26

Electrotechnology-Related Research in the FY 2004 Budget

Ron Hira, Russell Lefevre, Bill Williams, and Chris Brantley
Institute of Electrical and Electronics Engineers-USA

HIGHLIGHTS

- The President's budget request includes a healthy 7.6 percent increase in RDT&E for the Department of Defense (DOD). However, all of the increases are in the later stages of the R&D process, "6.4" through "6.7". Basic and applied research ("6.1" and "6.2") are slated for significant declines (see Table II-2).

- DOD's Science and Technology (S&T) budget ("6.1" through "6.3") would decrease by 5 percent (see Table II-2).

- The National Aeronautics and Space Administration (NASA) will restructure its budget again and revise its priorities in an essentially flat budget line (see Table II-12).

- The President has proposed a 2.4 percent decrease in the Electrical and Communications Systems Subactivity in the Engineering Directorate of the National Science Foundation (NSF), compared to a 2.8 percent increase for all NSF R&D (see Table II-7).

- FreedomCAR and Freedom Fuel programs in the Department of Energy (DOE) budget would receive a combined $272 million in funding in FY 2004 (see Table II-11).

- The United States' participation in the International Thermonuclear Experimental Reactor (ITER) program would be revitalized with a $12 million budget for FY 2004.

- DOE is planning to build four new Nanoscale Science Research Centers at a cost of $87 million.

- The National Nanotechnology Initiative (NNI) would increase substantially for the second year in a row (9.7 percent, $75 million) to a level of $849 million (see Table I-10).

- The newly created Department of Homeland Security would have a R&D budget of $1 billion, much of which would be conducted by the Homeland Security Advanced Research Projects Agency (HSARPA; see Table II-20).

INTRODUCTION

Electrotechnologies are ubiquitous in nearly every aspect of modern life, from the light bulb to the computer to emerging medical devices such as the M2A disposable diagnostic capsule used to non-invasively examine the small intestine. Economists attribute a substantial portion of recent national productivity gains to the impact of key electrotechnologies such as semiconductors and the Internet. Electrotechnologies are also critical for ensuring the nation's homeland and overseas security.

The federal government supports a substantial amount of research and development of electrical, electronics and computing technologies spanning a range of fields including electrical generation and energy efficiency, communication and information technologies, aerospace and satellites, intelligent highway systems, electronic warfare, telemedicine and medical devices. It is very difficult, if not impossible, to accurately identify the amount of federal support in electrotechnology research because federal agency investments are generally not identified by discipline. Nonetheless, one can identify longitudinal trends in electrotechnology research by examining budget trends of agencies that provide the bulk of electrotechnology related research.

The federal investment in electrotechnology research in FY 2004 should be viewed in the larger context of the country's overall investment in electrotechnology research. The significant slowdown in technology and capital spending by businesses has led to a drawback in electrotechnology research spending by industry. Electrotechnology industries have been disproportionately hit by the slump; *e.g.*, telecommunications, computer networking, semiconductors, computers, software, electric utilities, etc. Companies are moving to cut costs in response to reduced revenues, and research spending will not be spared.

Private equity investment, including venture capital, has plummeted in the past two years and the bulk of the remaining investment has moved away from more speculative early-stage high-risk research and development to products that are close to commercial launch. In light of the malaise in private sector investments in electrotechnology research, the federal role becomes even more critical in 2004. The agency budgets proposed by the President do not fill the gaps left by industrial research.

NATIONAL NANOTECHNOLOGY INITIATIVE (NNI)

The National Nanotechnology Initiative (NNI) is a multi-agency nanotechnology research initiative conducted at a total of ten federal agencies. The National Science Foundation (NSF), the Department of Defense (DOD), the Department of Energy (DOE), the National Institutes of Health (NIH), and NASA are the agencies with the most significant investments in nanotechnology research. The FY 2004 budget request would increase funding for NNI by 9.7 percent to a level $849 million (see Table I-10). The U.S. Department of Agriculture (USDA) is attempting to stake its claim in the nanotechnology arena with a whopping 900 percent increase in its budget for nanotechnology research (from $1 million to $10 million). DOE (up 48.1 percent) and NSF (up 12.7 percent) would also be big gainers in 2004, while DOD (down 8.6 percent) and the Department of Commerce (down 10.1 percent) would see their nanotechnology budgets reduced the most. (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). This program has participation from a broad array of government agencies, including DOD, NSF, DOE, and NASA. The NITRD budget overall would increase by 5.9 percent to $2.2 billion (see Table I-10). The largest contributor, NSF, would devote $724 million to NITRD, while DOD ($461 million), DOE ($317 million), and the Department of Health and Human Services (HHS; $441 million) are the other large participants. The High End Computing (HEC) program, which NITRD has identified as its highest priority, would receive the most funding at $846.5 million; its second priority, the Large Scale Networking (LSN), would receive $317 million in funding. (For full details of NITRD, please see Chapter 24.)

