion to $200 billion in economic losses in the affected areas. For FY 2009, the scope of the $4.0 million initiative includes work on the disaster resilience of structures and communities during extreme winds and storm surge, fires at the wildland-urban interface, and strong-motion earthquakes. It also includes work on multi-hazard failure analysis, decision-support tools for economic assessment of multi-hazard mitigation solutions, and standard methods to predict losses and evaluate disaster resilience at the community and regional scales. Further, the FY 2009 initiative is based on a joint program plan with NOAA that includes collaborative work in all hazard areas, with the exception of complementary work in earthquakes (NIST) and tsunamis (NOAA).

10. <u>Cybersecurity (+ 16 Permanent Positions, +12 FTE, +$5,000,000)</u>

Our Nation's industry, citizens and government rely upon the secure, robust and efficient operation of countless interconnected computer systems. Ensuring this security requires constant re-examination of existing protocols and technical structures in response to emerging threats. This initiative focuses on a NIST-generated infrastructure that will include a high-level framework for the generation, distribution, use, storage and destruction of the cryptographic keys used to secure communications over the network, a critical element of an overall strategy toward more effective Identity Management. A key focus of the effort will be meeting the critical challenges of affordability, flexibility, usability, and global scalability with security. The effort will be conducted in technical consultation with the National Security Agency (NSA) and other Department of Defense (DoD) elements, as well as other government agencies and non-government organizations.

11. <u>Going at Light Speed: Optical Communications and Computing (+25 Permanent Positions, +18 FTE, +$5,840,000)</u>

The success of U.S. communications is a fundamental driver of productivity gains and economic growth and a key platform for innovations in many current and future industries (telemedicine, entertainment, and security). For this reason the President, in "*A New Generation of American Innovation,*" has called for all Americans to have "universal, affordable access to broadband technology." This requires transmission rates 100 times faster than are available today; but the U.S. communications network was not designed for this large amount of data traffic. The information transmission that is our Nation's economic lifeblood is being choked both within our computers and along the transmission lines that connect them.

To take full advantage of the existing infrastructure and enable the next generation data transmission needs, industry must: 1) develop faster fiber-optic transmission lines and flexible transmission systems that diagnose and reconfigure the paths that signals follow in response to changing conditions; and 2) enable light-speed (photonic rather than electronic) operation in the computers to which these transmission systems connect. Industry currently lacks the optical measurement capabilities essential to achieve these goals. The Optoelectronics Industry Development Association calls for measurements to support higher transmission speeds, and the Telecommunications Industry Association Chief Technology Office council states that measurements are required to support flexible transmission systems. In addition, new measurement techniques are required to achieve the International Technology Roadmap for Semiconductor goal of achieving light-speed communications within computer chips by manipulating light at the nanoscale.

NIST is positioned to lead in developing precise measurement capabilities and standards necessary to allow systems from multiple vendors to interoperate and overcome critical communications bottlenecks. Working closely with industry, NIST, already the world leader in high-speed measurements and optoelectronic measurements, will expand its efforts to include research and development of: 1) new measurement, data analysis, and modeling tools that utilize signal measurements to remotely diagnose the locations of transmission problems on flexible networks, and 2) new nanoscale measurement techniques for analyzing light-based circuitry.

This initiative will address industry's and the Nation's need for higher speed, flexible networks by developing measurements that permit light speed communications from the scale of a computer to the scale of the Nation's optical network.

12. <u>Enabling Hydrogen Economy (+13 Permanent Positions, + 10 FTE, +$4,000,000, including a +$750,000 transfer to the Working Capital Fund)</u>

The development of a robust hydrogen economy will help the U.S. use energy more efficiently and cleanly and reduce the Nation's dependence on foreign sources of energy. NIST research will enable more powerful, efficient, and durable fuel-cell designs and high-volume manufacturing through the development of measurement tools, material characterization, theory, and models that allow real-time diagnostics of hydrogen fuel cell performance; ensure accurate measures of hydrogen at points of sale; and ensure safer storage, distribution, and delivery of hydrogen in the marketplace.

13. <u>Biometrics: Identifying Friend or Foe? (+ 4 Permanent Positions, + 3 FTE, +$2,000,000)</u>

Strategies for finding terrorists can be complicated by their efforts to disguise themselves among innocent civilians. As a counter to this, the implementation of biometric technologies (identifying an individual based on physical characteristics, such as fingerprinting, facial recognition, iris scans, etc.) shows great promise in improving the accuracy, consistency, and efficiency of identification devices. Enhanced biometric systems, with the associated test and evaluation infrastructures, have been identified as a Presidential research and development priority to further reduce vulnerabilities in protecting the homeland. DHS, FBI, and the State Department (US-VISIT) currently partner with NIST to draw on and leverage NIST's long experience and expertise in measurement science and standards in biometric technologies. NIST will develop measurements and standards to support testing and evaluation of enhanced biometric systems, including approaches using multiple modes of identification.

14. <u>Manufacturing Innovation through Supply Chain Integration (+ 3 Permanent Positions, + 2 FTE, +$1,000,000)</u>

The manufacturing and construction sectors represent a major fraction of the U.S. Gross Domestic Product and U.S. employment. Global competitiveness in these industries is critical to maintaining the Nation's standard of living. The inefficient exchange of product design and business data in manufacturing and construction costs the U.S. economy in excess of $25 billion per year. This initiative will advance industry towards a seamless global supply chain — shortening design-to-manufacturing cycle, improving product quality, and lowering costs. NIST will develop standards, measurements, and testing tools that are fundamental to enabling efficient supply chains, maintaining competitiveness, and increasing innovation.

President's Management Agenda: Advancing NIST's Organizational Performance

NIST has a long history of designing its programs in response to customer needs, evaluating its programs through external peer review and other rigorous methods, and continuously improving its organizational structure and work systems to maximize efficiency and effectiveness. Consistent with this history, NIST's management goals and processes support each of the six key initiatives of the President's Management Agenda, as described below. In FY 2009, NIST will pursue continued improvements in each of these areas using base resources.

Strategic Management of Human Capital: NIST is a high-performing organization with a flat, mission-focused structure. NIST has only four levels of management and has span-of-control numbers that compare favorably with other R&D organizations. NIST uses a variety of powerful human resource tools including pay banding, pay for performance, and recruitment and retention allowances to manage its workforce. NIST is committed to continuously improving its workforce management practices to meet mission requirements and changing customer needs. NIST's human capital planning and resource requirements are integrated within the Institute's programmatic planning, and human capital needs specific to each program are detailed within this budget request. In addition, NIST has developed a comprehensive Human Capital Strategic Plan that outlines goals and initiatives for meeting NIST's major human capital challenges.

Competitive Sourcing: NIST completed one feasibility study in fiscal year 2006 on the Office of the Chief Information Officer and completed one for the Fabrication Technology Division in the Manufacturing Engineering Laboratory in fiscal year 2007. NIST is conducting a fiscal year 2008 feasibility study in the Janitorial Services Group of the Plant Division.

Improved Financial Performance: NIST continues to receive unqualified audit opinions, provides accurate and timely financial information in response to routine audit opinions, and complies with all financial laws and regulations.

Expanded Electronic Government: NIST uses the Internet to deliver services to its customers. To avoid redundancy in that service delivery, NIST is implementing relevant solutions developed through e-Gov initiatives as they are available, such as grants.gov and e-Learning. NIST has certified and accredited 100 percent of its production systems, and continues to refine its IT security program to improve its level of security. NIST uses its Enterprise Architecture to guide new investments that increase the efficiency of its IT infrastructure, while providing the flexibility needed for a scientific organization to achieve its mission.

Budget and Performance Integration: NIST integrates planning, performance, and evaluation information into its budget submissions. This integration has improved the comprehensiveness and quality of NIST budget justifications.

R&D Investment Criteria: NIST has exemplary and long-standing practices in place for evaluating the relevance, quality, and performance of its research functions–the central objectives of the R&D investment criteria. NIST uses a combination of external peer review, analysis of outputs, industry and association technical roadmaps, and both retrospective and prospective economic impact studies to evaluate the performance and direction of its research programs. NIST's long-term planning process provides the framework for strategy formation and performance evaluation.

Summary of Performance and Resources

Data on performance evaluation and reporting for all NIST base programs are in Exhibit 3A of this budget request. Performance measures for program changes included in this budget request are found in the budget justification narrative of each program change.

The Administration recognized during the course of the FY 2005 PART assessment of the NIST Laboratories that "R&D-performing organizations typically cannot provide unit cost measures of efficiency due to the long time frame for research, multivariate inputs, and diverse sets of outputs that derive from R&D activities."

Resources: The following is a comparison of NIST's FY 2009 budget request with its FY 2008 Enacted level.

Appropriation	(Dollar amounts in thousands)					
	FY 2008 Enacted		**2009 Estimate**		**Increase or (Decrease) From FY 2008 Enacted**	
	FTE	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**
Scientific and Technical Research and Services	1,995	440,517	2,147	535,000	152	94,483
Industrial Technology Services	133	154,840	47	4,000	(86)	(150,840)
Construction of Research Facilities	54	160,490	60	99,000	6	(61,490)
Working Capital Fund	746	0	779	0	33	0
TOTAL	**2,928**	**755,847**	**3,033**	**638,000**	**105**	**(117,847)**

Reimbursable Program

NIST's reimbursable services consist of technical work performed for other Federal agencies, state and local governments, and the private sector. These services include calibrations and special tests, advisory services, and the sale of Standard Reference Materials. The unique measurements and standards expertise developed with appropriated funding gives NIST the capability to perform these services on a reimbursable basis. NIST accepts other-agency work based on an established set of criteria which include: 1) the need for traceability of measurements to national standards; 2) the need for work that can not or will not be addressed by the private sector; 3) work supported by legislation that authorizes or mandates certain services; 4) work that would result in an unavoidable conflict of interest if carried out by the private sector or regulatory agencies; and 5) requests by the private sector for NIST action or services. NIST's reimbursable program is estimated to be $175,709,000 in FY 2008 and $148,495,000 in FY 2009.

NIST Budget Structure

The Conference Report accompanying the FY 2008 Omnibus Appropriations Act stated that "NIST is directed to develop a new budget structure for the fiscal year 2009 budget which better reflects the organizational structure of the agency."

We appreciate the Appropriations Committees' interest in a revised budget structure. NIST took steps to present a budget that more closely reflects its organizational structure in the President's FY 2006 budget when the Scientific and Technical Research and Facilities appropriation was broken down into three activities including: 1) the NIST Laboratories; 2) National Research Facilities; and 3) the Baldrige National Quality Program. A comprehensive review of the various options will help determine what changes might improve the usefulness of the budget structure. NIST has begun this review, and the options are being developed in consultation with the Department of Commerce, the Office of Management and Budget and the Appropriations Committees. One area that will be evaluated is to what extent the various changes would increase or decrease NIST's flexibility to respond quickly to unexpected technical or public policy developments. Our goal is to have a system which is transparent and provides NIST with the agility necessary to meet urgent national challenges.

Crosswalk of FY 2009 NIST Requested Increases to Budget Subactivities/Line Items
(Dollars in thousands)

	STRS									CRF	
										Construction and Major Renovations	
	Laboratories and Technical Programs							National Research Facilities		Construction and Major Renovations	Total
Initiative Name	Electronics and Electrical Engineering	Manufacturing Engineering	Chemical Science and Technology	Physics	Building and Fire Research	Computer Science and Applied Mathematics	Innovations in Measurement Science	NIST Center for Neutron Research	Center for Nanoscale Science and Technology	Construction and Major Renovations	
American Competitiveness Initiative:											
Building 1 Extension										43,538	43,538
JILA Expansion: Preparing the Next Generation of Physicists										13,000	13,000
Safety, Capacity, Maintenance and Major Repairs (SCMMR)										5,151	5,151
NIST Center for Neutron Research Expansion and Reliability Improvements								2,000			2,000
Environment, Health and Safety Measurements & Standards for Nanotechnology			12,000								12,000
Measurements and Standards to Accelerate Innovation in the Biosciences			10,000								10,000
Quantum Information Science/Enabling Innovation through Quantum Science				7,000							7,000
Enabling Nanotechnology from Discovery to Manufacture									7,000		7,000
Measurements and Standards for the Climate Change Science Program				5,000							5,000
Innovations in Measurement Science							3,000				3,000
National Earthquake Hazard Reduction Program Initiative					3,250						3,250
Disaster Resilient Structures and Communities					4,000						4,000
Cybersecurity						5,000					5,000
Going at Light Speed: Optical Communications and Computing	5,840										5,840
Enabling the Hydrogen Economy				4,000							4,000
Biometrics: Identifying Friend or Foe						2,000					2,000
Manufacturing Innovation through Supply Chain Integration		1,000									1,000
Total, FY 2009 Initiatives by Subactivity and Line Item	**5,840**	**1,000**	**22,000**	**16,000**	**7,250**	**7,000**	**3,000**	**2,000**	**7,000**	**61,689**	**132,779**

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Exhibit 13

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
INCREASE FOR FY 2009
(Dollar amounts in thousands)

		2009 Base		2009 Estimate		Increase/(Decrease) Over 2009 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount
Total, American Competitiveness Initiative[1]	Pos./Approp					203	$132,779
	FTE/Obl.					150	121,229
Building 1 Extension (B1E).......................	Pos./Approp			0	$43,538	0	43,538
(Construction and Major Renovations)	FTE/Obl.			0	43,538	0	43,538

Building 1 Extension (B1E) - Providing the Tools of Science to Support Sustained Scientific Advancement and Innovation (Appropriation +$43,538,000, Direct Obligations +$43,538,000)

"Sustained scientific advancement and innovation are key to maintaining our competitive edge, and are supported by a pattern of related investments and policies, including ... Federal investment in the tools of science—facilities and instruments that enable discovery and development..." *American Competitiveness Initiative, February 2006*

- This initiative is the final year of funding for the phased construction of the Building 1 extension (B1E) in Boulder aimed at providing new high-performance laboratory space with stringent control of temperature, vibration, humidity, and air cleanliness.
- The FY 2008 appropriation provides $23.6 million of construction and major renovation funding for the B1E project. With the

[1] Includes both $61.7 million in Construction of Research Facilities funding and $71.1 million in Scientific and Technical Research and Services funding.

requested funding in FY 2009, NIST will finish construction, increasing the level of the laboratory space in B1E to achieve required performance.

- The improved space will enable NIST to support scientific discovery and technical development of transformational technology in homeland security, telecommunications, nanotechnology, precision timing, hydrogen energy sources, precision electrical standards, biotechnology, applications of lasers, electromagnetic interference testing, quantum computing and quantum communications, and other national needs.

Progress Update

Planning and design update are on schedule. In FY 2007, NIST received funding to update architectural and engineering (A&E) designs first created in 1995 for high-performance laboratory space. In the third quarter of FY 2007, NIST began working with the A&E design firm of record, Henningson, Durham & Richardson (HDR), to perform a project review and assessment. The B1E design update is scheduled to be complete by May 2008. Planned award and Notice to Proceed of Phase one construction is scheduled for September 2008. Additional details were provided as part of the President's FY 2008 proposed budget.

Proposed NIST Technical Program

To meet the technical specifications needed to support continued scientific progress and technical advance that are crucial to national economic security and industrial competitiveness in the 21st century, NIST has chosen to combine the construction of new laboratory facilities, renovation, and major repair of existing facilities. Construction of new laboratory space, with the highest level of environmental controls, *costs less* than renovating existing space to meet these performance requirements, *delivers higher performance* space than renovations alone could provide, and will make that high performance space available *more quickly* than under the previous plan. For these reasons, NIST-Boulder proposes to construct a limited amount of high-end laboratory space. When renovation is less costly than new construction, NIST will renovate.

NIST proposes to design and construct the new B1E to meet the needs for the most demanding research and measurements conducted at the NIST-Boulder laboratories. The B1E will represent approximately 58,000 net assignable square feet of advanced laboratory space with stringent control of temperature, vibration, humidity, and air cleanliness.

The FY 2007 appropriation provided $10.1 million for the A&E design and site infrastructure work in support of the B1E. The FY 2008 appropriation provides another $23.6 million of construction and major renovation funding for the B1E project. The total cost of constructing the B1E in three phases is estimated at $77.2 million, with $43.5 million needed in FY 2009 as the final funding phase.

The development of the B1E comprises of five main stages:

- Update of B1E construction documents (approximately 6 months)
- Solicitation of bids and contract award for construction of the first phase of the B1E facility (approximately 9 months)
- Phase one construction (approximately 12 months)
- Solicitation of bids and contract award for phase two construction of high performance laboratory space (approximately 9 months)
- Phase two construction (approximately 12 months)
- Final building inspection, commissioning, and acceptance (approximately 3 months)
- Fit-up, communications systems installation and relocation of equipment (approximately 6 months)

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Building 1 Extension	
Technical Area	**Outputs**
Construction of B1E at the NIST-Boulder site	• Complete A&E design update for the B1E with approximately 58,000 net assignable square feet of high performance laboratory space. • Award contract to construct B1E facility. • Award contract to construct high-performance laboratory space within the B1E facility. • Complete construction of the new high-performance laboratory facility. • Conduct acceptance testing of the new laboratory and final fit-up and relocation.

OUTYEAR FUNDING ESTIMATES (Budget Authority In Thousands)								
	FY 2007 & Prior	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**	**FY 2012**	**Estimate to Complete**	**Total Program Estimate**
Construction and major renovations - B1E	10,100	23,562	43,538				77,200	77,200

**Outyear costs are estimates and are subject to change. Future requests will be determined through the annual budget process.*

Exhibit 15

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollars in thousands)

Activity: Construction and major renovations
Subactivity: Construction and major renovations
Program Change: Building 1 extension

Object Class		2009 Increase/ (Decrease) Obligations
11	Personnel compensation	
11.1	Full-time permanent	0
11.9	Total personnel compensation	0
12.1	Civilian personnel benefits	0
21	Travel and transportation of persons	0
22	Transportation of things	0
23.3	Communications, utilities and miscellaneous charges	0
24	Printing and reproduction	0
25.1	Advisory and assistance services	0
25.2	Other services	0
25.3	Purchases of goods and services from Government accounts	0
25.5	Research and development contracts	0
25.7	Operation and maintenance of equipment	0
26	Supplies and materials	0
31	Equipment	0
32	Land and structures	$43,538
41	Grants, subsidies and contributions	0
99	Direct obligations	43,538
	Transfer to NIST Working Capital Fund	0
	Total increase requested	43,538

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
INCREASE FOR FY 2009
(Dollar amounts in thousands)

		2009 Base		2009 Estimate		Over 2009 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount
Total, American Competitiveness Initiative[1]	Pos./Approp					203	$132,779
	FTE/Obl.					150	121,229
JILA Expansion – Preparing the Next Generation of Physicists	Pos./Approp			0	$13,000	0	13,000
(Construction and Major Renovations)	FTE/Obl.			0	13,000	0	13,000

JILA Expansion: Preparing the Next Generation of Physicists (Appropriation +$13,000,000, Direct Obligations +$13,000,000)

"Sustained scientific advancement and innovation are key to maintaining our competitive edge, and are supported by a pattern of related investments and policies, including ... institutions of higher education that provide American students access to world-class education and research opportunities..." *American Competitiveness Initiative, February 2006*

- NIST proposes to expand the laboratories at JILA, a joint institute of the University of Colorado and NIST that is an international leader in Atomic, Molecular, and Optical (AMO) science – a field that the National Academy of Sciences says is "key to training our best scientists, engineers and technical professionals."

- NIST is the lead Federal agency in AMO science, accounting for almost 40 percent of all Federal funds for research in this area[2]. The additional space made available through this two year expansion initiative will enable NIST to support scientific discovery and develop radically new tools of science that will push the frontiers of science in all fields.

[1] Includes both $61.7 million in Construction of Research Facilities funding and $71.1 million in Scientific and Technical Research and Services funding.
[2] National Research Council (2005). "Controlling the Quantum World of Atoms, Molecules, and Photons: An Interim Report."

- The JILA expansion will increase JILA's capacity to train the next generation of AMO scientists by one third and the Nation's capacity by 10 percent[3]. Current facility space is inadequate, constrains the number of researchers who can work in this field, and will present safety-related difficulties if not expanded.

- The government's return on investment in expanding JILA will be increased since the cost will be shared between NIST ($22.5 million over two years) and the University of Colorado, which will contribute $5 million in direct funding in addition to valuable in-kind contributions including the land, utilities infrastructure such as electricity, chilled water and steam, and other services.

Problem Magnitude and NIST Role:

JILA is a recognized world-class institute. JILA, a joint institute of the University of Colorado and the NIST, is home to 28 Senior Fellows. JILA's AMO scientists are widely recognized as international leaders in their field and include three Nobel laureates.

Pushing scientific frontiers requires complex experiments and creates a demand for young scientists and specialized space. The National Academy of Sciences has laid out six "Grand Challenges" for AMO sciences. To meet these challenges, AMO scientists must increase the already exquisite amount of control that they have over light and matter and apply cutting edge molecular measurements to novel fields. These scientific opportunities are directly related to critical national needs such as nanotechnology, energy security, national defense, and a transformed understanding of human health. Meeting these challenges demands advances in experiment and theory using radically new scientific tools. According to the National Academy of Sciences, "an essential part of maintaining the country's leadership in AMO science, and one of the White House's R&D priorities, is to train and to equip the next generation of American scientists." Tomorrow's scientists are trained by working on teams of students and postdocs guided by today's leading researchers. Recognized as the "undeniable world leader in many areas of quantum optics," JILA is uniquely positioned to train these scientists and to answer these challenges[4]. JILA Fellows have responded to the demands of complex experimentation by increasing the size of the scientific teams that they lead creating additional training opportunities for next generation scientists.

Additional JILA laboratory space will increase JILA's capacity to train AMO scientists by one third and the Nation's capacity by 10 percent. Studies conducted by JILA have shown that the current number of Fellows have the need and capability to train approximately one third more postdocs and student researchers. The only obstacle is a lack of laboratory space for the junior scientists and increasingly

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[3] American Institute of Physics, "Number of Ph.Ds granted in selected subfields by citizenship, classes of 2003 & 2004," http://www.aip.org/statistics/trends/highlite/emp/figure15.htm

[4] National Research Council, *An Assessment of the National Institute of Standards and Technology Measurement and Standards Laboratories: Fiscal Years 2004-2005*, National Academies Press, 2006.

complex instruments. A key driver behind this capability is that JILA today has more Fellows under the age of 40 than any time in the past twenty years. Currently, these younger fellows lead groups of approximately five students and postdocs. This is about half the size of typical JILA groups. However, JILA is already over capacity. While there are 115 graduate students at JILA there are only 105 desks for them to use. There is also a need for a limited amount of specialized space such as clean rooms to support nanoelectronics research and cold rooms to support biophysics research. This need for space has long been recognized. The University of Colorado Master Plan from the late 1990s found that JILA was running out of space. More recently, an external assessment of the NIST laboratories found JILA "to be very stressed for space" and warned that this shortage threatened JILA's ability to retain and recruit world class scientists. The proposed increase in space represents approximately a ten percent increase in the Nation's capacity to train AMO scientists.

NIST is the lead federal agency in AMO science and JILA is at the height of its success. NIST provides almost 40 percent of all Federal funding for AMO science. In the past ten years, three JILA Fellows have received the Nobel Prize. By studying matter at temperatures colder than the darkest regions of space, JILA scientists have created two new types of matter. While these types of matter have been thought to exist for over 100 years, no other scientist had been able to prove their existence. These experiments may hold the key to unlocking the secrets of superconductivity. Thanks to these experiments and other ongoing research, JILA scientists are likely to seed innovation and technology development in biotechnology and healthcare, nanotechnology, energy, homeland security, and many other areas for years to come.

Expanding JILA is directly aligned with the American Competitiveness Initiative (ACI) goals. Expanding JILA will produce three direct results, each of which is called out in the ACI:

- increase the Nation's capacity to train next-generation scientists
- produce new tools of science to facilitate discovery, and
- deliver innovations that will improve our competitiveness and quality of life.

AMO science has proven to be done best by single investigators leading incredibly creative teams. This focus on "small science" fostered the creativity and innovation that produced notable discoveries year after year. Indeed, the National Academies has found that AMO science "has yielded a bumper crop of innovations that have had a significant impact on the growth, vitality, and transformation of our economy, our ability to provide ever-improving health care, our understanding and control of the environment, and our national security and homeland defense capabilities."

<u>Proposed NIST Technical Program</u>:

To meet the scientific challenges in AMO science laid out by the National Academies of Science and support technical advances that are crucial to national economic security and industrial competitiveness in the 21st century, NIST proposes a limited expansion of the laboratory and office space at JILA. This will be done in partnership with the state of Colorado. The total cost of constructing the JILA expansion is estimated at $27.5 million. Colorado will contribute $5 million, and NIST proposes to contribute $13 million in FY 2009 and an additional $9.5 million needed in FY 2010. In addition, Colorado will supply the land and utilities infrastructure.

To maintain the vitality and creativity of JILA, the number of senior scientists at JILA will remain roughly constant. However, given the increasing complexity of scientific instrumentation and experimental AMO science, this same number of senior scientist actually has a need to train a greater number of young scientists. The limited expansion will provide the physical support for these young scientists.

The advantages of JILA to NIST include:

- *Critical mass:* For both NIST and University alike, JILA provides a large concentration of scientific talent in any one area: atomic physics; molecular physics; chemical physics; optical physics; biological physics and chemistry. Neither institution—neither NIST with its broad responsibility for measurement and industrial support—nor the University with its primary responsibility for teaching—could support so many senior scientists in a single area.
- *Adjoint faculty appointments:* JILA provides the opportunity for close interaction with university faculty, postdocs and graduate students, and an opportunity to teach courses and participate in seminars.
- *Leverage in achieving the NIST mission:*
    - A Division of only 20 permanent NIST staff participates in the research of an institute of over 295 people, including 234 who are scientists
    - Of over 100 graduate students, 47 are advised by NIST scientists
    - Of 44 postdocs, 22 are advised by NIST scientists.
- *Opportunity to pioneer cutting edge technologies:* These include ultrastable lasers, external cavity laser diodes, interferometric length measurement, gravimeters, ultracold atomic vapors, cavity ringdown spectroscopy, and femtosecond combs.
- *Training of students and postdocs for NIST programs:* More than 70 JILA scientists have gone on to work elsewhere in NIST, including an NBS Director, a Laboratory Director, Division Chiefs, and Group Leaders (13 serve or have served as Group Leader or above).
- *Technology transfer:* Of the graduate students and postdocs supervised by NIST staff, about one fifth are now in industry, another fifth in government agencies, and the remainder largely in universities.
- *Special Leveraging Opportunities:* JILA has succeeded in attracting private funds from the Keck Foundation for two prime facilities.

The requested funding is for the construction of a building to expand JILA to be used by NIST and the University of Colorado for joint research. The proposed funding continues an existing "institutional award" made to maintain the long term partnership between NIST and JILA.

The proposed steps for this joint project are below.

Design and Construction

- Begin Design , Fall 2008
- Construction Start, Summer 2009
- Completion, December 2010

Based on the projected growth of young scientists and estimated cost per square foot, a total cost estimate for the two-year project is provided below.

	CURRENT FACILITIES		**PROPOSED EXPANSION**				
	Assignable Square Feet		*Assignable Square Feet*	*Grossing Factor*	*Gross Square Feet*	*Cost per Gross Square Foot*	*Total Cost*
Lab Space	27,000		6,840	0.31	22,065	$460.22	$10,154,532
Clean Room	0		1,536	0.19	8,303	$460.22	$3,821,070
Support	6,700		600	0.58	1,029	$460.22	$473,640
Scientist Offices	22,300		4,700	0.46	10,195	$460.22	$4,692,048
Public Use	5,800		4,700	0.58	8,062	$460.22	$3,710,178
Design							$3,861,767
Renovation							$786,992
Total	*61,800*		*18,376*		*49,653*		*$27,500,226*

These estimates incorporate all of the components previously mentioned. In addition, we have included funds in the estimate for renovating existing space as some of the current groups move into the new space.

Performance Measures: Outputs

At the proposed two-year funding level, NIST will generate the following outputs:

JILA Expansion	
Technical Area	**Outputs**
Construction of expansion of JILA at the University of Colorado	• Complete architectural and engineering design of the JILA laboratory expansion with approximately 49,600 gross square feet of new space. • Award contract for construction expansion. • Complete construction of the new laboratory facility. • Conduct acceptance testing of the new laboratory and final fit up.

Performance Measures: Outcomes

JILA will pursue research areas including those identified as grand challenges by the National Academy of Sciences. The research teams led by JILA Fellows will provide unparalleled training to future generations of scientists. The JILA expansion will increase JILA's capacity to train AMO scientists by one third and the Nation's capacity by 10 percent. The discoveries and new knowledge produced by these teams will revolutionize key national technology priorities such as nanotechnology, homeland security, new energy sources, biotechnology, and many other areas. Further, the tools of science that are created by JILA will increase the research productivity of scientists in all fields.

OUTYEAR FUNDING ESTIMATES (Budget Authority In Thousands)								
	FY 2007 & Prior	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**	**FY 2012**	**Estimate to Complete**	**Total Program Estimate**
Change from FY 2009 Base								
<u>JILA Expansion</u>			13,000	9,500			22,500	22,500

**Outyear costs are estimates and are subject to change. Future requests will be determined through the annual budget process.*

<u>Current Opportunity Costs</u>:
The costs to the Nation of not pursuing this initiative are high. The University of Colorado Master Plan from the late 1990s found that JILA was running out of space. More recently, an external assessment of the NIST laboratories found JILA "to be very stressed for space" and warned that this shortage threatened JILA's ability to retain and recruit world class scientists. The proposed increase in space represents approximately a ten percent increase in the Nation's capacity to train AMO scientists. The *status quo* puts at risk JILA's ability to train future generations of scientists and support the development of disruptive technologies in homeland security, telecommunications, nanotechnology, precision timing, biotechnology, applications of lasers, quantum computing and quantum communications, and other national needs. These advancements are critical to the future economic security and industrial competitiveness of the Nation.

Exhibit 15

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollars in thousands)

Activity: Construction and major renovations
Subactivity: Construction and major renovations
Program Change: JILA expansion: preparing the next generation of physicists

Object Class		2009 Increase/ (Decrease) Obligations
11	Personnel compensation	
11.1	Full-time permanent	0
11.9	Total personnel compensation	0
12.1	Civilian personnel benefits	0
21	Travel and transportation of persons	0
22	Transportation of things	0
23.3	Communications, utilities and miscellaneous charges	0
24	Printing and reproduction	0
25.1	Advisory and assistance services	0
25.2	Other services	0
25.3	Purchases of goods and services from Government accounts	0
25.5	Research and development contracts	0
25.7	Operation and maintenance of equipment	0
26	Supplies and materials	0
31	Equipment	0
32	Land and structures	0
41	Grants, subsidies and contributions	$13,000
99	Direct obligations	13,000
	Transfer to NIST Working Capital Fund	0
	Total increase requested	13,000

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
INCREASE FOR FY 2009
(Dollar amounts in thousands)

		2009 Base		2009 Estimate		Increase/(Decrease) Over 2009 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount
Total, American Competitiveness Initiative[1]	Pos./Approp					203	$132,779
	FTE/Obl.					150	121,229
Safety, Capacity, Maintenance, and Major Repairs increase	Pos./Approp	61	$37,311	61	$42,462	0	5,151
(Modifications and improvements)	FTE/Obl.	60	37,311	60	42,462	0	5,151

Safety, Capacity, Maintenance, and Major Repairs (SCMMR) Increase - (Appropriation +$5,151,000, Direct Obligations +$5,151,000)

"Sustained scientific advancement and innovation are key to maintaining our competitive edge, and are supported by a pattern of related investments and policies, including ... Federal investment in the tools of science—facilities and instruments that enable discovery and development..." *American Competitiveness Initiative, February 2006*

- This initiative provides additional base funding in support of NIST's Safety, Capacity, Maintenance, and Major Repairs (SCMMR) program.
- This proposed initiative will decrease the deferred maintenance backlog of safety, capacity, maintenance, and major repair projects.
- Increased resources are vital to maintaining NIST's ability to meet its mission.

[1] Includes both $61.7 million in Construction of Research Facilities funding and $71.1 million in Scientific and Technical Research and Services funding.

* Independent analysis recommends a significant increase in SCMMR funding.

Problem Magnitude and NIST Role

Aging and deteriorating buildings and infrastructure threaten NIST's ability to meet its mission. The Construction of Research Facilities (CRF) appropriation funds building construction and the safety, capacity, maintenance and major repairs (SCMMR) of NIST's physical plant. NIST maintains about 50 specialized laboratories, offices and support buildings at its two major sites in Gaithersburg, Maryland, and Boulder, Colorado. To support the NIST Time Scale and Network Time Service System, a National Critical Infrastructure Asset, NIST maintains additional facilities in Fort Collins, Colorado and Kauai, Hawaii. Most of the Gaithersburg structures were built in the 1960s and the Boulder facilities are a decade older. While recent increases to SCMMR have led to improvements in these facilities and infrastructure, the current state of NIST facilities – whether measured in terms of safety, capacity, or state of repair - remains a serious impediment to the NIST mission. NIST performs critical measurement science and standards research that enables scientific discovery and translation of these discoveries into economically meaningful products and services that impact the Nation and improve the quality of life for all Americans. NIST research is critical to advances in vital fields such as nanotechnology, semiconductor technology, bioscience and many other high impact areas. Deterioration of NIST buildings and infrastructure makes the task harder to achieve.

NIST measurement and standards research impact every sector of the economy ranging from advanced research, through manufacturing and distribution. The current state of NIST facilities limits NIST's ability to meet the measurement and standards challenges in each of these areas. For example, poor vibration control, poor temperature control, and low air quality due to a 40 year-old air-conditioning and heating system, increase the difficulty of even most basic calibrations such as the calibration of precision pressure gages. These calibrations are the critical first step in a national measurement chain that ensures the accuracy of airplane altimeters and supports a wide variety of manufacturing sectors, including semiconductors and pharmaceuticals.

SCMMR funds capacity, safety improvements as well as ongoing, recurring and preventative maintenance and major repair of the NIST physical plant in Gaithersburg, Maryland; Boulder and Fort Collins, Colorado; and Kauai, Hawaii. NIST first began receiving Congressional support for SCMMR work in 1995 under the CRF appropriation. The following are examples of the projects that have been conducted during this timeframe:

Critical infrastructure investments to meet the needs of modern research facilities

* increased capacity for Gaithersburg's Steam and Chilled Water Plant and systems (additional boilers, chillers, cooling tower cells, and pumping systems)
* replacement of Boulder's aging, obsolete, failed mechanical systems (includes heating and cooling coil control valves, chillers, condenser units, steam supply and condensate return main distribution lines)

- complete replacement of Gaithersburg's electrical substation
- roof replacements at Buildings 1 (Radio Building) and Building 2 (Cryogenic) in Boulder
- replacement of the Gaithersburg site-wide underground steam supply and condensate return main distribution lines
- replacement of 40 to 50 year-old networked electric transformers with new networked transformers, network protectors, unit substations, and switchgear at both Gaithersburg and Boulder sites
- replacement of the over 40-year-old condensate receivers, vacuum pumps, and steam traps for the General Purpose Laboratories (GPLs)

Investments to ensure handicap accessibility of NIST buildings and facilities

- a new elevator installed in Boulder's Building 24 (Plasma Physics)
- refurbishment of freight and passenger elevators in the GPLs

Investments to ensure the safety of NIST employees

- complete replacement of Gaithersburg's fire alarm system
- installation of the first and second phases of Boulder's new site fire alarm system
- remediation of asbestos and other known life safety hazards
- replacement of Boulder's site wide sanitary sewer system

Cost effective investments to increase the energy efficiency of NIST buildings

- replacement of the over 40-year-old single pane windows with double pane, low E, argon gas filled windows, and insulate the base exterior walls of a GPL
- replacement of deteriorated, leaking window caulking system on the 11-story Administrative Building
- replacement of aging, obsolete, failed heating and cooling coil control valves on GPL central HVAC units
- refurbishment of aging, failing central HVAC units that individually serve many laboratories and/or office spaces at both Boulder and Gaithersburg sites

However, the level of SCMMR funding has not kept pace with the backlog of major repair work that is required to maintain the NIST facilities in good working condition. Two independent engineering studies, one in FY 1997 by Booz-Allen and Hamilton, Inc and another completed in FY 2004 by Hanscomb, Faithful and Gould (HF&G) identified a significant deferred maintenance backlog and documented the need for increased funding to prevent building and infrastructure failures. These studies recommended that SCMMR funds should be increased to at least three (HF&G) to four percent (Booz-Allen and Hamilton, Inc) of facility replacement value. The studies were based on a rigorous business case analysis and drew upon standard industry practices for high-technology laboratories such as the NIST facilities. The HF&G study recommended a FY 2006 SCMMR level of $44.6 million for Gaithersburg alone, and when combined with Boulder, would total approximately $52.7 million. When it is converted into FY 2009 dollars, the total SCMMR program should equate to about $60.7 million[2]. In the period since the completion of these reports, the failure rate of major building systems (i.e., air handling systems, piping systems, and building closure systems – roofs, windows, and foundation waterproofing) has increased dramatically. The 2004 HF&G report focused on the Gaithersburg site, and calculated a Facility Condition Index (FCI) for each major building – a number ranging from 0.00 to 1.00 expressing the relative urgency for major repairs and renovations. In general, an index of up to 0.05 is good, 0.05 to 0.10 is fair, and any index above 0.10 is poor. All but three of the NIST Gaithersburg site buildings and structures surveyed had an FCI in excess of 0.10 (poor), some considerably in excess. The FCI for the Gaithersburg site as a whole is 0.308. The HF&G report concluded that most building systems on the Gaithersburg site are well past their expected service life and, with the exception of the newer laboratory buildings, every building has at least one or more systems that need to be repaired or replaced immediately, and all remaining systems should be repaired or replaced within a seven-year period.

Selected examples of recent building system and infrastructure failures:

In the late summer of 2005, a significant water line break occurred in the basement of Administration Building. A section of four-inch piping failed, and water quickly filled the mechanical room where the pipe was located. The water eventually overflowed into the hallway, two elevator shafts, and all neighboring rooms to include shelves of Library books, the Alumni Office, a computer training room, etc. It was weeks before things returned to normal in some of these water soaked rooms.

In July of 2006, a chilled water leak occurred in the attic of Building 220 (Metrology). An old, corroded fitting on a booster-cooling coil failed, and water drained from the attic down through all four occupied floors immediately below. Approximately 50 labs and offices were ultimately affected, and it was weeks before some of these spaces could be occupied again. In the meantime, researchers and support staff had to be temporarily relocated. All the remaining similar booster cooling coil fittings were subsequently checked and replaced as necessary in this GPL and other buildings of similar construction and potential risk.

In August of 2006, a broken domestic water line in the basement of Building 227 (Advanced Chemical Sciences Laboratory) flooded the space with about two feet of water. Rising water flooded the primary electrical switches to the building's three feeders, causing all three to fail. This in turn led to simultaneous building wide power outages in four GPLs, the Administrative Building, and Building 245 (Radiation Physics).This also caused an emergency shut down of the NIST Central Computing Facility. Eventually, all water was pumped out of the basement, the failed electrical switches were by-passed in a safe manner, and power was restored to all affected buildings within a day.

In October of 2006, a break occurred to the six-inch main line that supplies water to all of the Radiation Physics building. Recognizing that

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2 Inflationary factors taken from OMB's economic assumptions for FY 2009 Congressional Budget dated June 11, 2007, "Alternative Price Measures: Fiscal Year Over Fiscal Year Percent Change"

the east loading dock area would have to be excavated to a depth of 18 feet to work on the line, the repair effort quickly switched to installing a temporary domestic water line. Water was restored to the building the same evening and people were able to report to work the next business day, allowing critical research to continue as normal. The eventual repairs took another week to complete.

Over the past two years the Boulder site, as well as our supported field sites in Kauai and Fort Collins, there have been dramatic increases in the failure of aging mechanical systems. Domestic water service to the Fort Collins facility and Building 26 (Commerce Children's Center) on the Boulder site was interrupted after aging pipes at each location burst. Steam service and humidity controls were lost on the Boulder site at Buildings 1, 2, and 24 numerous times due to failure of aging steam traps and blocked or broken condensate return lines. In Kauai, the salt air off the Pacific has accelerated the aging of air conditioning service to the time station raising concerns relating to equipment cooling associated with the time transmission service. All of these building system failures have had an adverse impact on the research or services provided at each location as many of the electronic components require a constant temperature and humidity control over an extended period of time for calibration or testing.

Proposed NIST Technical Program

SCMMR funds necessary safety or capacity improvements, routine maintenance, and major repairs, to the infrastructure and about 50 specialized laboratories, offices and support buildings at sites in Gaithersburg, Maryland; Boulder and Fort Collins, Colorado; and Kauai, Hawaii. The NIST Time Scale and Network Time Service System, a National Critical Infrastructure Asset, is represented at the NIST sites in Colorado and Hawaii. The Gaithersburg facilities and infrastructure were built in the early 1960s; the Boulder facilities and infrastructure in the 1950s, and the Fort Collins and Hawaii field sites in the mid to late 1960s.

As documented above, an ever-pressing issue for NIST is the aging and obsolescence of the facilities and infrastructure at all NIST sites. These aging facilities and their extensive backlog of deferred maintenance have become serious impediments to the efficient completion of the NIST mission in all areas of research. While some progress has been made by strategically applying available SCMMR resources against the most critical repair needs, NIST still faces a large backlog of urgent SCMMR projects. Some of NIST's most serious facility deterioration directly affects the welfare and safety of the roughly 4,600 employees and guest researchers who are present on the two major sites at any given time. Each site still suffers from severe systems capacity problems, including antiquated electrical systems (transformers, switchgear, and motor starters) and non-existent or inadequate delivery of chilled water to the laboratories. Based on the independent architectural and engineering reviews and in conjunction with the need to maintain world class research, the proposed increase in funds, combined with the current base, will continue to target the most critical NIST SCMMR projects.

The requested SCMMR increase will be used for projects in the following areas:

- Aging Mechanical and Electrical Systems Repairs/Replacements;
- Hazardous Material Removal;
- Energy Conservation;
- Site Alarm System Upgrades;
- Handicap Accessibility;
- Steam and Chilled Water Generation Plant Expansion/Replacement;
- Site Utility Systems Replacements/Upgrades;
- Structural Repairs/Replacements;
- Civil and Site Environmental Repairs/Replacements;
- Conveying Systems Repairs/Replacements;
- Exhaust Air Filtration Systems Repair/Replacements; and
- Architectural Repairs/Replacements.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Safety, Capacity, Maintenance, and Major Repair increase	
Technical Area	**Outputs**
SCMMR increase	• For existing NIST buildings, keep the average unscheduled downtime to less than seven percent of total scheduled possible operating time.

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

The beneficial impact of renovating NIST's facilities on the U.S. economy will be long-term and significant. NIST researchers seek to reliably and accurately measure everything from length, to time, to mass, to electric current – before industry or science hits a roadblock in its pursuit of a better product or new understanding of the way the world works. In this way, NIST research helps foster technological innovation, which is the driving force for about 50 percent of U.S. economic growth. The critical measurement science and standards research performed by NIST enables scientific discovery and speeds the translation of these discoveries into economically meaningful products and services. These new and improved products make US industry more competitive and enhance the quality of life and economic security of all Americans.

Postponement of NIST's facility repairs is not cost-effective. For each year that maintenance and repair projects are delayed, the buildings become less functional, building system failures become more commonplace, and the repair costs continue to escalate.

