

Mechanical Engineering in the FY 2006 Budget

*Timothy Wei,
Board of Government Relations,
American Society of Mechanical Engineers International*

Table 1: Summary of Mechanical Engineering-Related Programs in the FY 2006 Budget (in millions of dollars)

| | FY 2004 Actual | FY 2005 Estimate | FY 2006 Request |
|---|-------------------|---------------------|--------------------|
| Department of Defense | 11,888 | 13,070 | 10,770 |
| Department of Energy | 2,621 | 2,742 | 2,723 |
| Department of Homeland Security | 304 | 436 | 250 |
| Environmental Protection Agency | 307 | 288 | 250 |
| National Aeronautics and Space Admin. | 1,734 | 1,629 | 1,771 |
| National Institute of Standards and Technology | 621 | 698 | 533 |
| National Institutes of Health | 899 | 910 | 916 |
| National Science Foundation | 336 | 339 | 350 |

Table 2: Detail of Mechanical Engineering-Related Programs in the FY 2006 Budget (in millions of dollars)

| | FY 2004 Actual | FY 2005 Estimate | FY 2006 Request |
|---|-------------------|---------------------|--------------------|
| Department of Defense (DOD) | | | |
| <i>Army</i> | | | |
| Basic Research (“6.1”) | 369 | 393 | 308 |
| Applied Research (“6.2”) | 1,046 | 1,117 | 671 |
| Advanced Technology Development (“6.3”) | 1,187 | 1,385 | 756 |
| <i>Navy</i> | | | |
| Basic Research (“6.1”) | 468 | 491 | 448 |
| Applied Research (“6.2”) | 667 | 882 | 598 |
| Advanced Technology Development (“6.3”) | 1,036 | 975 | 730 |
| <i>Air Force</i> | | | |
| Basic Research (“6.1”) | 326 | 383 | 341 |
| Applied Research (“6.2”) | 886 | 946 | 852 |
| Advanced Technology Development (“6.3”) | 1,073 | 1,000 | 788 |

Timothy Wei

Defense Wide

| | | | |
|---|---------------|---------------|---------------|
| Basic Research (“6.1”) | 195 | 246 | 222 |
| Applied Research (“6.2”) | 1,737 | 1,963 | 2,018 |
| Advanced Technology Development (“6.3”) | 2,876 | 3,332 | 2,790 |
| University Research Initiative | 275 | 294 | 248 |
| Total DOD | 11,888 | 13,070 | 10,770 |

Department of Energy (DOE)

| | | | |
|--|--------------|--------------|--------------|
| Basic Energy Sciences | 991 | 1,105 | 1,146 |
| Fusion Energy Sciences | 255 | 274 | 294 |
| Nuclear Energy S&T | 128 | 171 | 191 |
| Fossil Energy R&D | 659 | 572 | 491 |
| Energy Efficiency/Renewable Energy | 352 | 380 | 354 |
| Fuel Cell Tech. (Energy Conservation) | 64 | 75 | 84 |
| Vehicle Technology (Energy Conservation) | 172 | 165 | 166 |
| Total DOE | 2,621 | 2,742 | 2,723 |

Department of Homeland Security (DHS)

| | | | |
|--|------------|------------|------------|
| Radiological and Nuclear Countermeasures | 106 | 123 | 246 |
| Anti-missile devices | 17 | 61 | 110 |
| Rapid Prototyping of Technologies | 68 | 76 | 21 |
| Standards | 32 | 40 | 36 |
| Threat Vulnerability and Assessment | 59 | 66 | 47 |
| University and Fellowship Programs | 22 | 70 | 64 |
| Total DHS | 304 | 436 | 524 |

Environmental Protection Agency (EPA)

| | | | |
|---|----|----|-----|
| Sustainability S&T | 47 | 31 | 23 |
| Air Toxics Research | 20 | 18 | 16 |
| Climate Change Research | 16 | 21 | 21 |
| Environmental Technology Verification (ETV) | 4 | 3 | 3 |
| Superfund Innovative Technology Evaluation (SITE) | 6 | 7 | 1 |
| Particulate Matter Research * | 63 | 64 | 0 |
| Pollution Prevention Research | 49 | 33 | 0 |
| Drinking Water and Water Quality Research | 90 | 93 | 102 |
| Science Advisory Board | 5 | 5 | 5 |
| Tropospheric Ozone Research * | 5 | 5 | 0 |
| Fellowships | 2 | 8 | 8 |
| National Ambient Air Quality Standards (NAAQS)* | 0 | 0 | 71 |

MECHANICAL ENGINEERING IN THE FY 2006 BUDGET

Total EPA (with Superfund) 307 288 250
 * Consolidates the Particulate Matter and Tropospheric Ozone programs.

