Horizons

Volume 31, Number 2 AIAA Houston Section www.aiaa-houston.org November/December 2005

AIAA HOUSTON

American Institute of Aeronautics and Astronautics

November/December 2005

Horizons is a bi-monthly publication of the Houston section of the American Institute of Aeronautics and Astronautics.

Jon S. Berndt
Editor

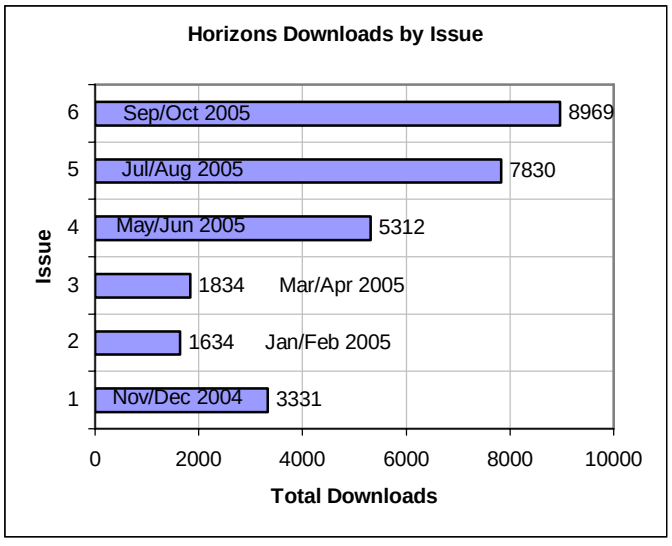
Cover: Photograph of the lunar module, Challenger, taken by Gene Cernan during an Apollo 17 EVA, December 1972. The LM is about two miles away, the South Massif rising behind the LM is five miles distant. Image courtesy of NASA.

From the Editor Looking Back, Looking Forward

JON S. BERNDT

[Note:This issue is a bit late due to a hard drive crash. I had backups made, but the CD backup software I was using changed format, and I installed a newer operating system than I had before. The result was a bit of a headache over the holidays.]

It's been a year of significant growth for *Horizons*. When we revamped the newsletter late in 2004, the number of downloads per newsletter (for the issues just prior to November/December 2004) varied between 30 to 50. At that time, of course, we also mailed out a paper copy of the newsletter to each local member. With the first issue in the new format, the number of downloads jumped to almost 2,000 in the month after it was released, as we began to phase out the paper copies to save on mailing and printing costs. The most recent issue (the September/October 2005 issue) has been downloaded almost 9,000 times as I write this.



With the format and delivery method changes, we have added freedom in adding content and providing links to content elsewhere.

One of the articles in this issue recounts the recent dinner meeting, where Dr. Michael Lembeck, Director of Northrop Grumman Corporation's Houston Operations, addressed the question, "Why is Space Important?". Also included in this issue is the full text of President John Kennedy's speech at Rice Stadium so many years ago. It's interesting to review Kennedy's speech in the context of history, and with the clarity of hindsight. How many of the justifications that he gave for going to the Moon still apply today in the effort to return to the Moon and continue on to Mars? Will today's justifications stand firm enough over the coming years to keep taxpayers and elected officials committed? Elaine Camhi, Editor-in-Chief of AIAA's monthly magazine, Aerospace America, asks the same question: "... the Vision for Space Exploration is a product of the current administration. The first goal of that vision, the CEV, is targeted to take to the skies in 2012, long after that administration has left Washington. Will a return to the Moon and voyages to Mars and beyond be goals for the next president?"

Peter Fosler, Guest essayist for the Rochester Democrat & Chronicle, submitted on January 5th a response to a reader who had considered the recent hurricane recovery efforts and concluded: "it is time to drop the space program and take care of (people's) basic needs" here on Earth." Mr. Fosler responded in part: "Space exploration provides both direct and indirect answers to our questions. Indirectly, the materials and techniques needed to survive in space have provided a wealth of knowledge that affects our everyday life.

A recently released Gallup Poll proclaims: "As NASA gets set to launch a new mission to photograph Pluto, a review of Gallup polling finds that Americans have typically viewed the space agency favorably. In addition, Americans have historically supported increased or current levels of government spending on space exploration."

Kennedy's hopes, expressed in his Rice speech, are understood by the public to have been realized over the years by our investment in space technologies and efforts. I believe the support to sustain the Vision for Space Exploration is solid.

There's going to be a lot to talk about this year; lots to do. If you'd like to share your thoughts in a letter, please do so. If you'd like to write an article, we'd like to hear from you. We hope you'll help us to grow, and in turn to be a resource for you and the local aerospace community. Best wishes for a great new year.

- JSB

Chair's Corner

STEVE KING, AIAA HOUSTON CHAIR

"Collaboration" – the act of working jointly with others or together – is an important strategy for success in today's workplace, one's family life, athletics, etc. Even thought the Houston Section is considered large with 1200+ diverse members, it is by no means the single professional organization that can serve everyone all the time. One of my focuses this term has been to increase AIAA's collaboration with other professional organizations in the JSC area. This with the intent of allowing our members to expand their network of professionals, share new ideas, catch other presentations of interest, and observe how different groups function. In addition, their activities may allow opportunities for further professional development and enrichment. So far this term, the Houston Section's active partnership with other professional organizations has involved:

- American Astronautical Society (AAS): AIAA National and our Section publicized their National Conference held at South Shore Harbour in November which allowed AIAA members to attend at AAS rates.

- Bay Area Houston Economic Partnership (BAHEP): Presented an overview of their Space Alliance Technology Outreach Program (SATOP) at our "Small Business Innovative Research, Small Business Technology Transfer" lunch n' learn in September. In addition, we share public policy information of mutual interest with BAHEP's "Citizens for Space Exploration" efforts.

- Kaplan Test Prep and Admissions: Hosted a "Business School Admissions" seminar.

- Mars Society – Houston Chapter: In planning a joint mixer with our Section for next May, and in the meantime, we help publicize their "Popcorn Series" lectures.

- NASA Alumni League (NAL) – Houston Chapter: Joined us in hosting the "Advent Launch System" lunch n' learn in October. They are also planning to join us in hosting a dinner meeting in March 2006 featuring the Saturn V restoration project.

- Society of Logistics Engineers (SOLE): Invited us to join them in presenting a lunch n' learn in August on "When Smart People Do Dumb Things: Lessons Learned in Data Analyses."

- United Space Alliance Leadership Association (USALA): Will be our partner is hosting a dinner meeting in Feb. 2006 featuring an AIAA Distinguished Lecturer on the "First Flight of a Mars Airplane."

Collaborative activities are not a new thing to the Houston Section. For at least the past 15-years, we have partnered with the Institute of Electrical and Electronic Engineers (IEEE) - Galveston Bay Section Joint Chapter and Instrumentation Society of America (ISA) - ROBEXS Division in holding the annual Workshop on Automation & Robotics (WAR). In conjunct with this event, the Houston Section has worked in cooperation with the Clear Lake Council of Technical Societies (CLCTS) and several of its member organizations (e.g., IEEE, ISA, Industrial Security Society of America [ISSA] and International Council on Systems Engineering [INCOSE]) in hosting the yearly "INNOVATION" lectures.

Getting the word out about our events is also a key in their success. The Houston Section relies of numerous organizations (e.g., government, corporate, media, professional organizations, and special interest groups) to help us with event publicity which includes those listed above. Also, the Houston chapters of the following organizations receive our publicity for their internal distribution:

- American Society of Chemical Engineers (ASCE)
- American Society of Mechanical Engineers (ASME)
- Experimental Aircraft Association (EAA)
- Houston Engineering and Scientific Society (HESS)
- National Society of Black Engineers (NSBE)
- National Management Association (NMA) – JSC Chapter
- Society of Hispanic Professional Engineers (SHPE)
- Society of Mexican American Engineers & Scientists (SMAES)
- Southwestern Aerospace Professional Representatives Association (SWAPRA)
- Toastmasters.

If you know of other groups that would like to collaborate with us on an activity or may just want to receive our event announcements, please have them contact chair@aiaa-houston.org. Together we can do amazing things. May all of you enjoy the very best this holiday season and let's continue the journey…

Report on the LEAG Conference on Lunar Exploration

Conference Report

LARRY JAY FRIESEN

This is a report on Space Resources Roundtable VII: LEAG Conference on Lunar Exploration that took place at South Shore Harbour in League City, Texas, October 25-28, 2005. This was a combined meeting of the Space Resources Roundtable (SRR) and the Lunar Exploration Analysis Group (LEAG). SRR people want to use extraterrestrial resources to leverage exploration of the Moon and the solar system. LEAG are scientists who have been providing input to the program managers of President Bush's Moon-to-Mars and Beyond Initiative, as to what sort of scientific investigations might be done on the Moon. This meeting also included NASA engineers who are designing hardware for Bush's initiative. The third day we were joined by the Lunar Commerce Executive Roundtable, a group of business people interested in finding ways to make money from lunar enterprises and harness the private sector in the endeavor. The first two days, the business people were having their own parallel meeting.

So we had at least three cultures, all trying to understand each other: Scientists who want to study the Moon, engineers who want to build equipment to get there and use the Moon's resources, and business people who want to make money from those resources. The tone of the conference was very upbeat. Everyone I spoke to thought that it was worth making the effort to communicate between cultures.

The first session focused on NASA's plans for returning to the Moon. Two speakers discussed NASA's Exploration Architecture. Robotic missions in the works so far are an orbiter to assess resources and photograph potential landing sites, and a lander to demonstrate automated landing capability and to get ground truth for polar water. Two contractors are working on designs for the Crew Excursion Vehicle (CEV). Vehicles will be sized to enable support for later Mars missions. NASA is looking at LOX-methane propellants for the Moon, because they look promising for ISRU (In Situ Resource Utilization) on Mars.

The CEV design must carry crew to the ISS, support lunar missions, and support Mars approach. A CEV is to carry 6 people to or from the ISS or 4 to the Moon. A service module will provide power and delta-V. The launch system for the CEV will use technology inherited from Shuttle and Apollo to save development cost and time.

LEO and lunar orbit (LLO) rendezvous have been chosen for lunar missions. The architecture is intended to support going anywhere on the Moon, and to enable return at any time. Lunar surface activities will start with sorties of about seven days and evolve to include outposts. Transitioning quickly to a permanent outpost turned out not to be affordable.

The lander will be able to put 2,000 kg of cargo onto the lunar surface and carry a habitation module. If cargo and habitation module are left on the surface, we can incrementally build outposts every time we revisit a site. The lunar south pole is a candidate outpost site, but this is not set in stone.

The second session Tuesday morning focused on lunar science. Paul Spudis discussed the proposed Robotic Lunar Exploration Program (RLEP)-2 mission, and gave a Lunar science overview, and how it fits into the return to the Moon.

We are going to the Moon to learn skills needed to live and work on other planets. We will use science to advance our understanding of the Moon and to gain experience for exploration. Spudis put forward his ideas about science on the Moon not as definitive answers, but as a beginning of discussion.

RLEP-2 is the second robotic mission to support return to the Moon, the first being a lunar reconnaissance orbiter. RLEP-2 is planned as a lunar south pole lander. This mission is intended to support developing infrastructure for robot/human exploration. It will seek to learn: Where are the locations of permanent sunlight and permanent shadow over an entire year? And what is the nature, state, and composition of polar volatiles? The lander will carry a rover to help investigate these questions.

In his science overview, Spudis suggested that instead of humans vs. machines, we should think of human and machines, and ask what is the optimum mix. He discussed candidate landing sites and criteria for selecting an outpost site, plus several scientific and engineering research topics a human lunar exploration program can help address.

Clive Neal talked about establishing a global lunar seismic network. The Moon is much less seismically active than Earth, but its average seismicity equals intra-plate seismicity in the U.S. Some shallow moonquakes have Richter magnitudes > 5. Seismic hazards cannot be ignored when planning lunar outposts.

Don Bogard spoke about the bombardment history of the Moon. Impacts define surface geology for many bodies in the solar system, and the Moon is the closest of these.

The final paper in this session discussed the recent use of the Hubble Space Telescope to observe the Moon.

Tuesday afternoon started with a session on biology and medicine. Not only will people need plants on the Moon to recycle oxygen and for food, plants can be used as biological reporting systems, telling us how organisms respond to the lunar environment. Another group reported on efforts to develop an active radiation dosimetry system that could support lunar EVA.

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One talk dealt with the need for development of sensors to detect and characterize lunar dust. The lunar dust's large portion of ultrafine particles makes it especially hazardous to health.

A panel discussion took place later Tuesday afternoon on what role the Moon should play in the future of astrophysics.

