

Gulf Coast Reporters' League

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Vol. V, Issue IV

A bi-monthly update of aerospace activities in the Gulf Coast I-10 region

February 2018



Support provided by



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Editor's note: This is the third of a four-part series focusing on aerospace and defense activities in the states that are members of the Aerospace Alliance.



GCRL photo by Michelle R. Thomas

It was a milestone for Alabama's aerospace sector when the first A321 built in Mobile had its maiden flight in March 21, 2016.

Economic development

Alabama's aerospace footprint

Long known for space and missile work in north Alabama, the south part of the state is a growing commercial aviation hub, and points in between are getting in on the action, too...

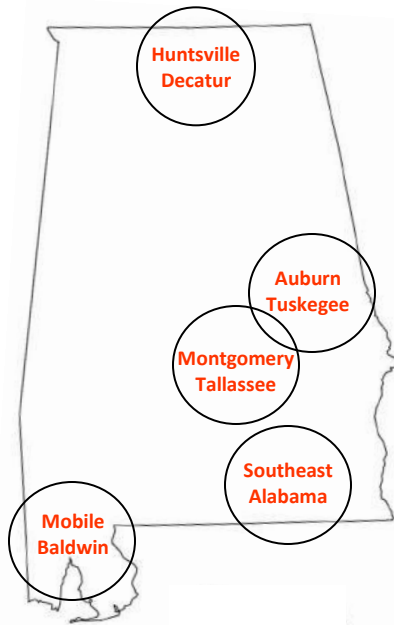
The large Airbus assembly facility in Mobile, Ala., Hangar 9, still has a new car smell to it, so to speak. It's only been around since 2015, with its formal opening in September. It was less than two years ago, in April 2016, that the first Mobile-built jet, an A321, was delivered to customer JetBlue.

But by the middle of December 2017, Airbus in Mobile had delivered its 50th passenger jet, that one to Delta Air Lines. And

the \$600 million U.S. Manufacturing Facility at the Mobile Aeroplex has reached its goal of four aircraft a month.

And now plans are in the works to create a second assembly line at the Aeroplex, this one building Bombardier CSeries jetliners in the wake of an agreement where Airbus takes a majority share in the project. While it initially was prompted by threatened tariffs, it seems clear it's a way for Bombardier to cope with an expected increase in CSeries orders and gain the Airbus marketing clout.

Mobile and its growing aerospace sector is just one of the hot spots in a state that has been a player in aviation since the Wright brothers in 1910 established a flying school in Montgomery. Today Alabama can say its aerospace activities run the gamut, from



designing spacecraft to maintenance, repair and overhaul and more.

“When we measure project activity, the second-fastest growing sector in the state is aerospace and aviation,” said Alabama Commerce Secretary Greg Canfield. “I think for the future of aerospace in the state of Alabama, activity is going to continue to climb.”

Aerospace and aviation operations can be found across the state. According to Canfield, about 400 aerospace companies from 30 countries have operations in Alabama. Boeing, Airbus, Lockheed Martin, GE Aviation, Raytheon and GKN Aerospace are among them. Canfield said 83,000 Alabamians work in aerospace and defense.

“We’re a state that’s built around an aerospace sector that is pretty diverse,” he said. “We do everything from Raytheon SM-3 and SM-6 missiles to 3D printing of jet fuel nozzles that go on the new neo engine ... from space to general aviation, we’ve got it covered.”

The Aerospace Industries Association says that aerospace and defense accounts for 1.7 percent of Alabama’s Gross Domestic Product, higher than aerospace-intensive Florida. Alabama in 2015 had \$8.7 billion in sales revenue and \$887 million in A&D export sales, according to AIA.

Aerospace is one of the largest industrial groups in the state, along with automotive, with wages among the highest.

Alabama is in the top five states for aerospace engineers, coming in fourth after California, Texas and Ohio. Alabama has the highest concentration of jobs and location quotient in the nation, according to the Bureau of Labor Statistics data from May 2016. Huntsville has the highest employment level of aerospace engineers in the nation.

