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Electrotechnology-Related Research in the FY 2005 Budget

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HIGHLIGHTS

- The National Science Foundation (NSF) research budget would increase by 3.6 percent to a level of $4.2 billion, but the President's budget request falls far short of the amount authorized in the NSF authorization bill signed into law last year (see Table II-7).

- Although NASA's overall R&D budget would increase by 3.9 percent, some NASA Enterprises, such as Aeronautics, would see large cuts in their R&D budgets (see Table II-12).

- The Department of Defense Science & Technology budget ('6.1'-'6.3') would see a 12.7 percent cut, to a level of $10.5 billion, with Applied Research (12.3 percent) and Advanced Technology Development (14.6 percent) taking the brunt of the cuts (see Table II-2).

- The National Nanotechnology Initiative (NNI) continues to be one of the bright spots in electrotechnology R&D funding with a $21 million increase over FY 2004 to a level of $982 million (see Table I-10).

- Research and development at the Department of Energy Office of Science, the largest federal supporter of electrotechnology basic research in the United States, would decrease by $14 million (see Table II-11).

- The Department of Homeland Security's R&D would increase by 15 percent to $1.2 billion (see Table II-20).

INTRODUCTION

The following chapter is a broad summary of the Bush Administration's proposed FY 2005 funding levels for select electrotechnology R&D programs at the National Science Foundation (NSF), NASA, the

Departments of Energy (DOE), Defense, Homeland Security (DHS), and Commerce and two multi-agency initiatives—the National Nanotechnology Initiative (NNI) and the Networking and Information Technology Research and Development Program (NITRD). The budget figures contained in this analysis are expressed in real dollars and are based on data provided by the federal agencies at the release of the Administration's FY 2005 budget

Electrotechnology research and development, like most other aspects of science and technology R&D, is feeling the squeeze of budget deficit restraints and election year politics in the FY 2005 President's budget request. Funding for most agencies is flat, decreasing, or increasing only slightly.

NATIONAL NANOTECHNOLOGY INITIATIVE (NNI)

Nanotechnology, as classified by the federal government, must satisfy three requirements. It must involve:

a) "Research and technology development at the atomic, molecular or macromolecular levels, in the length scale of approximately 1-100 nanometer range;"

b) "Creating and using structures, devices and systems that have novel properties and functions because of their small and/or intermediate size;" and

c) "Ability to control or manipulate on the atomic scale."

The National Nanotechnology Initiative (NNI) is a multi-agency nanotechnology research initiative conducted at a total of ten federal agencies. The National Science Foundation, the Department of Defense, the Department of Energy, the National Institutes of Health and NASA are the agencies with the most significant investments in nanotechnology research.

Nanotechnology has broad support in Congress and the Administration. In December 2003, President Bush signed into law the 21st Century Nanotechnology Research & Development Act, which authorizes $3.7 billion for nanotechnology R&D for FY 2005-2008. Funding in the President's budget request would increase by 2.2 percent over FY 2004 to a level of $982 billion, reflecting a $21 million increase (see Table I-

10). NSF would remain the leading agency for nanotechnology R&D, and it would receive a 20.1 percent increase to $305 million. DOD totals, on the other hand, would drop by $39 million. (For full information on NNI, please see Chapter 25.)

NETWORKING AND INFORMATION TECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAM (NITRD)

Another multi-agency research program of considerable importance is the Networking and Information Technology R&D Program (NITRD). Chartered in 1991 as a collaboration of federal agencies involved in fundamental high-end computer research, seven federal agencies participate in NITRD, including the Department of Defense (DOD), the National Science Foundation (NSF), the Department of Energy (DOE), NASA, the Department of Commerce, and the Environmental Protection Agency (EPA).

The NITRD budget will essentially remain even for FY 2005, at $2.0 billion, retaining the High End Computing (HEC) program as the initiative's main priority. According to the Office of Science and Technology Policy (OSTP), the HEC will also work with the High End Computing Revitalization Task Force (HECTRF), created by participating agencies in FY 2003, to "develop an interagency R&D roadmap for high-end computing technologies." (For full details of NITRD, please see Chapter 24.)