Wednesday morning dealt with ISRU. G. B. Sanders summarized capabilities needed. We need to plan for ISRU from the beginning, not as a later "add-on". He discussed plans for early ISRU sorties. He proposed to "scar" lander tanks so that they can be left on the Moon as storage tanks for liquid oxygen and other volatiles.

W. Nakagawa discussed lunar dust mitigation. We need a good simulant. Previous simulants don't include "nano-dust", which has only recently been recognized. Dust affects human health and impacts ISRU. Larry Taylor pointed out some lunar soil properties relevant for ISRU. It contains agglutinates loaded with nanophase metallic iron. Nearly all particles smaller than 10 microns are easily attracted by a hand magnet. This may offer a way to control dust. Nanophase iron makes for great coupling to microwaves. This could offer a way to make "bricks" for construction.

One talk dealt with trade studies of excavation systems. A talk by Whittaker *et al.* dealt with pragmatics of propellant production on the Moon.

Blair *et al.* discussed how ISRU may enable or benefit space commercialization.

Duke and Fort discussed how to engage the engines of commerce to help develop lunar resources and increase human activity on the Moon. They proposed a Lunar Resources Consortium as a private/public partnership.

During lunch on Wednesday, we were treated to a demonstration of a recent model of a space suit. This suit demonstrated a great deal more mobility than previous types, and so would be a good suit for lunar or Mars surface operations.

The topic Wednesday afternoon was exploration techniques. Charles O'Dale spoke on using secondary objectives to guide development of lunar industry. An objective he would like to see stated explicitly is to have people in space. His reason? On the Moon, people are a cost. They could eventually be eliminated from lunar operations in a profit-only situation, if human presence is not an explicit goal.

The next two presentations discussed human-machine interactions and integration for exploration operations. Other talks discussed tools, techniques, and operating procedures. One talk advocated a crew-centered operation strategy. The crew on the Moon or Mars should have the autonomy to make decisions locally. Further, all equipment on the Moon or Mars must be able to be serviced and maintained on site.

Two papers discussed how "superbots", modular robots made of multiples of duplicate units, could be used in lunar exploration. They are reconfigurable and multifunctional, because the units can link together in various ways.

A talk by Trygve Magelssen and S. Hooker stressed the need to avoid "analysis paralysis", where we study every topic to death, but never actually build anything. In their view, the biggest risk in the endeavor is cancellation of the program.

When the Lunar Commerce Executive Roundtable joined us, the first part of Thursday morning was devoted to lunar commerce. P. A. Eckert proposed that energy will be a key product from lunar commerce. We need to close the "near-term gap". A lot of activities in space and on the Moon are potentially profitable, but many have a long wait time before profits come in. This makes it difficult to attract capital. We need to find applications that bring profits on Earth before lunar profits come in.

Rick Tumlinson spoke on the synergy of science, engineering, and commerce. It is important to decide why we are going to the Moon. In his words, are we going to play or to stay? Are we going just to do science, or do we intend to settle the Moon as a frontier? This key decision will shape what kinds of systems we build.

Larry Austin spoke on what sorts of business plans the investment community looks for before they put forward money. Mark Nall discussed a road map, with near term markets. He discussed what forms of energy could be derived from the Moon, including electricity, chemical propellants, and He3, plus potential markets for energy in space and on Earth.

Neville Marzwell said that a new relationship is needed between government and the private sector in the space and lunar arena. Administrations and Congress change, while we want lunar research, exploration, and business to continue.

The second part of Thursday morning was devoted to breakout discussion groups on the topics of space (including lunar) solar power, propellant production on the Moon, a multiple-customer industrial/scientific/exploration facility, civil engineering enterprises, and media and related products and services. I sat in on the propellant production group, moderated by Larry Taylor with three other panelists.

Larry Taylor pointed out volatiles implanted by solar wind into lunar soil we could extract, even leaving out any water at the poles. These include hydrogen and carbon. We could combine them to get methane. We need to be careful how we handle regolith; we can lose 25 to 50% of volatiles just by shaking the material. Oxygen is abundant in lunar rocks and soil, and can be extracted by several processes. He mentioned two that are not sensitive to feed-

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"A lot of activities in space and on the Moon are potentially profitable, but many have a long wait time before profits come in. This makes it difficult to attract capital. We need to find applications that bring profits on Earth before lunar profits come in."

- P. A. Eckert

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stocks: carbothermal reduction and magma electrolysis.

Another panelist, Ed McCollough, proposed an aluminum/oxygen rocket. He also spoke of a need to demonstrate propellant production methods.

Open discussion began. Breakout groups were encouraged to present their findings in the format of three major questions: What should our goals be? What barriers might prevent the accomplishment of those goals? What solutions can we find to overcome the barriers?

Our Thursday lunchtime speaker was Mark Borkowski, who spoke on the RLEP program. RLEP program objectives are: to figure out where to send humans, learn what is there, develop a hardware heritage for manned systems, and emplace equipment for manned systems. There may be more missions after RLEP-1 and RLEP-2; RLEP is budgeted as a continuous program. RLEP offers opportunity for commercial and international participation.

Thursday afternoon began with reports from the breakout sessions. The space solar power group's goals were to create a secure world energy system, perform in-space and on-Moon tasks toward this end, and make this option politically and socially acceptable. The strongest barrier is launch and in-space transportation cost. Strategies they proposed: demonstrate technologies, demonstrate potential for economic return, promote recognition of this opportunity by the people developing the NASA exploration architecture, and create standard interfaces for space and lunar systems.

The report from the propellant production breakout group summarized the discussion described above.

People from the session on an industrial/scientific/exploration facility decided not try to combine all functions in the same facility. Their goals: Establish clear interfaces between NASA and businesses, and identify the lunar resource environment. The barriers are: no infrastructure yet exists; previous concepts tried to start too big; political and legal uncertainty; undemonstrated concepts. The strategies they proposed: Create clear interfaces (they saw this as a strategy as well as a goal). Create an entrepreneur-in-residence at NASA. Create enterprise zones in space. Let NASA be a customer, rather than doing everything itself. Commit to a permanent presence on the Moon.

Goals of the civil engineering group were to create a sustained lunar presence, change the economic paradigm and include the word profit, create infrastructure, develop planetary building codes, and combine NASA with small business. Among barriers: A "can't be done" attitude. Small businesses can't go it alone because of the cost barrier. Strategies they proposed: Identify dual-use products that can find markets on Earth as well as on the Moon or in space. Conduct empirical studies; actually try out things. Develop adequate simulants and simulation facilities.

Following the breakout reports, Dr. Gary Cadenhead spoke to us about a business student competition called "Moot Corp", analogous to "moot courts" law students have. This began at the Cox Business School at SMU and has grown into an international competition. Dr. Cadenhead made the first public announcement of a proposal for a Lunar Ventures Student Competition, to be held in conjunction with Moot Corp. This would be a separate competition and not be "moot". Winning competitors would be expected to launch their proposed businesses, with their prize as part of their seed money.

Friday's session focused on what follows getting to the Moon. The first talk promoted the idea of a "gateway" facility which can support both Moon and Mars traffic at the Earth-Moon L1 Lagrange point. Such a facility could provide lunar surface support by way of communications, space-based power management, telerobotic control, and space depoting of supplies and equipment. It could act as an in-space test bed for Mars hardware and provide assembly, support, repair, and recovery capabilities for Mars transfer vehicles. It can be built in stages; it does not have to be set up all at once.

C. Shearer discussed science and exploration linkages between the Moon and Mars. He spoke only on surface science, not orbital science. Both worlds can help us understand planet formation and evolution, planetary interior structure, and solar system impact history. We need to evaluate resources on both, especially water and sources for producing rocket propellants. Demonstrations can be performed on the Moon for several types of technologies and operations.

Head *et al.* spoke about using near-Earth objects (NEOs) to reduce risk and cost for Moon and Mars operations. One could fly a mission to an NEO as a test before a Mars mission.

Mark Berggreen discussed what materials could be extracted at Mars and the Moon using a closed-loop sulfuric acid aqueous processing system. This approach can generate a greater range of products than physical separation or thermal treatment methods. It is also flexible with respect to feedstock.

Robert Zubrin *et al.* proposed a Mars Gashopper Airplane. It would use solar power to compress CO2 from the Mars atmosphere into tanks. The gas would be heated and expand through a nozzle. This could propel a hopper or a VTOL airplane. A winged airplane could easily go 100-200 km per hop. Zubrin showed videos of a horizontal flyer his group has demonstrated. This system allows multiple flights to unlimited sites. It would take about a month to refuel between hops. The craft could carry rovers which could explore the landing site area while the aircraft was refilling its tank.

History

President John F. Kennedy's Speech at Rice Stadium, 12 September 1962

President Pitzer, Mr. Vice President, Governor, Congressman Thomas, Senator Wiley, and Congressman Miller, Mr. Webb, Mr. Bell, scientists, distinguished guests, and ladies and gentlemen:

I appreciate your president having made me an honorary visiting professor, and I will assure you that my first lecture will be very brief.

I am delighted to be here and I'm particularly delighted to be here on this occasion.

We meet at a college noted for knowledge, in a city noted for progress, in a State noted for strength, and we stand in need of all all three, for we meet in an hour of change and challenge, in a decade of hope and fear, in an age of both knowledge and ignorance. The greater our knowledge increases, the greater our ignorance unfolds.

Despite the striking fact that most of the scientists that the world has ever known are alive and working today, despite the fact that this Nation¹s own scientific manpower is doubling every 12 years in a rate of growth more than three times that of our population as a whole, despite that, the vast stretches of the unknown and the unanswered and the unfinished still far outstrip our collective comprehension.

No man can fully grasp how far and how fast we have come, but condense, if you will, the 50,000 years of man¹s recorded history in a time span of but a half-century. Stated in these terms, we know very little about the first 40 years, except at the end of them advanced man had learned to use the skins of animals to cover them. Then about 10 years ago, under this standard, man emerged from his caves to construct other kinds of shelter. Only five years ago man learned to write and use a cart with wheels. Christianity began less than two years ago. The printing press came this year, and then less than two months ago, during this whole 50-year span of human history, the steam engine provided a new source of power.

Newton explored the meaning of gravity. Last month electric lights and telephones and automobiles and airplanes became available. Only last week did we develop penicillin and television and nuclear power, and now if America's new spacecraft succeeds in reaching Venus, we will have literally reached the stars before midnight tonight.

This is a breathtaking pace, and such a pace cannot help but create new ills as it dispels old, new ignorance, new problems, new dangers. Surely the opening vistas of space promise high costs and hardships, as well as high reward.

So it is not surprising that some would have us stay where we are a little longer to rest, to wait. But this city of Houston, this State of Texas, this country of the United States was not built by those who waited and rested and wished to look behind them. This country was conquered by those who moved forward--and so will space. William Bradford, speaking in 1630 of the founding of the Plymouth Bay Colony, said that all great and honorable actions are accompanied with great difficulties, and both must be enterprised and overcome with answerable courage.

If this capsule history of our progress teaches us anything, it is that man, in his quest for knowledge and progress, is determined and cannot be deterred. The exploration of space will go ahead, whether we join in it or not, and it is one of the great adventures of all time, and no nation which expects to be the leader of other nations can expect to stay behind in the race for space.

Those who came before us made certain that this country rode the first waves of the industrial revolutions, the first waves of modern invention, and the first wave of nuclear power, and this generation does not intend to founder in the backwash of the coming age of space. We mean to be a part of it--we mean to lead it. For the eyes of the world now look into space, to the moon and to the planets beyond, and we have vowed that we shall not see it governed by a hostile flag of conquest, but by a banner of freedom and peace. We have vowed that we shall not see space filled with weapons of mass destruction, but with instruments of knowledge and understanding.

Yet the vows of this Nation can only be fulfilled if we in this Nation are first, and, therefore, we intend to be first. In short, our leadership in science and in industry, our hopes for peace and security, our obligations to ourselves as well as others, all require us to make this effort, to solve these mysteries, to solve them for the good of all men, and to become the world's leading space-faring nation.

We set sail on this new sea because there is new knowledge to be gained, and new rights to be won,

Source: The text of the Kennedy speech comes from the Johnson Space Center web site,

http://vesuvius.jsc.nasa.gov/er/seh/ricetalk.htm

The web site also features video and audio clips of the speech.

and they must be won and used for the progress of all people. For space science, like nuclear science and all technology, has no conscience of its own. Whether it will become a force for good or ill depends on man, and only if the United States occupies a position of pre-eminence can we help decide whether this new ocean will be a sea of peace or a new terrifying theater of war. I do not say the we should or will go unprotected against the hostile misuse of space any more than we go unprotected against the hostile use of land or sea, but I do say that space can be explored and mastered without feeding the fires of war, without repeating the mistakes that man has made in extending his writ around this globe of ours.