Southeast Alabama is ranked second among non-metro areas with the highest employment of aerospace engineers, and second with the highest concentration and location quotient, according to the Bureau of Labor Statistics data from May 2016.

Made in Alabama, a service of the Commerce Department, reported that by November 2017, aerospace companies unveiled plans to invest at least \$500 million and bring more than 2,200 jobs to Alabama in new facilities or expansions of existing operations. In 2016, project announcements involved \$260 million in new investment and 2,000 additional jobs.

Huntsville-Decatur

Long the place most think of when it comes to aerospace, north Alabama is home of NASA’s George C. Marshall Space Flight Center and Redstone Arsenal, a major research, engineering, and test center that houses the Army’s missile defense and aviation programs.

Home to Cummings Research Center, the second largest research and technology park in the United States, Huntsville’s reputation as a high-tech haven is underscored by the highly popular U.S. Space and Rocket Center.

The transformation of Huntsville from a cotton town into one of the nation’s premier technology centers began in the 1950s, when the Army transferred its missile program to Huntsville, followed by the arrival of NASA and its space program. Companies involved with the Army and NASA came in, thanks in no small



Welcome Center rocket display in Huntsville.

measure to the establishment of the University of Alabama in Huntsville and the development of a research park that would become Cummings.

The growth has continued. Last year Blue Origin announced it would make its BE-4 engine in a \$200 million facility. In addition, Aerojet Rocketdyne said it would expand its Huntsville operation with a manufacturing plant for its AR1 rocket engine and other parts.

Decatur, west of Huntsville, is known for its United Launch Alliance production facility, a joint venture of Lockheed Martin and Boeing created in 2006. Next door to ULA, work got underway in the summer of 2017 on a three-structure \$21 million Dynetics facility. The test stand, test control center and integration facility is designed to support NASA’s Space Launch System program and commercial customers. It’s set to open this year. RUAG Space of Switzerland leases space in the ULA facility.

“If we look at aerospace from a space perspective and missile defense, with the Blue Origin announcement in Alabama and with Aerojet Rocketdyne moving its defense headquarters from California to Huntsville, Ala., I think that Alabama’s looking good,” said Canfield.

Mobile-Baldwin

It could be argued that Mobile has for years been a sleeping giant in aerospace. Today it's fully awake.

Mobile has been interested in aerospace and aviation since the days of World War II-era Brookley Air Force Base. But the city took a hit when the base was shut down.

Converted to Brookley Industrial Complex, it did manage to attract some aerospace companies as well as a range of other tenants. But the trajectory of the former base, today called the Mobile Aeroplex at Brookley, changed when Europe's Airbus picked Mobile as a site to build aerial tankers for the Air Force.

But the Mobile-Airbus story actually began earlier. In April 2004, as part of a strategy to build its U.S. industrial base, the company decided to establish a customer service and training facility at Mobile Regional Airport to support Coast Guard's HC-144 (CN235) aircraft. It became operational in 2005.

That was followed in June 2005 with the announcement that the company chose Mobile's Brookley Complex to build tankers should it win the Air Force contract. The decision to build the engineering center followed. It opened in 2007.

The Air Force contract eventually went to Boeing, but Mobile ended up getting the A320 series assembly line, arguably a better deal in the long term. Mobile, which assembles the jetliners from sections shipped from Europe, is the newest location to build A320 series jetliners. The others are in Hamburg, Germany; Toulouse, France; and Tianjin, China.

Then came the startling news in October 2017 that Airbus would partner with Canada's Bombardier to bring a new production line for Bombardier's CSeries passenger jets to Alabama. That deal is moving forward, according to Bombardier CEO Alain Bellemare.

Between the first announcement at Airbus would build a plant in Mobile and the Bombardier announcement, at



A320 sections arrive in Mobile in 2017. *Airbus photo*

least two dozen suppliers have come to Mobile, and more are expected with a second assembly line.

Safran was the first Airbus supplier to announce it would open an operation in Mobile in the wake of the Airbus announcement. The planned engineering center didn't work out, but Safran opened a manufacturing operation to produce and install aircraft engine nacelles, the housing for an aircraft engine and its related components. In addition, Safran company Messier-Bugatti-Dowty has an operation at the Mobile Aeroplex.

