VISION 2001: FUTURE SPACE

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Chairman **ROHRABACHER.** Today we have four witnesses who will present testimony, examining issues as far-reaching as the physics of space travel, to the possible reality of making our science fiction fantasies a reality, and we are anxious to hear what they have to say. . .

We have with us as lead off witness, a doctor, a doctor, just, I just call him Buzz, we all call him Buzz, Dr. Buzz Aldrin, the President of Starcraft Enterprises. And Buzz was marveled as a man who has walked on the Moon, but he has authored several science fiction novels, and non-fiction books, as well. And he is a man who commands respect throughout this world, wherever he goes.

And he especially commands the respect of this Committee, and this Committee Chairman. And we were anxious, frankly, Buzz Aldrin came to me with the idea of trying to have, not just a hearing on the details, but a hearing on vision, and to try to get a good way to kick off this new Congress, and to have a better understanding of the potentials for space.

So, I thank him, first off, for suggesting to me that we have this hearing, and I want to welcome you, Buzz, here to testify today. You may proceed.

STATEMENT OF BUZZ ALDRIN, PRESIDENT, STARCRAFT ENTERPRISES

Mr. **ALDRIN.** Mr. Chairman, I really want to thank you very much for giving me this opportunity, and it is a great privilege to speak in front of all the members here who represent our body that determines what our future in space should be authorized to do, especially Congressman Hall, and the Chairman of this.

Vision 2001. I would like to mention that I am not going to speak about science fiction today, I hope. Even although it did offer a great opportunity in visiting Arthur C. Clark in 2001 less than a month ago. We shared some very interesting discussions.

I would like to excerpt a few remarks from my testimony, and I will be referring to it, and you may want to refer to it also, as I go through some of the visuals that I have.

Forty years ago, on Thursday, April 12th, Yuri Gargarin became the first human to use—to see the Earth from space, an event that sparked President Kennedy's commitment to put an American on the Moon. Next month will mark the fortieth anniversary of that historic speech.

Kennedy belonged to the so-called "Greatest Generation"—people who were willing to accept risk and sacrifice, as their last great gesture, they put humanity on the Moon.

One thinks of the dying lieutenant's last two words to Private Ryan: "Learn this."

We stand at the threshold of a new renaissance, what a time to be alive. Today's young will live to see settlements in space, unlimited energy from fusion, and explosions of knowledge on all frontiers.

The only obstacles to that future are complacency and a lack of commitment.

Risk has always been the price of any successful venture.

The Apollo program showed not only what humanity can achieve with strong leadership and solid commitment, but also the capacity of such pursuits to arouse public participation and inspire a sense of purpose. History will remember the inhabitants of the last century as the people who went from Kitty Hawk to the Moon in 66 years.

On page five of my testimony I have five recommendations. I will just briefly mention those. The highest priority of NASA and Congressional support must be to develop lower cost to orbit systems.

Second, to eliminate the stifling regulations and procedures that hamper so many of us.

Third, charge NASA with investigating lower cost transportation systems, to reduce the cost by factors of two or three, rather than order of magnitude cost reduction improvements.

Four, focus NASA and the private sector on the near-term objective of flying "people" in space, and thoroughly assess the impact of flying tens of thousands of prospective paying passengers on the development and evolution of the next generation of launch vehicles.

Finally, we should charge NASA to study recommendations. These recommendations including the reusable cycling transportation system that I have described in my written testimony. And that is very suitable for the economic exploration of the Moon and Mars.

If we can show a video now.

This is a system of a reusable first stage. What you are seeing now is a dual launch of a Booster B. I think that what we need is a two pillar architectural system, consisting of two stage to orbit, booster and an orbiter, that come in three sizes: small, medium, and large. And I think we may be clear just what those are.

This, I also have a model here that shows the booster medium, with an orbiter medium, external hydrogen tank.

The booster separates at about mach five and a half, or six; so that they can by-pass very expensive thermal protection systems, for heat seek aluminum.

The booster now, when it is empty of fuel, it re-enters the atmosphere 200 or 300 miles down range. Because it is staged at that minor velocity, the booster small, we are talking about, stages at about mach 3, as does this booster if we use it singly, with an upper stage expendable.

In the stage it has to be, after it turns back for the landing site it does not need to have jet engines to fly it back, it can glide back. Making it much simpler when it stages at that lower velocity.