There is no strife, no prejudice, no national conflict in outer space as yet. Its hazards are hostile to us all. Its conquest deserves the best of all mankind, and its opportunity for peaceful cooperation many never come again. But why, some say, the moon? Why choose this as our goal? And they may well ask why climb the highest mountain? Why, 35 years ago, fly the Atlantic? Why does Rice play Texas?

We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too.

It is for these reasons that I regard the decision last year to shift our efforts in space from low to high gear as among the most important decisions that will be made during my incumbency in the office of the Presidency.

In the last 24 hours we have seen facilities now being created for the greatest and most complex exploration in man's history. We have felt the ground shake and the air shattered by the testing of a Saturn C-1 booster rocket, many times as powerful as the Atlas which launched John Glenn, generating power equivalent to 10,000 automobiles with their accelerators on the floor. We have seen the site where the F-1 rocket engines, each one as powerful as all eight engines of the Saturn combined, will be clustered together to make the advanced Saturn missile, assembled in a new building to be built at Cape Canaveral as tall as a 48 story structure, as wide as a city block, and as long as two lengths of this field.

Within these last 19 months at least 45 satellites have circled the earth. Some 40 of them were "made in the United States of America" and they were far more sophisticated and supplied far more knowledge to the people of the world than those of the Soviet Union.

The Mariner spacecraft now on its way to Venus is the most intricate instrument in the history of space science. The accuracy of that shot is comparable to firing a missile from Cape Canaveral and dropping it in this stadium between the 40-yard lines.

Transit satellites are helping our ships at sea to steer a safer course. Tiros satellites have given us unprecedented warnings of hurricanes and storms, and will do the same for forest fires and icebergs.

We have had our failures, but so have others, even if they do not admit them. And they may be less public.

To be sure, we are behind, and will be behind for some time in manned flight. But we do not intend to stay behind, and in this decade, we shall make up and move ahead.

The growth of our science and education will be enriched by new knowledge of our universe and environment, by new techniques of learning and mapping and observation, by new tools and computers for industry, medicine, the home as well as the school. Technical institutions, such as Rice, will reap the harvest of these gains.

And finally, the space effort itself, while still in its infancy, has already created a great number of new companies, and tens of thousands of new jobs. Space and related industries are generating new demands in investment and skilled personnel, and this city and this State, and this region, will share greatly in this growth. What was once the furthest outpost on the old frontier of the West will be the furthest outpost on the new frontier of science and space. Houston, your City of Houston, with its Manned Spacecraft Center, will become the heart of a large scientific and engineering community. During the next 5 years the National Aeronautics and Space Administration expects to double the number of scientists and engineers in this area, to increase its outlays for salaries and expenses to $60 million a year; to invest some $200 million in plant and laboratory facilities; and to direct or contract for new space efforts over $1 billion from this Center in this City.

To be sure, all this costs us all a good deal of money. This year's space budget is three times what it was in January 1961, and it is greater than the space budget of the previous eight years combined. That budget now stands at $5,400 million a year--a staggering sum, though somewhat less than we pay for cigarettes and cigars every year. Space expenditures will soon rise some more, from 40 cents per person per week to more than 50 cents a week for every man, woman and child in the United Stated, for we have given this program a high national priority--even though I realize that this is in some measure an act of faith and vision, for we do not now know what benefits await us.

But if I were to say, my fellow citizens, that we shall send to the moon, 240,000 miles away from the control station in Houston, a giant rocket more than 300 feet tall, the length of this football field, made of new metal alloys, some of which have not yet been invented,

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"The growth of our science and education will be enriched by new knowledge of our universe and environment, by new techniques of learning and mapping and observation, by new tools and computers for industry, medicine, the home as well as the school. Technical institutions, such as Rice, will reap the harvest of these gains."

Meeting Report

American Astronautical Society (AAS) National Conference

ALICIA BAKER, STUDENT, UH

On November 15th and 16th of this year, the AAS hosted its National Conference at South Shore Harbour in League City, Texas. The conference theme was "Building Bridges to Exploration: The Role of the International Space Station". Various sessions were held to discuss the role of the ISS in the future of space exploration-the journey back to the moon, Mars, and beyond.

The conference opened with a greeting from the ISS Expedition 12 Crew Commander Bill McArthur and Flight Engineer Valery Tokarev. Former Johnson Space Center (JSC) director, Jefferson Howell, Jr., then introduced the keynote speaker, NASA Administrator Michael Griffin. Dr. Griffin discussed how our next step in supporting President Bush's Vision for Space Exploration is to complete the assembly of the ISS and then use the ISS to further exploration beyond lower Earth orbit. Before the sessions began, a quick presentation was made about the NASA Means Business student competition. The objective of the competition is for students to come up with a promotional product, such as a video, that communicates to the general public how import NASA space exploration programs are to life here on Earth. Sessions about the role of the space station then included aerospace professionals from all over the world. Representatives from the US space program, Russia, the Canadian Space Agency (CSA), the European Space Agency (ESA), and the Japan Aerospace Exploration Agency (JAXA) discussed the roles they play in the ISS program.

I had a unique opportunity as a student to participate in a student workshop as part of the session: "ISS as an Exploration Mission Testbed." Student Session Chairman, JSC's Paul Brower, helped organize students into teams that worked together before and during the conference to develop ideas on how the ISS can be utilized for testing technologies that will help us continue with our journey into space. Teams consisted of students from all over the country from various disciplines-from physics to engineering majors. Teams included Habitability, Robotics, Maintenance, and Medicine/Life Support Technology. Each team was given the task to develop a concept and prepare a 10 minute presentation. Prior to the conference students used an online chat room, discussion board, email correspondence, and teleconferences to prepare their presentation.

Each student team was assisted by an aerospace professional with experience in one of the four areas. Team mentors answered questions about their area of expertise. They assisted students in dividing up research and presentation responsibilities. A student lead was chosen to facilitate turning in pre-conference work to the student session committee. Students had to demonstrate their progress in various stages. Stage one included presenting a list of brainstormed ideas. Stage two included selecting a final idea and providing an outline to topics to be discussed during presentation. The final stage consisted of a draft PowerPoint presentation.
On the first day of the conference, students were able to attend the aerospace professional sessions. We then were treated to a pizza party at the Gilruth where students and mentors met for the first time! On the second day of the conference, students fine-tuned and practiced their presentations. We took a break during the day to attend the conference luncheon-where the speaker gave an update on the Chinese Human Space Flight Program. When it was time for the student session of the conference, students presented their ideas to a NASA panel that included astronauts Michael Foale and Scott Altman and AAS Houston Conference Planning Chair Nicholas Skytland.

My team was the habitability team. It was an eye opening experience learning about the importance of habitability in the space program. Habitability involves trying to create a safe and productive environment for the astronauts while living in space for extended periods of time. Our team mentor was Cynthia Rando from the Muniz Engineering, Inc. (MEI) ISS Flight Crew Integration Habitability and Human Factors Office. Our concept was "Virtual Earth". We were hoping to find a way to help alleviate homesickness for astronauts that are away on long duration space missions. It could be tested on the ISS and then used on a lunar base or a mission to Mars.

As an inspiration for our concept, we looked to astronaut John Phillips of Expedition 11 for inspiration: "It's kind of a sterile environment; I want to experience weather, the smell of trees, even the sound of cars going by, something that's more like the real world that I live in back home." Each astronaut would have a "Virtual Earth" module in their quarters that would consist of a LCD screen, speakers, web cam, optional headphones, and light boxes hooked up to a central computer.

"Virtual Earth" would have three different modes: "Earth Environment Simulator," "Window View," and "Family Interaction". The "Earth Environment Simulator" would provide day and night time pictures and video from earth, including scenes from astronaut's home towns. Light boxes would be attached on both sides of the LCD screens to provide

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light therapy. They would provide specific wavelengths of light similar to those provided by the sun. Lack of exposure to sun light on long duration space missions could affect an astronaut's circadian rhythm-lead to an increase in the hormone melatonin and a decrease in energy levels.
"Window View" would provide views of outside a space vehicle from cameras mounted on the vehicle. When astronauts where out of range of the earth, they could watch pre-recorded video of the Earth from orbit. The LCD screen would act as a window without the radiation effects of having a window in an astronaut's crew quarters.

"Family Interaction" mode would feature a live feed for family conferences and an option to view family videos when astronauts where out of live feed range. It would provide private time with family and psychological support for long duration missions.
Using current technology and a small budget, "Virtual Earth" could be tested on the ISS. We hoped it would make living on a moon base easier and the long journey to Mars feasible from a habitability standpoint.

The Robotics team proposed concepts for robots that would help astronauts with both Intravehicular Activity (IVA) and Extravehicular Activity (EVA). Maintenance group felt that a database listing all hardware and components on the ISS should be maintained in order to facilitate repairs and upgrades on the station. The Life Support group came up with the concept of using planters designed to grow plants in a hexagonal pattern in order to maximize use of volume on the ISS.
The panel critiqued each group's presentation-providing both positive feedback and constructive criticism. The winning student team, Life Support, received travel funds to assist with the costs of travel to Greenbelt, Maryland, where they will present their concept at the Robert H. Goddard Memorial Symposium in March of 2006. All students were treated to a photograph with the astronauts and signed certificates of participation from Foale and Altman!
This conference was an exciting time! I learned a lot about the ISS and its future in helping us prepare for a moon base and the long journey to Mars and beyond. I thoroughly enjoyed attending the professional presentations and hearing from aerospace professionals from all over the world! Working with students from all over the country on a team project was a very unique experience! I enjoyed seeing all the student group final presentations. I was also nice to run into other students in AIAA from other universities! I look forward to the return of the conference to our area in 2008!

For more details about the conference, including a transcript of Dr. Griffin's speech, go to www.aashouston.org. For details about the NASA Means Business student competition, go to http://www.tsgc.utexas.edu/nmb/this.html.

Alicia Baker is a student member of University of Houston AIAA Chapter and Houston AIAA GN&C Committee, Project Engineer Intern for the NASA-funded Space Alliance Technology Outreach Program (SATOP) run by Bay Area Houston Economic Partnership (BAHEP)

Kennedy Speech at Rice (cont'd.)

(Continued from page 9)
capable of standing heat and stresses several times more than have ever been experienced, fitted together with a precision better than the finest watch, carrying all the equipment needed for propulsion, guidance, control, communications, food and survival, on an untried mission, to an unknown celestial body, and then return it safely to earth, re-entering the atmosphere at speeds of over 25,000 miles per hour, causing heat about half that of the temperature of the sun--almost as hot as it is here today--and do all this, and do it right, and do it first before this decade is out--then we must be bold.

I'm the one who is doing all the work, so we just want you to stay cool for a minute. [laughter] However, I think we're going to do it, and I think that we must pay what needs to be paid. I don't think we ought to waste any money, but I think we ought to do the job. And this will be done in the decade of the sixties. It may be done while some of you are still here at school at this college and university. It will be done during the term of office of some of the people who sit here on this platform. But it will be done. And it will be done before the end of this decade.

I am delighted that this university is playing a part in putting a man on the moon as part of a great national effort of the United States of America.

Many years ago the great British explorer George Mallory, who was to die on Mount Everest, was asked why did he want to climb it. He said, "Because it is there." Well, space is there, and we're going to climb it, and the moon and the planets are there, and new hopes for knowledge and peace are there. And, therefore, as we set sail we ask God's blessing on the most hazardous and dangerous and greatest adventure on which man has ever embarked.

Thank you.

AIAA Awards, Call for Nominations

RAKESH BHARGAVA, HONORS & AWARDS

Recognize the achievements of your colleagues by nominating them for an award. Nominations are now being accepted for the following awards, and must be received at AIAA Headquarters no later than 1 February 2006. Nominees must be AIAA members.

The nomination form can be downloaded from www.aiaa.org, or AIAA members may submit nominations online by logging into www.aiaa.org, "MY AIAA."

If you have any questions, you may contact Dr. Rakesh Bhargava, Chair Honors & Awards at rkbhargava@earthlink.net or 281-776-3515.

Aerospace Communications Award

The Aerospace Communications Award is presented for an outstanding contribution in the field of aerospace communications.

Aerospace Guidance, Navigation, and Control Award

Approved by the Board of Directors in 1998, this award was established to recognize important contributions in the field of Guidance, Navigation and Control.

Aerospace Power Systems Award

Established in 1981, this award is presented for a significant contribution in the broad field of aerospace power systems, specifically as related to the application of engineering sciences and systems engineering to the production, storage, distribution, and processing of aerospace power.

Aircraft Design Award

This award was established in 1968 and is given to a design engineer or team for the conception, definition, or development of an original concept leading to a significant advancement in aircraft design or design technology.

