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Mechanical Engineering in the FY 2007 Budget

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Table 1: Summary of Mechanical Engineering-Related Programs in the FY 2007 Budget (in millions of dollars)

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Request
Department of Defense	13,026	13,191	11,083
Department of Energy	3,039	3,202	3,703
Department of Homeland Security	872	817	953
Environmental Protection Agency	249	240	229
National Aeronautics and Space Admin.	1,861	1,577	1,370
National Institute of Standards and Tech.	694	806	573
National Institutes of Health	921	894	891
National Science Foundation	373	393	427

Table 2: Detail of Mechanical Engineering-Related Programs in the FY 2007 Budget (in millions of dollars)

	FY 2005 Actual	FY 2006 Estimate	FY 2007 Request
Department of Defense (DOD)			
Army			
Basic Research ("6.1")	393	372	312
Applied Research ("6.2")	1,138	1,250	685
Advanced Technology Development ("6.3")	1,480	1,389	722
Navy			
Basic Research ("6.1")	478	475	456
Applied Research ("6.2")	802	799	639
Advanced Technology Development ("6.3")	1,088	1,022	505
Air Force			
Basic Research ("6.1")	374	363	370
Applied Research ("6.2")	924	1,071	973
Advanced Technology Development ("6.3")	925	1,010	805
Defense Wide			
Basic Research ("6.1")	240	260	284

Applied Research ("6.2")	1,924	2,049	2,181
Advanced Technology Development ("6.3")	3,340	3,182	3,152
*- University Research Initiative **	*287*	*272*	*249*
Total DOD	13,026	13,191	11,083

* URI has not been included in the DOD budget total.

Department of Energy (DOE)			
Office of Science			
Basic Energy Sciences	1,084	1,135	1,421
Advanced Scientific Computing Research	226	235	319
Fusion Energy Sciences	267	288	319
Office of Nuclear Energy, Science, & Tech.			
Nuclear Energy R&D	168	224	347
Univ. Nuclear Reactor Infrastructure & Edu.	24	27	0
Office of Energy Effic. /Renewable Energy			
Hydrogen Technology	167	156	196
Biomass and Biorefinery Systems R&D	87	91	150
Solar and Wind Energy	125	122	192
Geothermal Technology	25	23	0
Hydropower	5	0.5	0
Vehicle, Building & Industrial Technologies	300	308	289
Office of Fossil Energy	561	592	470
Total DOE	3,039	3,202	3,703

Department of Homeland Security (DHS)			
Science and Technology Directorate			
Biological Countermeasures	363	376	337
Chemical Countermeasures	53	94	83
Explosives Countermeasures	20	44	87
Radiological and Nuclear Countermeasures	123	19	0
Anti-missile devices	61	109	5
Rapid Prototyping of Technologies	76	35	0
Standards	40	35	22
Threat Vulnerability and Assessment	66	43	40
University and Fellowship Programs	70	62	52
Domestic Nuclear Detection Office R&D	0	0	327
Total DHS	872	817	953

Environmental Protection Agency (EPA)			
Air Toxics Research	14	16	12
Climate Change Research	19	19	17
Environmental Tech. Verification (ETV)	3	3	0

Superfund Innovative Tech. Evalu (SITE)	7	1	0
Drinking Water and Water Quality Research	93	96	106
Fellowships	14	12	8
Nat'l. Ambient Air Quality Stds. (NAAQS)	63	67	65
Sustainability Research	36	26	21
Total EPA (with Superfund)	249	240	229
National Aeronautics and Space Administration (NASA)			
Aeronautics Technology			
Aviation Safety and Security	183	148	102
Airspace Systems	149	174	120
Fundamental Aeronautics	630	562	447
Aeronautics Test Program	0	0	55
Exploration Systems Research &Technology	899	693	646
Total NASA	1,861	1,577	1,370
National Institute of Standards and Technology (NIST)			
Scientific & Tech. Res. & Services			
NIST Laboratories	373	387	459
Industrial Technology Services (ITS)			
Advanced Technology Program (ATP)	140	79	0
Manufacturing Extension Partnership	108	105	46
Construction of Research Facilities	73	174	68
Total NIST	694	806	573
National Institutes of Health (NIH)			
NIH-wide SBIR/STTR (excl. NIBIB)	614	597	596
National Institute of Biomedical Imaging & Bioengineering (NIBIB)	298	297	295
Total NIH	921	894	891
National Science Foundation (NSF)			
Chemical, Bioeng., Env., & Transport Sys.	112*	123*	124
Civil, Mechanical, & Manuf. Innovation	141**	147**	152
Engineering Education and Centers	120	123	126
Emerging Frontiers in Res. & Innov.	0	0	25
Total NSF	373	393	427

* Combines former Bioengineering and Chemical & Transport Sys. divisions.