DEPARTMENT OF DEFENSE (DOD)

In response to "lessons learned" from the wars in Afghanistan and Iraq, and the ongoing fight against terrorism, the Department of Defense has renewed its emphasis on "defense transformation and force modernization," according to the President's budget request. One of the key ways the DOD plans to achieve this transformation and modernization is by increasing defense capabilities through advanced technology, such as precision weapons, unmanned vehicles and state-of-the-art communications systems without necessarily increasing troop levels. This goal will be accomplished in large part through DOD's Research, Development, Test and Evaluation (RDT&E) program.

The RDT&E appropriation provides funding for future military hardware and software and their underlying technologies, covering the full spectrum of R&D from the most basic research to advanced, full-scale,

military systems development. RDT&E collectively consists of seven budget activities: Basic Research (‘6.1’), Applied Research (‘6.2’), Advanced Technology Development (‘6.3’), Advanced Component Development (‘6.4’), Systems Development and Demonstration (‘6.5’), Management Support (‘6.6’), and Operational Systems Development (‘6.7’). RDT&E is the federal government’s single largest research and development account.

Consistent with this renewed emphasis, RDT&E would receive a $4.4 billion, 6.6 percent increase over FY 2004 to a level of $68.9 billion (see Table II-2). However, as with the FY 2004 RDT&E budget levels, all of the increase would go to only two of the seven activities. This year, the two winners are Advanced Component Development (‘6.4’) and Operational Systems Development (‘6.7’). Funding for all other RDT&E activities would decrease.

Particularly, Basic Research (‘6.1’), Applied Research (‘6.2’), Advanced Technology Development (‘6.3’) and Medical Research, known collectively as Science and Technology (S&T), would take a significant hit in the FY 2005 budget with a 15.5 percent, $1.9 billion cut. Basic Research would fall by 5.3 percent, or $74 million, to a level of $1.3 billion. Applied Research would take an even bigger hit, falling 12.3 percent, or $545 million, to $3.8 billion. Total S&T funding levels would be $10.6 billion. Basic research in the Army would be cut by $64 million and the Navy by $7 million, but the Air Force would increase its ‘6.1’ program by $14 million. Basic research in the University Research Initiative (URI) programs would see a $9 million reduction in FY 2005.

RDT&E also funds the two major defense research agencies—the Defense Advanced Research Projects Agency (DARPA) and the Missile Defense Agency (MDA). For the third year in a row, the MDA, formerly known as the Ballistic Missile Defense Organization, would be a big winner in the President’s budget request, with a 20 percent increase to a level of $9.1 billion. DARPA, whose mission is to “develop imaginative, innovative and often high-risk research ideas, offering a significant technological impact that will go beyond the normal evolutionary developmental approaches,” also does quite well in the budget. DARPA funding would increase by 9.1 percent to a level of $3.1 billion. (For more on DOD, see Chapter 6.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

In a January 2004 presidential announcement, President George W. Bush said that NASA will begin laying the groundwork for an ambitious new plan for space exploration that will take man back to the moon by the year 2020, and eventually to Mars. That plan is outlined in a document released with the President's budget request called *A Renewed Spirit of Discovery, The President's Vision for U.S. Space Exploration.* As outlined in the budget request, the policy goals are a sustained human and robotic space exploration program; a return to the moon, Mars and beyond; and a strategy to develop and improve the "technologies, knowledge and infrastructures" for space exploration.

To accommodate the President's new plan, NASA has revised its organizational structure for the second year in a row. The Space Flight Capabilities (SFC) account, now Exploration Capabilities (EC), contains the Space Flight enterprise and a new Exploration Systems enterprise. The Space Flight enterprise contains the International Space Station (ISS), the Space Shuttle and Space and Flight Support. The NASA budget request indicates that "relevant elements from aerospace technology, space science, and space flight enterprises have been transferred to the Explorations Systems Enterprise." The Space, Aeronautics and Exploration (SAE) acronym is now Exploration, Science and Aeronautics (ESA)—apparently to reflect the Administration's new priorities. ESA is further divided into five separate Enterprises: Space Science, Earth Science, Biological and Physical Research, Aeronautics (formerly Aeronautics Technology), and Education. The request states that "The Exploration Systems Enterprise will work closely with the Space Science Enterprise to use the Moon as a testing ground for solar system exploration vehicles and technologies."

