Chapter xx
Mechanical Engineering in the FY 2006 Budget
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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	524
Environmental Protection Agency	307	288	250
National Aeronautics and Space Administration	1,734	1,629	1771
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)			
Army			
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
Navy			
Basic Research (6.1)	468	491	448
Applied Research (6.2)	667	882	598
Advanced Technology Development (6.3)	1,036	975	730
Air Force			
Basic Research (6.1)	326	383	341
Applied Research (6.2)	886	946	852

Advanced Technology Development (6.3)	1,073	1,000	788
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 (URI)	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	291
Nuclear Energy S&T	128	171	191
Fossil Energy R&D	659	572	491
Energy Efficiency/Renewable Energy	352	380	354
Fuel Cell Technology (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
National Ambient Air Quality Standards (NAAQS)*	0	0	71
Fellowships	2	8	8
Total EPA (with Superfund)	307	288	250

*NAAQS: Resources under this program project were formerly captured under the Particulate Matter and Tropospheric Ozone Program Projects.

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 the FY 2005 Exploration Systems Enterprise, the Exploration Systems Research and Technology Theme was the Human and Robotic Technology Theme. The Human System Research and Technology Theme in FY 2005 was the Biological and Physical Research Enterprise. Some projects have been transferred from this Enterprise to the Exploration Systems Research and Technology Theme.

National Institute of Standards and Technology (NIST)			
Scientific & Tech. Res. & Services			
NIST Laboratories	335	373	421
Baldridge National Quality Program (BNQP)	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 and Manufacturing 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 budget request for Defense Science and Technology (S&T) accounts is $10.770 billion, which is $2.300 billion less than the FY 2005 appropriated amount of $13.070 and represents a 17.6 percent reduction. The FY 2006 budget request for all of DOD, 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 three (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. This is unchanged relative to FY 2005.

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 $1.513 billion to $1.318 billion, a 12.9 percent decline, while Applied Research would be reduced from $4.849 billion to $4.139 billion, a 14.6 percent reduction. The largest reduction would occur in Advanced Technology Development, which would experience a 24.5 percent decline, from $6.707 billion to $5.046 billion.

The individual service's S&T accounts reflect the general trend of large reductions described above, and these figures shown in Table 2. However the largest reductions are in the Army's accounts, where Basic Research is cut by 21.6 percent, Advanced Technology Development by 39.9 percent, and Advanced Technology Development by 45.4 percent. The only major S&T component with an increase is "Defense-Wide" Applied Research (6.2) where a 2.8 percent increase is proposed, 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 decrease from $294 million in FY 2005 to $248 million next year, a 15.7 percent reduction.

Department of Energy (DOE)

The Department's budget for FY2006 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 DOE Office of Science for FY 2004, a $ 142 million decrease from the FY 2005 enacted level. The decrease includes reductions for nearly every program except for basic energy sciences (up $41 million; $1.15 billion total) and fusion energy research (an increase of $17 million;

$291 million total). 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; $257 million total), nuclear energy research (increased $25 million; $511 million total), the International Thermonuclear Experimental Reactor (ITER, near start at $50 million), and the Yucca Mountain nuclear waste repository (increased $79 million; $651 million total).

The FY 2006 proposed budget for nuclear energy research is $191 million, an increase of $20 million above the FY 2005 enacted level. 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 budget request of $491 million for fossil energy research represents a decrease of approximately $81 million from the FY 2005 enacted level of $572 million. 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, programs were decreased, including natural gas and petroleum technologies, which will be reduced to closeout levels (down $34.8 million, $10 million total for natural gas; $ decreased 23.9 million, $10 million total for petroleum); ultra clean fuels, which will used for funding hydrogen production from coal; and cooperative research and development (down $5.3 million; $3 million total).

The $1.2 billion total budget request for energy efficiency, renewable energy (EERE), and energy conservation reflects a decrease of approximately $48 million over FY 2005 enacted levels. 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 include hydrogen research (up $5 million; $99.1 million total), wind energy research (increased 3.4

million; $44.2 million total), 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. DHS is the 7th largest federal source of R&D funds, and currently devotes approximately 40 percent of the R&D budget to basic and applied research.

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. In addition to numerous postdocs and researchers, DHS projects will fund a rotating group of 300 students in FY 2006.