** Funding levels reflect the combination of the former Civil & Mechanical Systems and Design and Manufacturing Innovation divisions.

Mechanical engineering R&D spans a very wide range of problems and applications. Mechanical engineering has a presence in nanotechnology to multi-scale computing to astrodynamics. This comes about by virtue of the fact that the laws of mechanics hold from the nanoscale to galactic scales and that mankind is actively engaged in exploration and design across this entire spectrum. The function of this chapter is to provide the reader with a sense of the major activity areas in which mechanical engineering R&D may be found and trends in funding within these areas. In this regard, programs and initiatives may be highlighted that are not specifically mechanical engineering focused. It is important to note therefore that the funding requests discussed in this chapter represent potential sources of funding for mechanical engineers; they do not represent the state of federal funding specifically for mechanical engineering alone. Data for funding by agency are presented in Table 1. Individual agency breakdowns appear in Table 2.

In addition, it is important to keep in mind that only sources of research and development funding have been identified. Funding for application and missions involving mechanical engineering, such as the space shuttle, do not lie within the purview of this analysis. Where possible, these distinctions have been highlighted.

DEPARTMENT OF DEFENSE (DOD)

The FY 2007 request for DOD Science and Technology (S&T) accounts is $11.08 billion, which is a $1.86 billion or 16 percent reduction from FY 2006. The total FY 2007 DOD budget, which does not include anticipated supplemental appropriations for operations in Iraq and Afghanistan, is $489.3 billion. The 2001 Quadrennial Defense Review (QDR) recommended that 3 percent of the defense budget be allocated to S&T. The S&T portion of total DOD spending would be 2.5 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 reductions in funding. Basic Research would decrease from $1.47 billion to $1.43 billion, a 2.7 percent decline, while Applied Research would be reduced from $5.17 billion to $4.48 billion, a 13 percent reduction. The largest reduction would occur in Advanced Technology Development, which would experience a 21.5 percent decline, from $6.6 billion to $5.18 billion.

The services' S&T accounts reflect the general trend of reductions described above. However, the largest reductions would be in the Army's accounts, where Basic Research would fall 16.2 percent, Applied Research by 45.2 percent, and Advanced Technology Development by 48.0 percent. The only major S&T components proposed for increases are "Defense-Wide" Basic Research ("6.1") and Applied Research ("6.2") with 9.1 percent and 6.5 percent boosts respectively. The majority of that increase would go to the Defense Advanced Research Projects Agency (DARPA), up 10.6 percent to $3.3 billion.

Budgets for the University Research Initiative (URI) programs that support graduate education in Mathematics, Science, and Engineering would see a $23 million or 3.2 percent decrease from $272 million last year to $249 million in FY 2007.

DEPARTMENT OF ENERGY (DOE)

DOE's FY 2007 budget 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. Mechanical engineering related R&D lies primarily in four offices: Office of Science, Office of Energy Efficiency and Renewable Energy (EERE), Office of Nuclear Energy, Science and Technology (NE) and Office of Fossil Energy. These four offices' requests reflect increases of $505 million or 14.1 percent above FY 2006 for the Office of Science, $2.6 million or 0.2 percent for EERE and $97 million or 18.1 percent for NE. The lone decrease would be in the Office of Fossil Energy which would fall $193 million or 22.9 percent.

There are three programs within the Office of Science in which mechanical engineering related R&D typically occurs. These are Basic Energy Sciences (BES), $1.42 billion; Advanced Scientific Computing and Research (ASCR), $0.32 billion; and Fusion Energy Sciences (FES), $0.32 billion. All three of these programs would experience increases under the FY 2007 budget request.

There are a number of programs within EERE involving mechanical engineering R&D. These include Biomass and Biorefinery Systems R&D, $150 million; Wind and Solar Energy, $44 million and $148 million respectively; Hydrogen Technology, $196 million; and Vehicle, Industrial and Building Technologies, $166 million, $46 million and $77

million respectively. Funding for hydropower and geothermal technology would not continue in FY 2007. Those programs combined with decreases in vehicle and industrial technologies offset significant increases (up to 78.5 percent for solar energy) in the other programs.

The funding request within NE also reflects a balance of increases and decreases. Overall Nuclear Energy R&D would increase by 55.1 percent to $347 million. This is led by a $164 million increase to $243 million in the Advanced Fuel Cycle Initiative. Offsetting this gain, there would be reductions in Nuclear Power 2010, Generation IV and Nuclear Hydrogen Initiative.