As I mentioned the two pillar system that I propose is two stage to orbit, small, medium, and large; and then the development of a shuttle-derived, tank, habitat, heavy-lift vehicle. We want to land this at about 150 knots, and shortly you will see that the very significant feature that we have designed into this reusable first stage, and that is a removable propulsion module.

If you remember the early, the jet fighters, F–80's, F–86's, the tail section came off, you take the engine out, put it in overhaul, because it is not reliable, and put a new one in, and then go fly the airplane again.

We think we are at that stage right now. Rocket engines are just not as reliable as they should be. 95% perhaps, manned vehicles.

Now, I have a few other videos that I can explain to you, but let me just show again the orbiter, with the external fuel tank, external hydrogen, that is a space shuttle main engine. And this is an Atlas III rocket, with a two Russians Harvey 180 engines. Very light-weight structure on the Atlas.

This is about the size of the 737, and it is a booster medium. The booster small is about the size of an F-15. Again, it has a Russian engine in it, because they've been developing engines.

That medium—that small booster can boost various Air Force micro payloads into orbit, with expendable upper stages. It can also replace the solid rockets of both EELV's, both the Atlas V and the Delta IV, as the Air Force moves into reusable components. Of course you know that Lockheed has dropped out of launching EELV's from the West Coast, and they have also decided not to proceed with the heavy-lift version.

This is a very busy chart, but what it shows here is 4 year periods of implementation, up through 2021. A very modest start. We look at the stretched ET, with the hydrogen tank and two cylindrical oxygen tanks, and then the existing o-drive tank. So when we launch it into orbit, with solid rockets, and a side mount engine, but without an orbiter, we now can use those upper volume of empty hydrogen tanks that are connected to the wet oxygen/hydrogen tanks.

Sky Lab, when it put up—with just three people put up the empty third stage hydrogen tank, the second stage put it up. The big volume, up there, right along with it, but we didn't use it. We didn't make an attempt to, because we could only put three people up there. In the future, when we want to put large habitats in orbit, this is the kind of system. And I am referring down here to looking at this initially, and then augmenting the present ISS, with a half module, which we have postponed at this point, and we may accept a half module that goes unto the Russian portion of the station.

This is a crew ejectable, recoverable vehicle, that goes onto the orbiter medium. By that I mean that the crew section, up here, is ejectable. That also can be used as a life boat at the space station. Instead of having one that only goes up and down inside the shuttle, many of the systems can be economized by not making a dead-ended system, but by having something that also allows abort from any point during the assent trajectory.

We have—the orbiter large, it replaces the present shuttle for fuel and cargo, and versions of that, and the same analogy with the KC-135 was implemented as a tanker for the Air Force, because we had a version that supplied the civil needs of transferring from propeller airlines to jet airlines. So the KC-135 and the 707 were developed together, just like the next generation shuttle for NASA should have

versions of it that take people into space.

The entire complexion of the space program changes with high-volume traffic. That is what I believe we need to study.

These habitats that I have talked about support the L-1 port, and allow lunar landings with the orbiter medium, going to the L-1 port.

The same analogy, in essence, gives us cyling space ships that go to Mars.

This is the family of first stage, this is medium. Medium, first stage boosters. And Athena II, and it moves up to a Centaur initial from orbit, and Titan from orbit, but it qualifies as a propulsion system that goes with the orbiter.

This is an orbiter, the present orbiter with the booster heavy, which we justify to upgrade the present shuttle system. And during the transition period we are then developing the orbiter large, which goes with the booster large. So we have a transition from the present shuttle system to the next shuttle system.

These are the tanks down here that form the basis of the other part of the architectural stretch. Oxygen tanks on top, in place of the cargo that we would need eventually, to send cargo to the Moon, and to Mars.

There is way more on these charts, and I welcome you to study them as part of the testimony. There is also a series of charts at the end that show 4 year periods, what can be done in the 4 year periods that coincide with the 4 years of the executive branch of the government. They start at about 6 months into an executive President's term, and they carry on.

What I would envision is that you look ahead 16 to 20 years, and then each time you look at this, and update what it is that you want to be doing.

We need, I believe, an integrated plan into the future, something that can be accelerated if there is a loss of an orbiter.

I don't believe that NASA has a very good plan right now for what if we lose another orbiter.

This is a plan. There are many others. This is not a high-technology plan, it is one that can be modified as we move along. It is not revolutionary, it is evolutionary.

Thank you very much, Mr. Chairman, for your time.

