



**DEPARTMENT OF BUSINESS,  
ECONOMIC DEVELOPMENT & TOURISM**

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GOVERNOR

**RICHARD C. LIM**  
DIRECTOR

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Statement of

**RICHARD C. LIM**  
**Director**

Department of Business, Economic Development & Tourism  
before the

**SENATE COMMITTEE ON WAYS AND MEANS**

Thursday, February 21, 2013

9:00 a.m.

State Capitol, Conference Room 211

in consideration of

**SB 930**

**RELATING TO THE PACIFIC INTERNATIONAL SPACE CENTER FOR EXPLORATION  
SYSTEMS (PISCES) SUSTAINABLE CONCRETE INITIATIVE.**

Chair Ige, Vice Chair Kidani, and Members of the Committee. The Department of Business, Economic Development and Tourism supports the intent of this bill to enable PISCES to explore opportunities for establishing a program to develop, test and validate planetary construction techniques on the Big Island.

This initiative will enable future astronauts to develop sustainable human habitats, using *in-situ* resources, on the Moon, Mars and other planetary bodies, and also provide a creative and cost-effective means for manufacturing construction materials in Hawaii, using indigenous basaltic resources, that will (1) decrease Hawaii's dependence on concrete imports; (2) provide new education and training programs in engineering, architecture, and materials science; and (3) incorporate advanced manufacturing technologies, such as 3-D printing, that will expand and diversify our State's economic base.

We support this bill provided that its passage does not replace or adversely impact priorities indicated in our Executive Budget.

Thank you for the opportunity to testify on this legislation.



**BUZZ ALDRIN**  
Astronaut

02/11/2013

Testimony in strong support of SB 930, SB 1256, and HB 1419

Statement of Buzz Aldrin, Apollo XI

To the Members of the 27th Hawaii State Legislature:

I am pleased to offer my strong endorsement of Hawaii State Bills - SB930, SB1256 and HB1419 to provide continued support for the Pacific International Space Center for Exploration Systems (PISCES).

I had the pleasure of attending the excellent PISCES 2012 Conference on the Big Island in November, and was very impressed with the potential contribution that this unique asset represents for Hawaii, the United States, and the international space community, in helping humanity prepare for our next bold frontier – the sustainable exploration, commercial development, and settlement of space. I commend this Legislative Body for their vision and commitment to support this important effort - an investment that I feel confident will be returned many fold to the great State of Hawaii.

From my own personal experience in preparing for our historic Apollo XI mission to the Moon, the ability to conduct high-fidelity simulation and training in a highly relevant environment proved to be critical to the success of our mission. Hawaii is blessed to have a landscape on the Big Island that provides an excellent analog for the lunar surface, which will enable PISCES to play a leading role in collaboration with multiple space agencies, commercial space companies, and academic institutions toward the development, testing and validation of key technologies, systems and processes that will not only advance both robotic and human missions beyond low-Earth orbit, but also spin off commercially viable processes and technologies that will dramatically enhance economic enterprise and prosperity in Hawaii.

In addition to expanding commerce on the Big Island, this enterprise will also create the need for a highly-skilled technical workforce to support this work, while simultaneously inspiring student interest in, and pursuit of, science, technology, engineering and mathematics (the “STEM” disciplines).

It is my view that future journeys into space can and will begin here in Hawaii - with innovators, scientists, technologists, and explorers from across the world conducting vital research at PISCES on the Big Island. These experiments will subsequently be operated tele-robotically from other sites around our planet to simulate the control of lunar robots on the surface of the Moon from stable orbits near our natural satellite - thus reducing the time delays associated with attempting to conduct these operations from Earth.

I expect that ultimately, this approach will enable space commerce on the surface of the Moon on a scale that we have yet to anticipate, and that PISCES will continue to serve as the premier Earth-based proving grounds for these systems for the foreseeable future.

As you may be aware, my personal long term goal for humanity is a permanent international settlement of Mars, and I believe that the best way to accomplish this will be to replicate the process we will use to achieve the vision noted above on the Moon, by exploiting the moons of Mars to conduct similar, nearly real-time tele-robotic operations on the surface of Mars.

Having led a major effort toward the development of these remarkable systems for robotic commercial lunar operations, PISCES will again be able to play a most significant and critical role in validating more advanced capabilities to conduct these operations on Mars, thus paving the way for permanent human settlement of this planet.