National Aeronautics and Space Administration (NASA)

Aeronautics Technology
 Aviation Safety & Security 183 185 193
 Airspace Systems 232 152 200
 Vehicle Systems 641 587 459
Exploration Systems Research and Technology 677 723 919
 Total NASA 1,734 1,629 1,771

Exploration Systems: In FY 2005 and earlier years, Exploration Systems Research and Technology was Human and Robotic Technology. Some projects have been transferred from the former Biological and Physical Research program to Exploration Systems Research and Technology.

National Institute of Standards and Technology (NIST)

Scientific & Tech. Res. & Services
 NIST Laboratories 335 373 421
 Baldrige National Quality Program 6 5 6
Industrial Technology Services (ITS)
 Advanced Technology Program (ATP) 177 140 0
 Manufacturing Extension Partnership 39 108 47
 Construction of Research Facilities 64 72 59
 Total NIST 621 698 533

National Institutes of Health (NIH)

NIH-wide SBIR/STTR 610 612 616
 National Institute of Biomedical Imaging & Bioengineering (NIBIB) 289 298 300
 Total NIH 899 910 916

National Science Foundation (NSF)

Chemical and Transport Systems 69 66 69
 Civil and Mechanical Systems 67 82 84
 Design, Manufacture and Industrial Innovation 66 64 67
 Engineering Education and Centers (includes ERC and I/UCRC) 134 127 130
 Total NSF 336 339 350

DEPARTMENT OF DEFENSE (DOD)

The FY 2006 request for DOD Science and Technology (S&T) accounts is \$10.8 billion, which is \$2.3 billion less than the FY 2005 appropriation and represents a 17.6 percent reduction. The total FY 2006 DOD budget request, which does not include any funds that may be expended in FY 2006 from prior or future supplemental appropriations, is \$419.3 billion. The 2001 Quadrennial Defense Review (QDR) recommended that 3 percent of the defense budget be allocated to Science and Technology. However, the S&T portion of total DOD spending will be 2.6 percent.

These S&T funds support Basic Research (“6.1”), Applied Research (“6.2”), and Advanced Technology Development (“6.3”) and all categories would experience significant declines in funding. Basic Research would decrease from \$1.5 billion to \$1.3 billion, a 12.9 percent decline, while Applied Research would be reduced from \$4.8 billion to \$4.1 billion, a 14.6 percent reduction. The largest reduction would occur in Advanced Technology Development, which would experience a 24.5 percent decline, from \$6.7 billion to \$5.0 billion.

The services’ S&T accounts reflect the general trend of large reductions described above, and these figures are shown in Table 2. However, the largest reductions are in the Army’s accounts, where Basic Research would fall 21.6 percent, Advanced Technology Development by 39.9 percent, and Advanced Technology Development by 45.4 percent. The only major S&T component proposed for an increase is “Defense-Wide” Applied Research (“6.2”) with 2.8 percent, due to a 3.6 percent increase for the Defense Advanced Research Projects Agency (DARPA).

The budgets for the University Research Initiative (URI) programs that support graduate education in Mathematics, Science, and Engineering, which were transferred two years ago from OSD to the individual services, would see a \$46 million or 15.7 percent decrease from \$294 million in FY 2005 to \$248 million. (For more on DOD, see Chapter 6.)

