



NATIONAL ACADEMY OF ENGINEERING

HUMAN SPACE FLIGHT



APOLLO 50 YEARS ON

2019 ANNUAL MEETING

October 6-7, 2019
Washington, DC

The National Academies of
SCIENCES • ENGINEERING • MEDICINE



NATIONAL ACADEMY OF ENGINEERING 2019 ANNUAL MEETING

October 6–7, 2019
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SUNDAY, OCTOBER 6

10:00 am–4:00 pm **Registration** **NAS 120**

10:30 am–11:45 am **Brunch Buffet** **West Lawn**

10:30 am–11:45 am **Planned Giving in the Current Tax Environment** **Members' Room**
(advance registration required; brunch included)

Led by Alan L. Cates, JD
Partner, Husch Blackwell

Alan L. Cates focuses his practice on trust and estate issues and related private wealth matters and frequently presents on financial topics such as taxation, estate planning, business succession planning and probate and trust issues across the country. With decades of comprehensive legal experience, he has guided individuals and their businesses in estate planning and business succession planning. Additionally, he has represented individual and institutional executors and trustees in all sorts of litigation matters, both as defense counsel and in initiating action. He has also represented taxpayers in administrative proceedings and in courtrooms, and provided critical services to tax-exempt organizations. He also has served as “general counsel” to families and their businesses. His industry work includes assisting one of the largest American banks in the tax-exempt organization portion of a community development project in Chicago involving complex matters and advising a Fortune 500 bank holding company regarding trust and estate and litigation matters.

Alan is a fellow of the American College of Trust and Estate Counsel and a member of the Tennessee Probate Study Committee, which reviews and comments on pending legislation in the areas of trusts, estates, and similar issues. He served on the faculty of the National Planned Giving Institute of the College of William & Mary for more than 25 years.

12:00 noon–5:00 pm **PUBLIC PROGRAM** **Fred Kavli Auditorium**



Chair's Remarks
Mr. Gordon R. England
Chair, National Academy of Engineering

Gordon R. England is chair of the board of PFP Cybersecurity and a partner of Dyno-Tech, LLC. Previously, he served as deputy secretary of defense (2005–09) and, as secretary of the Navy (2001–06), was credited with developing successful surge plans for America's fleet, strengthening the ties between the Navy and Coast Guard, and increasing assistance to the US Marines on the front lines in Iraq. He was the first deputy secretary of the Department of Homeland Security (2003).

Mr. England's business career spanned over 40 years as an engineer and senior executive, largely at General Dynamics, where he was executive vice president of the Information Systems & Technology Sector (1997–2001); president of the GD Fort Worth Aircraft Company (later Lockheed) (1991–95), responsible for all domestic and international aircraft programs, including the F-16 fighter; president (1990–91) and vice president, engineering (1986–90), of GD Land Systems Company; and director of avionics of the Fort

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Worth Company (1980–86). He began his career at Honeywell, where he was an engineer on the Project Gemini space program.

Mr. England was elected to the NAE in 2012 for advances in digital avionics for aircraft, land, and naval platforms. He cochaired the Academies' Government-University-Industry Research Roundtable and served on the NAE Aerospace Engineering Peer Committee, organizing committee for the Workshop on Trends in the Innovation Ecosystem: Can Past Successes Help Inform Future Strategies?, Committee on Talent: Assessing and Meeting National Workforce Needs, and Committee on Fault Isolation, among others.

He has been active in a variety of civic, charitable, and government organizations, including serving as a city councilman. He chairs the board of the US Naval Institute Foundation, serves on the boards of the Community Learning Center and Gllot Capital Partners, advisory council of Business Executives for National Security, and University of Maryland trustees board, and is an honorary trustee on the board of directors of the National Museum of the Pacific War. He is vice president of the Academy of Medicine, Engineering, and Science of Texas. He served on the USO board of governors, DOD Defense Science Board, MERRA—Michigan R&D Cooperative (chair), Michigan Chapter of ADPA (president), Defense Manufacturing Board on Concurrent Engineering, Engineering Board of Advisors of the Universities of Texas and Michigan and Oakland University, board of Goodwill (vice chair), and CACI board of directors.

Mr. England has been recognized for numerous professional and service contributions, with an honorary doctor of science, Oakland University (2003), IEEE Centennial Award, Commander Cross—Republic of Poland, Silver Knight of Management Award from the National Management Association, DOD Distinguished Public Service Award, Henry M. Jackson Award, NIDA Dwight Eisenhower Award, USCG Distinguished Public Service Award, Navy League David M. Thompson Award, Naval Order of US Admiral George Dewey Award, 2005 Charles Francis Adams Award, Department of VA Exceptional Service Award, Armed Forces Foundation Award, Boy Scouts of America Distinguished Citizen Award Silver Beaver, Union League Lincoln Award, Goodwill Industries Person of the Year, and USO Distinguished Citizen Award. He is a member of Beta Gamma Sigma (business), Omicron Delta Kappa (leadership), and Eta Kappa Nu (engineering).

He received a BS degree in electrical engineering from the University of Maryland, College Park in 1961, and an MBA from Texas Christian University in 1975.



President's Address

Dr. John L. Anderson
President, National Academy of Engineering
Vice Chair of the National Research Council

John L. Anderson was most recently Distinguished Professor of Chemical Engineering and president (2007–15) of the Illinois Institute of Technology (IIT). Before that he was provost and executive vice president at Case Western Reserve University (2004–07), following 28 years at Carnegie Mellon University, including 8 years as dean of the College of Engineering. He began his career as a member of the Cornell University faculty (1971–76).

Dr. Anderson was elected to the NAE in 1992 for contributions to the understanding of colloidal hydrodynamics and membrane transport phenomena and has been actively involved since. He was elected an NAE councillor in 2015 and has served on the Executive Compensation Committee, Temporary Nominating Committee on Member Diversity, Membership Policy Committee, Nominating Committee (chair), Chemical Engineering Section (chair), Chemical Engineering Peer Committee (chair), and Committee on Membership (chair). His service also includes numerous National Academies activities, such as the Committee on Determining Basic Research Needs to Interrupt the Improvised Explosive Device Delivery Chain (chair); Committee on Review of Existing and Potential Standoff Explosives Detection Techniques (chair); Organizing Committee for the National Security and Homeland Defense Workshop (cochair); Board on Chemical Sciences and Technology (cochair); and Ford Foundation Minority Postdoctoral Review Panel on Physical Sciences, Mathematics, and Engineering.

In addition to his NAE membership, Dr. Anderson is a fellow of the American Academy of Arts and Sciences and American Association for the Advancement of Science, and he was appointed to the National Science Board in 2014. He received the Acrivos Professional Progress Award from the American Institute of Chemical Engineers (AIChE) and an award from the Pittsburgh Section of AIChE for “Outstanding Professional Accomplishments in the Field of Academics,” and he is listed on the Alumni Wall of Fame at the University of Delaware. In 2012 he received the National Engineering Award from the American Association of Engineering Societies. He has held visiting professorships at the Massachusetts Institute of Technology (fellow of the John Simon Guggenheim Foundation), University of Melbourne (Australia), and Landbouwwuniversiteit Wageningen (the Netherlands). He has presented guest lectures at universities throughout the United States and is the author of numerous journal articles and book chapters.