DEPARTMENT OF DEFENSE (DOD)

The Department of Defense's Research, Development, Test, and Evaluation (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 and Prototypes ("6.4"), System 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.

The President's budget request includes a healthy 7.6 percent increase in RDT&E for the Defense Department (see Table II-2). However all of the increases are in the later stages of the R&D process, "6.4" through "6.7". In fact, basic and applied research ("6.1" and "6.2") are slated for significant declines. Total RDT&E would increase by $4.3 billion to a record $61.8 billion.

The increases in RDT&E should be put in perspective. Of the $4.3 billion increase mentioned, $3.9 billion would go to two budget activities: Advanced Component Development and Prototypes ("6.4") and System Development and Demonstration ("6.5"). All other activities would either decline or remain relatively flat.

Basic Research ("6.1"), Applied Research ("6.2"), and Advanced Technology Development ("6.3"), known collectively as Science and Technology (S&T), would decrease by 5.0 percent to a level of $10.2 billion. This would be tempered by a 3.7 percent increase in "6.3" funding. Basic and Applied Research would take a 7.7 percent and 14.4 percent cut to $1.3 billion and $3.7 billion, respectively.

Management Support ("6.6") would decline 2.5 percent to a level of $3.0 billion, while Operational Systems Development ("6.7") would increase 4.3 percent to $19.5 billion.

Also funded by RDT&E are the two major defense research agencies, the Defense Advanced Research Projects Agency (DARPA) and the Missile Defense Agency (MDA; see Table II-3). 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," would receive a 9.8 percent increase to $3.0 billion. After a large increase in FY 2002 followed by a slight cut in FY 2003, the MDA, formerly known as the Ballistic Missile Defense Organization (BMDO), would receive a significant funding increase of 15.7 percent to $7.7 billion. (For more on DOD, see Chapter 6.)

DEPARTMENT OF HOMELAND SECURITY (DHS)

The new Department of Homeland Security (DHS) integrates such agencies as the U.S. Coast Guard, U.S. Customs Service, Federal Emergency Management Agency (FEMA), and the Immigration and Naturalization Service's (INS) enforcement division, and is expected to have a major impact on federal R&D. The DHS Science and Technology Directorate is the subject of an $803 million funding request, with R&D priorities related to information analysis, border entry/security technologies, and chemical/biological warfare detection. Of that total, $350 million would be administered through a new Homeland Security Advanced Research Projects Agency (HSARPA) charged with R&D, testing and evaluation to speed up deployment of promising homeland security technologies. Research in DHS' Information Analysis & Infrastructure Protection Directorate will focus on cyber-security and protection of critical infrastructures (including the electric grid, communications networks, the Internet, etc.). (For full information on DHS R&D, see Chapter 12 and Table II-20.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

The NASA budget contains several important electrotechnology programs. One major initiative that will have far-reaching consequences is the Optical Communication program. This program offers potential for many orders of magnitude improvement in the communication data rate. For example, using current technology the Mars Reconnaissance Orbiter will take 21 months to map 20 percent of the Mars surface. Using the proposed optical communications technology would enable the whole surface of Mars to be mapped in four months. Other important programs include the James Webb telescope to be launched in 2010 to build on the Hubble Telescope legacy, the Laser Interferometer Space Antenna to observe the distortion of space due to gravity waves, the Climate Change Research Initiative Acceleration, and several programs to enhance

Aviation Security and improve the operation of the National Airspace System.

For the second straight year, NASA's budget overall would see a slight increase from the previous year (a 0.9 percent increase to $15.5 billion). The R&D budget would also increase slightly by 0.2 percent to a level of $11.0 billion (see Table II-12).