Across the bay in Baldwin County, UTC Aerospace Systems in August 2017 unveiled a new 80,000-square-foot manufacturing and nacelle assembly facility at its campus in Foley. The Foley site assembles nacelles for integration with the Pratt & Whitney Geared Turbofan engine for a number of aircraft, including the A320neo, CSeries, Mitsubishi Regional Jet and Embraer E-Jet E2.

UTC in Foley trucks finished A320 engines to the Airbus U.S. manufacturing plant about an hour away. In early February 2018, UTC announced it delivered the first two fully integrated propulsion systems for the A320neo to the final assembly line in Mobile.

In addition to Airbus and its suppliers, the Mobile Aeroplex is also the home of VT MAE, which has operated a large MRO facility since 1991, and Continental Motors, which builds piston engines for small aircraft.

Mobile is also home to the U.S. Coast Guard Air Training Center, which trains pilots to fly Coast Guard-specific aircraft.

"I think that we will continue to see a lot of growth in the commercial aerospace and aviation sectors. We're seeing a lot of preliminary interest particularly with the announcement of the potential for the Airbus

Bombardier CSeries to be assembled in Mobile, Ala., alongside the existing Airbus final assembly line," said Canfield. "We think that's all going to portend a really good future in terms of a supply chain that will go to support aviation and aerospace in the state."

Southeast Alabama

Fort Rucker, established during World War II as Camp Rucker, is the primary flight training base for Army aviation - home to the Army Aviation Center of Excellence and Army Aviation Museum. The base is bordered by Daleville, Ozark and Enterprise and is northwest of Dothan.

All Army aviation training has been handled by Fort Rucker since 1973, as well as the training of Air Force and allied helicopter pilots and air crew. The center of excellence is home to the U.S. Army Aviation Technical Test Center, which conducts developmental aircraft testing for the Army.

Fort Rucker is the nucleus for the area's aerospace activities. The helicop-



Training at Fort Rucker.

Army photo

ter-related activities are a magnet for suppliers providing everything from fleet support to flight simulation.

Miami-based Commercial Jet has a 400,000-square-foot maintenance, repair and overhaul (MRO) operation at Dothan Regional Airport that provides passenger-to-freight conversions. It also operates CJET Academy, an eight-week training course for jobs at Commercial Jet.

There's also the Alabama Aviation Center (AAC) campus in Ozark, which has trained students to become FAA-certified aircraft mechanics for more than five decades. The AAC offers programs on unmanned aerial systems, advance material composites and flight simulation technology.

In Enterprise, Alabama Aircraft Support has an MRO facility for helicopters, and Vector Aerospace, an Airbus company, has an MRO in Andalusia. Further north in Troy, Lockheed Martin produces the Joint Air-to-Surface Standoff Missile (JASSM) and long-range anti-ship cruise missiles.

Auburn

The 300,000-square-foot GE Aviation advanced manufacturing plant in Auburn produces precision, super-alloy machined parts for GE jet engines that will power future commercial and military aircraft, and also to support the fleet of GE jet engines now in service.

The plant also uses additive manufacturing to mass produce fuel nozzle injectors. The company said the nozzle is the first complex jet engine component produced with 3-D printing technology. GE

chose Auburn as one of eight universities to participate in an innovative program focusing on 3-D printing research and education initiatives. Auburn was selected by



GE Aviation in part because of its access to skilled workforce and proximity to Alabama's university system.

Montgomery

It was big news Dec. 21 when Montgomery learned Alabama National Guard's 187th Fighter Wing at Dannelly Field would host a new F-35 mission. It will mean 1,000 jobs over the next few years and have a \$24 million annual economic impact.

Montgomery is also home of Maxwell Air Force Base (Maxwell-Gunter), under the Air Education and Training Command, and occupies the site of the first Wright Flying School. The base is the headquarters of Air University, and is the center for Joint Professional Military Education.