Dr. Anderson was born in Wilmington, DE, where he attended Mount Pleasant High School. He received his undergraduate degree from the University of Delaware in 1967, and MS and PhD degrees from the University of Illinois at Urbana-Champaign in 1969 and 1971, all in chemical engineering.

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Induction Ceremony for the NAE Class of 2019



Dr. Alton D. Romig, Jr.
Executive Officer, National Academy of Engineering

As executive officer, **Alton D. Romig, Jr.** is the chief operating officer responsible for the program, financial, and membership operations of the Academy, reporting to the NAE president. Under Congressional charter, the Academy provides advice to the federal government, when requested, on matters of engineering and technology.

He was previously vice president and general manager of Lockheed Martin Aeronautics Company Advanced Development Programs, better known as the Skunk Works®. He spent the majority of his career at Sandia National Laboratories, operated by the Lockheed Martin Corporation, having joined Sandia as a member of the technical staff in 1979 and moved through a succession of R&D management positions leading to his appointment as executive vice president in 2005. He served as deputy laboratories director and chief operating officer until 2010, when he transferred to the Skunk Works.

Dr. Romig serves or has served on a number of advisory committees including those at the University of Washington, MIT, Ohio State, Purdue, Georgia Tech, the Colorado School of Mines, and Sandia National Laboratories. He is also visiting associate of applied physics and materials science at Cal Tech. Dr. Romig is a member of the board of directors of Football Research, Inc., a non-profit entity created and supported by the National Football League to review engineering technology to improve the safety of the sport. From 2003 to 2008, he served on the board of AWE, Aldermaston, UK, and chaired the program committee.

Dr. Romig is a fellow TMS, IEEE, AIAA, and AAAS. He is also a fellow and honorary member of ASM International. He was elected to the National Academy of Engineering in 2003 and the Council of Foreign Relations in 2008. He was awarded the ASM Silver Medal for Materials Research in 1988.

Dr. Romig graduated from Lehigh University in 1975 with a BS in Materials Science and Engineering. He received his MS and PhD in Materials Science and Engineering from Lehigh University in 1977 and 1979, respectively.

1:45–2:15 pm

Break (NAE Class of 2019 and Anniversary Members group photo)
Class of 2019 and 25th Anniversary Members (Class of 1994) proceed with NAE staff guidance to the Constitution Avenue Lobby.

2:30–3:30 pm

Awards Program

Kavli Auditorium

2:30–2:45 pm

2019 Simon Ramo Founders Award Recipient



Dr. Cato T. Laurencin
University Professor
Albert and Wilda Van Dusen Distinguished Professor of Orthopaedic Surgery Professor of
Chemical and Biomolecular Engineering Professor of Materials Science and Engineering
Professor of Biomedical Engineering
Director, The Raymond and Beverly Sackler Center for Biomedical, Biological, Physical and
Engineering Sciences
Chief Executive Officer, The Connecticut Convergence Institute for Translation in
Regenerative Engineering
The University of Connecticut

The Simon Ramo Founders Award, the oldest award presented by the National Academy of Engineering, was established in 1965 to honor an outstanding NAE member or foreign member who has upheld the ideals and principles of the NAE through professional, educational, and personal achievement and accomplishment.

Cato T. Laurencin, recipient of the 2019 Simon Ramo Founders Award, is being honored “for fundamental, critical, and groundbreaking scientific advances in the engineering of tissues, guiding technology and science policy, and promoting diversity and excellence in science.”

Dr. Laurencin is an engineer, scientist, and surgeon. At the University of Connecticut, he is University Professor (the school’s highest academic title, and the 8th in the institution’s 138-year history); professor of chemical and biomolecular engineering, materials science and engineering, and biomedical engineering; the Albert and Wilda Van Dusen Distinguished Endowed Professor of Orthopaedic Surgery; and chief executive officer of the Connecticut Convergence Institute for Translation in Regenerative Engineering.

Dr. Laurencin is known as a world leader in biomaterials, nanotechnology, stem cell science, drug delivery systems, and a field he has pioneered, regenerative engineering. He has produced seminal studies in a number of areas of engineering and science. He and his colleagues were the first to develop nanofiber technologies for tissue regeneration, and his group pioneered the development and understanding of polymer-ceramic systems for bone regeneration. The American Institute of Chemical Engineers cited this achievement in naming him one of the 100 Engineers of the Modern Era.

In recognition of his accomplishments and contributions, Dr. Laurencin was selected for the National Medal of Technology and Innovation, the highest honor bestowed in America for technological achievement, presented in ceremonies at the White House. Further honors include the Clemson Award for Contributions to the Biomaterials Literature, the Technology Innovation and Development Award, the Founder’s Award from the Society for Biomaterials, and the Robinson Award for Excellence in Surgery. He has also received the most prestigious innovation grant awards from the National Institutes of Health (the NIH Director’s Pioneer Award) and the National Science Foundation (the NSF Emerging Frontiers in Research and Innovation Award). The American Institute for Medical and Biological Engineering honored him with the Pierre Galletti Award, medical and biological engineering’s highest honor. He received the Percy Julian Medal from the National Organization of Black Chemists and Chemical Engineers, and the Association of Bone and Joint Surgeons presented him with the Nicolas Andry Award, its highest honor. His work was honored by Scientific American as one of the 50 greatest achievements in science in 2007, and by National Geographic in its

“100 Discoveries That Have Changed Our World” in 2012. In 2019 the American Association for the Advancement of Science awarded him the Philip Hauge Abelson Prize, for “signal contributions to the advancement of science in the United States.”

In addition, Dr. Laurencin has had two awards named in his honor: The Cato T. Laurencin Travel Fellowship Award given by the Society for Biomaterials, and the Cato T. Laurencin Lifetime Research Achievement Award given by the Cobb/National Medical Association Health Institute.

Dr. Laurencin is an elected member of the National Academy of Engineering, National Academy of Medicine, and American Academy of Arts and Sciences. Internationally, he is an elected fellow of the African Academy of Sciences, National Academy of Sciences of India, Indian National Academy of Engineering, and World Academy of Sciences, as well as an academician and elected member of the Chinese Academy of Engineering.

He earned his BSE degree in chemical engineering from Princeton University, his PhD in biochemical engineering/biotechnology from the Massachusetts Institute of Technology, where he was named a Hugh Hampton Young Fellow, and his MD, magna cum laude, from the Harvard Medical School.

