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Case Study

Construction equipment manufacturer enhances quality with SIMATIC UHF RFID, boosting safety and investment returns

Customer: Large heavy construction equipment manufacturer.

Challenge: Boost engine tracking and visibility through final testing for quality assurance and safety.

Solution: Deploy a Siemens SIMATIC UHF RFID system for more precise hot test engine tracking.

Results: Improved testing throughput, visibility and safety, with a 50 percent return on investment.

Known for the strength and durability of its heavy-duty construction equipment, this global manufacturer produces some 50,000 massive engines, from 7 to 18 liters in size, each year in its newest 35-acre plant. Three production lines, each a quarter-mile long, are highly automated. They enable the plant to build every engine to a specific customer order, on-demand. The plant's output gets shipped to other company assembly plants domestically and around the world.

Once delivered to end-user customers in the field, the equipment is subject to harsh, often remote, operating conditions. Breakdowns, especially engines, are extremely costly – both for customers, who suffer disrupted operations, and for the manufacturer, which has to dispatch field mechanics to fix problems or pay distributors to do it for them.

That's why the plant has quality controls in place at every stage of engine assembly. And the last check before shipping is the plant's hot-test area, where final engine testing is done before each unit gets crated.

Challenge: Boost engine tracking and visibility through final testing for quality assurance and safety

The plant's hot test area consists of eight cells large enough to accommodate all engine sizes and capable of conducting dyno testing on each. Completed engines arrive from an overhead chain and are mounted on carts, more than 30 in all. A chain track in the floor pulls the carts through a rig line where exhaust, electrical, and fluid connections are made to the engine. Then the carts are routed to a dyno test cell for testing, with flip-up stops halting the carts within a 20-inch leeway. After that stage, the carts proceed to a derig line where the fluid, exhaust and power connections are removed. In all, 46 stops make up the hot-test process.

According to the plant's controls engineer, a floor-embedded, high-frequency (HF) RFID system with serial readers was falling short of providing the visibility and reliability the plant's hot test area needed. First, there were only 18 readers for all 46 stops on the hot test line. Second, tags were mounted under the carts and only stored a cart's ID number, as status data was stored in the system PLC data blocks.

"We had issues with oil and coolant residue on the floors and general wear-and-tear causing missed reads and part failures," the engineer recalls. "Readers might also be engaged before an actual stop and then RFID tags couldn't be read again, if the original read had failed or if a cart needed to be manually 're-arrived.' Mismatches were happening all the time."

The HF-RFID system's PLC-buffering arrangement wasn't working well, either, causing a lot of disruptions and frustration. "Because not every point in our hot-testing area had an RFID reader, the old system relied on a tracking scheme that used tokens on the RFID tag to track the engine data that was buffered in the line's PLC," he explains. "Since the data was not read at every station, any manual manipulation of carts by the operators, such as for rework, would propagate tracking errors on line that were time-consuming to correct."

In addition, if a power or equipment failure occurred, factory personnel would have to re-enter the information for all engines on the line by hand using a HyperTerminal, a process which was error-prone. "If anything on a cart needed rework, it could disrupt the tracking of the entire line and that would require a lot of maintenance time and effort," the engineer says.

He figures that the HF-RFID systems was costing the company 16–17 hours in monthly downtime, totaling more than $200,000 a year in lost production time. "Still the primary justification of this project wasn't cost but safety," he says. "All of these tracking errors resulted in operators and maintenance staff having to manually move carts with big, heavy engines mounted on them, and the safety risks were simply unacceptable."

Solution: Deploy a Siemens SIMATIC UHF RFID system for more precise hot test engine tracking

For assistance with a redesigned RFID tracking system, the engineer contacted Patti Engineering, Inc., a Siemens Solution Partner and systems integrator headquartered in Auburn Hills, Mich. with offices in Indiana and in Austin, TX. Patti Engineering has a long-standing relationship with the customer, having assisted the company with many complex automation projects, including a large SCALANCE wireless project at the same plant. Scores of its engineers have achieved Siemens Global Technical Certification. Patti Engineering assigned Controls Engineer Ian Mogab as the project lead.

After assessing the situation carefully, the customer's engineer and Mogab evaluated several alternative solutions. One was to upgrade the buffering scheme with a better system, but the projected effectiveness of that approach made it a risky proposition. Another was to replace the chain-driven carts and flip-up stops with automated guided vehicles, but capital costs would be high and installation time-consuming and disruptive. A third alternative was to modify the line stops mechanically and install a new, in-floor HF RFID system, but that would also be extremely costly and disruptive – and the same issues might persist.