DEPARTMENT OF ENERGY (DOE)

The Department’s budget for FY 2006 reflects three priorities: keeping DOE well positioned to help in fighting the war on terror, strengthening our homeland defenses, and sustaining the momentum of our economic recovery. The administration proposes a total of \$3.47 billion for the

MECHANICAL ENGINEERING IN THE FY 2006 BUDGET

DOE Office of Science for FY 2006, a \$142 million decrease from FY 2005. The decrease includes reductions for nearly every program except for Basic Energy Sciences (up \$41 million to \$1.15 billion) and Fusion Energy Sciences (an increase of \$17 million to \$291 million). While there are no major new policy initiatives, there are a number of proposed program terminations and several programs would see decreases. A few programs would see significant increases, including hydrogen research (up \$33 million to \$257 million), nuclear energy research (up \$25 million to \$511 million), the International Thermonuclear Experimental Reactor (ITER, near start at \$50 million), and the Yucca Mountain nuclear waste repository (increased \$79 million to \$651 million).

The FY 2006 budget for nuclear energy research is \$191 million, an increase of \$20 million above FY 2005. Within that budget, the largest increase would be for the Nuclear Hydrogen Initiative (up \$11.1 million; \$20 million total), followed by the Nuclear Power 2010 program (increased \$6.4 million; \$56 million total), the Generation IV Initiative (up \$5.3 million; \$45 million total), and the Advanced Fuel Cycle Initiative (increased \$2.5 million; \$70 million total).

The FY 2006 request of \$491 million for fossil energy research represents a decrease of \$81 million from FY 2005. The request includes a \$13.2 million (14.9 percent) increase for the President's Coal Research Initiative, including a \$21.8 million increase for carbon sequestration research. Otherwise, funding would decline, including natural gas and petroleum technologies, which would be reduced to closeout levels (down \$34.8 million, \$10 million total for natural gas; down \$23.9 million \$10 million for petroleum); ultra clean fuels, which will be used for funding hydrogen production from coal; and cooperative research and development (down \$5.3 million; \$3 million total).

The \$1.2 billion total request for energy efficiency, renewable energy (EERE), and energy conservation reflects a decrease of approximately \$48 million over FY 2005. This is due to the proposed elimination of the \$4.2 million hydropower research program, a substantial reduction in biomass and biorefinery systems research (decreased \$30.4 million; \$50.4 million total), and reductions in weatherization assistance (down \$10.8 million; \$298.2 million total), distributed energy R&D (decreased \$3.8 million; \$56.6 million total), building technologies (reduced \$7.5 million; \$58 million total), and industrial technologies (down \$18.3 million; \$56.5 million total). Proposed increases in the EERE budget

Timothy Wei

include hydrogen research (up \$5 million to \$99.1 million), wind energy research (up \$3.4 million to \$44.2 million), fuel cell technologies (up \$9 million; \$84 million total), and vehicle technologies, mostly in support of FreedomCAR (increased \$1 million; \$166 million total).

DEPARTMENT OF HOMELAND SECURITY (DHS)

Homeland Security R&D program funding would experience slower growth in FY 2006 compared to previous years, specifically, an increase of \$44 million (3.6 percent) to \$1.3 billion. The Science and Technology Directorate will assume control of all the agency's R&D portfolios and become responsible for 100 percent of the R&D funding.

In the FY 2006 budget request, a top priority in DHS R&D is radiological and nuclear countermeasures (increasing by 100 percent to \$246 million), wherein efforts will be focused on detection and reporting of terrorists attempts to transport or use nuclear or radiological materials. Programs will develop new technologies and transfer them to use in the field. Another top priority is anti-missile devices, termed counter MANPADS, which is increased by 80 percent to \$110 million. The R&D emphasis would be on the development, prototype and testing of promising missile technologies effective against man-portable air defense systems. Increases would be partially balanced by reductions in threat and vulnerability assessment (down 29 percent to \$47 million); standards development (decreased by 11 percent to \$36 million); and rapid prototyping of technologies (down 72 percent to \$21 million.)

The University Programs and Fellowship Programs request would also decline slightly (decreased by 9 percent to \$64 million.) Four university centers performing research are currently in operation. They are focused on agro-terrorism, threat assessment, and behavioral and social aspects of terrorism. Four additional centers will be awarded in FY 2006, one of which will be specializing in preparations and response to terrorist attacks. This program also supports fellowships and scholarships for graduate education and research opportunities for engineers and scientists. (For more on DHS, see Chapter 12.)