Exhibit 15

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollars in thousands)

Activity: Construction and major renovations
Subactivity: Construction and major renovations
Program Change: Safety, Capacity, Maintenance, and Major Repair increase

Object Class		2009 Increase/ (Decrease) Obligations
11	Personnel compensation	
11.1	Full-time permanent	$0
11.9	Total personnel compensation	0
12.1	Civilian personnel benefits	0
21	Travel and transportation of persons	0
22	Transportation of things	0
23.3	Communications, utilities and miscellaneous charges	0
24	Printing and reproduction	0
25.1	Advisory and assistance services	0
25.2	Other services	5,151
25.3	Purchases of goods and services from Government accounts	0
25.5	Research and development contracts	0
25.7	Operation and maintenance of equipment	0
26	Supplies and materials	0
31	Equipment	0
32	Land and structures	0
41	Grants, subsidies and contributions	0
99	Direct obligations	5,151
	Transfer to NIST Working Capital Fund	0
	Total increase requested	5,151

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
INCREASE FOR FY 2009
(Dollar amounts in thousands)

		2009 Base		2009 Estimate		Increase/(Decrease) Over 2009 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount
Total, American Competitiveness Initiative[1]	Pos./Approp					203	$132,779
	FTE/Obl.					150	121,229
National research facilities							
1. NIST Center for Neutron Research Expansion and Reliability Improvements	Pos./Approp	12	$10,000	18	$12,000	6	2,000
	FTE/Obl.	12	10,000	16	12,000	4	2,000
2. Enabling Nanotechnology from Discovery to Manufacture	Pos/Approp	27	15,000	45	22,000	18	7,000
(Center for Nanoscale Science and Technology)	FTE/Obl	27	15,000	40	20,000	13	5,000
Laboratories and technical programs							
1. Environment, Health, and Safety Measurements and Standards for Nanotechnology: Enabling the Safe Exploitation of Nanotechnology	Pos./Approp			31	12,000	31	12,000
(Chemical Science and Technology)	FTE/Obl.			23	8,000	23	8,000
2. Measurements and Standards to Accelerate Innovation in the Biosciences	Pos./Approp	6	3,000	31	13,000	25	10,000
(Chemical Science and Technology)	FTE/Obl.	6	3,000	25	10,800	19	7,800
3. Quantum Information Science/Enabling Innovation through Quantum Science	Pos/Approp	11	6,000	33	13,000	22	7,000
(Physics)	FTE/Obl	11	6,000	27	11,900	16	5,900

[1] *Includes both $61.7 million in Construction of Research Facilities (CRF) and $71.1 million in Scientific and Technical Research and Services (STRS) funding.*

		2009 Base		2009 Estimate		Increase/(Decrease) Over 2009 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount
4. Measurements and Standards for the Climate Change Science Program	Pos/Approp			20	5,000	20	5,000
(Physics)	FTE/Obl			15	4,000	15	4,000
5. Innovations in Measurement Science	Pos/Approp	14	4,253	26	7,253	12	3,000
	FTE/Obl	11	3,903	20	6,403	9	2,500
6. National Earthquake Hazard Reduction Program Initiative	Pos/Approp	1	800	4	4,050	3	3,250
(Building and Fire Research)	FTE/Obl	1	800	3	4,050	2	3,250
7. Disaster Resilient Structures and Communities	Pos/Approp	3	1,200	8	5,200	5	4,000
(Building and Fire Research)	FTE/Obl	3	1,200	7	5,200	4	4,000
8. Cybersecurity	Pos/Approp	6	1,400	22	6,400	16	5,000
(Computer Science and Applied Mathematics)	FTE/Obl	6	1,400	18	6,400	12	5,000
9. Going at Light Speed: Optical Communications and Computing	Pos./Approp			25	5,840	25	5,840
(Electronics and Electrical Engineering)	FTE/Obl.			18	5,840	18	5,840
10. Enabling the Hydrogen Economy	Pos/Approp	15	6,000	28	10,000	13	4,000
(Physics)	FTE/Obl	15	6,000	25	9,250	10	3,250
11. Biometrics: Identifying Friend or Foe	Pos/Approp			4	2,000	4	2,000
(Computer Science and Applied Mathematics)	FTE/Obl			3	2,000	3	2,000
12. Manufacturing Innovation through Supply Chain Integration	Pos/Approp	2	1,000	5	2,000	3	1,000
(Manufacturing Engineering)	FTE/Obl	2	1,000	4	2,000	2	1,000
Total, American Competitiveness Initiative Scientific and Technical Research and Services	Pos./Approp					203	71,090
	FTE/Obl.					150	59,540

American Competitiveness Initiative (ACI) STRS (+203 Permanent Positions, +150 FTE, Appropriation +$71,090,000, Direct Obligations +$59,540,000, Transfer to the Working Capital Fund +$11,550,000).

Technological innovation drives the Nation's economic growth and sustains our competitiveness in world markets. "Innovation will be the single most important factor in determining America's success through the 21st century," according to the Report of the National Innovation Initiative, Council on Competitiveness, December 2004. A 2005 National Academy of Sciences report, *Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future,* states, "Economic studies conducted even before the information-technology revolution have shown that as much as 85 percent of measured growth in U.S. income per capita is due to technological change." New technologies require a sophisticated set of supporting tools to succeed. These tools include knowledgeable people with easy access to key information, national facilities and instruments that enable discovery and development, measurement science, and production technologies. NIST plays a fundamental role in ensuring access to this innovation toolset.

The FY 2009 budget request for NIST provides the Nation with essential tools to enable continued innovation and economic vitality. It strongly supports the Department of Commerce goal to promote U.S. innovation and industrial competitiveness.

ACI STRS Components:

National research facilities:

1. NIST Center for Neutron Research Expansion and Reliability Improvements (+6 Permanent Position, +4 FTE, +$2,000,000)

This initiative request is the third fiscal year of funding increases required for the NIST Center for Neutron Research (NCNR) expansion. Funds are requested to install, test, and commission the new neutron instrumentation for an expansion of measurement capability at the NCNR and to provide for critical upgrades required to maintain the facility at the level of operational efficiency required by the world-class neutron research program it supports.

- This initiative request is the third and last fiscal year of funding increases required in the five year NCNR expansion.
- The NCNR, the Nation's leading neutron research facility, serves more scientists and engineers than all other U.S. facilities combined.
- NIST has begun construction of the expanded instrument hall (called a Guide Hall) and the required support and utility buildings for the new cold source, instruments, and experimental activities. A prototype liquid hydrogen cold source, two times as bright as the current cold source, has been constructed and successfully tested at NIST. In consultation with the national research community, NIST has developed concept proposals for the five neutron scattering instruments and associated guide tubes.

- The requested FY 2009 funding supports the next phase of the NCNR expansion: initiate installation, testing, and commissioning of the new neutron instruments that promise to bring new neutron measurement capability to U.S. researchers, either exceeding current capabilities by more than a factor of 100, or providing capabilities that are not presently available in the United States.

Problem Magnitude and NIST Role:

Despite recent gains in U.S. neutron source capability with the commissioning of Department of Energy's Spallation Neutron Source, there is still insufficient capacity to meet the many high priority research demands in this country.

To address this critical national need, NIST began an expansion of the NCNR in FY 2007. As a key part of the ACI, this effort will increase the use of the NCNR by U.S. researchers in a highly cost effective fashion. The design of the NIST reactor allows for the installation of a new cold neutron source, with a corresponding new neutron guide tube network to deliver the neutron beams, and new state-of-the-art instrumentation. This expansion will substantially augment the neutron measurement capacity at NIST with no additional costs in operating the nuclear reactor itself. With these expanded capabilities, the NCNR will provide cold neutrons to at least five new instruments, increase the overall measurement capacity of the NCNR by more than 25 percent, and serve more than 500 additional researchers each year. In FY 2009, the construction of the new instrument hall (called a guide hall) and the cold source will be nearing completion, with development of the new instrumentation well underway. The new instruments promise to bring new neutron measurement capability to U.S. researchers, either exceeding current capabilities by more than a factor of 100, or providing capabilities that are not presently available in the United States.

Proposed NIST Technical Program:

This additional funding request for FY 2009 is part of the original budget plan for the NCNR Expansion initiative. The initiative will develop a new neutron cold source, a new guide tube system, and new neutron instruments. The FY 2009 increase will allow NIST to begin installing the new instruments on the new guide tubes, and to initiate testing, commissioning, and eventual operation of the instruments. To date, the NIST staff has made substantial progress on the following:

- **Construction of support buildings**
  NIST has begun construction of the expanded instrument hall and the required support and utility buildings for the new cold source, instruments, and experimental activities. Construction activities have been carefully coordinated to minimize the impact on NCNR operations.

In FY 2009, the requested funding will be used to initiate installation, testing, and commissioning of the new instruments onto the beamlines. This involves relocation and modification of some existing instruments and optimization of the beamlines to ensure that the maximum neutron intensity is delivered to the instruments.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

NCNR Expansion and Reliability Improvements	
Technical Area	**Outputs**
Neutron instrumentation	• Installation of new neutron spectrometers. • Modification of beamlines and beamline shielding. • Modification of existing instruments affected by new beamlines. • Testing and characterization of new beamlines and instruments.

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

- serve an additional 500 research participants;
- install new beamlines with up to four times the neutron flux of existing neutron guide systems;
- install five new, world-class neutron instruments; and
- reduce by 30 percent the inevitable costs for future replacements or repairs of failed control room console components.

This initiative supports specific projects that NIST will develop to strengthen the Nation's technical infrastructure. While these projects link directly to the goals of the NIST Laboratory Programs, progress and performance are measured at the individual project level through milestone tracking of major project outputs, such as those described in the narrative. Without funding, those outputs will be lost along with the associated benefits (outcomes). Information about the performance evaluation and reporting methods used for the NIST Laboratories is provided in Exhibit 3A of this budget request.

2. Enabling Nanotechnology from Discovery to Manufacture (+18 Permanent Positions, +13 FTE, +$7,000,000, including $2,000,000 transfer to the Working Capital Fund)

- Continued Federal investment in the agency programs that make up the National Nanotechnology Initiative (NNI) facilitates breakthroughs and maintains U.S. competitiveness in this field. The NNI supports both basic and applied research in nanoscience, develop instrumentation and methods for nanoscale characterization and metrology, and disseminate new technical capabilities, including those to help industry advance nanofabrication and nanomanufacturing.
- The United States faces dramatic changes in manufacturing, with nanoscale manufacturing expected to be a dominant factor in the 21st century. The promise of the U.S. investment and innovation in nanoscience and nanotechnology will be realized only if our Nation can cost-effectively put basic scientific discoveries to work in the production of superior nanotechnology products. The global impact of nanotechnology-related products is predicted to exceed $1 trillion by 2015.[2]
  - This includes: Materials $340 billion; Electronics $300 billion; Pharmaceuticals $180 billion; Chemicals $100 billion; Aerospace $70 billion; Healthcare $30 billion; and Tools $20 billion.
- Nanotechnology increases the value of existing products, enables new products, and fosters the growth of high-tech jobs in the U.S. economy of the future.
- The commercial development of new nanotechnologies depends on the availability of adequate nanoscale measurement methods.
- Through the new NIST Center for Nanoscale Science and Technology (CNST) and the NIST Laboratory programs, NIST will enable science and industry by providing essential measurement methods, instrumentation, and standards to support all phases of nanotechnology development, from discovery to production.

Problem Magnitude and NIST Role:

Manufacturing accounts for 14 percent of U.S. Gross Domestic Product and 11 percent of total U.S. employment. More significantly, the manufacturing sector generates the innovations that lead to productivity gains. Manufacturers are responsible for almost two-thirds of all private-sector R&D.[3] Over the past two decades, manufacturing productivity gains have been double those of other economic sectors. These productivity gains are integral to the U.S. economy's ability to compete globally, create new jobs, and make higher wages possible for U.S. workers.

Today, U.S industry faces many challenges to incorporating nanotechnology into advanced products and devices. Measurement of properties, imaging of structures, and modeling of behavior are all difficult at the nano-scale level. Each will require significant effort to avoid stifling the commercial development and manufacture of nano-structured products. However, the opportunities associated

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[2] *M.C. Roco and W.S. Bainbridge, eds., 2001, "Societal Implications of Nanoscience and Nanotechnology", Springer, pp. 3-4.*
[3] *National Science Foundation, "Research and Development in Industry," 2000.*

with these challenges are far reaching. Commercial incorporation of nanostructures will have dramatic effects in the U.S. microelectronics industry, magnetic storage industry, micro-electromechanical system industry, nanomaterials and nanocomposites industry, chemical sensor industry, and catalyst industry. Many of these industries exhibit greater than 15 percent cumulative annual growth rates that are sustained by nanotechnology advances. All depend on having the measurement methods and standards necessary to make progress in the nanotechnology dominated production environment of the future.

Proposed NIST Technical Program:

In FY 2007, NIST began a major initiative aimed at enabling the production of nanotechnology-based products by addressing the measurement barriers hindering the rapid development of nanotechnology. To date, important milestones have been met: the CNST was established, its new research division was staffed, and the CNST, a state-of-the-art, national nanofabrication and nanometrology user facility was brought on-line. A multi-year plan began with major FY 2007 initiatives in standards and measurements for nanomanufacturing, advanced two-dimensional structural imaging and characterization, high-frequency and high-resolution nanomagnetics imaging, and nanofabrication via advanced lithographic techniques. The proposed NIST technical program for FY 2009 progresses from these previous initiatives. For example, in the very important nanoscale characterization category, a three-dimensional imaging and characterization initiative builds upon the two-dimensional imaging and characterization program. Similarly, an initiative in measurements and standards to support ultimate-CMOS (Complementary Metal Oxide Semiconductor) circuitry builds upon the advanced lithography program.

As shown in the four areas below and discussed in the following text, NIST has planned a multi-year, measured build-up of the Nation's measurement and standards infrastructure to nurture and ensure U.S. leadership in the production and use of nanotechnology. The following the table discusses each initiative planned for FY 2009. If the request for FY 2009 is fully funded, the FY 2010 and FY 2011 activities described below will not require additional funding increases in these fiscal years.

Theme	FY 2009	FY 2010	FY 2011
Manufacturing	Mechanical properties of nanostructures	3D fabrication and assembly of nanostructures	Nanomanufacturing of Post-CMOS electronics
Characterization	3D imaging and characterization of nanostructures	Atomic scale measurement and characterization	Bottom-up assembly of nanostructures

Theme	FY 2009	FY 2010	FY 2011
Devices	Simulation and modeling of nanostructures	Measurements and standards in support of nanophotonics	Standards for nanobiological and nanomedical devices
Electronics	Measurements and standards in support of ultimate CMOS	Measurements and standards in support of post-CMOS electronics	Measurements and standards in support of post-CMOS electronics

Mechanical Properties of Nanostructures: A crucial requirement for developing advanced devices incorporating nanostructures is quantitative knowledge of the mechanical properties of the materials and structures within a device. This type of knowledge is necessary for optimizing device design, materials selection, manufacturing processes and reliability predictions. The mechanical properties of materials in nanostructures are often difficult to estimate and may be very different from their bulk counterparts. In addition, the mechanical properties of nanostructures themselves are often difficult to measure, as the small length scales both preclude the use of many measurement techniques applied at larger scales and introduce new surface-related phenomena. Consequently, challenges exist for nanostructure developers in the materials science of structure-properties relations for materials and in the metrology of mechanical properties of nanostructures. <u>NIST will generate the measurement methods and standards for mechanical properties of nanostructures, focusing on those areas that will enable commercial development of new products including</u>:

- Ultra-fast microelectronic devices to increase the speed and productivity of information technology;
- Very high-density magnetic storage devices with applications ranging from archival information storage to personal music players;
- Extended lifetimes of micro-electromechanical systems through effective lubrication of surfaces and interfaces; and
- Small-scale sensors, high-efficiency engines and rapid fabrication of nanostructures through the application of engineered surfaces.

Three-Dimensional Imaging and Characterization of Nanostructures: Measurement techniques must improve as structures continue to scale toward atomic dimensions and as new organizations of matter are engineered for functionality. These improved techniques are not only needed for the resolution of measurement, but also for the ability to discern three-dimensional complexity in the composition and arrangement of components within the structures. Characterization of the fine details of structure, chemical composition, and defect formation–in three dimensions with resolution appropriate to the nanostructure under study–presents an important and challenging measurement problem. Fundamentally new measurement capabilities that are beyond those achievable with current techniques will need to be devised and developed to meet these challenges for three-dimensional, non-destructive imaging and characterization. NIST will generate the measurement methods and standards for three-dimensional imaging and characterization that will:

- Enable existing industry sectors to see what they make at the nanoscale and thereby speed both the development phase–as new concepts are explored–and the manufacturing process–as the reliability of nanostructure production is enhanced;
- Allow the next generation drug delivery systems to be developed more rapidly and manufactured more reproducibly, because detailed structures can be imaged on the nanoscale; and
- Improve the quality of life because the health impacts of nanotechnology can be approached on a sound scientific basis. It will be possible to see nanostructures as they interact with their environment.

Simulation and Modeling of Nanostructures: Almost by definition, nanotechnology requires new models, simulations and theories to explain the new properties that arise as a consequence of the nanostructure's size. New models and simulations of the phenomena governing the manufacture and performance of nanostructures are required for nanostructure science to progress. Nanoscale structures are so far removed from the size scale accessible with human senses that their observation and measurement is very indirect, requiring an accurate and reliable model to bridge the huge gap in length scales. An overlapping series of models may be required because no single model will be applicable over this enormous range of sizes. Without a reliable theory, measurements of nanostructures become nearly impossible to interpret. Additionally, in some cases, a measurement method has yet to be devised, and modeling alone will be relied on for information. NIST will develop methods for the simulation and modeling of nanostructures that will:

- Allow industry to reduce its product development cycle by providing a more accurate connection between the results of a measurement and the nanoscale phenomena being exploited;
- Allow for greater accuracy of measurement and thereby facilitate reliable and economical manufacture of products incorporating nanotechnology; and
- Help to advance the development of bottom-up assembly methods to allow the economical production complex nanodevices.

Measurements and Standards in Support of Ultimate CMOS: The semiconductor industry, one of the largest value-added manufacturing industries in the U.S., has been successful in employing miniaturization to increase performance of electronics at a constant cost. However, the process of miniaturization is ultimately limited by the discrete nature of matter and the prevalence of quantum phenomena as the atomic size scale is approached. The industry will continue to push current methodology as far as possible, to the endpoint of the development of CMOS technology, referred to as Ultimate CMOS. Developing the ultimate in CMOS technology will require major advances in nanoscale measurement and standards. NIST will partner with industry to provide the necessary measurements and standards to allow the development of Ultimate CMOS. This partnership will:

- Give industry the measurements and standards tools needed to continue the rapid increases in semiconductor devices;
- Enable the development of advanced information technology to further enhance American productivity; and
- Facilitate the development of new sensors and high-speed electronics that strengthens our military and enhances the defense of the homeland.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Enabling Nanotechnology from Discovery to Manufacture	
Technical Area	**Outputs**
Mechanical properties of nanostructures	• Methods for measuring the fracture, fatigue, and damage properties of nanostructures to improve reliability and determine how devices fail; • Methods for measuring stress and strain in nanostructures in order to reduce failure of devices and to permit the control of optical and electronic properties; • Measurement methods to facilitate the design of high strength materials incorporating nanocomposites; and • Measurements of the mechanical properties important to nanoscale energy conversion to further nanosensors and signal processing applications.
Three-dimensional imaging and characterization of nanostructures	• New methods for detection and location in three-dimensions of defects, inclusions, and other irregularities in nanoscale structures; • Fabrication of three-dimensional, nanoscale chemical compositional standard test structures with controlled elemental features; • Properties of nanoparticles, nanocrystals, and quantum dots used in 3D imaging applications; • New ultrasound holography instrument for high-resolution three-dimensional imaging; and • A super-resolution optical method, validated at the 200 nm length scale, for 3D imaging.

Enabling Nanotechnology from Discovery to Manufacture	
Technical Area	**Outputs**
Simulation and modeling of nanostructures	• Models and simulations to interpret and quantify experimental results; • State-of-the-art theoretical and simulation methodologies to guide experiments aimed at the measurement and characterization of size, shape, and composition of nanostructures; • Extension of modeling of electron trajectories to three-dimensional nanostructures of arbitrary shape; • Models and simulations of the reliability of nanodevices; and • Models and simulations of the routes to self-assembly of nanostructures.
Measurements and standards in support of ultimate CMOS	• New methods to measure critical dimensions in semiconductors with sub-nanometer resolution; • Method for measuring the electrical and thermal properties of, and identifying defects in, complex semiconductor interfaces; • Method for measuring the mechanical properties of dielectric films in semiconductors; • Methods to measure the nature and rates of the complex physico-chemical processes used in CMOS semiconductor fabrication; • A new state-of-the-art reference dimensional metrology scanning electron microscope (SEM) and accurate metrology methods for full-size semiconductor wafers and masks; and • Advanced models necessary for optical metrology at the "32-nanometer node" of semiconductor manufacturing.

Performance Measures: Outcomes

At the proposed funding level, this initiative will foster the following outcomes:

- Enhanced competitiveness for U.S. industry in the world for the manufacturers of products that incorporate nanotechnology;
- Speedier private sector commercialization of new products and innovations that integrate nanotechnology and nanomanufacturing, for example, high strength, high toughness materials for greater auto fuel efficiency and personal protection;
- More compact, powerful, and innovative products resulting from nanotechnology-enhanced electronic chips that are smaller, faster and more efficient; and
- Increased yield, productivity, and reliability in the manufacturing of nanostructures and devices for the electronics, sensor, information storage, and communications industries.

Without development of the measurement, modeling, and simulation capabilities described in this initiative, U.S. industry will not have available the full range of tools and atomic-level understanding necessary to design, characterize, and control three dimensional nanostructures in their fabrication processes, and minimize device failure due to mechanical properties and defects. Without advanced measurement and modeling capabilities at the nanoscale, industry will need to rely more on trial and error for discovery and development, which increases the time and cost to market and reduces American competitiveness.

Laboratories and technical programs

1. Environment, Health and Safety Measurements and Standards for Nanotechnology: Enabling the Safe Exploitation of Nanotechnology (+31 Permanent Positions, +23 FTE, +$12,000,000, including $4,000,000 transfer to the Working Capital Fund)

- Industry is increasingly finding that the unknown environmental, health, and safety (EHS) risks associated with nanotechnology is a threat to their innovation and competitiveness.
  - It is critical that potentially dangerous nanomaterials be detected before they can harm the public.
  - It is also critical that the next breakthrough technology or new cancer cure not be halted by unsubstantiated fears of adverse health effects.
  - Industrial innovation will suffer in an uncertain regulatory, liability, and investment environment if EHS risks are not addressed.
- There is no measurement infrastructure in place to assess the EHS risks that nanomaterials pose.
- NIST has been called on by the National Nanotechnology Initiative working group on EHS to lead in developing metrologies to determine the EHS risks of these materials.

Working through the National Nanotechnology Coordination Office (NNCO), Federal agencies are working to coordinate R&D efforts related to EHS impacts of nanotechnology. Areas of agency responsibility are outlined in the table below.

FY 2009 Interagency Coordination of Nano EHS R&D

	NIEHS	NIST	EPA	FDA	NIOSH	NSF
Metrology	User/Contributor	**Lead Agency**	User/Contributor	User/Contributor	User/Contributor	Contributor
Human health	**Lead Agency**	Contributor	User/Contributor	User/Contributor	User/Contributor	Contributor
Environment	User	Contributor	**Lead Agency**	User	Contributor	Contributor
Health & Environmental Surveillance	User	Contributor	User/Contributor	User/Contributor	**Lead Agency**	Contributor
Risk Management and Assessment		Contributor	User/Contributor	**Lead Agency**	User/Contributor	Contributor

Problem Magnitude and NIST Role:

Innovation derived from nanotechnology is vulnerable to backlash caused by unsubstantiated fears of new technology similar to that which hit the biotechnology industry when they invested in Genetically Modified Organisms, including high-yield and pesticide resistant crops. Innovation is also vulnerable to substantiated concerns regarding delayed health effects and liability of products such as what occurred with asbestos, a naturally occurring nano-scale fiber. NIST must address the fate, as well as the impact of nanoparticles that enter our bodies and our environment. NIST must establish the science-based assessment of nanomaterials EHS risks to protect ourselves and dispel unnecessary fears in order for nanotechnology innovation to thrive. Such science-based assessment requires that NIST be able to: 1) detect the presence of nanoparticles in the environment or biological systems, and 2) determine the EHS impact if they are indeed present. Detection of nanoparticles, already extremely challenging because of their size (less than one thousandth the width of a human hair), is more difficult in complex environments such as in a patient's lung, a tumor, a lake, a fish, a hamburger patty, or on a child's hands after holding a nanocomposite baseball bat. Studies of the EHS effects of nanoparticles are impeded by difficulties in characterizing the nanomaterials used. When a toxic effect is observed, contamination unrelated to the nanoparticles or the presence of different nanoparticles prevents evaluation of the underlying EHS risks. The absence of well-characterized materials and standard protocols for EHS testing make it impossible to compare and combine results from different laboratories. With no standard means to measure and determine the safety of nanotechnology products, no one can definitively address the EHS risks of nanomaterials; the research has not been done. To fill this gap, comprehensive EHS R&D (particularly development of techniques and instrumentation for measurement and characterization) is required.

> *Environmental detection and analysis of nanoparticles will require validation and evaluation for method sensitivity, accuracy, precision, and reproducibility.* U.S. Environmental Protection Agency[4]

The 2006 report[5] on the *Environmental, Health, and Safety Research Needs for Engineered Nanoscale Materials* from the interagency Subcommittee on Nanoscale Science, Engineering and Technology identifies supporting research to develop metrology tools and methods for measuring and characterizing nanomaterials as a role of the Federal Government. The report highlights NIST as the lead agency for nanometrology. This initiative builds upon existing NIST expertise. NIST is already engaged in collaborative efforts with the National Cancer Institute to address metrology needs that will enable physical and chemical characterization of nanoparticles as well as biocompatibility studies.

> *NIST is ideally positioned to lead the development of characterization methods and standards building on extensive expertise and experience in this area.* Woodrow Wilson International Center for Scholars[6]

NIST has interdisciplinary physical science expertise and world-class national facilities. The Institute conducts research on new analytical methods and measurement technology, develops methods to characterize and validate performance of conventional instrumentation, and creates and supplies Standard Reference Materials that enable accurate and uniform measurements in laboratories across the Nation. It also operates centers with unique national capabilities. In this initiative, the Center for Nanoscale Science and Technology (CNST), with its focus on the National Nanotechnology Initiative (NNI) and targeting of nanoscale instrumentation research, metrology, and standards, will accelerate efforts to address EHS aspects of nanomaterials. NIST-wide facilities, such as the Advanced Measurement Laboratory (AML) and the Advanced Chemical Sciences Laboratory (ACSL), provide access to a wide range of measurement capabilities. In particular, the AML is uniquely designed to assist U.S. industry, universities, and government partners to promote advances in nanomaterial science.

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[4] U.S. EPA Nanotechnology White Paper, Prepared for the U.S. Environmental Protection Agency by members of the Nanotechnology Workgroup, a group of EPA's Science Policy Council, EPA 100/B-07/001 February 2007; Science Policy Council, U.S. EPA, Washington, DC 20460

[5] National Nanotechnology Initiative, "*Environmental, Health, and Safety Research Needs for Engineered Nanoscale Materials*", September 2006.

[6] "*Nanotechnology: A Research Strategy for Addressing Risk*", Andrew D. Maynard, Project on Emerging Nanotechnologies, Woodrow Wilson International Center for Scholars, July 2006.

Proposed NIST Technical Program:

With this initiative, NIST will launch a coordinated effort for leveraging nanotechnology expertise and resources across its laboratories and facilities to develop analytical methods for quantifying the type and amount of nanomaterials in biological materials, the environment, and the workplace. Accurate and validated protocols and reference materials will be developed to define the uses and limitations of major analytical methods. Metrologies to enable understanding of EHS properties of nanomaterials will be developed, including techniques for standardizing assessment of nanoparticle size and size distribution, shape, structure, and surface area, and characterizing nanoparticle chemical composition, purity, and heterogeneity. It is only through such standardization and characterization that understanding and prediction of nanoparticle and nanomaterial EHS impact will be realized. Specific activities funded by this initiative are discussed below.

- **Guidance**
  This initiative will include the creation of a roadmap for development of an analytical framework to support risk assessment and management. The roadmap will be developed with the risk assessment community, including industry, federal regulatory agencies and the NNI leadership. It will focus on determining the characteristics of nanoparticles necessary for assessing the toxicity of nanomaterials, including size, shape, and chemical composition. Development of this classification scheme is required to coordinate and compare research results for highly diverse nanomaterials from a wide range of applications, thus leveraging greater understanding and impact. Subsequent efforts will focus on metrology for groups or classes of identified materials.

- **Detection and Measurement: Determining the number and nature of nanoparticles with EHS impact in biological and environmental media.**
  Methods for accurate detection and sizing of particles below ~100 nm will be developed with a focus on both microscopy and nonmicroscopy-based approaches that offer required speed and automation. Different measurement methods will be compared. Cutting-edge electron and ion-based microscopies as well as mass spectrometry techniques will be used for determining nanomaterial shape and structure. Standards for validation of these methods will be developed. Existing techniques for chemical and structural characterization with atomic resolution will be leveraged, and methods that provide information about the chemical structure of individual nanoparticles and the chemical structure of agglomerates of nanoparticles will be developed. Applicable approaches include a range of ion, electron and X-ray spectroscopies, microscopies and microanalysis techniques.

- **Assessment: understand the effect of modifications on the EHS properties of nanomaterials.**
  NIST will examine approaches for understanding the synthesis of materials and reagents to enable study of how modifications may affect EHS impact of nanomaterials on biological material. Impact of modifications on analytical protocols will be explored. New methods for obtaining internal chemical compositions of nanoparticles, including surface composition and reactivity and three-

dimensional chemical characterizations at the 1 nm resolution level, will be developed. In collaboration with other agencies, NIST will develop techniques for determining if nanomaterials are truly hazardous and toxic.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Environment, Health and Safety Measurements and Standards for Nanotechnology Enabling the Safe Exploitation of Nanotechnology	
Technical Area	**Outputs**
Guidance	• Roadmap for development of nanoEHS analytical framework in support of risk assessment and management developed with the Risk Assessment Community, including industry, federal regulatory agencies and the NNI leadership.
Detection	• Tools for detecting and characterizing nanomaterials in environmental and biological media. • Global-scale, inter-laboratory comparative studies to assess the quality and comparability of measurement methods for characterizing nanomaterials in biological materials.
Measurement	• Measurement protocols for quantifying the type and amount of nanomaterials in biological materials, the environment, and the workplace. • Methods to characterize the geometrical, chemical composition and modification characteristics that affect the EHS properties of nanomaterials. • Reference materials to enable accurate measurement of the type and amount of nanomaterials in biological materials, the environment, and the workplace. • Tools for measuring the amounts of nanomaterials in environmental and biological media. • A program to accredit laboratories to characterize nanomaterials.
Assessment	• Methods for standardizing assessment of nanoparticle size and shape that affects EHS properties of nanomaterials. • In collaboration with other agencies, developing techniques for determining if nanomaterials are truly hazardous or toxic.

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

- Industry will be able to accurately assess the quantities, types and EHS risks of nanomaterials in its products;
- Regulatory agencies will be able to accurately assess the quantities, types and EHS risks of nanomaterials in products and the environment;
- Regulatory agencies will have data on EHS effects of nanomaterials to enable appropriate regulation for their use; and
- Consumers will be able to obtain full and accurate information concerning the EHS risks of products containing nanomaterials.
- Industrial innovation will be enabled, subject only to real EHS risks.

If successful, NIST will have developed proven and trusted ways to measure the toxicity and the environmental release and control of nanomaterials that are understood and accepted by industry, regulators, and the public around the world. This will enable U.S. industry to safely exploit nanotechnology to its full capabilities so that when a company makes or someone buys or uses products employing nanotechnology, they will have scientific evidence that the manufacturing processes and fabricated products are safe.

2. Measurements and Standards to Accelerate Innovation in the Biosciences (+25 Permanent Positions, +19 FTE, +$10,000,000, including $2,200,000 transfer to the Working Capital Fund)

- The enhanced understanding of biological systems is a national scientific priority and the Administration is targeting investments toward the development of a deeper understanding of complex biological systems.
- Tremendous Federal and industry investment in the biosciences has dramatically increased our understanding of the complexity of living systems (e.g. the Human Genome Project) however; concurrent investments in bioscience measurement capabilities have not kept pace. The lack of an advanced quantitative and traceable bioscience measurement infrastructure capable of handling the complexity of biological systems and the molecular interactions that define them is stifling the Nation's ability to capitalize on its investment in the life sciences.
- There is no measurement infrastructure that assures that the data collected are accurate, comparable, easily used, or correctly interpreted by the life sciences community.
- The recent National Academies report, *Cancer Biomarkers: The Promises and Challenges of Improving Detection and Treatment*, highlights NIST and the need for the creation of standards for biomarker discovery, validation, and usage.
- Development of new measurement tools will require a combination of complex physical and information science expertise that lies outside the traditional life sciences community, but is NIST's specialty.

- Enhanced bioscience measurement capabilities would dramatically impact the biotechnology and pharmaceutical industries by decreasing both the time and cost associated with drug development.

Problem Magnitude and NIST Role:

The Federal government, through NIH alone, invests over $28 billion per year in advancing and applying our fundamental knowledge of biology while the biotechnology industry spends almost $20 billion more on drug development. This investment has transformed our understanding of the basic building blocks of life, leading to the expectation of tremendous breakthroughs for medicine in the biotech and pharmaceutical industries. Advances over the past decade, including the success of the Human Genome Project, have led to the generation of vast amounts of biological data and the understanding that living systems are defined by the complex interaction of thousands of biological molecules that occur within cells. Unfortunately, the pharmaceutical and biotechnology industries have not been able to capitalize on the Nation's investment in the life sciences in part due to an immature measurement infrastructure. Only a small percentage of the Nation's bioscience investment has focused on measurement tools and technologies. As a result, current bioscience measurement capabilities are inadequate for dealing with complex biological systems and are still largely limited to studying only a few biological interactions at a time, often with methods that are only semi-quantitative. Furthermore, the limited use of standards and a lack of validated methodologies make much of the data and models from bioscience research difficult to interpret and to use. Much of the research data being generated is questionable in terms of reliability and repeatability. Today, even standard measurements on a limited number of blood proteins often yield variable results between expert laboratories. Without a measurement infrastructure that can simultaneously measure significant numbers of biomolecules, and assure that the data collected are accurate, comparable, easily used, or correctly interpreted by others -- innovation in the biosciences will continue to be stifled. Improvements in physical measurement and data handling tools and methodologies are necessary to maximize our Nation's investment in the life sciences.

This initiative is part of a larger strategic effort to strengthen NIST's core competence in bioscience measurements research and standards. NIST will build on its recent investments in bioimaging and biophysical measurements to create the measurement tools and standards that will enable the study of the complex interplay of thousands of genes, proteins and other biological molecules simultaneously. Initially, NIST will apply physical and chemical science expertise in microfluidics, microarrays, cellular imaging, single molecule measurements to develop quantitative measurement technologies and standards necessary for a traceable measurement infrastructure that can address the current barriers to the measurement and modeling of biological systems. The efforts in physical measurement science will be assisted with an informatics and computing infrastructure that includes computation, statistics, experimental design, and error analysis. The close combination of measurement technology and bioinformatics will assure that multiplexed measurements and data from different sources can be combined and analyzed appropriately to provide reliable models of complex systems. In future years, expansion of the NIST bioscience measurement program will enable the development of the measurement tools and infrastructure necessary for true systems level measurements. NIST will continue to collaborate closely with the NIH and industry to ensure that the NIST biosciences measurement program addresses the highest priority measurement barriers of the life science community, as well as providing the next generation measurement technology for the biosciences.

Proposed NIST Technical Program:

The initiative will focus on three major intersecting areas of research aimed at providing necessary tools to enhance and improve the research capabilities of the bioscience community.

- **Quantitative Measurement Methods, Standards and Data for Biological Molecules**
  Many measurement methods in the biosciences are currently semi-quantitative at best. NIST will assure that fundamental measurements that underpin the life sciences have a strong basis in physical science by establishing benchmark data and standards. The measurement technologies of highest priority include mass spectrometry, protein-protein binding measurements, cellular imaging, gene expression arrays, and other measurement technologies that will have immediate impact in clinical and research applications.

- **High Volume Measurement Platforms, Technologies and Standards**
  Current measurements in the life sciences often examine only a few molecules at a time, but true understanding of biological systems requires the ability to measure hundreds to thousands of molecules at a time. Research at NIST will focus on the development and validation of new technologies for high-speed, high-throughput, simultaneous quantification of diverse sets of biomolecular components. These technologies include microfluidics, new types of microarrays, live cell imaging of dynamic protein activity, and single cell and single molecule measurements, as well as statistical and error analysis that will allow valid interpretation of data from multiplexed techniques.

- **Computational Tools for Systems Level Integration of Data and Models**
  Each measurement method produces data with associated analytical uncertainty, data file formats, experimental details, conventions, and nomenclature that are unique compared to data from other measurement methods. Many models are developed from such data for limited subsets of biological reactions. NIST will focus on computational and informatics standards that will allow data and models from different sources to be efficiently combined and compared. By developing reference datasets and algorithm test methods, and new ways of naming measurement-related information, NIST will help assure interoperability of data and models from the many scientific contributors, and help derive knowledge from biomolecular data.

At the proposed funding level the program will focus on the most immediate and pressing measurement needs and barriers inhibiting innovation in the biosciences today.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Measurements and Standards to Accelerate Innovation in the Biosciences	
Technical Area	**Outputs**
Quantitative Measurement Methods, Standards and Data for Biological Molecules	• Improve mass spectrometry methods and standards for proteomics; • Improved optical molecular recognition technologies (e.g., surface plasmon resonance); • Advanced quantitative imaging tools (e.g., quantum dots, fluorescence resonance energy transfer); • Technologies for rapid characterization of affinity reagents (e.g. antibodies) for clinical research; and • Robust single molecule detection, characterization, and quantification methods (e.g. femtosecond lasers for multidimensional spectroscopies).
High Volume Measurement Platforms, Technologies and Standards	• Demonstrate multiplexed and multimodal biological measurements in microfluidic platforms; • Develop methods for reliable and rapid gene expression analysis; • Optimized models and tools for evaluating biological variability; and • Data handling software and tools for multi-resolution analysis of subcellular, cellular, and tissue features.
Computational Tools for Systems Level Integration of Data and Models	• Develop robust standards for the exchange of biological data and information; • Computational methods for the classification of experimental data and conditions; and • Mathematical and computational methods to validate and apply data from diverse sources to complex models

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

NIST can provide underpinning physical science measurements and standards that will impact the quantitative nature of life science research. NIST research will advance technologies to speed the acquisition of data on biological molecules in complex systems, and will improve the reliability of the data, and of the models that integrate those data. Enhanced bioscience measurement tools will result in the following scientific outcomes:

- faster and more reliable biomolecular measurements;
- measuring and mapping of complex relationships between biological molecules; and
- improvements in measurements and models will lead to improved predictability of complex biological responses.

NIST measurement infrastructure will help to improve the reliability of relevant clinical and cellular measurements and predictive models. More reliable data and efficient data handling will improve the quality of models that explain the complex machinery of cells and organisms. Sufficient high quality data will permit the prediction of the variation in responses for different individuals to therapies and environmental factors. Specifically, NIST's bioscience measurement program will lead to the following industry relevant outcomes:

- more efficient drug discovery;
- better matching of therapies to individual patients; and
- better prediction, diagnosis, management, and understanding of disease.

3. Quantum Information Science/Enabling Innovation through Quantum Science (+22 Permanent Positions, +16 FTE, +$7,000,000, including $1,100,000 transfer to the Working Capital Fund)

"Quantum information is a radical departure in information technology, more fundamentally different from current technology than the digital computer is from the abacus." William D. Phillips, NIST 1997 Nobel Laureate in Physics

By exploring and harnessing the "special" properties of the quantum realm, NIST will open the gateway to a new and powerful technological frontier. If successful, NIST's work will pave the way to:

- Greater computing power than what is available with electronic computers;
- Secure communications for national security, financial, and market transactions; and
- Enable advanced measurement capabilities that exceed classical techniques.

Problem Magnitude and NIST Role:

Since the early 20th century we have known that the atomic, or quantum, realm works under vastly different rules than the world of our everyday experience. The ability to understand and exploit many aspects of the quantum realm led to many of the technological advances that defined the last century. Yet the quantum realm holds still more surprises, and more possibilities. Unique quantum properties that have no counterparts in our everyday world have been the most difficult aspects of the quantum world to understand. But understanding and mastering these quantum properties hold great promise for new technologies. It has only been in recent years that we have developed the capacity to create and control quantum properties in the laboratory, and it is this capacity that is opening a door to new possibilities with broad societal impact. Many of the greatest physicists believe that exploitation of these non-intuitive properties of nature will transform the technology of the 21st century, just as electronics transformed the technology of the 20th century. However, because there are so many unanswered questions, there must be a Federal presence to attain long-term national goals.

Researchers at NIST have been and are in the forefront of demonstrating that unique quantum properties can be created and controlled in the laboratory. These advances, which have led to three Nobel Prizes for NIST scientists, have fostered the hope of fantastic new capabilities, such as quantum computing with superior power compared to today's classical computers and quantum communication with unbreakable security. NIST scientists were the first to demonstrate a quantum logic operation with quantum "bit", or "qubit", and among the first to demonstrate the principle of quantum communication. These early advances prompted NIST to begin a focused program in Quantum Information Science. That program is now the largest internal quantum research program in the Federal government and one of the most successful programs in the world. Now NIST scientists are hoping to push still further ahead. The ultimate goal for the NIST program is to parlay early proof-of-principle demonstrations into working components from which integrated quantum systems will ultimately be built. The success of this endeavor is by no means certain.

The research and development steps required to realize a quantum computer can be described in analogy with those of the familiar desktop computer based on classical microelectronic circuits. The desktop computer is an integrated system built from several distinct components including a central processing unit (CPU) which functions as the brain of the computer, a temporary memory device for holding CPU instructions and data, a permanent storage device (hard drive) for holding data over the long term, input/output devices such as a keyboard, monitor, or internet connection for getting information into or out of the computer, and a communications bus for passing information between components.

NIST's previous initiatives in quantum information focused on demonstrating the most elementary function of a processing unit, a quantum logic operation on a quantum "bit", or "qubit". The classical desktop computer has a processing unit capable of processing billions of bits per second. Although a quantum computer will be very powerful while operating with far fewer logic "bits" than a classical computer, a great deal of effort is required to produce an integrated quantum processing unit with several hundred qubits. In the case of classical computing, the time between demonstration of a single logic "bit" and an integrated processor was more than two decades. Work on building a quantum processing unit with more than one qubit has been initiated with existing resources, but with the successful proof-of-principle demonstration of a few qubits, additional investment in this work to increase the rate of progress is warranted.

The realization of a quantum computer will also require the development of other components. Among these is a temporary memory capability, analogous to the random access memory (RAM) of the classical desktop computer. At present, qubits are lost relatively rapidly because of the extreme sensitivity of quantum "coherence" to external interactions. The ability to store qubits before or after a logic operation will enable more complex logic operations.

Also required for the realization of a quantum computer is some kind of communications bus that allows for the transfer of information, or qubits, between processor and memory or input/output devices. In a classical computer, this capability is achieved by the metal wires conducting electrical currents to the various devices. NIST scientists have already achieved a proof-of-principle demonstration of the quantum analogy of a communications bus through a process called "teleportation" of information. Now they must show that quantum information can be teleported reliably and quickly, and that these "quantum wires" can be incorporated into a working component.

The incorporation of input/output devices in a quantum computer will require the ability to convert qubits from one form to another. In a processor, a qubit may be an atom, ion, or solid-state system prepared in a "coherent" state. An output device will sometimes require conversion of the processor qubit into a "flying" qubit, i.e., a photon, the smallest unit of light. The analogy in the classical computer is the conversion of electrical signals in a computer to the optical signals that flow through the optical fibers of the internet. A robust, reliable conversion process requires further research.

All of the above capabilities, including those in quantum communications, require further development of optical materials for use in the blue and ultraviolet region of the spectrum. These materials will enable the diode lasers, modulators, and single photon sources and detectors that will be used to create, manipulate, and read quantum logic operations and transmit quantum information in a practical integrated quantum system. Most of these devices do not exist at all or do not exist with the required performance characteristics.

Proposed NIST Technical Program:

In moving closer to the realization of manipulating quantum phenomena in the quest for developing new measurement techniques and technologies, NIST is proposing to further expand its quantum science program in FY 2009. The FY 2009 request would be used to develop more quantum computer and communication components, to begin developing the basis for more advanced quantum applications, and to advance quantum measurement capabilities. NIST will:

- Begin development of quantum wires to be used for connecting various quantum components;
- Begin development of a quantum memory, to enable more complex quantum logic operations;
- Begin development of methods for inter-converting material qubits (atoms, ions, or solid-state systems) to photon qubits;
- Develop an all-optical clock as a next step in precision time and frequency measurement;
- Develop methods for higher rate production and counting of single electrons; and
- Continue to exploit quantum coherence and quantum entanglement for measurement capabilities exceeding classical limitations in sensitivity, accuracy, and speed.