The host wing is the 42nd Air Base Wing, and tenant units are the Air Force Reserve's 908th Airlift Wing, the only operational flying unit at Maxwell. It operates C-130H aircraft for theater airlift worldwide.

About 35 miles from Montgomery in Tallassee is the 380,000-square-foot GKN Aerospace facility, which has been in operation since 1985. It has a new composite design engineering center at its advanced composite structures facility.

Initially, work at the new Elmore County center will focus on design and development of advanced composite technologies for rotorcraft.

Tuskegee

A highly anticipated contract coming down the pike is the competition between Boeing, Lockheed Martin and Leonardo to build 350 training jets for the U.S. Air Force to replace the T-38.

As in the former tanker competition, the winning company will determine what area of the country will benefit from the jobs. In the T-X competition, Alabama wins if Leonardo is chosen to build the jets.



T-100 in race for Air Force contract. *Leonardo photo*

Italy's Leonardo, originally partnered with Raytheon, initially planned to build the planes in Mississippi. That changed when Raytheon pulled out of the partnership.

Leonardo opted to go it alone by teaming up with subsidiary Leonardo DRS. It shifted the site where it would build the twin-engine jet trainer at Tuskegee's Moton Field.

The project calls the creation of 750 jobs over a 10-year period beginning in 2019. Moton Field is where the legendary Tuskegee Airmen trained during World War II.

"We're seeing a lot of interest, from the military side, if Leonardo is successful in securing the T-100 competition to provide jet fighter trainers for the Air Force for the next 20 to 40 years. That's going to look really promising for the state in that regard," said Canfield.

The states commercial airports are heavy with aviation jobs. Birmingham, Dothan, Huntsville, Mobile and Montgomery all have primary airports that are the welcoming for visitors, and provide an important first impression.

General aviation airports also dot the state and can attract aviation businesses. Some are also locations for aviation education activities.

The state also hosts Army and Navy air fields that are used for touch and go and other training operations. Four in Baldwin County are used by aviation students for Naval Air Station Whiting Field in Milton, Fla., a primary military aviation base in the Florida Panhandle.

- *David Tortorano*

Research

AI Armageddon only if we let it happen

Concerns that intelligent robots will take over will only come to pass if humans are dumb enough to make them artificial humans with all our darker traits...

Pensacola, Fla.

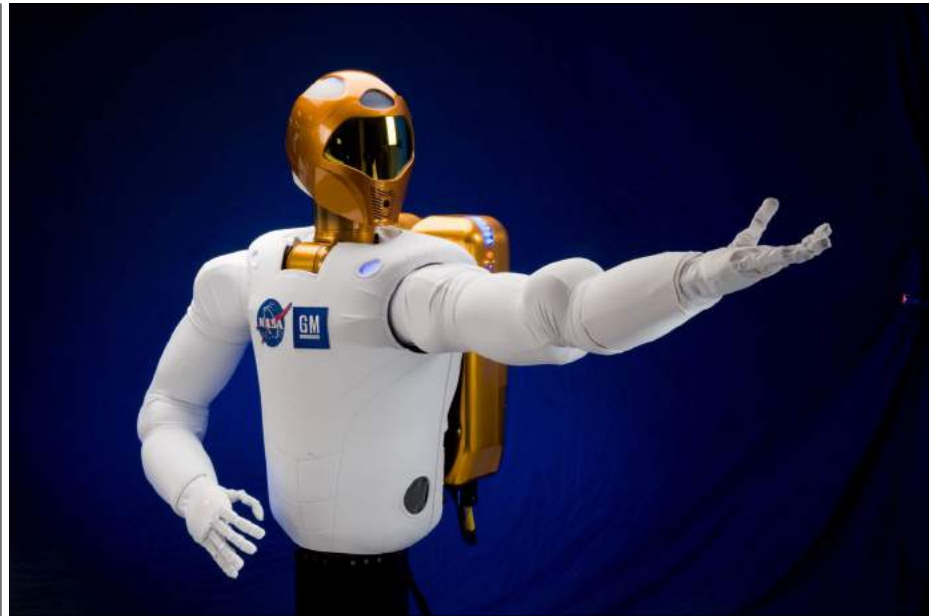
It's a vision of the future that is about as dark as one can imagine. Intelligent, autonomous robots on land, sea and air are no longer under human control and decide on their own what to target with their weapons. These machines, or so the apocalyptic vision goes, are smarter, stronger, in every way superior to their creators – and they're taking over.

