

Turning Pollution Into Gold

Leveraging IT/OT Convergence Technology
to Create Sustainable Solutions

What If Toxic H₂S Is Not a Nuisance Anymore, But a Gift?

Hydrogen sulfide (H₂S) is a flammable, colorless gas that impacts human safety, regulatory compliance, and infrastructure integrity (corrosion) tremendously in a wide variety of applications. Found in about 40 to 60 percent of natural gas wells worldwide, and in almost every gas well in North America, this poisonous gas, with its characteristic smell of rotten eggs, is both an irritant and chemical asphyxiant, thus affecting the central nervous system and breathing. Therefore, you do not want this toxic gas to come into your house when you turn on your stove. Fortunately, several technologies exist to remove H₂S. While chemicals exist that can directly remove the H₂S from gas, they can be expensive and hazardous to dispose of. Furthermore, these chemicals are only cost effective when dealing with low concentrations of H₂S. When dealing with vast amounts of H₂S, large plants need to be built to remove the toxic chemical. However, most gas wells only contain an intermediate amount of H₂S—not enough to warrant building a \$50M facility, but also too much to treat with a \$10/lb chemical. In between these two options, there is not a lot of good technologies available to remove H₂S efficiently.

Streamline Innovations

Founded in: 2016

Headquarters: San Antonio, Texas

Industry: Streamline Deploys advanced technology solutions for Water & Gas Treating and related processes in the Oil & Gas, Utilities and Industrial Markets

Website: www.streamlineinnovations.com

Streamline Innovations has significantly improved the Redox process and has created one of the most efficient H₂S treating solutions on the market. Their Valkyrie™ (Redox) H₂S Gas and Acid Gas Treating System employs new chemical processes and advanced control systems to remove H₂S from natural gas at size scales that range from single wells to entire fields. Representing a step change in H₂S treatment, this patented process removes 100% of H₂S from the natural gas stream at the lowest cost-per-pound of H₂S removal compared to all other competitors, lowering lease operating expenses (LOE). Most importantly, the Valkyrie™ converts H₂S into agricultural-grade elemental sulfur, which is beneficial for soil remediation, crop fertilizer, and pest control. As one of the fundamental elements of life, sulfur has long been regarded as a necessary nutrient in crops, and sulfur deficiency has been a problem for many crops, from cotton to wine grapes.

So far, Streamline innovations has produced over 20 million pounds of sulfur from its plants throughout Texas and New Mexico, and it is expanding into international markets, biogas treatment, and refinery treatment. The produced sulfur would otherwise have turned into SO₂, a key generator of acid rain.



Streamline Innovations is a technology solutions company focused on water and gas treatment and process improvements in oil and gas, utility, and industrial markets. Streamline Innovations provides differentiated product lines and deploys advanced treating capabilities through their solutions-driven team. They deliver innovative solutions to a variety of problems and operational challenges by leveraging their significant in-house experience and expertise in various markets.

Redox Tricky to Outfox

Redox requires running two precise chemical reactions: reduction and oxidation. However, it is very difficult to control these two processes optimally. What makes it challenging is that H₂S concentrations and flow rates vary in natural gas. Thus, the corresponding amounts of chemical agents added to the gas need to be adjusted constantly. If too much is added, the chemical process can come to a halt. On the other hand, if too little is added, then some of the H₂S might get into the pipeline. For this reason, the old process required an expert in the field to check the concentrations and flow rates every few minutes. Unfortunately, experts cannot be always on-site in natural gas facilities, or even travel to them frequently, especially to smaller units on remote wells. Streamline Innovations' Valkyrie process replaces the "expert in the field" with intelligent rigorous control of the chemistry, allowing the chemical processes to maintain the equilibrium of chemical agents without human intervention. This makes Streamline Innovations' H₂S-to-sulfur process one of the best economical solutions on the market.



At first, Streamline Innovations tested an automation platform written on a standard PLC, but it could not perform the complex calculations and model-based controls. They also built a customized OPC server that communicated with a cloud server, but it had no authentication and security protection. To explore and find the ideal solution, Streamline spent another half-year reaching out to almost every branded solution. Their search led them to Moxa and Inductive Automation to help them facilitate the control and automation process, data collection, and remote control to solve the redox challenges, reduce variability, and stabilize the chemical processes.