Under the FY 2007 budget request, the Office of Fossil Energy would see a 22.9 percent reduction to $649 million. Research on coal would decrease from $376 million to $330 million. Funding for Clean Coal Technology, Natural Gas Technologies and Petroleum Oil Technologies would be discontinued in FY 2007.

DEPARTMENT OF HOMELAND SECURITY (DHS)

The total FY 2007 budget request for DHS is $42.7 billion, a 6 percent increase over the previous year. The FY 2007 budget is centered around five themes: increasing overall preparedness (including strengthening FEMA), strengthening border security and reforming immigration, enhancing transportation security, improving information sharing, and strengthening the department's organization to maximize performance.

The DHS R&D portfolio would decline for the first time in 2007, falling 5.6 percent to $1.3 billion despite the overall budgetary increase. R&D is divided between the new Domestic Nuclear Detection Office, (DNDO), $327 million and the Science and Technology Directorate (S&T), $1.0 billion. Under this new organization, research, development and operations related to radiological and nuclear countermeasures moves to DNDO with an increase from $19 million in FY 2006 to $327 million.

The budget for S&T, in contrast, would decline 33 percent from $1.49 billion to just slightly over $1.0 billion. The biological and chemical countermeasures activities would fall 10 percent to $337 million and 11.7 percent to $83 million, respectively. Work on explosive countermeasures, conversely, would roughly double from $43.6 million in FY 2006 to $86.6 million in FY 2007. Funding for R&D on

technologies to counter shoulder-fired anti-aircraft missiles would fall from $109 million down to $5 million as prototype technologies transition out of R&D to deployment. The University Programs Fellowship Programs request would decline by $10.4 million to $51.97 billion. This is the second budget reduction for this program since its inception in FY 2005 when it received $70.0 million in funding.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

The FY 2007 budget request for EPA is $7.3 billion, a decrease from the FY 2006 enacted budget of $7.63 billion. While the Agency's Science and Technology account would increase from $730 million last year to $788 million in FY 2007, the overall R&D portfolio request within S&T of $557 million reflects a 7.2 percent cut. This is mostly due to the proposed elimination of earmarks after a similar-sized cut in 2006.

Areas in which mechanical engineering related R&D are most prevalent are highlighted in Table 2. These include the Environmental Technology Verification Program (ETV), which was funded at $3.0 million this year, but would not be funded under the FY 2007 budget request. Also note that research on ozone and particular matter would be made part of the National Ambient Air Quality Standards activity (NAAQS) in FY 2007. Fellowships also would be reduced to $8.4 million, down from $11.7 million. The Sustainability project, which last year replaced the Pollution Prevention project, would see its budget decline from $26.0 million to $21.4 million.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA's budget request for FY 2007 is $16.8 billion, an increase of 3.2 percent over the $16.27 billion provided in FY 2006. (The FY 2006 level does not include the $349.8 million emergency supplemental provided to fix facilities damaged by Hurricane Katrina.)

The Vision for Space Exploration continues to be the priority in NASA's budget. The Space Shuttle and the International Space Station account for 39 percent of the proposed NASA budget for FY 2007. Development of the Crew Exploration Vehicle (CEV) would be increased to $894.7 million in FY 2007 from $839.2 million in FY 2006, in order to accelerate the start of production and sustain engineering for the program. Project Prometheus, focusing on the development of nuclear

propulsion techniques, would fall substantially from $75.7 million in FY 2006 to $9.4 million in FY 2007 because Jupiter Icy Moons Orbiter (JIMO) and all other nuclear propulsion and nuclear reactor flight systems have been terminated. Funding for Prometheus would be shifted towards the CEV, with the remaining funds used for JIMO termination costs and towards a future restructuring of nuclear technology research and development programs.

For the second year in a row, 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 put into place to prevent further delays in Vision for Space Exploration missions.

Mechanical engineering-related research is primarily conducted in the Office of Aeronautics (OA) and in the Exploration Systems Mission Directorate (ESMD). Aeronautics research would decrease for the third consecutive year. NASA proposes $724.4 million for aeronautics technology in FY 2007, a decrease of $159.7 million from FY 2006. This would include $102.2 million, a decrease of $46.2 million, for the Aviation Safety and Security Program; $120.0 million for the Airspace Systems Program, a reduction of $53.9 million; $447.2 million for Fundamental Aeronautics, a decrease of $114.5 million; and a newly proposed Aeronautics Test Program with a request of $55 million in FY 2007. NASA proposes $646.1 million for Exploration Systems Research and Technology, a decrease of $46.4 million or 6.8 percent.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

The FY 2007 request for NIST is $583 million, down $175 million from the FY 2006 enacted level of $758 million. This is largely because of the proposed elimination of the Advanced Technology Program (ATP), which Congress funded at $79 million in 2006.

