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Abstract

The vision advanced in the United States 1958 National Aeronautics and Space Policy Act has remained remarkably consistent for the past 2 decades. The core tenets of this policy include peaceful uses of outer space, international collaboration using robotic platforms for space and Earth sciences research and an incremental strategy for a potential human visit to Mars and other Solar System targets of opportunity. Additional impetus for this strategy is the recent discovery of distant planets, the ubiquitous presence of water (ice) in the universe and the establishment of the National Aeronautics and Space Administration (NASA) Astrobiology program, to search for life beyond our planet Earth. NASA has been using commercial launch vehicles and satellites for many years. Between 1994 and 1997, NASA began a collaborative and reimbursable effort with the Russian Federation for the passage astronauts to the MIR Orbital Station. At the conclusion of the Space Shuttle program NASA continues to rely on the Russian Federal Space Agency space crafts for interim access to the International Space Station. NASA is also encouraging the commercial space to develop services for cargo and crews transport to Low Earth Orbit. NASA will continue to develop a new launch system for the human exploration of our Solar System.

Today commercial space is a reality. However the scope and extent of the commercial involvement in human space exploration is still evolving. The panel will explore the national policies and political trends which will shape the near future of space science and human

explorations

Agenda
1000-1010: Introduction of the Panel

Arnauld Nicogossian, MD, Editor World Medical and Health Policy Journal, School of Public Policy, George Mason University

The 1958 National Aeronautics and Space Act targets "research into problems of flight within and outside the earth's atmosphere, and for other purposes." Beyond the importance of preserving United States leadership in space, the U.S. Congress also declared that it is the policy of the United States to engage in space exploration for the peaceful purposes to benefit all mankind. The Act states that space exploration is undertaken to expand human knowledge of atmosphere and space and to improve safety and efficiency of operations in the air and space. Several amendments to the Act were introduced, such as the change from "benefit all mankind" to "benefit all humankind", to remove the notion of gender bias, and in 1984 the Commercial Space Launch Act was enacted to develop the commercial sector and provide access to NASA capabilities. The commercial development continues to be an emphasis in the current space policy. Launch systems, Earth observing and communication satellites, global positioning and information systems are now well established in the private sector.

Over the past 50 years the National Aeronautics and Space Act has fueled unprecedented scientific, medical, environmental and public health accomplishments. NASA helped rewrite textbooks in space, physical and environmental sciences. NASA vision "To reach for new heights and reveal the unknown, so that what we do and learn will benefit all humankind" will continue to inspire future generations. A sustained and stable policy to promote research and development, with the international participation, will be required to ensure that this vision is pursued. The private sector is now engaged and should contribute to the expansion of this vision.

1010- 1045: NASA Space Sciences Policy

Dr. Waleed Abdalati, NASA Chief Scientist

The U.S science community's drive for innovation is unwavering and is ready to produce the new discoveries and technologies that feed a strong economy. NASA science is unique - targeting not only matters of the human mind, but also matters of the human spirit and nourishing our need to explore the unknown.

As a leader in fundamental research, NASA works in and across the fields of Astrophysics, Planetary Science, Heliophysics, Earth Science, Life Sciences, Physical Sciences and technology development in ways that are unique to NASA's mission. Recognition of NASA's remarkable science contributions comes from many places. In the simplest sense, it can be seen in the incredulous eyes of people who see images of the famous Butterfly nebula or the Martian surface for the first time. It can also be evident in the appreciation of the farmer whose crop output is increased through the use of NASA data and information.

One of the most notable validations of the value of NASA science comes from objective assessments by scientific journals. In its report of the top ten insights of the 2000-2010 decade, the journal *Science* identifies four achievements that are directly derived from NASA science investments. NASA leads the Nation on a great journey of discovery, seeking new knowledge across domains that range from right here at home to distant galaxies and everywhere in between. In collaboration with the Nation's science community, NASA's space-based and suborbital observatories conduct scientific studies of the Earth, explore the nature and behavior of the Sun and other bodies in our solar system, and peer toward the edges of the universe, back toward the beginning of time. The International Space Station, with construction completed in 2011, serves as a fully functional and permanently crewed research laboratory and technology test bed in orbit around Earth. Work on board the International Space Station will expand scientific research opportunities in the areas of biological and physical research as well as technology development in the microgravity environment.

NASA's journey of scientific discovery helps motivate, and prepare for human exploration into the solar system. Science missions provide critical insights into the radiation environment of deep space, the characteristics and compositions of planetary atmospheres, the terrain and geology of planetary surfaces, and the nature and origin of small bodies. They identify the hazards and resources present as humans explore space and the science questions and regions of interest that warrant detailed examination by human explorers. The importance of NASA Science was recognized by Congress more than a half-century ago and codified in our founding document, the National Aeronautics and Space Act of 1958.