The FY 2009 request enables NIST to build on and exploit the research accomplishments supported by previously appropriated funds. For instance, NIST demonstrated simple quantum logic operations in FY 2005 and FY 2006, the basis for a quantum processor, using neutral atoms and trapped ions. NIST also demonstrated single photon sources and detectors, the basis of quantum communication system. FY 2007 funding enabled NIST to develop quantum components and early applications of quantum information science, specifically the demonstration of a complete quantum communication system operating at speeds high enough for practical use. NIST will demonstrate a quantum logic clock capable of serving as an improved time and frequency standard for the next generation of the Global Positioning System and in tests of fundamental physical theories. Funds provided in FY 2007 also supported efforts that include: 1) a quantum input/output device and expanded work on quantum logic operations, with the demonstration of quantum logic in a superconducting solid-state system as an alternative to trapped ions and neutral atoms; 2) new quantum measurement capabilities for improved determination of fundamental units in mass, temperature, time, light, and electric current; and 3) establishment of a Joint Quantum Institute, leveraging the interdisciplinary capabilities of NIST with those of the NSA and the university partner. All of the FY 2005, 2006, and 2007 efforts are ongoing, with increased activity levels in FY 2009.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Enabling Innovation through Quantum Science	
Technical Area	**Outputs**
Quantum components	• Quantum wires, including the demonstration of plasmonic communication pathways for single photon transmission; and • Demonstrate long storage time and stability for a quantum memory.
Basis for more advanced quantum devices	• Fabrication of an integrated ion quantum system containing a solid-state ultraviolet laser; • Advanced solid-state ultraviolet quantum lasers able to produce entangled photon pairs; • Fabrication of nano-mechanical resonator and demonstration of coupling to quantum system; • Single-photon detection at greater than 10 MHz with greater than 95 percent detection efficiency (100 times faster than present); • Single-photon detection at 1 GHz with greater than 80 percent detection efficiency (100 times faster than present); • Advanced high-speed optical modulators; • Teleportation and conversion of quantum information from one type of quantum system to another; • Conversion of individual quantum systems into composite quantum systems; • Demonstration of the coupling of quantum systems with classical electromagnetic fields; and • Better understanding of wider range of quantum systems and the fundamental limits of quantum noise.
Quantum measurements	• New quantum-based measurement technologies will be produced including a quantum enhanced clock, improved frequency measurement, methods for manipulating single electrons, quantum-based temperature, high speed single photon sources, and quantum realization of mass.

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

- NIST will begin bridging the gap between fundamental quantum science and new technologies by developing some of the quantum components needed for realization of a quantum computer, and
- NIST will develop quantum measurement techniques applicable to the Nation's most fundamental measurement needs.

Quantum Science Activity Matrix

Concept	Pre-FY 2009	FY 2009	FY 2010
Quantum Logic Operations	Demonstration of quantum logic operations with up to 10 atom qubits		Quantum logic operations with 10 or more atom/ion qubits
	Initial demonstration of quantum logic operations with 1-5 solid-state qubits	Quantum logic operations with 5-10 solid-state qubits	
Quantum Components	Demonstration of single photon sources and detectors		Improved higher-speed counting of single photons
	Demonstration of input/output devices	Improved input/output devices	
	Quantum wires		
	Quantum memory		
Early Applications of Quantum Science	Demonstration of quantum logic clock		
	Secure, high-speed quantum communications	Improved high-speed quantum communications	

Concept	Pre-FY 2009	FY 2009	FY 2010
Quantum Measurements	Application of quantum technologies to new measurement methodologies		
	Demonstration of higher rate of single electron counting/production	Application of single electron manipulation to nanosystems	
	Development of optical clock	Quantum enhanced clocks	
		Development of high-speed single photon source	Bridge gap between single photon sources and laser power
Basis for More Advanced Quantum Devices	Integrated optics for blue light		
	Conversion of material qubits to flying qubits		
		Coherent control and transformation of quantum information	
			Integrated ion traps and architectures for quantum computing

Note: Activities in the Joint Quantum Institute encompass many of the projects in this matrix.
The first appearance of an activity in a row represents initiation of that activity with new initiative funding.

4. **<u>Measurements and Standards for the Climate Change Science Program (+20 Positions, +15 FTE, +$5,000,000, including $1,000,000 transfer to the WCF)</u>**

NIST has the opportunity to address critical gaps in climate change science that are limiting long-term climate policy decision-making by proposing to:

- Resolve discrepancies in satellite–based measurements of solar intensity; and
- Provide critical information about an atmospheric component believed to play a major role in global climate change.

<u>Problem Magnitude and NIST Role:</u>

The Nation's ability to respond to climate change depends on our ability to predict the course and causes of climate changes as early as possible. Our ability to predict climate changes rests on the accuracy of atmospheric measurements and on knowledge of basic properties of atmospheric constituents. The two types of data identified by the Climate Change Science Program (CCSP) as critical to improved modeling of climate change are the solar irradiance (the intensity of sunlight falling on the Earth) and the properties of aerosols (microscopic airborne particles or droplets).

Numerous climate monitoring systems in space, in the air, and on the ground are documenting the current state of Earth's atmosphere. These measurements provide essential information for predictive modeling of future climate changes. If the investment in climate measurements is to pay off, these measurements must be made with sufficient accuracy and precision. The measurement instrumentation, at a minimum, must be calibrated in a way that allows comparison of results across different measurement platforms as well as over time as additional measurements are made. The <u>2003 Strategic Plan for the U.S. CCSP</u> emphasizes this priority by directly citing NIST's role.

"Efforts in the last decade to use current research and operational data sets in global climate change research have provided a critical set of lessons learned. ... Instrument calibration, characterization, and stability become paramount considerations. Instruments must be tied to national and international standards such as those provided by the National Institute of Standards and Technology (NIST)." p. 132.

One of the lessons learned, the need for greater attention to calibration of instruments, is illustrated in Figure 1. Since 1980, seven satellite-based instruments have monitored the solar irradiance for periods of a year or more. Despite the billions of dollars invested in these satellite programs, they have not provided a definitive picture of the true solar irradiance. The measurement results from the different instruments span a range of values that is an order of magnitude greater than the measurement accuracy required by the global climate change community. The desired accuracy is indicated by the vertical bar near the bottom of the graph. A satisfactory return on the heavy investment in these satellite systems will be obtained only if instrument calibration is given a higher priority. In the words of the *2003 Strategic Plan for the U.S. CCSP*:

"*Rigorous pre-launch instrument characterization and calibration, including radiance confirmation, against an international radiance scale provided by a national metrology institute, should be ensured.*"

Under this initiative, NIST will help develop that international scale and will ensure the highest quality calibrations possible for future satellite-based measurements of the solar irradiance. For a small fraction of the cost of building and operating a satellite platform, this effort will prevent future calibration-related discrepancies like those seen in Figure 1.

A second critical gap in climate change research is the impact of aerosols on global warming. As indicated by Figure 2, aerosols are believed to play a major role in climate change, perhaps as large as the role played by greenhouse gases. However, we know much less about aerosols than about the major greenhouse gases. For example, almost nothing is known about the magnitude of indirect effect of aerosols, but it could be as large as the effect of carbon-dioxide. In another example, not only is the magnitude of the effect of mineral dust unknown, but also unknown is whether mineral dust would tend to warm or to cool the atmosphere.

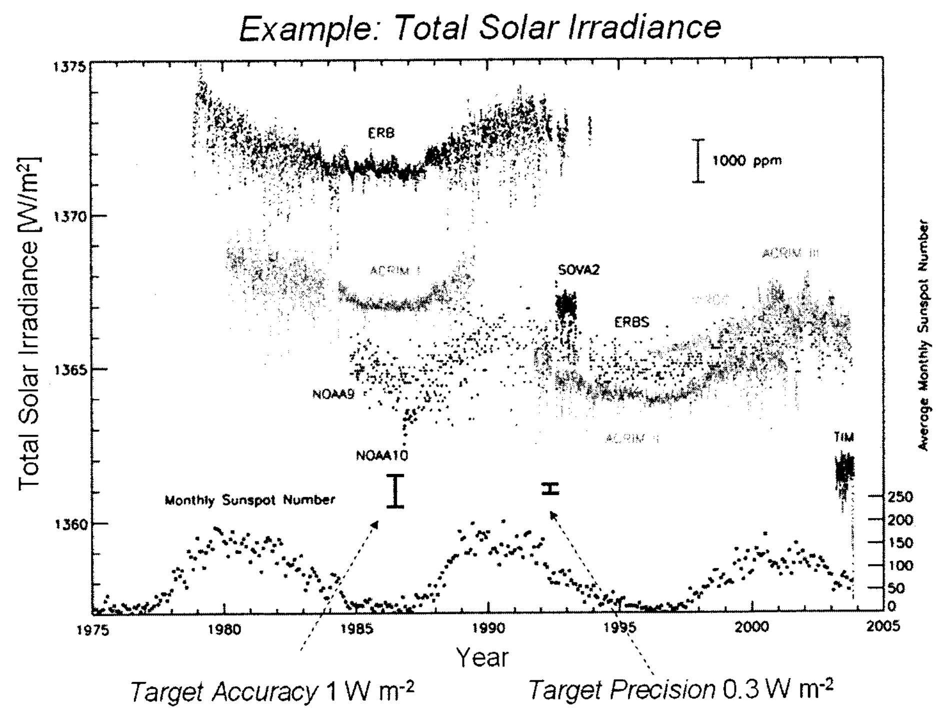

Figure 1. *The total solar irradiance during the period 1979-2004 as measured by 10 different satellite-based instruments. Also shown is the sunspot activity, which is correlated with a cyclical change in solar output. The two error bars in the bottom center of the graph indicate the needed accuracy and precision. Given the wide range of values obtained by individual instruments and the group as a whole, it is clear that neither of these has yet been achieved.*

Part of the reason we know so little about aerosols is that aerosols span a much wider range of properties than a given greenhouse gas. Aerosols are small particles, naturally-occurring or man-made, that are found in the atmosphere. Several major categories are given in Figure 2. Aerosols consist of complex aggregations of a number of different types of molecules, and can span four or more orders of magnitude in size. Because of their varied composition, aerosols also span a wide range of optical and chemical properties. For example, sulfate aerosols reflect solar radiation and generally cool the atmosphere, while black carbon-based aerosols absorb solar radiation and generally warm the atmosphere.

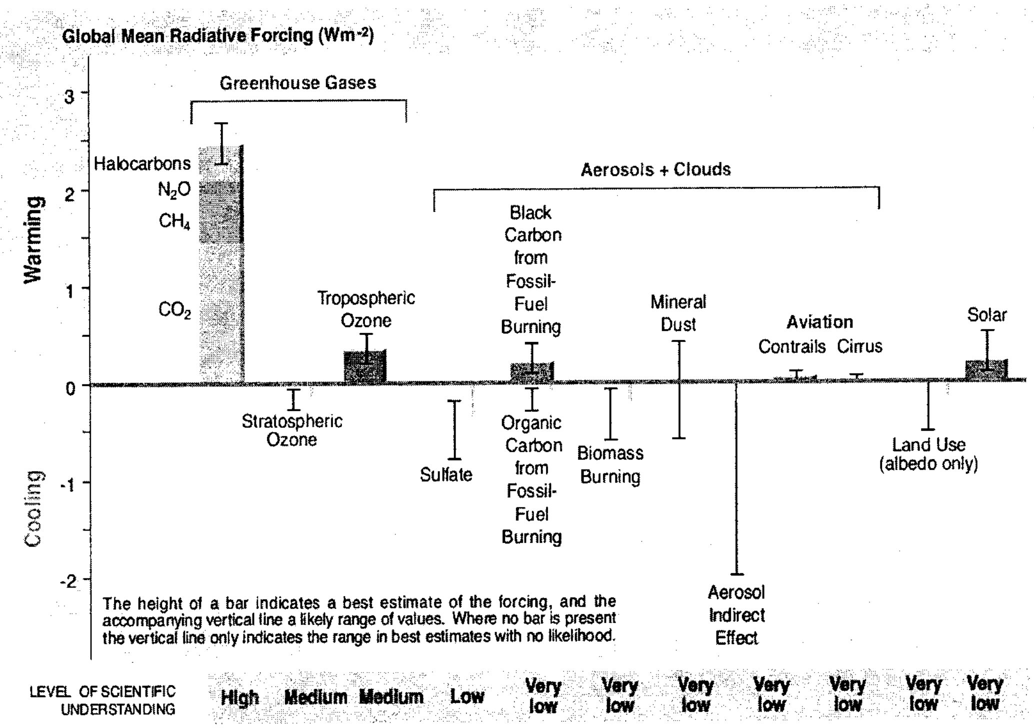

Figure 2. *Schematic comparing several factors influencing the global radiation budget. The length of each bar represents the best estimate of the change in Earth's radiation budget due to the various factors since 1750. The length of the vertical lines indicates uncertainty in the magnitude of the effect. Two principal categories of factors are the greenhouse gases and the combination of aerosols and clouds. Scientific understanding of aerosols is very low, as shown on the horizontal axis. Source: Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change, R. T. Watson and the Core Writing Team, eds., Cambridge University Press, Cambridge, UK and New York, NY, USA. March 2002.*

One of the biggest challenges in predicting climate change is the lack of detailed data for the wide range of aerosols that need to be included in numerical modeling. The reflection or absorption of solar radiation, cloud formation through ice and water droplet condensation, and catalysis of important chemical reactions such as those that lead to the destruction of stratospheric ozone cannot be correctly accounted for without a better understanding of basic properties. The 2003 Strategic Plan for the U.S. CCSP emphasizes this need in the first of five priority questions about atmospheric composition.

"What are the climate-relevant chemical, microphysical, and optical properties...of human-caused and naturally-occurring aerosols?"

Under this initiative, NIST will fill critical gaps in our understanding of climate-relevant aerosols. High-quality data on chemical, microphysical, and optical properties will be obtained by laboratory measurements or by computer calculation where measurements are too costly to perform. This data will show how aerosols absorb, reflect, or scatter direct sunlight or light reflected from the Earth. It will show how aerosols facilitate complex chemistry in the atmosphere, destroying or creating other important gases. The data will also help explain how aerosols are created, destroyed, or transported through the atmosphere to create the observed distributions, and will aid in the interpretation of atmospheric measurements.

In the end, basic information about the properties of aerosols and more accurate measurements of solar irradiance will both improve the accuracy of climate modeling. Accurate climate modeling will enable more accurate predictions of future climate changes and, ultimately, a better foundation for policy decisions.

Proposed NIST Technical Program:

At the proposed funding level:

- NIST, in coordination with NOAA, will develop a comprehensive pre-launch satellite system calibration program to ensure the highest possible accuracy for climate and atmospheric measurements. NIST will provide calibrations traceable to international standards so that measurements made from different satellites and at different points in time can be reliably integrated into an accurate picture of Earth's climate. Elements of this program will produce:
  - New techniques for ground-based calibration of satellite measurement systems using advanced radiometric standards:
    - that more realistically simulate the actual view seen in orbit;
    - that provide the higher accuracy required by climate research; and
    - that can be transported to other agency and vendor development sites.

- New instrument design strategies to optimize accuracy and stability of satellite-based measurement systems.
  - Measurement quality assurance programs for satellite instrument development teams including:
    - best practices training of instrument design and construction teams;

- on-site verification that instrument design standards and calibration standards are met;
- trouble-shooting for calibration problems that arise during design and construction; and
- inter-comparisons among international instrument calibration laboratories to ensure all satellite-based instruments, including those of international partners, are linked to the same standard.

- NIST, working with other agencies, will fill critical gaps in aerosol data required for accurate modeling of climate change. This effort will produce:
  - Techniques to generate aerosols in the laboratory so that required aerosol studies can be conducted both at NIST and elsewhere;
  - Metrology for characterizing the wide range of optical and physical properties of aerosols;
  - Computational techniques for calculating aerosol properties that cannot be measured in the laboratory; and
  - A database of critically-evaluated aerosol properties obtained from measurements at NIST and from other laboratories.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Measurements and Standards for the Climate Change Science Program	
Technical Area	**Outputs**
Standards for pre-launch satellite system calibration (FY 2009-ongoing)	• Hyper-spectral image projection technique will provide the capability for calibrating satellite sensors using sources matching spatial, spectral, and temporal profiles seen on-orbit; • Advanced accuracy, portable calibration sources based on light-emitting diodes; • New instrument design strategies resulting from collaboration with satellite development teams; • Curriculum and workshops on best practices for instrument design and construction teams; • Verification and documentation of implementation of critical calibration design criteria throughout instrument development process; • Technical support for instrument development teams on problems related to calibration; and • Inter-comparison round-robin among international instrument calibration laboratories to ensure adherence to a common standard.

Measurements and Standards for the Climate Change Science Program	
Technical Area	**Outputs**
Reference metrology and standards for critical atmospheric constituents (FY 2009-ongoing)	• Laboratory production methods for wide range of aerosols of interest to climate change modeling; • Metrology methods for characterizing optical and physical properties of aerosols; and • Computational methods for determining optical and physical properties of aerosols that cannot be measured.

Performance Measures: Outcomes

At the proposed funding level, NIST will fill two critical gaps in data needed for accurate climate modeling:

- NIST will enable the accurate determination of the solar irradiance as a function of time; and
- NIST will provide basic data on the behavior of aerosols that have the greatest impact on the global climate.

These data will improve the accuracy of climate change predictions, providing policymakers with accurate information about the advantages and consequences of various policy options.

5. Innovations in Measurement Science (+12 Permanent Positions, +9 FTE, +$3,000,000, including $500,000 transfer to the Working Capital Fund)

- The Innovations in Measurement Science Program is one of NIST's primary mechanisms for keeping pace with the measurement requirements needed for innovation in U.S. industry. This program is used to advance NIST's capabilities in the core measurement science areas underpinning technology innovation.
- Just as industry must innovate to survive in a competitive environment, NIST must develop innovative approaches to measurement challenges. NIST uses this program to anticipate industry needs and develop the measurement science needed by the next generation of technology.
- Established in 1979 and previously termed the NIST "Competence Program," this critical effort has not been able to keep pace with the rapidly evolving needs of industry and science. Increased funding would allow a higher level of effort and compressed timetable for meeting critical measurement needs.

Problem Magnitude and NIST Role:

The Innovations in Measurement Science Program provides funds to explore high-risk, leading-edge research concepts that anticipate future measurement and standards needs of industry and science. These funds are a principal mechanism for initiating the new programs and research directions necessary for NIST to keep pace with and respond quickly to the increasingly complex nature, and the shorter time frame, of technology development. They are also intended to permit NIST to better deal with the rapidly escalating costs associated with advanced measurements research.

Since its inception, the Innovations in Measurement Science Program has: 1) funded numerous projects that have evolved into core activities within the NIST Laboratories; 2) become the hallmark of NIST research; and 3) attracted some of the Nation's top scientific talent to NIST. Nobel Prize winners (Dr. William Phillips (Physics, 1997), Dr. Eric Cornell (Physics, 2001), and Dr. Jan Hall (Physics, 2005)) all had projects that were funded partially by the Innovations in Measurement Science Program. Other program achievements include the development of a cold-neutron small-angle scattering facility, a bold concept that ultimately led to the NCNR, a premier research program with over 1,600 users annually from outside NIST. As these examples demonstrate, the Innovations in Measurement Science Program provides the framework for the development of new ideas and the research needed to test their viability. The program continually revitalizes NIST, its staff, and its response to the needs of industry.

When the Innovations in Measurement Science Program began in the late 1970s, its funding was intended to increase in annual increments until funds equaled 15 percent of the total laboratory budget, including work for other Federal agencies. However, in FY 2007, the Innovations in Measurement Science Program was funded at only about four percent of the NIST Laboratories' budget, well below what is necessary to keep pace with the increasingly rapid and complex changes in technological development. The purchasing power of this program has been further eroded by the increased cost of cutting-edge research, which has significantly outstripped inflation and adjustments to base. With the notable exception of computers and related hardware, the cost of most advanced research equipment has risen dramatically in the past two decades, reflecting the much greater demands on equipment performance as technology advances.

Proposed NIST Technical Program:

At the requested funding level, the Innovations in Measurement Science Program will expand the scope and nature of the projects toward the development of multidisciplinary research areas at NIST that have greater visionary scope and impact. The program will continue to be administered as a highly competitive and closely reviewed effort designed to identify the best research proposals with the greatest chance for impact on future measurement needs. Each year, detailed research proposals are solicited from NIST technical staff. The NIST Laboratories carefully evaluate the technical merit, potential impact, and staff qualifications of these proposals, and forward only the top candidates for further consideration. The NIST Director solicits detailed technical reviews of the forwarded proposals from internal NIST technical experts and often from external experts, as well. Finalists deliver detailed oral presentations before the Director, other NIST senior technical managers, and technical experts. Only the strongest proposals survive this evaluation process. Successful proposals are funded for five years–thereby ensuring enough time for the innovative measurement science approach to be developed–and are periodically reviewed by the NIST Director to ensure satisfactory progress.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Innovations in Measurement Science	
Technical Area	**Outputs**
Innovations in Measurement Science	• Select and initiate several innovative strategic projects per year so that NIST is able to develop the technical capabilities required to meet the evolving needs of industry.

Performance Measures: Outcomes

At the proposed funding level, NIST will generate three outcomes.

- Measurements and standards for advanced technology industries, including semiconductors, biotechnology, telecommunications, and information technology;
- State-of-the-art measurement support for mature industry sectors, such as dimensional metrology of mass-produced parts in the motor vehicle, heavy equipment, and aircraft industries; and
- Research and development in support of emerging and future industry measurement needs such as those found in nanotechnology.

6. National Earthquake Hazards Reduction Program Initiative (+3 Positions, +2 FTE, +$3,250,000)

The Nation remains vulnerable to the damaging impacts of large earthquakes and other natural hazards. National Research Council (NRC) studies in 2003 and 2006 noted that there are several areas outside of California that have significant potential for earthquake-related damage and economic loss. Close to $8.6 trillion of structures and 75 million people are located in urban areas of moderate to high earthquake risk. These studies estimate that a single large earthquake in the U.S., like the one that struck Kobe, Japan, in 1995, will easily cause damage of $100 to $200 billion. This damage is on the order of the economic loss suffered in the 2001 terrorist attacks on the World Trade Center and the Pentagon. Such an event would be sudden, unannounced and potentially cause great loss of life.

Problem Magnitude and NIST Role:

Development and Implementation of *Advanced Earthquake Risk Mitigation Technologies and Practices* ($2,250,000 requested). This portion of the initiative fills a critical gap in the National Earthquake Hazards Reduction Program (NEHRP) process, which extends from basic research, to problem-focused research and development (R&D), and finally to technology implementation in the field. This gap has been termed the "research-to-implementation" gap. The problem-focused engineering R&D needs to transition basic engineering research that is performed largely by the academic community to a sufficient level of maturity for field implementation. Basic research, in effect, needs to be linked to field implementation via problem-focused engineering R&D. Within NEHRP, NIST is responsible for the problem-focused R&D. Research in this area will be performed in close collaboration with practitioners and will include activities to improve technical bases for current model building code provisions, development of design guidelines for practitioners (*e.g.*, guidelines for seismic design of port and harbor facilities), publishing of "tech briefs" for practitioners on focused engineering topics (*e.g.*, reinforced concrete seismic detailing), and problem-focused testing and analytical research that aims to advance fundamental research results to field usability (*e.g.*, application of emerging sensor technologies to improve structural performance).

Further Development of Techniques for *Evaluation and Rehabilitation of Existing Buildings* ($1,000,000 requested). In the 35+ years since the 1971 San Fernando earthquake, the Nation has made tremendous strides through research, development, and technology transfer in new building design and construction. There has been much less development related to existing buildings. The largest losses in future earthquakes will come in the existing older building stock and other older infrastructure. A 2003 NRC study states "Perhaps the greatest overall risk in the United States is the severe earthquake damage (including collapse) to existing facilities and lifelines designed without consideration of earthquake effects." The lack of research on which to base analytical models and develop good reconstruction practice has forced the engineering community to adopt ultra-conservative approaches to seismic evaluation of existing buildings and rehabilitation designs for deficient buildings. In addition, older building materials and details are often of a poorer quality than those found in new construction. The combination of conservative evaluations and costly "fixes" for problems that are found drives building owners away from considering earthquake safety, so that many older buildings in seismically active regions have not been evaluated or strengthened. This leads to large portions of the existing building stock being potentially deadly in earthquakes. Research that combines basic and problem-focused R&D efforts in this area will have immediate payoff. Research will focus on developing more accurate simplified analysis tools for older buildings and more cost-effective design tools and methods for highly vulnerable existing buildings. This component of the initiative will integrate NIST problem-focused R&D with basic research, and FEMA building code guideline development. A multi-pronged research, development, and implementation program will be developed and performed to address key problems found in analyzing and strengthening unreinforced masonry, non-ductile reinforced concrete, concrete precast tilt-up walls, and vulnerable residential systems. The inputs of state and local governments and other stakeholders will be obtained through multiple mechanisms (including workshops) in establishing priorities for the research and guidelines development effort and to ensure that the results can be used in standards, codes, and practices.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

National Earthquake Hazards Reduction Program Initiative	
Technical Area	**Outputs**
Advanced Earthquake Risk Mitigation Technologies and Practices	• Identify implementation gaps between basic research results and design guidance and national model building code provisions; • Develop rational, cost-effective, consensus-based seismic design and analysis procedures for use in national model building codes; and • Design guidelines for the testing and design of major structural systems.
Evaluation and Rehabilitation of Existing Buildings	• Characterize fully the seismic capacities of typical older building structural components and systems, as they were built; and • Develop structural performance criteria, analytical models, and cost-effective rehabilitation techniques for existing buildings.

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

- Reduction in the national risk to life and property from earthquakes;
- Transition of the products of basic research related to earthquake effects on buildings and infrastructure into practical, science-based, cost-effective tools for evaluating new and existing buildings;
- The earthquake-related provisions of national model building codes will be improved in both the short and long-term; and
- Technical resources such as guidelines, manuals and mitigation technologies will enhance U.S. structural engineering practice and improve U.S. economic competitiveness in national and international construction markets.

7. **Disaster Resilient Structures and Communities (+5 Positions, +4 FTE, +$4,000,000)**

In the wake of the Hurricane Katrina disaster in the summer of 2005, President George W. Bush stood in Jackson Square in New Orleans and called upon the Nation to be "better prepared for any challenge of nature or act of evil men that could threaten our people."

Problem Magnitude and NIST Role:

Despite significant progress in disaster-related science and technology, natural and technological disasters in the United States are responsible for an estimated $52 billion in average annual costs in terms of lives lost, disruption of commerce and financial networks, properties destroyed, and the cost of mobilizing emergency response personnel and equipment. Natural hazards–including extreme winds (hurricanes, tornadoes, windstorms) and storm surge, wildland fires, earthquakes, and tsunamis–are a continuing and significant threat to U.S. communities. Activities of man that are accidental, criminal, or terrorist can lead to disastrous community losses as well. A single event such as a major earthquake or hurricane could potentially cause $80 billion to $200 billion in economic losses in the affected areas.

The disaster resilience of our structures and communities today is determined in large measure by the building codes, standards, and practices used when they were built. With few exceptions, these legacy codes, standards, and practices which have evolved over several decades are prescriptive, oversimplified, and inconsistent with respect to risk. Codes and standards are developed through a voluntary consensus process by private sector organizations that lack the resources to carry out the research required to develop the technical basis for improved codes and standards.

As costs continue to rise, there is increasing recognition of the need to move from response and recovery to proactively identifying hazards that pose threats and taking action to reduce the potential impacts. Whether hazards become disasters depends upon the disaster resilience of our structures and communities. This, in turn, depends upon the capacity to prepare for and mitigate the impacts of hazards, preventing them from becoming disasters. This initiative is focused directly on selected solutions demanded by five of six Grand Challenges identified by the President's National Science and Technology Council in June 2005 for advancing science and technology to enhance disaster resilience, and thus, improve the Nation's ability to face disasters. They are:

- Provide hazard and disaster information where and when it is needed;
- Understand the natural processes that produce hazards;
- Develop hazard mitigation strategies and technologies;
- Assess disaster resilience using standard methods; and
- Promote risk-wise behavior.

NIST and NOAA have coordinated their programs to work together to provide (1) advanced hazard assessment, warning guidance, forecasting tools, and mitigation strategies; (2) models, metrics, and knowledge to modernize building codes, standards and practices; and (3) optimized delivery of information to enable Disaster Resilient Communities. In addition, NOAA will provide real-world observations and scalable hazard model output data at the community level, and NIST will provide expertise on building and fire resilience based on the NOAA hazard models.

This program proposes to develop the scientific basis required to enable technology innovations, improve prediction capabilities, and improve codes and standards for cost effectively reducing loss of life and property damage due to natural and man-made hazards. The fundamental new idea underpinning this initiative is that disaster resilience can be enhanced by developing a robust capability to *predict* the effects of hazards on the *performance* of complex structural systems and at scale in the community. This will be achieved by developing validated *data* to characterize the hazard environment, validated physics-based *models* to predict performance, *metrics* for measuring performance, acceptance *criteria* for differing levels of performance objectives, and *mitigation* strategies based on evaluated performance.

The role of NIST is well-established in these areas.

- NIST is authorized to both lead and conduct performance-based seismic engineering research under the National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act of 2004.
- NIST is authorized to conduct wind research under the National Windstorm Impact Reduction Act of 2004.
- NIST is authorized to conduct basic and applied research that enables protection of life and property from fire under the Federal Fire Prevention and Control Act of 1974.
- NIST houses the national Building and Fire Research Laboratory whose technologies are used by standards, codes, and building and fire engineering professionals around the world.

The scope of the $2.0 million provided by the Congress in FY 2007 included work on the safety of structures during extreme winds, fires at the wildland-urban interface, and strong-motion earthquakes, and this FY 2009 request ramps up this effort.[7] The combined funding supports a sustained critical mass effort with potential for significant impact in these areas.

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[7] *The industry-developed R&D roadmap to close the research-to-practice gap and accelerate the use of new earthquake risk mitigation technologies recommended a sustained budget of $6.5 million per year. Congress authorized $4 million in FY 2007 and FY 2008 under the National Windstorm Impact Reduction Act of 2004 (P.L. 108-360). Congress also authorized $12.1 million in FY 2007 and $13.31 million in FY 2008 under the National Earthquake Hazards Reduction Program Reauthorization Act of 2004 (P.L. 108-360). A summary budget table itemized by technical area is provided at the end of this initiative justification.*

For FY 2009, the scope of the $4.0 million initiative includes work on the disaster resilience of structures and *communities* during extreme winds and *storm surge*, fires at the wildland-urban interface, and strong-motion earthquakes. It also includes work on multi-hazard failure analysis, *decision-support tools for economic assessment of multi-hazard mitigation solutions,* and *standard methods to predict losses and evaluate disaster resilience at the community and regional scales.* Further, *the FY 2009 initiative is based on a joint program plan with NOAA that includes collaborative work in all hazard areas, with the exception of complementary work in earthquakes (NIST) and tsunamis (NOAA).* (Note: The items in italics above are new starts for FY 2009.)

Proposed NIST Technical Program:

New program starts in FY 2009 (tightly coupled to FY 2007 initiative):

- **Standard Methods to Predict Losses and Evaluate Disaster Resilience at the Community and Regional Scales**
  NIST–in partnership with NOAA, FEMA and other entities, notably insurance industry organizations–will develop an enhanced science base and standard methods that can be used to improve existing models and tools used by public or private organizations to predict losses and evaluate disaster resilience at the community and regional scales. Activities will focus on fires at the wildland-urban interface and hurricane-induced wind and surge simulations.

- **Validated "Computational Wind Tunnel" for Predicting Hurricane Wind Effects on Structures.**
  The resulting "computational wind tunnel" has the potential to revolutionize structural design for extreme wind conditions by providing a computational method for testing structural designs—minimizing the need for physical wind tunnel testing and allowing for faster testing over a wider range of conditions and lower costs.

- **Decision Support Tools for Economic Assessment of Multi-Hazard Solutions.**
  NIST will develop decision support tools for economic assessment of multi-hazard mitigation solutions to help building designers, owners, and operators select the optimal mix of disaster protection strategies and efficient level of investment in each strategy to achieve a target level of protection at minimum life-cycle cost.

- **Risk-Based Storm Surge Maps for the Design of Structures in Coastal Regions and an Improved Saffir-Simpson Hurricane Intensity Classification Scale.**
  NIST will work in partnership with NOAA to develop risk-based storm-surge maps for the design of structures and an enhanced Saffir-Simpson hurricane intensity classification scale. This FY 2009 new start will build on earlier work associated with

Hurricanes Katrina and Rita which will be extended to cover the entire U.S. Gulf and Atlantic Coast regions. The enhanced Saffir-Simpson hurricane intensity scale will consider risk-consistent combinations of wind speed and storm-surge height.[8]

Programs in FY 2007 President's Budget to be Enhanced in FY 2009:

Prediction of Fire Hazards at the Wildland-Urban Interface (WUI). The additional FY 2009 funds for the WUI fire program will be used to expand and initiate new efforts in two major areas: (1) creating and maintaining the database of structural and vegetative fuels unique to the WUI with an initial focus on communities identified as high risk; and (2) extending and validating model-based tools for WUI fire behavior and smoke transport in close collaboration with NOAA and integrating the resulting model within NOAA's Fire Weather Forecast system. The NOAA-NIST Fire Decision Support Tool created with funding from this FY 2009 initiative will include the following information for tactical and strategic planning to improve community and fire fighter safety and reduce property losses:

- Predictions of fire behavior and changes in fire intensity based on fuel maps, topography, man-made features (e.g., roads), and wind;
- Predictions of fire location relative to WUI communities and first responder access roads;
- Air quality and obscuration assessment of predicted smoke levels in WUI communities, over access roads, evacuation routes, and air corridors in the proximity of the fire; and
- Air quality assessment of predicted smoke levels in downwind communities.

Earthquake Resistant Structures: Tools for Design, Construction, and Mitigation. The FY 2007 and FY 2009 areas of work are all separate but complementary and are based on separate recommendations found in the industry R&D roadmap developed by the Applied Technology Council (The Missing Piece: Improving Seismic Design and Construction Practices, ATC-57). ATC-57 had its genesis in the 2001-2005 NEHRP Strategic Plan. ATC-57 recommends that NIST focus on two broad programmatic areas in support of NEHRP: systematic support for seismic building code development, and improvement of seismic design and construction productivity. In the first program area, two areas of research are suggested: providing technical support for code development and developing the technical basis for performance-based seismic engineering (PBSE). PBSE research has been mandated by Congress in P.L. 108-360. In the second program area, three areas of research are suggested: developing national design guidelines and manuals; disseminating evaluated technologies to practitioners in clear and succinct form; and developing tools to improve productivity in the design process. The roadmap identified component projects within these program areas with a recommended sustained budget of $6.5 million/year. NIST will implement the highest priority projects in the roadmap consistent with appropriations.

[8] *While Hurricane Katrina wind speeds were consistent with a Category 3 storm, the storm-surge heights exceeded Category 5 on the hurricane intensity scale.*

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Disaster Resilient Structures and Communities	
Technical Area	**Outputs**
Understanding hazards to the built environment	Hurricane-induced extreme winds and storm surge-understanding the hazards • Improved Risk-based Storm Surge maps of all geographic station/basins along the U.S. Atlantic and Gulf coasts developed from validated/improved methodologies and software tools for storm surge simulation in collaboration with NOAA. These maps are essential for designing and developing standards for coastal structures and lifeline systems to withstand storm surges along the Atlantic and Gulf regions. • Improve and validate hurricane simulations for prediction of path, size, speed, and intensity by comparing best models with data from historical records. • Improved Warning and Emergency Evacuations-evaluate both wind and storm surge effects that are needed to enhance the Saffir-Simpson Hurricane Scale.

Disaster resilient structures and communities	
Technical Area	**Outputs**
Understanding hazards to the built environment (continued)	Fires at the wildland-urban interface (WUI)-understanding the hazards • Database of fuels (vegetation and structures) in WUI communities, beginning with communities identified at high risk from wildfires. Work in 2009 will include road and terrain features. • Develop methodologies for long-term maintenance and assessment of database, as well as new techniques for acquiring real time data during a fire by NIST's WUI rapid response team. • Database of experimental results for validation and calibration of model collected from controlled laboratory and field experiments, conducted by NIST, that extend the existing database for structural and vegetative WUI fuels. Includes collaboration with State Fire Marshall's and USDA Forest Service's efforts to establish WUI building standards and safety guidelines. • Stand-alone fire behavior and smoke transport model-based tools that are validated in a stepwise manner and capable of predicting the behavior and resulting smoke movement from fires spreading in WUI communities and adjacent wildlands. These tools have capabilities that range from operational to strategic.
Predictive technologies and mitigation strategies to enhance disaster resilience	Advanced computational tools for determining realistic wind loads in the built environment • Develop "computational wind tunnel" as an alternative to wind tunnel testing for structural design, beginning with the documented evaluation of current computational options, in cooperation with NOAA's National Weather Research program, standards associations for wind engineering, leading university programs, and industrial and commercial computational fluids dynamics software developers. Fires at the wildland-urban interface – predicting and mitigating the hazards • An integrated NOAA/NIST Fire Decision-Support tool. NOAA forecasts of fire weather will now provide predictions of fire behavior and smoke movement for use in tactical and strategic planning resulting in improved community and fire fighter safety and reduced property losses. • A Roadmap leading to the coupled NOAA/NIST operational fire weather / fire behavior prediction tool, incorporating NOAA's atmospheric simulations for background wind (input to fire model) and NIST's fire behavior model for fire location and heat and mass flux (input to atmospheric model) will be developed in FY 2009.

Disaster resilient structures and communities	
Technical Area	**Outputs**
Predictive technologies and mitigation strategies to enhance disaster resilience (continued)	Seismic practice and code development for built structures to minimize risk from earthquakes. • Improve procedures to evaluate performance of structure as a whole and interactions between components, rather than the current practice of piecemeal specifications and testing. Better data will be obtained from extensive analytical modeling and field observations during actual earthquakes. Translating these procedures into formats usable in national model building codes will result in more resilient structures at lower cost. • Publish Technical Brief: Tilt-Up Construction Details. The connections of pre-cast tilt-up wall and floor/roof panels to their underlying structural supports have been shown to fail in earthquakes. A catalog will be developed of connections that are expected to perform well in earthquakes. • Publish Technical Brief: Shotcrete Quality Control and Assurance (QC/QA). Shotcrete is often used to strengthen existing concrete or masonry walls in seismic retrofit projects. Robust field QC/QA measures will be developed to assure that shotcreting performs properly. • Publish Technical Brief: Earthquake Lessons Learned. Valuable field observations from damaging earthquakes will be documented. These would address significant technical topics not considered in post-earthquake investigation reports. Tools and scientific basis for multi-hazard failure analysis and mitigation of complex structural systems* • Methodology proposed for determining the residual reserve capacity of a structural system at any point during the failure sequence. • Methodology proposed for assessing alternative methods for attaining the performance design objective of full building burnout without partial collapse. **Structural failure of complex systems can result from a sequential cascade of failure events.*

Disaster Resilience Structures and Communities	
Technical Area	**Outputs**
Standard methods to assess disaster resilience of the built environment	<u>Decision support tools for economic assessment of multi-hazard mitigation solutions to help building designers, owners, and operators</u> • Produce economic case study that uses the methodology to evaluate strategies for protecting against a selected hazard to the built environment. • Draft report on methodology (e.g., life-cycle costs and net present value) for measuring economic performance of mitigation strategies to help stakeholders select appropriate protection measures for four types of hazards to the built environment (i.e., earthquakes, storm surge, wildland-urban interface fires, and extreme wind events). <u>Predicting losses and evaluating disaster resilience at the community or regional scale</u> • Conduct laboratory and field measurement to provide scientifically based data for use in loss estimation models (*e.g.*, probability distribution of damage of various building components such as roofing, door, window, walls, siding components and other systems under various wind loads.) • Develop fragility relationships that are capable of predicting the level of damage to buildings, bridges, geotechnical structures, towers, masts, pipelines, roads and various other components of a functioning infrastructure system. • Identify potential community costs (*e.g.*, medical expenses, property losses, foregone business income) and corresponding stakeholders (*e.g.*, residents, businesses, insurance companies) impacted by natural and man-made hazards.

<u>Performance Measures: Outcomes</u>

At the proposed funding level, NIST will generate four outcomes.

- There will be a reduction of risk from hurricanes and windstorms, fires at the wildland-urban interface, and earthquakes;
- The science-based tools will enable more robust hazard mitigation assessments, better resource allocation decisions, and guidance to communities for response to large-scale fires at the wildland-urban interface;
- The seismic, wind, and fire provisions for model building codes will be improved in both the short- and long-term; and

- Technical resources such as guidelines, manuals, and evaluation of mitigation technologies will enhance structural engineering practice.

A 2005 National Institute of Building Sciences study found that a dollar spent on mitigation saves society an average of $4, with positive benefit-cost ratios for all hazard types studied. Mitigation is sufficiently cost effective to warrant Federal funding on an ongoing basis both before disasters and during post-disaster recovery. Without this initiative, the data and predictive tools will not be available to identify the communities at greatest risk and to prioritize the most effective steps that can be taken to mitigate the impact of disasters. To remain in response and recovery mode – rather than proactive strategic planning and risk management – increases the likelihood of significant loss of life, property, and infrastructure due to accumulated annual events, as well as the potential for another major $80-200 billion loss due to a single severe event such as an earthquake or a Katrina-scale hurricane.

Disaster Resilient Structures and Communities Summary Budget Table:

Technical Area	Budget (Dollar amounts in thousands) FY 2007	FY 2009	Total
Extreme Winds			
Database Assisted Design	$300		$300
Computational Fluid Dynamics		$300	300
Storm Surge Maps		300	300
Fires at Wildland-Urban Interface			
Database of Unique WUI Fuels	350	680	1,030
Outdoor-scale Predictive Model	250	720	970
Earthquake-Resistant Structures			
Code Development Technical Support	225	210	435
Performance-Based Engineering	275	500	775
National Design Guidelines	225	350	575
Disseminating Evaluated Technologies	75	40	115
Design Productivity and Interoperability		400	400
Multi-Hazard Failure Analysis	300		300
Assessing Disaster Resilience			
Economic Decision Support Tools		150	150
Community-Scale Loss Estimation		350	350
Total	**2,000**	**4,000**	**6,000**

8. <u>Cyber Security: Leap-Ahead Security Technologies for Interconnected Systems (+16 Permanent Positions, +12 FTE, +$5,000,000)</u>

- Cyber security is critical to the economic and national security interests of the United States. Public and the private sector organizations are increasingly reliant on the operation of substantial, interconnected networks of computers and information stores to meet their missions. These networked systems face an ever-increasing threat of malicious attack from individuals, organizations, and nation states that are targeting key information technology operations and assets.
- Improving the security of the government and commercial information systems is a national priority that has been explicitly identified in presidential directives (HSPD-7 and HSPD-12), legislation (Federal Information Security Management Act, Cyber Security & Research, Privacy Act, Sarbanes-Oxley, Gramm-Leach-Bliley, HIPPA, and Clinger-Cohen), regulations (OMB Circular A-130 and OMB Circular A-11).
- Advanced research in cyber security will lead to leap-ahead advances in the nation's ability to protect its critical information systems and defend against the growing threats by sophisticated attackers. This research, which is part of the Comprehensive National Cybersecurity Initiative, includes the development of scalable, affordable, flexible security approaches that can be used easily and effectively by average individuals to protect systems against emerging threats.
- Because of our experience and expertise, NIST is positioned to perform research in vital cyber security disciplines.

<u>Problem Magnitude and NIST Role</u>:

Cyber security is focused upon establishing and maintaining the three security objectives for information and information systems: confidentiality, integrity, and availability. *Confidentiality* preserves authorized restrictions on information access and disclosure, including means for protecting personal privacy and proprietary information. *Integrity* guards against improper information modification or destruction, and includes ensuring information non-repudiation and authenticity. *Availability* ensures timely and reliable access to and use of information. Depending upon the nature of the system or information store, some or all of these objectives may be desired to some degree. The essential challenge of cyber security is providing appropriate levels of the right security objectives in a cost-effective manner.

While the security objectives are well understood, many of the tools and mechanisms available today were designed with yesterday's technology in mind. Information systems have evolved from physically isolated systems to highly distributed heterogeneous systems interconnected by the global internet. Operating systems are composed of millions of lines of code, rather than thousands. Information system users are now ordinary individuals, rather than information technology experts. Achieving real security in the context of today's information systems remains an elusive goal, and even greater challenges are on the horizon. For example, many implementations of security technologies have been developed to support single applications or protocols. This has created stove pipe security mechanisms that cannot scale to provide a complete security solution. Two examples are cryptographic key management and identity management solutions. There are several small, independent key management and identity management solutions that support single applications or a few protocols but there are no general frameworks in place today that can support all layers on the network and work across a variety of applications. In addition to the development of stove pipe solutions, the complexity of essential information technologies has compounded the problem of providing robust security environments that thwart attacks. Attackers must only find one point of penetration for success while the security practitioner must close all potential vulnerabilities in the system. This begins with operating systems that support the core of all information systems. Providing consistent core operating system configurations that can be used by ordinary individuals to support computers and other devices is an essential challenge to protecting the entire network infrastructure.

NIST has the necessary expertise and experience in fundamental security technologies such as: cryptography, risk management, biometrics, tokens, operating system security, security protocols, and authentication. In addition, NIST has experience in design usability of information systems and can establish broad based framework solutions that cut across independent, proprietary solutions. NIST has the strategic relationships with IT system developers and vendors to promote adoption of the research results.