IT/OT Convergence Drives Transformation

Streamline Innovations uses Inductive Automation's Ignition SCADA software running on Moxa's computers, which communicate with an Ignition server via the MQTT communication protocol. MQTT allows transfers of relevant data without consuming too much bandwidth, meaning cellular data in remote areas is usually sufficient for operations. As managing the data can be a challenge, intelligently tiered calculations are done between the edge and cloud. Complex calculations, such as model predictive control, by contrast, require historical data and therefore can be done cloud-side. By contrast, motor vibration data generates huge quantities of subsecond data, and the data is processed at the edge as it is too bandwidth-intensive to send all of it to the cloud. Finding the right technology for edge-side processing is critical for successful operations.

Parallel with Ignition software, Moxa computers also run Python scripts, enabling Streamline Innovations to perform complex calculations, which include incorporating weather forecasts from the U.S. National Weather Service to help determine optimal operating temperatures. These calculations would not have been possible with a PLC alone. Machine learning (ML) and fuzzy logic algorithms running on Python provide advanced control efficiency and a self-tuning system that increases operational efficiency. "Ambient temperatures and humidity can have a big impact on sulfur production. ML helps us to predict the temperature and allows us to adjust our surfactant and pH levels for more optimal performance. For example, if the temperature would drop over the next 6 hours,

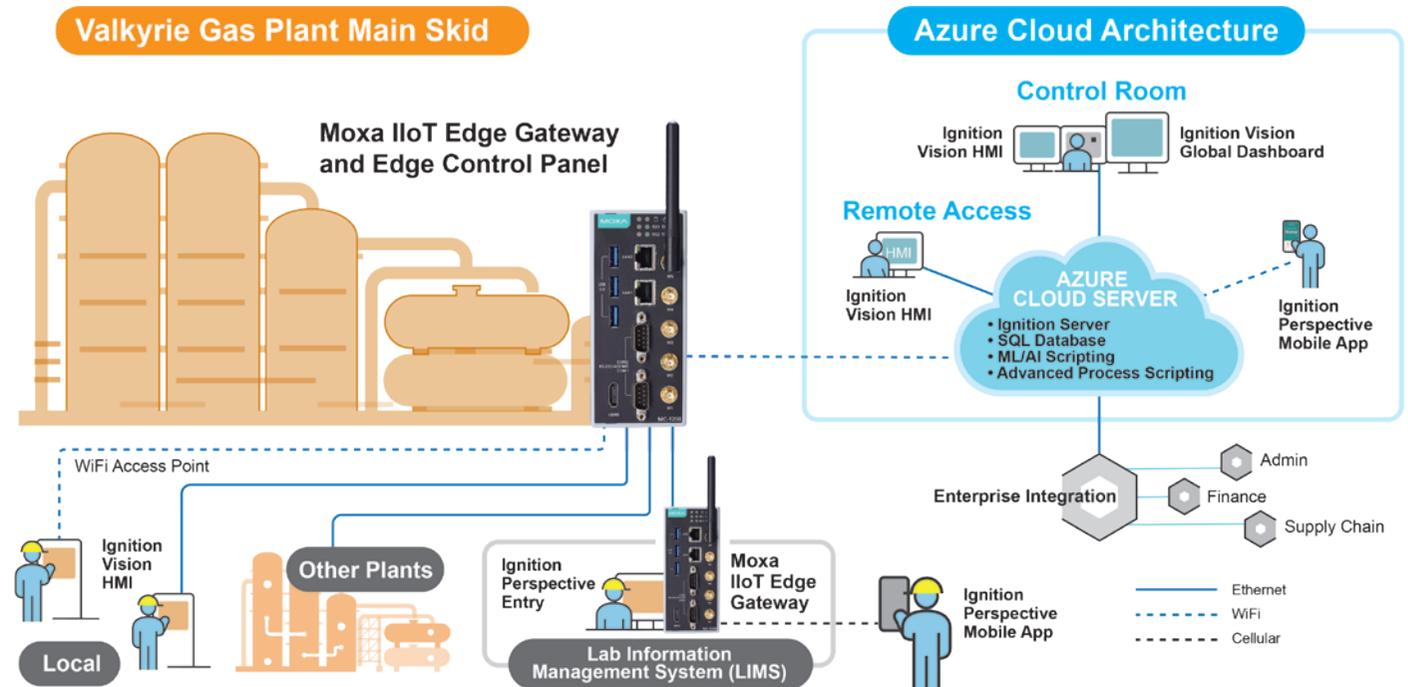
we will actually start heating up our unit even if the ambient temperature is fine," explained Peter Photos, Ph.D, chief technology officer at Streamline Innovations.

