Bridging Water Infrastructure Monitoring Challenges with Tech Innovations

STAKEHOLDERS

CURRENT
Technology Partner

SIGA OT Solutions, Inc.
Developer of SIGAPlatform, a technology platform that provides incipient failure detection for infrastructure operators to improve the reliability, safety, and cybersecurity of their assets.

Wilmington, DE

CURRENT
Founding Member

Metropolitan Water Reclamation District of Greater Chicago (MWRD)
Special-purpose utility responsible for treating wastewater, and providing stormwater management for residents and businesses in its Chicago service area, which encompasses 882.1 square miles. MWRD serves approximately 10.3 million people each day.

Chicago, IL

THE WATER INNOVATION CHALLENGE

MWRD sought to explore potential solutions related to monitoring the Lockport Powerhouse dam's gates and water level, a critical element of the waterway operations. They wanted to improve security and gain access to higher resolution data. Yet, sourcing and troubleshooting technological improvements that could work seamlessly with their existing operations presented a challenge.

SIGA, which is headquartered in Israel and provides a technology platform for water infrastructure management solutions, needed to establish their first proof of concept (POC) under U.S. regulations. A successful POC would enhance their opportunities for expanding their technology in the U.S. water and energy markets.

THE WATER INNOVATION OPPORTUNITY

CURRENT recognized the opportunity to bring the two organizations together. CURRENT identified SIGA as a great-fit candidate to assist MWRD in monitoring their equipment through the sensor data at the waterway's roller gates, while also detecting operational anomalies responsible for changes in the water level.

This project originated in 2018 as a pilot program designed to evaluate and validate SIGA's critical infrastructure monitoring technology, via MWRD, with the intent of establishing POC and piloting new, innovative water technology solutions in Chicago that can help solve global problems.

"The MWRD Lockport Powerhouse project was the first project SIGA launched in the U.S. market. It had tremendous impact on SIGA's ability to demonstrate its innovative solution and capabilities to critical infrastructures there. SIGA's cooperation with CURRENT, who facilitated this project, demonstrated a strong and strategic bond with a major utility in the Unites States, with the highest professional conduct."

— Ilan Sosnovitch, Global Sales Manager and Water Technology Specialist, SIGA

"Reliable remote monitoring of critical water infrastructure is an essential capability. It increases our resilience during both the best and worst of times, and the current public health crisis only sharpens the case. Siga's technology is a strong example and we are fortunate to have been able to demonstrate it right here in Chicago with MWRD."

— Alaina Harkness, Executive Director, Current

SIGA'S SOLUTION FOR MWRD

SIGA introduced MWRD to its SIGAPlatform, which uses out-of-band technology and machine-learning predictive analytics to safeguard critical water infrastructure assets. The SIGAPlatform monitors the electronic signals of critical assets for problems due to mechanical failure and cybersecurity breaches. The platform shows operators the most accurate, real-time situation about the status of their infrastructure – from machines that are nearing failure to the beginning of a cyberattack – to protect the critical assets and communities they serve.

PROJECT GOALS

SIGA's primary goals for MWRD's POC project were to 1) monitor MWRD's water level equipment using the SIGAPlatform; 2) detect any cyber or process related anomalies; and 3) provide further insights to MWRD's powerhouse operators, who regulate canal levels to prevent local flooding and river reversals into Lake Michigan during heavy rain events.

The pilot project ran for six months in 2018 at MWRD's Lockport Powerhouse on the Chicago Sanitary and Ship Canal. Significant milestones of the project included:

- February: Technical survey to determine critical assets
- April: Dispatched shipment of hardware to Lockport, installation, and beginning of the project
- April – June: Machine learning period
- June: Anomalies in water levels were detected and reported (See *Technical Notes*)

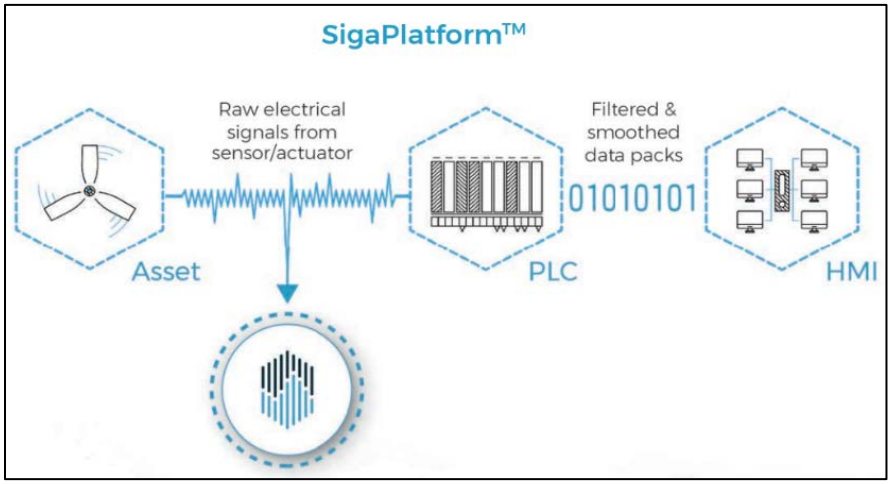
RESULTS

- All detected anomalies, including power failures, were sent as automatic alerts to MWRD staff, who reviewed the information and planned appropriate corrective actions.
- SIGA's first water infrastructure-related POC project and installation in North America allowed the company to further validate its technology in a major water infrastructure setting, under US regulations.