Proposed NIST Technical Program:

This initiative focuses on three essential cyber security infrastructure elements.

- **Cryptographic Key Management**
  NIST generated infrastructure will include a high-level framework for the generation, distribution, use, storage and destruction of the cryptographic keys used to secure communications over the network, a critical element of an overall strategy toward more effective Identity Management. A key focus will be meeting the critical challenges of affordability, flexibility, usability and global scalability with real trusted cryptographic keys that can support both the internal protocols of network communications and user applications. The effort will be conducted in technical consultation with the National Security Agency (NSA) and Department of Defense (DoD), as well as other government agencies and non-government organizations.

- **Multifactor Authentication Systems Interoperability**
  NIST will develop a framework and implementation plan for interoperable tokens that contain biometric and cryptographic credentials to support logical access control on a multi-platform and multi-operating environment basis. This will eliminate the difficulties with achieving interoperability that have impeded the widespread use of multifactor authentication technologies that are more secure than single factor, e.g., password, security systems. For example, while interoperable biometric templates

currently exist, operating system and applications interfaces necessary for enterprise-wide reliance on biometric authentication are still rare. Standardization of the protocols, interfaces and data structures as well as usability for enabling interoperability will be undertaken in coordination with vendors and Federal departments, including the Department of Homeland Security and DoD.

- **Automated Security Conformance Tools**
  NIST will extend the Federal Desktop Core Configuration (FDCC) automated security configuration and compliance monitoring model to other operating systems, applications, and network devices. A critical element of the initiative is exploration of the general problem of applying standard security configurations in process control applications without causing unacceptable degradation of service and reliability. NIST will also quantify the security value of standardizing security settings. NIST will coordinate the efforts of this initiative with cyber security efforts being conducted by various other Federal agencies.

Performance Measures: Outputs

Cyber Security	
Technical Area	**Outputs**
Cryptographic Key Management	• Framework for the generation, distribution, use, storage and destruction of the cryptographic keys used to secure communications over the network • Usability guideline for cryptography. • Technical requirements guideline for trusted cryptographic keys.
Multifactor Authentication Systems Interoperability	• Framework and implementation plan for interoperable token/biometrics-based logical access control on multiple platforms and operating environments. • Standard protocols for initializing and using credentials on multiple platforms. • Standard token interfaces.
Automated Security Conformance Tools	• Standardized settings, reference platform, automated deployment tools, machine readable and standardized security configuration baseline, • Certified assessment products for operating system environments. • Assessment guideline for standard security settings.

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

- Security infrastructure required to provide confidentiality for computers, information in transit, and information stores;

- Improved interoperability of identity management systems to ensure that authentication of individual and machines on networks;
- Improved operating system and application interfaces to support critical access control decisions across networked environments;
- Standardized protocols, interfaces and data structures for determining the identity of individuals and devices on networks;
- Standardized security settings to support the operation and use of computers and devices for general system users; and
- Increased security of US communications, information, and critical infrastructures.

This initiative will address the development of security frameworks that are required to secure the information backbone of our Nation's commercial enterprises. This initiative will enable development of computer security infrastructures that are impervious to unauthorized penetration, robust against threats, standardized for maximum compatibility and control, and capable of secure data transmission.

9. <u>Going at Light Speed: Optical Communications and Computing (+25 Permanent Positions, +18 FTE, +$5,840,000)</u>

- The success of U.S. communications is a fundamental driver of productivity gains and economic growth and is a key platform for innovations in many current and future industries (telemedicine, entertainment, and security). For this reason in "*A New Generation of American Innovation.*" the President has called for all Americans to have "universal, affordable access to broadband technology," which requires transmission rates 100 times faster than are available today.
- Information transmission is our Nation's economic lifeblood but is being choked both within our computers and along the transmission lines that connect them.
  - The U.S. communications network was not designed for this large amount of data traffic. Just as commuter traffic can be brought to a halt by traffic light failure, the communication traffic in our fiber optic systems is now limited by many sophisticated but uncoordinated components.
  - Our computer systems are based on integrated electronic devices that are rapidly approaching a fundamental limitation in speed due to communication bottlenecks.
- It is believed that *optical technology* will be able to solve these communication needs, but the technology is still in its infancy. To take full advantage of the existing infrastructure and enable the next generation data transmission needs, industry must:
  - develop faster fiber-optic transmission lines and flexible transmission systems that diagnose and reconfigure the paths that signals follow in response to changing conditions, and
  - enable light-speed (photonic rather than electronic) operation in the computers to which these transmission systems connect.
- A critical barrier is industry's lack of optical measurement capabilities required to achieve these goals.
- The Optoelectronics Industry Development Association calls for measurements to support higher transmission speeds

- The Telecommunications Industry Association CTO council states that measurements are required to support flexible transmission systems.
  - New measurement techniques are required to achieve the International Technology Roadmap for Semiconductor goal of manipulating light at the nanoscale in order to achieve light-speed communications within computer chips.
- NIST is positioned to lead the development of the precise measurement capabilities and standards that will be necessary to allow systems from multiple vendors to interoperate, as well as overcome critical communications bottlenecks.

Problem Magnitude and NIST Role:

Demand for information processing and data transfer continues to grow rapidly. While today's network was designed for transmission of voice, email and pictures, tomorrow's users are expected to require data transmission rates more than 100 times higher in order to enable transmission of medical images for telemedicine, data for telecommuting and video for consumer applications. Computer speed must keep up accordingly. Technology has enabled dramatic growth in capacity, but this technology is approaching its physical limits. New measurement and control capabilities are required in order to deal with the increased system complexity needed to meet demand.

Light-Speed Networks:
To economically address the increasing demand for network capacity, industry envisions a shift toward higher transmission speeds and more flexible networks that can reconfigure the paths that data follow in response to changing transmission conditions. Industry has noted, however, that it lacks significant measurement capabilities to achieve these goals. The Optoelectronics Industry Development Association has called for measurements to support transmission at speeds of 100 billion data bits each second (100 Gb/s). The Telecommunications Industry Association CTO council has stated that measurements for determining performance at different levels within the transmission system are required to support wide-scale network flexibility. Such measurements would have a substantial impact on the competitiveness of U.S. industry.

- The CTO of Telcordia has stated that at least $2.5 billion would be saved if diagnostic measurements were developed and incorporated into network operations (5 percent of the estimated $500 billion that will be invested over the next 10 years in new optical communications network infrastructure).

However, the optical transmission system presently includes dozens of independent optical fiber networks, tens of thousands of connections and millions of miles of optical fibers, each fiber capable of simultaneously carrying hundreds of separate signals. The challenges of developing the exceedingly high speed, highly accurate measurements of signal quality and degradation needed to diagnose a problem and pinpoint it to a physical location on a particular optical fiber will be extremely challenging in such a complex system. As speed and flexibility increase, evaluating transmission systems will require new measurements that can provide more detail and information than is available through existing evaluation procedures. These new measurements are essential if industry is going to implement the flexible networks that it needs to meet demand.

> *"As optical networks become more transparent, it becomes increasingly difficult to monitor the integrity of signals within the network."*
> S. Woodward, AT&T, 2007

Light-Speed Computers:
Fully benefiting from the enhanced speeds of these fiber optic networks also requires that the speed of light be used in place of the comparatively slow, and energy expensive, electrical communications channels (interconnects) within the computers that interface with optical networks and the chips that power them. Optical communications are increasingly seen as the only route for eliminating these bottlenecks.

> *"Today, optics is a niche technology. Tomorrow, it's the mainstream of every chip that we build."*
> Intel Senior Vice-President P. Gelsinger, 2005

However, optical devices and components that interface between light-transmission on optical fibers and the electrical signals within the computer ("optoelectronics") are not yet capable of achieving this goal: commercial devices still suffer from manufacturing yields as low as 10 percent.

- Two major US manufacturers in the $2 billion market for transceivers, a critical component in optical communications, state that improved measurements could increase their manufacturing yields by 10 percent.

Furthermore, there are no functioning technologies for transmitting signals within computers or the chips that power them using light. New and better measurements are required to improve yields and performance and to increase the level of integration of light speed communications within computers and computer chips. New techniques for measuring the nanoscale technologies by which light can be guided, switched, and controlled are required in order to enable these technologies and to fully realize the improved network capabilities that they would permit.

Why NIST:
Advances in optical communications are the principal means for addressing the demand for increasing communications speed and capacity. The measurement needs for this next-generation of optical communications outstrip existing measurement capabilities. NIST will meet these measurement needs through this initiative. The end result will be decreased industrial capital expenses, through improved utilization of infrastructure and fabrication and design of critical components, and decreased industrial operating expenses, through enhanced troubleshooting.

For example, in the 1980's the optical communications industry that included commercial giants such as Corning and AT&T were running into barriers to future technology development due to a lack of standardization and control of optical fiber dimensions. The industry reached out to NIST for assistance in developing improved measurement capabilities. The subsequent improvements in metrology in fiber optics allowed the U.S. to capture the worldwide fiber market:

> *Without the NIST assistance and leadership, the U.S. fiber optics industry would not be in the competitive position it is today.* A.R. Frischkorn, Jr., President Telecommunications Industry Association, 1990

> *The opportunity to work with NIST on this project gave Corning and other American fiber manufacturers a clear competitive advantage...* Jan H. Suwinski, Executive Vice President Corning, Inc., 1993

The technical needs of today's optical communications industry are substantial and continue to pose a significant technical challenge to the numerous companies involved. At the core of these challenges are measurement needs that NIST can, and has been asked, to address: the need for new, accurate measurement methods to enable high speed, flexible networks.

Proposed NIST Technical Program:

Working closely with industry, NIST, already the world leader in high-speed measurements and simple optoelectronic measurements, will expand its work to include research and development of:

- new measurement, data analysis, and modeling tools that utilize signal measurements to remotely diagnose the locations of transmission problems on flexible networks; and
- new nanoscale measurement techniques for analyzing light-based circuitry.

This initiative will address industry's need for higher speed, flexible networks by developing measurements that permit real-time control of signal routing that is critical for next generation optical communications systems. Specifically, NIST will develop the highly accurate measurements that will enable information on transmission problems to be extracted from changes of complex shapes of signals on optical networks. NIST will develop analysis tools and models that use these measurements to provide unprecedented real-time knowledge of network performance through remote determination and localization of transmission problems. NIST will develop new measurement science to support next-generation light-based circuitry by enabling nanoscale characterization of innovative nanomaterials, structures and devices for controlling and guiding light.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Measurements for Optical Communications: Meeting Current and Future Needs	
Technical Area	**Outputs**
Measurements for higher transmission speeds	• Improved measurements of data degradation at 40 Gb/s data transmission speeds; • Measurements for higher speed electrical and optical signals; and • New measurement capabilities for 100 Gb/s and higher data transmission speeds.
Measurements for flexible transmission systems	• Tools for analyzing complex transmission structures; • Measurement techniques for analysis of complex signals to enable systems to reconfigure the complex paths that signals follow in response to need; • Measurement tools to enable remote diagnosis of the locations of transmission problems; • Measurement methods to resolve transmission problems; and • Develop standards, as appropriate, through relevant standards development organizations.
Measurements for light speed computers	• Measurements to enable the interconnection of nanoscale electrical and light-based transmission structures; and • Measurements to enable manipulation of light within computer chips.

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

- higher speed, more robust and lower cost data processing and transmission;
- higher speed, lower power computers;
- improved functionality of optical communications equipment and lower network operations costs;
- maintained and increased competitiveness of US communications and information technology industries; and
- implementation of our Nation's next-generation light-speed transmission infrastructure.

This initiative will address critical measurement needs of our computing and communications industry. It will enable development of the technologies from nanoscale light-manipulating materials to continent-spanning flexible transmission systems that are required to achieve next generation optical communications and computation. It will ensure the effectiveness of the data transmission systems that underlie our economy and form the foundation of our Nation's competitiveness.

10. Enabling the Hydrogen Economy (+13 Permanent Positions, +10 FTE, +$4,000,000, including $750,000 transfer to the Working Capital Fund))

- The development of a robust hydrogen economy will help the U.S. use energy more efficiently and cleanly, and reduce the Nation's dependence on foreign sources of energy.
- NIST research will:
  - Enable development of more powerful, efficient, and durable fuel-cell designs; and
  - Ensure safer storage, distribution, and delivery of hydrogen in the marketplace.
- NIST's research, measurements, and standards will be integral to the Nation's transition to a hydrogen economy.

Problem Magnitude and NIST Role:

> *"With a new national commitment, our scientists and engineers will overcome obstacles to taking these cars from laboratory to showroom, so that the first car driven by a child born today could be powered by hydrogen, and pollution-free."*
>
> George W. Bush, State of the Union 2003

A recent U.S. Department of Energy (DoE) Workshop report on Hydrogen Production, Storage and Use identifies "safe and efficient infrastructure for seamless delivery of hydrogen from production to storage to use" as one of the four major challenges for the hydrogen economy. It further states, "Hydrogen is significantly different from today's common fuels because of its tendency to embrittle metals and other containment materials, its rapid leaking behavior ...and combustion behavior." In conjunction with the President's Hydrogen Fuel Initiative, DoE also recognized that low-cost, high-volume manufacturing processes are critical to our Nation's transition to a hydrogen economy.

Under this initiative, NIST will apply long-standing experience in measurement science, standards, and the Nation's model building codes, as well as its unique neutron probes and fuel-cell test facility, to accelerate development of the innovative tools needed for assuring safe commercial production, storage, and delivery of hydrogen as an energy carrier in a hydrogen economy.

In addition to contributing knowledge and tools that are essential to making hydrogen a viable energy option for distributed energy generation, this initiative will help NIST to carry out its responsibilities as the lead U.S. agency for weights and measures for vehicle systems and refueling facilities, fuel cells, and on-site hydrogen generation, as designated by the DoE Hydrogen Codes and Standards Coordinating Committee. NIST will be instrumental in the development of appropriate fuel cell performance-based testing and rating procedures, development of fire hazard predictive models, and evaluation of fire suppression systems.

Proposed NIST Technical Program:

At the proposed funding level, NIST will:

- Adapt, extend, and leverage the unique resources of the NCNR to address critical barriers in hydrogen production, storage, and utilization. The NCNR is the Nation's premier facility for neutron imaging and allows real-time, three-dimensional analysis/images of hydrogen dynamics in operating devices.
- Contribute to the technical development of the Nation's model building codes by producing and assessing testing methodologies, experimental data, predictive models, and sensor integration.
- Advance the fundamental understanding of the role of fabrication, manufacturing metrology, and process control technologies that are critical to the performance characteristics of hydrogen systems. This work will focus on the development of knowledge bases of manufacturing process technologies, reliable measurements, and standards that are necessary to enable the design of fuel cells that can be manufactured cost-effectively.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Enabling the Hydrogen Economy	
Technical Area	**Outputs**
Enabling the hydrogen economy	• Develop appropriate test and rating methodologies for stationary fuel cell units, develop simulation tools, construct database of representative fuel cell performance parameters, develop standard measurement techniques to quantify electrical and thermal performance, and validate rating methodologies. (FY 2009-FY 2011) • Develop advanced new neutron imaging and scattering tools/methods leading to both design and performance criteria that increase the reliability and efficiency of fuel cell operation. (FY 2009-ongoing) • Perform tests of fuel cells and hydrogen storage devices used for research by industry and academic institutions, tests of fully assembled commercial fuel cell stacks suitable for various applications, and tests of corrosion and hydrogen-induced damage. (FY 2009-ongoing) • Develop a database of infrastructural manufacturing knowledge for fuel cell and other hydrogen system design and production. (FY 2009-ongoing)

Performance Measures: Outcomes

At the proposed funding level, NIST will generate the following outcomes:

- Developed consensus standards that provide the technical foundation for model building codes, facilitating the adoption of hydrogen technologies in local communities;
- Enabled private sector innovation towards progressively more powerful, efficient, and durable fuel-cell designs; and
- Improved industrial safety standards for materials used in hydrogen systems developed in collaboration with consensus standards organizations.

11. Biometrics: Identifying Friend or Foe? (+4 Permanent Positions, +3 FTE, +$2,000,000)

Rapid, reliable and accurate biometric-based recognition of individuals is necessary for successful homeland security, counterterrorism, border control, law enforcement, e-commerce and e-government, and identity theft prevention. Enhanced biometric systems, with the associated test and evaluation infrastructures, have been identified as an Administration research and development priority to further reduce vulnerabilities in protecting the homeland. The Department of Homeland Security (US-VISIT), FBI, and the State Department currently partner with NIST to draw on and leverage NIST's long experience and expertise in measurement science and standards in biometric technologies. NIST will develop appropriate measurements and standards to support testing and evaluation of enhanced biometric systems.

Problem Magnitude and NIST Role:

Prevention of terrorist attacks. Protecting the homeland against sabotage, conspiracy, and other outside threats requires intercepting known and suspected terrorists and people with terrorist ties at the Nation's borders and other points of entry, where hundreds of millions of people enter the United States every year. Accurate, reliable biometric technologies–automated tools that identify people on the basis of physical or behavioral characteristics–are crucial to achieving this security requirement without seriously disrupting and inconveniencing the large flow of visitors at ports and border crossings.

With NIST's assistance, biometrics technology is already being used to ensure that a person holding a visa is the same person to whom the visa was issued. It is also used to ensure that persons attempting to cross the border have been checked against watch lists of terrorists and criminals. Through the USA PATRIOT Act and the Enhanced Border Security and Visa Entry Reform Act, NIST has the statutory mandate to certify technology standards for biometrics for these applications. Because this technology is constantly evolving, NIST's certification activities must maintain momentum to keep pace with the changes in this dynamic field.

Although biometrics technologies are in place today for border security, new technologies under development promise to bring significant improvements. In the area of facial recognition, detailed NIST studies have shown that the accuracy of today's systems is relatively poor compared to fingerprints. However, facial recognition technologies have the advantage of being less obtrusive and therefore more accepted by the general public. If future border security systems are to use facial recognition technologies, NIST certification of such technologies will be crucial to make certain all requirements for border security are met.

This request will provide funding to develop tests for technologies that combine multimodal (that is, more than one approach --such as fingerprint, facial, iris) and other biometric technologies that work in real-time environments. This funding also will result in tests that provide greater accuracy and interoperability among vendors and systems – something that is essential to ensure that the equipment put in place by one jurisdiction or organization is compatible with others. This initiative will result in a more robust program, one that can more easily explore both near-term and long-term issues that will result in a vastly superior capability for protecting our Nation's borders.

Proposed NIST Technical Program

The impact of this work will be a dramatic improvement in the accuracy of biometrics for border security and much better use of taxpayer dollars invested in homeland security purchases. As terrorist and criminal databases become larger and larger, it is important that biometrics technologies perform quickly, accurately, and efficiently. Also, as technology continues to evolve, certifications must be continually revisited to ensure that the government is using the most accurate biometric recognition technology for a given application. This initiative will allow international travel and U.S. commerce to continue more smoothly, but with reliable safeguards in place to secure the Nation.

- NIST will enable facial recognition technologies to be used for border security.
- NIST will build on its testing program for determining the accuracy of emerging multi-modal systems, those that combine two or more biometric approaches.
- NIST will develop tests and guidelines to assure that future biometric systems are interoperable, and work efficiently in real-time applications by:
  - Improving the use of fingerprints with real-time fingerprint readers;
  - Improving the interoperability of fingerprint systems, and facial recognition systems; and
  - Improving biometric systems by enabling simultaneous use of facial recognition, fingerprint, and iris scan technologies.

All of NIST's work in this area will be coordinated with other government agencies and with the private sector. NIST also will ensure that international standards developments are taken into account.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Biometrics: Identifying Friend or Foe?	
Technical Area	**Outputs**
Improve real-time use of fingerprints	• Design image quality-based live scan fingerprint acceptance testing method.
Improve accuracy and interoperability of facial recognition systems	• Develop image quality standards for multiple facial images that show high correlation with biometric accuracy and number of images; and • Develop standard measurement techniques that allow future face templates to be compared to images based tests.
Improve multimodal biometric systems	• Implement image quality-based certification tests for multi-modal biometrics that use facial images and fingerprints simultaneously, and for iris-based biometrics systems; and • Develop a standard prototype system that optimally combines facial images and one or more fingerprints for verification using image quality as a logical selection device.

Performance Measures: Outcomes

At the proposed funding level, NIST will increase speed and smooth flow of international travelers at border checkpoints through:

- Increased accuracy of biometrics for border security;
- Increased efficiency, speed, and usability of biometrics for border security; and
- Increased acceptance of biometrics by international travelers.

This initiative represents specific projects that NIST will develop in support of the Nation's technical infrastructure. While these projects link directly to the goals of the NIST Laboratory Programs, progress and performance is measured at the individual project level through milestone tracking of major project outputs, such as those described in the narrative. Without increased funding, those outputs will be lost along with the associated benefits (outcomes). Information on the performance evaluation and reporting methods for the NIST Laboratories is provided in Exhibit 3A of this budget request.

12. Manufacturing Innovation through Supply Chain Integration (+3 Permanent Positions, +2 FTE, +$1,000,000)

- Inefficient product design and business data exchange in manufacturing and construction costs the U.S. economy in excess of $25 billion per year. This initiative will foster a seamless global supply chain — shortening the design-to-manufacturing cycle, improving quality, and lowering costs for large and small U.S. firms.
- The manufacturing and construction sectors represent a significant fraction of the U.S. Gross Domestic Product and U.S. employment. Global competitiveness in these industries is critical to maintaining the Nation's standard of living.
- Standards, measurements, and testing tools are fundamental to enabling efficient supply chains, maintaining competitiveness, and increasing innovation.

Problem Magnitude and NIST Role:

The private sector increasingly recognizes the need for open standards for the exchange of business information, commonly called e-business, to support supply chains. A Commerce Department policy report, *Manufacturing in America* (January 2004),[9] identified the global movement towards international standards for supply chain integration as both a threat and an opportunity for the Nation's small and mid-sized manufacturers: "Indeed, in many respects, international standards will *define access to the global marketplace*… NIST should expand the reach of programs designed to provide technical assistance to standards developers – particularly in significant potential export markets."

To meet this challenge and support the Enterprise Integration Act, NIST proposes a wide-ranging program to work with U.S. manufacturers. This private/public partnership will:

- Create "roadmaps" for the development of open standards for enterprise integration in target industry sectors;
- Develop and test developed standards through standard conformance tests;
- Ensure standards are integrated and consistent with developing international standards; and
- Deploy standards to small and medium manufacturers in the United States.

America's large manufacturers are globally distributed enterprises that rely on a system of small manufacturers, parts suppliers, shippers, and raw materials producers organized in extended supply chains. The construction industry is made up of an equally diverse network of over one million firms in the United States. Using the auto industry as an example, the average car has over 15,000 parts coming from 5,000 manufacturers that must be there on time, every time, with the precise specifications of the large manufacturers.

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[9] "Manufacturing in America: A Comprehensive Strategy to Address the Challenges to U.S. Manufacturers," Department of Commerce, January 2004.

Production costs are no longer the major cost drivers in these global supply chains – the dominant factor is the cost of engineering and business activities, which depend critically upon clear and error-free exchange of information among partners. Successfully managing production throughout the supply chain is critical to the competitiveness of these extended enterprises.

Unless small manufacturers are able to participate in supply chains they will be excluded from key markets and larger firms at the top of the supply chain will not be able to take advantage of a fully integrated business environment. But these small firms need to be capable of exchanging information electronically with ease. Today, many small manufacturers who are operating electronically incur unnecessary costs due to inefficient exchange of poorly formatted engineering and business data.

Independent economic studies commissioned by NIST clearly illustrate the adverse impacts of supply chain inefficiencies:

- The U.S. automotive supply chain loses $1 billion annually due to inefficient engineering data exchanges;[10]
- Inefficient exchange of business data in the transportation (automotive, aerospace, shipbuilding) and electronics manufacturing industries wastes $9 billion per year;[11] and
- The U.S. capital facilities industry (i.e., the construction industry) loses $15.8 billion per year.[12]

Interoperability standards are the key to successful information exchange in a world where technologies and software systems change rapidly, and these standards become effective through three types of activities:

- Development of open, international and technically sound standards specifications;
- Pilot implementations to test the standards and help convince software vendors to incorporate them in their products; and
- Deployment to manufacturers and testing of systems (to convince manufacturers that standards-compliant software products are in fact interoperable).

A comprehensive, broadly backed standards framework for enterprise integration will open the global marketplace to the small manufacturing community in the United States as a result of improved global competitiveness and connectivity. A recent study performed by AMR Research puts "the potential new operating margins available to the U.S. manufacturing economy from enhanced Internet connectivity in the supply chain" at a staggering $488 billion.[13] Such an infrastructure also could result in a 20 percent

[10] "Interoperability Cost Analysis of U.S. Automotive Supply Chain," NIST Planning Study 99-1, March 1999.
[11] "Economic Impact of Inadequate Infrastructure for Supply Chain Integration," NIST Planning Study 04-2, May 2004.
[12] "Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry," NIST GCR 04-867, August 2004.
[13] Supply Chain Management Review, January/February 2005. http://www.scmr.com

reduction in time-to-market for manufacturers and producers in target industries – significantly contributing to the global competitiveness of U.S. manufacturing.

Proposed NIST Technical Program:

Consistent with the Enterprise Integration Act of 2002, NIST will ensure that global e-commerce standards are technically sound and unbiased, and that U.S. manufacturers are equipped to compete in this global marketplace. NIST will work with a variety of industry sectors, small business associations, Federal agencies (especially the DoD), and other organizations to accomplish this goal.

Specific activities related to this proposed program include:

- Support the development, testing, deployment, and use of open standards enabling supply-chain integration in target manufacturing industries;
- Engage key industry organizations to lead the development of manufacturing enterprise integration roadmaps for key aerospace and automotive industrial sectors;
- Develop standards and technologies for Intelligent and Integrated Manufacturing – one of three R&D priority areas identified by the National Science and Technology Council (NSTC) Interagency Working Group on Manufacturing R&D;
- Provide organizational and technical assistance for pilot trials of evolving enterprise integration standards to demonstrate the usefulness to small and medium manufacturers;
- Roll out standards, test methods, protocols, best practices; work with firms to use and improve them;
- Develop guidelines for specifications that will allow enterprise integration software to be developed with the level of quality required for trust and confidence in transactions;
- Develop methods to ensure security of manufacturing process control systems and supply chain information exchange that is essential to protecting manufacturing facilities; and
- Develop conformance tests and automatic test generation technologies to ensure enterprise integration software meets predefined requirements and dramatically increase the quality of software code.

Performance Measures: Outputs

At the proposed funding level, NIST will generate the following outputs:

Manufacturing Innovation through Supply Chain Integration	
Technical Area	**Outputs**
Manufacturing enterprise integration standards Target Industries: - Automotive - Aerospace - Construction	• Manufacturing enterprise integration specifications, documentary standards and test methods according to the Action Plans for target industries. (FY 2009 – FY 2012) • Infrastructure and tools to assist the automotive, aerospace, and construction industries in implementing manufacturing enterprise integration standards. (FY 2010)
Standards conformance testing and interoperability	• Software applications enabling conformance assessment of manufacturing enterprise integration standard implementations. (FY 2011) • Software applications enabling analysis of interoperability test results among manufacturing enterprise integration implementations. (FY 2012)
Pilot projects and other outreach	• Manufacturing enterprise integration pilot projects and documented results for each of the target industries. (FY 2009 – FY 2011) • National conferences that promote awareness of manufacturing enterprise integration activities and provision of internet-accessible materials presented at the conference. (FY 2009 – FY 2010) • Training materials, documentation of best practices, and regional/industry-specific manufacturing enterprise integration adoption workshops for small and medium-sized businesses. (FY 2009 - FY 2010) • Guidelines and tools for validation of content for industry standards. (FY 2009 – FY 2011)

Performance Measures: Outcomes

At the proposed funding level, NIST will establish and test the standards, testing, and pilots to enable:

- Improved productivity and global competitiveness for manufacturers, especially small and medium enterprises, and increased business opportunities;
- Savings of approximately $1 billion in enterprise integration costs for U.S. manufacturers and producers in target industries;
- Reduction of 20 percent in "time-to-market" for manufacturers and producers in target industries;
- Reduction of 50 percent in information technology burden costs for small/medium-sized manufacturers in target industries; and
- Spillover benefits to other industries such as, electronics, shipbuilding, furniture manufacturers, chemicals production, textiles, and apparel.

Exhibit 14

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
PROGRAM CHANGE PERSONNEL DETAIL

Activity: NIST laboratories
Subactivity: Laboratories and technical programs
Program Change: American competitiveness initiative

Title	Grade	Number	Annual Salary	Total Salaries
Biologist	ZP V	1	113,674	113,674
Chemical engineer	ZP V	1	113,674	113,674
Chemist	ZP V	2	113,674	227,348
Computer scientist	ZP V	4	113,674	454,696
Electrical engineer	ZP V	2	113,674	227,348
Electricial engineer	ZP V	1	113,674	113,674
Fire protection engineer	ZP V	2	113,674	227,348
IT specialist	ZP V	1	113,674	113,674
Materials scientist	ZP V	1	113,674	113,674
Mathematician	ZP V	1	113,674	113,674
Mechanical engineer	ZP V	1	113,674	113,674
Mechinal engineer	ZP V	1	113,674	113,674
Metallurgist	ZP V	1	113,674	113,674
Operation research analyst	ZP V	1	113,674	113,674
Physicist	ZP V	7	113,674	795,718
Research chemist	ZP V	1	113,674	113,674
Supervisory computer scientist	ZP V	1	113,674	113,674
Supervisory electronic engineer	ZP V	1	113,674	113,674
Toxicologist	ZP V	2	113,674	227,348
Analytical chemist	ZP IV	7	96,637	676,459

Biochemist	ZP IV	2	96,637	193,274
Bioengineer	ZP IV	2	96,637	193,274
Biologist	ZP IV	6	96,637	579,822
Chemical engineer	ZP IV	3	96,637	289,911
Chemist	ZP IV	7	96,637	676,459
Civil engineer	ZP IV	2	96,637	193,274
Computer scientist	ZP IV	15	96,637	1,449,555
Electrical engineer	ZP IV	3	96,637	289,911
Electricial engineer	ZP IV	2	96,637	193,274
Electronics engineer	ZP IV	2	96,637	193,274
Fire protection engineer	ZP IV	2	96,637	193,274
General physical scientst	ZP IV	11	96,637	1,063,007
Industrial engineer	ZP IV	2	96,637	193,274
Instrument scientist	ZP IV	4	96,637	386,548
IT specialist	ZP IV	2	96,637	193,274
Material scientist	ZP IV	4	96,637	386,548
Materials science engineer	ZP IV	1	96,637	96,637
Materials scientist	ZP IV	1	96,637	96,637
Mathematician	ZP IV	5	96,637	483,185
Mathematicians	ZP IV	1	96,637	96,637
Mechanical engineer	ZP IV	4	96,637	386,548
Metallurgist	ZP IV	1	96,637	96,637
Microsopist	ZP IV	5	96,637	483,185
Nanometrologist	ZP IV	2	96,637	193,274
Physical chemist	ZP IV	2	96,637	193,274
Physical scientist	ZP IV	2	96,637	193,274
Physicist	ZP IV	20	96,637	1,932,740
Research chemist	ZP IV	2	96,637	193,274
Research structural engineer	ZP IV	4	96,637	386,548
Statistician	ZP IV	2	96,637	193,274
Toxicologist	ZP IV	2	96,637	193,274
Chemist	ZP III	4	68,770	275,080
Computer scientist	ZP III	4	68,770	275,080
Electronics technician	ZT IV	1	68,770	68,770
IT specialist	ZP III	1	68,770	68,770
Physical scientist	ZP III	3	68,770	206,310
Physicist	ZP III	4	68,770	275,080

Sample environment engineer	ZP III	1	68,770	68,770
Technician	ZP III	2	68,770	137,540
Cold source technician	ZT III	1	52,224	52,224
Physical science technicians	ZT III	3	52,224	156,672
Administrative/technical support	ZA II	16	47,422	758,752
Secretary	ZS III	1	34,888	34,888
Subtotal		203		18,578,314
Less lapse	25 %	(53)		(4,644,579)
Total full-time permanent (FTE)		150		13,933,735
2009 Pay Adjustment (2.9%)				404,078
Total				14,337,813

Personnel Data

Full-Time Equivalent Employment:	
Full-time permanent	150
Authorized Positions:	
Full-time permanent	203

Exhibit 15

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollars in thousands)

Activity: NIST laboratories
Subactivity: Laboratories and technical programs
Program Change: American competitiveness initiative

Object Class		2009 Increase/ (Decrease) Obligations
11	Personnel compensation	
11.1	Full-time permanent	$14,337
11.9	Total personnel compensation	14,337
12.1	Civilian personnel benefits	3,873
21	Travel and transportation of persons	1,904
22	Transportation of things	879
23.3	Communications, utilities and miscellaneous charges	5,582
24	Printing and reproduction	160
25.1	Advisory and assistance services	0
25.2	Other services	3,738
25.3	Purchases of goods and services from Government accounts	6,055
25.5	Research and development contracts	9,917
25.7	Operation and maintenance of equipment	1,934
26	Supplies and materials	4,259
31	Equipment	3,302
32	Land and structures	0
41	Grants, subsidies and contributions	3,600
99	Direct obligations	59,540
	Transfer to NIST Working Capital Fund	11,550
	Total increase requested	71,090

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Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations	Appropriation
2008 Currently available	1,933	1,995	$444,397	$454,495	$440,517
less: Unobligated balance from prior year			0	(9,098)	0
less: Transfer from EAC	0	0	(1,880) [2/]	(1,880) [2/]	0
less: Transfer from EAC	0	0	(3,250) [1/]	(3,250) [1/]	0
2009 Adjustments to base:					
Annualization of positions financed in FY 2008	0	2			
plus: Restoration of 2008 deobligation offset	0	0	1,000	0	1,000
plus: Adjustment of WCF transfer for prior program changes	0	0	500	500	0
plus: Uncontrollable cost changes	0	0	23,393	23,393	23,393
less: Estimated recoveries, 2009	0	0	(1,000)	0	(1,000)
2009 Base Request	1,933	1,997	463,160	464,160	463,910
plus: 2009 Program changes	203	150	59,540	59,540	71,090
plus: Transfer from EAC			4,000 [1/]	4,000 [1/]	0
2009 Estimate	2,136	2,147	526,700	527,700	535,000

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Comparison by activity/subactivity:		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
NIST laboratories											
Laboratories and technical programs	Pos./Approp	1,735	$362,503	1,696	$368,649	1,696	$388,791	1,875	$450,881	179	$62,090
	FTE/Obl.	1,620	370,391	1,749	381,630	1,751	388,797	1,884	445,337	133	56,540
National research facilities	Pos./Approp	205	64,237	186	63,937	186	66,597	210	75,597	24	9,000
	FTE/Obl.	163	62,588	196	64,690	196	66,820	213	73,820	17	7,000
Subtotal, NIST laboratories	Pos./Approp	1,940	426,740	1,882	432,586	1,882	455,388	2,085	526,478	203	71,090
	FTE/Obl.	1,783	432,979	1,945	446,320	1,947	455,617	2,097	519,157	150	63,540
Baldrige national quality program	Pos./Approp	51	7,631	51	7,931	51	8,522	51	8,522	0	0
	FTE/Obl.	47	7,835	50	8,175	50	8,543	50	8,543	0	0
TOTALS	Pos./Approp	1,991	434,371	1,933	440,517	1,933	463,910	2,136	535,000	203	71,090
	FTE/Obl.	1,830	440,814	1,995	454,495	1,997	464,160	2,147	527,700	150	63,540

Comparison by activity/subactivity:	2007 Actual Per-sonnel	2007 Actual Amount	2008 Currently Available Per-sonnel	2008 Currently Available Amount	2009 Base Per-sonnel	2009 Base Amount	2009 Estimate Per-sonnel	2009 Estimate Amount	Increase/ (Decrease) Over 2009 Base Per-sonnel	Increase/ (Decrease) Over 2009 Base Amount
Adjustments for:										
Recoveries		(2,001)		(1,000)		(1,000)		(1,000)		0
Unobligated balance, start of year		(4,898)		(9,098)		0		0		0
Unobligated balance, end of year		9,098		0		0		0		0
Unobligated balance, expired account		9								
Transfer from Community Oriented Policing Services, DoJ		(5,000) [2/]								
Budget Authority		438,021		444,397		463,160		526,700		63,540
Financing from transfers:										
Transfers to other accounts		1,300		1,250		750		12,300		11,550
Transfer from Community Oriented Policing Services, DoJ		0		(1,880) [2/]						
Transfer from Election Assistance Commission		(4,950) [1/]		(3,250) [1/]				(4,000) [1/]		(4,000) [1/]
Appropriation		434,371		440,517		463,910		535,000		71,090

[1/] Actual and proposed transfers from Election Assistance Commission.

[2/] Actual transfers from Community Oriented Policing Services.

Exhibit 8

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	Perm. Pos.	FTE	Amount
Adjustments:			
Non-recurring Nanotechnology Center	...	...	(893)
Restoration of FY 2008 deobligation offset	...	...	$1,000
Restoration of unfunded prior-year base	...	...	14,136
Subtotal, Adjustments			14,243
Financing:			
Recoveries of prior year deobligations	...	...	(1,000)
Other Changes:			
Annualization of 2008 Pay raise	...	...	1,661
2009 Pay increase and related costs	...	...	4,710
Annualization of positions funded in FY 2008	2	2	0
Change in compensable days	...	...	(805)
Personnel benefits:			
Civil Service Retirement System (CSRS)	...	...	(222)
Federal Employees' Retirement System (FERS)	...	...	355
Thrift Savings Plan (TSP)	...	...	147
Federal Insurance Contribution Act (FICA) - OASDI	...	...	212
Health insurance	...	...	226
Employees' Compensation Fund	...	...	(10)
Travel and transportation of persons:			
Mileage	...	...	1
Communications, utilities, and miscellaneous charges:			
Postage	...	...	9
Natural Gas rate increase	...	...	1,193
Electricity rate decrease	...	...	(179)
Other services:			
Working Capital Fund (Departmental Management)	...	...	126
Commerce Business Systems (CBS)	...	...	132
NARA storage costs	...	...	10
Supplies and materials:			
Scientific journal subscriptions	...	...	65

	Perm. Pos.	FTE	Amount
General pricing level adjustment:			
Transportation of things	...	...	29
Rental payments to others	...	...	29
Communications, utilities, and miscellaneous charges	...	...	58
Printing and reproduction	...	...	13
Other services	...	...	1,269
Supplies and materials	...	...	420
Equipment	...	...	701
Subtotal, Other changes	2	2	10,150
Total, Adjustments to base	2	2	23,393

Exhibit 9

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
JUSTIFICATION OF ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	FTE	Amount
Adjustments:		
Non-recurring Nanotechnology Center	0	$(893)

In FY 2008, NIST's STRS appropriation included funding for a New York Nanotechnology Technology Center. This adjustment removes this one-time cost from the FY 2009 base.

Restoration of FY 2008 deobligation offset	0	1,000

In FY 2008, NIST's STRS budget authority was reduced by $1,000,000 based on an estimated level of prior year deobligations. This adjustment would restore the reduction in FY 2009.

Restoration of unfunded prior year base	0	14,136

NIST did not receive all requested base funding increases in FY 2007 and FY 2008. This restoration adjustment provides funding to help restore base funding in FY 2009.

Subtotal, Adjustments	0	14,243
Financing:		
Recoveries of prior year deobligations	0	(1,000)

NIST's FY 2009 STRS budget authority is reduced by the estimated level of prior year deobligations in FY 2009.

Other Changes:

Annualization of 2008 pay raise	0	1,661

A pay raise of 3.5 percent is assumed to be effective January 1, 2008.

Total cost in FY 2009 of 2008 pay raise	$6,645,333
Less amount requested in FY 2008	(4,984,000)
Less amount absorbed in FY 2008	0
Amount requested in 2009 to provide full-year cost of 2008 pay raise	1,661,333
Payment to Departmental Management Working Capital Fund	0
Total, FY 2008 pay raise increase in FY 2009	1,661,333

2009 Pay increase and related costs	0	4,710

A general pay raise of 2.9 percent is assumed to be effective January 1, 2009.

Total cost in FY 2009 of pay increase	$4,633,000
Less amount absorbed in FY 2008	0
Amount requested for FY 2009 pay increase	4,633,000
Payment to Departmental Management Working Capital Fund	77,000
Total adjustment for FY 2009 pay increase	4,710,000

Annualization of positions financed in FY 2008	2	0

NIST requires an additional 2 FTE to staff FY 2008 requested increases at their full operating level in FY 2009.

Change in compensable days	0	(805)

The decreased cost of one less compensable day in FY 2009 compared to FY 2008 is calculated by dividing the FY 2008 estimated personnel compensation ($176,562,000) and applicable benefits ($34,357,000) by 262 compensable days. The cost decrease of one less compensable days is $805,034.

Personnel benefits	0	708

Civil Service Retirement System (CSRS)	($222)
Federal Employees' Retirement System (FERS)	355
Thrift Savings Plan (TSP)........................	147
Federal Insurance Contribution Act (FICA) - OASDI	212
Health Insurance	226
Employees Compensation Fund........................	(10)

Civil Service Retirement System (-$222,000) – The number of employees covered by the Civil Service Retirement System (CSRS) continues to drop as positions become vacant and are filled by employees who are covered by the Federal Employees' Retirement System (FERS). The estimated percentage of payroll for employees covered by CSRS will decrease from 18.6 percent in FY 2008 to 16.8 percent in FY 2009. The contribution rate will remain at 7.0 percent in FY 2009.

Payroll subject to retirement systems ($176,208,876)	
Cost of CSRS contributions in FY 2009 ($176,208,876 x .168 x .07).....................	$2,072,216
Cost of CSRS contributions in FY 2008 ($176,208,876 x .186 x .07).....................	2,294,240
Total adjustment to base	(222,024)

Federal Employees' Retirement System ($355,000) – The number of employees covered by FERS continues to rise as employees covered by CSRS leave and are replaced by employees covered by FERS. The estimated percentage of payroll for employees covered by FERS will increase from 81.4 percent in FY 2008 to 83.2 percent in FY 2009. The contribution rate will remain at 11.2 percent in FY 2009.

Payroll subject to retirement systems ($176,208,876)	
Basic benefit cost in FY 2009 ($176,208,876 x .832 x .112)........................	$16,419,848
Basic benefit cost in FY 2008 ($176,208,876 x .814 x .112)........................	16,064,611
Total adjustment to base	355,237

Thrift Savings Plan ($147,000) – The cost of agency contributions to the Thrift Savings Plan will also rise as FERS participation increases. The contribution rate will remain at 4.65 percent in FY 2009.

Thrift plan cost in FY 2009 ($176,208,876 x .832 x .0465)	$6,817,169
Thrift plan cost in FY 2008 ($176,208,876 x .814 x .0465)	6,669,682
Total adjustment to base	147,487

Federal Insurance Contributions Act (FICA) - OASDI ($212,000) – As the percentage of payroll covered by FERS rises, the cost of OASDI contributions will increase. In addition, the maximum salary subject to OASDI tax will increase from $102,300 in FY 2008 to $106,425 in FY 2009. The OASDI tax rate will remain 6.2 percent in FY 2009.

FERS payroll subject to FICA tax in 2009 ($176,208,876 x .832 x .905 x .062)	$8,226,051
FERS payroll subject to FICA tax in 2008 ($176,208,876 x .814 x .902 x .062)	8,021,404
Increase (FY 2008-FY 2009)	204,647
OTP payroll subject to FICA tax in FY 2009 ($6,081,124 x .832 x .905 x .062)	283,888
OTP payroll subject to FICA tax in FY 2008 ($6,081,124 x .814 x .902 x .062)	276,826
Increase (FY 2007-FY 2008)	7,062
Total adjustment to base	211,709

Health insurance ($226,000) – Effective January 2007, NIST's contribution to Federal employees' health insurance premiums increased by 2.1 percent. Applied against the FY 2008 estimate of $10,770,000, the additional amount required is $226,170.

Employees Compensation Fund - (-$10,000) – The Employees Compensation Fund bill for the year ending June 30, 2007 is a net $32,000 lower than for the year ending June 30, 2006. The STRS share of the decrease is $10,000.

Travel and transportation of persons	0	1

The General Services Administration increased the mileage rate from 44.5 cents to 48.5 cents, a 9.0 percent increase. This percentage was applied to the FY 2008 estimate of $15,000 to arrive at an increase of $1,350.

Communications, utilities, and miscellaneous charges		0	1,023
Postage	$9		
Natural Gas rate increase	1,193		
Electricity rate decrease	(179)		

Effective May 14, 2007, the Governors of the Postal Service implemented a rate increase for first class mail from 39 cents to 41 cents, an increase of 5.1 per cent. This percentage was applied to the FY 2008 estimate of $169,000 to arrive at an increase of $8,619.

