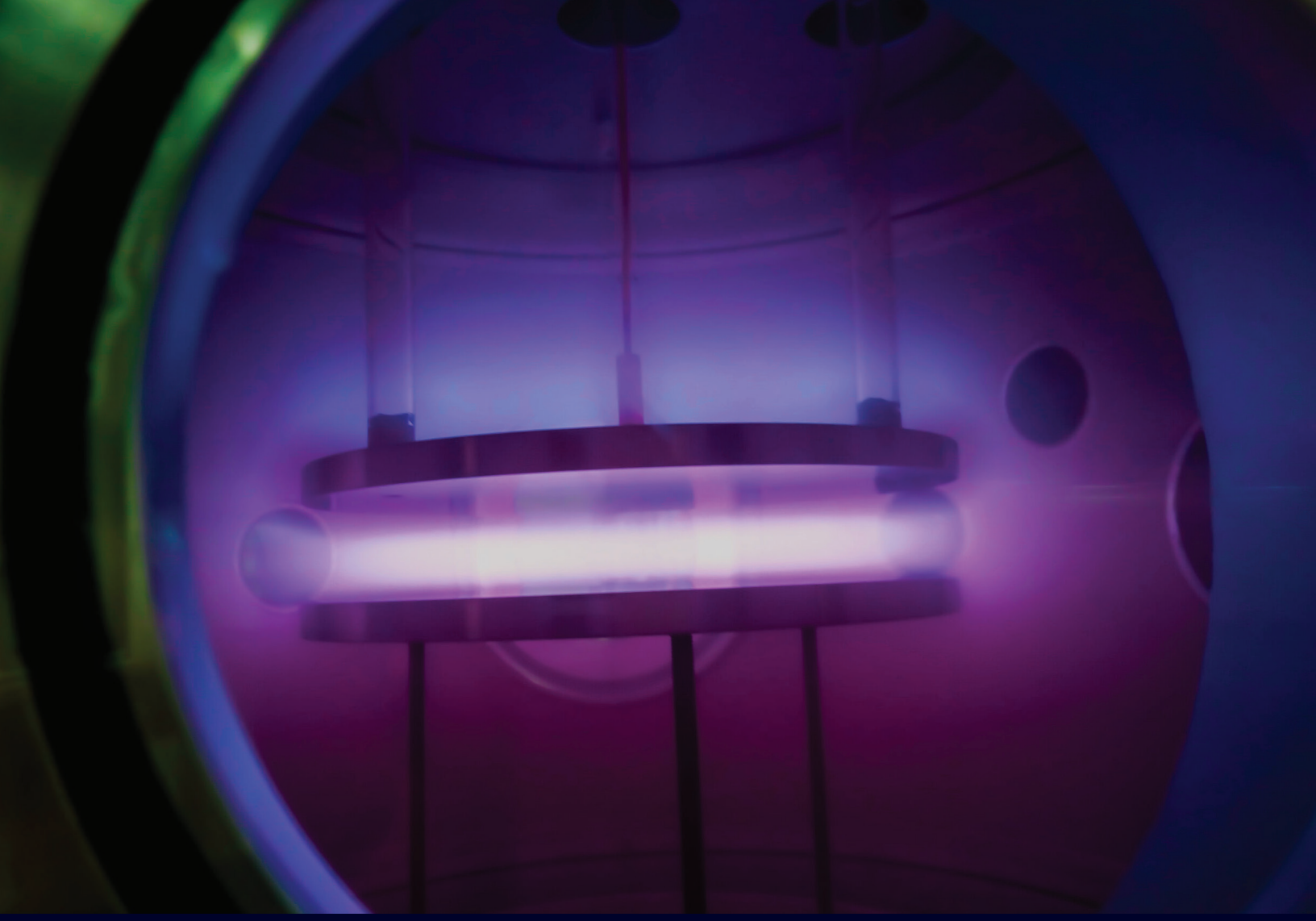

CASE STUDY

Leading systems integrator expands complex process design capabilities with sophisticated recipe handling and production orchestration, especially for advanced vacuum coatings

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GP Plasma is known as an expert in solving complex surface material problems from design to manufacture, particularly in thin-film vacuum coating applications and new coating equipment. Now, to help customers deploy or upgrade processes involving many recipes needing precise execution, the company is the first in North America to offer specialized systems integration using Siemens SIMATIC WinCC Unified with Line Coordination System and Sequential Execution System options.

Across the vacuum coating industry, GP Plasma has established itself as a leading systems integrator and OEM of new custom equipment as well as system retrofits.