2:45–3:00 pm

2019 Arthur M. Bueche Award Recipient



Dr. Roderic Ivan Pettigrew
CEO EnHealth | Health Science Center and College of Engineering
Robert A. Welch Professor and Executive Dean, EnMed | Colleges of Medicine, Engineering
and Houston Methodist Hospital
Texas A&M University

The Arthur M. Bueche Award of the National Academy of Engineering recognizes an engineer who has been actively involved in determining US science and technology policy, promoting technological developments, and contributing to the enhancement of relations between industries, government, and universities.

Roderic Ivan Pettigrew, recipient of the 2019 Arthur M. Bueche Award, is being honored “for leadership at the NIH and for academic and industrial convergence research and education, resulting in innovations that have improved global health care.”

Dr. Pettigrew is CEO of Engineering Health (EnHealth) and executive dean for Engineering Medicine (EnMed) at Texas A&M and Houston Methodist Hospital. EnHealth is the world’s first initiative to holistically integrate engineering in all the colleges of a university that are part of the healthcare enterprise. EnMed is the first constituent initiative, integrating engineering in medical training to develop a new kind of engineering-minded physician, a physicianeer, who invents solutions to healthcare problems. An invention is required of each EnMed graduate, who will earn both MD and MEng degrees in 4 years.

Previously, as founding director of the US National Institute of Biomedical Imaging and Bioengineering (NIBIB) of the NIH (2002–2017), Dr. Pettigrew oversaw \$5 billion in research investments and is credited with building it into the signature NIH institute for emerging medical technologies. Under his leadership, NIBIB produced more patents per appropriated dollar than any other institute or federal agency, returning \$30 per \$1 invested in research (3000%, 5 times the already remarkable NIH average of 600%). On the 10th anniversary

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of NIBIB, the US Senate unanimously passed a resolution commending the institute for its leadership and impact in improving the nation's well-being through advancing technological innovation to improve human health.

Before his NIH appointment, he was a professor of radiology at Emory University School of Medicine, professor of bioengineering at the Georgia Institute of Technology, and director of the Emory Center for Magnetic Resonance Research at the Emory University.

Dr. Pettigrew's expertise is in health technologies emerging from the convergence of the life sciences, physical sciences, and engineering inclusive of nanotechnology, regenerative medicine, and point-of-care technologies. He is known internationally for his pioneering work involving four-dimensional imaging of the cardiovascular system using magnetic resonance imaging.

His accomplishments have been recognized by election to the NAE, National Academy of Medicine, National Academy of Inventors, and Indian National Academy of Sciences (as a foreign member). Other honors include the Bennie Award for Achievement (Morehouse College), Most Distinguished Alumnus Award of the University of Miami, Pierre Galletti Award of the American Institute of Medical and Biological Engineering, inaugural Gold Medal of the Academy of Radiology Research, Distinguished Service Award of the National Medical Association, UM Miller Medical School Hall of Fame, Pritzker Achievement Award of the Biomedical Engineering Society, Distinguished Service Medal of the International Society of Magnetic Resonance in Medicine, Spirit of the Heart Award of the Association of Black Cardiologists, and Gold Medal of the Radiological Society of North America.

Dr. Pettigrew earned his BS in physics from Morehouse College, MS in nuclear science and engineering from Rensselaer Polytechnic Institute, PhD in applied radiation physics from MIT, and MD from the University of Miami School of Medicine, and completed his medical training at UCSD.

3:00–3:30 pm

2019 Bernard M. Gordon Prize for Innovation in Engineering and Technology Education Lecture

The Bernard M. Gordon Prize for Innovation in Engineering and Technology Education recognizes new modalities and experiments in education that develop effective engineering leaders. It focuses on innovations such as curricular design, teaching methods, and technology-related learning that strengthen students' capabilities and desire to grow into leadership roles.

This year's Bernard M. Gordon Prize for Innovation in Engineering and Technology Education recognized Georgia Institute of Technology and Emory University educators Paul J. Benkeser, Joseph M. Le Doux, and Wendy C. Newstetter "for fusing problem-driven engineering education with learning science principles to create a pioneering program that develops leaders in biomedical engineering."



Paul J. Benkeser is a professor and senior associate chair in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University. A member of the Georgia Tech faculty since 1985, he was one of the founding faculty of the Coulter Department in 1998 and served as its first associate chair for undergraduate studies.

His early research interests were in therapeutic and diagnostic applications of ultrasound. After joining the Coulter Department he redirected his energies toward enhancing undergraduate biomedical engineering education, with particular interests in integrating problem-driven learning and global experiential learning opportunities in the curriculum. His research and education endeavors have been funded by grants from NIH, NSF, the Department of Veterans Affairs, and the Whitaker Foundation.

Dr. Benkeser has been active in engineering accreditation activities for ABET since 2002, serving in a number of capacities including program evaluator, EAC commissioner, and member of its board of delegates. He is a member of the American Institute for Medical and Biological Engineering, Biomedical Engineering Society, and American Society for Engineering Education, and a senior member of the Institute of Electrical and Electronics Engineers.

He received his BS from Purdue University and MS and PhD from the University of Illinois at Urbana-Champaign, all in electrical engineering.



Joseph M. Le Doux is the associate chair for undergraduate learning and experience and an associate professor in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University. He joined the department in 1999 as an assistant professor because he was inspired by the vision of the department's founding chair, Don Giddens, to educate engineers who were integrative thinkers who could operate seamlessly between the engineering and life sciences. As part of his contribution to the department's efforts to realize this vision, Dr. Le Doux invented the problem-solving studio approach for teaching engineering, which he implemented in 2008 in a sophomore-level introductory course. He has since worked with faculty and learning science colleagues to refine and adapt the approach for use in multiple courses in biomedical and other engineering disciplines.

He now leads two major department-wide projects to further transform engineering education. One project, funded by the National Science Foundation's Revolutionizing Engineering Departments initiative, is implementing new approaches to learning, in the department's required engineering courses, that will develop students' skills in forming and thriving on diverse and inclusive teams, an essential skillset for the 21st century engineer. The second project, funded by the Kern Family Foundation, infuses portfolio thinking throughout the engineering curriculum to develop engineers with an entrepreneurial mindset who are curious, who gain insights by integrating multiple sources of information, and who relentlessly seek to create value for others.

Dr. Le Doux has been honored by Georgia Tech with the Educational Partnership Award (2005), Excellence in Teaching Award (2011 and 2012), Women in Engineering Teaching Excellence Award (2014), and Curriculum Innovation Award (2017). In addition, he and his colleagues received the 2013 University System of Georgia's Regents' Teaching Excellence Award in the Department/Program Division.

Dr. Le Doux earned his BS and master's degree in chemical engineering from Cornell University and PhD in chemical and biochemical engineering from Rutgers University. Between earning his master's and PhD degrees he served for five years as an officer in the US Navy's submarine force aboard the USS Archerfish (SSN 678).