For FY 2004, NASA states that its budget will "emphasize research that is most appropriate for NASA to do, including reducing or terminating programs that are lower priority or not central to the agency's mission." In order to help accomplish this, NASA will also focus on attempting to control spiraling costs in "enabling capabilities" such as launch vehicles, space platforms and ground facilities.

NASA's request for FY 2004 includes $337 million for new initiatives including $26 million for Aviation Security, $27 million for National Airspace System Transition Augmentation, $15 million for Quiet Aircraft Technology Acceleration, and $26 million for an Education Initiative. Another new initiative, Project Prometheus, adds $186 million from the Nuclear Systems Initiative to $93 million of new spending for a mission to explore three of Jupiter's Galilean moons.

In the FY 2004 proposal, NASA's budget is separated into two new accounts, Science, Aeronautics and Exploration (SAE) and Space Flight Capabilities (SFC). (These were changed from Human Space Flight (HSF) and Science, Aeronautics, and Technology (SAT).) SAE is further divided into five separate Enterprises: Space Science, Earth Science, Biological and Physical Research, Aerospace Technology, and Education. Space Flight Capabilities is divided into Space Flight, which includes the Space Station, Space Shuttle and support activities; and Crosscutting Technologies, which includes the Space Launch Initiative and Tech Transfer Partnerships.

Within SAE, the Space Science would see a substantial increase (12.7 percent) over last year to a level of $4.0 billion with the majority of the increase ($286 million) going towards Solar System Exploration. Meanwhile, Earth Science would take an 8.1 percent hit down to a level of $1.6 billion.

The Biological and Physical Research programs, which focus on basic and applied research, would increase by $37 million (4.0 percent) to a

level of $973 million. That amount includes a $47 million increase for Biological Sciences Research and $7 million cut in Physical Sciences Research. Aerospace Technology would take an 8.5 percent or $89 million cut to a level of $959 million.

It is unclear as of this writing how or if the Columbia shuttle disaster on February 1, 2003 will change these priorities or budget amounts. (For more on the NASA budget, see Chapter 10.)

NATIONAL SCIENCE FOUNDATION (NSF)

Electrotechnology has a high priority in the 2004 NSF budget request. One highlight is the initiation of a Cyberinfrastructure program to fund projects to demonstrate how high-performance super computers and net works could be linked with massive databases, sensors, and visualization capabilities to bring supercomputer capabilities to the desks of researchers.

In addition there is a 60 percent increase in Major Research Equipment and Facilities Construction (MREFC) that would fund many electrotechnology projects. This includes the Atacama Large Millimeter Array, EarthScope, a multi-purpose geophysical instrument array, the High-performance Instrumented Airborne Platform for Environmental Research and other smaller projects.

The NSF has long been recognized as one of the federal government's most successful and efficient agencies. It is the only agency to receive the highest rating in both of the President's Management Agenda initiatives. The NSF reviews over 60,000 proposals for fellowships and grants each year and distributes approximately $4 billion in research funding with a direct overhead of only 5 percent. This tremendous "bang for the buck" is not lost on the Bush Administration. In its FY 2004 budget request, the Administration cites great value in the contributions of NSF: "These investments will sustain and build U.S. global leadership in science, engineering, and technology, and assist the U.S. in addressing priorities of immediate national importance." Indeed, during the last Congress, President Bush signed into law a bill (H.R. 4664) authorizing the doubling of NSF funding over the next five years, to the surprise of many in the science and engineering communities.

The Administration's budget request for NSF, however, is not in line with the amounts recommended by H.R. 4664. The authorization bill

calls for a level of $4.8 billion for Research and Related Activities (R&RA) and $6.4 billion overall in FY 2004. The actual budget request calls for $4.1 billion for R&RA, an increase of $50 million or 1.2 percent. NSF overall would be funded at $5.5 billion. Total R&D in the request would be $4.0 billion, a 2.8 percent or $109 million increase over FY 2003 (see Table II-7).

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).

The Engineering Directorate, which supports research in areas including information technology, biotechnology, and microeletronics would increase by $6 million to a level of $537 million. The Mathematical and Physical Sciences (MPS) activity would increase by 2.6 percent to a level of $1.1 billion. This Directorate supports education and research in the physical and mathematical sciences. The Electrical and Communications Systems Subactivity in the Engineering Directorate would see 2.4 percent decline from $73 million to $71 million.