Think HAL of "2001: A Space Odyssey," disobeying humans in order to survive, or perhaps the cyborgs in "The Terminator," intent on destroying the human resistance.

That vision or a variant is embraced by some well-known people. Elon Musk, the head of SpaceX, has called artificial intelligence probably humanity's "biggest existential threat." Physicist Stephen Hawking holds that while development of artificial intelligence could be the biggest event in human history, "unfortunately, it might also be the last."

Musk, Hawking and hundreds of artificial intelligence researchers and experts have called for a worldwide ban on autonomous weapons – those with humans out of the loop – warning that it could set off a revolution in weaponry.

But Dr. Ken Ford, founder and CEO of the Florida Institute for Human and Machine Cognition in Pensacola, sees it differently. AI is not inherently a danger to humanity. Yes, our worst fears could come to pass, but only if we create robots in our own image, including our darker traits.



Robonaut is on the International Space Station and will not act like HAL.

NASA photo

Ford received his Ph.D. in computer science from Tulane University. In 2015, the Association for the Advancement of Artificial Intelligence named him the recipient of the 2015 Distinguished Service Award. The same year Ford was elected as Fellow of the American Association for the Advancement of Science, and in 2017 Ford was inducted into the Florida Inventors Hall of Fame.

Author of hundreds of scientific papers and six books. Ford's research interests include AI, human-centered computing, and human performance and resilience.

IHMC, which is well-known on the international stage, has created wearable exoskeletons that improve performance of the human body, like the Mina v2, which placed second in the first Cyathlon in Switzerland in October 2016 against global competition. It also created an algorithm that allowed the robot Atlas to perform life-saving skills during disasters. That effort won for IHMC second place in an international DARPA competition in 2015.

Ford made clear from the start the reason for his Jan. 31 lecture at IHMC in downtown Pensacola.

"After decades of pundits and philosophers arguing that AI is provably impossible, suddenly that argument has been replaced with the assertion that not only is it possible, but that superhuman AI represents the greatest danger ever faced by the human race. So in only about a decade it went from you can't do it ... to you shouldn't do it," he said.

"My purpose of this talk will be to draw our attention to an interesting historical parallel. Another older technology, which was also controversial and thought to be impossible, and then deemed to be a great danger to the human race – that is artificial flight."

As he put it, "the parallel between AI and AF is illuminating."

Ford's talk was something of a history lesson about mankind's fascination with flying. Originally thought to be impossible, it was later deemed dangerous on a spiritual level – if God meant for man to fly he would have given

him wings. From that it turned to concerns that it was dangerous to people on the ground.

“Flight has always been one of humanity’s oldest dreams,” he said, and the world’s best thinkers tried to come up with answers for one of the mankind’s “big ideas.”

In the quest, artificial flight from the beginning sought to imitate birds, including the vigorous flapping wings, donning feathers and even a beak. The goal, he said, seemed to be creating an “artificial bird.”

It wasn’t until humanity started understanding the science of flight – like the role of air flow and lift – that flight finally became possible. The Wright brothers were not trying to mimic birds, but focused on lift, stability and the dynamics of turning in the air.

Once it was possible to fly, some sought to ban the practice through legislation. It was only over a matter of time that those concerns faded.

Like early flyers trying to imitate birds, AI for a long time tried to imitate humans. Ford said creating a machine that can do human feats is misdirected. He’s averse to technology that is done simply because it can be done.

Books and movies have provided us with the idea that artificial intelligence can be hazardous to humans. Ford said the movie “2001: A Space Odyssey” shaped our thoughts. The computer HAL was all too human and went mad when humans tried to shut him down.

