GE Aviation to build unique materials factories

-Adjacent factories to produce raw material for ceramic matrix composites (CMCs)
-Enables GE to produce ceramic matrix composite components (CMCs) in high volume
-GE partnering with USAF Research Lab Title III Office on silicon carbide technology

HUNTSVILLE, Ala. – October 27, 2015 – GE Aviation is creating adjacent factories in Huntsville, Alabama, to mass-produce silicon carbide (SiC) materials used to manufacture ceramic matrix composite components (CMCs) for jet engines and land-based gas turbines.

GE Aviation will invest more than $200 million to construct two factories on 100 acres in Huntsville. When the factories are operational later this decade, they are expected to employ up to 300 people.

Today, GE Aviation's Sanjay Correa was joined by Governor Robert J. Bentley and members of the Alabama delegation at the Alabama State Capital in Montgomery to make the announcement.

"Establishing the new GE factories in Alabama is a very significant step in developing the supply chain we need in order to produce CMC components in large volume," said Correa, Vice President, CMC Program at GE Aviation.

One plant will produce silicon carbide (SiC) ceramic fiber. It will be the first such operation in the United States. Today, the only large-scale SiC ceramic fiber factory in the world is operated by NGS Advanced Fibers in Japan, which is a joint company of Nippon Carbon, GE, and Safran of France. The adjacent GE factory in Alabama will use the SiC ceramic fiber to produce the unidirectional CMC tape necessary to fabricate CMC components.

Construction of the two plants will begin in mid-2016, with full completion by the first half of 2018. Production begins in 2018. GE has already begun hiring the technical team that will transfer to the Huntsville operation. GE expects to begin hiring the hourly workforce in late 2016.

An advanced materials revolution in jet propulsion

The use of lightweight, heat-resistant CMCs in the hot section of GE jet engines is a breakthrough for the jet propulsion industry. CMCs comprise SiC ceramic fibers in a SiC matrix, enhanced by proprietary coatings.

With one-third the density of metal alloys, these ultra-lightweight CMCs reduce the overall engine weight. Further, their high-temperature properties greatly enhance engine performance, durability, and fuel economy. CMCs are far more heat resistant than metal alloys, hence requiring less cooling air in the engine's hot section. By using this air instead in the engine flow path, an engine runs more efficiently.

For more than 20 years, scientists at GE's Global Research Centers and GE's industrial businesses have worked to develop CMCs for commercial applications. The best-selling LEAP engine, being developed by CFM International, the 50/50 joint company of GE and Snecma (Safran) of France, is the first commercial jet engine to use CMCs in the high-pressure turbine section. The LEAP engine, with more than 9,500 orders and commitments, is currently completing certification testing. It is scheduled to enter airline service next year powering the Airbus A320neo, and in 2017 powering the Boeing 737 MAX.

The Alabama plants: From ceramic fiber to ceramic tape to CMC components

Producing CMCs requires complex processing steps using a synthetically produced compound of silicon and carbon. The two GE Aviation factories being established are involved in separate steps in the process – the production of SiC ceramic fibers and the production of SiC ceramic tape. The factories:

*Ceramic Fiber Plant. Supported by funding ($21.9 million) from the U.S. Air Force Research Lab Title III Office, this plant will dramatically increase U.S. capability to produce SiC ceramic fiber capable of withstanding temperatures of 2400F.

The SiC ceramic fibers plant will license fiber-producing technology from NGS Advanced Fibers Co. in Japan, a joint company formed in 2012 with Japan's Nippon Carbon (with 50% ownership in NGS), GE (25% ownership), and Herakles Safran France (25% ownership). NGS, which already produces SiC fibers for GE's CMC components, is establishing a second factory in Japan to increase capacity to meet growing demand. The GE fiber plant in Huntsville will complement the growing capacity at NGS.

Once the Huntsville plant is operational, it will sell fiber to the Department of Defense, GE businesses, Herakles (Safran), and other outside customers subject to U.S. regulations. It will be the first U.S.-based factory to produce SiC ceramic fiber on a large industrial scale. The two other NGS partners will ultimately have the opportunity to become equity partners in the Huntsville plant.

*CMC Tape Operation. This adjacent plant, financed solely by GE, will apply proprietary coatings to the ceramic fiber and form them into a matrix to produce CMC tape. The ceramic tape will be used by GE Aviation at its new CMC manufacturing site in Asheville, N.C., which opened in 2014. The Asheville facility fabricates CMC shrouds for the LEAP engine's high-pressure turbine section.

In addition, GE's Power and Water business is testing CMCs in its newest and most efficient, air-cooled gas turbine. At GE Power and Water's new Advanced Manufacturing Works facility in Greenville, SC, prototype CMC components are being built to replace super alloys in large gas turbines.

Rising GE Demand for CMC Components

The demand for CMCs is expected to grow tenfold over the next decade. Each LEAP has 18 CMC turbine shrouds, which are stationary parts in the high-pressure turbine that direct air and ensure turbine blade efficiency. Also, CMCs are being used in the combustor and high-pressure turbine section of the new GE9X engine under development for the Boeing 777X twin-aisle aircraft. Almost 700 GE9X engines are on order today, with the aircraft entering service by 2020.

GE is incorporating CMC components in advanced military engines including the GE3000 for the U.S. Army. GE's advanced turboshaft demonstrator FATE (Future Affordable Turbine Engine) also for the Army increases the use of hot-section CMCs to achieve aggressive fuel efficiency, power-to-weight ratio, and lower maintenance cost goals. CMCs are currently being evaluated for upgrades to existing engines like the highly popular T700 helicopter engine.