This approach would afford PISCES several decades of continuing pioneering research on the Big Island, and bring long-term development and prosperity to this region, and indeed to all islands of Hawaii.

By supporting PISCES through the legislation before you today, you will affirm that Hawaii can be a leader in the international exploration and development of space, which will afford exceptional economic and societal returns to humanity on Earth, as well as to this great State, and that will enhance economic prosperity and wellbeing for generations to come.

I again would, strongly encourage your continued leadership in supporting PISCES - a timely and vitally important asset for not only your State, but also the international space community.

Thank you for the opportunity to testify on this measure.

Sincerely,

A handwritten signature in black ink that reads "Buzz Aldrin". The signature is written in a cursive style and is underlined with a single horizontal line.

BUZZ ALDRIN  
Apollo XI

## **Testimony in strong support of S.B. 930, S.B. 1256, and H.B. 1419**

January 31, 2013

To Members of the 27<sup>th</sup> Hawaii State Legislature:

I am writing to strongly endorse three bills relating to the Pacific International Space Center for Exploration Systems (PISCES). These bills include: S.B. 930, S.B. 1256, and H.B. 1419. Please include these comments as written testimony in favor of these measures.

As the former and founding director of PISCES, I am intimately familiar with its history and, as a result, with its great potential as an economic development tool for the State of Hawai`i in general and the Big Island of Hawai`i in particular.

During its first five years of operation (while I served as its director), PISCES became a household word at NASA headquarters and throughout the NASA field centers. This came about through the numerous collaborative efforts we instituted with the agency, the funding proposals we submitted for NASA funding, the PISCES conferences NASA personnel attended, and the three major field demonstrations NASA conducted at the PISCES test sites. These campaigns brought substantially more money into the local economy and UH Hilo than was spent by the State, providing seed funding to PISCES.

Also during this five-year period, while establishing our credibility with our principal funding agency (NASA), we also made major progress building relationships with the local community. These relationships were anchored in our Cultural Advisory Board comprised of local community leaders, many of them from the education sector (both K-12 and university). This Board guided our efforts to reach out to other civic leaders and organizations. A key component of this outreach included periodic presentations we gave to local K-12 classes, often involving NASA engineers who were visiting Hawaii to perform field tests at PISCES. Other outreach efforts included Onizuka Days and the Big Island Science Fair, which PISCES personnel helped judge and at which a PISCES award was given to the entry with the greatest significance for space exploration.

All of these successes with external funding and local engagement have put PISCES in a sound position for further progress under new leadership and restructured administration with the Department of Business, Economic Development and Tourism (DBEDT), the University of Hawai`i at Hilo (UHH), and the Research Corporation of the University of Hawai`i (RCUH). I am very optimistic that PISCES can grow even stronger in this new environment. I also am fully supportive of PISCES' new director, Rob Kelso, and am encouraged by the confidence and enthusiasm with which he has evidenced in this position. His contacts and experience with public/private partnerships at the NASA Johnson Space Center will bring added credibility to PISCES as it pursues its own partnerships with industry, particularly with Google Lunar X-Prize contestants.

However, in order to ensure that PISCES is able to achieve its full potential, it is absolutely critical (from both an internal and external perspective) that the Legislature maintain its traditional support for this outstanding program, and that adequate funding be provided in the coming fiscal year to enable PISCES' continued development. The funding levels indicated in all three bills are essential for this purpose, and I would strongly urge you to appropriate the full amounts proposed.

Concerning aerospace in Hawai'i in general, of which PISCES is a most prominent component, I can think of no other industry with greater economic development potential for your State. Given its central location relative to the many space-faring countries around the Pacific Rim, its proximity to attractive ocean-based launch sites, its own advantageous location for horizontal-launch sub-orbital flights that promise to be early leaders in the emerging space tourism market, its Martian- and Lunar-like terrain and soil that have made PISCES the premier "go-to" place for international tests of rovers, material processing equipment bound for space, and energy collection technologies for future space outposts, and the countless spinoffs to the State's economy from all of these opportunities, Hawai'i is in an excellent position to become both a major leader in and beneficiary of global space enterprise. The best way to realize this potential, in addition to funding PISCES, is to fully fund and support the Office of Aerospace Development within DBEDT.