The Computer and Information Science and Engineering Directorate (CISE) budget would increase by 1.0 percent to $584 million, $218 million of which would go to the NSF's Information Technology Research priority area (an increase of 4.2 percent). The IT Research work is being directed at seeking ways to improve methods of gathering, storing, analyzing, sharing, and displaying information. All other programs under CISE would decrease or stay flat.

The NSF also is also a major source of funds for nanotechnology research. As part of the National Nanotechnology Initiative (NNI), the NSF would fund Nanoscale Science and Engineering at $249 million (see Table I-10 and Chapter 25 for more on NNI).

One of the stated priorities for the NSF in the FY 2004 budget is to "attract more students to graduate study in science and engineering, improve the quality of preK-12 math and science educations, and advance research on learning." The President's budget request includes $200 million for the Math and Science Partnership (MSP) program, $73

million over last year. This is the third year in a 5-year, $1 billion program designed to improve achievement in math and science at the pre-kindergarten to 12th grade level

The FY 2004 funding level for Major Research Equipment and Facilities Construction (MREFC) is also slated for a large increase: $54 million (36.2 percent) to a level of $202 million. (For more on NSF, see Chapter 7.)

DEPARTMENT OF ENERGY (DOE)

After a slight increase in FY 2003, DOE's R&D budget would increase in FY 2004 by $330 million (4.0 percent) to a level of $8.5 billion (see Table II-11). The DOE R&D budget is divided into seven separate accounts: Energy Supply; Science; Fossil Energy; Energy Conservation; Atomic Energy Defense; Clean Coal Technology; and Radioactive Waste Management.

For the second year in a row, Fossil Energy is hit hard in the request. Following a 17.3 percent requested cut last year in the President's budget, Fossil Energy is slated for 14.9 percent or $72 million cut in FY 2004 to a level of $411 million. R&D in Radioactive Waste Management would be another big loser with a 5.4 percent or $3 million cut. The most substantial increase would be R&D in the Energy Supply account which would increase by 21.9 percent to a level of $376 million.

As President George W. Bush stated in his State of the Union address in January, this administration will make a major push to accelerate the development and utilization of hydrogen-powered fuel cells. With a goal of commercializing hydrogen-powered cars by 2015, the administration will add a new Hydrogen Fuel initiative to its existing FreedomCAR Partnership. The combined budget for these initiatives is $272 million for FY 2004 and is projected to be $1.5 billion over 5 years.

Through the expertise inherent at its national laboratories, the DOE is a major contributor to nanotechnology research, and is making a strong bid for an even larger role. The FY 2004 budget requests $64 million more for nanoscience research to a level of $197 million, a 48 percent increase over FY 2003. DOE is proceeding under this budget for four Nanoscale Science Research Centers at a cost of $87 million and is constructing the equipment for a potential fifth center. (For more on DOE, see Chapter 9; for more on DOE's role in NNI, see Chapter 25.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

Within the Department of Commerce, the National Institute of Standards and Technology (NIST) and its Scientific and Technical Research and Services budget would receive an increase of 7.3 percent, or $22 million, to $330 million for R&D (see Table II-14) to support testing, measurement and standards research in its Electronic and Electronics, Physics, Computer Science and other laboratories. Priorities for new funding include nanotechnology measurements and biometrics.

Due largely to the proposed elimination of two extramural programs, however, overall NIST R&D would decrease by 22.1 percent to a level of $410 million. The Bush Administration attempted unsuccessfully to eliminate the NIST Advanced Technology Program (ATP) in FY 2002-2003, but funding was restored by Congress, which looks more favorably on this program that seeks to accelerate the development of innovative technologies that promise significant commercial payoffs and widespread benefits for the nation. The ATP is yet again a target for elimination in the FY 2004 budget. Another program targeted for phase-out in 2004 is the Manufacturing Extension Partnership (MEP) program. While not strictly an electrotechnology R&D program, the MEP does help small businesses to manufacture advanced electrotechnology products. The Administration's rationale is that the program was originally designed to become self-supporting after six years. (For more on NIST, see Chapter 13.)

NATIONAL INSTITUTES OF HEALTH (NIH)

Almost buried within the huge $27.9 billion NIH budget request is $282 million to support NIH's fledgling National Institute for Biomedical Imaging and Bioengineering (NIBIB), which supports R&D geared toward applying electro- and other technologies to medical applications (see Table II-9). (For more on NIBIB, see Chapter 27; for more on the NIH budget, see Chapter 8.)