"We've really changed the game in terms of IT/OT convergence. That's one of the major reasons we were able to develop the technology at a much smaller scale," adds Photos. "If you think about it, from an IT standpoint using an API for the weather forecast is a trivial calculation. But, with regards to an OT application, in the past, there was no rugged equipment with a fair amount of reliability in an oilfield to facilitate a process like this," added.



"We needed a system that was robust enough, can do the calculations, provide good uptime, and is reasonable priced – and that's why we chose Moxa."

Peter Photos
Chief Technology Officer at Streamline Innovations





Data-Driven Decision Making Spurs Business Growth

Now, Streamline Innovations employs Moxa's robust technology, using straightforward IT practices that have incorporated IT into the OT world. Streamline Innovations' architecture includes Moxa Class I, Div 2 certified rugged computers that gather data from the PLC and convert it to useful KPIs. The KPI data is transmitted to the cloud, with the cloud server distributing the data to the users. What's more, Moxa's computers go a step further: When the cellular modem is down, Moxa's computers record the data and then transmit it to the cloud as soon as the modem is back up and running to ensure maximum uptime of the OT equipment. "That means the system is watching itself, which demonstrates the power of connectivity by using Moxa's computers," said Photos.

In addition, Streamline Innovations has extended Ignition software by running a full version with its Perspective module deployed via a local Wi-Fi network. This allows users to access the unit, including its full HMI and historical on-site data from any computer near the unit. This means operators can access the unit from their laptops in their trucks shortly after pulling into the site. This has virtually eliminated the need for a dedicated HMI. Additionally, the cellular communications module allows users to access the same HMI from anywhere, meaning the centralized control room or even the operators' cell phone can see and control exactly as if they were on-site. This has greatly eliminated the need for operators to go into the field, for example, if the unit has shut down or an alarm has been triggered. They can simply restart the unit remotely with their phone from the comfort of their home or office.

With Moxa's solution and Ignition, Streamline Innovations has benefited from a 75% reduction in labor costs as they do not need so many full-time employees on-site to manage the units. The constant updating of flow rates and chemical addition by an employee is no longer necessary. Moxa's computers are doing the calculations and provide maximum uptime. Furthermore, in the past, Streamline Innovations could not address several variables, such as temperature and humidity variations, which could affect the amount of water during the chemical process. Now, they can because ML has been added to model-predictive control with help from Ignition and Python scripts running on Moxa's computers. "I call it Edge of Glory. It is the data revolution. It helps Streamline unveil the revolutionary H₂S removal technology," adds Peter.

Not only does a robust data collection system improve operational performance, but the integration of the data does benefit every branch of the company. The data is used in maintenance planning, designing more efficient units, and even corporate-wide business model calculations. In the future, the fully integrated data will help automate the business across the spectrum, allowing data-driven decisions to be made at every level of the company.

The improved Valkyrie™ System, leveraging Moxa's computers and Ignition software, has brought several benefits to both Streamline Innovations and their clients. These benefits not only include cost-savings with the set up of the solution, but also labor reduction, improved uptime, and efficient intelligence gathering from the systems for continuous operational improvement. Going forward, Streamline Innovations plans to expand the Valkyrie™ solution to more customers by leveraging their solutions team and experience to help solve the challenges facing industrial markets.

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