About the SIGAPlatform System

The SIGAPlatform is a next-generation anomaly detection platform that secures raw data duplication. It is based on fully out-of-band hardware, reliably encrypted data delivery, and multi layered analysis, which aim to identify process abnormalities and generate new and valuable operational insights. SIGAPlatform is comprised of a hardware layer installed at the critical infrastructure level to measure raw electrical signals, as well as a software layer that applies advanced analytics. The electrical signals are acquired directly from the control loop, between the PLC and the sensors/actuators, using uni-directional isolators that connect them to a separate network. This raw data is analyzed by SigaPlatform's smart AI engine, which provides a reliable, real-time status of the critical end-devices of the OT network, and sends notifications according to customer specs. (See Figure 1.)

Figure 1. Conceptual design of the SigaPlatform



This figure depicts the relationship among the physical asset monitored by the SigaPlatform, the programmable logical computer (PLC), and the human monitored interface (HMI).

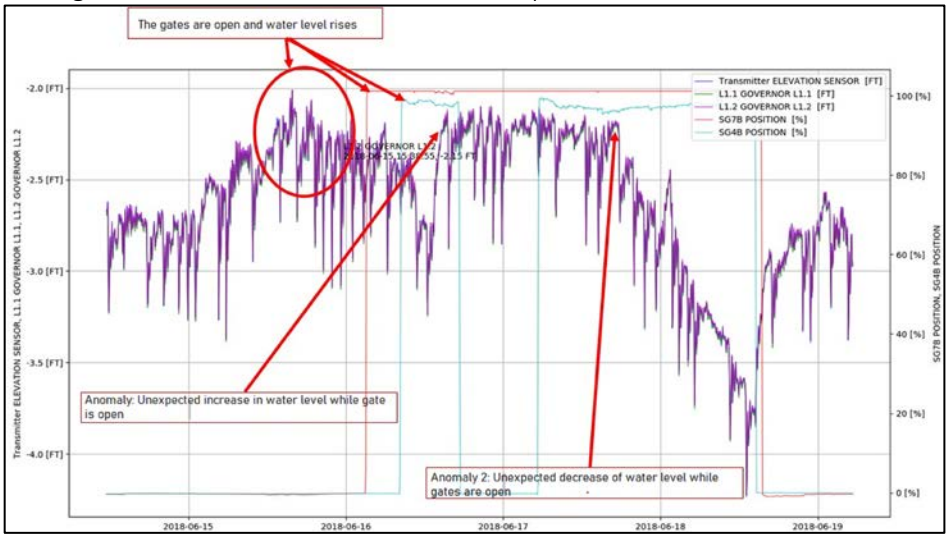
MWRD Pilot Program – Anomalies Found

Figure 2 shows a screen capture of the real-time water levels at the Lockport Powerhouse in June 2018. The gates are open on June 16 and water levels are rising. The first anomaly occurs during that day, showing an unexpected increase in water level the next day, followed by a water level decrease while the gates were open.

This is an example of an alert created by SIGA's Machine Learning (ML) algorithms, which was identified by the system as an anomaly (something happening that is not part of the normal behavior of the system). The SIGA system identified a correlation between the opening/closing of the gates and the decline/increase of the water level.

At this specific occurrence, the SIGA system identified behavior that is not typical for the normal pattern of operation: the gates were opened so the water level is expected to decrease. However, the water level increased instead, perhaps due to rain or another event. This figure shows that the ML engine was able to identify the anomaly by itself, without any human pre-configuration. These, as well as many more insights, are examples of what can be achieved using ML algorithms to help operators monitor processes and identify inconsistencies in the flow of data through the SigaPlatform.

Figure 2. Anomalies detected at the Lockport Powerhouse in June 2018.



In Figure 3, the SIGAPlatform indicates the status of the gates and whether they are open or closed. This shows the SigaPlatform's remote monitoring capabilities. There are two advantages of the SIGA system:

1. SIGA is connected directly to the electrical signals of the field devices, which means access to much more granular, raw, high-speed, high-resolution and unfiltered information, directly from the source (and not from a digital representation of it in the control system).
2. Cybersecurity. Since SIGA is not connected to the ICS network, it is completely out-of-band, and thus cannot be hacked or manipulated in any way through the network. This allows authentication and validation of the monitoring process.