After a slight increase in FY 2004, NASA's R&D budget would see a more significant increase in FY 2005: a 3.9 percent, $425 million increase to $11.3 billion (see Table II-12). However, consistent with the President's intention to refocus NASA priorities, it appears major shifts occur in funding for individual enterprises. Some, such as Human & Robotic Technology, would see major gains (61 percent); while others, like Education Programs would see significant cuts (25.5 percent, in this case). NASA has indicated that it will continue to meet its commitment to the International Space Station, and R&D funding would increase accordingly ($365 million, 24 percent.) NASA also reports that it plans to retire the Space Shuttle by the end of the decade. And it has created a

new program, called *Project Constellation*, to develop a new Crew Exploration Vehicle (CEV), which NASA expects to complete by 2014. The Space Shuttle account would increase by 9.5 percent in FY 2005, to a level of $4.3 billion.

Under the Exploration, Science, and Aeronautics (ESA) Enterprise, Space Science would increase by 4.2 percent to a level of $4.1 billion, and Biological and Physical Research would increase by 6.4 percent to $1.05 billion. On the other hand, Earth Science would decrease by 7.9 percent to $1.5 billion. Likewise, Aeronautics would take a large cut at 11.1 percent to $919 million. As stated earlier, the Education Programs Enterprise would be hit by 25.5 percent to a level of $169 million. (For more on the NASA budget, see Chapter 10.)

NATIONAL SCIENCE FOUNDATION (NSF)

Dr. Rita Colwell, director of the National Science Foundation, calls the FY 2005 NSF budget "a sea of mixed opportunity and constraint." True to Dr. Colwell's characterization, the $5.7 billion NSF budget would continue a six-year trend of steadily increasing budgets (62 percent between FY 1998 and FY 2004). But it would fall far below the $7.4 billion levels authorized by legislation passed last year, as part of a plan to double the NSF budget over five years. The total NSF budget would increase by three percent over FY 2004 levels, while the budget for research and development would increase by 3.6 percent to a level of $4.2 billion (see Table II-7).

The NSF supports seven major research areas, or Directorates, including: Biological Sciences (BIO), Computer and Information Science and Engineering (CISE), Education and Human Resources (EHR), Engineering (ENG), Geosciences (GEO), Mathematical and Physical Sciences (MPS), and Social, Behavioral and Economic Sciences (SBE.) It also has accounts for Polar Programs and Major Research Equipment and Facilities Construction (MREFC).

Most of the budgets for the major Directorates are essentially flat compared to FY 2004. The Engineering Directorate, which supports research in areas including information technology, biotechnology, and microeletronics would increase by 1.9 percent to a level of $576 million. Under that, the Electrical & Communication Systems sub-activity would take a $2 million cut, and the Engineering Education and Centers sub-activity budget would fall by $3 million. The Mathematical and Physical

Sciences (MPS) activity would increase by 2.2 percent, which is a $24 million increase, to a level of $1.2 billion. This Directorate supports education and research in the physical and mathematical sciences.

The Sub-activities under the Computer and Information Science and Engineering Directorate (CISE) would see major winners and losers, even though the overall budget for the Directorate would increase by 2.2 percent to $618 million. The Computer & Network Systems, Computing & Communication, and Information & Intelligent Systems Sub-activities would all see increases of roughly 15 percent, while the Information Technology Research Sub-activity would get hit with a $40 million, 18 percent cut. Shared Cyber-infrastructure would increase by 9.7 percent, or $11 million. Last year, all other Sub-activities were relatively flat, while IT Research received a large boost.

In addition to the Directorates, Dr. Colwell has designated five "emerging areas of research" for priority in the FY 2005 budget "that hold exceptional potential to advance knowledge in areas of global economic and social importance." Three of these areas, Mathematical Sciences, Nanoscale Science and Engineering (NS&E), and Workforce for the 21st Century, are of particular significance for electrotechnology research and development. The other two priority areas are Biocomplexity in the Environment and Social Dynamics. The NS&E budget would see an increase of $50 million over the FY 2004 levels to $305 million. The Mathematical Sciences budget would remain essentially flat from the previous year at $89 million, with $70 million of that amount going to the Math and Physical Sciences Directorate, with the other $19 million spread across various other NSF research directorates.

The Workforce for the 21st Century priority area, funded at $20 million, focuses on all education levels from K-12 to postdoctoral education and is designed to "strengthen the nation's capacity to produce world-class scientists and engineers, and a general workforce with the skills to thrive in the 21st century workplace."

For the second year in a row, the funding level for Major Research Equipment and Facilities Construction (MREFC) would receive a large increase. Last year's $55 million increase would be followed again this year by a 37.6 percent, $58 million increase. (For more on NSF, see Chapter 7.)