Command, Control, Communications, & Intelligence Award

The Command, Control, Communication & Intelligence Award is presented for significant contribution to the overall effectiveness of C3I Systems through the development of improved C3I Systems and Systems Technology.

de Florez Award for Flight Simulation

This award is named in honor for the late Admiral Luis de Florez and is presented for an outstanding *individual* achievement in the application of *flight* simulation to aerospace training, research, and development.

Energy Systems

Established in 1981, the Energy Systems Award is presented for a significant contribution in the broad field of energy systems, specifically as related to the application of engineering sciences and systems engineering to the production, storage, distribution, and conservation of energy.

George M. Low Space Transportation Award

Established in 1988, this award honors the achievements in space transportation by Dr. George M. Low, who played a leading role in planning and executing all of the Apollo missions, and originated the plans for the first manned lunar orbital flight, Apollo 8.

Hap Arnold Award for Excellence in Aeronautical Program Management

The Hap Arnold Award for Excellence in Aeronautical Program Management was approved by the AIAA Board of Directors in 1997 and is presented to an individual for outstanding contributions in the management of a significant aeronautical or aeronautical related program or project.

Mechanics and Control of Flight Award

This award is presented for an outstanding recent technical or scientific contribution by an individual in the mechanics, guidance, or control of flight in space or the atmosphere.

Missile Systems Award

This award is presented in two categories, Technical and Management:

The Technical Award is presented for a significant accomplishment in developing or using technology that is required for missile systems. The candidate must have demonstrated expertise in aerodynamics, guidance, thermophysics, navigation, control, propulsion, or other fundamental technical disciplines that has led to substantial improvement in missile systems.

The Management Award is presented for a significant accomplishment in the management of missile systems programs. The candidate must have demonstrated innovative leadership that has established an environment in which creativity in missile system technology can flourish and which led to the successful management of a major program by a government agency or an industry team.

(continued from page 12)

Multidisciplinary Design Optimization Award

Established in 1993, this award is presented to an individual for outstanding contributions to the development and/or application of techniques of multidisciplinary design optimization in the context of aerospace engineering.

Otto C. Winzen Lifetime Achievement Award

Approved by the Board of Directors in 1993, this award is in memory of Otto C. Winzen, a pioneer of modern day ballooning. The award is presented for outstanding contributions and achievements in the advancement of free flight balloon systems or related technologies.

Piper General Aviation Award

Formerly the General Aviation Award, this award honors William Piper, and is presented for outstanding contributions leading to the advancement of general aviation.

Space Automation and Robotics Award

Established in 1995, this award is presented for leadership and technical contributions by individuals and teams in the field of space automation and robotics.

Space Science Award

Reestablished in August 1998, the Space Science Award is now presented to an individual for demonstrated leadership of innovative scientific investigations associated with space science missions.

Space Operations and Support Award

This award is presented for outstanding efforts in overcoming space operations problems and assuring success, and recognizes those teams or individuals whose exceptional contributions were critical to an anomaly recovery, crew rescue, or space failure.

Space Systems Award

Formerly the Spacecraft Design Award, the Space Systems Award is presented to recognize outstanding achievements in the architecture, analysis, design, and implementation of space systems.

von Braun Award for Excellence in Space Program Management

Approved by the Board of Directors in 1987, this award gives national recognition to an individual(s) for outstanding contributions in the management of a significant space or space-related program or project.

Wright Brothers Lectureship in Aeronautics

Commemorating the first powered flights made by Orville and Wilbur Wright at Kitty Hawk in 1903, this lectureship emphasizes significant advances in aeronautics by recognizing major leaders and contributors.

AIAA proudly participates with other technical societies and organizations in the selection of recipients for the following awards. The deadline date for nominations is shown below.

Robert J. Collier Trophy Award - Nominations due to AIAA by 15 January
Presented for the greatest achievement in aeronautics or astronautics in America, with respect to improving the performance, efficiency, or safety of air or space vehicles, the value of which has been thoroughly demonstrated by actual use during the preceding year. NAA and AIAA sponsor the award.

J. Leland Atwood Award - Nominations due to AIAA by 1 January
This award is bestowed annually upon an aerospace engineering educator in recognition of outstanding contributions to the profession. AIAA and ASEE sponsor the award.

Daniel Guggenheim Medal – Nominations due to AIAA by 1 February
The industry-renowned Daniel Guggenheim Medal was established in 1929 for the purpose of honoring persons who make notable achievements in the advancement of aeronautics. AIAA, ASME, SAE, and AHS sponsor the award.

Elmer A. Sperry Award – Nominations due to AIAA by 1 February
The award is given in recognition of a distinguished engineering contribution, which, through application proved in actual service, has advanced the art of transportation whether by land, sea or air. AIAA, IEEE, SAE, ASME, SNAME and ASCE sponsor the award.

William Littlewood Memorial Lecture– Nominations due to AIAA by 1 February
The William Littlewood Memorial Lecture perpetuates the memory of William Littlewood, who was renowned for the many significant contributions he made to the design of an operational requirements for civil transport aircraft. The topics for the Lecture, which is presented in even years, shall deal with a broad phase of civil air transportation considered of current interest and major importance.

For further information, contact Carol Stewart, Honors & Awards Liaison, at carols@aiaa.org or at 703/264-7623.

Section Awards

Young and Energetic JSC Engineer is Recognized by AIAA

Nicole Smith, Electrical System Integrator for the ISS Vehicle Office at NASA Johnson Space Center, has been selected to receive the 2006 AIAA Lawrence Sperry Award. This award is presented for a notable contribution made by a person under 35 years of age to the advancement of aeronautics or astronautics.

Nicole Smith previously trained astronauts in ISS electrical and thermal systems, and performed thermal analysis and hypervelocity impact studies for Lockheed Martin Space Mission Systems. She is the AIAA Young Professional Committee liaison to the Board of Directors, has organized Team Texas for CVD, and is a past-Chairperson of the Houston Section. She has an M.S. in Aerospace Engineering at the University of Cincinnati, and a B.A. in Mathematics/Statistics and a B.S. in Aeronautics from Miami University in Oxford, Ohio. Nicole is an Ohio Space Grant Consortium Fellow and the recipient of the AIAA Sustained Service Award and Special Service Citation. In her copious free time she enjoys traveling, rollerblading, cycling, and being politically active.

"Future vehicles for cargo and passenger transport should be designed to be readily operable by the private sector after development is complete and routine operation is reached. To accomplish this the Commission recommends: That wherever possible the private sector be given the cask of providing specified services or products in space, and be free to determine the most cost-effective ways to satisfy those requirements, consistent with evolving Federal regulations."

- The Report of the National Commission on Space (1986)

Staying Informed

COMPILED BY THE EDITOR

This column points out useful web sites, documents, policy papers, periodicals, etc.

NASA Exploration Systems Architecture Study
http://www.nasa.gov/mission_pages/exploration/news/ESAS_report.html

Pioneering Programs: Accelerating the Pace to Space
http://www-1.ibm.com/services/us/index.wss/ibvstudy/imc/a1022923

Stardust@home
http://stardustathome.ssl.berkeley.edu/

NASA Advisory Council Documents
http://www.hq.nasa.gov/office/oer/nac/documents.html

NASA Commercial Orbital Transportation Services (COTS) Demonstrations web page
http://procurement.jsc.nasa.gov/cots/

Pioneering the Space Frontier, The Report of the National Commission on Space (1986)
http://history.nasa.gov/painerep/begin.html

Project Apollo Archive
http://www.apolloarchive.com/

Vision for Space Exploration Gallery
http://spaceflight.nasa.gov/gallery/images/vision/index.html

Aerospace Industries Association Year-End Review and Forecast
http://www.aia-aerospace.org/stats/yr_ender/yr_ender.cfm

AIAA Career Center
http://www.aiaa.org/content.cfm?pageid=336

New Members

ELIZABETH BLOME, MEMBERSHIP

The Houston Section has many new members. If you see one of these folks at the next section event, please welcome them:

Steven Berry
Cheree Bolser
Robin Bostwick
Kathleen Brown
Kimberly Christian
Tonya Coffman
Amy Coppage
Deirdre Davenport
Lisa Drago
Michelle Duhon
Leeann England
Andrew Feistel
Jessica Fichuk
Brenda Ford
Camile Franklin
Julie Gregory
Richard Hammer
Jean-Pierre Harrison
Joyce Hayes
Sally Hunt
Catherine Huntley
James Janscha
A. Johnson
James Johnson
Crystal Jones
David Kinney
Lori Koesters
Ginger Leblanc
Jose Lozano
Betty Mathews
Michael McCulley
Kim Eric Moore
Justin Morrow
Catherine Nelson
Mary Parker
Lea Parks
Patti Parks
Brenda Piazza
Jeanne Rhines
Mellaney Rutherford
Carmen Saenz
Fae Sandifer
Kenneth Standley
Suzan Steed
Thomas Terrando
Pamela Thompson
Kaite Usoff
Carrie Vincent
Deetrice Wallace
Brian Watson
Ryan Whitley
Sandra Willis
Gregory Zenner

Important notes:

- Not a member? See the end page.

Local AIAA Associate Fellows Named

ELIZABETH BLOME, MEMBERSHIP

The Houston Section is proud to announce the following members were selected to become Associate Fellows:

Hamn-Ching Chen
William H. Gerstenmaier
Richard J. Hieb
Jefferson D. Howell
Patrick L. Swaim
Richard A. Swaim
John B. Vollmer
James S. Voss.

They will be recognized at the Houston Section's dinner meeting on Feb. 9, 2006. Associate Fellows are individuals who have accomplished or been in charge of important engineering or scientific work, have done original work of outstanding merit, or have otherwise made outstanding contributions to the arts, sciences, or technology of aeronautics or astronautics. Nominees must be Senior Members with at least 12 years of professional experience (four years of post-graduate studies may be included, if applicable).

Also, Region IV had one Fellow selected from Region IV and none from Houston; however, two former Houston Section members were selected, Dr. Bonnie Dunbar, (Museum of Flight-Seattle) and Dr. George Nield (Federal Aviation Administration). Congratulations to all. If you are interested in receiving information about membership upgrades or know of possible candidates, please contact Rakesh Bhargava (our Honors & Awards Chair) at rkbhargava@earthlink.net.

Associate Fellow and Fellow nominations are due April 15th & June 15th, respectively, each year. More information can be found at www.aiaa.org/content.cfm?pageid=183.

Help AIAA Help You - Update Your Membership Records

ELIZABETH BLOME, MEMBERSHIP

We have no contact information for the following members. If you know where they are, please ask them to update their information on www.aiaa.org.

Daniel Allgood
Robert Ambrose
Nick Baker
Forrest Carpenter
Justin Doyle
Kevin Dries
Cory Logan
Jeffrey Marshall
Chuck Miller
Catherine Modica
Lena Norris
Ozden Ochoa
Alicia Rutledge
Timothy Snyder
Grant Threatt
Jaime Valverde
Luis Velasquez
Sean Welch
Bryan Witt
Pamela Workings

A Lunch and Learn Summary Report

The 2003 Johnson Space Center Systems Engineering Benchmarking Study

GARY BROWN, JACK GAVALAS

On November 10, 2005, the Houston AIAA Systems Engineering Technical Committee was pleased to present a Lunch-and Learn seminar by John B. (Jack) Gavalas entitled "The 2003 Johnson Space Center Systems Engineering Benchmarking Study". This lunch-and-learn was conducted in Building 16 of the Johnson Space Center, and was enjoyed by approximately 30 people.

EIA-632 Requirements for Engineering a System

Supply Process Requirements
1. Product Supply

Acquisition Process Requirements
2. Product Acquisition
3. Supplier Performance

Planning Process Requirements
4. Process Implementation Strategy
5. Technical Effort Definition
6. Schedule and Organization
7. Technical Plans
8. Work Directives

Assessment Process Requirements
9. Progress Against Plans and Schedules
10. Progress Against Requirements
11. Technical Reviews

Control Process Requirements
12. Outcomes Management
13. Information Dissemination

Requirements Definition Process Requirements
14. Acquirer Requirements
15. Other Stakeholder Requirements
16. System Technical Requirements

Solution Definition Process Requirements
17. Logical Solution Representation
18. Physical Solution Representation
19. Specified Requirements

Implementation Process Requirements
20. Implementation

Transition to Use Process Requirements
21. Transition to Use

Systems Analysis Process Requirements
22. Effectiveness Analysis
23. Tradeoff Analysis
24. Risk Analysis

Requirements Validation Process Requirements
25. Requirement Statements Validation
26. Acquirer Requirements Validation
27. Other Stakeholder Requirements Validation
28. System Technical Requirements Validation
29. Logical Solution Representations Validation

System Verification Process Requirements
30. Design Solution Verification
31. End Product Verification
32. Enabling Product Readiness

End Products Validation Process Requirements
33. End Products Validation

This presentation described the systems engineering approach used to conduct a benchmark study at JSC. The Systems Management Office under the JSC Office of the Chief Engineer (OCE/SMO) led the study to benchmark the Center-wide Systems Engineering (SE) practice for the information of its Systems Engineering Working Group (J-SEWG, with delegates from each major Center organization) and the Chief Engineer. The NASA/Booz Allen/Raytheon study team accomplished this in two stages: Part A comprised preliminary planning and initial research, and determining whether a case existed for proceeding with Part B, the benchmarking study itself. The two-part effort lasted from December 2002 through early July 2003.