Wendy C. Newstetter is assistant dean for educational research and innovation in the College of Engineering at Georgia Tech. She was a founding faculty member in the university's Coulter Department of Biomedical Engineering (BME), where she was a cognitive and learning scientist (2000–2012). During this time, she worked with faculty to build an innovative curriculum both based on the principles of problem-based learning (PBL) and informed by the ethnographic studies she and her research team conducted in biomedical engineering research laboratories. The objective was to enhance fidelity between the authentic, unscripted learning environment of a research lab and the synthetic or designed environment of a classroom. What started as a single PBL class has grown to a suite of carefully designed engineering learning environments collectively referred to as problem-driven learning (PDL). This unique collection of classroom environments was recognized in 2013 with the Georgia Regents' Teaching Excellence Award. More recently, Dr. Newstetter and BME colleagues were awarded an NSF Revolutionizing Engineering Departments (RED) grant to create inclusive engineering leaders.

For their work in the research laboratories, Dr. Newstetter and her team received the American Psychological Association William James Book Award in 2012. She is a past senior associate editor for the *Journal of Engineering Education* and a current member of the federal Army Science Board.

Dr. Newstetter earned her BA from Colby College and her MA and PhD in linguistics from Lancaster University (UK).

3:30–4:45 pm

Plenary Speakers

Introduction

Dr. Alton D. Romig, Jr.

Executive Officer, National Academy of Engineering



The Apollo Experience: General Thomas P. Stafford (NAE)

Former US Air Force Deputy Chief of Staff, Research, Development, and Acquisition, and Astronaut

Thomas P. Stafford has logged nearly 521 hours in space, flying six rendezvous on four types of spacecraft. In 1965 he piloted Gemini VI, the first rendezvous in space, and in 1966, commanding Gemini IX, he demonstrated a rendezvous used in the Apollo lunar missions. He headed the mission planning analysis and software development for Project Apollo, and as commander of Apollo 10 in 1969 he flew the first rendezvous around the moon and designated the first lunar landing site. He was cited in the *Guinness Book of World Records* for the highest speed ever attained by a human, when Apollo 10 attained 27621.7 statute mph or Mach 36 during reentry. In 1975 he was commander of the Apollo-Soyuz Test Project mission, which culminated in the historic first meeting in space between US astronauts and Soviet cosmonauts, ending the international space race.

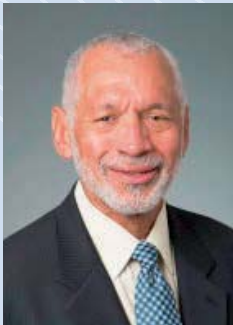
As Commanding General at Edwards AFB, he presided over the development of the B-1A, F-15, YF-16, A-10, YC-14, and YC-15, and as US Air Force Deputy Chief of Staff for Research, Development, and Acquisitions, he conceived of and started the stealth aircraft programs the F-117A, B-2A, AGM-129 and the roadmap for the F-22 Raptor. He retired from the Air Force in 1979 and in 1982 cofounded the technical consulting firm of Stafford, Burke, and Hecker in Alexandria, VA.

In 1990 in response to a request from Vice President Dan Quayle and Admiral Richard Truly, then NASA administrator, General Stafford assembled teams from the DOD, DOE, and NASA to prepare "America at the Threshold," a roadmap for the next 30 years of the US Manned Space Flight Program beyond low Earth orbit.

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He chaired the Operations Oversight Committee of the first Hubble Telescope Spacecraft Servicing and Repair Mission that corrected the instrument's design and manufacturing defect, for which he received the NASA Public Service Award (1994), and also chaired the Shuttle Return to Flight Group to carry out the recommendations of the Spaceship Columbia Accident Board. He has received numerous other honors and medals from NASA and the Air Force, as well as the Congressional Space Medal of Honor, Wright Brothers Memorial Trophy, and AIAA Chanute Flight Award, to name just a few. In addition to his NAE membership, he is a fellow of the American Astronautical Society, American Institute of Aeronautics and Astronautics (AIAA), and Society of Experimental Test Pilots, and he has been inducted into the Astronaut Hall of Fame and National Aviation Hall of Fame.

General Stafford received his BS with honors, in electrical and mechanical engineering, from the US Naval Academy and graduated 1st in class at the USAF Test Pilot School in 1959.



Humans Go to Mars: The Honorable Charles F. Bolden Jr.
Former Administrator and Astronaut, NASA

Charles Bolden Jr. was NASA administrator from 2009 to 2017, overseeing the transition from the Space Shuttle system to a new era of exploration focused on the International Space Station (ISS) and aeronautics technology development. He is now president and CEO of the Bolden Consulting Group LLC.

During his 34-year career with the Marine Corps, he worked in NASA's Astronaut Office, during which he traveled into orbit four times and logged over 680 hours in space. He piloted the Space Shuttles *Columbia* in 1986 (STS-61C) and, in 1990, *Discovery* (STS-31), the mission that deployed the Hubble Space Telescope, and he was mission commander on Space Shuttles *Atlantis* in 1992 (STS-45) and *Discovery* in 1994 (STS-60). He also served as chief of NASA's Safety Division in the wake of the 1986 Space Shuttle *Challenger* disaster.

As NASA administrator, Maj. Gen. Bolden oversaw the shift toward commercial space initiatives handling ISS resupply and created the Space Technology Mission Directorate, responsible for developing the technology to make future exploration missions successful. His tenure included the triumph of the Mars *Curiosity* Rover landing, the success of the *Juno* mission that is enhancing knowledge of the planet Jupiter, an increase in the number of Earth observation satellites, and progress toward the expected 2020 launch of the James Webb Space Telescope.

He was a US Department of State Science Envoy for Space (2018–19) and is an independent director of the LORD Corporation, Atlas Air Worldwide Holdings, and Blue Cross Blue Shield of South Carolina in addition to numerous other professional affiliations.

Maj. Gen. Bolden earned his BS in electrical science from the US Naval Academy and MS in systems management from the University of Southern California.

5:00–6:00 pm

Reception

West Lawn

6:30–9:30 pm

Golden Bridge Society Reception and Dinner
(by invitation)

Offsite

MONDAY, OCTOBER 7

7:00 am – 2:00 pm	Registration	NAS 120
7:00-8:30 am	Home Secretary's Breakfast (by invitation)	Lecture Room
7:30–8:30 am	Continental Breakfast	West Lawn
	Foreign Secretary's Breakfast (by invitation only to the foreign members)	Members' Room
8:45–9:30 am	NAE Business Session (members and foreign members only)	Kavli Auditorium
9:45–11:45 am	Forum: HUMAN SPACE FLIGHT: APOLLO 50 YEARS ON	Kavli Auditorium
	Welcome Dr. John L. Anderson President, National Academy of Engineering	
	The Apollo Experience: General Thomas P. Stafford (NAE) Former US Air Force Deputy Chief of Staff, Research, Development, and Acquisition, and Astronaut	
	Space Shuttle Development and Early Flights: Captain Robert L. Crippen (NAE) Captain, US Navy (retired); Former President, Thiokol Propulsion	
	Commercial Space Exploration: Captain Christopher J. Ferguson Boeing Test Pilot Astronaut and CST-100 Starliner Director of Crew and Mission Systems, Commercial Crew Program, Boeing	
	Commercial Space Exploration: Dr. Hans Koenigsmann Vice President, Build and Flight Reliability, SpaceX	
	The Space Station Experience: Dr. Sandra H. Magnus Principal, AstroPlanetview	
	The Diplomacy of Space Exploration: The Honorable Charles F. Bolden Jr. Former Administrator and Astronaut, NASA	
	Moderator: Ms. Deanne Bell TV Host and Founder/CEO, Future Engineers	