The natural gas ATB amount was derived using a year to year comparison of the average cost per therm. In analyzing the 12 months ended March 2007 and 2006, the per therm rate decreased 3.00% (from 10.465 to 10.155) and increased 17.9% (from 1.374 to 1.6199) for Boulder and Gaithersburg respectively resulting in a net increase of $1,193,000.

The electricity ATB amount was derived using a year to year comparison of the cost per kilowatt hour. In analyzing the 12 months ended February 2007 and 2006, the per kilowatt hour rate decreased 2.20% (from 8.9 cents to 8.7 cents) for Gaithersburg, Maryland; increased 8.4% (from 28.7 cents to 31.1 cents) for Kauai, Hawaii; decreased 11.4% (from 6.4 cents to 5.67 cents) for Boulder, Colorado; and increased 3.9% (from 7.7 cents to 8.0 cents) for Ft. Collins, Colorado for a net decrease of $179,000.

Other Services		0	268
Working Capital Fund (Departmental Management)	$126		
Commerce Business Systems (CBS)	132		
National Archives and Records Administration (NARA) storage costs	10		

Working Capital Fund (Departmental Management) ($126,000) – An additional $126,000 is required to fund costs increases in the Departmental Management Working Capital Fund.

Commerce Business Systems (CBS) ($132,000) – An increase of $132,000 is required in FY 2009 consistent with the CBS Capital Asset Plan.

National Archives and Records Administration (NARA) storage costs ($10,000) - NARA estimates reflect an increase of $10,000 in FY 2009 for records storage and maintenance costs.

Scientific journal subscriptions	0	65

This adjustment to base addresses the FY 2005 to FY 2006 inflationary increase in costs for NIST's subscription journals, which exceed the inflationary increases provided through the regular general pricing level deflator.

General pricing level adjustment	0	2,519

This request applies the OMB economic assumptions of 1.9 percent for FY 2009 where the prices that the government pays are established through the market system. Factors are applied to sub-object classes that result in the following adjustments to base: transportation of things $29,000; rental payments to others $29,000; communications, utilities, and miscellaneous charges $58,000; printing and reproduction $13,000; other services $1,269,000; supplies and materials $420,000; and equipment $701,000.

Subtotal, Other changes	2	10,150
Total adjustments to base	2	23,393

Exhibit 10

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Activity: NIST laboratories
Subactivity: Laboratories and technical programs

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Electronics and electrical engineering	Pos./Approp	235	$49,702	235	$49,702	235	$52,434	260	$58,274	25	$5,840
	FTE/Obl.	221	50,023	233	57,091	233	52,542	251	58,382	18	5,840
Manufacturing engineering	Pos./Approp	111	22,923	108	22,923	108	24,259	111	25,259	3	1,000
	FTE/Obl.	102	23,797	109	23,188	109	24,305	111	25,305	2	1,000
Chemical science and technology	Pos./Approp	245	48,081	240	48,781	240	51,543	296	73,543	56	22,000
	FTE/Obl.	230	47,683	246	49,086	246	51,606	288	67,406	42	15,800
Physics	Pos./Approp	211	54,823	182	54,823	182	57,559	237	73,559	55	16,000
	FTE/Obl.	194	54,484	218	55,004	218	57,261	259	70,411	41	13,150
Materials science and engineering	Pos./Approp	169	36,606	166	36,606	166	38,589	166	38,589	0	0
	FTE/Obl.	156	36,401	168	36,769	168	38,653	168	38,653	0	0
Building and fire research	Pos./Approp	118	23,829	118	23,729	118	25,127	126	32,377	8	7,250
	FTE/Obl.	109	23,624	118	23,952	118	25,177	124	32,427	6	7,250
Computer science and applied mathematics	Pos./Approp	334	65,381	328	65,381	328	69,644	348	76,644	20	7,000
	FTE/Obl.	326	70,959	350	69,312	350	69,767	365	80,767	15	11,000

Line Item		2007 Actual Personnel	2007 Actual Amount	2008 Currently Available Personnel	2008 Currently Available Amount	2009 Base Personnel	2009 Base Amount	2009 Estimate Personnel	2009 Estimate Amount	Increase/ (Decrease) Over 2009 Base Personnel	Increase/ (Decrease) Over 2009 Base Amount
Standards and technology services	Pos./Approp	101	16,788	97	18,188	97	19,356	97	19,356	0	0
	FTE/Obl.	86	17,762	93	18,466	93	19,444	93	19,444	0	0
Innovations in measurement science program	Pos./Approp	76	16,685	87	19,938	87	20,840	99	23,840	12	3,000
	FTE/Obl.	70	16,987	84	19,344	86	20,515	95	23,015	9	2,500
Postdoctoral research associates program	Pos./Approp	96	10,483	96	10,483	96	11,643	96	11,643	0	0
	FTE/Obl.	96	10,085	100	11,143	100	11,660	100	11,660	0	0
Computer support	Pos./Approp	6	6,732	6	6,732	6	6,985	6	6,985	0	0
	FTE/Obl.	5	7,359	5	6,803	5	7,000	5	7,000	0	0
Business systems	Pos./Approp	33	10,470	33	10,470	33	10,812	33	10,812	0	0
	FTE/Obl.	25	11,227	25	10,579	25	10,867	25	10,867	0	0
External projects	Pos./Approp	0	0	0	893	0	0	0	0	0	0
	FTE/Obl.	0	0	0	893	0	0	0	0	0	0
Total	Pos./Approp	1,735	362,503	1,696	368,649	1,696	388,791	1,875	450,881	179	62,090
	FTE/Obl.	1,620	370,391	1,749	381,630	1,751	388,797	1,884	445,337	133	56,540

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
PROGRAM AND PERFORMANCE: REIMBURSABLE OBLIGATIONS
(Dollar amounts in thousands)

Activity: NIST laboratories
Subactivity: Laboratories and technical programs

Line Item	2007 Actual FTE	2007 Actual Amount	2008 Currently Available FTE	2008 Currently Available Amount	2009 Base FTE	2009 Base Amount	2009 Estimate FTE	2009 Estimate Amount	Increase/(Decrease) Over 2009 Base FTE	Increase/(Decrease) Over 2009 Base Amount
Electronics and electrical engineering										
WCF transfer		0		0		0		0		0
Reimbursables	161	$43,375	181	$43,068	$181	$36,534	$192	$36,534	11	0
WCF investments	0	(2,009)	0	(1,947)	0	0	0	0	0	0
Total	161	41,366	181	41,121	181	36,534	192	36,534	11	0
Manufacturing engineering										
WCF transfer		0		0		0		0		0
Reimbursables	38	7,203	43	7,280	43	7,013	46	7,013	3	0
WCF investments	0	(1,415)	0	(1,407)	0	0	0	0	0	0
Total	38	5,788	43	5,873	43	7,013	46	7,013	3	0
Chemical science and technology										
WCF transfer		0		0		0		6,200		$6,200
Reimbursables	81	15,769	92	18,699	92	13,050	99	13,050	7	0
WCF investments	0	(1,193)	0	(1,132)	0	0	0	0	0	0
Total	81	14,576	92	17,567	92	13,050	99	19,250	7	6,200
Physics										
WCF transfer		400		400		400		3,250		2,850
Reimbursables	77	21,793	87	24,836	87	24,557	94	24,557	7	0
WCF investments	0	(1,362)	0	(999)	0	0	0	0	0	0
Total	77	20,831	87	24,237	87	24,957	94	27,807	7	2,850

Line Item	2007 Actual FTE	2007 Actual Amount	2008 Currently Available FTE	2008 Currently Available Amount	2009 Base FTE	2009 Base Amount	2009 Estimate FTE	2009 Estimate Amount	Increase/ (Decrease) Over 2009 Base FTE	Increase/ (Decrease) Over 2009 Base Amount
Materials science and engineering										
WCF transfer		0		0		0		0		0
Reimbursables	21	4,976	24	5,701	24	4,738	26	4,738	2	0
WCF investments	0	(869)	0	(796)	0	0	0	0	0	0
Total	21	4,107	24	4,905	24	4,738	26	4,738	2	0
Building and fire research										
WCF transfer		0		0		0		0		0
Reimbursables	33	6,459	37	6,396	37	6,396	40	6,396	3	0
WCF investments	0	(463)	0	(433)	0	0	0	0	0	0
Total	33	5,996	37	5,963	37	6,396	40	6,396	3	0
Computer science and applied mathematics										
WCF transfer		0		0		0		0		0
Reimbursables	75	13,811	85	23,606	85	9,796	92	9,796	7	0
WCF investments	0	(253)	0	(233)	0	0	0	0	0	0
Total	75	13,558	85	23,373	85	9,796	92	9,796	7	0
Standards and technology services										
WCF transfer		0		0		0		0		0
Reimbursables	103	24,163	103	21,000	103	21,309	103	21,309	0	0
WCF investments	0	39	0	41	0	0	0	0	0	0
Total	103	24,202	103	21,041	103	21,309	103	21,309	0	0
Innovations in measurement science program										
WCF transfer		350		850		350		850		500
Reimbursables	0	0	0	0	0	0	0	0	0	0
WCF investments	0	6,077	0	6,524	0	0	0	0	0	0
Total	0	6,427	0	7,374	0	350	0	850	0	500
Postdoctoral research associates program										
WCF transfer		0		0		0		0		0
Reimbursables	0	0	0	0	0	0	0	0	0	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

Line Item	2007 Actual FTE	2007 Actual Amount	2008 Currently Available FTE	2008 Currently Available Amount	2009 Base FTE	2009 Base Amount	2009 Estimate FTE	2009 Estimate Amount	Increase/ (Decrease) Over 2009 Base FTE	Increase/ (Decrease) Over 2009 Base Amount
Computer support										
WCF transfer		0		0		0		0		0
Reimbursables	0	0	0	0	0	0	0	0	0	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Business systems										
WCF transfer		0		0		0		0		0
Reimbursables	0	1,648	0	1,648	0	1,648	0	1,648	0	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Total	0	1,648	0	1,648	0	1,648	0	1,648	0	0
Technical reimbursable services										
WCF transfer		0		0		0		0		0
Reimbursables	1	192	1	75	1	75	1	75	0	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Total	1	192	1	75	1	75	1	75	0	0
Non-technical support services										
WCF transfer		0		0		0		0		0
Reimbursables	74	13,728	74	15,471	68	16,060	68	16,060	0	0
WCF investments	0	544	0	559	0	0	0	0	0	0
Total	74	14,272	74	16,030	68	16,060	68	16,060	0	0
WCF inventory and operating adjustments										
WCF transfer		0		0		0		0		0
Reimbursables		0	0	0		0	0	0	0	0
WCF investments	0	8,443	0	0	0	0	0	0	0	0
Total	0	8,443	0	0	0	0	0	0	0	0
Total										
WCF transfer		750		1,250		750		10,300		9,550
Reimbursables	664	153,117	727	167,780	721	141,176	761	141,176	40	0
WCF investments	0	7,539	0	177	0	0	0	0	0	0
Total	664	161,406	727	169,207	721	141,926	761	151,476	40	9,550

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
JUSTIFICATION OF PROGRAM AND PERFORMANCE
LABORATORIES AND TECHNICAL PROGRAMS

Goal Statement

This subactivity supports the Department of Commerce's and NIST's goal to promote U.S. innovation and industrial competitiveness by strengthening the Nation's measurement and standards infrastructure.

The NIST Laboratories play a unique role in the Nation's scientific, industrial and business communities. NIST's role in the Nation's measurement and standards system enables companies, researchers, government agencies and universities to work with each other, to enhance and improve the Nation's economic security and quality of life. When scientists, engineers, health care professionals, manufacturers and business people compare and trade data, test results, manufactured goods, and commodities, they do so with confidence in the exchange because of NIST's presence in the background, anchoring the national measurement and standards system that is the language of research and commerce.

This is the oldest and one of the most important of NIST's long-standing missions. This NIST mission affects every American who goes to the store, buys gasoline or pays a utility bill because each year over $4.6 trillion in wholesale and retail trade is measured against standards that are ultimately traceable to NIST. It affects every American whose job depends on the ability of our industries to innovate and to compete in global trade, because product quality and productivity depend on the ability to measure and precisely control the production process, and because more and more high-tech and high-value products are subject to foreign regulations that require measurements traceable to internationally recognized standards. It affects every American who relies on fundamental business services and communications devices, because so many of these services depend upon NIST measurements and standards in ways that are invisible to most consumers and service sector employees. It affects every American concerned with homeland security because NIST is being called upon increasingly to provide the measurement assurance behind sensitive detection systems for chemical, biological, explosive or radiological weapons. It is a vital mission, and one that is far from static, because a modern, progressive, industrialized society in a global economy imposes constant demands for improvements in its measurements and its standards. The pace of America's technological innovation both drives and is driven by our ability to observe and to measure, and NIST's infrastructure is vital to the pace of innovation.

Base Program

NIST's support of measurements, standards and technology--a mission which embraces everything from validating the testing system used to assure the quality of concrete in new construction to the frontiers of quantum computing and quantum-level encryption–is funded under the Scientific and Technical Research and Services (STRS) appropriation, and includes eight technical and four centrally-managed programs:

1) Electronics and Electrical Engineering - Assisting a huge section of the established and emerging industrial landscape, NIST supports the U.S. electronics industries (shipments, both domestic and international, of $420 billion projected in 2006[1]) and electric power industries (sales of $298 billion of electricity in 2005[2]) and the electrical equipment industry (shipments of $120 billion projected in 2006). The U.S. electronics and electrical equipment industries (including computer, communications, semiconductor component and equipment manufacturing) employed over 3 million people at the end of 2006[3], and the products of these industries, representing over $830 billion in U.S. shipments annually, support other major manufacturing and service industries, such as the automotive, aerospace, and health-care industries. As with all high-tech industries, electronics is highly dependent on measurement. In 2007, for example, it is estimated that the semiconductor industry will spend approximately $9 billion on measurement services. This investment is highly dependent on a comprehensive infrastructure support program from NIST, as demonstrated by a number of economic impact studies of NIST programs.

NIST's work in this programmatic area includes maintaining and improving existing measurement references and standards, developing new measurement technologies and ways to tie needed measurements to fundamental national standards, and pursuing basic research on electronic devices and the processes used to manufacture them. The research concerns of NIST touch nearly every aspect of today's high-tech electronics, including the fundamental properties of semiconductors and semiconductor devices; new materials and technologies for magnetic data recording; electronics for information technology and communications; electronic measurement instrumentation; fiber optics; optoelectronics; superconducting electronics; radio-frequency electronics; microelectromechanical systems (MEMs) and nanoscale electronic devices.

NIST also provides the fundamental measurement expertise that underlies the Nation's electric power grids, helping to assure the accuracy of electric power and energy metering and the integrity of the system. It provides the foundation for all electrical measurements by maintaining the national standards for voltage, resistance, capacitance, current and power (including electrical, microwave and laser). NIST's work in electronics-based sensors and instrumentation has broad impacts in homeland security and public health and safety. The aerospace and defense industries rely on NIST's expertise in antenna measurements when designing and

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[1] *http://www.census.gov/indicator/www/m3/PastPressReleases/Prel/2006/dec06prel.pdf*
[2] *http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html*
[3] *http://www.bls.gov/news.release/empsit.t14.htm*

using systems for satellite communications, navigation, aircraft collision-avoidance, weather monitoring, earth surveying, and defense and homeland security. This program also includes the NIST Office of Law Enforcement Standards (OLES), which helps homeland security and criminal justice agencies ensure that the equipment they purchase and the technologies they use are safe, dependable, and effective.

NIST research focuses on industry and government priorities, as demonstrated by these recent examples:

- NIST has made the first confirmed "spintronic" device incorporating organic molecules, a potentially superior approach for innovative electronics. In contrast to conventional electronic devices that depend on the movement of electrons and their charge, spintronics works with changes in magnetic orientation caused by changes in electron spin (imagine electrons as tiny bar magnets whose poles are rotated up and down). Already used in read-heads for computer hard disks, spintronics can offer more desirable properties–such as higher speeds and smaller size–than conventional electronics. Although spintronic devices are usually made of inorganic materials, the use of organic molecules may be preferable because electron spins can be preserved for longer time periods and distances, and because these molecules can be easily manipulated and self-assembled. The NIST researchers created a nanoscale test structure to obtain the first clear evidence of the presence and action of specific molecules and magnetic switching behavior. The new NIST results are expected to assist in the development of practical molecular spintronic devices.

- NIST has developed new "best-in-the-world" capability to measure gamma-rays and alpha particles (alpha particles are two protons and two neutrons bound together, emitted by radioactive nuclei) for nuclear nonproliferation purposes. NIST's gamma-ray and alpha particle detection technology is based on cryogenic microcalorimeter detectors with exceptionally high energy-resolving capability. Applications include measuring the plutonium content of spent reactor fuel, including weapons-useable fissile material, with an efficient, stand-off, non-destructive technique. In recent new work, NIST demonstrated alpha particle spectroscopy with initial "best-in-the-world" energy resolution that is already four times better than conventional sensors. Using this new alpha particle detector in collaboration with staff at Los Alamos National Laboratory (LANL), NIST and LANL researchers demonstrated the ability to resolve isotopes of plutonium in an alpha spectrum. This significant accomplishment is expected to lead to increased speed of analysis of "samples of interest" using this new NIST-developed detection technology, in comparison to current analytical methods that require slow and expensive mass spectrometry to separate isotopes.

NIST's FY 2009 base program operating objectives in electronics and electrical engineering include the following:

- Developing and implementing new quantum-physics-based systems for fundamental electrical metrology applications. Examples include developing improved AC and automated "turnkey" voltage standards, which can be used directly by technology companies to enable the development of innovative electronics instrumentation with the highest accuracy and performance, such as advanced digital-to-analog and analog-to-digital converters with highest linearity performance specifications world-wide.

- Developing a redesigned electronic kilogram experiment linking electrical and mechanical power. The kilogram is the only remaining base measurement unit in the International System of Units (SI) whose definition is based on a physical artifact rather than on fundamental properties of nature. As the recognized leader in this field, NIST will fabricate a new improved electronic kilogram with enhanced practical usability to ensure our ability to realize the kilogram on behalf of U.S. industry under proposed international redefinitions of SI units.

- Develop advanced measurement science, test structures, and infrastructure to support the development of advanced nano-electronics and nanophotonics with capabilities beyond the projected limits of traditional semiconductor-based technologies. Examples include measurements for spin electronics ("spintronics"), molecular electronics, nanowires, quantum dots and solid-state quantum computational systems. NIST-developed infrastructure will enable industry to perform robust, reproducible measurements, support better fundamental understanding of these technologies, and improve U.S. innovation and competitiveness.

- Develop new sensors and metrology for biotechnology, homeland security and other imaging technologies, based on x-ray, terahertz, and other technologies, including:
  - magnetic Resonance Imaging (MRI) contrast agents and standards to improve the uniformity and reliability of biomagnetic imaging systems, benefiting large National Institutes of Health-sponsored medical research studies nation-wide that rely on these systems to monitor treatment progressions;
  - nanopore-based sensors and metrology based on electronic impedance measurements to enable rapid and sensitive detection of lethal toxins secreted by a variety of pathogenic organisms that pose significant threats to society and homeland security;
  - large, fast, high-energy-resolution cryogenic x-ray detector arrays that will provide unique materials analysis capabilities for user instruments at the National Synchrotron Light Source; and
  - electronic-based methods to manipulate and probe the response of small cell populations to enable quantitative cell-based biometrology, which will enable predictability in complex biological systems and drive innovation in health, energy and environmental applications.

- Develop and implement improved microwave power and scattering parameter measurement services, including increasing the maximum frequency of coaxial power measurements services from 50 gigahertz to 110 gigahertz frequency and enabling calibrations using 1.0 mm and 1.85 mm connectors, which have been requested by U.S. industry and which are not supported by any other National Metrology Institute in the world. These advances will support innovation and promote global competitiveness for a range of U.S. industries, including microwave test equipment manufacturers, who will be introducing devices based on such connections for telecommunications, aerospace and radar applications.

2) Manufacturing Engineering - Manufacturing, accounting for about 12 percent of the Nation's total economic output, is a vital component of the U.S. economy, and is fundamentally linked to the performance of other key economic sectors - including the service

industries.[4] Dollar for dollar, manufacturing has the highest-leverage economic impact of all of the economic sectors. For every dollar of economic output produced by manufacturing, $2.36 of additional output is stimulated in the rest of industry.[5]

The NIST manufacturing engineering activity focuses on high-leverage, high-impact infrastructural work on measurements and standards to stimulate innovation and foster U.S. manufacturing competitiveness. Work on measurement science, measurement services, and critical technical contributions to standards is driven by key manufacturing trends–current and anticipated–including:

- the competitive pressure for higher quality, higher performing products at lower cost;
- compressed cycles of product innovation; and
- innovation at the frontiers of manufacturing processes and systems.

In the area of dimensional measurement, mechanical measurement (i.e., mass, force, vibration and acoustics), and nanomanufacturing metrology, NIST work on measurement science and measurement services underpins areas of important industrial application that range from the assured interchangeability of parts produced at different locations, and acoustical standards for the safety of workers in noisy manufacturing environments, to promoting equity and meeting quality requirements for commerce and international trade.

In the area of manufacturing systems, processes, equipment, and data, NIST work on measurement science, standards, test methods, and performance metrics promotes innovation in manufacturing processes, fosters more efficient transactions in purchasing manufacturing equipment, and facilitates the exchange of distributed manufacturing enterprise information.

U.S. industry's ability to innovate and compete in a global market depends upon NIST. The following are examples of work completed within the last year:

- Piloted the 2 mega-Newton and 4 mega-Newton international key comparisons in force. Accurate force measurements are widely needed by industry for testing mechanical structures (e.g., bridges, aircraft, and medical prosthetics) and in the determination of the strength of innovative materials, assuring quality control in production, measuring jet and rocket engine thrust, and certifying load cells used at the heart of weighing systems throughout the Nation. NIST's participation in international comparisons provides the foundation for domestic confidence in measurements for commerce and regulation, and world-wide confidence in measurement for international trade.

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[4] *Thomas F. Howells III, Kevin B. Barefoot, and Brian M. Lindberg, "Annual Industry Accounts. Revised Estimates for 2003-2005," Survey of Current Business, Bureau of Economic Analysis, Department of Commerce, December 2006.*

[5] *U.S. Department of Commerce Bureau of Economic Analysis, Industry-by-Industry Total Requirements after Redefinitions (1997 to 2005). Available at:* http://www.bea.gov/bea/dn2/i-o_annual.htm .

- Led the development of a comprehensive series of standards designed to address how dimensional measurements of parts can be used more efficiently to assure the final quality of manufactured products. The American Society of Chemical Engineers (ASME) B89.7 standards series addresses the role of measurement uncertainty (i.e., the level of confidence that the user has in that measurement) when accepting or rejecting parts based on dimensional measurements; and provides ways to demonstrate dimensional measurement traceability to the international system (SI) unit of length so that all parties can be assured of the reliability of part measurements. These NIST-led standards will enhance U.S. manufacturing productivity by minimizing the scrapping of acceptable parts, reducing unnecessary rework, and minimizing disputes.
- Produced the world's first standard for large-scale dimensional measuring instruments, known as laser trackers. Industries as diverse as aerospace, ground transport, automotive, machine tools, robotics, and shipyards use laser trackers to make fast, accurate, and portable 3-dimensional measurements. The NIST-led ASME B89.4.19 standard allows manufacturers to specify instrument performance using a common set of standardized tests, saving time and money for both the manufacturer and user. The new U.S. standard is now well on its way to becoming an international standard.
- Developed measurement services for precision optical flats and a range of spherical reference optics. The new NIST ultra precision-optics measurement capability will promote innovation and product quality in the fabrication of micro-electronic chips, computer hard disk read/write heads, micro-electro-mechanical systems, missile defense systems, night vision equipment, and a growing array of digital displays and cameras. The service will also allow manufacturers to meet an increasing need for traceable optics measurements, e.g., for ISO 9001 certification, and will enhance the competitiveness of a highly leveraged U.S. optics industry.

NIST's FY 2009 base program operating objectives in manufacturing engineering include the following:

- Develop measurement methods and analysis tools for in-process verification of manufacturing equipment performance (e.g., 5-axis machine tools). Fabricating complex, innovative, high-precision, products (e.g., turbine blades and high-precision optical assemblies) is an extremely challenging task that depends critically on the ability of manufacturing equipment to perform a complex set of coordinated motions, while compensating for the dynamic behavior of machine components. NIST's work in this area will give equipment suppliers and users the ability to tune their machines to produce complex parts, reduce cycle times, produce better surface finishes, and facilitate machining complex parts right the first time.
- Develop a dedicated 3-dimensional coordinate measuring machine facility capable of measuring miniature features less than 100 micrometers in size, about the diameter of a human hair. Modern technological innovation in the automotive, aerospace, medical, and electronics industries is increasingly dependent on the manufactured accuracy of very small, complex parts and features. The new measurement system will use extremely low force probing to measure miniature structures critical to innovation and quality advances in optical fiber communication (connectors), implantable medical devices (e.g., stents, drug delivery systems), the economy of fuel injection systems, and increases the accuracy of numerous other highly-leveraged fundamental

NIST measurement areas (e.g., flow measurements, optical radiation intensity.) NIST will ensure that there exists a traceable measurement path for these industries when the time comes for them to need it.

- Demonstrate a key step in the practical realization of mass, from fundamental constants, which can be disseminated to our customers. The Kilogram, the last remaining international system (SI) unit defined by a physical artifact, suffers from long-term instability attributed to wear from periodic cleanings and other chemical surface effects. This instability propagates to other SI base units that are tied to the kilogram, thereby, impacting a broad range of measurements and standards in science and engineering. An entirely new balance system, employing magnetic levitation, will allow the comparison of kilogram mass standards in air – as mass is normally disseminated to customers – with the kilogram mass in vacuum, as it will be realized from fundamental physical constants. This comparison is a critical element in the realization of a practical, more stable, non-artifact based international system (SI) unit of mass to support the future needs of science and technology.

3) <u>Chemical Science and Technology</u> - NIST is the Nation's primary reference laboratory for chemical measurements, and promotes commerce, improved quality of life and innovation in the United States in the areas broadly encompassed by chemistry, biosciences, and chemical engineering. NIST develops and disseminates the standards needed to support measurements of national interest, assuring that U.S. industry has access to accurate and reliable data, and predictive models to determine the chemical and physical properties of materials and processes. NIST maintains the national standards for temperature, pressure, vacuum, leak rate, fluid flow, humidity, liquid density, volume, air speed, pH, and electrolytic conductivity. NIST's efforts address next generation standards and data needs that underpin the development, implementation and/or assessment of new technologies in critical industries such as biotechnology, pharmaceuticals, chemical manufacturing, health and medical products, and energy production. NIST measurements also support environmental research and monitoring, food and nutrition analysis, criminal forensics, and homeland security.

NIST's work in chemical measurements ranges from gathering and validating property data for thousands of chemical compounds to developing sensitive new technologies for DNA analysis. For example:

- NIST is developing a human blood plasma-based Standard Reference Material to enable evaluation of new procedures and equipment for measuring metabolites and improve the reproducibility of measurements. The NIH Metabolomics Technology Development Initiative has articulated the need for new tools to quantify metabolites in human systems. These measurements may provide insight into the chemical and molecular pathways that are involved in normal function as well as disease.

- NIST scientists have developed a microsensor for detection in varied gas phase mixtures, of relatively low concentrations of a number of different toxic industrial chemical analytes. Important progress has been made toward making tunable, widely deployable microsensors for utility in differing gas mixtures. Such sensors have application in environmental health and safety monitoring and in chemical threat detection for homeland security.

- NIST is developing a comprehensive set of human identity DNA markers to enable more accurate DNA analysis for human identity testing. Based upon sequences reported in the literature, 26 new miniature short tandem repeats (miniSTRs) were designed to maximize their utility for human identity testing. The 26 new miniSTRs are being calibrated for use in tandem with the widely used NIST SRM 2391b to enable the highest integrity human DNA identity testing.
- NIST has developed a new technology called Chem-BLAST (Chemical Block Layered Alignment of Substructure Technique) that has proven to be highly successful to query therapeutic drugs that can be used to treat AIDS. Chem-BLAST is a user friendly Web interfaces for organizing and retrieving chemical data, based on chemical structure, not chemical name. This will enable reliable exchange of chemical data over the Web, enabling new innovations in drug discovery and development.
- NIST is developing a high-accuracy primary standard for pressure in the range 0.3 MPa to 7 MPa based on fundamental physical properties of helium. With this new standard, it will be possible to test models of piston-cylinder sets and to reduce the uncertainty in the assignment of their effective area. This work is expected to enable new innovations in the manufacturing sector.
- NIST is conducting research to characterize the physical size and chemical composition of organic and biological coatings of modified gold nanoparticles. Both the NIH and FDA have stated that an urgent measurement need is the development of novel methods to characterize the chemical or biological coatings on nanoparticle surfaces. These coatings play critical roles in fighting cancers because they frequently are designed as therapeutic or targeting agents.

NIST's FY 2009 base program in chemical science and technology includes enhanced objectives in advanced measurements, standards and data for chemical processes, nanotechnology, bioscience and health care measurements, and chemical and bio-informatics. These objectives include the following:

- Develop methods and standards to assess performance of DNA microarrays in quantitation of mRNA for gene expression. More reliable DNA microarray-based measurements will enable better gene expression determinations to be performed and advance new innovations in medical diagnostics.
- Develop reference methods for the sensitive and direct measurement of proteins in blood plasma and serum, employing advanced analytical methods to help meet the standardization needs of clinical medicine and drug discovery research. In efforts to accelerate advances in cancer biomarker research, the National Cancer Institute sought NIST expertise to provide sophisticated, metrologically sound analytical approaches.
- Develop measurement methods and standards to enable a new generation of molecular imaging tools, such as high resolution neutron imaging and three-dimensional secondary ion mass spectrometry. These new technologies enable observation of the chemical reactions at the nanoscale in diverse applications from a fuel cell to a single biological cell. Wide-ranging impacts

include innovations in alternate energy technologies, image-guided surgeries, early cancer detection, and directed drug therapies.

- Develop measurement methods, data, and models at nanometer spatial scales to improve chemical measurements and the chemical characterization of nanomaterials. This enables U.S. industry to characterize and manipulate the physical and chemical nanoscale structures in commercial devices. Improved characterization methods will help assess health and environmental risks of nanomaterials, currently considered a roadblock for commercialization of nanotechnology.
- Assess and improve the global comparability for chemical and biochemical measurements by leading and participating in a wide range of international studies conducted under the auspices of the International Bureau of Weights and Measures. These activities provide a global, dynamic comparability structure for measurements in chemistry that help ensure efficient and fair international trade.

4) Physics - NIST meets the Nation's measurement needs in many critical areas of physics, most notably atomic and optical physics, electronic and magnetic technologies, and ionizing radiation. NIST also performs world-leading basic research in fundamental physical quantities and quantum physics.

NIST's base activities within Physics support a broad range of scientific, technological, commercial, and consumer needs, in such areas as:

- Time and frequency–NIST maintains the Nation's standards for time and frequency measurement, an increasingly important field that supports advanced communications, electronic systems, power grids, and high-speed commerce. NIST focuses on developing the highest accuracy standards and methods of disseminating them, e.g., through the Internet, radio broadcasts, and satellites.

- Medical radiation–NIST calibrations underlie the safety and efficacy of diagnostic procedures, such as mammography, and therapeutic procedures, such as brachytherapy (used to treat prostate cancer). Well in excess of 20 million therapeutic radiation procedures,[6] and nearly 35 million x-ray mammograms[7] *annually* are traced to NIST standards.
- Optical technology–The optical products industry is a $100 billion sector, requiring accurate and trusted standards in areas such as lighting, photography, color and appearance, spectroscopy, and imaging. Work at NIST is important for environmental monitoring instruments used to measure temperature, atmospheric composition, and other things important in large-scale climate studies.
- Quantum information–NIST is at the forefront of the nascent field of quantum information processing–computing and communications–challenging preconceived notions of computational complexity and communications security. We seek to learn how to better measure the interactions of single photons–the fundamental constituent of light–with nanoscale structures and objects.
- Metrology innovation–NIST's extreme ultraviolet optics facility supports the electronic industry in its drive to develop advanced lithographic systems for producing ever smaller chips. NIST researchers are developing ultrasensitive measurement tools using optical techniques that support biotechnology studies of single molecules and their effects in biological systems, and better imaging.
- Public health and safety–NIST expertise in radiation detection and measurement supports critical needs of first responders, homeland security surveillance, medical sterility, and nuclear energy. Optical measurement systems support needs in highway and aviation safety, missile defense, and medical diagnosis.

NIST's FY 2009 base program operating objectives in physics include the following:

- Develop new national standards to evaluate the accuracy and precision of medical imaging procedures, to detect and locate tumors, reduce biopsy sampling errors, and improve planning and assessment of therapies. Earlier detection, accurate disease staging, and more precise treatment and patient monitoring reduce medical costs and mortality.

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[6] *All therapeutic radiation procedures performed in the United States must be traceable to NIST standards. According to the American Cancer Society (http://www.cancer.org), there will be more than 1.4 million newly diagnosed cancers in the United States in 2007. Approximately 60 percent of cancer patients are treated with radiation therapy during the course of the disease. An estimate of the number of cancer patients treated annually using radiation therapy is, therefore, about 867,000. Each patient will have a total of between 25 and 30 fractionated dose procedures (between 21 million and 26 million individual procedures performed annually). Therapeutic radiation procedures are also used for diseases other than cancers. However, statistics on these are not available.*

[7] *All mammograms performed in the United States must be traceable to NIST standards. As of April 1, 2007, nearly 35 million mammograms were being performed annually. See http://www.fda.gov/cdrh/mammography/scorecard-statistics.html.*

- Support development of commercially competitive technology to reduce imported fossil fuel consumption. Advancements in fuel-cell imaging support real-world engineering of hydrogen-powered vehicles by the automotive industry, while development of appropriate metrics for solid-state (LED) lighting removes barriers for market entry of replacement lighting systems.
- Establish protocols and procedures to evaluate active (neutron) interrogation methods for non-intrusive inspection of cargo and baggage for homeland security applications, and expand the critical measurement infrastructure for the accurate and sensitive background measurements crucial for passive detection of contraband nuclear material.
- Develop an approach for improved measurements of the Rydberg constant, a fundamental constant of nature important to quantifying the energy levels of atoms, with the goal of achieving an accuracy of 1 part in 10^{16}. This improvement in accuracy will provide a stringent test of current theories in physics.

5) Materials Science and Engineering - Through its materials science and engineering research and services, NIST directly contributes across the entire spectrum of materials, including metals, polymers, ceramics, composites and biomaterials, to develop, maintain, and apply measurement science, measurement standards and measurement technology to enable its customers to develop an integrated understanding of materials processing, structure, properties, and performance. These measurement solutions provide tools needed for industrial competitiveness during all stages of technological innovation, and include:

- advanced metrologies, such as combinatorial methods, to enhance and accelerate materials discovery and development;
- fundamental measurement science to enable the development of nanomaterials and devices, including standards and methods for nanocharacterization and measurement methods for mechanical and wear properties at the nanoscale;
- benchmark materials data to enable industrial designs;
- robust standard test methods to accelerate process development and manufacturing; and
- documentary standards to enable worldwide trade of commercialized materials products.

Industrial scientists and engineers, university researchers, national and international standards organizations, and other technical communities rely on NIST for its technical expertise, objectivity, measurement methods, materials databases, practice guides, and standard reference materials.

Recent NIST accomplishments include:

- Following the analysis of materials from the World Trade Center, NIST has become a primary resource for measurements of infrastructural materials under extreme loading conditions. NIST has ascertained critical properties for efficient use of fire-resistant steel; developed quick, accurate tests for measuring relevant high temperature properties; and provided data and standards development for fire-resistant steel.

- In support of the Pipeline Safety and Integrity Act of 2002, NIST has developed new test methods for new and existing pipelines. The suggested improvements are now under discussion in a number of international standards bodies.
- The NIST Combinatorial Methods Center pioneered development of high-throughput measurement tools that speed innovation across the materials spectrum. The Center has 22 participating member organizations, including Air Products, Dow Chemical, ExxonMobil, Honeywell, National Starch, and Procter & Gamble. The Center has spawned innovative technologies for rapid discovery and optimization of products, including detergents, dental fillings, electronics, and contact lenses.
- A newly constructed spectroscopic microscope for three-dimensional chemical imaging of biological systems will enable the identification of live biological cells as well as the determination of their metabolism in real time, with no damage to the cells themselves.
- In partnership with the National Cancer Institute, NIST has developed gold nanoparticle reference materials for calibrating instruments that measure particle diameter, a critical physical parameter in the application of nanoparticles in healthcare such as cancer treatment, as well as in environmental, safety, and health studies of nanoparticles.

NIST's FY 2009 base program operating objectives in materials science and engineering include the following:

- Develop methods to rapidly measure, via combinatorial fabrication and testing, ultra-low density hydrogen storage materials to support needs of the Hydrogen Economy. New methods are needed for storage materials based on, for instance, lithium (with a density half that of water) and quasi-crystalline phases of lithium alloys.
- Develop experimental and computational techniques to measure the properties of discrete magnetic data storage and memory elements. NIST leads the world in understanding interface and edge effects which become dominant as these materials go into the nanoscale regime. Stability and integrity of stored data depend on control of these heretofore disregarded quantities.
- Develop an interdisciplinary suite of measurements to correlate the performance of next generation organic electronic devices with structure, properties, and chemistry of critical materials and interfaces. NIST will guide the development of standard test methods and provide the fundamental measurements needed to realize exciting new devices and applications including wearable electronics, electronic newspapers, low-cost photovoltaic cells, and low cost radio-frequency identification (RFID) tags.
- Develop experimental and computational techniques to measure the properties of polymer, ceramic, and metal thin films and electrical interconnects to be used by the U.S. microelectronics industry to design a new generation of electronic products more quickly and economically. New high-throughput combinatorial methods are being developed specifically to assist the electronics industry in identifying materials and manufacturing processes needed for nanotechnology applications.
- Develop materials measurement methods and standards required to bring advanced medical technologies to market quickly and efficiently. Specifically, derive the foundation for a measurement system that will speed the development and growth of the

emerging tissue engineering industry, including standards, experimental protocols, and their validations from fundamental physical, biological, and engineering sciences.

- Develop unique in-situ instrumentation, measurement techniques, and models for the control of manufacturing processes used to fabricate nanostructure materials and devices reliably and reproducibly in a high volume, production environment. Anticipated milestones include development of techniques to measure the nanoscale stresses that develop in self-assembled monolayers and templated systems.

6) Building and Fire Research - Building construction in the United States is a mammoth-sized industry–with an estimated value of construction put in place of $1.3 trillion in 2005 (almost five percent of the GDP), and employing between almost eight percent of the workforce–but the vast majority of construction firms are small (including about 1.8 million self-employed workers) and without the resources to conduct the sort of in-depth research needed to improve building practices. Fire protection and firefighting, largely handled by local communities, is similarly fragmented, and fire is a major problem in the United States, which has one of the worst fire fatality rates of the world's industrialized nations. Even with improvements in fire protection and safety, in 2005, 3,675 lives were lost in fires, 17,925 more were seriously injured, direct property loss reached $12 billion, and fire costs the U.S. economy in excess of $200 billion per year. NIST's building and fire research program was established to meet the need for a continuing, high-quality research effort to support the construction and fire-safety communities – better buildings that are safer, built faster, at lower cost and higher quality, and that are less costly to operate and have less impact on the environment.

NIST's program in building and fire research has four main thrusts:

- High performance construction materials and systems to enable scientific and technology-based innovation to modernize and enhance the performance of construction materials and systems. Among other services, NIST is pioneering the development of highly-reliable materials-science-based methods for measuring and predicting the performance and durability of concrete and a wide range of polymeric materials used outdoors such as paints, coatings, vinyl siding, asphalt roofing, sealants, and caulks.
- Enhanced building performance to provide the means to assure buildings work better throughout their useful lives. Among other services, NIST maintains the national standard for measuring the R-value of thermal insulation used in construction and other industrial applications and has enabled energy savings, reduced operating costs, and consumer awareness by supporting the development of standard testing and rating procedures for heating, ventilating, and air-conditioning (HVAC) equipment, water heaters, and appliances.
- Fire loss reduction to enable engineered fire safety for people, products, and facilities, and enhance fire fighter effectiveness. Among other services, NIST has enabled reductions in loss of life and property due to fire by developing the only installation and design standard for residential sprinkler systems, and it is now developing the measurement and prediction tools to prevent,

characterize, detect, and mitigate fire hazards associated with accidental or intentional hydrogen releases in buildings and structures.

- Homeland security and disaster resilience to enable the development and implementation of the standards, technology, and practices needed for cost-effective improvements to the safety, security, and disaster resilience of buildings, building occupants, first responders, and communities (including evacuation, emergency response procedures, and mitigation of natural and manmade threats).

In recognition of NIST's expertise in building and fire safety, the Congress passed, and the President signed into law, the National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act of 2004, which transferred the lead agency function for this multi-agency program to NIST from the Federal Emergency Management Agency. NEHRP is the Federal government's long-term program to reduce U.S. earthquake risks to life and property. The statute assigned major new research and coordination responsibilities for the program to NIST. In addition, the National Windstorm Impact Reduction Act of 2004 authorizes NIST to support research and development to improve codes, standards, and practices for buildings, structures, and lifelines that will measurably reduce the loss of life and property from windstorms.

NIST's FY 2009 base program operating objectives in building and fire research include the following:

- Complete development of a multi-hazard structural and failure analysis and assessment tool for buildings. A multi-hazard approach to building design enables safer, more economical, and disaster resilient structures and communities by considering all hazards to which a building might be exposed and exploiting synergies among single hazard design details to enable cost-effective risk mitigation solutions.

- Complete development of framework for assessing building sustainability performance, enabling metrics directly linking building technology innovation with life-cycle environmental and economic benefits and costs. Building sustainability metrics will inform carbon trading markets with the traceable measurements essential to enabling and harmonizing reporting of the building industry's carbon footprint.

- Release version 9.0 of the Virtual Cement and Concrete Testing Laboratory (VCCTL) software which permits the rapid, virtual exploration of new concrete formulations that will drive innovation in the concrete materials industry by serving as the basis of virtual standards and performance-based specifications. Version 9 will reflect the needs of the industrial consortium members including the incorporation of enhanced algorithms for material creation and property determination, and a state-of-the-art user interface that allows the VCCTL software to operate like a real physical testing laboratory while an abbreviated version of this software will allow students across the world to investigate the power and capabilities of a virtual concrete laboratory.

- Complete comparison of photovoltaic performance measurements conducted under outdoor conditions to indoor measurements using a solar simulator. The ability of the solar industry to replicate outdoor conditions using a solar simulator during the manufacturing process will result in fair and equitable performance ratings removing a significant barrier to the widespread adoption of this renewable energy technology.
- Complete development and validation of techniques for detecting equipment faults and control errors in control systems for building heating, ventilating, and air conditioning systems. Improved operation through fault detection is necessary to achieve national goals of reduced energy consumption in buildings while maintaining safe and comfortable conditions.
- Complete development of the scientific basis for fire fighting guidelines on the effective implementation of positive pressure ventilation (PPV) tactics. The PPV tactics when used properly can provide a safer environment for occupant egress and fire fighting operations in large structures, can reduce the number of fatalities, and can help decrease the $4 billion annual cost of fire fighter injuries.
- Extend and validate the capabilities of the NIST Fire Dynamics Simulator to predict fire behavior within wildland-urban interface communities. The resulting computer model and experimental database will provide a scientific basis for new and improved building standards that will reduce community risk to wildland-urban interface fires.

7) Computer Science and Applied Mathematics - The IT sector that encompasses computers, software, telecommunications products and services, Internet and online services, systems integration, and professional services companies, is one of the Nation's largest sectors, exceeding 15 percent of U.S. GDP[8] in 2005, and employing more than 10 million employees[9] in 2004. Access to the Internet in U.S. households has grown rapidly to more than 70 percent, with 42 percent of those utilizing broadband access.[10] Nearly 100 percent of public schools and 94 percent of public school instructional rooms have Internet access.[11] Total e-commerce sales for 2006 were estimated at $108.7 billion, an increase of 23.5 percent from 2005.[12] Additionally, IT research and development expenditures matched revenue growth, accounting for 14.4 percent of all industry R&D. It is an industry that impacts the lives of virtually every American, every day. However, the growth of information technology has led to growing pains throughout a number of fields. For example, a recent NIST planning study estimated that inadequate software testing is costing the economy $60 billion per year, of which approximately $22 billion could be eliminated with an improved testing infrastructure. NIST collaborates with industry,

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[8] *"Annual Industry Accounts", United States Department of Commerce, December 2006, http://www.bea.gov/scb/pdf/2006/12december/1206_indyaccts.pdf.*
[9] *"Occupational Outlook Handbook 2006-2007 Edition," United States Department of Labor, Bureau of Labor Statistics.*
[10] *"Home Broadband Adoption 2006," Pew/Internet and American Life Project, http://www.pewinternet.org/pdfs/PIP_Broadband_trends2006.pdf.*
[11] *U.S. Department of Education, National Center for Education Statistics (2006). Internet Access in U.S. Public Schools and Classrooms: 1994-2005 (NCES 2007-020), http://nces.ed.gov/fastfacts/display.asp?id=46.*
[12] *"Quarterly Retail E-Commerce Sales 4th Quarter 2006," United States Census Bureau, 16 February 2007, http://www.census.gov/mrts/www/data/html/06Q4.html.*

consortia, and other Federal agencies to utilize its core competencies in IT measurement and testing, mathematical and statistical analysis for measurement science, modeling and simulation for measurement science, and IT standards development and deployment to resolve issues of growth throughout its fields of technical expertise including software, networking, cybersecurity, information access, mathematics, and statistics. NIST works to make information technology, mathematics, and statistics more usable, more accessible, more reliable, and more secure.