Environmental Protection Agency (EPA)

The total EPA budget request for FY 2006 is $7.57 billion. This represents a decrease of $455 million, or 5.7 percent from FY 2005. The EPA R&D request for FY 2006 is $568 million, down $4 million or 0.7 percent relative to FY 2005. Most of the R&D request will be funded in the Science and Technology account, which will 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 have been consolidated into the NAAQS project. Funding for research on air toxics increases in the requested budget. 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 increased (10 percent) in this budget request. 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 experience an overall increase in funding, research in the areas of risk and dose exposure will decline. Exploratory grants are reduced $5 million, with the remaining funds to focus on nanotechnology. The Pollution Prevention project has been replaced by Sustainability in this year's proposed budget, with a decrease in funding of $10 million spanning all areas of the initiative.

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 the $126 million emergency supplemental provided to fix facilities damaged from last year's hurricanes.)

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 techniques, is being 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 research on human physiology.

The budget proposes additional cuts to programs in Earth Science, Aeronautics and some portions of Space Science. The proposed cuts in these areas are being accompanied by a reassessment of NASA's personnel needs related to the Vision for Space Exploration.

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 the FY 2005 appropriation. This would include $193 million, an increase of $7.5 million above FY 2005 appropriation, for the Aviation Safety and Security Program; $200.3 million for the Airspace Systems Program, an increase of $48.1 million above the FY 2005 appropriation, and $459.1 million for the Vehicle Systems Program, a decrease of $109.5 million from the FY 2005 appropriation. The Exploration Systems Research and Technology program ($919 million) would replace the Office of Space Exploration (OSE) Human and Robotic Technology program.

National Institute of Standards and Technology (NIST)

The FY 2006 request for mechanical engineering-related R&D for NIST is $533 million, down $165 million from the FY 2005 enacted level, largely because of the proposed elimination of the Advanced Technology Program, which Congress funded at $140.4 million last 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 from current level) 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 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 border security.

National Institutes of Health (NIH)

The total FY 2006 NIH budget request is $28.8 billion, which represents an increase of $195 million, or a 0.7 percent increase over the FY 2005 enacted level. 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. However, the number of competitive RPGs is expected to increase.

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). The mission of the NIBIB 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.

Most of the mechanical engineering R&D related to NIH 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. Most NIH institutes are slated to receive increases between 0.3 and 1.3 percent for FY 2006.

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.

National Science Foundation (NSF)

The total FY 2006 NSF budget request is $5.605 billion representing a $132.2 million or 2.4 percent increase over the current FY 2005 estimate. However, since NSF received a 3.1 percent ($180 million) cut in FY 2005, the overall request for FY 2006 is actually 1 percent below the actual FY 2004 expenditures.

The request is divided into six appropriation accounts. Research and Related Activities (R&RA) comprises the dominant part of the total NSF request at $4.334 billion. This is a 2.7 percent increase relative to FY 2005. The next largest category is Education and Human Resources with a request for $737.0 million, down 12.4 percent from FY 2005. Requests for the remaining three categories are Major Research Equipment and Facilities Construction ($250.0 million), Salaries and Expenses ($269.0 million), National Science Board ($4.0 million), and the Office of the Inspector General ($11.5 million). These amounts represent increases of 44.0 percent, 20.5 percent, 0.8 percent, and 14.7 percent respectively, relative to the

current year's budget estimate, 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.

There are ten activities under R&RA 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 remains the fifth largest activity in R&RA behind Mathematical and Physical Sciences ($1,086.2 million), Geosciences ($709.1 million), Computer and Information Science and Engineering ($620.6 million) and Biological Sciences ($581.8 million). The remaining activities in the category are: US Polar Research Programs ($319.4 million), Social, Behavioral and Economic Sciences ($198.8 million), Integrative Activities ($134.9 million), US Antarctic Logistical Support Activities ($67.5 million), and Office of International Science and Engineering ($34.5 million).

ENG will continue to support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment ($6M), Nanoscale Science and Engineering ($127.8 million), Mathematical Sciences ($2.9 million), and Human and Social Dynamics ($2 million), at the same funding level as the FY2005 estimate.

Funding for mechanical engineering related research within ENG reflects an increase of 3.4 percent to $350.32 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 CMS includes the operations and research phase for the Network for Earthquake Engineering Simulation (NEES).