ENVIRONMENTAL PROTECTION AGENCY (EPA)

The total EPA budget for FY 2006 is \$7.6 billion, a cut of 5.7 percent. The EPA R&D request for FY 2006 is \$568 million, down \$4 million or

MECHANICAL ENGINEERING IN THE FY 2006 BUDGET

0.7 percent relative to FY 2005. Most of the R&D request will be funded in the Science and Technology account, which would increase by \$1 million to \$536 million. This year's request for Science and Technology incorporates significant shifts in the structure of its programs. These shifts include consolidation of projects and funding of the Office of Research and Development (ORD) by specific offices within the agency rather than direct funding to ORD. Funding requests related to mechanical engineering for FY 2006 total \$194 million. This is a \$47 million, or 19.5 percent decrease from the FY 2005 request.

The particulate matter and tropospheric ozone programs would be consolidated into the NAAQS project. Funding for research on air toxics would increase. There are two homeland security related initiatives: \$11.5 million for decontamination technology development, and approximately \$1.2 million for radiation response team development. Research funding for drinking water and water quality would increase (10 percent) in this budget. Also included is a \$44 million homeland security related initiative to employ sensors and monitoring systems into the nation's water supply. Projects in ecosystem science will experience a significant reduction in order to pay for increases in homeland security initiatives and other higher priority projects. Although projects in the area of Human Health Risks would increase overall, research in the areas of risk and dose exposure would decline. Exploratory grants would fall \$5 million, with the remaining funds to focus on nanotechnology. The Pollution Prevention project would be replaced by Sustainability, with a decrease in funding of \$10 million spanning all areas of the initiative. (For more on EPA, see Chapter 13.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA's budget request for FY 2006 is \$16.5 billion, an increase of 2.4 percent over the \$16.1 billion provided in FY 2005. (The FY 2005 level does not include a \$126 million emergency supplemental.)

The Vision for Space Exploration continues to be the priority in NASA's budget. The Space Shuttle and Space Station account for 39 percent of the proposed NASA budget for FY 2006. Development of the Crew Exploration Vehicle (CEV) would jump in the FY 2006 budget by more than 500 percent, from \$140 million in FY 2005 to \$753 million in FY 2006, as work on the vehicle destined for test in 2008 gets underway. Project Prometheus, focusing on the development of nuclear propulsion

Timothy Wei

techniques, would be reduced due to its potential use on the Jupiter Icy Moons Orbiter (JIMO) proving to be too complex and expensive. NASA is reviewing options before deciding what mission to substitute for JIMO as a test. Funding for research aboard the Space Station is proposed for a cut as NASA reorients the program toward human physiology research.

Mechanical engineering-related research is primarily conducted in the Office of Aeronautics (OA) and in the newly formed Exploration Systems Mission Directorate. NASA proposes \$852.3 million for aeronautics technology in FY 2006, a decrease of \$53.9 million from FY 2005. This would include \$193 million, an increase of \$7.5 million above FY 2005, for the Aviation Safety and Security Program; \$200.3 million for the Airspace Systems Program, an increase of \$48.1 million; and \$459.1 million for the Vehicle Systems Program, a decrease of \$109.5 million. The Exploration Systems Research and Technology program (\$919 million) would replace the Office of Space Exploration (OSE) Human and Robotic Technology program. (For more on NASA, see Chapter 10.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

The FY 2006 request for mechanical engineering-related R&D at NIST is \$533 million, down \$165 million from FY 2005, largely because of the proposed elimination of the Advanced Technology Program, which Congress funded at \$140.4 million this year.

The portion of the NIST budget related to mechanical engineering consists of two components: The NIST laboratory portion of the Scientific and Technical Research Services budget (\$420.6 million proposed, \$47.5 million above the FY 2005 enacted level) and Industrial Technology Services, which consists of the Advanced Technology Program (\$0 proposed, down \$140.4 million) and the newly-named Hollings Manufacturing Extension Partnership (HMEP - \$46.8 million proposed; down \$60.7 million from the FY 2005 level).