In the end, only one solution stood out: an ultra high-frequency (UHF) RFID solution from Siemens, namely a SIMATIC RF600 Series identification system using the following components:

- SIMATIC RF680R reader modules;
- SIMATIC RF640A antenna modules with adjustable brackets for tuning;
- SIMATIC RF620T UHF EPC Gen 2, 64-bit tags mounted on each cart;
- SIMATIC 319F failsafe PLC for processing;
- SCALANCE X208 industrial Ethernet managed switch with;
- PROFINET industrial Ethernet, using the Media Redundancy Protocol (MRP) to create a redundant PROFINET ring structure.

Mogab points out that manufacturing has traditionally used HF RFID at 13.56 MHz with short read distances and fields, but with the longer read distances and fields of UHF RFID operating at an 865–928 MHz range, depending on the country, new applications are possible. "We used the 915 MHz band that's typical here in the U.S. for this particular solution," he says. "And the Siemens UHF RFID system's large, 70-degree read field gave us read/write functionality for anywhere the cart is located in the hot test station."

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An important first step was to conduct an RF survey of the hot test area to determine optimal antenna placement and angle for reliable operation. “Our primary concerns were the long read distances of up to 12 feet, a high antenna density and proximity to large quantities of metal,” Mogab says. “Given those factors, we picked the four most challenging test stations and, using test readers and antennas, determined that 45 degrees gave us the best trade-off between readability and distance.”

Installation was fast, Mogab reports. “We used the plant’s existing overhead structure for mounting the UHF antennas and readers, instead of putting them in the ground. That way, we didn’t have to put up any ceiling struts or cut any concrete. It really dropped the cost and made installation much quicker, which was done over a series of weekends, so engine testing was never disrupted.”

But both Mogab and the customer’s engineer counterpart think the real secret to the Siemens SIMATIC UHF RFID system’s ease and speed of installation was its filtering and tuning tools and their web-based, graphical interfaces. “One reason UHF RFID has been slow to catch on in manufacturing environments is the amount of RF-reflective metal that factories like our plant has,” Mogab says. “It can make RF-tuning a nightmare, especially given UHF’s long read distances and wide fields.”

Without those tools and with the number of UHF RFID devices that needed commissioning – 12 readers and 46 antennas – the company’s engineer figures it could have taken much longer, even weeks longer, to configure and commission the Siemens SIMATIC UHF RFID system.

“We would have had to write the filtering logic ourselves, whereas Siemens has it all built into their tools as Step 7 function blocks,” he says. “It would have also cost us more money and caused more downtime. Instead, we quickly got 100-percent reliable reads at every station. Each reader’s built-in web interface let us log into it by using its assigned IP address. It was really simple to do.”

Results: Improved testing throughput, visibility and safety, with a 50 percent investment return

The manufacturing company couldn’t be more satisfied with the project’s outcome. No longer are factory personnel having to “re-arrive” the carts with their heavy payloads, removing the dangers of those intermittent chores. At the same time, the Siemens SIMATIC UHF RFID system has eliminated the time-consuming manual data inputs that were so frequently a source of frustration and errors.

Operators can also input data using a scanner instead of doing so manually, saving time and effort. They can also quickly see all engine information, making changes in a graphical interface if the data is incorrect. “We’re also able to use the Siemens UHF RFID system to schedule proactive maintenance on the carts,” Mogab says. “When you’re putting two-, three- and four-thousand-pound engines on them day after day, regular, proactive maintenance is critical, so we’re able to monitor cart usage and optimize our maintenance schedules.”

In its first eight months of operation, the customer reports that the Siemens SIMATIC UHF RFID system has had no downtime due to RFID or tracking failures of about 200 custom-built engines each working day. The system has also eliminated recovery time due to power or equipment failures. Additionally, during this period, the plant has saved more than 150 hours of labor overtime. “In all, we figure our investment return to be 50 percent annualized, so our payback is just two years, which our finance people consider excellent,” the company’s engineer says.

“After that, with the Siemens UHF RFID system pretty much a set-and-forget part of our automation infrastructure, the dividends will accrue year after year with faster testing throughput, better visibility, and above all, improved safety.”

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