1050-1120: The International Space Station: A New U.S. National Laboratory

Mark L.Uhran, NASA Director International Space Station Division

A nation's economic growth is affected by its' investments in research & development (R&D). Basic scientific research coupled with advances in applied technologies, drives new, value-added, products and services out of the laboratory and into practical use at large. This is a critical measure of asset productivity and it has become the mission objective of the fully operational International Space Station (ISS). The ISS represents perhaps the largest international collaborative science and technology endeavor in history. It affords continuous human operations in a virtually zero gravity laboratory environment — an unusually unique environment where motion at the molecular and cellular levels fundamentally differs from that experienced on the ground in the one-G environment. However, in order to achieve high productivity as a national laboratory, the public policies that govern use of the ISS must be judiciously implemented and rigorously maintained. Scientists, engineers and industrialists each have an important role to play and no single community can succeed by advocating a public policy for their exclusive use of the ISS.

1125- 1150: Prospects for Space Medicine Practice

Richard S. Williams, MD, NASA Chief Health and Medical Officer

Space flight is among the highest risk occupation that humans have ever undertaken. The extremes of heat, cold, vacuum, remoteness, orbital debris and micrometeoroids, and the tremendous speeds and energy levels required to achieve orbital space flight and return to Earth pose the greatest challenges to spacecraft integrity and the crew health. Microgravity, the space radiation environment, isolation and confinement also represent short and long term threats to crew well-being. Increased lifetime risk of malignancy, bone demineralization, compromise of muscle strength and cardiovascular deconditioning are among health threats that have long been acknowledged. Limited resources with which to practice medicine, and communication delays during exploration class missions will be constant features with which to contend. Recently, a symptom complex characterized by changes in visual acuity, changes in ocular anatomy, and high pressure in the central nervous system, has been described as a newly emerging health risk. NASA has responded to these risks with standards and requirements designed to protect human health. These standards drive both spacecraft design and development and guide human research and technology development efforts towards specific risk mitigation. Biomedical research and space medical practice are coordinated and integrated to the greatest extent possible. A variety of tools, including solicited, peer reviewed research and open innovation techniques are being used to address risks in as effective and timely a manner as possible. The success of these efforts will form the foundation of space medical care systems of the future, and translate to improved medical care on Earth.

1155-1220: Commercial Space – Questions Regarding the Legal and Regulatory Environment

Franceska O. Schroeder, Principal, Fish & Richardson P.C. (accepted)

The United States is relying on the commercial sector to design new systems to ferry astronauts and cargo to the International Space Station and to develop new ways to explore space. Visionary space industry entrepreneurs are creating new opportunities for the next generation of space travelers. Soon, spaceships routinely taking off from commercial spaceports will be carrying space adventurers on suborbital rides around the Earth and maybe also taking them to inflatable space habitats. These are bold and exciting developments that require new rules – or do they? Which U.S. laws and regulations apply to these activities? Are they helping or hurting these efforts. How are the laws of other space faring nations handling these issues? Are the international space treaties, including the *Outer Space Treaty*, the *Liability Convention*, the *Registration Convention*, and the *Rescue and Return Agreement*, prepared to respond to private human space activities? How will liability be allocated and risks managed? How will export controls affect international cooperation? All of these questions currently are being debated throughout the space community and will be the focus of this presentation.

1220-1235 Discussions and concluding remarks

Biographies

Professor Waleed Abdalati was appointed NASA chief scientist on January 3, 2011. He is currently on leave from his position as director of the University of Colorado's Earth Science and Observation Center, which carries out research and education activities on the use of remote sensing observations to understand the Earth. Abdalati is also a fellow of the Cooperative Institute for Research in Environmental Sciences at the University. His research has focused on the use of satellites and aircraft to understand how and why Earth's ice cover is changing, and what those changes mean for life on our planet. He also has served as leader of the Ice Cloud and land Elevation Satellite-2 (ICESat-2) Science Definition Team and has led or participated in nine field and airborne campaigns in the Arctic and Antarctic.

His appointment as chief scientist marks a return to NASA, where he worked from 1996-2008. From 2004-2008, he was head of the Cryospheric Sciences Branch at NASA's Goddard Space Flight Center in Greenbelt, Md., where he supervised a group of scientists who carried out research in the development and analysis of remote sensing observations to study the behavior of ice sheets, sea ice, and glaciers. From 2000-2004, he managed NASA's Cryospheric Sciences Program at NASA Headquarters, managing the agency's interests and research investments in cryospheric research, and serving as program scientist on the ICESat and RADARSAT missions. From 1996-2000, Abdalati was a researcher at Goddard in the Oceans and Ice Branch, where he analyzed satellite and aircraft measurements of glaciers and ice sheets to assess their contributions to sea level rise. He also served as deputy project scientist for NASA's Ice Cloud and land Elevation Satellite (ICESat).

Abdalati received a Bachelor of Science degree from Syracuse University in 1986, a Master of Science degree from the University of Colorado in 1991, and a Ph.D. from University of Colorado in 1996. In the mid-1980s, before returning to graduate school, he worked as an engineer in the aerospace industry, designing, analyzing and testing components of various spacecraft and submarine systems.