Part A's preparatory steps were as follows:

- Determination of SE standard(s) and preliminary review of the non-JSC SE environment. This survey of the government-aerospace SE world-at-large permitted the team to put JSC's SE practice into perspective.
- Introduction of the study to JSC directorate, office, and divisional leadership, and to the J-SEWG members. This step was critical to establishing an appropriate degree of comfort with, and trust of, the examination among JSC technical experts and line management, so that needed information would be provided readily by interviewed project staff. The team took this opportunity to detail the collaborative and confidential provisions of the study that would preclude a "boarding party" dynamic between the study team and any given examined project's staff.
- Preliminary review of current JSC SE activities. The team's appreciation of the existing SE regulatory and practical environments at JSC was a prerequisite to formulating evaluation criteria that would yield constructive feedback for the client.
- Identification of all possible projects for benchmark examination at JSC, then down-selection to a final list of the most probably revealing projects, for economy of effort.
- Preliminary selection of an optimum benchmarking approach, tools, and report-out method. The concepts for the methodology, the instruments, and the report had to be custom-designed in order to offer a proposal to the JSC projects community that was non-intrusive, collaborative, and confidential.
- Obtaining approval from the J-SEWG and the JSC Chief Engineer to implement the benchmarking plan with Part B. The team had to make its case, both confirming the need for the study, and specifying the planned research tools and methods.

After the Chief Engineer had approved the study plan developed in Part A, the team performed Part B. The search for external best practices was completed by one part of the team, culminating in the conduct and analysis of an external best-practices survey. During the same period, using Electronic Industries Alliance Standard Number 632, "Processes for Engineering a System" (EIA-632) as a guide, the complement of the team finalized the tools for requesting SE-related project documentation and interviewing project personnel. Following interview rehearsals with a volunteer, actual JSC project, the SE content of which was familiar to several study team members in order to provide for a controlled environment, the team conducted project information repository examinations and project personnel interviews, and determined project scores. The external best practices research results were combined with organizational SE profile results determined from the internal study, in order to make observations, draw conclusions, and formulate recommendations to OCE/SMO. Included in this process were the mapping of internal study results into established NASA Program Guide SE categories, and, finally, the confidential reporting of project examination results back to the projects.

The LnL presentation is available at our Houston AIAA website www.aiaa-houston.org.

Why is Space Important?

DR. MICHAEL LEMBECK, NORTHROP GRUMMAN CORPORATION
EXCERPTS FROM THE LECTURE, WITH COMMENTARY BY THE EDITOR

Dinner Lecture Summary

The question is a recurring one: why explore space? More specifically, why explore space ourselves? Why travel through a vacuum, to a desolate place? Why expend the resources, the money, and the time? What's in it for us?

In occasional speeches and editorials, various reasons are given for why we should go one way or the other, how much we should spend (or not), etc. On the evening of December 14th, we gathered at Gilruth to listen to and consider the words of Dr. Michael Lembeck, Director, Northrop Grumman Corporation, Houston Operations.

Dr. Lembeck began by recalling that President Kennedy asked that question, and attempted an answer. President Kennedy did a pretty good job of laying out the list of benefits. But, it's a different world, now. Dr. Lembeck suggested that the aerospace community has not done a very good job of conveying what kind of space program we should have.

Dr. Lembeck explained:

"*It is a fact that the general public overwhelmingly supports the space program. Excitement was initially generated by daring feats of heroism undertaken by the astronauts. We have since added to that support with the awe-inspiring pictures returned by the "right-stuff robots:" the Hubble Space Telescope and the Spirit and Opportunity rovers on Mars. Everyone believes that space exploration is a good thing, even if we can't fully explain why. Let me try to answer that question with another set of questions.*

Why do we visit monuments and other historical places and walk around museums looking at paintings from hundreds of years ago? Why do we pay hard earned money to sit in dark theaters watching films with subtitles we can barely read? And why do we race to Barnes and Noble to buy the just released bestseller? Why do we spend so many millions of dollars a year listening to music on CDs?

These questions are interesting ones and you all probably have good answers for them. And I'd bet most of your answers are related to how you like to learn new things, understand your heritage, or just flat out want a break from the everyday world. As final justification you'd probably say the words, "Because I enjoy it." And you'll spend money on these things, sometimes even when you don't have it in the bank.
However, not everyone is satisfied with a visit to the King Tut exhibit at the local museum. Many of us want to hop on a plane and visit the actual pyramids. When you want to take a vacation, are you satisfied to go to a web site, stare at pictures of wondrous, far away places, and only imagine what it is like to be there? Of course not! No, you want to go to that place and experience all that it has to offer. That's partially why we have a space program today and why space tourism is inevitable."

We want to go there. Sending an unmanned probe first is a good start, but sooner or later we'll want to go there ourselves. Then what? Dr. Lembeck continued:

"*And then what will happen after we make those inevitable discoveries? Analogy may finally help us here. What has become of those early frontiers opened by Columbus and fellow explorers like Lewis and Clark? Look around! Most of the easy to get to, over the horizon, around the corner, types of frontiers are now covered with parking lots.*

That's right, parking lots.

Wal Mart parking lots.

Filled with cars. Cars driven by real people, with real jobs, spending real money, pumping our economy. And that economy provides the means to pay for the parks for our kids to play in, it pays for our national security, and it pays to fix the damage caused by Rita and Katrina.

Some of those people even work in aerospace, making real salaries right here in Houston. I didn't see a Brinks truck with all of the money being spent on the space program tucked into the last Shuttle cargo bay, being rocketed into space, never to be seen again. No, a good chunk of the space program's budget was spent right here by you and me at the former western frontier now occupied by the Clear Lake Wal-Mart.

After we have the infrastructure to reliably get off the planet, we will make those inevitable discoveries on the moon. And those discoveries will be closely followed by opportunities for commerce. And more parking lots. And maybe a pub or two. "

The entire text of Dr. Lembeck's lecture can be read at, www.aiaa-houston.org.

Local Industry News and Announcements

NASA TO TEST ADVENT METHANE ENGINE

10/20/2005 - NASA has requested an Advent Launch Services 18,000 pound thrust methane fueled rocket engine for a test item to verify the modification of their rocket engine test facility. They are converting one of their facilities from hydrogen to methane.

Advent Launch Services has promoted the use of methane for a rocket fuel for almost 10 years. Replacing the conventional hydrogen fuel with methane reduces the size and cost of the tank significantly. However, the change was not seriously considered until the lunar and mars mission requirements were recognized.

The lunar and mars missions require long storage of the propellant. Cryogenic methane is much easier to isolate thermally than hydrogen. The reduced size of the tank and the higher temperature of methane are the key factors.

Also, there is a possibility that methane may be available at the destination sites. Not having to carry along fuel for the return flight is a very significant factor. Hydrogen may also be available at the destination sites but the preparation of hydrogen for use as rocket fuel is much more complex than the preparation of methane.
NASA is planning a very complete test of the Advent engine to verify all of their test capabilities at the modified facility. The data will be of great value to both Advent and NASA.

[Source: Advent Launch Services, www.adventlaunchservices.com]

SPACEHAB RECEIVES PERFECT SCORE ON NASA CONTRACT

Houston, Texas, November 29, 2005 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, announced today that NASA's Performance Evaluation Board bestowed a 100% award fee evaluation score on the Program Integration and Control contract for which the Company is a subcontractor. The performance period was April through September 2005.

SPACEHAB began work on the International Space Station Program Integration and Control (PI&C) contract in November 2003 as a subcontractor to the ARES Corporation. The evaluation is a performance-based assessment, specifically in the areas of technical performance, contract management and cost control, and is generally provided every six months. The evaluation board noted that the PI&C team had "exceeded expectations" and displayed "exceptional professionalism and dedication."

For more information, see www.spacehab.com
[Source: SPACEHAB]

SPACEHAB ELECTS BOARD OF DIRECTORS AT ANNUAL MEETING

Houston, Texas, December 1, 2005 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, announced today that all matters put forward by management for consideration by shareholders were overwhelmingly approved at the December 1, 2005 Annual Meeting of Shareholders.

In particular, management's slate of directors was confirmed, which included eight members from the pervious year's Board. The following members of the Board representing shareholders of the Company's common stock were re-elected for the period ending at the close of the next annual shareholders meeting: Chairman Shelley A. Harrison, Edward E. David, Jr., Michael E. Kearney, Roscoe M. Moore, III, Thomas Boone Pickens, III, James R. Thompson, and Barry A. Williamson. Stefan Graul, as the director representing shareholders of SPACEHAB's preferred stock, was also re-elected.

For more information, see www.spacehab.com
[Source: SPACEHAB]

SPACEHAB PENS AGREEMENT WITH EUROPEAN FIRM

Houston, Texas, December 8, 2005 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading space access provider, announced today that it has signed an agreement with Netherlands-based HE Space Operations to market SPACEHAB's commercial space services throughout Europe.

Through the representation agreement, the companies committed to work together on European space initiatives addressing government and commercial customers. The arrangement establishes HE Space Operations as a European-registered entity representing SPACEHAB in offering commercial space access on European, United States, Russian and other space vehicles. This agreement is expected to increase SPACEHAB's business opportunities throughout Europe.

SPACEHAB and HE Space Operations have also entered into a Memorandum of Understanding regarding numerous areas of mutual interest. Benefits include an enhanced global exposure of SPACEHAB's extensive engineering and operations core competencies (e.g. payload processing, mission integration, and human factors), as well as increased access to SPACEHAB-provided research flight opportunities.

"This strategic alliance will create opportunities for SPACEHAB to provide commercial space access to a broad range of government, industry and academic institutions eager to engage in space-based research, technology development and industrial processing," said Michael E. Bain, SPACEHAB Chief Operating Officer. "HE Space Operations will help us open European markets to SPACEHAB commercial space services including spacecraft design and development, payload integration and operations, human spaceflight mission operations, as well as turn-key commercial space access on Russia's Soyuz and Progress, the European Space Agency's Auto-

(Continued on page 19)

(Continued from page 18)
mated Transfer Vehicle and SPACEHAB's own commercial carrier, Apex."

For more information, see www.spacehab.com
[Source: SPACEHAB]

SPACEHAB SUBSIDIARY AWARDED NEW $1.0 MILLION NASA CONTRACT

Houston, Texas, December 22, 2005 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, announced today that its Astrotech Space Operations subsidiary has been awarded a new contract by NASA/Kennedy Space Center to provide payload processing services from the Company's high-tech facilities in Titusville, Florida.

The contract, which is valued at approximately $1.0 million, is for the processing of NASA's THEMIS spacecraft. This new mission is part of the indefinite-delivery, indefinite-quantity (ID/IQ) contract that NASA awarded to Astrotech in September 2005 and has a total value of up to $4.9 million.

"We are pleased to be able to support yet another NASA research mission set to answer more questions about the development of our planet and the surrounding universe," stated Jim Royston, Deputy General Manager of Astrotech Space Operations. "With hundreds of successfully processed commercial spacecraft passing through our doors, it is exciting to have continued growth in our government sector initiatives."

For more information, see www.spacehab.com
[Source: SPACEHAB]

SPACEHAB SUBSIDIARY OBTAINS NEW BUSINESS

Houston, Texas, January 5, 2006 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, announced today that its Astrotech subsidiary will be providing payload processing services to Lockheed Martin's International Launch Services (ILS) for the ASTRA 1KR satellite.

ASTRA was initially set for launch on a Proton launch vehicle. With a recent change in the type of spacecraft model to be flown, a launch vehicle switch was made and the satellite will now fly aboard Lockheed Martin's Atlas V. SPACEHAB's Astrotech subsidiary in Titusville, Florida provides facilities and payload processing support for the Atlas program and will now open its doors to ASTRA and its team this February in order to support an April 2006 liftoff from Cape Canaveral Air Force Station.