NIST programs are guided by national priorities, including mandated activities and broad IT industry drivers, including the globalization and pervasiveness of IT, the information explosion, the new fundamental technologies enabled by IT, and the inadequate reliability, quality, security, and trustworthiness of computing. Generally, NIST uses its core competencies and technical expertise as applied to these guides to develops tests, metrics, and tools to advance, accelerate, and expedite improvements in the interoperability, security, privacy, scalability, quality and uncertainty, and usability of common technologies. NIST has many important programs, including those that impact national security, such as the improvement of the accuracy and interoperability of biometrics recognition systems and the communications among first responders. NIST is also a focal point for developing and implementing computer security standards and procedures for Federal civilian agencies that are also widely used in industry.

NIST works across the IT industry, industry consortia, and the Federal government while also participating in interagency planning activities such as the Federal Networking and Information Technology R&D Program (NITRD). NIST also provides leadership and collaborative research in the application of mathematics, statistics, and computers to science and engineering throughout the research community.

Some specific examples of NIST's leadership in computer science and applied mathematics include:

- NIST developed a Profile for Internet Protocol version 6 (IPv6) for use in the U.S. Government. The profile provides a selection of IPv6 standards and specifications to assist Federal agencies in developing plans to acquire and deploy products that implement IPv6. The profile recommends IPv6 capabilities for common network devices, including hosts, routers, intrusion detection systems, and firewalls that will meet the minimum operational requirements of most Federal agencies. The profile clarifies the functional requirements and guides the government agencies in planning for their IPv6 networks.
- NIST completed the fingerprint Minutia Interoperability Exchange Test (MINEX) for standard fingerprint minutia templates and developed a report, *MINEX: Performance and Interoperability of the INCITS 378 Fingerprint Template*, describing accuracies using these templates by various vendors. MINEX provides the capability to measure biometric interoperability and accuracy for combinations of different vendor products which helps vendors improve their tools and users to select interoperable products.
- In response to the Federal Information Security Management Act, NIST published Federal Information Processing Standard Publication 200 (FIPS 200), *Minimum Security Requirements for Federal Information and Information Systems*, in March 2006.

FIPS 200 is the second of two mandatory security standards that requires all Federal agencies to develop, document, and implement agency-wide information security programs, and to provide security for the information and information systems that support the operations and assets of the agencies. FIPS 200, when used in conjunction with NIST Special Publication 800-53 *Recommended Security Controls for Federal Information Systems*, will ensure that Federal agencies appropriately protect their critical enterprise operations (including mission, functions, image, and reputation) and assets.

- Computational scientists at NIST have published the most accurate values yet of fundamental properties of the hydrogen molecule H_2–values calculated from theory alone. Accurate to 1 part in 100 billion, these are the most accurate energy values ever obtained for a molecule of that size, 100 times better than any previous calculated or experimental value. The "virtual measurement" techniques developed represent an important new method for determining fundamental atomic properties.
- NIST researchers made advances in statistical methods to facilitate the use of hydrogen as a fuel, which included the development of methods that improve the quality of images of fuel cells obtained by neutron tomography. Neutron tomography is used to study whether water accumulates in fuel cells without the need for destructive testing. Improving the image quality associated with neutron tomography enables improvements in fuel cell design.
- NIST developed the Cross Enterprise Document Sharing Profile (XDS), which allows clinical documents to be shared regardless of where they are located or what format they are in, and an XDS reference implementation that is used by over 40 vendors and is currently part of several countries' national health care infrastructures. This will help advance the national goal of providing doctors access to all patients electronic health records, thereby enabling accurate diagnosis and treatment of disease.

NIST's FY 2009 base program operating objectives in computer science and applied mathematics include the following:

- Develop information security standards, measurements, and tools to address systems and networks extending the reach of strong mechanisms to emerging lightweight platforms. Produce guidelines and automated tools to promote adoption of interoperable, secure technologies and infrastructures. These activities will support innovative classes of networked devices by establishing new foundational security mechanisms necessary to establish end-user trust.
- Develop techniques, in collaboration with industry, to evaluate and improve the mobility, interoperability, security, resilience, and robustness of key network technologies. This will provide the telecommunications industry with new, improved standards needed to develop and offer interoperable mobile devices that allow dynamic roaming between various wireless network technologies. In addition, this will give the networking industry the means to maintain a more resilient network even under stress, and to provide support for public safety communications.
- Measure the performance of multimodal biometrics matching systems, including iris, fingerprint, and facial images, which will enable industry to improve the accuracy and interoperability of biometric recognition systems, thereby enhancing the real-time

verification and identification of those seeking to enter the United States. Providing the infrastructure for industry to measure the performance of biometric technologies will lead to improved performance through lower error rates and greater interoperability. This allows industry to increase innovation and competitiveness as it develops new biometric system technologies.

- Develop mathematical, statistical, and computational methods and tools to enable NIST research on measurement of the properties of materials and processes operating at all physical levels, including nanoscale. Those methods and tools are the result of creative research in mathematics, statistics, and computation, and the measurement science they enable provides the foundation for the development of innovative processes and materials relevant to government and industry.
- Develop critical measurements, software tools, and technology to improve the quality, safety, and cost-effectiveness of healthcare delivery systems and processes. NIST will work with industry and other agencies to develop standards and measurements that are needed to improve interoperability and quality, both of which are necessary to allow the healthcare industry to transform itself through innovative IT.

8) Standards and Technology Services - For research advances of the NIST Laboratories to be most useful, the results must reach the intended users. NIST enables U.S. industry to develop competitive technologies by providing U.S. industry with central access to standard reference materials, standard reference data, calibrations, and laboratory accreditation, and thereby traceability to national and international standards of measurement. These NIST services meet industry needs for accurate measurements and measurement traceability to ensure product quality, production efficiency, parts interchangeability, conformance to specifications, and performance suitability. NIST programs also provide a central source of information and leadership for U.S. industry regarding national and international standardization and conformity assessment activities, including product testing and certification. Domestically, NIST provides the technical underpinning for the U.S. commercial metrology system, through the development and dissemination of handbooks, guidance, documents and recommendations, focused training, and technical support for laboratory metrology.

NIST provides unbiased evaluation and recognition of laboratory performance through the National Voluntary Laboratory Accreditation Program. These accredited laboratories play an important role in conformity assurance for commerce and regulatory purposes, as well as in support of international trade. By working with industry, state and local weights and measures officials, other Federal agencies, retailers, consumer groups, the National Conference on Weights and Measures, and the International Organization of Legal Metrology (OIML), NIST helps to establish uniform and accurate legal metrology standards used in national and international trade. NIST also coordinates metric transition activities throughout the Federal government and initiates actions to remove regulatory barriers to the use of the metric system to increase the competitiveness of U.S. industry in the global market. NIST promotes efficiency in the U.S. documentary standards and conformity assessment systems by carrying out its statutory role of coordinating the use by Federal agencies of private-sector standards, and coordinating Federal, State, and local technical standards and conformity assessment activities with those of the private sector. NIST also conducts programs to enhance the flow of standards information to U.S. industry, promote foreign adoption of U.S. standards and technology, and align U.S. standards with international standards.

NIST's FY 2009 base program operating objectives in standards and technology services include the following:

- Deliver calibration services, standard reference materials, and standard reference data to provide industry, government, and the public with accurate physical, chemical, and engineering measurements. NIST measurement services support U.S. industry through traceability to NIST and to the International System of Units (SI), and are recognized as complying with the international measurement system, thus reducing the need for additional testing.

- Maintain compatible systems, at both the national and international levels, for recognizing competent laboratory accreditation bodies to accredit calibration and testing laboratories to meet private and public-sector needs, and to support U.S. exports through increased acceptance of test and calibration reports in foreign markets.

- Deliver comprehensive standards-related information provided through the National Center for Standards and Certification Information and the U.S. Inquiry Point for the World Trade Organization to provide to U.S. businesses market intelligence and information from priority foreign markets, and provide training for regulatory and trade officials from developing countries on the proper use of documentary standards conformity assessment practices, and metrology to enhance acceptance of U.S. procedures and products.

- Provide policy and technical leadership in key standards development activities in emerging technology areas, working with industry and other partners to identify key priority standards-related needs in priority areas such as alternative/renewable energy, nanotechnology and biotechnology.

- Improve the national infrastructure for advanced legal metrology by providing laboratory metrology training, conducting proficiency testing to ensure accurate measurements, and promoting the documentation and use of quality system practices in conformity with international standards and guidelines for testing and calibration laboratories resulting in increased international acceptance of U.S. measurement results and accreditation programs.

- Strengthen state and local weights and measures programs, using industry/regulatory working groups as a solution and implement requirements needed to support hydrogen as a viable commercial fuel. Ensure compatibility of U.S. and international standards by developing uniform legal metrology requirements, manuals, training, and test methods to improve efficiency and fairness in the U.S. and foreign markets resulting in fewer differing requirements for manufacturers to meet and sell their instrument and products, thereby reducing overall costs to both the manufacturer and the consumer.

The four centrally-managed programs that provide support to all NIST programs include:

1) Innovations in Measurement Science Program - NIST must maintain the capacity to contribute effectively to future national needs and goals by investing in high-risk, high-payoff research to enable innovation.[13]. This program provides funding for high priority fundamental research to build new capabilities necessary to develop and maintain state-of-the-art knowledge in areas of science and engineering related to measurement techniques and fundamental data. The capacity to respond is based on the availability of teams of scientists and engineers, working at the forefront of research in various areas related to future advanced technologies, who have the ability to devote their efforts to specific, new problems as they arise.

Projects previously undertaken in this program have resulted in focused areas for new program development. In the past, all three of NIST's Nobel Prizes began with work funded by the Innovations in Measurement Science (IMS) Program. One example of a successful new effort established as a result of the IMS program is the Testbed for Combinatorial Methods for rapid innovation in polymer thin films. The demonstration of sound infrastructure technologies and next-generation measurement platforms to rapidly screen and analyze performance of polymer thin films attracted strong industrial and institutional support that led to the establishment in 2002 of a new type of "non-proprietary" consortium, the NIST Combinatorial Methods Center (NCMC), and a Department of Commerce Silver Medal in Customer Service. To date over 30 companies and institutions have been served by this consortium, and this cross-cutting technology has been successfully transferred to companies such as Air Products, Dow, National Starch, Intel, Boston Scientific, and Proctor and Gamble, accelerating innovation in products as diverse as microelectronics fabrication, packaging, and hydrogels like contact lenses. The wide impact is also illustrated by over 530 literature citations and 200 national and international invited talks. The NCMC is poised to provide measurement solutions for fresh industrial challenges in the emerging areas of nanostructured materials, organic electronics, energy, and fuel materials.

The FY 2009 base program operating objectives for the Innovations in Measurement Science Program include the following:

- select and initiate several new exploratory projects through a competitive review process; and
- selected projects continue to be supported for a maximum of five years which build NIST's research capabilities and technical readiness to address state-of-the-art measurements and standards opportunities and needs.

2) Postdoctoral Research Associates Program - NIST supports a nationally competitive Postdoctoral Research Associates Program, which is administered in cooperation with the National Academy of Sciences/National Research Council (NRC). The Postdoctoral program recruits outstanding research scientists and engineers to work on NIST research projects, strengthens communications with

[13] *Called for in Rising Above the Gathering Storm, National Academies Report.*

university researchers, and provides a valuable mechanism for the transfer of research results from NIST to the scientific and engineering communities.

The FY 2009 base program operating objectives for the Postdoctoral Research Associates Program include the following:

- select postdoctoral scientists and engineers of exceptional promise and ability for two-year appointments to perform advanced research related to the NIST mission; and
- introduce the latest university research results and techniques to NIST scientific programs and share NIST's unique research capabilities with the U.S. scientific and engineering communities.

3) Computer Support - The NIST central information technology (IT) support for science programs provides secure, centrally-managed IT infrastructure resources in support of NIST's technical mission leading to improved measurement methods, standards advances, reference data, and research results benefiting numerous sectors of the U.S. economy. The scope of the program includes: deploying and managing new secure, high-performance computing and networking resources; providing computer facilities meeting Federal IT security requirements, as well as the specialized requirements of the equipment located at NIST; and providing secure, distributed, redundant storage for NIST data.

These resources enable NIST laboratories and programs to implement computational platforms supporting research-specific needs, dissemination of NIST results to the public, and collaborations with NIST partners.

The FY 2009 base program operating objectives for Computer Support include the following:

- manage the IT infrastructure including computing systems, associated communications, mass storage, networking, and software capabilities to support all NIST programs; and
- optimize the portfolio of computing platforms, online data storage, backup and archival storage, network interconnects, system security mechanisms, and application software packages to meet mission-specific requirements of NIST users and programs.

4) Business Systems - This program provides the necessary resources to operate and maintain administrative and financial management systems at NIST that satisfy the requirements established by the Department of Commerce (DoC), Office of Management and Budget, Government Accountability Office, Department of Treasury, General Services Administration, and Congress.

The Department and the Administration have undertaken major modernization initiatives of various business systems, functions, and processes. DoC envisions common, Department-wide, user-friendly, and flexible systems to support financial management, procurement management, travel management, grants management, property management, and other administrative functions. New business systems or upgrades to existing systems will be implemented over the next several years. Any new systems acquired will be integrated with the Department's Commerce Business System (CBS). They will also interface with other internal and external administrative and management systems. NIST's business systems are an integral part of the vision for the administrative and financial management systems formulated by the DoC.

The FY 2009 base program operating objectives for Business Systems include:

- implement, operate, and maintain administrative management systems that support the delivery of administrative services to NIST and its cross-service customers; and
- operate and maintain CBS and the NIST CBS Portal that supports delivery of services to NIST and its cross-service customers.

Performance Measures

Data on NIST programmatic performance evaluation and reporting are provided in Exhibit 3A of this budget request.

Department of Commerce
National Institute of Standards and Technology
Laboratories and Technical Programs
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2007 Actual	FY 2008 Currently Available	FY 2009 Estimate
Department of Defense			
Air Force	$10,042	$11,146	$7,747
Army	2,239	2,357	2,161
Navy	1,136	1,392	1,244
Other	14,105	13,162	11,098
Subtotal, Department of Defense	27,521	28,057	22,250
Department of Agriculture	133	70	70
Department of Commerce	11,379	13,790	13,872
Department of Energy	4,491	5,309	4,565
Department of Health & Human Services	6,114	8,882	7,335
Department of Homeland Security	32,254	33,453	25,114
Department of Housing & Urban Development	70	100	100
Department of the Interior	70	157	148
Department of Justice	11,163	17,127	14,300
Department of State	434	265	55
Department of Transportation	1,630	560	200
Department of the Treasury	17	18	18
Department of Veterans Affairs	137	140	140
Environmental Protection Agency	1,596	1,435	1,423
General Services Administration	526	500	217
National Aeronautics & Space Administration	2,499	6,221	3,925
National Science Foundation	563	345	335
Nuclear Regulatory Commission	157	150	150
Other	4,318	6,914	3,201
Subtotal, Federal Agencies	105,072	123,493	97,418
Calibrations & Testing	8,899	8,408	8,408
Technical & Advisory Services	25,562	21,899	21,370
Standard Reference Materials	13,585	13,980	13,980
Subtotal, Other Reimbursables	48,046	44,287	43,758
Total, Reimbursable Program	153,118	167,780	141,176
Equipment Transfers	750	1,250	10,300
Subtotal, WCF transfer	750	1,250	10,300
Equipment Investments	17,765	18,996	18,996
IE Amortization	(18,669)	(18,819)	(18,996)
WCF Operating Adjustments	8,443	0	0
Total, WCF Investments	7,539	177	0
Total, Reimbursable Program and WCF Investments	161,406	169,207	151,476

Exhibit 10

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Activity: NIST laboratories
Subactivity: National research facilities

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
NIST center for neutron research	Pos./Approp	136	$37,923	136	$37,723	136	$39,522	142	$41,522	6	$2,000
	FTE/Obl.	135	36,555	151	38,370	151	39,719	155	41,719	4	2,000
Center for nanoscale science and technology	Pos./Approp	69	26,314	50	26,214	50	27,075	68	34,075	18	7,000
	FTE/Obl.	28	26,033	45	26,320	45	27,101	58	32,101	13	5,000
Total	Pos./Approp	205	64,237	186	63,937	186	66,597	210	75,597	24	9,000
	FTE/Obl.	163	62,588	196	64,690	196	66,820	213	73,820	17	7,000

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
PROGRAM AND PERFORMANCE: REIMBURSABLE OBLIGATIONS
(Dollar amounts in thousands)

Activity: NIST laboratories
Subactivity: National research facilities

	2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
NIST center for neutron research										
WCF transfer		$550		0		0		0		0
Reimbursables	14	3,763	16	$3,766	16	$3,784	17	$3,784	1	0
WCF investments	0	108	0	(342)	0	0	0	0	0	0
Total	14	4,421	16	3,424	16	3,784	17	3,784	1	0
Center for nanoscale science and technology										
WCF transfer		0		0		0		2,000		$2,000
Reimbursables	1	211	1	25	1	35	1	35	0	0
WCF investments	0	(233)	0	119	0	0	0	0	0	0
Total	1	(22)	1	144	1	35	1	2,035	0	2,000
Total										
WCF transfer		550		0		0		2,000		2,000
Reimbursables	15	3,974	17	3,791	17	3,819	18	3,819	1	0
WCF investments	0	(125)	0	(223)	0	0	0	0	0	0
Total	15	4,399	17	3,568	17	3,819	18	5,819	1	2,000

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
JUSTIFICATION OF PROGRAM AND PERFORMANCE
NATIONAL RESEARCH FACILITIES

Goal Statement

This subactivity supports the Department of Commerce's and NIST's goal to promote U.S. innovation by strengthening the Nation's measurement and standards infrastructure.

Base Program

This subactivity includes two major NIST research facilities: the NIST Center for Neutron Research and the Center for Nanoscale Science and Technology.

NIST Center for Neutron Research (NCNR). The NCNR is the Nation's premier neutron research facility. It is a major national user facility that serves the majority of all neutron scattering users in the United States. The facility provides an intense source of neutron beams that are used to probe the molecular and atomic structures and dynamics of a wide range of materials. The NCNR also boasts a unique, large-volume, liquid hydrogen *cold source*, which produces the highest intensity of "cold" (or low-energy) neutron beams in the country. Cold neutrons are used to probe the underlying structures and slow dynamics in advanced materials such as plastics, magnetic films, chemical catalysts, biological materials, and composites. With such state-of-the-art measurement capabilities unavailable elsewhere in North America, the NCNR plays an essential role in broad sectors of nano-science and technology. In breadth of applications, neutron beam measurement techniques are on a par with the x-ray or microscope in their ability to probe materials that are the focus of study in today's most important research areas, including materials technology, biotechnology, and nanotechnology. The range of scientific activities also includes *discovery-oriented research in fundamental physics where some of nature's most penetrating questions are explored through measurements in the fundamental properties of the neutron.* This is just one example of a partnership with another NIST laboratory that leverages the NCNR as a resource to explore an area substantially different from materials research.

The NCNR operates as a national user facility that provides merit-based access to all qualified researchers. Use of the NCNR facilities for proprietary research is possible on a full-cost recovery basis. As a result, researchers from industry, academia, and other Federal agencies depend on NIST's unique research capabilities to work on cutting edge science. The capabilities of this leading facility are further leveraged through a variety of cost-sharing partnerships with other agencies, industries, and universities to expand specific measurement capabilities, and to broaden the access to unique neutron instrumentation. The NCNR is significantly expanding its collaboration with the Nation's industrial and academic researchers with new instrumentation and analysis methods for macromolecular dynamics, neutron trace analysis, neutron chemical spectroscopy, neutron imaging, and neutron spectroscopy.

Last year, more than 2,200 researchers directly benefited from access to NCNR capabilities, which accounts for over two-thirds of all neutron research done in the United States. Included in this total are researchers from 40 States and the District of Columbia; and representing nearly 140 U.S. universities, 60 U.S. corporations, and 40 U.S. government organizations and laboratories. Research performed at the NCNR resulted in over 350 publications in FY 2007. With a significant fraction of these papers published in the leading journals, the NCNR ranks as one of the highest impact neutron facilities in the world.

The FY 2009 NCNR base program operating objectives include the following:

- Studying the structure and behavior of new materials at the nano-scale, making it possible to improve process technologies and develop new materials applications in areas ranging from lighter weight composites for the auto industry to advanced materials for the efficient storage of hydrogen for energy applications.
- Imaging the interior of complex devices and materials non-destructively to "see" how they function under various operating conditions. NCNR neutron imaging has made it possible to look through the steel casings of operating fuel cells and watch the flow and movement of water molecules as the cell functions, leading to better designs and performance.
- Studying the structure and motions of very large biological molecules such as proteins. Neutrons can see how they bend and fold-properties essential to protein function–and the insights gained could lead to the development of new drug therapies, new anti-toxins, and improved vaccines.
- Studying chemical interactions with porous or other complex structured materials. The unparalleled penetration and imaging power of neutrons is being used to develop new, more efficient, industrial catalysts and better ways to remove toxins from the environment, as well as to achieve a better understanding of complex biological systems at the cellular level.
- Probing the internal stresses in materials such as turbine blades, railroad rails, and shock absorbers, which are essential to understanding and improving the performance of products used in industry, transportation, and national defense.

- Developing ultra-high sensitivity detection methods for trace levels of chemicals. The NCNR leads the world in performing the most accurate neutron trace analysis, which has made it possible to track environmental pollutants in marine animals, to develop more accurate methods to detect arsenic in drinking water, and to detect potential explosives and other terrorist materials.

The Center for Nanoscale Science and Technology (CNST). Recent appropriations have enabled NIST to develop the CNST, a leading national center for collaborative research in nanoscale measurement. The CNST is dedicated to providing U.S. industry with the ability to succeed in the global quest to deliver new products using the unique opportunities for innovation afforded by nanotechnology. The CNST includes a research program and a nanofabrication and measurement facility known as the Nanofab. It also maintains strong linkages to the discipline-oriented NIST Laboratories and the NCNR, affording its many partners unique opportunities to use the rich portfolio of measurement solutions and expertise available at the Nation's premier measurement science laboratory.

Commercialization of nanotechnology involves measurement in a significant way at every stage of development, from discovery to manufacture. Further, in many important technologies (for example, those related to energy production, storage, or transport) nanotechnology plays a crucial role at the earliest stage in the process. By collaborating with industry, academia, and other government agencies, the CNST endeavors to remove the existing measurement barriers to innovation and thereby advance technologies important to the national interest. CNST has developed, and will continue developing, strategic alliances with universities, manufacturers, government laboratories and other partners to leverage this work.

The CNST consists of a multidisciplinary research program and the Nanofab. The CNST research program pursues collaborative opportunities with emphasis on the areas of future electronics, nanomanufacturing and nanofabrication, as well as energy storage, conversion and transport. The CNST Nanofab is an open, fee-based, shared use facility modeled after the National Science Foundation's highly successful, National Science Foundation supported National Nanotechnology Infrastructure Network, but specifically focused on infrastructural knowledge and metrologies for enabling industrial innovations in nanotechnology. Following an internal ramp-up of its capabilities, in FY 2007 the CNST Nanofab was opened in 2007 to academia, industry, and other government agencies to provide ready access to state-of-the-art nanofabrication and measurement tools. Staffed by experienced professionals, the Nanofab offers the latest in electron beam, ion beam, optical and nanoimprint lithography methods as well as advanced metrology tools and linkages to the CNST's research programs and those of the NIST laboratories,' which collectively provide great experience in nanoscale measurement.

The CNST is located in NIST's Advanced Measurement Laboratory, where the CNST Nanofab operates a large, "class 100" cleanroom, and the CNST research laboratories benefit greatly from the stringent environmental controls on temperature, humidity, vibration, electrical, and magnetic fields in its other laboratories. These are critical to CNST's provision of world-leading capabilities at NIST that can produce accurate measurements down to the scale of individual atoms.

The FY 2009 CNST base program operating objectives include the following:

- Further expand NIST's research on the quantification and characterization of nanoparticles to further nanoparticle health and safety research and the control of nanoparticles in the environment.
- Broaden the scope of our nanocharacterization metrology problem solving effort to include nanodevices proposed as to provide a basis for future electronics thereby facilitating advances in communications and information technology that promise to transform our lives while maintaining the vitality of the electronics industry.
- Develop a variety of new methods for forms of nanofabrication and nanomanufacturing and extend current methods to create industrial standards and, consequently, maintain the U.S. leadership position in nanotechnology.
- Further expand access to the exceptional nanometrology and nanofabrication capabilities of the CNST research laboratories program and Nanofab, thus to providing new research opportunities for enable new researchers from industry, academia, and other Federal laboratories over a to use the facility and open new research opportunities into a broad range of scientific, engineering, and technological fields.
- Develop new ways to characterize and, thereby, improve the performance and reliability of nanostructured materials and devices. This will advance both the development of U.S. nanoproducts and their manufacture, affecting a wide variety of applications in transportation, housing, defense, medicine, agriculture, and homeland security.
- Help educate the new generation of nanotechnologist by providing young scientists and engineers with the ability to use some of the world's most advanced instrumentation to address the challenge of measuring the subtle phenomena ties of nature that occur only on the atomic scale.

Performance Measures

Data on NIST programmatic performance evaluation and reporting are provided in Exhibit 3A of this budget request.

Department of Commerce
National Institute of Standards and Technology
National Research Facilities
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2007 Actual	FY 2008 Currently Available	FY 2009 Estimate
Department of Defense			
Navy	$200	0	0
Subtotal, Department of Defense	200	0	0
Department of Energy	420	$420	$437
Department of Health & Human Services	68	68	68
National Science Foundation	2,856	2,856	2,856
Subtotal, Federal Agencies	3,544	3,344	3,361
Technical & Advisory Services	429	447	458
Subtotal, Other Reimbursables	429	447	458
Total, Reimbursable Program	3,974	3,791	3,819
Equipment Transfers	0	0	2,000
Reactor Fuel Transfers	550	0	0
Subtotal, WCF transfer	550	0	2,000
Equipment Investments	436	448	448
IE Amortization	(561)	(671)	(448)
Total, WCF Investments	(125)	(223)	0
Total, Reimbursable Program and WCF Investments	4,399	3,568	5,819

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Exhibit 10

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Activity: Baldrige national quality program
Subactivity: Baldrige national quality program

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Baldrige national quality program	Pos./Approp	51	$7,631	51	$7,931	51	$8,522	51	$8,522	0	0
	FTE/Obl.	47	7,835	50	8,175	50	8,543	50	8,543	0	0

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
PROGRAM AND PERFORMANCE: REIMBURSABLE OBLIGATIONS
(Dollar amounts in thousands)

Activity: Baldrige national quality program
Subactivity: Baldrige national quality program

Line Item	2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
Baldrige national quality program										
WCF transfer		0		0		0		0		0
Reimbursables	0	$2,345	0	$3,400	0	$3,500	0	$3,500	0	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Total	0	2,345	0	3,400	0	3,500	0	3,500	0	0

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
JUSTIFICATION OF PROGRAM AND PERFORMANCE
BALDRIGE NATIONAL QUALITY PROGRAM

Goal Statement

This program supports DoC's and NIST's mission of promoting U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

Base Program

The program has, as its foundation, the Malcolm Baldrige National Quality Award (MBNQA), created by P.L. 100-107 in August 1987. In 1999, the award was expanded to include categories in education and health care as authorized by the Technology Administration Act of 1998 (P.L. 105-309). In October 2004, Congress expanded the award to include all nonprofit organizations, including Federal, state, and local governments (P.L. 108-320), funds were appropriated in fiscal year 2006 for this purpose. The Baldrige program conducted a pilot project for the nonprofit category in fiscal year 2006 and launched the full category in fiscal year 2007. The program has become a focal point for strengthening America's competitive position. The Baldrige Award has proven to be highly effective in stimulating interest in performance improvement, performance excellence, sharing and cooperation, and creation of new information networks within the business community and the public benefit sectors. With the program's expansion to the nonprofit sector, all American organizations are now able to receive these benefits.

NIST responsibilities under P.L. 100-107, P.L. 105-309, and P.L. 108-320 are carried out by the Baldrige National Quality Program (BNQP). The program continues to build key linkages with other organizations and provide limited educational outreach services. U.S. businesses and non-profit organizations throughout the country are now turning to NIST for leadership in performance improvement. The BNQP aims to improve its leadership as a focal point and educational resource for all U.S. organizations interested in improving their competitiveness and overall performance.

The Program's design and operational strategy is three-fold: 1) to create a standard for performance excellence that fosters communications and sharing among organizations of all types (e.g., business, education, health care, and nonprofit/government); 2) to build networks and other key linkages with external organizations to deliver performance, quality, and promote competitiveness throughout the United States; and 3) to build on the success of the present program by sharing lessons learned in the business, education, health care, and nonprofit communities with other sectors of the economy, thereby accelerating the process of performance improvement for those sectors.

The FY 2009 base program operating objectives include the following:

- implement the MBNQA competition, including examiner selection, examiner training, and application review, to provide services to applicants in business, education, health care, and nonprofit categories;
- conduct the Quest for Excellence Conference and Baldrige Regional Conferences where MBNQA recipients share their performance excellence strategies;
- strengthen collaboration and information sharing with state and local quality award programs;
- facilitate information sharing among all sectors of the U.S. economy through partnerships with key business, education, health care, and nonprofit organizations; and
- use e-technology (e.g., e-learning and online collaborative tools) to provide improved services to Baldrige stakeholders while maintaining confidentiality and security of stakeholder information.

Performance Measures

The BNQP evaluates its performance through a combination of methods, including independent expert review of all aspects of the program's plans and operations by its Board of Overseers and output measures focused on the program's key objectives of improving applicant and other stakeholder satisfaction, increasing participation in the MBNQA, and promoting the growth of quality awareness and performance excellence throughout the United States.

Department of Commerce
National Institute of Standards and Technology
Baldrige National Quality Program
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2007 Actual	FY 2008 Currently Available	FY 2009 Estimate
Technical & Advisory Services	$2,345	$3,400	$3,500
Subtotal, Other Reimbursables	2,345	3,400	3,500
Total, Reimbursable Program	2,345	3,400	3,500

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Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
11	Personnel compensation					
11.1	Full-time permanent	$153,870	$167,951	$177,288	$191,625	$14,337
11.3	Other than full-time permanent	13,216	13,552	14,096	14,096	0
11.5	Other personnel compensation	5,940	5,940	5,940	5,940	0
11.9	Total personnel compensation	173,026	187,443	197,324	211,661	14,337
12.1	Civilian personnel benefits	44,972	48,602	53,932	57,805	3,873
13	Benefits for former personnel	11	11	11	11	0
21	Travel and transportation of persons	10,027	10,051	10,054	11,958	1,904
22	Transportation of things	1,487	1,521	1,563	2,442	879
23.1	Rental payments to GSA	0	0	0	0	0
23.2	Rental payments to others	1,502	1,266	1,544	1,544	0
23.3	Communications, utilities, and miscellaneous charges	24,186	24,469	29,551	35,131	5,580
24	Printing and reproduction	584	669	688	848	160
25.1	Advisory and assistance services	4,686	3,067	2,364	2,364	0
25.2	Other services	45,024	40,019	26,455	34,195	7,740
25.3	Purchases of goods and services from Government accounts	23,547	23,567	24,264	30,319	6,055
25.5	Research and development contracts	1,856	1,824	2,107	12,024	9,917
25.7	Operation and maintenance of equipment	14,188	14,009	14,308	16,242	1,934
26	Supplies and materials	22,936	23,730	24,487	28,746	4,259
31	Equipment	36,338	36,876	39,030	42,332	3,302
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	36,430	37,371	36,478	40,078	3,600
42	Insurance claims and indemnities	0	0	0	0	0
43	Interest and dividends	14	0	0	0	0
99	Total Obligations	440,814	454,495	464,160	527,700	63,540

	Object Class	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
99	Total Obligations	440,814	454,495	464,160	527,700	63,540
	Less Prior Year Recoveries	(2,001)	(1,000)	(1,000)	(1,000)	0
	Less Prior Year Unobligated Balance	(4,898)	(9,098)	0	0	0
	Transfer from Office of Law Enforcement Standards	(5,000)	0	0	0	0
	Plus Unobligated Balance, End of Year	9,098	0			
	Plus Expired Balance from EAC Transfer	9				
	Total Budget Authority	438,021	444,397	463,160	526,700	63,540
	Unobligated Balance Rescission					
	Transfer to NIST Working Capital Fund	1,300	1,250	750	12,300	11,550
	Transfer from Election Assistance Commission	(4,950)	(3,250)	0	(4,000)	(4,000)
	Transfer from Community Oriented Policing Services, DoJ	0	(1,880)	0	0	0
	Total Requirements	434,371	440,517	463,910	535,000	71,090

Personnel Data

	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
Full-time equivalent employment:					
Full-time permanent	1,596	1,761	1,763	1,913	150
Other than full-time permanent	234	234	234	234	0
Total	1,830	1,995	1,997	2,147	150
Authorized Positions:					
Full-time permanent	1,939	1,881	1,881	2,084	203
Other than full-time permanent	52	52	52	52	0
Total	1,991	1,933	1,933	2,136	203

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
DETAILED REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
11 Personnel compensation				
11.1 Full-time permanent				
Executive level	$3	$150	$150	0
Senior executive service	171	3,508	3,508	0
Career path	8,327	163,542	177,879	$14,337
Wage board	331	6,257	6,257	0
Scientific & professional (P.L. 80-313)	196	3,831	3,831	0
Subtotal	9,028	177,288	191,625	14,337
11.3 Other than full-time permanent				
Career path	534	13,968	13,968	0
Wage board	9	27	27	0
Scientific & professional (P.L. 80-313)	0	0	0	0
Experts & consultants	1	101	101	0
	0	0	0	0
Subtotal	544	14,096	14,096	0
11.5 Other personnel compensation				
Overtime	0	1,128	1,128	0
SES performance awards	0	212	212	0
Cash awards	0	4,319	4,319	0
Other	0	281	281	0
Subtotal	0	5,940	5,940	0
11.9 Total personnel compensation	9,572	197,324	211,661	14,337

Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
12.1 Civilian personnel benefits				
Civil service retirement	(148)	2,512	2,512	0
Federal employees' retirement	1,345	17,045	18,653	1,608
Thrift savings plan	2,497	8,665	8,949	284
Federal Insurance Contribution Act	755	11,336	12,433	1,097
Health insurance	740	11,828	12,690	862
Life insurance	15	287	309	22
Employees' Compensation Fund	(10)	503	503	0
Other	53	1,755	1,755	0
Subtotal	5,247	53,932	57,805	3,873
13 Benefits for former personnel				
Severance pay	0	0	0	0
Unemployment compensation	0	11	11	0
Other	0	0	0	0
Subtotal	0	11	11	0
21 Travel and transportation of persons				
Common carrier	0	3,470	4,166	696
Mileage	3	18	20	2
Per diem/actual	0	4,910	5,827	917
Other	0	1,656	1,945	289
Subtotal	3	10,054	11,958	1,904
22 Transportation of things	42	1,563	2,442	879
23.1 Rental payments to GSA	(2)	0	0	0
23.2 Rental payments to others	46	1,544	1,544	0

Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
23.3 Communications, utilities, and miscellaneous charges				
Rental of ADP equipment	2	14	24	10
Rental of office copying equipment	5	170	211	41
Other equipment rental	16	277	484	207
Federal telecommunications system	3	393	505	112
Other telecommunications services	35	1,487	1,769	282
Postal Service by USPS	17	186	214	28
Utilities:				
Electric	960	15,869	18,438	2,569
Gas	4,009	9,982	12,088	2,106
Water/Sewer	35	1,173	1,398	225
Subtotal	5,082	29,551	35,131	5,580
24 Printing and reproduction				
Publications	6	169	223	54
Other	13	519	625	106
Subtotal	19	688	848	160
25.1 Advisory and assistance services				
Management & professional support services	6	382	382	0
Studies, analyses, & evaluation	1	620	620	0
Engineering & technical services	6	1,362	1,362	0
Subtotal	13	2,364	2,364	0
25.2 Other services				
Training	72	1,694	2,552	858
ADP Services	27	2,156	2,554	398
Other non-government contracts	2,067	22,605	29,089	6,484
Subtotal	2,166	26,455	34,195	7,740

Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
25.3 Purchases of goods and services from Government accounts				
Payments to DM, WCF	152	7,192	7,192	0
[Commerce Business System (shared)]	[0]	[1,327]	[1,327]	[0]
Office of Personnel Management	128	495	495	0
Other Federal agencies:				
Department of Commerce	199	2,949	7,703	4,754
Other	218	13,628	14,929	1,301
Subtotal	697	24,264	30,319	6,055
25.5 Research and development contracts	283	2,107	12,024	9,917
25.7 Operation and maintenance of equipment	299	14,308	16,242	1,934
26 Supplies and materials				
Office & laboratory supplies	499	18,621	22,880	4,259
Scientific publications & journals	122	1,179	1,179	0
Fuel oil	6	232	232	0
Reactor materials	130	4,455	4,455	0
Subtotal	757	24,487	28,746	4,259
31 Equipment				
Office machines and other equipment	428	14,508	16,756	2,248
ADP equipment	233	8,154	9,208	1,054
Equipment amortization	401	16,368	16,368	0
Subtotal	1,062	39,030	42,332	3,302
32 Land and structures	0	0	0	0

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
41	Grants, subsidies, and contributions	(893)	36,478	40,078	3,600
42	Insurance claims and indemnities	0	0	0	0
43	Interest and dividends	0	0	0	0
99	Total Obligations	24,393	464,160	527,700	63,540
	Less Prior Year Recoveries	(1,000)	(1,000)	(1,000)	0
	Total Budget Authority	23,393	463,160	526,700	63,540
	Transfer to NIST Working Capital Fund	0	750	12,300	11,550
	Transfer from Election Assistance Commission	0	0	(4,000)	(4,000)
	Total Requirements	23,393	463,910	535,000	71,090

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
APPROPRIATION LANGUAGE AND CODE CITATIONS

1. For necessary expenses of the National Institute of Standards and Technology,

15 U.S.C. 272; 273; 278b-j; p
15 U.S.C. 290b-f
15 U.S.C. 1151-52
15 U.S.C. 1454(d-e)
15 U.S.C. 1511, 1512
15 U.S.C. 3710a-d
15 U.S.C. 3711a
15 U.S.C. 7301-7313
15 U.S.C. 7406
15 U.S.C. 7506(a)

15 U.S.C. 272; 273; 278b-j; p provides basic authority for the performance of the functions and activities of the National Institute of Standards and Technology, authorizes appropriations for these purposes to be provided to the general public and specific institutions, governments, firms, and individuals, and requires the notification of Congress of a reprogramming of funds that exceeds a limit specified in public law.

15 U.S.C. 290b-f directs the Secretary of Commerce to provide for the collection, compilation, critical evaluation, publication, and dissemination of standard reference data and the authority to establish a non-agricultural technology office.

15 U.S.C. 1151-1152 establishes within the Department of Commerce, a central clearinghouse for technical information useful to American business and industry and provides for the dissemination of this technical, scientific information via the National Technical Information Service.

15 U.S.C. 1454(d-e) provides NIST with the authority to request that manufacturers and distributors of a commodity participate in voluntary product standards when there is undue proliferation of weights, measures, and quantities. Reports and recommendations to Congress are to be made upon industry failure to adopt these standards.

15 U.S.C. 1511, 1512 specifies that all bureaus of the Department of Commerce come under the authority of the Secretary of Commerce and that such bureaus including NIST shall be subject to the authority of the Secretary of Commerce.

15 U.S.C. 3710a-d provides the authority to enter into CRADAs, to make cash awards to scientific personnel for inventions, to retain royalties and to distribute royalties for inventions, and to communicate and coordinate for the Offices of Research and Technology Applications in Federal laboratories.

15 U.S.C. 3711a provides the authority for the Baldrige National Quality award.

15 U.S.C. 7301-7313 establishes National Construction Safety Teams within NIST to respond to building and structural emergencies.

15 U.S.C. 7406 provides authority for NIST to conduct Cyber Security Research and Development to minimize security risks associated with computer systems used by the Federal government.

15 U.S.C. 7506(a) provides for the establishment of a nanotechnology research and development program within NIST.

2. $535,000,000, to remain available until expended,

    no specific authority

3. of which not to exceed $12,300,000 may be transferred to the "Working Capital Fund."

    15 U.S.C. 278b

    15 U.S.C. 278b provides in part: "The National Institute of Standards and Technology is authorized to utilize in the performance of its functions the Working Capital Fund".

4. Public Law 110-69 121 Stat 572, passed August 9, 2007 reauthorizes the Scientific and Technical Research and Services appropriation through 2010

Department of Commerce
National Institute of Standards and Technology
Scientific and Technical Research and Services
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate
Management and professional support services	$742	$391	$382
Studies, analyses, and evaluations	1,543	1,044	620
Engineering and technical services	2,401	1,632	1,362
Total	4,686	3,067	2,364

Significant Activities

Advisory and assistance services funded by the STRS appropriation include the review and evaluation of the technical functions and operations of NIST by the Board on Assessment of the National Academy of Sciences. The Evaluation Panels consider the importance and relative priority of projects, quality of staff, equipment needs, and finances, and the relation of the programs to the mission of NIST.

Need for Advisory and Assistance Services:

The need for advisory and assistance services stems from the NIST role in dealing with the private sector, professional organizations, and the public sector. Inputs must be obtained from consultants who can bring their individual expertise to bear and help NIST in assessing its program plans to meet the needs of its customers. The alternative to utilizing these services is to make no attempt to have expertise from sources outside NIST and risk degradation of the working and professional relationship with those in the business of using the products and services offered by NIST.

Exhibit 5

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations	Appro-priation
2008 Currently Available	127	133	$136,040	$161,274	$154,840
less: Unobligated balance from prior year	0	0	0	(19,734)	0
2009 Adjustments to base:					
plus: Restoration of 2008 deobligation offset	0	0	6,200	700	6,200
plus: Restoration of unobligated balance rescission	0	0	18,800	18,800	0
plus: Uncontrollable cost changes	0	0	683	683	683
less: Amount absorbed	0	0	(683)	(683)	(683)
less: Estimated recoveries 2009	0	0	(6,200)	0	(6,200)
2009 Base Request	127	133	154,840	161,040	154,840
less: 2009 Program changes	(127)	(86)	(150,840)	(150,840)	(150,840)
2009 Estimate	0	47	4,000	10,200	4,000

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Comparison by activity/subactivity:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Advanced technology program/Technology innovation program											
Advanced technology program/Technology innovation program	Pos./Approp	122	$79,078	66	$65,200	66	$65,200	0	0	(66)	($65,200)
	FTE/Obl.	127	93,353	66	70,231	66	71,400	28	$6,200	(38)	(65,200)
Hollings manufacturing extension partnership											
Hollings manufacturing extension partnership	Pos./Approp	61	104,741	61	89,640	61	89,640	0	4,000	(61)	(85,640)
	FTE/Obl.	65	106,516	67	91,043	67	89,640	19	4,000	(48)	(85,640)
TOTALS	Pos./Approp	183	183,819	127	154,840	127	154,840	0	4,000	(127)	(150,840)
	FTE/Obl.	192	199,869	133	161,274	133	161,040	47	10,200	(86)	(150,840)

Comparison by activity/subactivity:	2007 Actual Personnel	2007 Actual Amount	2008 Currently Available Personnel	2008 Currently Available Amount	2009 Base Personnel	2009 Base Amount	2009 Estimate Personnel	2009 Estimate Amount	Increase/ (Decrease) Over 2009 Base Personnel	Increase/ (Decrease) Over 2009 Base Amount
Adjustments for:										
Recoveries		(11,950)		(5,500)		(6,200)		(6,200)		0
Refunds		(754)		0		0		0		0
Unobligated balance, start of year		(30,080)		(19,734)		0		0		0
Unobligated balance, end of year		19,734		0		0		0		0
Budget Authority		176,819		136,040		154,840		4,000		(150,840)
Unobligated balance rescission		7,000		18,800		0		0		0
Financing from transfers:										
Transfers to other accounts (+)		0		0		0		0		0
Appropriation		183,819		154,840		154,840		4,000		(150,840)

Exhibit 8

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	Perm. Pos.	FTE	Amount
Adjustments:			
Restoration of FY 2008 deobligation offset	...	...	$6,200
Restoration of FY 2008 unobligated balance rescission	...	...	18,800
Subtotal adjustments	...	...	25,000
Financing:			
Recoveries of prior year deobligations	...	...	(6,200)
Other Changes:			
Annualization of 2008 Pay raise	...	...	47
2009 Pay increase and related costs	...	...	329
Annualization of position reductions in FY 2008	0	0	0
Change in compensable days	...	...	(55)
Personnel Benefits:			
Civil Service Retirement System (CSRS)	...	...	(15)
Federal Employees' Retirement System (FERS)	...	...	24
Thrift Savings Plan (TSP)	...	...	10
Federal Insurance Contribution Act (FICA) - OASDI	...	...	14
Health insurance	...	...	15
Employees' Compensation Fund	...	...	(22)
Communications, utilities, and miscellaneous charges:			
Natural Gas rate increase	...	...	66
Electricity rate decrease	...	...	(7)
Other services:			
Working Capital Fund (Departmental Management)	...	...	19
General pricing level adjustment:	...	...	
Transportation of Things	...	...	1
Rental Payments to others	...	...	1
Postage	...	...	1
Communications, utilities, and miscellaneous charges	...	...	6
Printing and reproduction	...	...	2
Other services	...	...	213
Supplies and materials			12
Equipment	...	...	22
Subtotal, Other changes	0	0	683
Subtotal, Adjustments to base	0	0	19,483
Less, Amount absorbed	0	0	(683)
Total, Adjustments to base	0	0	18,800

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
JUSTIFICATION OF ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	FTE	Amount
Adjustments:		
Restoration of FY 2008 deobligation offset		$6,200

In FY 2008, NIST's ITS budget authority was reduced by $6,200,000 based on an estimated level of ATP/TIP prior year deobligations. This adjustment would restore funding in FY 2009.