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Thomas P. Stafford has logged nearly 521 hours in space, flying six rendezvous on four types of spacecraft. In 1965 he piloted Gemini VI, the first rendezvous in space, and in 1966, commanding Gemini IX, he demonstrated a rendezvous used in the Apollo lunar missions. He headed the mission planning analysis and software development for Project Apollo, and as commander of Apollo 10 in 1969 he flew the first rendezvous around the moon and designated the first lunar landing site. He was cited in the *Guinness Book of World Records* for the highest speed ever attained by a human, when Apollo 10 attained 27621.7 statute mph or Mach 36 during reentry. In 1975 he was commander of the Apollo-Soyuz Test Project mission, which culminated in the historic first meeting in space between US astronauts and Soviet cosmonauts, ending the international space race.

As Commanding General at Edwards AFB he presided over the development of the B-1A, F-15, YF-16, A-10, YC-14, and YC-15, and as US Air Force Deputy Chief of Staff for Research, Development, and Acquisitions he conceived of and started the stealth aircraft programs the F-117A, B-2A, AGM-129 and the roadmap for the F-22 Raptor. He retired from the Air Force in 1979 and in 1982 cofounded the technical consulting firm of Stafford, Burke, and Hecker in Alexandria, VA.

In 1990 in response to a request from Vice President Dan Quayle and Admiral Richard Truly, then NASA administrator, General Stafford assembled teams from the DOD, DOE, and NASA to prepare "America at the Threshold," a roadmap for the next 30 years of the US Manned Space Flight Program beyond low Earth orbit.

He chaired the Operations Oversight Committee of the first Hubble Telescope Spacecraft Servicing and Repair Mission that corrected the instrument's design and manufacturing defect, for which he received the NASA Public Service Award (1994), and also chaired the Shuttle Return to Flight Group to carry out the recommendations of the Spaceship Columbia Accident Board. He has received numerous other honors and medals from NASA and the Air Force, as well as the Congressional Space Medal of Honor, Wright Brothers Memorial Trophy, and AIAA Chanute Flight Award, to name just a few. In addition to his NAE membership, he is a fellow of the American Astronautical Society, American Institute of Aeronautics and Astronautics (AIAA), and Society of Experimental Test Pilots, and has been inducted into the Astronaut Hall of Fame and National Aviation Hall of Fame.

General Stafford received his BS with honors, in electrical and mechanical engineering, from the US Naval Academy and graduated 1st in class at the USAF Test Pilot School in 1959.



Robert L. Crippen was the pilot of the first Space Shuttle flight in April 1981 and went on to command three other Space Shuttle missions. He has logged more than 565 hours in space and orbited the earth 374 times.

During his 30 years in the United States Navy, he was an attack pilot aboard the USS *Independence* and then a test pilot instructor at Edwards Air Force Base in California. In 1969 he was selected as a NASA astronaut and was on the support crew for the Skylab 2, 3, and 4 missions and the Apollo-Soyuz Test Project.

Captain Crippen became director of the Space Shuttle program at NASA Headquarters in Washington and then director of the Kennedy Space Center in Florida. He entered the private sector as a vice president at Lockheed Martin in Orlando and then served as president of the Thiokol Propulsion Company in Brigham City, Utah.

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His numerous awards include the Distinguished Flying Cross from the US Navy, Defense Superior Service Medal, Federal Aviation Administration Award for Distinguished Service, Goddard Memorial Trophy, National Geographic Society Hubbard Medal, American Legion Distinguished Service Medal, Congressional Medal of Honor for Space, and Leadership and Service Medals from NASA. He has been inducted into the Astronaut Hall of Fame, Aerospace Walk of Fame, and National Aviation Hall of Fame in 2016. He is a fellow in the Society of Experimental Test Pilots and an honorary fellow in the American Institute of Aeronautics and Astronautics. He was elected to the NAE in 2012.

Captain Crippen earned his BS in aerospace engineering from the University of Texas at Austin.



As Boeing's first commercial test pilot astronaut, **Christopher Ferguson** will be among the first to fly to space aboard the CST-100 Starliner. He has led the development of the spacecraft's mission systems and crew interfaces.

Since 2011 he has worked with NASA's Human Exploration and Operations Directorate; Johnson Space Center's Engineering, Flight Crew, and Mission Operations organizations; and NASA's Commercial Crew Program at Kennedy Space Center to ensure that Boeing's design supports NASA's human rating requirements. He was also a leader in the development and testing of system concepts and technologies for the spacecraft's launch and ground systems.

A retired US Navy captain and former NASA astronaut, he piloted STS-115 (*Atlantis*) and commanded STS-126 (*Endeavour*) and the final shuttle mission, STS-135 (*Atlantis*), logging more than 40 days in space and 5,700 hours in high-performance aircraft. Capt. Ferguson also served as deputy chief of the NASA Astronaut Office and as spacecraft communicator for the STS-118, STS-120, STS-128, and STS-129 missions.

His service has been recognized with the Legion of Merit, Distinguished Flying Cross, Defense Meritorious Service Medal, Navy Strike/Flight Air Medal, NASA Spaceflight Medal (three), Navy Commendation Medal (three), and Navy Achievement Medal.

Capt. Ferguson holds a BS in mechanical engineering from Drexel University and an MS in aeronautical engineering from the Naval Postgraduate School.



As vice president of the Build and Flight Reliability Team at SpaceX, **Hans Koenigsmann** leads the company's quality engineering and process development teams; oversees the launch readiness process during launch campaigns; and assesses launch risks, identifying and resolving anomalies during integration and launch.

He has more than 25 years of experience designing, developing, and building complex avionics and guidance, navigation, and control (GNC) systems for launch vehicles and satellites. At SpaceX since the company's inception in 2002, he has built up the avionics, software, and GNC departments and developed the launch readiness process used during each launch campaign. He designed the company's risk mitigation process and initiated the risk database, establishing a similar process for system-level changes to the vehicle and ground systems. He was the chief avionics architect of the Falcon 1 and early Falcon 9 efforts, and launch chief engineer for the last three Falcon 1 missions and most of the Falcon 9 flights.