The laboratory budget request reflects an increase (\$47.5 million) to provide the measurement and standards infrastructure to support advances in manufacturing and to improve measurements and standards for homeland security. With the additional funds, NIST proposes to use \$17.2 million to help the U.S. scientific and industrial communities keep pace with fast-breaking developments through innovation in biosystems

MECHANICAL ENGINEERING IN THE FY 2006 BUDGET

and health, interoperability, quantum processing, and competence in advanced measurements.

An additional \$10 million of the proposed increase would go toward establishing a National Nanomanufacturing and Nanometrology Facility, \$1.6 million would help small manufacturers communicate electronically with global business partners, and \$4 million would help align U.S. standards for measuring instruments with international standards. An additional \$1 million is requested to improve the accuracy of biometrics. (For more on NIST and ATP, see Chapter 13.)

NATIONAL INSTITUTES OF HEALTH (NIH)

The total FY 2006 NIH budget is \$28.8 billion, which represents an increase of \$195 million or 0.7 percent over FY 2005. Of this increase, \$50 million is slated for radiological/nuclear countermeasures development. NIH R&D would rise 0.5 percent to \$27.9 billion. NIH projects a decline in the total number of Research Project Grants (RPGs) for the second year in a row.

The largest percentage increase in the FY 2006 budget request would go to the Office of the Director (OD; up 7.6 percent) to boost OD funding for clinical research, high-risk basic research, and collaborative research outlined in the NIH Roadmap for Biomedical Research. The Roadmap would receive \$333 million in FY 2006 (up 41 percent), with \$250 million coming from institute budgets.

The Roadmap initiative should prove beneficial to biomedical engineers accustomed to working in collaborative environments consistent with the mission of the National Institute of Biomedical Imaging and Bioengineering (NIBIB). NIBIB's mission is to improve health by leading the development and application of emerging and breakthrough technologies based in the biological, physical, and engineering sciences. One key focus of the Roadmap and the NIBIB is molecular libraries and imaging; a component of the New Pathways to Discovery Initiative. The Research Teams of the Future initiative aims to encourage interdisciplinary collaborations through special funding. There are additional programs to encourage Translational Research that aim to bring new technologies more directly to the clinical setting.

Timothy Wei

Most of NIH's mechanical engineering R&D would be associated with NIBIB. The President's FY 2006 budget requests \$299.8 million for the NIBIB, an increase of \$1.6 million (0.5 percent) over the FY 2005 enacted level.

NIBIB Extramural Research would decline 0.2 percent, to \$276.6 million while intramural research would grow 35.1 percent to \$9.7 million. NIBIB's Research Management and Support request is \$15.5 million, an increase of 0.7 percent. (For more on NIH, see Chapter 8.)

NATIONAL SCIENCE FOUNDATION (NSF)

The total FY 2006 NSF budget request is \$5.6 billion representing a \$132 million or 2.4 percent increase over the FY 2005 estimate. However, since NSF received a 3.1 percent (\$180 million) cut in FY 2005, the FY 2006 request is actually 1 percent below FY 2004. It should be noted that the FY 2006 request includes a \$48 million transfer from the U.S. Coast Guard to the NSF to pay for polar ice-breaker activities formally paid for by the Coast Guard. When this is removed, the actual requested increase for NSF is 1.5 percent. (For more on NSF, see Chapter 7.)

There are ten activities under NSF's main Research and Related Activities (R&RA) account, including the Engineering Directorate (ENG). The FY 2006 budget request for ENG is \$580.7 million, a 3.5 percent increase over the current year estimate. ENG will continue to support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment (\$6 million), Nanoscale Science and Engineering (\$128 million), Mathematical Sciences (\$2.9 million), and Human and Social Dynamics (\$2 million).

Funding for mechanical engineering-related research within ENG reflects an increase of 3.4 percent to \$350.3 million. Mechanical engineering related programs are often funded outside the selected group and even outside ENG. Detailed examination of individual programs, however, is beyond the scope of this analysis. The mechanical engineering related funding increase slightly exceeds NSF's overall 2.4 percent rate of increase and is approximately equivalent to ENG's 3.5 percent increase. Note that the budget for Civil and Mechanical Systems (CMS) within ENG includes the operations and research phase for the Network for Earthquake Engineering Simulation (NEES).