This leadership won't happen overnight, and as such should not be compared to quick "show-me-the-money" economic fixes for the State. Over the long run, with steady State support, aerospace will produce good, high-paying jobs that can't be outsourced. Other states that historically have led in this field have found this to be true; but again, it didn't happen overnight. California's formidable aerospace industry was built mostly on defense and other government enterprises initiated during World War II. Other states, such as Alabama, Florida and Texas saw their aerospace fortunes evolve with NASA. But Hawai'i has different and, in some ways, stronger attributes for becoming a truly international leader in aerospace (as discussed above), and can leverage these assets and capabilities to help pioneer the space frontier.

In conclusion, I urge you to continue funding PISCES at a level that will evidence to both our nation and the world that Hawai'i means business when it claims to pursue a leadership role in aerospace. PISCES is a superb example of what State funding can enable in this industry. Thank you for your historical and continuing support for this program.

Sincerely,



Dr. Frank Schowengerdt  
Former Director, PISCES  
Former Director, Space Product Development and Innovative Partnerships Programs  
NASA Headquarters  
Former Vice President for Academic Affairs and Dean of the Faculty  
Colorado School of Mines



February 3, 2013

Members of the 27<sup>th</sup> Hawaii State Legislature  
Hawaii State Capitol  
415 S. Beretania Street  
Honolulu, Hawai'i 96813

Aloha Members of the Hawaii State Legislature,

As the Chairman of the Hawai'i Aerospace Advisory Committee, I am writing to express my strong support for SB930, which would appropriate funds to investigate the feasibility of establishing a sustainable concrete manufacturing initiative on the Big Island.

This legislation will enable Hawai'i, through its Pacific International Space Center for Exploration Systems (PISCES), to assume a leadership role in the development and utilization of innovative technologies and methodologies for building structures to support human outposts on other planetary bodies (e.g., the Moon, Mars, and Martian moons). It also will help reduce Hawaii's reliance on imported concrete while enabling new education and training opportunities in engineering and materials science, as well as new applications of cutting edge manufacturing technologies such as 3-D printing that will expand and diversify your State's economy.

As such, I strongly urge your committee to support passage of SB930 to help bring these timely opportunities to the Aloha State.

'O wau me ka ha'aha'a,

A handwritten signature in black ink, appearing to read "E. Pulham", is written over a horizontal line.

Elliot Holokauahi Pulham  
Chairman

**George R. Ariyoshi**  
999 Bishop Street, 23<sup>rd</sup> Floor  
Honolulu, HI 96813

**February 1, 2013**

TESTIMONY IN SUPPORT OF SB930 - RELATING TO THE PACIFIC  
INTERNATIONAL SPACE CENTER FOR EXPLORATION SYSTEMS (PISCES)  
SUSTAINABLE CONCRETE INITIATIVE

Dear Members of the 27<sup>th</sup> State Legislature,

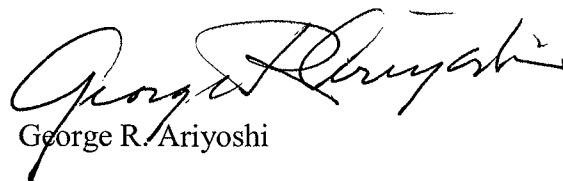
I strongly support the intent of this bill to investigate the feasibility and applicability of a sustainable concrete manufacturing initiative on the Big Island.

This legislation will not only help "path-find" techniques for building planetary structures (e.g., human-rated habitats on the Moon) using *in situ* resources, but also help reduce Hawaii's reliance on imported concrete while creating new employment opportunities in Hawaii's construction industry, providing new education and training programs in engineering, architecture, and materials science, and promoting applications of advanced manufacturing technologies (such as 3-D printing) that will help expand and diversify our State's economic base.

I would be happy to address any questions you may have concerning this recommendation and thank you for the opportunity to testify on this bill.

I can be reached by e-mail at [kyahiku@wik.com](mailto:kyahiku@wik.com) , by phone at (808) 544-6765 or by fax at (808) 544-8398.