"We welcome the ILS and ASTRA teams and we are excited about showcasing our recent facility upgrades that will help us exceed their payload processing needs as well as those of our other customers," stated Jim Royston, Deputy General Manager of Astrotech Space Operations. In support of ongoing government contracts, Astrotech has been able to increase its facility capabilities and is nearing completion of significant facility enhancements including advanced security capabilities, communications and cleanroom improvements, and the addition of a large capacity conference center.

or more information, see www.spacehab.com
[Source: SPACEHAB]

SPACEHAB TASKED TO SUPPORT NASA IN NEW SPACE STATION ACTIVITIES

Houston, Texas, January 17, 2006 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, announced today that NASA has awarded new work to the Company in support of International Space Station assembly and operations activities.

New requirements for the International Space Station have resulted in NASA's need to reprioritize the payloads set for launch on the STS-121 space shuttle mission currently set for liftoff in May 2006. These requirements have resulted in NASA engaging SPACEHAB's support, through its contract with Lockheed Martin, in removing and replacing equipment set for launch on the Company's cargo carrier being flown on this mission. SPACEHAB, in conjunction with EADS Space Transportation, will be incorporating the changes into the fourteen-month mission preparation process, of which just four months remain. The Company has been authorized approximately $500,000 for the first sixty days of this effort in support of NASA's mission objectives.

"One of the many advantages of using a commercially provided carrier and related services is our ability to quickly respond to the customers evolving needs, allowing us to again demonstrate our flexibility, capabilities, and responsiveness," stated E. Michael Chewning, Senior Vice President of SPACEHAB Flight Services. "Our external cargo carrier that rides in the shuttle's cargo bay is ideal for ferrying this needed space station equipment, and we have the capability to accomplish the cargo changeout, support the current launch schedule, and provide a high-value commercial solution to NASA."

For more information, see www.spacehab.com
[Source: SPACEHAB]

Northrop Grumman Expands Houston Operations, Looks to Local Businesses to Join Space Exploration Team

HOUSTON, Dec. 14, 2005 -- Northrop Grumman Corporation (NYSE: NOC), whose association with Houston began more than four decades ago during the Apollo program, is expanding its Houston operation to support the growing role of NASA's Johnson Space Center in developing the nation's next generation of human space exploration systems.

The expansion has the potential to bring 200 to 300 high-tech production, engineering and management

(Continued on page 20)

Public Policy

2006 Congressional Visits Day

NICOLE SMITH, PUBLIC POLICY

Raise the Image of Aerospace in Washington!

You're invited! Every year, AIAA members come to Washington, D.C. to take part in our annual Congressional Visits Day (CVD). Here, you'll meet with national decision-makers to discuss critical industry issues in civil aeronautics, civil astronautics, and defense.

Congressional Visits Day (CVD) brings scientists, engineers, researchers, educators, and technology executives to Washington to raise the visibility of and support for science, engineering, and technology. "Team captains" coordinate the event for their state's delegation, which is open to all who believe that science and engineering are the cornerstones of our Nation's future. The Day consists of a series of briefings and meetings with "your" Congressional representatives. What's our goal? Through face-to-face meetings with Members of Congress, congressional staff, key Administration officials, and other decision-makers, Congressional Visits Day raises their awareness of the long-term value that science, engineering and technology bring to America.

The 2006 CVD is scheduled for **4-5 April 2006** in Washington, D.C. Anyone who is interested in attending this year as part of the Houston Section contingency, please contact Nicole Smith at PublicPolicy@aiaa-houston.org.

For more information about AIAA Public Policy (including CVD and our Legislative Action Center), please visit:

www.AIAA.org/PublicPolicy

Local Industry news (cont'd.)

(Continued from page 19)
jobs to the region, while offering opportunities for local small, woman- and minority-owned businesses to become suppliers to a Northrop Grumman-led space exploration team.
That team, which includes Houston-based Boeing NASA Systems as Northrop Grumman's principal subcontractor, is currently under contract developing requirements and a conceptual design for NASA's planned Crew Exploration Vehicle (CEV), a successor to the space shuttle that will enable human exploration of the moon, Mars and beyond in coming decades.
More than a half-dozen Houston-area small businesses support the team's work on this Phase 1 CEV contract. If NASA selects the team to support the CEV development and production phase, the list of Houston-based suppliers could more than double. NASA expects to select a CEV prime contractor by summer 2006.

"Since the early 1960s, Northrop Grumman has played significant roles in the success of Houston's human spaceflight, oil exploration and information technology markets," said Jim Reinhartsen, president of the Bay Area Houston Economic Partnership (BAHEP). "Their participation and expanding interest in the economic development of Bay Area Houston will have a positive, 'trickle down' effect on our local service economy while helping to grow local small businesses that offer products and services relevant to human space exploration."

On Nov. 28, Northrop Grumman moved into a new 6,000-square-foot office complex it has leased near Johnson Space Center. The facility, which serves as the company's Houston headquarters, currently supports approximately 25 employees. Michael Lembeck, a former NASA official, serves as the director of operations for the new office. He is also a member of the BAHEP board of directors.

Northrop Grumman is also investing in Houston's space education community. In November, the company signed a three-year agreement with Space Center Houston to become the name sponsor for the center's giant-screen theater. The theater is used not only to present space-related educational films, but also as a venue for community events.

[Source: Northrop Grumman Corporation]

MARS HOUSTON BANQUET
Feb 16th 2006 5:30 to 10:00 PM
Gloria Dei Lutheran Church

The Mars Houston Banquet was established to recognize individuals who make important contributions towards the future exploration of the Moon, Mars, Asteroids, and beyond. It is at this annual banquet that we celebrate those individuals who toil for little or no payment, doing hard work in hope of receiving eternal glory. Join us as we recognize this year's award recipients, celebrating their efforts to push the envelope and to help us explore the mysteries of space and beyond. Mr. Joseph E. Palaia IV and his team members at the 4Frontiers Corporation and at the Mars Foundation are striving to open the space frontier for humanity. These dreamers have a vision which may hold the promise for the future exploration and settlement of the solar system. Mr. Palaia will be the keynote speaker at this year's banquet and will share this vision, explaining the steps 4Frontiers is taking to make it a reality.

Contact: BeBe Serrato
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bserrato@marshouston.org
http://www.marshouston.org/

Outreach and Education

Elves and More

LAURA SLOVEY, YOUNG PROFESSIONALS

This past December the AIAA Young Professionals and their friends volunteered to build bicycles with the Elves and More charity. This charity has been providing bicycles and gifts to local Houston children since 2002. During their first year, they gave away 1,000 bicycles to underprivileged children. This year, they reached their goal of providing hope to 25,000 children with the bikes and other various gifts. The AIAA Houston Section would like to thank all that volunteered and supported this worthy cause. Please continue to check the Young Professionals page at www.aiaa-houston.org/yp/ for future activities.

Mars Rover Competition

JOY CONRAD KING, PRE-COLLEGE CHAIR

The University of Houston held a Mars Rover Competition on Saturday January 21st. Over forty rovers were submitted from schools all over Houston. The rovers were constructed by teams of 1 to 4 students in grades 3-8 as part of a school project on Mars. The students determined a mission and landing location for their rover then built them with 'found objects' around the house. The rovers could also utilize an optional inexpensive solar powered or radio controlled kit. After extensive judging (including several AIAA and Mars Society members), awards were presented to the winners in each category by the Mayor's wife Andrea White. The Mars Rover Competition Committee was lead by University of Houston professor Dr. Edgar Bering.

CALENDAR

Dates, events, and times are subject to change. See the AIAA Houston web site for more information at: www.aiaa-houston.org

January

21	Mars Rover Model Competition (UH)
25	"State of the Center" Address by Mike Coats/NASA-JSC. JSC NMA Event with AIAA invited to participate as guests (Gilruth)
27	Lunch n' Learn: "Capability Maturity Model Integration" by Robert Vickroy/ESCG (JSC Bldg 16 Rm 111/113)
28	YP Outing: Houston Aeros (Toyota Center)

February

2	Lunch n' Learn: "Where Did That Equation Come From?" (Knowledge Capture) by John Goodman/USA (JSC Bldg 16 Rm 111/113)
6	Executive Council Meeting (ARES Corp.)
9	Dinner Meeting: "First Flight of a Mars Airplane" by Dr. Robert D. Braun/Georgia Tech & AIAA Distinguished Lecturer; Joint with USALA/NMA (Gilruth)
10	Lunch n' Learn: "Nanomaterials Applications for Human Space Exploration" by Padraig Moloney/NASA-JSC (JSC Bldg 16 Rm 111/113)
24	Engineers Appreciation Social – During National Engineers Week (Outpost)

March

2	Dinner Meeting: "Space Shuttle Orbiter Lessons Learned" presented by Boeing (Gilruth)
6	Executive Council Meeting (ARES Corp.)
10-12	Space Settlement Design Competition (JSC)
16	Dinner Meeting: "Saturn V Restoration Project at JSC" by Jee Skavdahl/Conversation Solutions (Gilruth)
TBD	AIAA Aerospace Historical Site Dedication at JSC

April

3	Executive Council Meeting (ARES Corp.)
4-5	AIAA's Congessional Visits Day (Washington DC)
12	Yuri's Night - World Space Party
27-29	Region IV Student Paper Conference (Texas A&M University, College Station)
TBD	"Space Trivia Night" (Gilruth)
TBD	"Spirit of Flight" Airshow (Lone Star Flight Museum, Galveston)
TBD	Texas A&M University Student Branch Banquet (College Station)

May

1	Executive Council Meeting (ARES Corp.)
5	"Space Day" Event
19	Annual Technical Symposium (Gilruth)
20	Career & Professional Development Workshop (Gilruth)
TBD	Mixer with the Mars Society - Houston Chapter

June

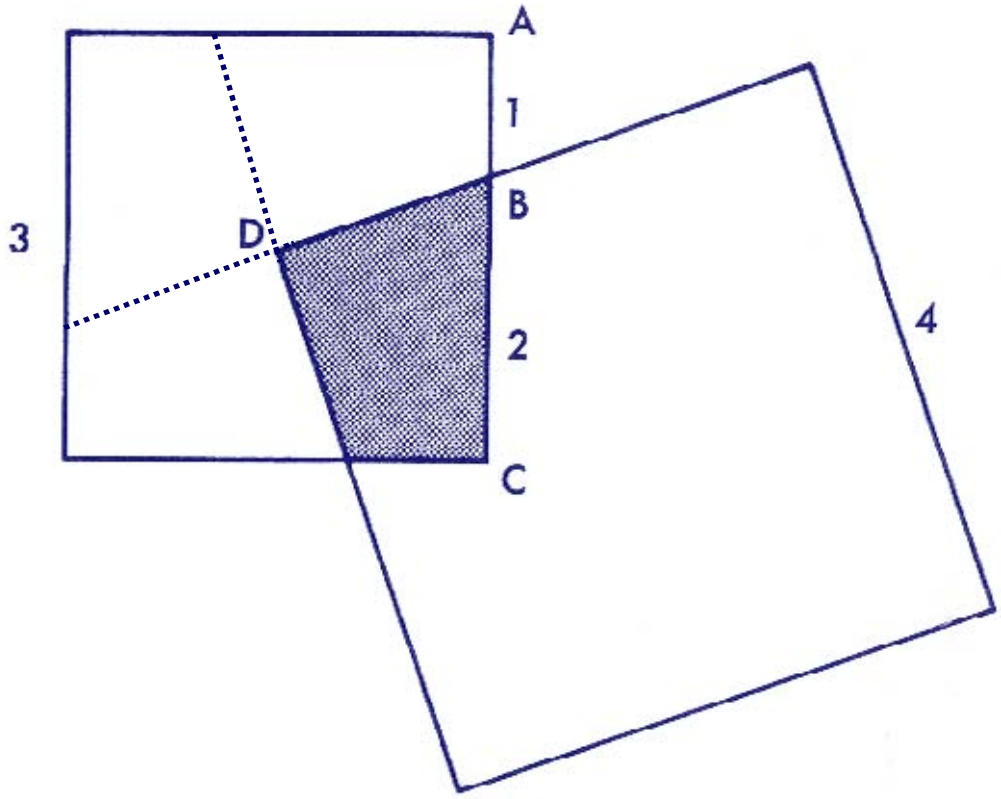
5	Executive Council Meeting (ARES Corp.)
22	Annual Honors & Awards Banquet: "SR-71 Blackbird – An Engineering Marvel" by Col. R. Graham/USAF Retired & AIAA Distinguished Lecturer (Gilruth)

Contact chair@aiaa-houston.org or events@aiaa-houston.org for further details.

Cranium Cruncher

BILL MILLER, SENIOR MEMBER

Last month's geometric puzzle was from Chapter 15 of Martin Gardner's Mathematical Magic Show (1971). AIAA members must enjoy abstract math – I got the largest response on this problem of any since I started writing the column. The problem was to compute the area of the shaded region in the following figure. Both figures are squares, and point D is at the center of the smaller square. The dashed lines were not in the original figure, but by adding them, it can be easily seen that the smaller square is divided into four congruent regions. Therefore the area of the shaded region is one fourth of the total area, 9/4 or 2.25.