His experience includes the development of two suborbital and two orbital launchers as well as several satellite projects and attitude control systems. He headed the Space Technology Division of Germany's Center of Applied Space Technology and Microgravity (ZARM) at the University of Bremen, where he was responsible for the development and operation of the satellite BREM-SAT. He then worked for Microcosm as chief scientist and flight systems manager for their suborbital vehicles.

Dr. Koenigsmann has a PhD in aerospace engineering and production from the University of Bremen and an MS in aerospace engineering from the Technical University of Berlin.



Sandra H. Magnus is principal of AstroPlanetview, LLC and former executive director of the American Institute of Aeronautics and Astronautics (AIAA).

Selected to the NASA Astronaut Corps in 1996, Dr. Magnus flew in space on the STS-112 shuttle mission in 2002 and on the final shuttle flight, STS-135, in 2011. She also flew to the International Space Station on STS-126 in 2008, served as flight engineer and science officer on Expedition 18, and returned home on STS-119 after 4½ months on board. She then served at NASA Headquarters in the Exploration Systems Mission Directorate. Her last duty at NASA, after STS-135, was as deputy chief of the Astronaut Office.

At NASA Dr. Magnus worked extensively with the international community, including the European Space Agency (ESA) and Japan Aerospace Exploration Agency (JAXA) as well as Brazil on facility-type payloads. She also spent time in Russia developing and integrating operational products and procedures for the ISS.

She was previously a stealth engineer at McDonnell Douglas Aircraft Company (1986–1991), working on internal research and development and on the Navy's A-12 Attack Aircraft program, studying the effectiveness of radar signature reduction techniques.

Her service has been recognized with the NASA Space Flight Medal, NASA Distinguished Service Medal, NASA Exceptional Service Medal, and the 40 at 40 Award (given to former collegiate women athletes to recognize the impact of Title IX).

Dr. Magnus earned her BS in physics and MS in electrical engineering from the Missouri University of Science and Technology, and her PhD from the School of Materials Science and Engineering at Georgia Tech.



Charles Bolden Jr. was NASA administrator from 2009 to 2017, overseeing the transition from the Space Shuttle system to a new era of exploration focused on the International Space Station (ISS) and aeronautics technology development. He is now president and CEO of the Bolden Consulting Group LLC.

During his 34-year career with the Marine Corps, he worked in NASA's Astronaut Office, during which he traveled into orbit four times and logged over 680 hours in space. He piloted the Space Shuttles *Columbia* in 1986 (STS-61C) and, in 1990, *Discovery* (STS-31), the mission that deployed the Hubble Space Telescope, and he was mission commander on Space Shuttles *Atlantis* in 1992 (STS-45) and *Discovery* in 1994 (STS-60). He also served as chief of NASA's Safety Division in the wake of the 1986 Space Shuttle *Challenger* disaster.

MONDAY, OCTOBER 7

As NASA administrator, Maj. Gen. Bolden oversaw the shift toward commercial space initiatives handling ISS resupply and created the Space Technology Mission Directorate, responsible for developing the technology to make future exploration missions successful. His tenure included the triumph of the Mars *Curiosity* Rover landing, the success of the *Juno* mission that is enhancing knowledge of the planet Jupiter, an increase in the number of Earth observation satellites, and progress toward the expected 2020 launch of the James Webb Space Telescope.

He was a US Department of State Science Envoy for Space (2018–19) and is an independent director of the LORD Corporation, Atlas Air Worldwide Holdings, and Blue Cross Blue Shield of South Carolina in addition to numerous other professional affiliations.

Maj. Gen. Bolden earned his BS in electrical science from the US Naval Academy and MS in systems management from the University of Southern California.



Deanne Bell is an engineer, television host, and entrepreneur. Her television hosting credits include PBS, ESPN, Discovery Channel, National Geographic, DIY Network, and most recently CNBC's *Make Me a Millionaire* Inventor. She is also the founder and CEO of Future Engineers, an education technology company that engages students in online contests and challenges. Future Engineers' inaugural competition, developed with the ASME Foundation and NASA, produced historic achievements including the first student-designed 3D print in space. Her company has since become a US Department of Education SBIR awardee, and was selected by NASA to host the Mars 2020 "Name the Rover" contest.

Previously she worked at Raytheon for three years as an optomechanical engineer. She focused on packaging FLIR into a helicopter-mounted gimbal, involving the redesign of the afocal telescope and the packaging of the cryo-cooled imager and CCD camera. She then worked for other R&D programs at the company, including as head of the mechanical design and build of a synthetic aperture ladar (SALT) optical test bench.

She earned her BS in mechanical engineering at Washington University in St. Louis and is the 2019 Young Alumni Award recipient for its McKelvey School of Engineering. She is also the featured interviewer in the fall 2019 issue of *The Bridge*.

11:45 am–1:30 pm

Lunch

West Lawn

11:45 am–12:30 pm

Testifying Before Congress: A Tutorial

Lecture Room

Lunch buffet served in the East Court



Mr. Christopher King

Executive Director, Office of Congressional and Government Affairs

It is essential that congressional policymakers hear a clear and objective interpretation of what science and technology bring to the policy agenda. This communication is a special type of oral presentation, and several elements are key to its success.

Christopher King is executive director of the Academies' Office of Congressional and Government Affairs. He was previously acting assistant secretary for Congressional and Intergovernmental Affairs at the US Department of Energy, where he also served as a senior advisor in the Office of Energy Policy and Systems Analysis and director of policy and

MONDAY, OCTOBER 7

analysis for the Office of Energy Efficiency and Renewable Energy. Before joining DOE, Mr. King spent over a decade on Capitol Hill, including as the Energy and Environment Subcommittee staff director for the US House Science, Space, and Technology Committee. During his tenure he was chief advisor on DOE matters and involved in a number of successful legislative initiatives, including passage of the America COMPETES Act and establishment of the Advanced Research Projects Agency–Energy (ARPA-E). Mr. King is a graduate of the University of Texas at Austin.

2:00–5:00 pm

Section Meetings

NAS Building/Keck Center

See page 18 for details.

6:30–7:30 pm

Reception

**Grand Ballroom
JW Marriott Hotel**

7:30–midnight

Dinner and Dancing
(black tie optional)

**Grand Ballroom
JW Marriott Hotel**

The JW Marriott Hotel is at 1331 Pennsylvania Avenue NW in downtown Washington. As ever, dance music will be provided by the popular Odyssey Band.

MEETING SERVICES

Food Service

Efforts are made to provide healthy, nutritionally balanced meals at all meetings. If you have special dietary restrictions or any questions about food service, please see Ervin Pinckney in the registration room (NAS 120).

Information Desk

The NAE Information Desk is in the Great Hall of the NAS Building. Staff will be available to provide assistance and answer questions about the annual meeting and the NAE membership.

Logo Items and Rosettes

NAE logo items are available for purchase at the NAE Store (NAS 118).

Lost and Found

Lost and found is located in the registration room (NAS 120).

Medical Assistance

For medical assistance go to the Information Desk in the Great Hall of the NAS Building. An emergency medical technician (EMT) will be onsite.

