



\$150 million overhaul at NASA Plum Brook readies Ohio to lead space testing

Published: Tuesday, July 27, 2010, 8:00 AM Updated: Tuesday, July 27, 2010, 10:14 AM



John Mangels, The Plain Dealer



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NASA

The Space Power Facility at NASA's Plum Brook Station near Sandusky contains the world's largest vacuum chamber, as well as new facilities for vibration and acoustic testing of spacecraft.

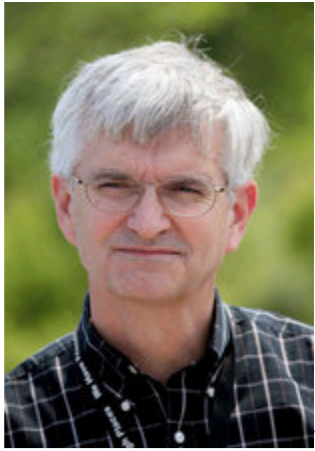
Perkins Township -- The new "horn room" at NASA's **Plum Brook** testing facility is a headbanger's dream.

If you were to stand within its 2-foot-thick walls when engineers fire up 36 nitrogen-powered loudspeakers to simulate the rumble of a rocket launch – and nobody will be allowed to, for obvious safety reasons – the 163 decibels of raw noise would burst your eardrums.

"It's sort of the Lamborghini of boom boxes," said Plum Brook director **David Stringer**. Whoa, party on, dude.

Next door, at the bottom of a concrete-lined crypt big enough to hold a house, they're preparing to install a massive "shaker table." Its hydraulic rams will rock and roll a 38-ton space capsule like a pebble atop a clothes dryer, to mimic the buffeting of a ride into space.

If all this equipment sounds like a 21st Century torture chamber, well, that's the point. Plum Brook Station, operated by Cleveland's **NASA Glenn Research Center**, is a proving ground for spacecraft. It's where prototype space capsules, satellites, landing vehicles and rocket components can be exposed to the harsh condition they'll encounter aloft, from searing heat and sub-zero cold to the absence of air pressure.



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NASA Plum Brook director David Stringer

Marvin Fong / The Plain Dealer

Now, with \$150 million in new facilities and upgrades nearing completion, this 6,400-acre **former World War II explosives plant** south of Sandusky is poised to make Ohio an international leader in "space environment testing." The vibration and acoustic chambers to be finished in 2011, coupled with other ongoing and planned improvements, are meant to make Plum Brook a "one-stop shop," providing a unique suite of cutting-edge tests in one location.

NASA launched the enhancements in 2007 mainly to benefit the space agency's **Constellation Program**, an initiative of then President George W. Bush that aimed to build new rockets and spacecraft to replace the space shuttle fleet and ferry astronauts to the moon and Mars.

The planned **Orion space capsule** and **Altair lunar lander** were supposed to be pummeled with sound and vibrations at the Plum Brook complex, as well as undergoing other tests there, to see how well they hold up.

But with President Barack Obama and Congress wrestling over NASA's space exploration goals, **Constellation is in limbo**. Obama wants to shift space shuttle duties to commercially made rockets and rethink how NASA will get beyond low Earth orbit.

Orion may survive, either as a rescue craft for space station crews or as an astronaut capsule carried by a still-to-be -designed "heavy lift" rocket to the moon, an asteroid or some other deep-space destination.

Even if lawmakers decide to scrap Constellation, Plum Brook officials figure the \$150 million in federal and state money invested there will have been well-spent. NASA still will need enhanced testing capabilities for future spacecraft. The center and area economic officials also are working to expand Plum Brook's clientele of traditional U.S. aerospace firms and foreign space agencies to include start-up commercial rocket-makers, satellite manufacturers and other paying customers.

"If you didn't have a Constellation tomorrow, this place would still be fine," said Stringer, a retired Air Force brigadier general who has been Plum Brook's director since 2007. "Why? Because it affords you more opportunities to get at real problems. We've tried to destroy this place's status as the best-kept secret in NASA."

Upgrades add vibration, acoustic testing

The improvements likely will heighten Plum Brook's appeal.



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NASA

In this photo from 2001, workers prepare a Delta IV rocket faring for tests inside the Space Power Facility's vacuum chamber.

The new shaker table and horn room are in a building connected to the world's largest vacuum chamber, the 10-story **Space Power Facility**. Railways and overhead cranes will whisk space hardware from one test area to the next, where they'll be exposed to launch vibration, sonic pounding, extreme heat, cold and airlessness, and the wash of electromagnetic interference that could be encountered in orbit.

"We have the ability to do four major space simulation tests all under one roof," said the facility's manager, Jerry Carek.

The huge shaker table will vibrate as fast as 150 times a second, a rattling more severe than a bad earthquake. And in the horn room, the peak sound level will be more than twice as loud as standing next to a jet engine at takeoff.

Carek's office is nearby, but insulation and damping mechanisms should minimize the disruption. "I suspect . . . my coffee cup will jiggle," he said.

About 2 miles to the northwest on the sprawling Plum Brook complex, in the **Spacecraft Propulsion Facility**, workers are overhauling or replacing every major component in another big vacuum chamber and its control room in preparation for future testing.



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NASA

A crane lowers a rocket upper stage into the B2 vacuum chamber for propulsion testing in this photo from 1998.

The chamber, a vertical tube big enough to swallow three diesel locomotives side by side, is the only place in the world where upper-stage rocket engines can be fired in space-like conditions.