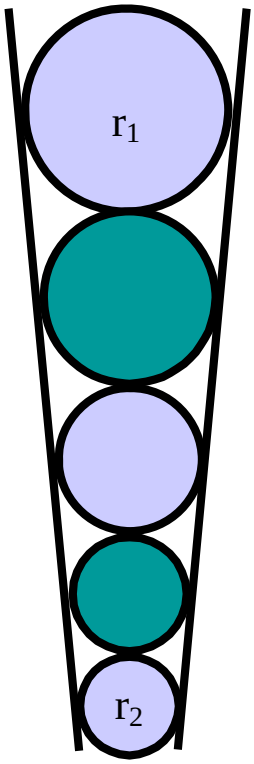


Jason Hopper
Carl Scott
Brian Schoonmaker
Josh Gibson
Wendell Mendell
Steven Del Papa
Larry Jay Friesen
Glenn Jenkinson (extra credit for submitting three different correct methods)
Brian Johnson
David Dannemiller
Frank Baiamonte

Current Cruncher

Here's this month's puzzle.

Five spherical lunar samples of decreasing size are placed into a conical funnel. The investigator notices that each sample is in contact with the adjacent samples as well as with the wall of the funnel (all the way around the sample). The largest sample has a radius r_1 of 18 millimeters, and the smallest has a radius r_2 of 8 millimeters. What is the radius of the central sample?



Here is a (not-to-scale) sketch of the configuration.

Send solutions to Bill Miller at wbmiller3@houston.rr.com. The answer, along with credits, references, and names of the solvers, will be provided next time.

Odds and Ends

SPECIAL EVENTS, PICTORIALS, ETC. **THE GIMLI GLIDER**, *BY WADE NELSON* (REPRINTED WITH PERMISSION)

[Remember the "Gimli Glider"? *This is from an article published in Soaring Magazine by Wade H.Nelson* . It's still a great read, and an important lesson.]

If a Boeing 767 runs out of fuel at 41,000 feet what do you have? Answer: A 132 ton glider with a sink rate of over 2000 feet-per-minute and marginally enough hydraulic pressure to control the ailerons, elevator, and rudder. Put veteran pilots Bob Pearson and cool-as-a-cucumber Maurice Quintal in the cockpit and you've got the unbelievable but true story of Air Canada Flight 143, known ever since as the Gimli Glider.

Flight 143's problems began on the ground in Montreal. A computer known as the Fuel Quantity Information System Processor manages the entire 767 fuel loading process. The FQIS controls all of the fuel pumps and drives all the 767's fuel gauges. Little is left for crew and refuelers to do but hook up the hoses and dial in the desired fuel load. But the FQIS was not working properly on Flight 143. The fault was later discovered to be a poorly soldered sensor. A highly improbable, one-in-a-million sequence of mistakes by Air Canada technicians investigating the problem defeated several layers of redundancy built into the system. This left Aircraft #604 without working fuel gauges.

In order to make their flight from Montreal to Ottawa and on to Edmonton, Flight 143's maintenance crew resorted to calculating the 767's fuel load by hand. This was done using a procedure known as dripping the tanks. "Dripping" could be compared to calculating the amount of oil in a car based on the dipstick reading. Among other things, the specific gravity of jet fuel is needed to make the proper drip calculations.

The flight crew had never been trained how to perform the drip calculations. To be safe they re-ran the numbers three times to be absolutely, positively sure the refuelers hadn't made any mistakes;each time using 1.77 pounds/liter as the specific gravity factor. This was the factor written on the refueler's slip and used on all of the other planes in Air Canada's fleet. The factor the refuelers and the crew should have used on the brand new, all-metric 767 was .8 kg/liter of kerosene.

After a brief hop Flight 143 landed in Ottawa. To be completely safe, Pearson insisted on having the 767 re-dripped. The refuelers reporting the plane as having 11,430 liters of fuel contained in the two wing tanks. Pearson and Quintal, again using the same incorrect factor used in Montreal, calculated they had 20,400 kilos of fuel on board. In fact, they left for Ottawa with only 9144 kilos, roughly half what would be needed to reach Edmonton.

Lacking real fuel gauges Quintal and Pearson manually keyed 20,400 into the 767's flight management computer. The flight management computer kept rough track of the amount of fuel remaining by subtracting the amount of fuel burned from the amount (they believed) they had started with. Their fate was now sealed.

According to Pearson, the crew and passengers had just finished dinner when the first warning light came on. Flight 143 was outbound over Red Lake Ontario at 41,000 feet and 469 knots at the time. The 767's Engine Indicator and Crew Alerting System beeped four times in quick succession, alerting them to a fuel pressure problem. "At that point" Pearson

says "We believed we had a failed fuel pump in the left wing, and switched it off. We also considered the possibility we were having some kind of a computer problem. Our flight management computer showed more than adequate fuel remaining for the duration of the flight. We'd made fuel checks at two waypoints and had no other indications of a fuel shortage." When a second fuel pressure warning light came on, Pearson felt it was too much of a coincidence and made a decision to divert to Winnipeg. Flight 143 requested an emergency clearance and began a gradual descent to 28,000. Says Pearson, "Circumstances then began to build fairly rapidly." The other left wing pressure gauge lit up, and the 767's left engine quickly flamed out. The crew tried crossfeeding the tanks, initially suspecting a pump failure.

Pearson and Quintal immediately began making preparations for a one engine landing. Then another fuel light lit up. Two minutes later, just as preparations were being completed, the EICAS issued a sharp bong--indicating the complete and total loss of both engines. Says Quintal "It's a sound that Bob and I had never heard before. It's not in the simulator." After the "bong," things got quiet. Real quite. Starved of fuel, both Pratt & Whitney engines had flamed out. Pearson's response, recorded on the cockpit voice recorder was "Oh F___."

At 1:21 GMT, the forty million dollar, state-of-the-art Boeing 767 had become a glider. The APU, designed to supply electrical and pneumatic power under emergency conditions was no help because it drank from the same fuel tanks as the main engines. Approaching 28,000 feet the 767's glass cockpit went dark. Pilot Bob Pearson was left with a radio and standby instruments, noticeably lacking a vertical speed indicator - the glider pilot's instrument of choice. Hydraulic pressure was falling fast and the plane's controls were quickly becoming inoperative. But the engineers at Boeing had foreseen even this most unlikely of scenarios and provided one last failsafe&emdash;the RAT.

The RAT is the Ram Air Turbine, a propeller driven hydraulic pump tucked under the belly of the 767. The RAT can supply just enough hydraulic pressure to move the control surfaces and enable a dead-stick landing. The loss of both engines caused the RAT to automatically drop into the airstream and begin supplying hydraulic pressure.

As Pearson began gliding the big bird, Quintal "got busy" in the manuals looking for procedures for dealing with the loss of both engines. There were none.. Neither he nor Pearson nor any other 767 pilot had ever been trained on this contingency. Pearson reports he was thinking "I wonder how it's all going to turn out." Controllers in Winnipeg began suggesting alternate landing spots, but none of the airports suggested, including Gimli, had the emergency equipment Flight 143 would need for a crash landing. The 767's radar transponder had gone dark leaving controllers in Winnipeg using a cardboard ruler on the radar screen to try and determine the 767's location and rate of descent.

Pearson glided the 767 at 220 knots, his best guess as to the optimum airspeed. There was nothing in the manual about minimum sink - Boeing never expected anyone to try and glide one of their jet airliners. The windmilling engine fans were creating enormous drag, giving the 767 a sink rate of somewhere between 2000 and 2500 fpm. Copilot Quintal began making glide-slope calculations to see if they'd make Winnipeg. The 767 had lost 5000 feet of altitude over the prior ten nautical (11 statute) miles, giving a glide ratio of approximately 11:1. ATC controllers and Quintal both calculated that Winnipeg was going to be too far a glide;the 767 was sinking too fast. "We're not going to make Winnipeg" he told Pearson. Pearson trusted Quintal, and immediately turned north.

Only Gimli, the site of an abandoned Royal Canadian Air Force Base remained as a possible landing spot. It was 12 miles away. It wasn't in Air Canada's equivalent of Jeppensen manuals,but Quintal was familiar with it because he'd been stationed there in the service. Unknown to him and the controllers in Winnipeg, Runway 32L (left) of Gimli's twin 6800 foot runways had become inactive and was now used for auto racing. A steel guard rail had been installed down most of the southeastern portion of 32L, dividing it into a two lane dragstrip. This was the runway Pearson would ultimately try and land on, courting tragedy of epic proportions.

To say that runway 32L was being used for auto racing is perhaps an understatement. Gimli's inactive runway had been "carved up" into a variety of racing courses, including the aforementioned dragstrip. Drag races were perhaps the only auto racing event not taking place on July 23rd, 1983 since this was "Family Day" for the Winnipeg Sports Car Club. Go-cart races were being held on one portion of runway 32L and just past the dragstrip another portion of the runway served as the final straightaway for a road course. Around the edges of the straightaway were cars, campers, kids, and families in abundance. To land an airplane in the midst of all of this activity was certain disaster.

Pearson and Copilot Quintal turned toward Gimli and continued their steep glide. Flight 143 disappeared below Winnipeg's radar screens, the controllers frantically radioing for information about the number of "souls" on board. Approaching Gimli Pearson and Quintal made their next unpleasant discovery: The RAT didn't supply hydraulic pressure to the 767's landing gear. Pearson ordered a "gravity drop" as Pearson thumbed frantically through the Quick Reference Handbook, or QRH. Quintal soon tossed the QRH aside and hit the button to release the gear door pins. They heard the main gear fall and lock in place. But Quintal only got two green lights, not three. The nose gear, which fell forward against the wind, hadn't gone over center.

Six miles out Pearson began his final approach onto what was formerly RCAFB Gimli. Pearson says his attention was totally concentrated on the airspeed indicator from this point on. Approaching runway 32L he realized he was too high and too fast, and slowed to 180 knots. Lacking divebrakes, he did what any sailplane pilot would do: He crossed the controls and threw the 767 into a vicious sideslip. Slips are normally avoided on commercial flights because of the the tremendous buffeting it creates, unnerving passengers. As he put the plane into a slip some of Flight 143's passengers ended up looking at nothing but blue sky, the others straight down at a golf course. Says Quintal, "It was an odd feeling. The left wing was down, so I was up compared to Bob. I sort of looked down at him, not sideways anymore.

The only problem was that the slip further slowed the RAT, costing Pearson precious hydraulic pressure. Would he be able to wrestle the 767's dipped wing back up before the plane struck the ground? Trees and golfers were visible out the starboard side passengers' windows as the 767 hurtled toward the threshold at 180 knots, 30-50 knots faster than normal. The RAT didn't supply "juice" to the 767's flaps or slats so the landing was going to be hot. Pearson didn't recover from the slip until the very last moment. A passenger reportedly said "Christ, I can almost see what clubs they are using." Copilot Quintal suspected Pearson hadn't seen the guardrail and the multitude of people and cars down the runway. But at this point it was too late to say anything. A glider only gets one chance at a landing,and they were committed. Quintal bit his lip and remained silent.

Why did Pearson select 32L instead of 32R? Gimli was uncontrolled so Pearson had to rely on visual cues. It was approaching dusk. Runway 32L was a bit wider, having been the primary runway at Gimli in prior year. Light stantions still led up to 32L. And the "X" painted on 32L, indicating its inactive status, was reportedly quite faded or non-existent. Having made an initial decision to go for 32L the wide separation of the runways would have made it impossible for Pearson to divert to 32R at the last moment. Pearson says he: "Never even saw 32R, focusing instead on airspeed, attitude, and his plane's relationship to the threshold of 32L."

The 767 silently leveled off and the main gear touched down as spectators, racers, and kids on bicycles fled the runway. The gigantic Boeing was about to become a 132 ton, silver bulldozer. One member of the Winnipeg Sports Car Club reportedly was walking down the dragstrip, five gallon can full of hi-octane racing fuel in hand, when he looked up and saw the 767 headed right for him. Pearson stood on the brakes the instant the main gear touched down. An explosion rocked through the 767's cabin as two tires blew out. The nose gear, which hadn't locked down, collapsed with a loud bang.. The nose of the 767 slammed against the tarmac, bounced, then began throwing a three hundred foot shower of sparks. The right engine nacelle struck the ground. The 767 reached the tail end of the dragstrip and the nose grazed a few of the guardrail's wooden support poles. (The dragstrip began in the middle of the runway with the guardrail extending towards 32L's threshold) Pearson applied extra right brake so the main gear would straddle the guardrail. Would all the sports car fans all be able to get out of the way, or would Pearson have to veer the big jet off the runway to avoid hitting stragglers?