Mother's Room

The NAS Building Mother's Room is located in room 355. The Keck Building Mother's Room is located in room 336.

Smoking Policy

Smoking is not permitted in any building of the National Academies. It is permitted only in designated outdoor areas.

SECTION MEETINGS

The National Academy of Engineering is organized in twelve sections representing broad engineering categories. These are the annual business meetings for each section. Meetings are held from 2:00–5:00 pm in the NAS Building and the Keck Center.

NAS Building, 2101 Constitution Avenue NW

- 02 Bioengineering
- 05 Computer Science
- 06 Electric Power/Energy Systems
- 08 Industrial, Manufacturing & Operational Systems
- 10 Mechanical
- 11 Earth Resources

NAS 125
Board Room
Members' Room
NAS 280
Lecture Room
NAS 250

Keck Center, 500 Fifth Street NW

- 01 Aerospace
- 03 Chemical
- 04 Civil
- 07 Electronics, Communications & Information Systems
- 09 Materials
- 12 Special Fields & Interdisciplinary

Keck 208
Keck 106
Keck 103
Keck 206
Keck 101
Keck 105

GENERAL INFORMATION

Registration Check-In

On Sunday, October 6, and Monday, October 7, meeting registration will be in room 120 at the NAS Building. Please be sure to check in to receive your registration materials.

Registration Hours

Sunday, October 6, 10:00 am–4:00 pm
Monday, October 7, 7:00 am–2:00 pm

NAE Store Hours

Sunday, October 6, 10:00 am–3:00 pm
Monday, October 7, 7:00 am–2:00 pm

Shuttle Bus Service

Sunday, October 6

Morning

Departs at 10:00 am, every 15 minutes, last bus departs at noon

Afternoon

Departs at 1:45 pm, every 15 minutes, last bus departs at 2:30 pm

Evening

Departs at 5:00 pm, every 15 minutes, last bus departs at 6:30 pm

Monday, October 7

Morning

Departs at 6:45 am, every 15 minutes, last bus departs at 8:30 am

Afternoon

Departs at 1:15 pm, every 15 minutes, last bus departs at 1:45 pm

Evening

Departs at 4:00 pm, every 15 minutes, last bus departs at 5:30 pm

Departs at 4:00 pm, every 15 minutes, last bus departs at 5:30 pm

Guest Tour Bus Service

Monday, October 7

Buses Depart

9:15 am (loads at 9:00 am)
9:45 am (loads at 9:30 am)
12:15 pm (loads at 12:00 pm)
1:15 pm (loads at 1:00 pm)
2:30 pm (loads at 2:15 pm)

Information Desk Hours

Sunday, October 6, 10:00 am–6:30 pm
Monday, October 7, 7:00 am–5:30 pm

IT Help Desk Hours

Sunday, October 6, 9:00 am–5:30 pm
Monday, October 7, 7:30 am–5:30 pm

From	To
JW Marriott	NAS Building
NAS Building	JW Marriott
NAS Building	JW Marriott
JW Marriott	NAS Building
NAS Building	Keck Center
NAS Building	JW Marriott
Keck Center	JW Marriott

From	To
NAS Building	Steven F. Udvar-Hazy Center
NAS Building	Green Spring Gardens
Steven F. Udvar-Hazy Center	PassionFish Restaurant
Green Spring Gardens	JW Marriott Hotel
PassionFish Restaurant	JW Marriott Hotel

GUEST PROGRAM

On **Sunday, October 6**, guests are welcome to join NAE members for brunch, followed by the public program—the induction of new members, the awards ceremonies, and other presentations—after which they are invited to the reception on the West Lawn.

On the morning of **Monday, October 7**, guests are invited to the public forum on Human Space Flight: Apollo 50 Years On, or to tour Green Spring Gardens Horticultural Center and Historic House or the Smithsonian National Air and Space Museum–Steven F. Udvar-Hazy Center, Chantilly, VA.

At the **Green Spring Gardens Horticultural Center and Historic House**, guests will “take the garden path less traveled” and explore the beauty of fall on a docent-led tour of Green Spring’s woodland stream valley and ponds. Stroll through this lush, naturalistic area and enjoy its varied plantings, streambank, magnolia bog, and wildlife. Hear the story of the historic house, built in 1784, whose ownership spans three centuries, and learn of the mysterious ruin nearby. The historic house offers changing art exhibits, a Horticulture Center and gift shop, and year-round programs. This tour concludes with a traditional English afternoon tea with finger sandwiches, assorted pastries, and scones, cream, and jam. The tour is approximately 2 hours and involves moderate terrain walking, so comfortable shoes and clothing are highly recommended. Limited to 40 guests.

Opened in 2003, the **Steven F. Udvar-Hazy Center** is a companion facility to the National Air and Space Museum of the Smithsonian Institution in Washington, DC. Its thousands of aviation and space artifacts in two huge hangars, the Boeing Aviation Hangar and the James S. McDonnell Space Hangar, include the SR-71 Blackbird, an Air France Concorde, and the Space Shuttle *Discovery*. Guests will view the preservation of the National Air and Space Museum’s collections as they walk through the glassed-in mezzanine and witness restoration projects in progress. The Donald D. Engen Observation Tower offers a 360-degree bird’s-eye view of Dulles International Airport and the surrounding area. Guests will participate in a 90-minute docent-led tour, with time afterward to explore the museum or gift shops. The tour involves extensive walking on concrete flooring, so comfortable shoes are highly recommended. This tour will conclude with a lunch at PassionFish in Reston, VA. Limited to 30 guests.

Also offered is a tour of the **NAS Building** led by Janice Goldblum, National Academies archivist. The tour will feature and explain artistic and architectural details of the Great Hall and other ceremonial rooms.

Please register for this tour in room 120. The program will last approximately 30 minutes and will begin in the West Court at 8:30 am. The forum starts at 9:45 am in the Kavli Auditorium and lunch will be provided afterward in the tent on the West Lawn.

SECTION CHAIRS

SECTION LEADERSHIP

Section Chairs

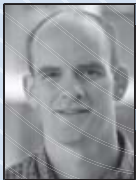
Note: Numbers following Section Chairs' names denote primary and secondary NAE section affiliations. Terms end June 30 of year shown.