But in fact, the current application of AI is nothing like this sci-fi version, and we live with it on a daily basis. It’s all around us, including our vehicles and phones, and in all cases it’s designed to make our tools a little smarter, Ford said.

Any really remarkable technology is often perceived as morally bankrupt and dangerous. But technology is neutral and doesn’t convey any inherent moral component, Ford said.

But there’s the caveat. Humans are capable of a lot of things, and technology can be used for good or ill.

“Whether we will as a species wisely apply our technology, that is very much in question,” Ford said.

“It’s up to us, but we should not imagine that our salvation from malevolent machines will be brought to us by our state legislators drafting laws to regulate their behavior,” Ford said, or that some kind of knowledge should be forbidden fruit of the human brain. “We have already bitten from this apple.”

A little more than a week after Ford’s lecture, another speaker at IHMC discussed how research has led to technologies we now take for granted.

Dr. Richard McCullough said scientific discoveries over the past 30 years are now leading to revolutionary new consumer products that will improve mankind’s future. He said plastics that are lights and energy producing materials will significantly reduce energy consumption and lead to zero energy buildings in the future.

The printing of metals and other electronic materials in two and three dimensions are already impacting robotics.

McCullough is a professor of materials science and engineering and has been vice provost for research at Harvard University since 2012. Previously he was vice president for research at Carnegie Mellon University in Pittsburgh. McCullough founded Liquid X Printed Metals and Plextronics.

He showed how seemingly esoteric research can later lead to products we all use. We’ve already seen it, and will continue to see it in the future.

“We’re going to have the bendable future,” he said about research that has led to plastics that can conduct electricity.

“Your cell phone might be a piece of plastic ... your newspaper may be just a piece of rolled-up plastic that you pull out or pull down ... and then it would download from the internet the



Mark Daniel and Mina v2. IHMC photo

newspaper of the day just like it does on your cell phone.”

He envisioned the military using lightweight plastic maps on which they can download coordinates of the enemy.

“So this is the future, the bendable, plastic future – throw away electronics that are completely printed. We’re not there yet, but these are real prototypes that have been made.”

In the near future, lighting will be replaced by printed plastic lighting that can be used in a way only limited by the imagination. Some of the products being developed include window that you can look through in the daytime and at night can be turned on and become lights. None of this is far away, he said.

“It’s pretty cool stuff,” he said, including the possibility of painting a roof on a house that can generate electricity.

“If you can print electronics, imagine what you can do with robotics in the future,” he said. Robots can be printed and integrated with the electronics in them.

“This is a brave new world with a lot of really cool things going on,” he said.

- David Tortorano

Space

Unheralded stars of the SLS program

The historic engine test stand in South Mississippi has been testing engines for NASA since the 1960s, and it will do the same thing for the next generation of NASA space rockets...

Stennis Space Center, Miss.

It's a supporting actor in NASA's high-profile program to send astronauts to the Moon and beyond, but a close look at the B-2 test stand shows it's anything but a minor player in the Space Launch System.

Stennis Space Center (SSC), which has been testing RS-25 engine controllers, is where the 212-foot core stage will be tested in the first quarter of calendar year 2019. All four RS-25 engines will produce 2 million pounds of thrust and will fire for just under 500 seconds. It will be the loudest test at SSC since the Saturn V during the '70s.

It's hard to envision just how massive the rocket engine test stands at SSC are until you get up close. SSC gave that opportunity to social media bloggers and traditional journalists during a tour and briefing at the test center in mid-February.

The tour included a visit to the B-1/B-2 test stand, which can test rocket engines on both sides of the structure. The RS-68 engine for the ULA Delta IV is tested on B-1. An engine was in that stand during the tour. It had been tested the week before and was scheduled to be removed the following week.

But it was the 360-foot B-2 portion of the stand that was the star of the tour. It was the stand that tested the five-engine Saturn V, and it was also used to test the three-engine RS-25 for the Space Shuttle. It was also used to test the common booster stage for Delta IV before it was mothballed for a time.