	FTE	Amount
Restoration of FY 2008 unobligated balance rescission		18,800

In FY 2008, unobligated balances in NIST's ITS account was reduced by an $18,800,000 rescission. This adjustment would restore that funding in FY 2009.

	FTE	Amount
Subtotal, Adjustments		25,000
Financing:		
Recoveries of prior year deobligations		(6,200)

This reduction is the estimated level of ATP/TIP prior year deobligations in FY 2009.

Other Changes:

Annualization of 2008 pay raise		0	47

A pay raise of 3.5 percent is assumed to be effective January 1, 2008.

Total cost in FY 2009 of 2008 pay raise	$188,000
Less amount requested in FY 2008	(141,000)
Less amount absorbed in FY 2009	0
Amount requested in 2009 to provide full-year cost of 2008 pay raise	47,000
Payment to Departmental Management Working Capital Fund	0
Total, FY 2008 pay raise increase in FY 2009	47,000

2009 Pay increase and related costs		0	329

A general pay raise of 2.9 percent is assumed to be effective January 1, 2009.

Total cost in FY 2009 of pay increase.	$317,000
Amount absorbed in FY 2009	0
Amount requested for FY 2009 pay raise	317,000
Payment to Departmental Management Working Capital Fund	12,000
Total adjustment for FY 2009 pay increase	329,000

Change in compensable days		0	(55)

The decreased cost of one less compensable day in FY 2009 compared to FY 2008 is calculated by dividing the FY 2008 estimated personnel compensation ($12,031,000) and applicable benefits ($2,422,000) by 262 compensable days. The cost decrease of one more compensable day is $55,164.

Personnel benefits.	0	26

Civil Service Retirement System (CSRS)	($15)
Federal Employees' Retirement System (FERS)	24
Thrift Savings Plan (TSP)	10
Federal Insurance Contribution Act (FICA) – OASDI	14
Health Insurance	15
Employees' Compensation Fund	(22)

Civil Service Retirement System (-$15,000) – The number of employees covered by the Civil Service Retirement System (CSRS) continues to drop as positions become vacant and are filled by employees who are covered by the Federal Employees' Retirement System (FERS). The estimated percentage of payroll for employees covered by CSRS will decrease from 18.6 percent in FY 2008 to 16.8 percent in FY 2009. The contribution rate will remain at 7.0 percent in FY 2009.

Payroll subject to retirement systems ($12,006,938)	
Cost of CSRS contributions in FY 2009 ($12,006,938 x .168 x .07)	$141,202
Cost of CSRS contributions in FY 2008 ($12,006,938 x .186 x .07)	156,330
Total adjustment to base	(15,128)

Federal Employees' Retirement System ($24,000) – The number of employees covered by FERS continues to rise as employees covered by CSRS leave and are replaced by employees covered by FERS. The estimated percentage of payroll for employees covered by FERS will increase from 81.4 percent in FY 2008 to 83.2 percent in FY 2009. The contribution rate will remain at 11.2 percent in FY 2009.

Payroll subject to retirement systems ($12,006,938)	
Basic benefit cost in FY 2009 ($12,006,938 x .832 x .112)	$1,118,855
Basic benefit cost in FY 2008 ($12,006,938 x .814 x .112)	1,094,649
Total adjustment to base	24,206

Thrift Savings Plan ($10,000) – The cost of agency contributions to the Thrift Savings Plan will also rise as FERS participation increases. The contribution rate will remain at 4.65 percent.

Thrift plan cost in FY 2009 ($12,006,938, x .832 x .0465)	$464,524
Thrift plan cost in FY 2008 ($12,006,938 x .814 x .0465)	454,475
Total adjustment to base	10,049

Federal Insurance Contributions Act (FICA) - OASDI ($14,000) – As the percentage of payroll covered by FERS increases, the cost of OASDI contributions will increase. In addition, the maximum salary subject to OASDI tax will increase from $102,300 in FY 2008 to $106,425 in FY 2009. The OASDI tax rate will remain 6.2 percent in FY 2009.

FERS payroll subject to FICA tax in 2009 ($12,006,938 x .832 x .905 x .062)	$560,526
FERS payroll subject to FICA tax in 2008 ($12,006,938 x .814 x .902 x .062)	546,581
Increase (FY 2008-FY 2009)	13,945
OTP payroll subject to FICA tax in 2009 ($537,062 x .832 x .905 x .062)	25,072
OTP payroll subject to FICA tax in 2008 ($537,062 x .814 x .902 x .062)	24,448
Increase (FY 2008-2009)	624
Total adjustment to base	14,569

Health insurance ($15,000) – Effective January 2007, NIST's contribution to Federal employees' health insurance premiums increased by 2.1 percent. Applied against the FY 2008 estimate of $700,000, the additional amount required is $14,700.

Employees Compensation Fund ($-22,000) – The Employees' Compensation Fund bill for the year ending July 30, 2007, is a net $32,000 lower than for the year ending July 30, 2006. The ITS share of the decrease is $22,000.

Communications, utilities, and miscellaneous charges		0	60
Postage	$1		
Natural Gas rate increase	66		
Electricity rate decrease	(7)		

Effective May 14, 2007, the Governors of the Postal Service implemented a rate increase for first class mail from 39 cents to 41 cents, an increase of 5.1 per cent. This percentage was applied to the FY 2008 estimate of $10,000 to arrive at an increase of $510.

The natural gas ATB amount was derived using a year to year comparison of the cost per therm. In analyzing the 12 months ended March 2007 and 2006, the per therm rate decreased 3.00 percent (from 10.465 to 10.155) and increased 17.9 percent (from 1.374 to 1.6199) for Boulder and Gaithersburg respectively resulting in a net increase of $66,000.

The electricity ATB amount was derived using a year to year comparison of the cost per kilowatt hour. In analyzing the 12 months ended February 2007 and 2006, the per kilowatt hour rate decreased 2.2 percent (from 8.9 cents to 8.7 cents) for Gaithersburg, Maryland; increased 8.4 percent (from 28.7 cents to 31.1 cents) for Kauai, Hawaii; decreased 11.4 percent (from 6.4 cents to 5.67 cents) for Boulder, Colorado; and increased 3.9 percent (from 7.7 cents to 8.0 cents) for Ft. Collins, Colorado for a net decrease of $7,000.

Other services	0	19

Working Capital Fund (Departmental Management) ($19,000) – An additional $19,000 is required to fund cost increases in the Departmental Management Working Capital Fund.

General pricing level adjustment	0	257

This request applies the OMB economic assumptions of 1.9 percent for FY 2009 where the prices that the government pays are established through the market system. Factors are applied to sub-object classes that result in the following adjustments to base: transportation of things $779; rental payments to others $703; communications, utilities, and miscellaneous charges $5,510; printing $2,166, other services $213,000; supplies $12,369; and equipment $22,401.

Subtotal, Other Changes	0	683
Adjustments to base	0	19,483
Less, amount absorbed	0	(683)
Total, Adjustments to base	0	18,800

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Activity: Advanced technology program/Technology innovation program
Subactivity: Advanced technology program/Technology innovation program

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
Advanced technology program/	Pos./Approp	122	$79,078	66	$65,200	66	$65,200	0	0	(66)	($65,200)
Technology innovation program	FTE/Obl.	127	93,353	66	70,231	66	71,400	28	$6,200	(38)	(65,200)

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
PROGRAM AND PERFORMANCE: REIMBURSABLE OBLIGATIONS
(Dollar amounts in thousands)

Activity: Advanced technology program/Technology innovation program
Subactivity: Advanced technology program/Technology innovation program

	2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
Advanced technology program/ Technology innovation program										
WCF transfer		0		0		0		0		0
Reimbursables	0	$2	0	$171	0	0	0	0	0	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Total	0	2	0	171	0	0	0	0	0	0

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
JUSTIFICATION OF PROGRAM AND PERFORMANCE
TECHNOLOGY INNOVATION PROGRAM

On August 9, 2007, the President signed Public Law 110-69, the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act. The act eliminates NIST's Advanced Technology Program (ATP), but allows for continued support for previous and pending ATP awards.

The same statute creates the Technology Innovation Program (TIP). While TIP is intended to target areas of national need to a greater extent than ATP, it would continue to provide subsidies for activities that private industry has the means and incentive to support. Therefore, the FY 2009 President's budget requests no funding for TIP, but continues to support critical national research needs through the intramural programs of the American Competitiveness Initiative.

Exhibit 13

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
DECREASE FOR FY 2009
(Dollar amounts in thousands)

		2009 Base		2009 Estimate		Increase/(Decrease) Over 2009 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount
Technology Innovation Program	Pos./Approp	66	$65,200	0	0	(66)	($65,200)
	FTE/Obl.	66	71,400	28	$6,200	(38)	(65,200)

Technology Innovation Program (-66 Permanent Positions, -38 FTE, Appropriation -$65,200,000, Direct Obligations -$65,200,000) – On August 9, 2007, the President signed Public Law 110-69, the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science (COMPETES) Act. The COMPETES Act eliminated NIST's Advanced Technology Program (ATP), but allowed for continued support for ATP prior-year awards (mortgages). The same statute created the Technology Innovation Program (TIP), which provides assistance for proposed technologies with strong potential to address critical national needs. The Administration's FY 2009 budget continues investing in basic research through mechanisms such as the American Competitiveness Initiative (ACI), which proposes doubling the support over the coming decade for high-payoff physical science research in the National Institute of Standards and Technology (NIST), the National Science Foundation, and the Department of Energy Office of Science. The FY 2009 budget request continues the ACI as NIST's highest priority for the nation. As a result, no funds are requested for TIP in FY 2009. Anticipated prior-year recoveries will be sufficient to phase out the program.

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM CHANGE PERSONNEL DETAIL

Activity: Technology Innovation Program
Subactivity: Technology Innovation Program
Program Change: Technology Innovation Program

Title	Grade	Number	Annual Salary	Total Salaries
Director	SES	(1)	163,500	(163,500)
Division Director	SES	(1)	163,500	(163,500)
Administrative Specialist	ZA V	(1)	113,674	(113,674)
Biologist	ZP V	(4)	113,674	(454,696)
Chemical Engineer	ZP V	(2)	113,674	(227,348)
Chemist	ZP V	(3)	113,674	(341,022)
Computer Scientist	ZP V	(4)	113,674	(454,696)
Economist	ZP V	(4)	113,674	(454,696)
Materials Engineer	ZP V	(2)	113,674	(227,348)
Mechanical Engineer	ZP V	(3)	113,674	(341,022)
Physical Scientist	ZP V	(4)	113,674	(454,696)
Senior Management Advisor	ZA V	(1)	113,674	(113,674)
Administrative Officer	ZA IV	(1)	96,637	(96,637)
Biologist	ZP IV	(1)	96,637	(96,637)
Chemist	ZP IV	(1)	96,637	(96,637)
Computer Scientist	ZP IV	(4)	96,637	(386,548)

Title	Grade	Number	Annual Salary	Total Salaries
Economist	ZP IV	(10)	96,637	(966,370)
Electronics Engineer	ZP IV	(1)	96,637	(96,637)
General Business Specialists	ZA IV	(3)	96,637	(289,911)
IT Specialist	ZP IV	(2)	96,637	(193,274)
Physical Scientist	ZP IV	(1)	96,637	(96,637)
Physicist	ZP IV	(2)	96,637	(193,274)
Social Scientist	ZP IV	(1)	96,637	(96,637)
Business Liaison Specialist	ZA III	(2)	68,770	(137,540)
Information Specialists	ZA III	(2)	68,770	(137,540)
Statistician	ZP III	(1)	68,770	(68,770)
Secretary	ZS V	(1)	52,224	(52,224)
Administrative/technical support	ZS IV	(3)	42,937	(128,811)
Subtotal		(66)		(6,643,956)
Less lapse	56 %	38		3,733,903
Total full-time permanent (FTE)		(28)		(2,910,053)
2009 Pay Adjustment (2.9%)				(91,392)
Total				(3,001,445)

Personnel Data		
Full-Time Equivalent Employment:		
Full-time permanent		(28)
Authorized Positions:		
Full-time permanent		(66)

Exhibit 15

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollars in thousands)

Activity: Technology Innovation Program
Subactivity: Technology Innovation Program
Program Change: Technology Innovation Program

Object Class		2009 Increase/ (Decrease) Obligations
11	Personnel compensation	
11.1	Full-time permanent	($3,001)
11.9	Total personnel compensation	(3,001)
12.1	Civilian personnel benefits	(724)
21	Travel and transportation of persons	(364)
22	Transportation of things	(18)
23.3	Communications, utilities and miscellaneous charges	(1,297)
24	Printing and reproduction	(71)
25.1	Advisory and assistance services	(1,379)
25.2	Other services	(4,333)
25.3	Purchases of goods and services from Government accounts	(896)
25.5	Research and development contracts	(1,245)
25.7	Operation and maintenance of equipment	(889)
26	Supplies and materials	(383)
31	Equipment	(814)
32	Land and structures	0
41	Grants, subsidies and contributions	(49,786)
99	Direct obligations	(65,200)
	Transfer to NIST Working Capital Fund	0
	Total increase requested	(65,200)

Department of Commerce
National Institute of Standards and Technology
Advanced technology program/Technology innovation program
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2007 Actual	FY 2008 Currently Available	FY 2009 Estimate
Technical & Advisory Services	$2	$171	0
Subtotal, Other Reimbursables	2	171	0
Total, Reimbursable Program	2	171	0

Exhibit 10

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Activity: Hollings manufacturing extension partnership
Subactivity: Hollings manufacturing extension partnership

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Hollings manufacturing	Pos./Approp	61	$104,741	61	$89,640	61	$89,640	0	$4,000	(61)	($85,640)
extension partnership	FTE/Obl.	65	106,516	67	91,043	67	89,640	19	4,000	(48)	(85,640)

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
PROGRAM AND PERFORMANCE: REIMBURSABLE OBLIGATIONS
(Dollar amounts in thousands)

Activity: Hollings manufacturing extension partnership
Subactivity: Hollings manufacturing extension partnership

	2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Line Item	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
Hollings manufacturing extension partnership										
WCF transfer		0		0		0		0		0
Reimbursables	2	$791	2	$567	2	0	0	0	(2)	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Total	2	791	2	567	2	0	0	0	(2)	0

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
JUSTIFICATION OF PROGRAM AND PERFORMANCE
HOLLINGS MANUFACTURING EXTENSION PARTNERSHIP

The Hollings Manufacturing Extension Partnership (MEP) Program provided small U.S. manufacturers with information, decision support, and implementation assistance in adopting advanced manufacturing technologies, tools, and business best practices. The FY 2009 budget ends Federal funding for MEP centers, which will change to a self-supporting basis, as intended in the program's original authorization. No center renewal funding will occur with FY 2009 funding.

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
DECREASE FOR FY 2009
(Dollar amounts in thousands)

		2009 Base		2009 Estimate		Increase/(Decrease) Over 2009 Base	
		Personnel	Amount	Personnel	Amount	Personnel	Amount
Hollings Manufacturing Extension Partnership Program	Pos./Approp	61	$89,640	0	$4,000	(61)	($85,640)
	FTE/Obl.	67	89,640	19	4,000	(48)	(85,640)

Hollings Manufacturing Extension Partnership Program (-61 Permanent Positions, -48 FTE, Appropriation -$85,640, Direct Obligations -$85,640) – The FY 2009 budget discontinues Federal funding for the MEP. The FY 2009 funding request allows for the orderly change of MEP centers to a self-supporting basis. No center renewal funding will occur with FY 2009 funding.

Exhibit 14

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM CHANGE PERSONNEL DETAIL

Activity: Hollings manufacturing extension partnership
Subactivity: Hollings manufacturing extension partnership
Program Change: Hollings manufacturing extension partnership program

Title	Grade	Number	Annual Salary	Total Salaries
Deputy director	ZA V	(1)	113,674	(113,674)
Director	ZA V	(1)	113,674	(113,674)
Industrial specialist	ZA V	(2)	113,674	(227,348)
Mechnical engineer	ZP V	(1)	113,674	(113,674)
Social science analyst	ZP V	(1)	113,674	(113,674)
Supervisory industrial specialist	ZA V	(2)	113,674	(227,348)
Administrative/financial specialist	ZA IV	(1)	96,637	(96,637)
Economist	ZP IV	(2)	96,637	(193,274)
General business specialist	ZA IV	(4)	96,637	(386,548)
Industrial specialist	ZA IV	(12)	96,637	(1,159,644)
IT specialist	ZP IV	(2)	96,637	(193,274)
Program analyst	ZA IV	(1)	96,637	(96,637)
Business liaison specialist	ZA III	(2)	68,770	(137,540)
Information specialist	ZA III	(1)	68,770	(68,770)
Adminstrative officer	ZS V	(2)	52,224	(104,448)
Administrative/technical support	ZA II	(13)	47,422	(616,486)
Industrial specialist	ZA II	(2)	47,422	(94,844)
Administrative/technical support	ZS II	(10)	27,974	(279,740)
Office automation clerk	ZS II	(1)	27,974	(27,974)
Subtotal		(61)		(4,365,208)
Less lapse	20 %	13		873,041
Total full-time permanent (FTE)		(48)		(3,492,167)
2009 Pay Adjustment (2.9%)				(101,272)
Total				(3,593,439)

Personnel Data	Number
Full-Time Equivalent Employment:	
Full-time permanent	(48)
Authorized Positions:	
Full-time permanent	(61)

Exhibit 15

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
PROGRAM CHANGE DETAIL BY OBJECT CLASS
(Dollars in thousands)

Activity: Hollings manufacturing extension partnership
Subactivity: Hollings manufacturing extension partnership
Program Change: Hollings manufacturing extension partnership program

Object Class		2009 Increase/ (Decrease) Obligations
11	Personnel compensation	
11.1	Full-time permanent	($3,593)
11.9	Total personnel compensation	(3,593)
12.1	Civilian personnel benefits	(971)
13	Benefits to former personnel	700
21	Travel and transportation of persons	(510)
22	Transportation of things	(10)
23.3	Communications, utilities and miscellaneous charges	(778)
24	Printing and reproduction	(7)
25.1	Advisory and assistance services	(2,125)
25.2	Other services	(4,783)
25.3	Purchases of goods and services from Government accounts	(527)
25.5	Research and development contracts	0
25.7	Operation and maintenance of equipment	(185)
26	Supplies and materials	(305)
31	Equipment	(296)
32	Land and structures	0
41	Grants, subsidies and contributions	(72,250)
99	Direct obligations	(85,640)
	Transfer to NIST Working Capital Fund	0
	Total increase requested	(85,640)

Department of Commerce
National Institute of Standards and Technology
Hollings Manufacturing Extension Partnership
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2007 Actual	FY 2008 Currently Available	FY 2009 Estimate
Department of Defense			
Other	$200	0	0
Subtotal, Department of Defense	200	0	0
Department of Health & Human Services	300	0	0
Department of Homeland Security	0	$200	0
Department of Labor	245	119	0
Environmental Protection Agency	45	248	0
Subtotal, Federal Agencies	790	567	0
Technical & Advisory Services	1	0	0
Subtotal, Other Reimbursables	1	0	0
Total, Reimbursable Program	791	567	0
Total, Reimbursable Program and WCF Investments	791	567	0

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Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
11	Personnel compensation					
11.1	Full-time permanent	$16,499	$11,927	$11,574	$5,907	($5,667)
11.3	Other than full-time permanent	1,370	457	457	85	(372)
11.5	Other personnel compensation	555	555	555	0	(555)
11.9	Total personnel compensation	18,424	12,939	12,586	5,992	(6,594)
12.1	Civilian personnel benefits	4,759	3,254	3,196	1,501	(1,695)
13	Benefits for former personnel	1	0	0	700	700
21	Travel and transportation of persons	818	1,045	1,045	171	(874)
22	Transportation of things	42	44	44	16	(28)
23.1	Rental payments to GSA	0	0	0	0	0
23.2	Rental payments to others	227	37	30	17	(13)
23.3	Communications, utilities, and miscellaneous charges	2,828	2,871	2,876	814	(2,062)
24	Printing and reproduction	115	115	115	37	(78)
25.1	Advisory and assistance services	6,462	3,736	3,504	0	(3,504)
25.2	Other services	5,590	8,205	9,616	500	(9,116)
25.3	Purchases of goods and services from government accounts	1,588	1,645	1,645	222	(1,423)
25.5	Research and development contracts	647	1,245	1,245	0	(1,245)
25.7	Operation and maintenance of equipment	1,061	1,119	1,119	45	(1,074)
26	Supplies and materials	842	742	742	54	(688)
31	Equipment	1,188	1,241	1,241	131	(1,110)
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	155,275	123,036	122,036	0	(122,036)
42	Insurance claims and indemnities	2	0	0	0	0
99	Total Obligations	199,869	161,274	161,040	10,200	(150,840)

	Object Class	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
99	Total Obligations	199,869	161,274	161,040	10,200	(150,840)
	Less Prior Year Recoveries	(11,950)	(5,500)	(6,200)	(6,200)	0
	Less Prior Year Refunds	(754)	0	0	0	0
	Less Prior Year Unobligated Balance	(30,080)	(19,734)	0	0	0
	Plus Unobligated Balance End of Year	19,734	0	0	0	0
	Total Budget Authority	176,819	136,040	154,840	4,000	(150,840)
	Plus Unobligated Balance Rescission	7,000	18,800	0	0	0
	Appropriation	183,819	154,840	154,840	4,000	(150,840)

Personnel Data

	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
Full-time equivalent employment:					
Full-time permanent	181	133	133	47	(86)
Other than full-time permanent	11	0	0	0	0
Total	192	133	133	47	(86)
Authorized Positions:					
Full-time permanent	175	127	127	0	(127)
Other than full-time permanent	8	0	0	0	0
Total	183	127	127	0	(127)

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
DETAILED REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
11	Personnel compensation				
11.1	Full-time permanent				
	Executive level	0	0	0	0
	Senior executive service	0	$654	$396	($258)
	Career path	0	10,920	5,511	(5,409)
	Wage board	0	0	0	0
	Scientific & professional (P.L. 80-313)	0	0	0	0
	Subtotal	0	11,574	5,907	(5,667)
11.3	Other than full-time permanent				
	Career path	0	457	85	(372)
	Wage board	0	0	0	0
	Scientific & professional (P.L. 80-313)	0	0	0	0
	Experts & consultants	0	0	0	0
	Subtotal	0	457	85	(372)
11.5	Other personnel compensation				
	Overtime	0	132	0	(132)
	SES performance awards	0	42	0	(42)
	Cash awards	0	381	0	(381)
	Other	0	0	0	0
	Subtotal	0	555	0	(555)
11.9	Total personnel compensation	0	12,586	5,992	(6,594)

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
12.1	Civilian personnel benefits				
	Civil service retirement	0	178	135	(43)
	Federal employees' retirement	0	1,039	390	(649)
	Thrift savings plan	0	410	241	(169)
	Federal Insurance Contribution Act	0	701	261	(440)
	Health insurance	0	700	346	(354)
	Life insurance	0	17	7	(10)
	Employees' Compensation Fund	0	74	61	(13)
	Other	0	77	60	(17)
	Subtotal	0	3,196	1,501	(1,695)
13	Benefits for former personnel				
	Severance pay	0	0	500	500
	Voluntary separation incentives	0	0	200	200
	Unemployment compensation	0	0	0	0
	Other	0	0	0	0
	Subtotal	0	0	700	700
21	Travel and transportation of persons				
	Common carrier	0	454	71	(383)
	Mileage	0	4	0	(4)
	Per diem/actual	0	366	62	(304)
	Other	0	221	38	(183)
	Subtotal	0	1,045	171	(874)
22	Transportation of things	0	44	16	(28)
23.1	Rental payments to GSA	0	0	0	0
23.2	Rental payments to others	0	30	17	(13)

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
23.3	Communications, utilities, and miscellaneous charges				
	Rental of ADP equipment	0	4	1	(3)
	Rental of office copying equipment	0	24	8	(16)
	Other equipment rental	0	29	9	(20)
	Federal telecommunications system	0	65	19	(46)
	Other telecommunications services	0	181	30	(151)
	Postal Service by USPS	0	15	11	(4)
	Utilities:				
	Electric	0	1,658	453	(1,205)
	Gas	0	790	241	(549)
	Water/Sewer	0	110	42	(68)
	Subtotal	0	2,876	814	(2,062)
24	Printing and reproduction				
	Publications	0	7	2	(5)
	Other	0	108	35	(73)
	Subtotal	0	115	37	(78)
25.1	Advisory and assistance services				
	Management & professional support services	0	2,971	0	(2,971)
	Studies, analyses, & evaluation	0	533	0	(533)
	Engineering & technical services	0	0	0	0
	Subtotal	0	3,504	0	(3,504)
25.2	Other services				
	Training	0	928	20	(908)
	ADP Services	0	152	39	(113)
	Other non-government contracts	0	8,536	441	(8,095)
	Subtotal	0	9,616	500	(9,116)
25.3	Purchases of goods and services from Government accounts				
	Payments to DM, WCF	0	1,083	129	(954)
	Office of Personnel Management	0	30	15	(15)
	Other Federal agencies:				
	Department of Commerce	0	183	53	(130)
	Other	0	349	25	(324)
	Subtotal	0	1,645	222	(1,423)

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
25.5	Research and development contracts	0	1,245	0	(1,245)
25.7	Operation and maintenance of equipment	0	1,119	45	(1,074)
26	Supplies and materials				
	Office & laboratory supplies	0	533	30	(503)
	Scientific publications & journals	0	174	10	(164)
	Fuel oil	0	35	14	(21)
	Subtotal	0	742	54	(688)
31	Equipment				
	Office machines and other equipment	0	188	55	(133)
	ADP equipment	0	367	56	(311)
	Equipment amortization	0	686	20	(666)
	Subtotal	0	1,241	131	(1,110)
32	Land and structures	0	0	0	0
41	Grants, subsidies, and contributions	0	122,036	0	(122,036)
42	Insurance claims and indemnities	0	0	0	0
99	Total Obligations	0	161,040	10,200	(150,840)
	Less Prior Year Recoveries	0	(6,200)	(6,200)	0
	Total Budget Authority	0	154,840	4,000	(150,840)
	Transfer to NIST Working Capital Fund	0	0	0	0
	Total Requirements	0	154,840	4,000	(150,840)

Exhibit 33

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
APPROPRIATION LANGUAGE AND CODE CITATIONS

1. For necessary expenses of the Hollings Manufacturing Extension Partnership Program of the National Institute of Standards and Technology,

    15 U.S.C.271
    15 U.S.C. 278b
    15 U.S.C. 278k
    15 U.S.C. 278l
    15 U.S.C. 278n
    15 U.S.C. 7506(b)(2)

    15 U.S.C. 271 provides for NIST to support State technology programs supporting scientific and engineering research for accurate measurements and standards and improved technological processes.

    15 U.S.C. 278b provides for a Working Capital Fund to support NIST activities.

    15 U.S.C. 278k directs the Secretary, through the Director of NIST, to provide assistance for the creation of Regional Centers for the Transfer of Manufacturing Technology.

    15 U.S.C. 278l provides authority for technical assistance to State technology programs.

    15 U.S.C. 278n established the Advanced Technology Program within NIST to assist U.S. businesses in applying generic technology and research results to commercialize scientific discoveries and refine manufacturing technologies. Public Law 110-69 signed on August 9, 2007 has now abolished the Advanced Technology Program (ATP).

15 U.S.C. 7506(b)(2) instructs the NIST Director to utilize the Manufacturing Extension Partnership program to ensure that results of research on issues related to the development and manufacture of nanotechnology reach small- and medium-sized manufacturing companies.

2. $4,000,000, to remain available until expended.

no specific authority

3. Public Law 110-69 121 Stat 572, passed August 9, 2007 reauthorizes the Industrial Technology Services appropriation through 2010. In addition, it eliminated the Advanced Technology Program (ATP) and established the Technology Innovation Program (TIP) which provides grants to eligible companies or joint ventures whose proposed technology has strong potential to address critical national needs. It also amended 15 U.S.C. 3711 by changing the name of the National Medal of Technology from "Technology Medal" to "Technology and Innovation Medal".

Department of Commerce
National Institute of Standards and Technology
Industrial Technology Services
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate
Management and professional support services	$4,465	$3,036	$0
Studies, analyses, and evaluations	1,997	700	0
Engineering and technical services	0	0	0
Total	6,462	$3,736	0

Significant Activities

Advisory and assistance services funded by the Industrial Technology Services appropriation are used to conduct evaluations of the programmatic outcomes, service delivery efficiency, and internal infrastructure requirements of ATP/TIP and the Hollings MEP Program.

Need for Advisory and Assistance Services:

The need for advisory and assistance services stems from the role of NIST's extramural programs with its outside partners and small businesses to relate to the private sector, professional organizations, and the public sector. Inputs must be obtained from consultants who can bring their individual expertise to bear and help NIST in assessing its program plans to meet the needs of its customers. The alternative to utilizing these services is to make no attempt to have expertise from sources outside NIST and risk having a poorer working and professional relationship with those in the business of using the products and services offered by NIST. These services provide for economic assessment and external evaluation of NIST's extramural programs.

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Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations	Appro-priation
2008 Currently Available	61	54	$160,490	$177,570	$160,490
less: Unobligated balance from prior year	0	0	0	(17,080)	0
2009 Adjustments to base:					
less: Non-recurring 2007 costs	0	0	(123,904)	(123,904)	(123,904)
plus: Uncontrollable cost changes	0	6	725	725	725
2009 Base Request	61	60	37,311	37,311	37,311
plus: 2008 Program changes	0	0	61,689	61,689	61,689
2009 Estimate	61	60	99,000	99,000	99,000

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
Comparison by activity/subactivity:		Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount	Per-sonnel	Amount
Construction and major renovations											
Construction and major	Pos/Approp	51	$58,686	61	$160,490	61	$37,311	61	$99,000	0	$61,689
renovations	FTE/Obl.	50	51,493	54	177,570	60	37,311	60	99,000	0	61,689
Adjustments for:											
Prior year recoveries			(872)		0		0		0		0
Unobligated balance, start of year			(9,015)		(17,080)		0		0		0
Unobligated balance, end of year			17,080		0		0		0		0
Financing from transfers:											
Transfers to other accounts (+)			0		0		0		0		0
Appropriation			58,686		160,490		37,311		99,000		61,689

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
Total Obligations	$51,493	$177,723	$37,311	$99,000	$61,689
Financing:					
Offsetting collections from:					
Federal funds	0	0	0	0	0
Non-Federal sources	(153)	0	0	0	0
Total offsetting collections	(153)	0	0	0	0
Adjustments for:					
Prior year recoveries	(872)	0	0	0	0
Unobligated balance, start of year (Direct)	(9,015)	(17,080)	0	0	0
Unobligated balance, start of year (Reimbursable)	0	(153)	0	0	0
Unobligated balance, end of year (Direct)	17,080	0	0	0	0
Unobligated balance, end of year (Reimbursable)	153	0	0	0	0
Budget Authority	58,686	160,490	37,311	99,000	61,689
Financing:					
Transfer to other accounts	0	0	0	0	0
Transfer from other accounts	0	0	0	0	0
Appropriation	58,686	160,490	37,311	99,000	61,689

Exhibit 8

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	Perm. Pos.	FTE	Amount
Adjustments:			
Adjustment for one-time Facilities Improvement Plan items	...	...	($42,562)
Non-recurring Congressional items			($81,342)
Subtotal, Adjustments			($123,904)
Other Changes:			
Annualization of 2008 Pay raise	...	...	33
2009 Pay increase and related costs	...	...	111
Annualization of positions funded in FY 2008	6	6	
Change in compensable days	...	...	(20)
Personnel benefits:			
Civil Service Retirement System (CSRS)	...	...	(5)
Federal Employees' Retirement System (FERS)	...	...	9
Thrift Savings Plan (TSP)	...	...	4
Federal Insurance Contribution Act (FICA) - OASDI	...	...	6
Health insurance	...	...	6
General pricing level adjustment:			
Communications, utilities, and miscellaneous charges	...	...	2
Other services	...	...	502
Supplies and materials	...	...	68
Equipment	...	...	9
Subtotal, Other changes	6	6	725
Total, Adjustments to base	6	6	(123,179)

Exhibit 9

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
JUSTIFICATION OF ADJUSTMENTS TO BASE
(Dollar amounts in thousands)

	FTE	Amount
Adjustments:		
Adjustment for one-time Facilities Improvement Plan items	0	($42,562)

The FY 2008 President's Budget included one-time increases totaling $42,562,000 for the construction and modernization of facilities at the Gaithersburg, Maryland, and Boulder, Colorado worksites.

	FTE	Amount
Non-recurring Congressional items	0	($81,342)

The FY 2008 enacted Omnibus Appropriations bill contained one-time congressional items totaling $81,342,000. This adjustments removes these one-time costs from the FY 2009 base.

	FTE	Amount
Subtotal, Adjustments	0	($123,904)

Other Changes:

Annualization of 2008 pay raise.		0	33

A pay raise of 3.5 percent is assumed to be effective January 1, 2008.

Total cost in FY 2009 of 2008 pay raise	$130,667
Less amount requested in FY 2008	(98,000)
Less amount absorbed in FY 2008	0
Amount requested in 2009 to provide full-year cost of 2008 pay raise	32,667
Payment to Departmental Management Working Capital Fund	0
Total FY 2008 pay raise increase in FY 2009	32,667

2009 Pay increase and related costs	0	111

A general pay raise of 2.9 percent is assumed to be effective January 1, 2009.

Total cost in FY 2009 of pay increase	$111,000
Less amount absorbed in FY 2009	0
Amount requested for FY 2009 pay increase	111,000
Payment to Departmental Management Working Capital Fund	0
Total adjustment for FY 2009 pay increase	111,000

Annualization of positions financed in FY 2008	6	0

CRF requires an additional 6 FTE to staff FY 2008 requested increases at their full operating level in FY 2009.

Change in compensable days	0	(20)

The decreased cost of one less compensable day in FY 2009 compared to FY 2008 is calculated by dividing the FY 2008 estimated personnel compensation ($4,244,000) and applicable benefits ($947,000) by 262 compensable days. The cost decrease of one less compensable day is $19,813.

Personnel benefits	0	20

Civil Service Retirement System (CSRS)	($5)
Federal Employees' Retirement System (FERS)	9
Thrift Savings Plan (TSP)	4
Federal Insurance Contribution Act (FICA) - OASDI	6
Health Insurance	6

Civil Service Retirement System (-$5,000) – The number of employees covered by the Civil Service Retirement System (CSRS) continues to drop as positions become vacant and are filled by employees who are covered by the Federal Employees Retirement System (FERS). The estimated percentage of payroll for employees covered by CSRS will decrease from 18.6 percent in FY 2008 to 16.8 percent in FY 2009. The contribution rate will remain at 7.0 percent in FY 2009.

Payroll subject to retirement systems ($4,244,000)	
Cost of CSRS contributions in FY 2009 ($4,244,000 x .168 x .07)	$49,909
Cost of CSRS contributions in FY 2008 ($4,244,000 x .186 x .07)	55,257
Total adjustment to base	(5,348)

Federal Employees' Retirement System ($9,000) – The number of employees covered by FERS continues to rise as employees covered by CSRS leave and are replaced by employees covered by FERS. The estimated percentage of payroll for employees covered by FERS will increase from 81.4 percent in FY 2008 to 83.2 percent FY 2009. The contribution rate will remain at 11.2 percent in FY 2009.

Payroll subject to retirement systems ($4,244,000)	
Basic benefit cost in FY 2009 ($4,244,000 x .832 x .112)	$395,473
Basic benefit cost in FY 2008 ($4,244,000 x .814 x .112)	386,917
Total adjustment to base	8,556

Thrift Savings Plan ($4,000) – The cost of agency contributions to the Thrift Savings Plan will also rise as FERS participation increases. The contribution rate will remain at 4.65 percent.

Thrift plan cost in FY 2009 ($4,244,000 x .832 x .0465)	$164,192
Thrift plan cost in FY 2008 ($4,244,000 x .814 x .0465)	160,640
Total adjustment to base	3,552

Federal Insurance Contributions Act (FICA) - OASDI ($6,000) – As the percentage of payroll covered by FERS increases, the cost of OASDI contributions will increase. In addition, the maximum salary subject to OASDI tax will increase from $102,300 in FY 2008 to $106,425 in FY 2009. The OASDI tax rate will remain 6.2 percent in FY 2009.

FERS payroll subject to FICA tax in 2009 ($4,244,000 x .832 x .905 x .062)	$198,125
FERS payroll subject to FICA tax in 2008 ($4,244,000 x .814 x .902 x .062)	193,196
Increase (FY 2008-FY 2009)	4,929
OTP payroll subject to FICA tax in FY 2009 ($515,000 x .832 x .905 x .062)	24,042
OTP payroll subject to FICA tax in FY 2008 ($515,000 x .814 x .902 x .062)	23,444
Increase (FY 2008-FY 2009)	598
Total adjustment to base	5,527

Health insurance ($6,000) – Effective January 2007, NIST's contribution to Federal employees' health insurance premiums increased by 2.1 percent. Applied against the FY 2008 estimate of $303,000, the additional amount required is $6,363.

General pricing level adjustment	0	581

This request applies the OMB economic assumptions of 1.9 percent for FY 2009 where the prices that the government pays are established through the market system. Factors are applied to sub-object classes that result in the following adjustments to base: communications, utilities, and miscellaneous charges $1,843; other services $502,056; supplies and materials $67,526; and equipment $8,740.

Subtotal, Other changes	6	725
Total adjustments to base	6	(123,179)

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
PROGRAM AND PERFORMANCE: DIRECT OBLIGATIONS
(Dollar amounts in thousands)

Activity: Construction and major renovations
Subactivity: Construction and major renovations

Line Item		2007 Actual Personnel	2007 Actual Amount	2008 Currently Available Personnel	2008 Currently Available Amount	2009 Base Personnel	2009 Base Amount	2009 Estimate Personnel	2009 Estimate Amount	(Increase/Decrease) Over 2009 Base Personnel	(Increase/Decrease) Over 2009 Base Amount
Construction and major renovations	Pos/Approp	2	$22,100	0	$123,904	0	0	0	$56,538	0	$56,538
	FTE/Obl.	2	15,422	0	139,801	0	0	0	56,538	0	56,538
Modifications and improvements	Pos/Approp	49	36,586	61	36,586	61	$37,311	61	42,462	0	5,151
	FTE/Obl.	48	36,071	54	37,767	60	37,311	60	42,462	0	5,151
Site Security	Pos/Approp	0	0	0	0	0	0	0	0	0	0
	FTE/Obl.	0	0	0	2	0	0	0	0	0	0
Total	Pos/Approp	51	58,686	61	160,490	61	37,311	61	99,000	0	61,689
	FTE/Obl.	50	51,493	54	177,570	60	37,311	60	99,000	0	61,689

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
JUSTIFICATION OF PROGRAM AND PERFORMANCE
MODIFICATIONS AND IMPROVEMENTS

Goal Statement

This program supports the Department of Commerce's and NIST's goal to promote U.S. innovation and industrial competitiveness by strengthening the Nation's measurement and standards infrastructure.

Base Program

The base program includes funding for the construction, maintenance, repair, and improvements of facilities occupied or used by NIST in Gaithersburg, Maryland; Boulder and Fort Collins, Colorado; and Kauai, Hawaii; to meet the measurement and research needs of the 21st century. Base funding of $37.3 million is used to address the highest priority safety, capacity, maintenance and major repair projects at NIST. This will help ensure compliance with various health and safety regulations, improve access for people with disabilities, and permit the performance of maintenance and major repairs, as well as safeguard the utility infrastructure of existing buildings.

The FY 2009 base program operating objectives include the following:

- continue the repair/upgrade of facilities that have a high impact on staff and visitor safety;
- continue abatement of hazardous materials from site buildings and structures;
- continue to modify the sites to comply with the Access to Federal Buildings Act and the Americans with Disabilities Act;
- continue repairs/replacements of utility systems, exhaust and air filtration systems, mechanical-electrical systems, and site alarm and fire safety systems that are failing at an accelerated rate due to the fact that the systems are over 40 to 50 years old;
- continue architectural, structural, and energy conservation related repairs, as needed; and
- enable or maintain building environmental conditions required for meeting scientific requirements.

While a plan for the use of the base funds has been developed, it is important to note that the planned use of these funds is subject to change if and when facilities-related emergency situations arise. Also, in many cases, final cost estimates resulting from contract negotiations may affect the number of projects that can be funded.

Performance Measures

Within available resources, the goal of this program is to keep laboratory and office space safe and appropriate for the work conducted. For existing buildings, NIST will keep the average unscheduled downtime to less than seven percent of the total scheduled operating time.

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Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
11	Personnel compensation					
11.1	Full-time permanent	$3,724	$4,319	$4,851	$4,851	0
11.3	Other than full-time permanent	0	0	0	0	0
11.5	Other personnel compensation	487	495	582	582	0
11.9	Total personnel compensation	4,211	4,814	5,433	5,433	0
12.1	Civilian personnel benefits	1,087	1,336	1,445	1,445	0
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	12	12	12	12	0
22	Transportation of things	14	14	14	14	0
23.1	Rental payments to GSA	0	0	0	0	0
23.2	Rental payments to others	0	0	0	0	0
23.3	Communications, utilities, and miscellaneous charges	102	102	104	104	0
24	Printing and reproduction	0	0	0	0	0
25.1	Advisory and assistance services	0	0	0	0	0
25.2	Other services	23,486	25,728	24,685	29,836	$5,151
25.3	Purchases of goods and services from government accounts	354	354	361	361	0
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and maintenance of equipment	1,144	1,144	1,166	1,166	0
26	Supplies and materials	3,554	3,803	3,622	3,622	0
31	Equipment	460	460	469	469	0
32	Land and structures	17,066	57,949	0	43,538	43,538
41	Grants, subsidies, and contributions	0	81,854	0	13,000	13,000
42	Insurance claims and indemnities	3	0	0	0	0
99	Total Obligations	51,493	177,570	37,311	99,000	61,689

	Object Class	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
99	Total Obligations	51,493	177,570	37,311	99,000	61,689
	Less Prior Year Recoveries	(872)	0	0	0	0
	Less Prior Year Unobligated Balance	(9,015)	(17,080)	0	0	0
	Plus Unobligated Balance End of Year	17,080	0	0	0	0
	Total Budget Authority	58,686	160,490	37,311	99,000	61,689
	Plus Transfers from Other Accounts	0	0	0	0	0
	Appropriation	58,686	160,490	37,311	99,000	61,689

Personnel Data

Full-time equivalent employment:					
Full-time permanent	50	54	60	60	0
Other than full-time permanent	0	0	0	0	0
Total	50	54	60	60	0
Authorized Positions:					
Full-time permanent	51	61	61	61	0
Other than full-time permanent	0	0	0	0	0
Total	51	61	61	61	0

Note: The object class distribution reported in the President's FY 2009 Budget Appendix does not reflect the final settle out of the Construction and Major Renovations and the Modifications and Improvements line items for FY 2008 and FY 2009. The object class distribution above reflects the final decisions.