The 767 came to a stop on it's nose, mains, and right engine nacelle less than a hundred feet from spectators, barbecues and campers. All of the race fans had managed to flee the path of the silver bulldozer. The 767's fuselage was intact. For an instant, there was silence in the cabin. Then cheers and applause broke out among Flight 143's passengers. They'd made it; they were all still alive. But it wasn't over yet. A small fire had broken out in the nose of the aircraft. Oily black smoke began to pour into the cockpit. The fiery deaths of passengers in an Air Canada DC-9 that had made an emergency landing in Cincinnati a month before was on the flight attendants' minds and an emergency evacuation was ordered. The unusual nose-down angle the plane was resting at made the rear emergency slides nearly vertical. Descending them was going to be treacherous.

The only injuries that resulted from Pearson's dead-stick landing of Flight 143 came from passengers exiting the rear emergency slide hitting the asphalt. None of the injuries were life-threatening. The fire in the aircraft's nose area was battled by members of the Winnipeg Sports Car Club who converged on the plane with dozens of hand-held fire extinguishers. Pearson had touched down 800 feet from the threshold and used a mere 3000 feet of runway to stop. A general aviation pilot who viewed the landing from a Cessna on the apron of 32R described it as "Impeccable." The 767 was relatively undamaged.

Air Canada Aircraft #604 was repaired sufficiently to be flown out of Gimli two days later. After approximately $1M in repairs, consisting primarily of nose gear replacement, skin repairs and replacement of a wiring harness it re-entered the Air Canada fleet. To this day Aircraft #604 is known to insiders as "The Gimli Glider." The avoidance of disaster was credited to Capt. Pearson's "Knowledge of gliding which he applied in an emergency situation to the landing of one of the most sophisticated aircraft ever built." Captain Pearson strongly credits Quintal for his cockpit management of "Everything but the actual flight controls," including his recommendation of Gimli as an landing spot. Captains Pearson and Quintal spoke at the 1991 SSA Convention in Albuquerque about their experiences. Pearson was, at the time, still employed and flying for Air Canada, and occasionally flying his Blanik L-13 sailplane on the weekends; he has since retired to raise horses. Maurice Quintal is now an A-320 Pilot for Air Canada,and will soon be captaining 767's; including Aircraft #604.

Upcoming Conference Presentations by Houston Section Members

COMPILED BY THE EDITOR FROM AIAA AGENDAS

Information here is taken from preliminary AIAA conference agendas. As such, it is subject to change.

47th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conf.
14th AIAA/ASME/AHS Adaptive Structures Conf.
7th AIAA Gossamer Spacecraft Forum
2nd AIAA Multidisciplinary Design Optimization Specialist Conf.
8th AIAA Non-Deterministic Approaches Conference
Newport, Rhode Island, 1 - 4 May 2006

Keynote Lecture "Research and Engineering Challenges for STS-114 and Return To Flight", *Dr. Charles J. Camarda, NASA Johnson Spaceflight Center, Houston, TX*

Nonlinear Aeroelastic Analysis of a Wing in Nonzero Trims, *C. Nichkawde and T. Strganac, Texas A&M University, College Station, TX; and P. Beran, U.S. Air Force Research Laboratory, Dayton, OH*

Computational Modeling of Highly Flexible Membrane Wings in Micro Air Vehicles, *P. Seshaiyer, Texas Tech University, Lubbock, TX; and R. Gordnier, U.S. Air Force Research Laboratory, Wright-Patt. AFB, OH*

Effect of Material System on Non- Linearity in 2x2 Biaxial Braided Composites, *D. Goyal and J. Whitcomb, Texas A&M University, College Station, TX; A. Kelkar, North Carolina A&T State University, Greensboro, NC; J. Tate, Texas State University, San Marcos, TX*

Multiscale Analysis of Delamination of Carbon Fiber Textile Composites with Carbon Nanotubes, *J. Riddick, U.S. Army Research Laboratory, Hampton, VA; S. Frankland and J. Ratcliffe, National Institute of Aerospace, Hampton, VA; T. Gates, NASA Langley Research Center, Hampton, VA; D. Lagoudas, Texas A&M University, College Station, TX; E. Barrera, Rice University, Houston, TX; and J. Zhu, NanoRidge Materials, Inc., Houston, TX*

Modeling of Interface Behavior in Carbon Nanotube Composites, *A. Awasthi and D. Lagoudas, Texas A&M University, College Station, TX; D. Hammerand, Sandia National Laboratories, Albuquerque, NM*

(Student Paper) Micromechanics Modeling of Functionally Graded Interphase Regions in Carbon Nanotube- Polymer Composites, *G. Seidel and D. Lagoudas, Texas A&M University, College Station, TX; S. Frankland, National Institute of Aerospace, Hampton, VA; T. Gates, NASA Langley Research Center, Hampton, VA*

Using Microelectrodes to Pattern Particles in Liquid Polymers: An Experimental and Computational Study, *J. Boyd and J. Lee, Texas A&M University, College Station, TX*

Modeling of the Hysteretic Strain and Magnetization Response in MSMA, *B. Kiefer and D. Lagoudas, Texas A&M University, College St.*

Effect of Single Wall Carbon Nanotubes (SWNTs) on the Electromechanical Response of a Polyimide Nanocomposite, *S. Deshmukh, Texas A&M University, College Station, TX; C. Call, Virginia Commonwealth University, Richmond, VA; Z. Ounaies, Texas A&M University, College Station, TX; C. Park, National Institute of Aerospace, Hampton, VA; J. Harrison, NASA Langley Research Center, Hampton, VA*

Suppression of Limit Cycle Oscillations with a Nonlinear Energy Sink: Experimental Results, *W. Hill, T. Strganac and C. Nichkawde, Texas A&M University, College Station, TX; Y. Lee, G. Kerschen and D. McFarland, University of Illinois at Urbana-Champaign, Urbana, IL*

Processing and Characterization of Epoxy/SWCNT/Woven Fabric Composites, *P. Thakre and D. Lagoudas, Texas A&M University, College Station, TX; J. Zhu and E. Barrera, Rice University, Houston, TX; and T. Gates, NASA Langley Research Center, Hampton, VA*

An Experimental Investigation of the Effect of Thermal Shock on Damage in Cryogenic Composite Laminates, *B. Oh, Y. Kawatsuji, V. Kinra and D. Lagoudas, Texas A&M University, College Station, TX*

Fracture Toughness of Space Shuttle External Tank Insulation Foam, *V. Kinra and A. Ganpatye, Texas A&M University, College Station, TX*

Parallel Algorithm for Fully Nonlinear Aeroelastic Analysis, *J. Gargoloff, C. Nichkawde, P. Cizmas, and T. Strganac, Texas A&M University, College Station, TX; and P. Beran, U.S. Air Force Research Laboratory, Wright-Patterson AFB, OH*

Multiscale Analysis of Failure of Closed Cell Foams, *J. Sue and J. Whitcomb, Texas A&M University, College Station, TX*

Particle Impact Damping in the Horizontal Plane, *V. Kinra and B. Witt, Texas A&M University, College Station, TX*

(Student Paper) Development, Structure, and Application of MAST: A Generic Mission Architecture Sizing Tool, *J. Lafleur, C. Restrepo and M. Grant, NASA Johnson Space Center, Houston, TX*

Component Effective Modal Mass, *A. Majed and E. Henkel, Applied Structural Dynamics Inc., Houston, TX*

Processing of Lightweight Shape Memory Alloys Using Spark Plasma Sintering, *G. Majkic, T. Raizada and Y. Chen, University of Houston,TX*

Dynamic Behavior of Ferromagnetic Shape Memory Alloys, *S. Scoby and Y. Chen, University of Houston, Houston, TX*

An Overview of NASA's Probabilistic Debris Transport Activities for Shuttle Return to Flight, *R. Gomez, NASA Johnson Space Center, TX*

Thermal Protection System (TPS) Impact Experiments, *D. Grosch, Southwest Research Institute, San Antonio, TX; F. Bertrand, Jacobs Sverdrup, Houston, TX*

Shuttle- ISS Detailed Test Objective: Model Correlation - Development and Implementation, *T. Bartkowicz, S. McNeill and M. Kaouk, The Boeing Company, Houston, TX*

Alternative Techniques for Developing Dynamic Analysis Computer Models of the International Space Station and Orbiter Repair Maneuvers, *J. Granda, California State University Sacramento, Sacramaento, CA; L. Nguyen, NASA Johnson Space Center, Houston, TX*

AIAA Local Section News

Darby Cooper Recognized

Darby Cooper was recently recognized for his contributions to the Space Shuttle program and leadership in developing the Debris Transport Analysis capabilities. His technical abilities in conjunction with his problem resolution approach were responsible for the success of this project. He turned very complex issues into coherent, focused engineering processes, and turned the schedule into an aggressive yet flexible plan that addressed the Shuttle program's high expectations, and met NASA's need for analyses critical to return to flight. The Silver Snoopy pin presented to Darby was flown on STS-42.

Darby Cooper receives his award

Darby has also made significant contributions to AIAA as an active member of the AIAA Houston Section Executive Committee. He has served in numerous roles including: member and then chair of the Student Paper Competition (SPC) Committee; Membership Committee Chair; Program Committee Chair; and Houston Section Chair-Elect, Chair, and Past-Chair.

Mike Mott Remembered

From the Being press release:

Mike Mott, Boeing Vice President and General Manager of the NASA Systems business unit passed away on Saturday, Nov. 19, following a courageous battle with cancer.

"Mike will be remembered for his strong leadership, his patriotism and service to his country, his unfailing support of the U.S. space program and his commitment to family, friends, coworkers and customers," said Jim Albaugh, president and CEO, Boeing Integrated Defense Systems. "All of us at IDS are deeply saddened by his untimely death and offer our sympathy to his family and many friends around the world."

Mike was an ardent supporter of NASA's Vision for Space Exploration and firmly committed to ensuring a safe Space Shuttle return to flight, full assembly of the International Space Station, return to the Moon, and future missions to Mars and other destinations.

Mike was a senior member of the Houston section of AIAA, and was very supportive of the section. He was our dinner meeting speaker on Feb. 11, 2003 speaking on Boeing's civil space programs.

FAA Requests Feedback to Proposed Commercial Spaceflight Rules

The FAA is requesting feedback on its Commercial "Human Space Flight Requirement for Crew and Space Flight Participants" proposed rules. The requirements can be reviewed at

http://ast.faa.gov/files/pdf/Human_Space_Flight_NPRM.pdf

An additional fact sheet can be found at

www.faa.gov/news/news_story.cfm?type=fact_sheet&year=2005&date=122905.

The Houston Section Public Policy Committee requests inputs from the members to compile a unified voice on this issue. Please submit any comments you may have on the new rules to publicpolicy@aiaa-houston.org by 27 January 2006.

Volunteers Wanted for the AIAA Houston Section 2006 Annual Technical Symposium

The 2006 Annual Technical Symposium is scheduled for May 16 at the JSC Gilruth Center. Last year this event attracted an audience of 200, representing over 25 different NASA and contractor organizations. The AIAA Houston Section is currently forming the 2006 ATS planning committee. We are looking for volunteers for both the pre-event planning and for the day of the symposium. Please contact our Vice Chair-Technical at vicechair-tech@aiaa-houston.org if you are interested in volunteering.

John Keener Moves to Georgia

After working in JSC community since 1979 on various human spaceflight projects, John Keener (Vice Chair – Operations) has elected to spread his wings by accepting a work transfer to Lockheed Martin Aeronautics – Georgia. There John will be a key member of the C-5 Galaxy service life extension team. Everyone in the Houston Section wishes him well in his new position and thanks him for his many years of service to the Houston Section as newsletter editor and in various other roles.

As a result of John's departure, the Houston Section is looking for candidates to fill through June 30, 2006 the role he is vacating on the Executive Council, that of Vice Chair – Operations. Responsibilities of this position include oversight of 14 Operations Committees that range from Pre-College Outreach, Professional Development, Public Policy, to Integrated Communications. More detail on this position can be found at www.aiaa-houston.org/pd. This is a key position allowing networking with many area professionals and honing of one's leadership and project management skills. All interested parties should contact chair@aiaa-houston.org for additional details. In addition, the Houston Section is also looking for Officer Candidates for the next term which starts July 1st, and the Nominating Committee charged with these upcoming elections. Please use the same e-mail as above if interested in serving.

Assistant Newsletter Editor Sought

An assistant newsletter editor is being sought. Interested parties should contact the newsletter editor at editor@aiaa-houston.org.

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www.aiaa.org

Select the AIAA membership option.