Alabama Leadership reacts to GE's investment in Huntsville

Governor Robert Bentley: "We are honored that GE Aviation has chosen Huntsville for an advanced technology manufacturing operation to produce silicon carbide materials for commercial and military engines.

Today's announcement is important because Alabama is expanding our partnership with a global aviation leader. We have prioritized advanced manufacturing in aerospace and aviation, and I appreciate the investment by GE Aviation in this new Huntsville operation."

U.S. Senator Richard Shelby: "GE Aviation's decision to open two adjacent factories in Huntsville is great news for the region and our state. This announcement is a testament to the exceptional workforce in Huntsville and highlights that Alabama is open for business. I look forward to the jobs and economic growth that this investment will bring to Huntsville."

U.S. Senator Jeff Sessions: "GE Aviation's decision to build two new world-class factories in North Alabama is a vote of confidence in the strength and talent of Alabama and its workers. It continues Huntsville's strong tradition of supporting our men and women in uniform. This $200 million investment will expand the footprint and impact of GE Aviation in the area while providing new opportunities for hundreds of workers. The cutting-edge technology employed in Huntsville demonstrates GE Aviation's continued leadership in this industry. A strong manufacturing base is essential for a robust economy, and I am pleased that Alabama and GE Aviation have been leaders by investing in high-paying manufacturing jobs."

U.S. Rep. Mo Brooks, 5th Congressional District: "North Alabama prides itself on manufacturing excellence, and its high-technology workforce, making it a perfect match for global aviation leaders like GE Aviation. This investment will bolster Alabama's pivotal role in the development of GE Aviation's world-class engines and the future of aerospace engineering. We are grateful for this commitment to Huntsville and the additional growth it will inspire across the state."

U.S. Rep. Robert Aderholt, 4th Congressional District: "This is wonderful news for North Alabama. GE has been committed to this area for decades, and I'm glad to know that dedication continues with even more well paying jobs for 300 people. Job creation continues to be the number one priority for Alabama. As Ronald Reagan once said, 'the best social program is a job.' This investment from GE is a clear sign that Alabama is open for business."

Huntsville Mayor Tommy Battle: "GE is an innovation company. Huntsville is an innovation city. This announcement by GE is the latest chapter in that history of innovation. The products that will be manufactured here represent the future of aerospace. We are proud that Huntsville will help GE change the way we travel through the skies."

GE Aviation's growing commitment to Alabama

Today's announcement represents GE Aviation's second significant factory investment in Alabama in recent years. Since 2013, GE Aviation has also invested more than $100 million in a 300,000-square-foot factory in Auburn, near the storied Auburn University campus, where the company is engaged in jet engine component manufacturing (super-alloy machined parts) as well as establishing the world's highest-volume additive manufacturing center.

Over the past year, the Auburn plant has been installing and qualifying additive manufacturing capability, including more than a dozen laser melting machines. Fuel nozzles will be the first components to be built using additive processes for the best-selling LEAP engine by CFM International. It marks the first time such a complex component will be manufactured using additive technology.

GE Aviation, an operating unit of GE, is a world-leading provider of jet engines, components and integrated systems for commercial and military aircraft. GE Aviation has a global service network to support these offerings. Visit us at www.geaviation.com

Learn more about GE Aviation's journey into CMCs with the following YouTube video:

https://www.youtube.com/edit?video_id=ZSbaClAB6SI&video_referrer=watch

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GE Aviation and Ceramic Matrix Composites – A Recent Chronology

For more than 20 years, scientists at GE's Global Research Centers and GE's industrial businesses have worked to develop CMCs. In recent years, GE Aviation has made significant strides in advancing CMCs for jet propulsion.

2007: GE Aviation acquires Ceramic Composite Products (in Delaware) from GE Energy. It becomes a "lean laboratory" where GE develops processes for mass producing CMC components.

2009: GE runs a F136 military engine with CMC hot-section components – a first in jet propulsion.

2012: Nippon Carbon (NCK) of Japan, a producer of composite fibers, forms a joint venture with GE (25% ownership) and Safran (25%) called NGS Advanced Fibers to produce fibers for CMC components.

2013: GE expands CMC "lean lab" operations in Delaware.

2013: GE selects Asheville, NC, for a new CMC factory to mass produce CMC components. It opens in 2014.

2013: GE runs an advanced military engine with CMCs in the combustor and turbine sections.

2013: CFM International runs the LEAP core with CMC shrouds in the high-pressure turbine section, and a full LEAP engine in 2014.

2014: NGS Advanced Fibers announces plans to increase production capability by 10X in response to demand for CMC fiber used to produce CMC shrouds for the LEAP engine. (Broke ground in 2015.)

2014: GE and Turbocoating SPA of Italy form the Advanced Ceramic Coatings joint venture for producing environmental-barrier coatings for CMCs in Hickory, NC.

2014: GE Aviation establishes a new CMC Research Laboratory at its Evendale, Ohio, headquarters to rapidly prototype and test CMC concepts, and to develop production techniques for first-of-a-kind CMC parts.

2015: GE completes running of a GEnx demonstrator engine that incorporates CMCs components in the hot section to mature the technology for the future GE9X engine.

2015: CFM begins the flight test program for the LEAP engine.

2015: GE Aviation and the U.S. Department of Defense partner to develop ceramic fiber capacity in the United States. GE Aviation announces the creation of two U.S. factories in Huntsville, Alabama, to produce silicon carbide (SiC) materials (one to produce SiC ceramic fibers and one to produce SiC CMC tape) needed to manufacture CMCs in high volume.

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