In fact, the company has completed numerous machine retrofits and has been producing new solutions for emerging technologies. The company is also currently expanding into markets outside of the vacuum coating industry, such as defense, aerospace, and environmental.

Manager Marion McEuen, who is a company partner, explains that this machine is just part of the wide range of available services GP Plasma provides.

"We have extensive experience with a wide range of thin-film vacuum coating applications, such as atomic layer disposition, plasma electrolytic processing, and high-power impulse magnetron sputtering," he says. "Our machines and those of our customers are this essential for fabricating all kinds of components, including active and passive devices, complex optical systems, and even protective coatings for tools."

- **Challenge: Improving deposition recipe integration for the complex processes and equipment of vacuum coating — and expanding into new markets**

According the McEuen, the vacuum coating industry faces many challenges. Among them are the sizeable costs of consistently producing high-quality thin films on a large scale, including the costs of materials, equipment, and maintaining the necessary vacuum environments.

But that's not all. "First, there's accurately predicting the properties of different kinds of thin films in their various applications, especially when sub-micron thicknesses are specified," he says. "Then there's maintaining a stable vacuum production environment using specialized equipment and carefully monitoring process parameters to maximize yields."

GP PLASMA
PROCESS ENGINEERING

Customer: GP Plasma, LLC. Tucson, Arizona
www.gpplasma.com

Challenge: Improving deposition recipe integration for the complex processes and equipment of vacuum coating — and expanding into new markets

Solution: A more standardized recipe-handling system that enables flexible process design at machine and line levels

Results: More intuitive, easier-to-use systems for customers — plus expanded margins and markets for GP Plasma

These complexities provide GP Plasma with both its core mission — Making Functional Surfaces Work — and plenty of customers needing the company's expert surface and process engineering services as well as, in many cases, new vacuum coating equipment or retrofits of existing equipment. .

As an example, McEuen cites a customer who manufactures photovoltaic solar panels and needed a 15-year-old, roll-to-roll coater repurposed and reconditioned to deposit state-of-the-art, thin-film PV coatings. "The project involved a complete system teardown, the design and rebuilding of magnetrons in-house, a new pump system, an updated automation and web interface, a full update to the electricals and controls, including the operating code, and so on," he says. "We even designed and built a new, ultra-thin metal foil web handling system."

GP Plasma works with a wide range of customers across many diverse industries, providing them with new equipment and retrofitting their old equipment. One of the most common challenges across all the company's various customer engagements is recipe integration.

"For the complicated equipment like what we design, engineer, and build — or for the equipment we're asked to retrofit — recipe integration is typically a big deal because each customer's requirements are always different," says David Schumaker, GP's principal controls engineer. "This has meant that each system, whether new, existing, or a retrofit, has typically required custom software and coding that would rarely be introduced in a robust or refined state. So, that would require individual contributors from our staff to work on the system rather than have a standard that any industrial software engineer could work on."

- **Solution: A more standardized recipe-handling system that enables flexible process design at machine and line levels**

Given the complexities of thin-film vacuum coating and different requirements across customers, GP Plasma sought a way to avoid having to custom-code each customer's solution. This allows its engineers to be much more efficient, with testing, commissioning, and support easier and faster — and, ultimately, improve both customer satisfaction and project margins.

"We were looking for a technology that could enable us to offer our customers a more standardized recipe-handling system that could operate flexibly but still within a well-defined, intelligent, and automated framework to reduce the amount of custom engineering and programming on our part," McEuen says. "Then, in its runtime operation, all of the ultra-precise coating processes had to be fully orchestrated and synchronized in real-time to ensure consistent quality and maximum yields."

McEuen concedes all those requirements were a tall order, but he found the advanced technology he needed in the Siemens SIMATIC WinCC Unified System, programmed via the Totally Integrated Automation (TIA) Portal engineering framework, and using the SIMATIC S7-1500 Software Controller, a programmable logic controller (PLC) running on a SIMATIC IPC (industrial PC).

This technology stack was just the foundation for two optional add-on modules that can work together to take process design and recipe control engineering to much higher levels of sophistication and capability. GP Plasma has utilized these modules with great success to improve and even exceed their customer's requirements.

GP Plasma's vertical inline coater is available for contract R&D projects at its facility in Tucson, Arizona.

- **Line Coordination System (LCS):** This module enables recipe and ISA-88 batch-controlled production processes to be automated in the TIA Portal. For example, production sequences for various networked machines along an entire vacuum coating production line — or any other recipe-driven production line — can be coordinated, synchronized, and monitored in real time.
- **Sequential Execution System (SES):** With this module, process engineers can flexibly design and automate individual production steps at machine and line levels. Production sequences and parameters can be adjusted at any time — even during operation — without making changes to the S7-1500 PLC's programming. If desired, operators can manually access the automatic sequence online and jump to another step or adjust setpoints as required. This may be necessary, for example, due to variations in feedstock or, in general, if a different sequence for individual production steps is required for flexible paths through production.