"It was built in 1965 and most of the equipment is original," said Plum Brook deputy director **David Taylor**. "So we needed to shut it down, go through it system by system, and completely refurbish the facility." The work should be done in time for tests of Japanese or European space agency rockets in 2013.

A third big Plum Brook vacuum chamber known as the **K-Site** is currently abandoned, but center officials said if several million dollars in additional money can be found, it could be revived for so-called "dirty" testing.

Unlike other super-clean vacuum chambers, the hardy K-site and its 1950s-vintage vacuum pumps aren't bothered by dust and dirt. So the chamber could be pumped down to match the airless chill of the moon, Mars or an asteroid, and filled with material to simulate the **dusty surface** of those worlds, allowing realistic testing of space suits, rovers or other equipment.

"We're saying why not have this [vacuum chamber] be the mud room tester," Stringer said.

Officials say runway is needed

To further boost the new and improved Plum Brook's chances to lure business to the region and create more jobs, civic leaders in the facility's home base of Erie County, and in Cleveland, where NASA Glenn is located, are scouring for money to build a 9,000-foot runway on the testing site.

The runway, Stringer and others contend, would make it much easier to transport large, bulky spacecraft components and sensitive satellites to Plum Brook for testing.

Currently, they're flown into airports in Cleveland or Mansfield and trucked 50 to 60 miles to the NASA facility, requiring police escorts and special traffic arrangements. Some potential Plum Brook customers opt to test bits and pieces of their space hardware at smaller government or private facilities rather than transport the full-sized article to Ohio.

View full sizeNASAPolice cars escort a truck headed for Plum Brook Station in 2007 carrying a faring for an Ariane V rocket for testing.

United Launch Alliance, a Denver-based commercial space launch company, tested the nosecone of its **Atlas V** rocket in Plum Brook's biggest vacuum chamber in 2002 after flying it into Cleveland Hopkins International Airport aboard a giant **Russian cargo jet**.

"Certainly having a runway out there would have made that a lot easier," said United Launch vice president George Sowers.

NASA's budget doesn't have the estimated \$31 million the

Plum Brook runway would cost, nor the additional \$30 million or more for roads and other infrastructure to support it. So the Erie County Commission and the Greater Cleveland Partnership, Northeast Ohio's main economic development organization, are working together to secure the funds from various sources.

After losing out on the first round of federal transportation stimulus money earlier this year, the runway's backers are re-applying for a \$60 million grant, as well as seeking \$8 million in development funds from the state.

The runway project "remains one of our highest priorities," said Carol Caruso, a vice president at the Greater Cleveland Partnership.

Runway may lead to business park

The officials think that the runway, in turn, would be a catalyst for development of a 1,200-acre high-tech business park on Plum Brook land that NASA is willing to lease. The site has railroad and highway access, and ample, cheap water, electricity and sewer service.

Erie County commissioner Patrick Shenigo foresees a cluster of spacecraft and satellite company tenants who want to take advantage of the proximity to Plum Brook's facilities for quick-turnaround tests, as well as alternative energy or other research firms that could benefit from NASA's engineering expertise.

Such business clusters already exist near NASA centers in Florida, Alabama and Texas.



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Space Power Facility manager Jerry Carek shows the massive pumps that are used to remove air from the vacuum chamber, simulating space conditions.

Currently, about 25 NASA employees work at Plum Brook. If the runway brings more testing work to the center as expected and its NASA workforce rises to 100, that should generate 475 new commercial jobs in the area and an economic boost of \$45 million, according to a 2009

Bowling Green State University study. A NASA payroll of 325 would spin off 1,776 new jobs, the study found.

The Plum Brook project is "a developer's dream" and "an opportunity to reinvent the state," Shenigo said.

Aerospace companies that have used Plum Brook's existing test equipment know its value. "It's a very unique facility in terms of its size and the capability to do vacuum testing," United Launch's Sowers said.

His company recently proposed a series of tests starting as early as next year in the vacuum chamber of Plum Brook's spacecraft propulsion research facility.

The

\$10 million project would determine if a modified fuel tank from United Launch's **Centaur** upper-stage rocket could be used for long-term fuel storage in space – an orbiting "gas station" that could supply rockets headed for Mars or other distant sites. Such fuel depots **are vital** to NASA's future space exploration plans.

"Plum Brook would be the ideal place to test those new technologies on the ground before NASA attempts a flagship mission," Sowers said.

Satellite testing poses challenge

Selling satellite makers and non-traditional aerospace firms on Plum Brook might be tougher, acknowledged Stringer, the facility's director.

Because an individual satellite can cost hundreds of millions of dollars, manufacturers have been reluctant to make non-flying prototypes strictly to be boiled, frozen and exposed to other launch and orbital hazards. "Right now, we have faith-based testing and evaluation for most of our satellite launches," Stringer said.

Likewise, start-up commercial rocket-makers such as **SpaceX**, founded in 2002 by PayPal magnate Elon Musk with the goal of reducing bureaucracy and launch costs, have so far opted against full-scale space environment testing.

Musk, who Stringer has approached about using Plum Brook, "has made the decision he'd rather fly and learn from flying, and he's right," Stringer said, as long as the company has the time and money to rebound from any problems that result. After three launch failures, SpaceX's Falcon 1 rocket reached orbit in September 2008, and its larger Falcon 9 had a successful **first flight** in June 2010.

"I think the contribution that [space simulation] testing can do for you is enormous," Stringer said. However, "we don't try to do the hard sell. In the end, we can't make them test here. They've got to want to test here."

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