



Siemens Energy Improves Service Efficiency with the Markforged Platform

INDUSTRY	Energy
APPLICATION	Tooling
LOCATION	Florida, United States
CUSTOMER SINCE	2016
MATERIALS	Onyx, Carbon Fiber

SIEMENS

The Customer

Siemens Energy is the global energy business of the Siemens group and offers a comprehensive portfolio of technology as well as digital and traditional services for utilities, independent power producers, transmission system operators, the oil and gas industry, and other energy-intensive industries. In support of its energy operations, the company recently opened the Siemens Innovation Center in Orlando, Florida. It is the only one of its kind in the U.S. to offer a unique pairing of design with manufacturing, implementing robotics, rapid prototyping, scanning, digital tools and on-site metal additive manufacturing. The Siemens Innovation Center focuses on rapid problem solving supporting the company's energy businesses.

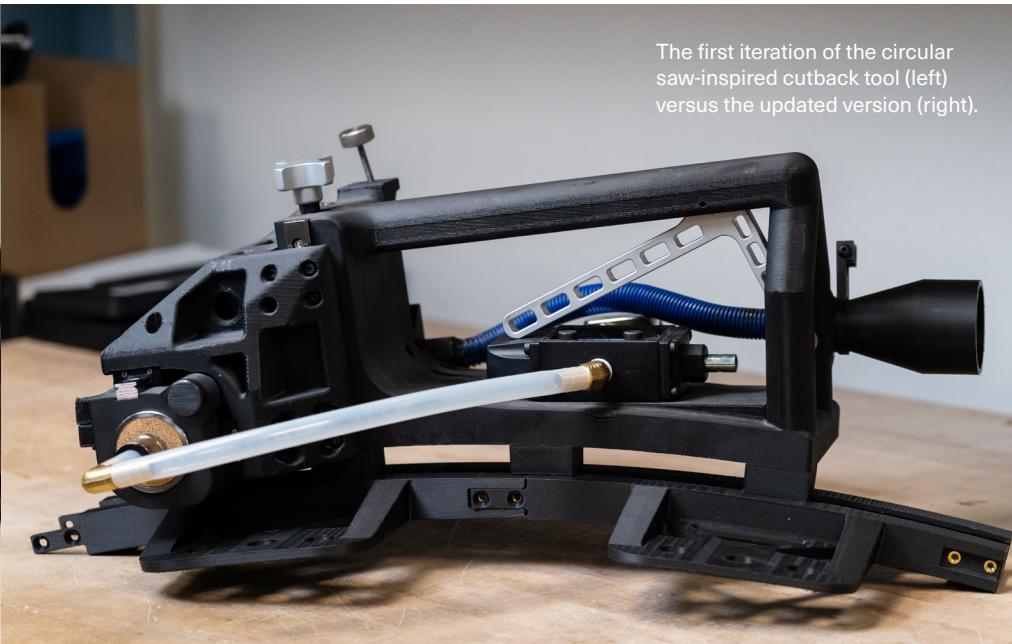
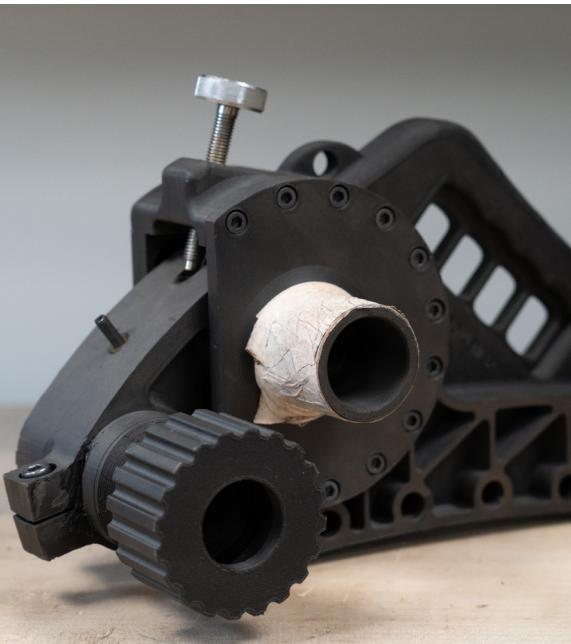
"Rapidly iterating with Markforged 3D printers has revolutionized the way we look at tooling. The Markforged platform gives us the ability to produce powerful, durable tools."

