

## **POSITION STATEMENT**

# **Low Cost Access to Space**

**(Approved by the IEEE-USA  
Board of Directors, 14 February 2014)**

The goal of deep reductions in the cost of access to space should receive much greater priority, energy and substantive technical leadership than it does today in the United States. The key barriers are technical in nature, and warrant new incentives from the public sector to bring out the full capabilities of the private sector. There is one key number – dollars per pound to low earth orbit (\$/pound-LEO) – which will have a driving effect on everything we try to do in space, now and in the future. A long-range marginal cost of access to space, of \$200/pound-LEO, is of special and urgent importance now because:

- 1) With the retirement of the space shuttle, the United States must buy passage on foreign rockets to send people to the International Space Station (ISS).
- 2) The United States is working on a replacement for the shuttle. Commercial launch and space launch systems are being developed, but it is time to aim for a new solution with lower costs for the future.
- 3) The United States risks losing its ability to achieve deep cost reductions due to the disbanding of key research groups and the retirement of experienced engineers. New incentives and investments are needed to re-establish key endangered technologies, including hot structures for re-entry and advanced propulsion systems.

Currently there two competing approaches for access to space in NASA programs:

- The Space Launch System (SLS), proposed by the United Launch Alliance, which revisits the Ares concept of “Apollo on steroids” using large-scale expendable rockets; and
- Commercial Off the Shelf (COTS) services provided by competing launch suppliers like Space X , that develop their own reusable vehicles using private investment capital.

Because of the high costs of large-scale expendable rockets, IEEE-USA calls for a major redirection of the SLS effort to include the use of more advanced technology. Whatever room that may exist for incremental progress with expendable rockets, the chances are slim for reaching \$200/pound-LEO.

Experience with COTS suggests that we can move our launch service purchases to American companies like Space X much sooner than we can build a new heavy launcher. Expendable rockets, on the other hand, offer a major opportunity to save money while we work to develop a more reusable launch system.

## **RECOMMENDATIONS**

To accomplish these objectives, IEEE-USA recommends that

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- Crucial systems studies be conducted to identify technical and other barriers that delay benefits from current programs
- The United States invest in a strategy to reduce space launch costs to \$200/pound LEO and enable American companies to re-establish endangered technologies, including passive hot structures and advanced propulsion technologies
- NASA and the Administration fund a restructured version of SLS using an innovative approach that addresses crucial cost factors, considers the lessons of the past, and explores other options on a competitive basis
- The U.S. government continue to sponsor long-range programs to exploit novel technologies like those recommended by the Institute of Advanced Studies, Bigelow Aerospace and the 100-Year Starship Venture
- There be a major effort to integrate civilian space activity into the National Aerospace System (NAS) and to incentivize greater use of standardization and commercial off-the-shelf components and vehicles
- Incidental costs associated with the development and use of commercial launch vehicles be borne by their owners and users.

To maximize the possibility of getting to \$200/pound-LEO, crucial cost factors must be controlled by:

- Emphasizing total reusability
- Reducing vehicle manufacturing costs by using the assembly-line model that the private sector uses to produce civilian aircraft
- Minimizing operational costs by adopting the commercial aeronautics industry model

This statement was developed by the IEEE-USA Committee on Transportation and Aerospace Policy and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of the more than 210,000 engineers, scientists and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of the IEEE or its other organizational units.

## **BACKGROUND**

The original NASA analysis which led to the design of the space shuttle remains as valid today as it was in 1979. During the early stages of the Ares program, it was suggested that a new generation of expendable rockets could be developed less expensively than the recent, partially reusable shuttle was. The actual experience with Ares disproved that claim. More importantly, when OMB evaluated the original NASA proposal for a fully reusable shuttle [1], the agency agreed that the marginal cost per mission would have been far less with that system than with the modified version recommended by the White House. We are still paying today for not moving the US to a much lower \$/pound-LEO [2, 3].

The challenge of low cost access to space has short-term and long-term aspects. Some advocates call for more spending on 1960's vintage technologies. Others call for a fundamental re-examination of the laws of physics for the sake of inter-stellar travel. Both of these perspectives deserve support, but the key target for low cost access to space in the coming decade should be \$200/pound-LEO. This objective is achievable using well-established technologies [4]. There are two issues here:

- 1) only by setting an ambitious and achievable target can we break out of the downward cycles caused by incremental thinking of the past
- 2) we need an ambitious target to justify preserving and upgrading the key technologies necessary for deeper cost reductions in the future

Today's global aviation package delivery costs are already approaching the \$200/pound range. With applied engineering, comparable space package delivery costs are also achievable. These costs should be low enough that additional uses of space will be possible that are simply not economical today.

To achieve this goal, we have to understand the limits of the useful, short-range work that is already underway [5]. We also need to consider the lessons of the past [2, 3], promising new options and the costs of existing high performance systems. Exciting new alternatives to SLS and expendable COTS are being developed [4, 6] that feature total reusability and operational concepts based on experience with high speed aircraft. The Aerospace America design concept [4], for example, came with a wealth of supplementary material, including peer-reviewed papers published by the American Institute of Aeronautics and Astronautics (AIAA). The Boeing proposal builds on that company's successes in more recent programs [6].

Engineering workforce shortages are another constraint on our ability to achieve deep cost reductions and have become a major concern for IEEE and other professional societies [7]. This issue has serious implications for economic growth as well as for national security. In the case of low-cost access to space, the problem is particularly acute because of national security clearance requirements.

The use of public resources also comes with inefficiencies. Low cost access to space will require measures like those mandated by the Space Act Agreement between NASA and Bigelow Aerospace [8]. The costs associated with commercial launch should be borne by sponsor/users and owner/ operators rather by US taxpayers. Such costs will include, but not be limited to, mitigation of space debris, vehicle operations and maintenance, insurance and aerospace traffic control.

The U. S. government should sponsor long-range plans to exploit novel technologies like the ones recommended by the Institute of Advanced Studies [10], Bigelow Aerospace [11] and the 100-Year Starship Venture [12]. And to better our understanding of the laws of physics, we also need to explore opportunities to develop new technologies and to test them with new experiments in space.

With respect to international collaboration, IEEE-USA supports foreign investments in U.S. technologies that will reduce commercial space launch costs. But such collaboration should not enable the development of foreign military capabilities that threaten our national security. Publicly funded commercial space launch capabilities should be owned and operated by U.S. entities and be subject to government regulation and export controls.

If the U. S. does not move quickly to develop low cost launch capabilities, other nations are certain to do so and to use them for any purpose they choose. The United States can get there first - on its own or with partners – but only if it adopts the vigorous and focused approaches recommended in this position statement.

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