He has published more than 50 peer-reviewed papers, book chapters and NASA-related technical reports, with approximately 1,500 citations in the peer-reviewed literature. He has given featured lectures and keynote addresses to the United Nations, AIAA, SPIE, AGU and various other professional and international organizations, as well as public lectures at The Smithsonian Institution, The American Museum of Natural History, and The Adler Planetarium. Abdalati has

received various awards and recognition, most notably the NASA Exceptional Service Medal and The Presidential Early Career Award for Scientists and Engineers from the White House.

Mark L. Uhran is Director for the International Space Station in NASA's Office of Human Exploration and Operations. He has been a leader in evaluating practical applications of orbital space stations since 1984, when he began evaluating mission requirements for the NASA space station during the concept phase. Since that time, he has held key management positions in both the private and public sectors, and has traveled worldwide developing strategies for use of the International Space Station (ISS) – a cooperative partnership in science & technology among Canada, Europe, Japan, Russia and the United States. In his current post, he is staff director for program-wide cost, schedule and technical oversight of the ~ 500 metric ton, $60 billion orbital laboratory complex.

Mr. Uhran received a Bachelor of Science degree from Cornell University (1976), a Master of Science degree from the University of Maryland (1987), a Master of Public Administration degree from Harvard University (1998), and is an Associate Fellow of the American Institute of Aeronautics and Astronautics. He is a recipient of the NASA Leadership Medal for his role in determining the final flights of the Space Shuttle Program, and has received both distinguished (2010) and meritorious (2007) Presidential Rank Awards for his services to the nation on the ISS Program. He resides in the historic Capitol Hill district of Washington, DC where he and his wife have designed and built a popular bed & breakfast inn.

Dr. Richard S. Williams serves as NASA's Chief Health and Medical Officer and is responsible for the oversight of all medical aspects of national and international NASA missions involving humans. He holds a Doctor of Medicine. degree from the Virginia Commonwealth University (Medical College of Virginia), and completed residencies in General Surgery at Wright State University and in Aerospace Medicine and Occupational Medicine at the USAF School of Aerospace Medicine at Brooks AFB, Texas. A Fellow of the American College of Surgeons, he is certified by both the American Board of Surgery and the American Board of Preventive

Medicine (Aerospace Medicine). He has extensive experience in the clinical practice of general surgery, aerospace medicine and occupational medicine as well as in administrative medical management. He has held appointments as Assistant Clinical Professor of Surgery at Wright State University and Associate Clinical Professor of Surgery at the Medical College of Virginia.

During his 27 year Air Force career, Dr. Williams served in a wide variety of settings as a clinical practitioner and medical leader, including service in contingency deployments. His military decorations and civilian honors include the Bronze Star Medal, the John R. Tamisea Award, the NASA Space Flight Safety Award, and the Melbourne C. Boynton Award. Dr. Williams is also a designated senior FAA Aviation Medical Examiner and an active instrument-rated private pilot with over 3500 hours flying single and multi-engine aircraft.

Franceska O. Schroeder, Esq. is a Principal in the Washington, D.C. office of Fish & Richardson. She is a member of the firm's Regulatory and Government Affairs group and White Collar Criminal Defense section. Her practice emphasizes export controls and economic sanctions, commercial and government contracts, risk management, insurance, and legislative and policy matters that affect the aviation, space, defense, and national security sectors. Ms. Schroeder's clients include aerospace and defense contractors, satellite manufacturers and operators, launch services providers, systems engineering firms, software companies, and investors in high-technology projects. She also is Legal Counsel to the American Astronautical Society and serves as a Private Sector Advisor to the U.S. Delegation to the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space.

Franceska is a member and also serves on the board of many national and international societies, including the American Astronautical Society; American Institute of Aeronautics and Astronautics; District of Columbia Bar Association; International Academy of Astronautics; National Defense Industrial Association; International Aviation Women's Association; Women in Aerospace; and Women in Defense. She is the recipient of numerous awards and is sought after as a speaker on commercial space law issues.

Dr. Arnauld Nicogossian is the Director of the Center for the Study of International Medical Policies and Practices (CSIMPP), School of Public Policy, George Mason University. He completed his post graduate training in internal and preventive medicine, sub-specialty aerospace medicine. He was the Associate Administrator for Life and Microgravity Sciences and the Chief

Medical Officer at the National Aeronautics and Space Administration (NASA). He served as president of three professional societies, holds a faculty appointment at the Uniformed Services University of Health Sciences, Bethesda, Maryland and has over 50 publications in the peer reviewed literature, three textbooks and co-edited the Joint NASA-Russian Academy of Sciences 5 volume series of the Foundations in Space Biology and Medicine. Dr. Nicogossian contributions to space medicine and research management were recognized by many national and international awards.