The portion of the NIST budget in which mechanical engineering R&D occurs consists of two components. The NIST Laboratory portion of the Scientific and Technical Research Services budget contains a request for $420.6 million, $47.5 million above FY 2006. The second component, Industrial Technology Services, consists of the ATP and the newly-named Hollings Manufacturing Extension Partnership (HMEP). As noted, the FY 2007 budget request does not include funding for the ATP. The request for HMEP is $46.8 million, $60.7 million below FY 2006.

The $47.5 million increase in the NIST Laboratory budget was requested to provide measurement and standards infrastructure to support advances in manufacturing and to improve measurements and standards for homeland security. As part of this request, 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. Additional funds would be used to help small manufacturers communicate electronically with global business partners, align U.S. standards for measuring instruments with international standards, and improve the accuracy of biometrics for border security.

NATIONAL INSTITUTES OF HEALTH (NIH)

The total FY 2007 NIH budget request is $28.6 billion, remaining at the same level as in FY 2006. NIH R&D would also stay at its current level of $27.8 billion. Funds for the majority of NIH institutes and centers would be reduced and the total number of Research Project Grants (RPGs) is projected to decline for the third consecutive year.

The largest percentage increase, 27 percent, in the FY 2007 budget request would go to the Office of the Director (OD) to increase funding for the NIH Roadmap for Biomedical Research and for biodefense countermeasures. The Roadmap would receive $443 million in FY 2007, an increase of 24.5 percent, with $332 million coming from institute budgets. NIH Biodefense R&D would grow 6.2 percent to $1.9 billion.

Most of NIH's mechanical engineering R&D would be associated with NIBIB. The FY 2007 budget requests $295 million for NIBIB, a decrease of $2 million or 0.7 percent from FY 2006. NIBIB Extramural Research would decline 1.3 percent, to $268 million, while intramural research would grow 6.5 percent to $7.7 million.

NATIONAL SCIENCE FOUNDATION (NSF)

The total FY 2007 NSF budget request is $6.02 billion, a $439 million or 7.9 percent increase. Research and Related Activities (R&RA) comprises the dominant part of the total NSF request at $4.66 billion, a 7.7 percent increase. The next largest category is Education and Human Resources with a request for $816 million, up 2.5 percent.

There are twelve activities under R&RA, including the Engineering Directorate (ENG). The FY 2007 budget request for ENG is $628.6 million, an 8.2 percent increase over the current year. ENG is the third-largest activity in R&RA behind Mathematical and Physical Sciences, and Geosciences.

ENG will support research and education efforts related to broad, Foundation-wide investments. Biocomplexity in the Environment with a requested funding level of $4.0 million and Mathematical Sciences at $1.5 million would experience 32.7 percent and 49.3 percent decreases, respectively, relative to the FY 2006 estimate. Requests for the Climate Change Science Program, $1.0 million, Human and Social Dynamics, $2.0 million, and Networking and Information Technology R&D, $11.2 million, are at the same level as the FY 2006 estimate. Cyberinfrastructure, $54.0 million, and National Nanotechnology Initiative, $137.0 million, would receive 3.8 percent and 7.2 percent increases, respectively, over the FY 2006 estimate. For FY 2007, a new investment area, Sensors/IED, will be established with a request for funding of $20 million.

For FY 2007, ENG will complete a comprehensive reorganization intended to reflect the multidisciplinary nature of engineering and the complex integration of the sub-disciplines comprising ENG. The new divisions will be: Chemical, Bioengineering, Environmental, and Transport Systems (CBET), $124.4 million; Civil, Mechanical and Manufacturing Innovation (CMMI), $152.2 million; Electrical, Communications and Cyber Systems (ECCS), $80.9 million; Industrial Innovation and Partnerships (IIP), $120.1 million; Engineering Education and Centers (EEC), $126.0 million; and Emerging Frontiers in Research and Innovation (EFRI), $25.0 million. This last division is being created to provide mechanisms to rapidly respond to breakthrough innovations at the interface between divisions and directorates. While mechanical engineering continues to participate in programs across these division and, indeed, throughout the Foundation, traditional mechanical engineering research will principally lie in CBETS and CMMI. (For more on NSF, see Chapter 7.)