Aloha,



George R. Ariyoshi

GRA:khy



Hoyt L. Davidson  
Managing Partner  
Near Earth LLC  
243 Tresser Boulevard, 17<sup>th</sup> Floor  
Stamford, CT 06901

February 3, 2013

TESTIMONY IN SUPPORT OF SB930 – RELATING TO THE PACIFIC INTERNATIONAL  
SPACE CENTER FOR EXPLORATION SYSTEMS (PISCES)  
SUSTAINABLE CONCRETE INITIATIVE

Dear Members of the 27th State Legislature,

I strongly support the intent of this bill to investigate the feasibility and applicability of a sustainable concrete manufacturing initiative on the Big Island of Hawaii.

In addition to the broader goals of PISCES to support the international development of robotic space technologies, I believe this 3D manufacturing initiative is of particular near term importance. If mankind is to establish a sustained presence on the Moon, Mars and other destinations, it will be far easier and more affordable to do so using in situ resources for construction of habitats and infrastructure. Having an early demonstration of this promising technology should positively influence the decision processes for future mission profiles and technology roadmaps for exploring space.

Hawaii itself seems to be in a similar situation and would benefit greatly from developing concrete from its own resources to reduce reliance on expensive imports. This initiative may also provide inspiration and encouragement for Hawaii's students to seek education, training and careers in this new 21<sup>st</sup> century manufacturing technology and ultimately attract new manufacturing and construction businesses to the State.

Given the benefits above, I strongly encourage you to pass SB930 with the requested funding allocation. I am available to answer any questions you may have and can be reached at (203) 355-3527 or by email at [hoyt@nearearthllc.com](mailto:hoyt@nearearthllc.com).

Thank you for the opportunity to testify on this bill.

Aloha,



Hoyt Davidson



2<sup>nd</sup> February 2013

**Testimony in Support of SB930  
Relating to the Pacific International Space Center for Exploration Systems (PISCES)  
Sustainable Concrete Initiative**

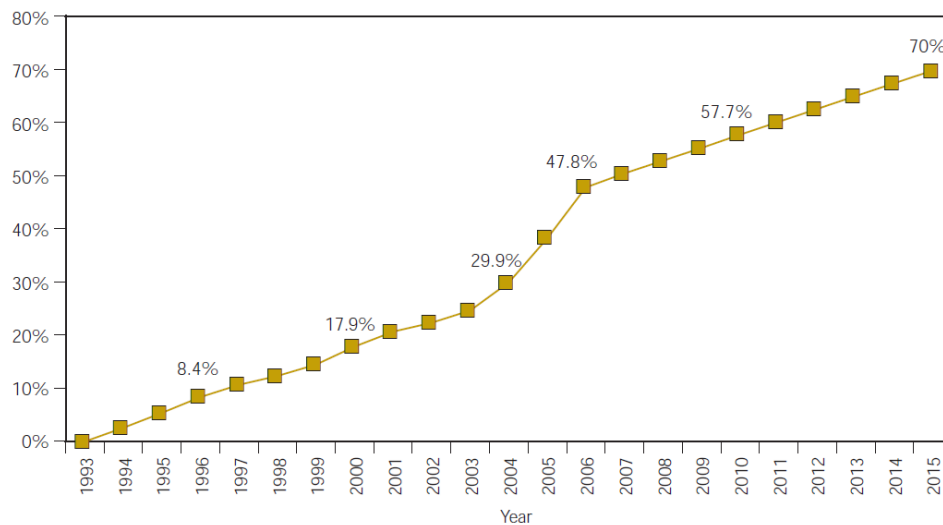
Dear Members of the 27<sup>th</sup> State Legislature

I strongly support the intent of this bill to investigate the feasibility and applicability of a sustainable concrete manufacturing initiative on the Big Island.

The application of new techniques to this sector promises to yield significant dual applicability benefits both for terrestrial and space based markets. By establishing a focus of excellence in this area, multiple methods of concrete, brick and construction materials, manufacturing and processing methodologies will arise. Market growth in the emerging world is projected to be 6% compared to 2.8% in the US in 2014<sup>1</sup>. (World Bank Global Economic Prospects June 2012). The growth of these new markets will require innovation in production of base infrastructure, especially in construction and transport systems such as roads and bridges. For example:

- China is building a 53,000 mile National Expressway System, which when complete in 2020, will rival the 47,000 mile Interstate Highway System<sup>2</sup>.
- India is building a 10,000 miles expressway system.
- Europe is spending hundreds of billions of euros on highways, bridges, tunnels, ports and rail lines.