Ryan Roberts, B2 stand manager, provided a briefing for the visitors. He admits he could talk for hours about the stand. But the information he did provide in his 15 minutes showed just how much work goes into the stand, and just how important is its role.

When it was chosen to test the SLS core, it was necessary to modify the test stand to handle the huge rocket, the most powerful one ever built. The stand was refurbished from top to bottom and expanded upward. The core stage is smaller than the stand, but when it's put in place above the flame deflector it will top out 14 feet higher than the B-2 test stand.

The flame deflector, which sits under the engines and redirects the flames, was repainted and 32,000 of the 5/8-inch diameter holes in the deflector, where cooling water is



B-2 will be used to test the SLS core stage in 2019. GCAC photo

ejected, had to be welded shut and re-drilled in the right pattern, Roberts said. The piping system to bring fuel to the rocket is brand new as well, and portion of the stand in the middle between B-1 and B-2, the "soft core," was repainted. One guy in a bucket painted the NASA "meatball" with a brush, Roberts said.

The rocket engines are cooled by water sprayed during the test as both sound suppressant and to prevent the flame deflector from getting too hot, providing the characteristic condensation associated with the test.

The water is supplied by a 66 million gallon reservoir and brought to the test stand with 10 large pumps and 96-inch diameter pipes. The water flows at the rate of 330,000 gallons per minute, according to Roberts.



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*David Tortorano
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*February 13, 2018
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In December 2018, the core stage will be brought by covered barge from Michoud Assembly Facility in New Orleans to SSC, using the canal system built at the test facility. The stage will be rolled out of the barge then lifted with cranes into position on the test stand.

The test stand is busy with activity while the rocket is put in place, including the time the fuel is put into the rocket. But during the test itself, personnel are at a control center a safe distance from the test stand.

Nobody is in the soft core area of the test stand during a test. "That would be one heck of a sight," a media member said.

"For a little while," chimed in another.

The other star of SLS testing is the A-1 test stand. It's been used by NASA and SSC to test the flight controllers, the brain of the RS-25 engines. As of mid-February there have been two tests of the controllers this year, as well as previous tests last year. The second test was a full-duration, 365-second certification test.

The second test marked completion of green run testing for all four of the new RS-25 engine flight controllers needed for the second flight of NASA's SLS rocket. The RS-25 controllers for the EM-1 flight already are installed on the engines that will be part of the SLS core stage.

About 40 miles away from SSC at Michoud Assembly Facility in New Orleans, construction has officially begun on the spaceship that will return astronauts to the Moon and beyond, the first deep space mission in more than 40 years. Lockheed Martin technicians and engineers at the Michoud welded the first two components of the Orion crew module capsule for Exploration Mission-2 (EM-2).

Before that, EM-1, an unscrewed mission, will take off into space for a trip beyond the moon. That capsule assembled at Michoud is now at Kennedy Space Center, Fla., for final work. Michoud will finish the work on the Orion slated for EM-2 in September and ship that one to Kennedy Space Center, where the Lockheed Martin team will perform assembly and test of that spacecraft.

Space buffs didn't have to wait for SLS to get their engines fired up. The SpaceX



A-1 used for RS-25 controller tests. *GCAC photo*

Heavy Falcon, the most powerful commercial rocket in the world, roared skyward this month at Kennedy Space Center, Fla., atop a pillar of smoke in a spectacular launch.

Later, two of the three boosters made vertical landings back at Kennedy, while the third booster scheduled to land on a drone ship hit the ocean about 100 yards from the ship.

The 23-story rocket was built with three of the company's proven Falcon 9 rockets, providing a total of 27 Merlin engines that generated a combined 5 million pounds of thrust. This rocket is more powerful and can lift more weight than the biggest rockets offered by either United Launch Alliance or Arianespace.

It was a crucial win for commercial space exploration. A recent report by Bank of America Merrill Lynch forecast the size of the space industry octupling over the next three decades to at least \$2.7 trillion. And this is good for our region. Some commercial space companies, including SpaceX, are using engine testing facilities at Stennis Space Center. For SpaceX, it's developing its next-generation Raptor engines.

- David Tortorano