McEuen reports that several GP Plasma customers are now successfully operating installations of production control systems that use the SIMATIC S7-1500 PLC with WinCC Unified and its integrated LCS and SES modules. "Once installed, the SES handles customer recipes — both new and legacy ones — with ease," he says. "And the system is operating flawlessly."

To this, Schumaker adds: "Because the Siemens SES is a rule-driven sequencer, it has changed how we design a complete system. So, on new systems especially, we can focus on system startup and machine debugging without debugging the sequencer. This is a fundamental change for us and for our customers. These new systems that are running the SIMATIC SES have yet to fail in their sequence executions."

For GP Plasma, the Siemens solution has also provided a big competitive edge. "WinCC Unified with the LCS and SES capabilities are together a game changer for us," McEuen says. "Best I know, we're the first systems integrator in North America to implement these two WinCC Unified options, and they offer our customers huge potential benefits, one of the biggest being that we can migrate legacy recipes in control system retrofits without having to code them from scratch."

- **Results: More intuitive, easier-to-use systems for customers — plus expanded margins and markets for GP Plasma**

When McEuen calls the Siemens SIMATIC solution a "game changer" for his company, he's referencing the new, more standardized development approaches enabled by the S7-1500 PLC with the WinCC Unified LCS and SES modules.

"With SES and LCS, we can now quickly generate recipe systems using the same base structures regardless of the machine type or operation, reducing or eliminating the need for custom recipe systems for every type of machine," says Ian Haehnlein, the company's process and controls engineer.

This new development model is in stark contrast to the past. "Before, when we were designing new systems or refurbishing older ones, our primary — and most time consuming — challenge was programming the recipe system and its sequence execution," Schumaker recalls.

"We had to completely design a new recipe system that had to conform to the existing machine or customer's custom requirements. For a refurbished system, this meant we had to painstakingly review, update and, if necessary, fix custom code.

GP Plasma is a qualified systems integrator for Siemens SIMATIC WinCC Unified Line Coordination System (LCS) and Sequential Execution System (SES) platform designed for complex recipe handling and execution across process industries ranging from thin-film vacuum coatings to pharmaceuticals to food and beverage.

The Siemens SIMATIC WinCC Unified system, with its SES and LCS modules, is designed to handle process variations in thin film vacuum deposition for greater process precision, consistency, and yields. Here's how:

1. Real-Time Monitoring and Control: The system continuously monitors critical parameters such as temperature, pressure, and deposition rates. Any deviations from the set parameters are detected in real-time, allowing for immediate adjustments.

2. Recipe Management: Each recipe can be finely tuned to account for specific process variations. This includes setting precise control points and tolerances for each step of the deposition process.

3. Adaptive Control: The system can adapt to changes in the process environment. For example, if there is a fluctuation in gas flow or temperature, the system can adjust other parameters to maintain the desired deposition quality.

4. Data Logging and Analysis: All process data is logged and can be analyzed to identify trends and variations. This historical data helps in refining recipes and improving process stability over time.

5. Alarm and notification System: If a parameter goes out of the acceptable range, the system can trigger alarms and notifications, ensuring that operators can take corrective actions promptly.

6. Integration with Other Systems: he WinCC Unified system can integrate with other control systems and equipment, providing a comprehensive approach to managing process variations.

Now, we rarely need to update or rebuild old code for refurbs or program new code for new systems. Plus, we're able to fully simulate and test our systems under development in runtime without needing hardware. Not only does that save us time, but it also de-risks projects."

By streamlining the development of recipe handling and sequencing, GP Plasma is now able to design and build different machine types much faster. "These time savings translate into substantial cost savings, which help us expand our margins," McEuen says. "We're also able to handle more projects and expand our business beyond thin-film vacuum coatings, which we've started to do."

GP Plasma can now offer solutions that are superior to what is out there with respect to capability and reliability — and do so more affordably for its customers. "Many industries are using automated equipment and processes that could benefit from the SES and LCS control system," McEuen says. "That's why, given our deep knowledge in this area, we can reach outside the vacuum coating industry and bring these solutions to the world's vast and diverse market for industrial control systems that can deliver much higher levels of sophistication, especially to meet complex recipe-management requirements. And because we can confidently compete in these other industries, we have tremendously expanded the potential opportunities for our company, making our future quite bright and most promising."

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