By assessing the trends in construction costs from 1993 to 2015 it is clear that the cost structure that supported this growth in the past will come under increasing pressure to reduce costs to maintain schedules and requirements.



<sup>1</sup> World Bank Global Economic Prospects June 2012

<sup>2</sup> AASHTO Report 2007- Future Needs of the U.S. Surface Transportation System

**SHACKLETON ENERGY COMPANY**

3511 Caldwell Lane, Del Valle, TX 78617-3017

The advantages of new concrete fabrication methods for local consumption is clear. What is indicated above however, is that the establishment of leadership in the field of alternative concrete fabrication solutions will provide an economic productivity center for Hawai'i that can provide solutions and valuable intellectual property for serving these clearly present markets whilst addressing the local production cost issue. The interlacing disciplines of 3D-printing, synthetic biology, robotic fabrication and new production methods. when applied to these fields, will also provide Hawai'i with developing educational opportunities for the younger generation opening new research and learning opportunities for many of the State's citizens.

Building upon the opportunities for terrestrial export markets and local supply, many innovative concrete production methods being developed will have direct applications to high profile and inspiring planetary activities such as the development of Lunar facilities for a range of commercial and international missions. Although the timescales for these activities are in the order of 5-10 years from present, the lead times for preparation and leadership are of the same. By engaging these activities with a sense of urgency, the State can position itself in a position of leadership in a commanding niche of space engineering that will only further consolidate the economic and educational benefits generated by serving the large terrestrial markets.

In light of the above, I strongly support the intent of SB930 and would urge the Legislature to appropriate the full funding amount requested through this legislation.

Best regards



Jim Keravala  
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**"Fueling the Space Frontier"**

Testimony in strong support of SB 930, SB 1256, and H.B. 1419

To the Members of the 27th Hawaii State Legislature:

I am deeply honored to have the opportunity and great privilege to offer my testimony in strong support of Hawaii State Bills SB930, SB1256 and HB1419, providing State support for the Pacific International Space Center for Exploration Systems (PISCES).

I regret that I am unable to offer my testimony in person, however unfortunately these hearings conflict with a long-standing prior commitment, as I will be hosting an important event for NASA, and many of our international space agencies partners, at NASA's Kennedy Space Center this week, so please accept this written testimony as my strongest endorsement of your continued leadership in this important work.

I would like to begin by thanking you for the opportunity to serve as a member of the Board of Directors for PISCES, an opportunity that affords me the honor of working with an incredible team from the Hawaii Office of Aerospace Development, the University of Hawaii, and the Legislators of the great State of Hawaii, that collectively embraced the vision to establish this vitally important asset that will enable Hawaii to become both a leader in, and major beneficiary of, the next bold step for humanity - the sustainable exploration, commercial development, and settlement of space.

PISCES is clearly an enterprise that will allow Hawaii to demonstrate its continued leadership in international space endeavors, and that will continue to afford exceptional economic and societal returns to humanity on Earth, as well as inspire strong interest in the pursuit of science, mathematics and engineering among students in pursuit of careers that will enhance economic prosperity and wellbeing for future generations.

It is entirely fitting that Hawaii, founded by courageous navigators during the great age of human migration and exploration on our planet, would now become a world leader in forging humanity's next "giant leap" into the future, and I commend your leadership for supporting the great vision and opportunity that is embodied in PISCES.

As a retired Senior Executive Service member of NASA, I have dedicated my entire career to the exploration of space, and I continue to support this enterprise as a consultant and advisor to NASA, as well as a space advocate on behalf of both key policy makers in Washington, DC, and many international space agency partners.

In fact, I spent most of this past week with my long-time good friend and space pioneer, Dr. Buzz Aldrin (who also joined me at the recent PISCES Conference on the Big Island in November 2012), talking with key policy officials and executives at the White House, NASA Headquarters, the State Department, and other government organizations. During these discussions, we frequently referenced the important role that PISCES can play in helping our nation realize its full potential on the space frontier.

As we learned from the earliest days of human space flight (during the Mercury, Gemini and Apollo Programs), the ability to conduct high-fidelity analog demonstrations is key to validating the instruments, systems, and processes that will be used in actual space missions.