[The prepared statement of Dr. Buzz Aldrin follows:]

PREPARED STATEMENT OF DR. BUZZ ALDRIN

VISION 2001: FUTURE SPACE

Forty years ago this coming April 12th, Yuri Gargarin became the first human to see the Earth from space, an event that sparked President Kennedy's commitment to put an American on the moon. Next month will mark the fortieth anniversary of that historic speech.

Kennedy belonged to the so-called "Greatest Generation"—people who were willing to accept risk and sacrifice, who had a vision of something larger than themselves, who abided depression and war and left America a colossus astride the Earth. As their last great gesture they put humanity on the Moon.

One thinks of the dying lieutenant's last two words to Private Ryan: "Earn this." In our attempts to create a risk-free society, we've often failed to honor that debt. There is a failure of nerve in postmodern society. We seem to have reached a crossroads similar to that of sixteenth-century Europe on the eve of expansion into the New World—a crisis now more ominous than the cold war threat that compelled Kennedy's commitment. On the one hand, there is a loss of vigor, a spreading irrationalism, and a collective hypochondria that seems to cripple our larger visions. Funding for basic research and development continues to decline, while the dream of space exploration succumbs to the dream of animal comfort. "Where there is no vision," says the proverb of Solomon, "the people perish."

On the other hand, we stand at the threshold of a new Renaissance, a moment much like the morning of the modern age when most of the globe lay deep in mystery. What a time this is to be alive! Today's young will live to see settlements in space, unlimited energy from fusion, and explosions of knowledge on all frontiers—from the workings of the brain to the origin and nature of the cosmos itself.

The only obstacles to that future are complacency and a lack of clear commitment. If we insist that the human quest await the healing of every sore on the body politic, we condemn ourselves to stagnation. In the long run, the whole politics of society is more profoundly changed by a new sense of human potential than by any amount of obsessive self-maintenance. Like all living systems, cultures cannot remain static; they evolve or decline. They explore or expire. They take risks.

Risk has always been the price of any successful venture—whether it be our migration out of Africa into the northern ice, the discovery of the New World, the shaping of a continent, or the preservation of that new freedom. The continued exploration of the solar system is a challenge that can bind together nations, inspire youth, advance science, and ultimately end our confinement to one vulnerable world. Beyond all the political and economic rationales, momentous as they are, spaceflight is a spiritual quest in the broadest sense, one promising a revitalization of humanity and a rebirth of hope no less profound than the great opening out of mind and spirit at the dawn of the modern age.

The Apollo program showed not only what humanity can achieve with strong leadership and solid commitment, but also the capacity of such pursuits to arouse public participation and inspire a sense of purpose. Three decades after the event, people still feel compelled to tell me exactly where they were at the moment I walked on the moon. Yet history will remember the inhabitants of the last century as the people who went from Kitty Hawk to the moon in 66 years—only to languish for the next 30 in low-Earth orbit.

If we are to resurrect the profound feeling of participation that accompanied Apollo we will need a Kennedy-like commitment to

human exploration, which must begin with a permanent and profitable presence in space. This is why I've been intensely involved in an effort to put citizens on the Shuttle by lottery, and to develop cost-effective, reusable boosters to take tourists into space and foster the birth of an expanded "hospitality" industry in orbit. A new generation of space vehicles can carry private citizens to orbiting hotels, settlers to the moon and Mars, and waves of explorers to the far reaches of the solar system.

Beyond robotics and Earth-serving space stations lies the infinite journey. But within a two or three decades, space can be an open frontier for all people. I see a near-term future where economical, two-stage space launchers place paying passengers and cargo into Earth orbit with the efficiency and routine-like nature of today's airline traffic. A booming tourism industry will be cultivated as space hotels become a point-of-arrival and departure above our planet. This burgeoning business enterprise will bring about heavy-1ift rockets enabling grander civil steps of exploration, back to the Moon, to the distant dunes of Mars, and beyond.

I further envision long-haul transportation systems, deep space cruisers that not only continuously cycle tourists between the Earth and Moon, but constantly transfer explorers and settlers between Mars and the Earth. A fully reusable lunar and interplanetary system is the ultimate way of transporting people and cargo across the vast vacuum void of space.

But how do we get there from here? I see an action plan for the future—a plan based on years of training and experience this country so graciously invested in me.