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Lester L. Lyles (1)
Independent Consultant
(2021)



Section 7: Electronics, Communication & Information Systems Engineering
James S. Harris (7, 9)
James and Ellenor Chesebrough Professor
Stanford University
(2021)



Section 2: Bioengineering
David J. Mooney (2, 3)
Robert P. Pinkas Family Professor of
Bioengineering
Harvard University
(2021)



Section 8: Industrial, Manufacturing & Operational Systems Engineering
Thom J. Hodgson (8)
Distinguished University Professor Emeritus
North Carolina State University
(2020)



Section 3: Chemical Engineering
Enrique Iglesia (3)
Theodore Vermeulen Chair in Chemical
Engineering
University of California, Berkeley
(2020)



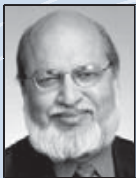
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Chairman of the Board
wTe Corporation
(2020)



Section 4: Civil Engineering
Henry G. Schwartz (4)
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Section 10: Mechanical Engineering
Michael Ortiz (10)
Frank and Ora Lee Marble Professor of
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California Institute of Technology
(2020)



Section 5: Computer Science & Engineering
Arvind (5)
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Section 11: Earth Resources Engineering
Franklin M. Orr (11)
Professor Emeritus
Stanford University
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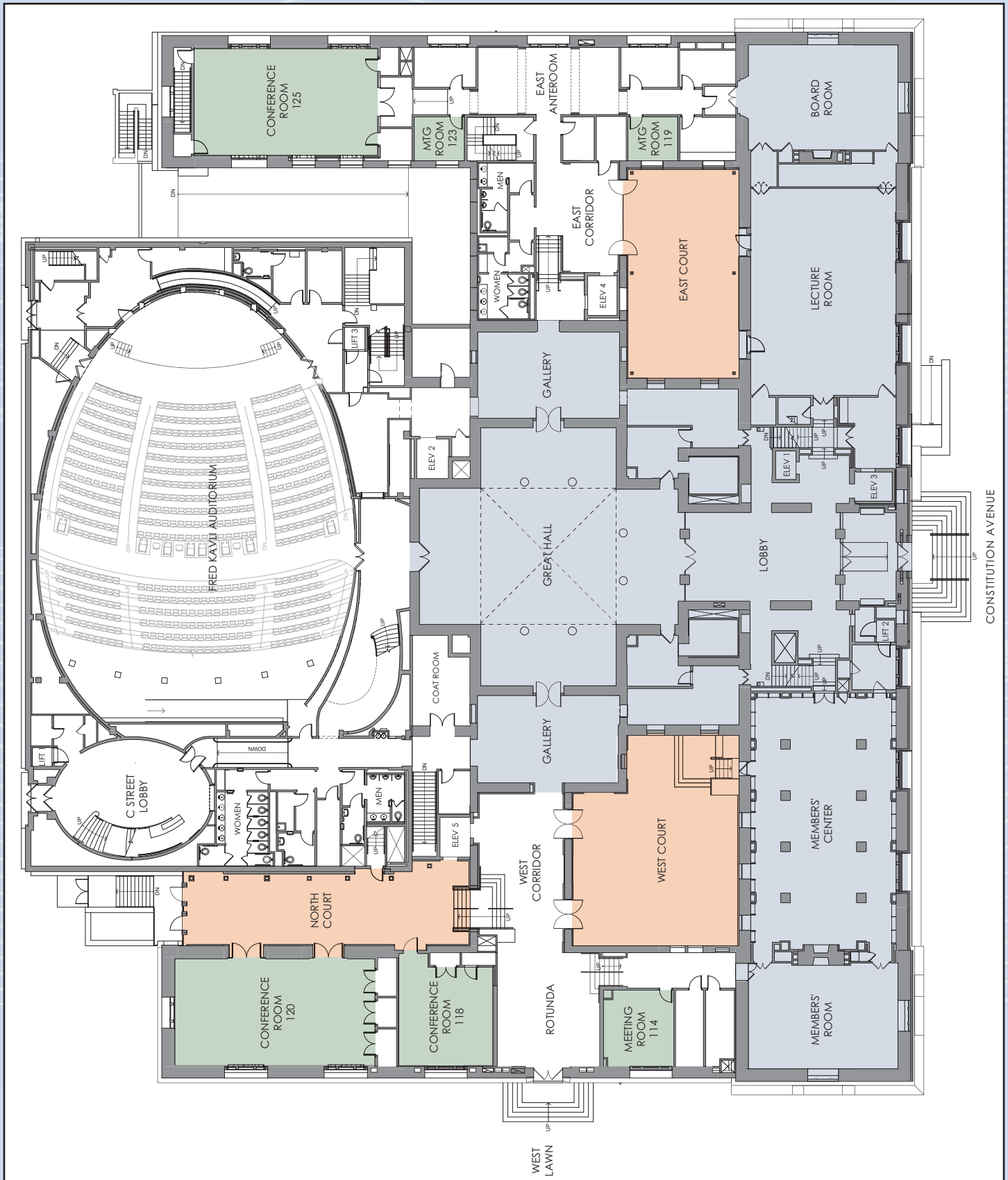


Section 6: Electric Power/Energy Systems Engineering
Mark G. Adamiak (6, 7)
Chief Application Architect (Retired),
Grid Automation (Protection, Control, and
SCADA) GE Power
(2021)



Section 12: Special Fields and Interdisciplinary Engineering
Rafael L. Bras (12, 4)
Provost and Executive VP for Academic Affairs
Georgia Institute of Technology
(2020)

NAS BUILDING MAP



AREA MAP



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We gratefully acknowledge the following members and friends who have made generous charitable lifetime contributions. Their collective, private philanthropy enhances the impact of the academies as advisor to the nation on matters of science, engineering, and medicine.

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QUICK REFERENCE SCHEDULE

Sunday, October 6

All events take place at the NAS Building, 2101 Constitution Avenue NW, unless otherwise noted.

10:00 am–4:00 pm	Registration	NAS 120
10:30–11:45 am	Brunch	West Lawn
10:30–11:45 am	Planned Giving in the Current Tax Environment (with brunch)	Members' Room
	PUBLIC PROGRAM	
12:00–1:45 pm	Induction Ceremony for NAE Class of 2019	Kavli Auditorium
1:45–2:30 pm	Break	
2:30–3:30 pm	Awards Program	Kavli Auditorium
3:30–4:45 pm	Plenary Speakers	Kavli Auditorium
5:00–6:00 pm	Reception	West Lawn
6:30–9:30 pm	Golden Bridge Society Reception and Dinner (by invitation)	Offsite

Monday, October 7

7:00 am–2:00 pm	Registration	NAS 120
7:00–8:30 am	Home Secretary's Breakfast (by invitation)	Lecture Room
7:30–8:30 am	Continental Breakfast	West Lawn
7:30–8:30 am	Foreign Secretary's Breakfast (by invitation to the foreign members)	Members' Room
8:45–9:30 am	NAE Business Session	Kavli Auditorium
9:30–9:45 am	Break	
9:45–11:45 am	Forum: Human Space Flight: Apollo 50 Years On	Kavli Auditorium
11:45 am–1:30 pm	Lunch	West Lawn
11:45 am–12:30 pm	Testifying before Congress: A Tutorial (with lunch)	Lecture Room
2:00–5:00 pm	Section Meetings	NAS Building and Keck Center
6:30–7:30 pm	Reception	JW Marriott, Grand Ballroom
7:30 pm–midnight	Dinner and Dancing	JW Marriott Grand Ballroom

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