DEPARTMENT OF ENERGY (DOE)

According to Secretary of Energy Spencer Abraham, the Department of Energy has "an ambitious, long-term vision of a zero-emission future, free of reliance on imported energy." To try to achieve this goal, the Bush Administration has laid out a list of priorities for research and development in the FY 2005 President's budget request that focuses heavily on alternative energy resources and clean coal initiatives. The DOE will again be the lead agency in implementing the President's multi-agency Hydrogen Fuel Initiative, as proposed in Mr. Bush's January 2003 State of the Union Address. The $1.3 billion request includes $455 million to be spread across several DOE research accounts. Other priorities include $447 million for the Coal Research Initiative, $237 million for the Clean Coal Power Initiative, and $9 million to explore ways to produce hydrogen through nuclear power.

The DOE research and development budget is divided into seven separate accounts: Energy Supply, Science, Fossil Energy, Energy Conservation, Atomic Energy Defense, Clean Coal Technology, and Radioactive Waste Management. DOE's overall R&D budget would increase slightly over FY 2004, by $110 million (1.3 percent), to a level of $8.87 billion (see Table II-11).

Of significant importance to electrical and electronics engineers is the Office of Science, which "manages fundamental research programs in basic energy sciences, biological and environmental sciences, and computational science." The Office of Science is the largest supporter of electrotechnology-related basic research in the United States. Research and development in this office would decrease by $14 million to a level of $3.2 billion. Energy Supply also would be cut, by $16 million to $361 million. Taking the largest hit would be the Office of Energy Conservation which is cut by $74 million. The budget for Radioactive Waste Management on the other hand, would nearly quadruple from $69 million to $275 million. The bulk of this is a 506 percent increase in the Nuclear Waste Disposal Depository Program, which the DOE says is "to fund the national defense programs' share of a long-term geological repository for defense nuclear waste."

Other Bush Administration research and development priorities include $38 million for the International Thermonuclear Experimental Reactor (ITER) project, $204 million for Advanced Scientific Computing

Research (ASCR), and $113.6 million for construction and operation of the Spallation Neutron Source. (For more on DOE, see Chapter 9.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

The perennial attempt by the Bush Administration to eliminate the Advanced Technology Program (ATP) resurfaces in the FY 2005 budget for the Department of Commerce, as funding for the program falls to zero from $171 million. The purpose of the ATP is to "accelerate the development of innovative technologies that promise significant commercial payoffs and widespread benefits for the nation." Those funds would be used to give the National Institute of Standards and Technology (NIST) and its Scientific and Technical Research and Services budget an increase in R&D of 29.8 percent to a level of $367 million (see Table II-14). The Bush Administration has attempted to eliminate the ATP in every budget from FY 2002-2005, but funding has always been restored by Congress.

However, another program consistently targeted for elimination in the past, the Manufacturing Extension Partnership (MEP), is not targeted this year but funding is flat over last year's level. The MEP, while not strictly an electrotechnology R&D program, does help small businesses to manufacture advanced electrotechnology products developed under R&D. The MEP funding request for FY 2005 is again $39 million. (For more on NIST, see Chapter 13.)

DEPARTMENT OF HOMELAND SECURITY (DHS)

Funding for research and development at the Department of Homeland Security (DHS) would see significant increases again in the second year of its existence. The R&D budget would increase by 15.5 percent, to a level of $1.2 billion. The largest portion of the DHS R&D budget goes to the Science and Technology Directorate with a FY 2005 budget of $987 million. This represents an increase in programs of $118 million, all of which is in the Biological Countermeasures Program. The $118 million includes $13 million for the Plum Island Animal Disease Center, and $65 million for the Bio-Surveillance Initiative. The initiative has several elements that will impact electrotechnology. These include expanding Bio-Watch coverage in the top ten threat cities, piloting of an integrated attack warning and assessment system known as BIWICXS (Bio-Warning and Incident Characterization System), and accelerating R&D on the next generation environmental monitoring systems. All other

programs affecting electrotechnology including Threat and Vulnerability, Testing and Assessment (TVTA), Standards, Emerging Threats, Rapid Prototyping, and Counter Man Portable Defense Systems (MANPAD) are budgeted at their FY 2004 enacted levels. (For full information on DHS R&D, see Chapter 12 and Table II-20.)