As our next step in space, lowering the cost of space access with a reusable two-stage-to-orbit launcher is critical. The first step is the incorporation of a Reusable First Stage into our space architecture. Sized properly, it will be a commercially competitive workhorse. It will hurl another rocket-powered vehicle, with payload, allowing it to reach space with greater economy than if purely self-propelled. By dropping the expense of attaining Earth orbit, many new industries are waiting to develop, one of which will be space tourism. Soon, tens of thousands of citizens will have the opportunity to travel into

space, gaining a sense of "participation" in opening the frontier of space to enterprise, exploration and settlement.

From this step, an add-on to the reusable space program philosophy is building a "bridge between worlds." Through a system of reusable spacecraft that I call "Cyclers", traffic routes—first between Earth and the Moon, then Mars and Earth—should be put in motion. Very much like ocean liners, the Cycler system would perpetually glide along predictable pathways, moving people, equipment, and other materials to and from the Earth over inner-Solar System mileage. A sequential buildup of a Full Cycling Network could be in place within two decades of a go-ahead, geared to the maturation of lunar and Mars activities. The Earth, the Moon, and Mars will form a celestial triad of worlds—busy hubs for the ebb and flow of passengers, cargo and commerce traversing the inner-Solar System.

My schedule for accomplishing these objectives is practical, achievable and affordable, drawing from decades of space expertise already honed by our early exploits, including the Space Shuttle and International Space Station projects.

I call for a strong and vibrant space tourism business and a return to the Moon by 2015, then reaching Mars by 2020. The common link between steps in this timetable is a progressive set of reusable boosters, reusable access to space, then reusable interplanetary Cyclers.

This vision spans two decades of enterprise, exploration and settlement. Ideally, it should be enunciated by the new U .S. President on the upcoming fortieth anniversary of President Kennedy's space commitment speech. By the year 2030, I see the same people looking back and cherishing the moment that a leader of our country committed us to a gradual, but progressive plan of permanent settlement of space, not just occasional visits that leave little more than flags and footprints.

The surface area of Mars is equivalent to the land area of Earth. Once a human presence on this planet is established, a second home for Humankind is possible. A growing settlement on Mars is, in

essence, an "assurance" policy. Not only is the survival of the human race then assured, but the ability to reach from Mars into the resource-rich bounty of the Martian satellites and the nearby asteroids is also possible. These invaluable resources can be tapped to sustain increasing numbers of Martian settlers, as well as foster expanded interplanetary commerce and large-scale industrial activities to benefit the home planet—Earth. Of course, some will insist on building outer-Solar System Cyclers as humanity continues outbound into the Universe at large.

My vision is a call for a sustained space program. We can now chart a course that returns us to the Moon, then allows humanity to strike out for the New World of our future—the planet Mars. But our near-term space efforts, both manned and robotic missions, must be tailored to support the longer-range purpose of opening the frontier. Step by step, program by program, we can construct a future of limitless potential. I must ask you gentlemen, if not for these bold endeavors, then what is our space program for?

Please allow me to address five significant points that Congress, as a governing oversight body, can do to help guarantee the vision I have described here today can come to fruition for future generations.

First, the highest priority of NASA and Congressional guidance of NASA's activities must be to develop lower cost to orbit systems. Congress should continue its leadership role in this direction by expanding the spectrum of development options to now include two-stage-to-orbit systems beginning with a rationally sized, commercially competitive, Reusable First Stage vehicle.

Second, continue to identify and eliminate stifling regulations that inhibit the private sector from competing in the commercial launch vehicle market to facilitate the development of lower cost space transportation options.

Third, charge NASA with investigating an expanded scope of lower cost space transportation system options to include those options that promise to reduce costs by factors of two or three rather than to focus exclusively on only order of magnitude cost reduction improvements.

Fourth, focus NASA and the private sector on the near-term objective of flying ''people'' in space and thoroughly assess the impact of flying tens of thousands of prospective paying passengers on the development and evolution of next generation of space transportation systems and new orbital industries.

And finally, charge NASA to study in depth these recommendations including the reusable cycling transportation system I have described for economical exploration and development of the moon and Mars.

Chairman **ROHRABACHER .** Thank you very much, Buzz. And I have talked to Buzz on several occasions about this, and I will say that the first time you hear this it seems a little confusing. It took me three times before I caught the genius of this. And let me just say that we appreciate you sharing this with us today, and I would ask that the members pay very close attention, and it takes some study, but the modularization and the long-term strategy is there, and we appreciate you sharing that with us today.