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
DETAILED REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
11	Personnel compensation				
11.1	Full-time permanent				
	Executive level	0	0	0	0
	Senior executive service	0	0	0	0
	Career path	$72	$3,241	$3,241	0
	Wage board	36	1,610	1,610	0
	Scientific & professional (P.L. 80-313)	0	0	0	0
	Subtotal	108	4,851	4,851	0
11.3	Other than full-time permanent				
	Career path	0	0	0	0
	Wage board	0	0	0	0
	Scientific & professional (P.L. 80-313)	0	0	0	0
	Experts & consultants	0	0	0	0
	Subtotal	0	0	0	0
11.5	Other personnel compensation				
	Overtime	0	556	556	0
	SES performance awards	0	0	0	0
	Cash awards	0	26	26	0
	Other	0	0	0	0
	Subtotal	0	582	582	0
11.9	Total personnel compensation	108	5,433	5,433	0

Object Class		2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
12.1	Civilian personnel benefits				
	Civil service retirement	(4)	67	67	0
	Federal employees' retirement	16	489	489	0
	Thrift savings plan	7	190	190	0
	Federal Insurance Contribution Act	12	326	326	0
	Health insurance	5	343	343	0
	Life insurance	0	8	8	0
	Employees' Compensation Fund	0	11	11	0
	Other	0	11	11	0
	Subtotal	36	1,445	1,445	0
13	Benefits for former personnel				
	Severance pay	0	0	0	0
	Unemployment compensation	0	0	0	0
	Other	0	0	0	0
	Subtotal	0	0	0	0
21	Travel and transportation of persons				
	Common carrier	0	3	3	0
	Mileage	0	0	0	0
	Per diem/actual	0	4	4	0
	Other	0	5	5	0
	Subtotal	0	12	12	0
22	Transportation of things	0	14	14	0
23.1	Rental payments to GSA	0	0	0	0
23.2	Rental payments to others	0	0	0	0

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
23.3	Communications, utilities, and miscellaneous charges				
	Rental of ADP equipment	0	0	0	0
	Rental of office copying equipment	1	58	58	0
	Other equipment rental	0	1	1	0
	Federal telecommunications system	0	0	0	0
	Other telecommunications services	1	40	40	0
	Postal Service by USPS	0	5	5	0
	Utilities:				
	Electric	0	0	0	0
	Gas	0	0	0	0
	Water/Sewer	0	0	0	0
	Subtotal	2	104	104	0
24	Printing and reproduction				
	Publications	0	0	0	0
	Other	0	0	0	0
	Subtotal	0	0	0	0
25.1	Advisory and assistance services				
	Management & professional support services	0	0	0	0
	Studies, analyses, & evaluation	0	0	0	0
	Engineering & technical services	0	0	0	0
	Subtotal	0	0	0	0
25.2	Other services				
	Training	0	32	32	0
	ADP Services	0	0	0	0
	Other non-government contracts	473	24,653	29,804	$5,151
	Subtotal	473	24,685	29,836	5,151
25.3	Purchases of goods and services from Government accounts				
	Payments to DM, WCF	0	0	0	0
	Office of Personnel Management	0	0	0	0
	Other Federal agencies:				
	Department of Commerce	2	102	102	0
	Other	5	259	259	0
	Subtotal	7	361	361	0

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
25.5	Research and development contracts	0	0	0	0
25.7	Operation and maintenance of equipment	22	1,166	1,166	0
26	Supplies and materials				
	Office & laboratory supplies	68	3,622	3,622	0
	Scientific publications & journals	0	0	0	0
	Fuel oil	0	0	0	0
	Subtotal	68	3,622	3,622	0
31	Equipment				
	Office machines and other equipment	6	323	323	0
	ADP equipment	0	16	16	0
	Equipment amortization	3	130	130	0
	Subtotal	9	469	469	0
32	Land and structures	(42,562)	0	43,538	43,538
41	Grants, subsidies, and contributions	(81,342)	0	13,000	13,000
42	Insurance claims and indemnities	0	0	0	0
99	Total Obligations	(123,179)	37,311	99,000	61,689
	Less Prior Year Recoveries	0	0	0	0
	Less Unobligated Balance start of year	0	0	0	0
	Plus Unobligated Balance end of year	0	0	0	0
	Total Budget Authority	(123,179)	37,311	99,000	61,689
	Transfer to NIST Working Capital Fund	0	0	0	0
	Total Requirements	(123,179)	37,311	99,000	61,689

Exhibit 33

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
APPROPRIATION LANGUAGE AND CODE CITATIONS

1. For construction of new research facilities, including architectural and engineering design, and for renovation and maintenance of existing facilities, not otherwise provided for the National Institute of Standards and Technology, as authorized by 15 U.S.C. 278c-278e.

   15 U.S.C. 278c authorizes that the Secretary of Commerce to acquire land for such field sites as are necessary for the proper and efficient conduct of the activities authorized.

   15 U.S.C. 278d authorizes that the Secretary of Commerce to undertake such construction of buildings and other facilities and to make such improvements to existing buildings, grounds, and other facilities as are necessary for the proper and efficient conduct of authorized activities.

   15 U.S.C. 278e provides that in the performance of the functions of the National Institute of Standards and Technology the Secretary of Commerce is authorized to undertake: the care, maintenance, protection, repair, and alteration of Institute buildings and other plant facilities, equipment, and property.

2. $99,000,000, to remain available until expended.

   no specific authority

3. Public law 110-69, HR 2272 Public Law 110-69 121 Stat 572, passed August 9, 2007 reauthorizes the Construction of Research Facilities appropriation through 2010. It also provided for the Retention of Fees to the Construction of Research Facilities account. "The Director is authorized to retain all building use and depreciation surcharge fees collected pursuant to OMB Circular A-25. Such fees shall be collected and credited to the Construction of Research Facilities Appropriation Account for use in maintenance and repair of the Institute's existing facilities".

Department of Commerce
National Institute of Standards and Technology
Construction of Research Facilities
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate
Management and professional support services	$0	$0	$0
Studies, analyses, and evaluations	0	0	0
Engineering and technical services	0	0	0
Total	0	0	0

Significant Activities

Professional support and engineering and technical services are obtained when required to support the construction and major repairs and renovations of NIST's physical infrastructures in Gaithersburg, Maryland, and Boulder, Colorado. Strategies and action plans are also developed to further ensure structural building safety when the need arises.

Need for Advisory and Assistance Services

NIST uses outside professional support and engineering and technical services whenever necessary expertise is not available in-house to ensure the safety of NIST staff and visitors.

Exhibit 5

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

	Positions	FTE	Budget Authority	Direct Obligations
2008 Currently available	665	746	$1,250	$1,250
Offset for reinstating previously reduced CRF FTEs		(6)		
Reduction in transfers from prior STRS program changes			(500)	(500)
2009 Base	665	740	750	750
Transfer of institute supported FTEs due to ATP & MEP shut down	43	39		
Transfer from STRS program changes for equipment investments			11,550	11,550
2009 Estimate	708	779	12,300	12,300

Exhibit 6

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
SUMMARY OF REIMBURSABLE OBLIGATIONS
(Dollar amounts in thousands)

Comparison by activity:	2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) Over 2009 Base	
	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
NIST laboratories										
Laboratories and technical programs										
WCF transfer		$750		$1,250		$750		$10,300		$9,550
Reimbursables	664	153,117	727	167,780	721	141,176	761	141,176	40	0
WCF investments	0	7,539	0	177	0	0	0	0	0	0
Subtotal	664	161,406	727	169,207	721	141,926	761	151,476	40	9,550
National research facilities										
WCF transfer		550		0		0		2,000		2,000
Reimbursables	15	3,974	17	3,791	17	3,819	18	3,819	1	0
WCF investments	0	(125)	0	(223)	0	0	0	0	0	0
Subtotal	15	4,399	17	3,568	17	3,819	18	5,819	1	2,000
Baldrige national quality program										
WCF transfer		0		0		0		0		0
Reimbursables	0	2,345	0	3,400	0	3,500	0	3,500	0	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Subtotal	0	2,345	0	3,400	0	3,500	0	3,500	0	0
Advanced technology program										
WCF transfer		0		0		0		0		0
Reimbursables	0	2	0	171	0	0	0	0	0	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Subtotal	0	2	0	171	0	0	0	0	0	0

Comparison by activity:	2007 Actual FTE	2007 Actual Amount	2008 Currently Available FTE	2008 Currently Available Amount	2009 Base FTE	2009 Base Amount	2009 Estimate FTE	2009 Estimate Amount	Increase/ (Decrease) Over 2009 Base FTE	Increase/ (Decrease) Over 2009 Base Amount
Hollings manufacturing extension partnership										
WCF transfer		0		0		0		0		0
Reimbursables	2	791	2	567	2	0	0	0	(2)	0
WCF investments	0	0	0	0	0	0	0	0	0	0
Subtotal	2	791	2	567	2	0	0	0	(2)	0
Total, National Institute of Standards and Technology										
WCF transfer		1,300		1,250		750		12,300		11,550
Reimbursables	681	160,229	746	175,709	740	148,495	779	148,495	39	0
WCF investments	0	7,414	0	(46)	0	0	0	0	0	0
Grand Total	681	168,943	746	176,913	740	149,245	779	160,795	39	11,550

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
Total Obligations	$168,943	$176,913	$149,245	$160,795	$11,550
Offsetting collections from:					
Federal funds	(118,444)	(127,404)	(100,779)	(100,779)	0
Non-Federal sources	(58,379)	(48,259)	(47,716)	(47,716)	0
Total offsetting collections	(176,823)	(175,663)	(148,495)	(148,495)	0
Unobligated balance, start of year	(131,598)	(140,778)	(140,778)	(140,778)	0
Unobligated balance, end of year	140,778	140,778	140,778	140,778	0
Budget Authority	1,300	1,250	750	12,300	11,550
Financing:					
Transfer from other accounts	(1,300)	(1,250)	(750)	(12,300)	(11,550)
Appropriation	0	0	0	0	0

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
JUSTIFICATION OF PROGRAM AND PERFORMANCE

Goal Statement

This Working Capital Fund (WCF) supports the NIST goal to promote innovation, facilitate trade and ensure public safety and security by strengthening the Nation's measurement and standards infrastructure, and the Department of Commerce strategic goal to promote U.S. innovation and industrial competitiveness by protecting intellectual property, enhancing technical standards, and advancing measurement science. The WCF reflects the full-time equivalent (FTE) employment and reimbursable obligations associated with the reimbursable work performed by NIST for other agencies and the public, and WCF investments.

Base Program

NIST's reimbursable services consist of technical work performed for other Federal agencies, state and local governments, and the private sector, including calibrations and special tests, advisory services, and the sale of Standard Reference Materials (SRMs). The unique measurement and standards expertise developed with appropriated funding gives NIST the capability to perform these services on a reimbursable basis. NIST accepts other agency work based on an established set of criteria which include: (1) the need for traceability of measurements to national standards; (2) the need for work which cannot or will not be addressed by the private sector; (3) work supported by legislation that authorizes or mandates certain services; (4) work which would result in an unavoidable conflict of interest if carried out by the private sector or regulatory agencies; and (5) requests by the private sector for NIST action or services.

The operations of the NIST WCF are reported in a program and financing schedule printed in the President's Budget, as well as reflected in the reimbursable amounts throughout this budget. In addition to its function as a revolving fund, the WCF is also used to handle annual leave on an accrued basis, to acquire equipment as an investment to be recovered through amortization charges to programs, to distribute indirect costs to programs as overhead, to carry the recoverable costs associated with the production of SRMs, and to carry supply inventories until issued for program use. A detailed cost accounting system is used to ensure that the actual cost of work performed for each job or task is recorded and identified with the appropriate source of financing.

Performance Measures

Data on NIST programmatic performance evaluation and reporting are provided in Exhibit 3A of this budget request.

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
11	Personnel compensation					
11.1	Full-time permanent	0	0	0	0	0
11.3	Other than full-time permanent	0	0	0	0	0
11.5	Other personnel compensation	0	0	0	0	0
11.9	Total personnel compensation	0	0	0	0	0
12.1	Civilian personnel benefits	0	0	0	0	0
13	Benefits for former personnel	0	0	0	0	0
21	Travel and transportation of persons	0	0	0	0	0
22	Transportation of things	0	0	0	0	0
23.1	Rental payments to GSA	0	0	0	0	0
23.2	Rental payments to others	0	0	0	0	0
23.3	Communications, utilities, and miscellaneous charges	0	0	0	0	0
24	Printing and reproduction	0	0	0	0	0
25.1	Advisory and assistance services	0	0	0	0	0
25.2	Other services	0	0	0	0	0
25.3	Purchases of goods and services from Government accounts	0	0	0	0	0
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and maintenance of equipment	0	0	0	0	0
26	Supplies and materials	$550	0	0	0	0
31	Equipment	750	$1,250	$750	$12,300	$11,550
32	Land and structures	0	0	0	0	0
41	Grants, subsidies, and contributions	0	0	0	0	0
42	Insurance claims and indemnities	0	0	0	0	0
99	Total Obligations	1,300	1,250	750	12,300	11,550

Personnel Data	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
Full-time equivalent employment:					
Full-time permanent	618	683	677	716	39
Other than full-time permanent	63	63	63	63	0
Total	681	746	740	779	39
Authorized Positions:					
Full-time permanent	633	647	647	690	43
Other than full-time permanent	18	18	18	18	0
Total	651	665	665	708	43

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
DETAILED REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

	Object Class	2009 Adjustments to Base	2009 Base	2009 Estimate	Increase/ (Decrease) Over 2009 Base
26	Supplies and materials				
	Office & laboratory supplies	0	0	0	0
	Other	0	0	0	0
	Subtotal	0	0	0	0
31	Equipment				
	Office machines and other equipment	($500)	$750	$12,300	$11,550
	ADP equipment	0	0	0	0
	Equipment amortization	0	0	0	0
	Subtotal	(500)	750	12,300	11,550
99	Total Obligations	(500)	750	12,300	11,550

Exhibit 34

Department of Commerce
National Institute of Standards and Technology
Working Capital Fund
ADVISORY AND ASSISTANCE SERVICES
(Obligations in thousands of dollars)

	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate
Management and professional support services	$179	$40	$31
Studies, analyses, and evaluations	1,306	617	300
Engineering and technical services	1,133	1,243	1,275
Total	2,618	1,900	1,606

Significant Activities

Advisory and assistance services funded by the Working Capital Fund represent services funded by reimbursable funds in support of reimbursable work conducted at NIST.

Need for Advisory and Assistance Services

Advisory and Assistance services have been necessary to obtain additional expertise for conducting activities like the technical evaluation of the World Trade Center collapses, for example.

Working Capital Fund, National Institute of Standards and Technology (NIST)

The operations of the NIST Working Capital Fund are reported in a program and financing schedule printed in the President's Budget, as well as reflected in the reimbursable amounts throughout this budget. The fund finances the initial costs of work performed by NIST and is reimbursed by applicable appropriations and advances or reimbursements from other agencies. A detailed cost accounting system is used to ensure that the actual cost of work performed for each job or task is recorded and identified with the appropriate source of financing. In addition to its function as a revolving fund, the Working Capital Fund is also used to handle annual and sick leave on an accrued basis, to acquire equipment as an investment to be recovered through amortization charges to programs, to distribute indirect costs to programs as overhead, to carry the recoverable costs associated with the production of Standard Reference Materials, and to carry supply inventories until issued for program use.

The table below summarizes the total NIST program, according to the source of financing. Following this table is a summary of the NIST reimbursable program by sponsor and source of support.

Summary of Total NIST Program
(Obligations in thousands)

	FY 2007			FY 2008			FY 2009			
Source and Use of Funds Spent	Perm. Pos. [1]	FTE	Oblig.	Perm. Pos. [1]	FTE	Oblig.	Perm. Pos. [1]	FTE	Oblig.	Approp. Requested
Direct Funding										
Scientific and technical research and services	1,991	1,830	$440,814	1,933	1,995	$454,495	2,136	2,147	$527,700	$535,000
Industrial technology services	183	192	199,869	127	133	161,274	0	47	10,200	4,000
Construction of research facilities	51	50	58,686	61	54	160,490	61	60	99,000	99,000
Gifts and bequests	0	0	4	0	0	4	0	0	4	0
Total, direct funding	2,225	2,072	699,373	2,121	2,182	776,263	2,197	2,254	636,904	638,000
Reimbursable Funding and WCF Investments										
Research, development and supporting services:										
Federal government	440	460	109,406	449	504	127,404	479	527	100,779	
Calibrations and tests, technical and advisory services:										
Federal government	17	18	6,868	17	19	6,226	18	20	6,028	
Public and non-federal government	94	98	24,965	96	108	22,629	102	112	21,910	
Subtotal, Services	111	116	31,833	113	127	28,855	120	132	27,938	
National Voluntary Laboratory Accreditation Program	20	21	5,405	21	23	5,470	22	24	5,798	
Standard reference materials (SRMs):										
SRM Sales:										
Federal government	2	2	199	2	2	234	2	2	235	
Public and non-federal government	78	82	11,682	80	90	13,746	85	94	13,745	
Subtotal, SRM sales	80	84	11,881	82	92	13,980	87	96	13,980	
SRM investment adjustment	0	0	1,704	0	0	0	0	0	0	
Subtotal, SRM	80	84	13,585	82	92	13,980	87	96	13,980	
Total, Reimbursable program	651	681	160,229	665	746	175,709	708	779	148,495	
WCF Investments and Operating Adjustments										
WCF investments	0	0	18,201	0	0	19,444	0	0	19,444	
WCF transfers	0	0	1,300	0	0	1,250	0	0	12,300	
WCF operating adjustments	0	0	8,443	0	0	0	0	0	0	
Total, WCF Investments and operating adjustments	0	0	27,944	0	0	20,694	0	0	31,744	
Total, NIST program	2,876	2,753	887,546	2,786	2,928	972,666	2,905	3,033	817,143	
Offsetting adjustment for amortization of equipment	0	0	(19,230)	0	0	(19,490)	0	0	(19,444)	
Adjusted total, NIST program	2,876	2,753	868,316	2,786	2,928	953,176	2,905	3,033	797,699	

[1] Most NIST scientists and engineers are not engaged solely on one research project. Individuals may divide their time between two or more projects financed by different sources of support. Also, salary costs of many staff members are charged to an overhead account and subsequently prorated to all directly funded projects. For these reasons, it is not possible to report employment directly for any source of financing. The Permanent Positions above are statistically-derived numbers, based on the estimated work years distribution for NIST programs.

Department of Commerce
National Institute of Standards and Technology
REIMBURSABLE PROGRAM AND WORKING CAPITAL FUND INVESTMENTS
(Dollar amounts in thousands)

	FY 2007 Actual	FY 2008 Currently Available	FY 2009 Estimate
Department of Defense			
Air Force	$10,042	$11,146	$7,747
Army	2,239	2,357	2,161
Navy	1,336	1,392	1,244
Other	14,305	13,162	11,098
Subtotal, Department of Defense	27,921	28,057	22,250
Department of Agriculture	133	70	70
Department of Commerce	11,379	13,790	13,872
Department of Energy	4,911	5,729	5,002
Department of Health & Human Services	6,482	8,950	7,403
Department of Homeland Security	32,254	33,653	25,114
Department of Housing & Urban Development	70	100	100
Department of the Interior	70	157	148
Department of Justice	11,163	17,127	14,300
Department of State	434	265	55
Department of Transportation	1,630	560	200
Department of the Treasury	17	18	18
Department of Veterans Affairs	137	140	140
Environmental Protection Agency	1,641	1,683	1,423
General Services Administration	526	500	217
National Aeronautics & Space Administration	2,499	6,221	3,925
National Science Foundation	3,419	3,201	3,191
Nuclear Regulatory Commission	157	150	150
Other	4,318	6,914	3,201
Subtotal, Federal Agencies	109,406	127,404	100,779
Calibrations & Testing	8,899	8,408	8,408
Technical & Advisory Services	28,338	25,917	25,328
Standard Reference Materials	13,585	13,980	13,980
Subtotal, Other Reimbursables	50,823	48,305	47,716
Total, Reimbursable Program	160,229	175,709	148,495
Equipment Transfers	750	1,250	12,300
Reactor Fuel Transfers	550	0	0
Subtotal, WCF transfer	1,300	1,250	12,300
Equipment Investments	18,201	19,444	19,444
IE Amortization	(19,230)	(19,490)	(19,444)
WCF Operating Adjustments	8,443	0	0
Total, WCF Investments	7,414	(46)	0
Total, Reimbursable Program and WCF Investments	168,943	176,913	160,795

Department of Commerce
National Institute of Standards and Technology
PERIODICALS, PAMPHLETS, AND AUDIOVISUAL SERVICES
(Obligations in thousands)

	2006 Actual	2007 Actual	2008 Currently Available	2009 Estimate
Periodicals	$30	$9	$34	$34
Pamphlets	14	25	57	34
Audiovisuals	0	5	29	20
Total	44	39	120	88

The National Institute of Standards and Technology produces only one periodical - The Journal of Research. *The Journal of Research of the National Institute of Standards and Technology,* issued six times a year, reports NIST research and development in those disciplines of the physical and engineering sciences in which NIST is active (physics, chemistry, engineering, mathematics, and computer sciences).

Department of Commerce
National Institute of Standards and Technology
AVERAGE SALARY

	2007 Actual	2008 Estimate	2009 Estimate
Average ES salary	$154,846	$159,491	$164,116
Average scientific and professional	153,547	158,153	162,739
Average Career Path Salary	95,312	98,171	101,018
Average salary of ungraded positions	49,844	51,339	52,828

Exhibit 1

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
Budget Estimates, Fiscal Year 2009
President's Submission

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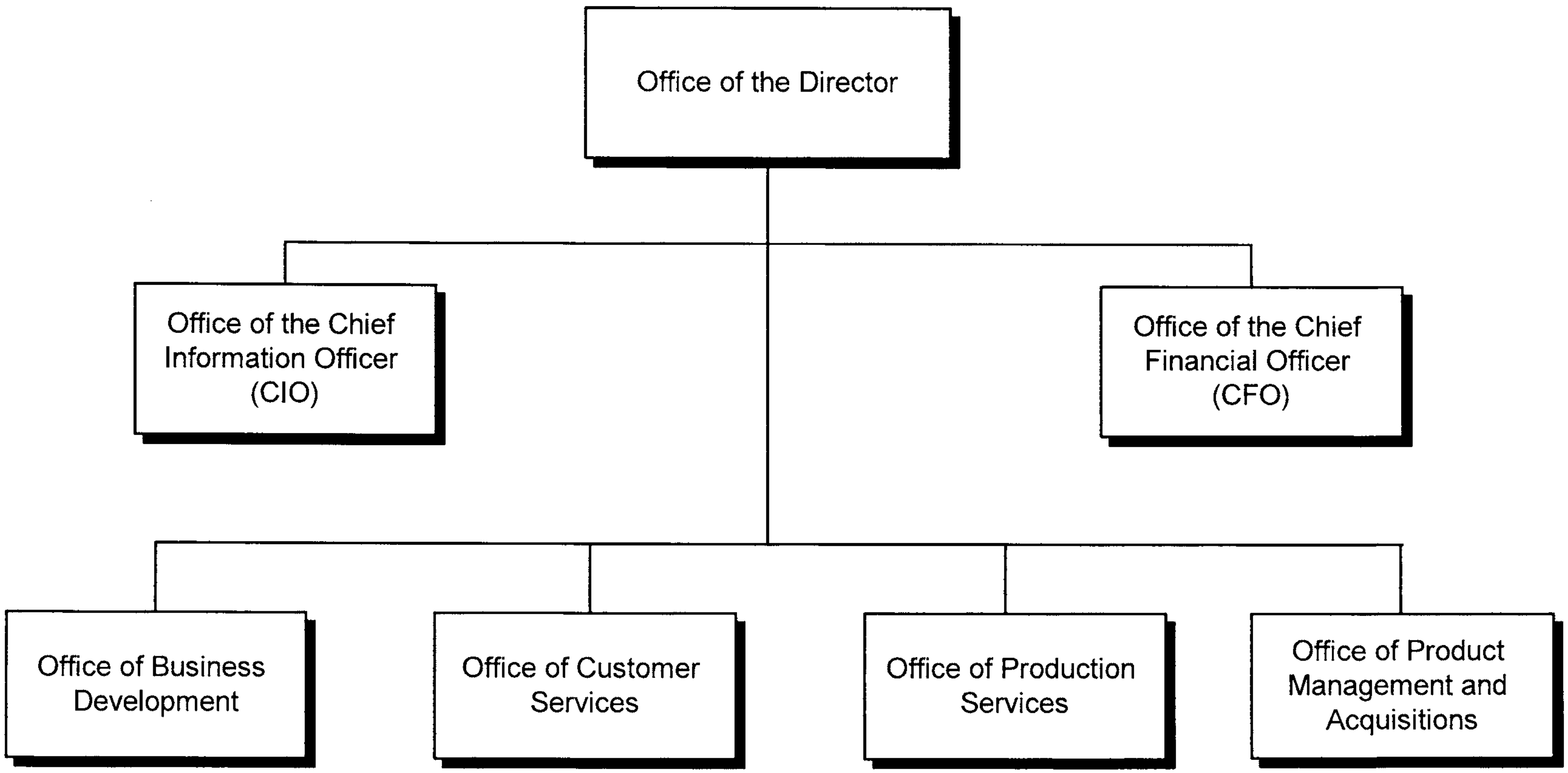
Exhibit 2

U.S. Department of Commerce
National Technical Information Service



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DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
Budget Estimates, Fiscal Year 2009
President's Submission

General Statement

Goals of the Program

The National Technical Information Service (NTIS), seeks to promote innovation and economic growth of America's economy by (a) collecting, classifying, coordinating, integrating, recording and cataloging scientific and technical information from whatever sources, foreign and domestic, that may be available, (b) disseminating this information to the public, and (c) providing information management services to other Federal agencies that help them interact with and better serve the information needs of their own constituents, and to do all without appropriated funds.

Statement of Objectives

NTIS' principal objective supports the Department's strategic plan to promote U.S. innovation and industrial competitiveness by providing business and industry, academia and the general public easy access to scientific and technical research and to ensure that such research is permanently available to future generations of researchers. To this end, NTIS acquires information products from agencies; abstracts, catalogs and indexes them so that they can easily be identified and merged into NTIS' permanent bibliographic database; and physically stores them or scans them into electronic image for reproduction on demand by customers.

NTIS' objectives are to (a) make it easier for the general public to locate federal technical information electronically; (b) build an array of collaborative working arrangements with private sector partners; (c) help other federal agencies meet their own information management and dissemination requirements, and (d) meet objectives in the most cost effective and efficient manner possible.

NTIS has demonstrated innovative achievements in its information dissemination activities as provided in the National Technical Information Act of 1988, codified at 15 U.S.C. 3704b. This Act directed NTIS to "implement new methods or media for the dissemination of scientific and technical, and engineering information." Supporting this directive, NTIS, as part of its base program and without appropriations, made its bibliographic database since 1990 available on the Internet, making the collection more widely available to the public and allowing customers to download products electronically. During FY 2008-2009 those efforts will continue to be expanded and refined as analysis of the activities warrant. In this continuing effort, NTIS continues to follow all Administration policies restricting access to information that could be used improperly.

Summary of Performance and Resources

NTIS continues to make substantial progress in improving its service to the public. NTIS collects approximately 40,000 scientific and technical reports annually and another 685,000 items in the form of articles, updates, advisories, etc. that are contained in various subscription products and/or databases it distributes. Although the amount of new material is highly dependent on budgetary and program decisions made by other agencies, NTIS' activities and accomplishments continue to support its basic public purpose of serving as a comprehensive point of access and dissemination to federally-funded scientific, technical and related information.

The explosive growth of the Internet has provided NTIS with a unique opportunity to expand its information dissemination activities. Information products are disseminated in a variety of formats, including paper, microfiche, diskettes, audio-visual, CD-ROM, database leases, web site hits and electronic downloads. NTIS estimates it will provide approximately 32 million information items to the public in FY 2008.

NTIS plans to obligate $42,000,000 of earned revenue in FY 2009.

(Dollar amounts in thousands)

	2007	2008	2009	2010	2011	2012	2013
National Technical Information Service:							
Reimbursement from offsetting collections:							
Information clearinghouse program	$27,886	$50,416	$42,000	$42,500	$43,000	$43,500	$44,000
Total, NTIS	$27,886	$50,416	$42,000	$42,500	$43,000	$43,500	$44,000

Note: Reimbursable Budget Authority, receipt and obligation data are estimates. Actuals will vary depending on products and services sold.

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
SUMMARY OF RESOURCE REQUIREMENTS
(Dollar amounts in thousands)

Page No.		Positions	FTE	Budget Authority	Direct Obligations
	Estimate, 2009	0	0	0	0
	Plus 2009 Adjustments to Base	0	0	0	0
	Less: Obligations from prior years	0	0	0	0
	2009 Base Request	0	0	0	0
	Plus 2009 program changes	0	0	0	0
	2009 Estimate	0	0	0	0

		2007 Actual		2008 Currently Available		2009 Base		2009 Estimate		Increase/ (Decrease) over 2009 Base	
Comparison by Activity:		Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount	Personnel	Amount
National Technical Information Service:											
Organization, Preservation and Public	Pos./BA	0	0	0	0	0	0	0	0	0	0
Access to Technical Information	FTE/Obl.	0	0	0	0	0	0	0	0	0	0
TOTALS	Pos./BA	0	0	0	0	0	0	0	0	0	0
	FTE/Obl.	0	0	0	0	0	0	0	0	0	0
Adjustments to Obligations											
Recoveries		0	0	0	0	0	0	0	0	0	0
Unobligated balance, start of year		0	0	0	0	0	0	0	0	0	0
Unobligated balance, end of year		0	0	0	0	0	0	0	0	0	0
Financing from transfers:											
Transfer from other accounts (-)		0	0	0	0	0	0	0	0	0	0
Transfer to other accounts (+)		0	0	0	0	0	0	0	0	0	0
Appropriation		0	0	0	0	0	0	0	0	0	0

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Exhibit 7

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
SUMMARY OF FINANCING
(Dollar amounts in thousands)

	2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase (Decrease)
Total Obligations	$27,886	$50,416	$42,000	$42,000	$0
Offsetting collections from:					
Federal funds	(15,732)	(24,485)	(24,780)	(24,780)	0
Trust funds	0	0	0	0	0
Non-Federal sources	(10,932)	(17,015)	(17,220)	(17,220)	0
Recoveries	0	0	0	0	0
Unobligated balance, start of year	(10,138)	(8,916)	0	0	0
Unobligated balance transferred	0	0	0	0	0
Unobligated balance, end of year	8,916	0	0	0	0
Budget Authority	0	0	0	0	0
Financing:					
Transferred from other accounts (-)	0	0	0	0	0
Transferred to other accounts (+)	0	0	0	0	0
Appropriation	0	0	0	0	0

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Exhibit 12

DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund
JUSTIFICATION OF PROGRAM AND PERFORMANCE

Activity: National Technical Information Service
Subactivity: Revolving Fund

Goal Statement

Promote innovation and economic growth of America's economy by collecting, organizing, preserving, and disseminating government scientific, technical, and business-related information.

Base Program

Information Clearinghouse Program

Since 1945, the Department of Commerce has discharged its statutory obligation "to make the results of research and development more readily available to industry and business... and to the general public" (15 U.S.C. 1152) through NTIS and its predecessors. In support of this mission, NTIS has (1) collected technical information products both domestic and foreign, along with complementary information from foreign sources; (2) organized it so it can be located easily; (3) preserved it for the benefit of future generations of researchers; (4) disseminated it in a variety of formats; and (5) helped other Federal agencies serve the information needs of their own constituencies. As such, NTIS contributes directly and substantially to the broader Department of Commerce goal of fostering the Nation's economic growth.

During FY 2008-2009, NTIS will, as part of its base program and without appropriations, continue to make improvements to its web site. This site contains its bibliographic database since 1990, and also offers documents to the public for downloading. For FY 2009

NTIS expects to obligate $42 million to operate as a central source for the public sale of domestic and foreign government-funded scientific, technical and business information.

The new information environment has provided NTIS with expanded opportunities to offer public access to federally-funded R&D on the Internet as part of its base program - and to do so without appropriations. NTIS will continue to use the internet to expand its efforts to build a broader customer base, and explore new opportunities. NTIS will continue to follow all Administrative policies restricting access to information that could be used improperly.

During FY 2008 – FY 2009 NTIS, in cooperation with other federal agencies, will continue to assist the public in finding federally-funded scientific and technical publications wherever they exist – whether in the NTIS collection or at agency web sites – and even after they no longer exist at such sites. It will offer the public the convenience of one-stop shopping and deep searching of federal databases where Government technical information is likely to be found. NTIS will continue to provide permanent access to each document entering the NTIS collection. Thus, if the report ever becomes unavailable at the agency web site, the researcher will have the option of ordering the information from NTIS in the traditional manner.

Explanation and Justification

NTIS was established by law in order "to make the results of technological research more readily available to industry and business, and to the general public" (15 USC 1151). To accomplish this, the Service has been directed to operate a Clearinghouse of scientific and technical information, which is now over three million titles.

Measures of Performance

NTIS' goal to collect and disseminate government scientific, technical, and business related information to the public can be evaluated using the following measures:

Quantitative Measures	2007 Actual	2008 Estimate	2009 Estimate
Number of updated items available (annual).............................	744,322	725,000	745,000

The number of information items available to the public includes scientific, technical, and engineering information products added to the permanent collection, as well as items made available through online electronic subscriptions. NTIS has expanded and refined its efforts to acquire new scientific and technical information products by harvesting products from the Internet. These harvesting efforts together with increased availability of online electronic subscription products demonstrate NTIS' success in making new products available to the public.

Number of information products disseminated (annual)..........................	32,027,113	32,100,000	32,850,000

This measure represents the volume of information products disseminated to the public and includes compact discs, diskettes, tapes, online subscriptions, web site pages, as well as the traditional paper and microfiche products. NTIS is taking advantage of information dissemination opportunities offered by the Internet, and plans to continue to expand its customer base and meet the increased demands of the public.

Customer Satisfaction	98%	95% - 98%	95% - 98%

This measure represents the percentage of NTIS customers that are satisfied with the quality of their order, the ease of order placement, and the timely processing of that order. Orders for NTIS' vast collection of scientific and technical information are received by phone, fax, mail, and online, and are filled in a variety of formats.

NTIS continues to successfully meet the challenge of permanent preservation of and ready access to the taxpayers' investment in research and development through the acquisition, organization, and preservation of the titles added to the permanent collection, and dissemination of that information through various media. However, collection of scientific and technical information from various contributors, and dissemination of that information to an even larger audience is highly dependant on external factors and therefore, not entirely controllable. NTIS plans to continue to enhance public access to world wide scientific and technical information through increased availability of information products, increased dissemination opportunities, and consistent customer satisfaction as presented in the estimates above.

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DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
NTIS Revolving Fund – Reimbursable Obligations
SUMMARY OF REQUIREMENTS BY OBJCT CLASS
(Dollar amounts in thousands)

Object Class		2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease)
11.1	Full-time permanent (Compensation)	$9,233	$13,400	$10,700	$10,700	0
11.3	Other than full-time permanent	42	150	150	150	0
11.5	Other personnel compensation	54	800	500	500	0
11.8	Special personnel services payments	120	150	150	150	0
11.9	Total personnel compensation	9,449	14,500	11,500	11,500	0
12.1	Civilian personnel benefits	2,520	3,800	3,800	3,800	0
13	Benefits for former personnel	125	0	0	0	0
21	Travel and transportation of persons	60	200	200	200	0
22	Transportation of things	1,033	1,000	1,000	1,000	0
23.1	Rental payments to GSA	1,304	1,236	1,237	1,237	0
23.2	Rental payments to others	1,116	1,500	1,500	1,500	0
23.3	Communications, utilities and miscellaneous charges	384	2,000	2,000	2,000	0
24	Printing and reproduction	(159)	4,000	4,000	4,000	0
25.1	Consulting services	24	0	0	0	0
25.2	Other services	10,297	14,480	9,063	9,063	0
25.3	Purchase of goods and services from Government accounts	866	1,500	1,500	1,500	0
25.4	Operation of GOCOs	0	0	0	0	0
25.5	Research and development contracts	0	0	0	0	0
25.7	Operation and Maintenance of Equipment	357	1,200	1,200	1,200	0
26	Supplies and materials	321	3,000	3,000	3,000	0
31	Equipment	189	2,000	2,000	2,000	0

Department of Commerce
National Technical Information Service
NTIS Revolving Fund – Reimbursable Obligations
SUMMARY OF REQUIREMENTS BY OBJECT CLASS
(Dollar amounts in thousands)

Object Class		2007 Actual	2008 Currently Available	2009 Base	2009 Estimate	Increase/ (Decrease)
41	Grants, subsidies and contributions	0	0	0	0	0
42	Insurance claims and indemnities	0	0	0	0	0
43	Interest and dividends	0	0	0	0	0
44	Refunds	0	0	0	0	0
99	Total Obligations	27,886	50,416	42,000	42,000	0
	Earned Revenue/Reimbursable Obligations.	27,886	50,416	42,000	42,000	0
	Total Obligations	27,886	50,416	42,000	42,000	0
Personnel Data						
Full-Time equivalent Employment:						
Full-time permanent		130	145	145	145	0
Other than full-time permanent		1	5	5	5	0
Total		131	150	150	150	0
Authorized Positions:						
Full-time permanent		120	270	270	270	0
Other than full-time permanent		6	10	10	10	0
Total		126	280	280	280	0

Note: Due to infrastructure improvements achieved as a result of strategic plan activities FTE estimates are declining.

Exhibit 17

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
DETAILED REQUIREMENTS BY OBJECT CLASS - Earned Revenue Obligations
(Dollar amounts in thousands)

Object Class		2009 Adjust. to Base	2009 Base	2009 Estimate	Increase/ (Decrease)
11	Personnel compensation				
11.1	Full-time permanent				
	Executive level	$0	$0	$0	$0
	Senior executive service	0	400	400	0
	General schedule	0	9,950	9,950	0
	Commissioned officers	0	0	0	0
	Wage board/wage marine	0	350	350	0
	Scientific & professional (P.L. 80-313)	0	0	0	0
	Senior foreign service	0	0	0	0
	Foreign service staff	0	0	0	0
	Foreign service nationals	0	0	0	0
	Consultants & experts	0	0	0	0
	Students	0	0	0	0
	Subtotal	0	10,700	10,700	0
11.3	Other than full-time permanent				
	General schedule	0	150	150	0
	Wage board	0	0	0	0
	Experts & consultants	0	0	0	0
	Hourly	0	0	0	0
	Subtotal	0	150	150	0

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
DETAILED REQUIREMENTS BY OBJECT CLASS - Earned Revenue Obligations
(Dollar amounts in thousands)

		2009 Adjust. to Base	2009 Base	2009 Estimate	Increase/ (Decrease)
11.5	Other personnel compensation				
	Overtime	0	50	50	0
	SES performance awards	0	100	100	0
	Cash awards	0	350	350	0
	Merit pay awards	0	0	0	0
	Other	0	0	0	0
	Subtotal	0	500	500	0
11.8	Special personnel services payments				
	Foreign service officers (State)	0	0	0	0
	Other	0	150	150	0
	Subtotal	0	150	150	0
11.9	Total personnel compensation	0	11,500	11,500	0
12.1	Civilian personnel benefits				
	Civil service retirement	0	500	500	0
	Federal employees' retirement	0	1,300	1,300	0
	Thrift savings plan	0	500	500	0
	Federal insurance contribution act	0	300	300	0
	Health insurance	0	900	900	0
	Life insurance	0	50	50	0
	Employees' compensation fund	0	200	200	0
	Other	0	50	50	0
	Subtotal	0	3,800	3,800	0

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
DETAILED REQUIREMENTS BY OBJECT CLASS - Earned Revenue Obligations
(Dollar amounts in thousands)

		2009 Adjust. to Base	2009 Base	2009 Estimate	Increase/ (Decrease)
13	Benefits for former personnel				
	Severance pay	0	0	0	0
	Unemployment compensation	0	0	0	0
	Other	0	0	0	0
	Subtotal	0	0	0	0
21	Travel and transportation of persons				
	Common carrier	0	130	130	0
	Mileage	0	50	50	0
	Vehicular	0	20	20	0
	Other	0	0	0	0
	Subtotal	0	200	200	0
22	Transportation of things	0	1,000	1,000	0
23.1	Rental payments to GSA	0	1,237	1,237	0
23.2	Rental payments to others	0	1,500	1,500	0
23.3	Communications, utilities and miscellaneous charges				
	Rental of ADP equipment	0	200	200	0
	Rental of office copying equipment	0	10	10	0
	Other equipment rental	0	190	190	0
	Federal telecommunications systems	0	0	0	0
	Other telecommunications services	0	1,000	1,000	0
	Postal Service by USPS	0	300	300	0
	Other	0	300	300	0
	Subtotal	0	2,000	2,000	0

Exhibit 17

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
DETAILED REQUIREMENTS BY OBJECT CLASS - Earned Revenue Obligations
(Dollar amounts in thousands)

		2009 Adjust. to Base	2009 Base	2009 Estimate	Increase/ (Decrease)
24	Printing and reproduction				
	Publications	0	3,700	3,700	0
	Public use forms	0	0	0	0
	Envelopes	0	5	5	0
	Other	0	295	295	0
	Subtotal	0	4,000	4,000	0
25	Consulting and Other Services				
25.1	Consulting Services				
	Management and Professional services	0	0	0	0
	Studies, analyses and evaluation	0	0	0	0
	Engineering and technical services	0	0	0	0
	Subtotal	0	0	0	0
25.2	Other Services				
	Training:				
	University	0	0	0	0
	Other	0	200	200	0
	ADP services	0	0	0	0
	Telecommunications services	0	0	0	0
	Other non-government contracts	0	3,090	3,090	0
	Other	0	5,773	5,773	0
	Subtotal	0	9,063	9,063	0

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
DETAILED REQUIREMENTS BY OBJECT CLASS - Earned Revenue Obligations
(Dollar amounts in thousands)

		2009 Adjust. to Base	2009 Base	2009 Estimate	Increase/ (Decrease)
25.3	Purchases of goods and services from Gov't accounts				
	Training:				
	Office of personnel management	0	0	0	0
	GSA reimbursable services	0	0	0	0
	Payments to GA, WCF	0	1,500	1,500	0
	Other (CAMS)	0	0	0	0
	Subtotal	0	1,500	1,500	0
25.4	Operations of GOCOs	0	0	0	0
25.5	Research and development contracts	0	0	0	0
25.7	Operations and Maintenance of Equipment	0	1,200	1,200	0
	Subtotal Object Class 25	0	11,763	11,763	0
26	Supplies and materials				
	Office supplies	0	700	700	0
	ADP supplies	0	1,300	1,300	0
	Other	0	1,000	1,000	0
	Subtotal	0	3,000	3,000	0

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
DETAILED REQUIREMENTS BY OBJECT CLASS - Earned Revenue Obligations
(Dollar amounts in thousands)

		2009 Adjust. to Base	2009 Base	2009 Estimate	Increase/ (Decrease)
31	Equipment				
	Office machines and equipment	0	100	100	0
	ADP hardware	0	1,100	1,100	0
	ADP software	0	800	800	0
	Other	0	0	0	0
	Subtotal	0	2,000	2,000	0
32	Lands and structure	0	0	0	0
33	Investments and loans	0	0	0	0
41	Grants, subsidies and contributions	0	0	0	0
42	Insurance claims and indemnities	0	0	0	0
43	Interest and dividends	0	0	0	0
44	Refunds	0	0	0	0
99	Total Obligations		42,000	42,000	0
	Total Budget Authority		42,000	42,000	0

Exhibit 34

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
CONSULTING AND RELATED SERVICES
(Obligations in thousands)

	2007 Actual	2008 Estimate	2009 Estimate
Consulting Services	$24	$0	$0
Management and professional services	0	0	0
Special studies and analysis	0	0	0
Management and Support Services for research and development	0	0	0
Total	$24	$0	$0

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
PERIODICALS, PAMPHLETS, AND AUDIOVISUAL PRODUCTS
(obligations in thousands)

Exhibit 35

	2007 Actual	2008 Estimate	2009 Estimate
Periodicals	$2	$3	$4
Pamphlets	0	0	0
Audiovisuals	0	0	0
Total	$2	$3	$4

Exhibit 36

Department of Commerce
National Technical Information Service
NTIS Revolving Fund
AVERAGE GRADE AND SALARIES

	2007 Actual	2008 Estimate	2009 Estimate
Average GS/GM Grade	10.6	10.8	11.0
Average GS/GM Salary	$74,430	$78,200	$82,100

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