TRENT ALMOND
MECHANICAL ENGINEER, SIEMENS

The Challenge

Siemens supports its customers worldwide with robust service and maintenance operations. Many routine service and maintenance tasks can be carried out on site, or remotely using digital tools, but more intensive repairs can sometimes require a turbine to be shipped to a Siemens repair facility. This can result in increased downtime and extend a planned outage, time in which the turbine is not operating.

With Siemens supporting many of the world's highest performing compression stations, power plants, and refineries, taking a turbine offline for multiple weeks is certainly not desirable and so any process that can reduce that downtime is welcome.



The first iteration of the circular saw-inspired cutback tool (left) versus the updated version (right).

The Solution

Engineers at the Siemens Innovation Center were tasked with finding a better way to maintain turbines that could help reduce offsite repairs and costly downtime. Within four weeks of receiving the brief, the team designed and created a circular saw-inspired cutback tool that accurately matched the contour of the turbine. If the design worked, field engineers could provide simple on-site maintenance instead of shipping the gas turbines to a repair facility for maintenance saving weeks of time.

They initially utilized their seven Markforged X7 3D printers to rapidly prototype the cutting tool — printing every aspect of the tool except for the pneumatic spindle and a few off-the-shelf screws. Working with Markforged partner The SolidExperts, they selected their fleet of Markforged industrial 3D printers for the job because they provided an easy way to make quick iterations while still delivering industrial strength to withstand field conditions. Markforged's unique 3D printing process leverages continuous carbon fiber material, which gives parts the extra strength and durability needed for high-impact environments.

What happened next surprised the engineers and designers at the Innovation Center. While originally meant as only a form and fit prototype, the cutback tool continued to exceed load capacity and stiffness requirements while testing for actual production use. "We were originally just planning to do a test fit and ensure that it would actuate the spindle as it was intended to," says Trent Almond, Siemens Mechanical Engineer. "But we found that the Markforged carbon fiber composite material was actually robust enough to withstand field use." Clifford Hatcher, Director of the Siemens Energy Innovation Center, agrees. "What people quickly learned was that we could use it for actual tooling, based on the overall strength of the material and the quality of the print." Previously, a tool like this would have taken months to design, source materials, program CAM software, and then iterate on designs using traditional, expensive materials on their CNC machine.

After receiving feedback from engineers in the field, Siemens' Innovation Center engineers made improvements to the design using their fleet of Markforged 3D printers. The new and improved 3D printed tool is regularly used in the field to repair turbine components, which can now be performed over three shifts during a routine inspection. Siemens has found that they can provide a better customer solution while staying on the forefront of a competitive industry. "We're saving on time, and we're making their jobs much easier by taking additive manufacturing to the field," says Hatcher.

"The Markforged printers have allowed our engineers to be more innovative, by encouraging them to fail fast. It's a change in design philosophy."

CLIFFORD HATCHER
DIRECTOR OF THE INNOVATION CENTER
SIEMENS



The team has printed everything from end-of-arm tooling to modular fixtures for turbine blades.



Several of the team's prototype designs, such as this seal height inspection tool, have been used as final production parts in the field.

The Future

Engineers and designers at the Siemens Energy Innovation Center now turn to their Markforged platform first when tackling a new challenge. They are constantly exploring new applications — such as modular fixtures for turbine blades or end effectors for their in-house robots — to enhance their product line and workstream. The printers have allowed engineers to be more innovative, with the Center adopting a fail-fast approach to product design.

The company has also utilized its Metal X to create custom one-off parts, and their go-to machine shop is now purchasing its own Metal X to keep up with the company's need for fast turnaround on metal components. "The Markforged industrial printers act as a digital factory for us," says Hatcher. "If there is an item that we need that day within one or two hours, we don't have to wait one or two days."