As the former Director of Advanced Programs at NASA, I co-founded the NASA/NSF (National Science Foundation) Antarctic Analog Program nearly twenty-five years ago. This program continues to sponsor some of the world's leading scientists to conduct groundbreaking science in this region, as well as to validate the types of scientific investigations that we will one day conduct on the Moon, on Mars and its moons, on Saturn's moon Europa, and on other planetary bodies.

I also sponsored work at additional exploration analog sites in the Arctic region, as well as in the deserts of the Southwest and in other areas, which offer high-fidelity analogs for the scientific and technological investigations we will conduct elsewhere in our solar system.

Clearly, this type of analog research will enable us to understand our own origins, address questions about the uniqueness or abundance of life in the universe, and expand our fundamental knowledge about the fate of our home planet and our future in the universe.

The Big Island affords one of the highest fidelity lunar analog sites on Earth that can be used to test and validate new technologies that will enable humankind's inevitable journey beyond Low-Earth Orbit (to the Moon, Asteroids, Mars and beyond). As such, PISCES will present tremendous opportunities for the United States, and for other space-faring nations, to economically demonstrate and refine space-faring hardware and systems in preparation for future interplanetary missions, while also creating exceptional economic benefits to Hawaii.

In addition, this research will also support the development of new manufacturing processes and procedures to utilize natural, *in situ* resources in an environmentally conscious way, while also enabling new approaches to harness energy to power to sustain future exploration sites on the moon and Mars, as well as state of the art tele-robotic and autonomous robotic systems for applications both in space and on Earth – all of which will provide new business and employment opportunities in Hawaii.

The unique attributes of PISCES as a premier analog site will also afford opportunities for new education, workforce development, and other social, environmental and economic programs statewide.

I am most honored to have an opportunity to contribute toward the development of PISCES, and again would strongly encourage your continued leadership in supporting this timely and vitally important program for Hawaii, and for the international space program community.

Respectfully,

Lewis L. Peach, Jr.  
Member, PISCES Board of Directors

**International Ventures, Associates, 5333 Potomac Ave. NW, Washington. DC 20016**

January 30, 2013

Members of the 27th State Legislature  
Hawaii State Capitol  
415 S. Beretania Street  
Honolulu, Hawaii 96813

Re: **SB930**. Appropriates funds to support the investigative stage of the Pacific international space center for exploration systems sustainable concrete initiative, contingent upon a dollar-for-dollar match from other sources.

I am pleased to provide testimony in strong support of this measure.

The Hawaii State Legislature has been a strong supporter of PISCES since its inception, and, as a result, the Center has gained substantial visibility at NASA, as well as among other international Space agencies in Asia, Canada and Europe, and also has entered into research and development alliances with private sector partners, such as the Boeing Company, NORCAT, and Shackleton Energy, to conduct a variety of research applications and field experiments.

One timely area where PISCES could play a global leadership role – especially in light of the similarity of Hawaii’s volcanic dust and larva to the regolith on the surface of the Moon and Mars – is in the development of technologies that could support the manufacture of concrete and other materials that could be used to construct facilities on other planetary bodies.

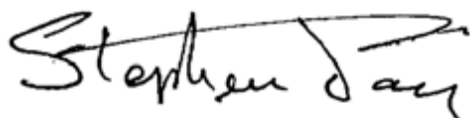
I also understand that Hawaii imports most or all of the concrete used across the Islands. Yet Hawaii has an abundance of lava fields that could be used in part as a readily available sustainable substitute for conventional concrete for applications, including buildings, bridges, and road construction.

The same technologies that could be used to develop construction materials on the Moon and Mars could also be used to manufacture concrete for applications in Hawaii. This initiative, if handled sensitively in relation to the environment and local customs and beliefs, could have a major positive economic impact on the State. In addition, an experimental facility could attract industrial partners familiar with large-scale processes for extraction, extrusion, bonding, lamination, melting, construction, and environmental containment and regulation, to develop one or more pilot plants in Hawaii to test the feasibility of using such an abundant resource.

In light of the significant potential of the proposed lunar concrete initiative, I strongly urge your Legislature to appropriate the funding support requested for PISCES through this legislation.

Thank you for the opportunity to testify on this measure.

Sincerely,



Stephen M. D. Day  
Chairman Emeritus - Japan-U.S. Science, Technology & Space Applications Program (JUSTSAP)  
Member, Hawaii Aerospace Advisory Committee