Figure 3: Depiction of gate status at the Lockport Powerhouse in June-July 2018

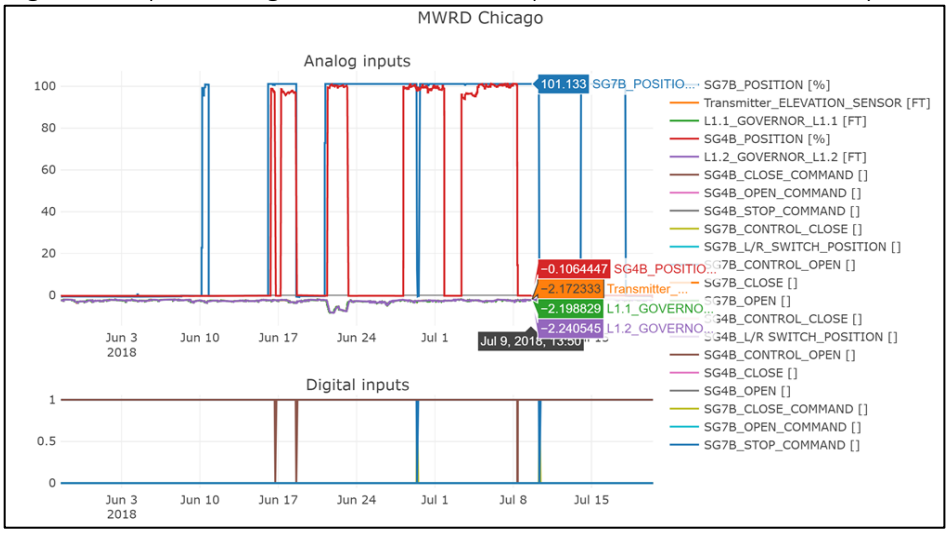
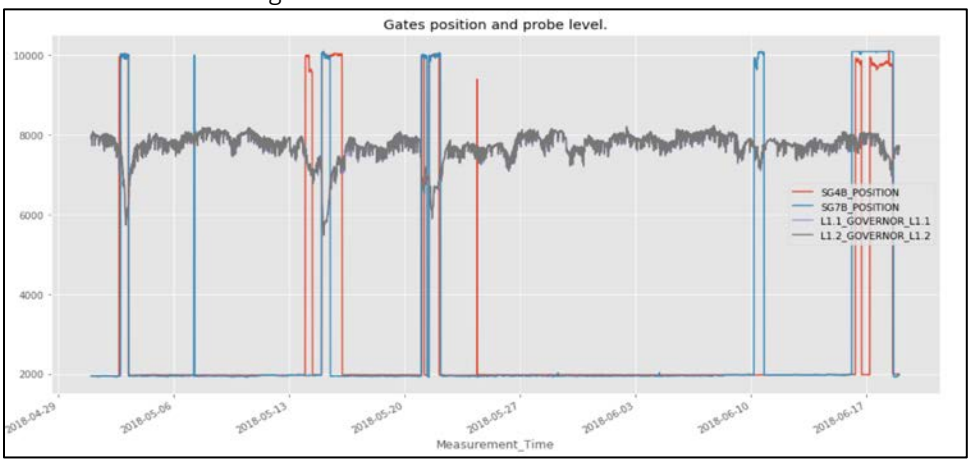


Figure 4 depicts the gate positions and probe levels for the Lockport Powerhouse. The transmitter elevation sensor and the field device L1.1_Governor_L1.1 represent the height of the water as measured by the sensor in the river. These determine how much the gates should be opened based on the river's height from the water table contribution. SIGA monitored the electric flow, which represents the flow of water, height of water, and gate (L1.1-L1.2). SG4B and SG7B are the gates that SIGA monitored. Each gate provided data points when it opened or closed, so those actions could be monitored. The unit of measurement is in millivolts because SIGA was connected to the electrical signal, which allowed them to directly authenticate the actual situation in high speed resolution in real-time from the source. SIGA is receiving the data directly from the electrical signals, and then interprets, analyzes, and provides powerful ML insights for the operators.

Figure 4. Gate Position and Probe Levels



In this figure, the X-axis equals millivolts and the Y-axis represents the date. 2000 = millivolts = 0% and 10000 = 100%. These metrics represent the electrical flow to the gate.

CURRENT

CURRENT's mission is to grow Chicago and Illinois' blue economy – the companies developing innovative water technologies and industries that use them – to build solutions that will solve the world's water challenges.

Launched in 2016 as a nonprofit water innovation hub, CURRENT is headquartered in Chicago, IL. CURRENT is a collaborative that leverages partnerships with the state's world class utilities, research institutions, industries and innovation community for global environmental and economic impacts. As a cross-sector connector of local and global water sector stakeholders, CURRENT builds networks, organize events and convenings, and helps develop pilot projects in real-world settings to solve persistent local water challenges

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