HID Global's Passive RFID Sensor TAGs Help GE Hydro Optimize Operations of Its Generator Installations

RAIN RFID temperature and strain sensors from Asygn embedded in HID's rugged and innovative TAG design enable new use cases.

BACKGROUND

GE Hydro, a wholly-owned subsidiary of GE Renewable Energy, provides a full range of solutions for small and large hydropower installations, including machinery and equipment sensor integration, testing and measurements, and data interpretation through its Asset Performance Management (APM) platform. GE Hydro's customers around the world include integrators and government-owned companies, federal utilities, independent power producers and investors.

CHALLENGE

Hydropower, which uses the power of moving water to generate electricity, is one of the oldest and largest forms of renewable energy. Hydropower installations are located in severe environments, so they typically have aging connections between the rotor poles which exhibit drastic temperature rises and cause unplanned failures in production. Because these rotating connections are subject to significant radial accelerations, the use of batteries and direct wired connection is prohibitive. Infrared devices and fiber-based temperature sensors aren't ideal either: wet and dusty environments typically limit the range of infrared signals, while fiber-based sensors make the removal and retrofitting of poles during maintenance difficult. The direct proximity of metal parts as well as the high speed of transit in front of the antenna (which can go up to 250 km per hour) are challenges by themselves.

In these hydropower applications, it is very important to track generator temperatures and shaft line strain and this is done in harsh conditions where traditional solutions are ineffective. GE Hydro uses wired sensors in static parts of turbine generators to check its conditions, but high-moving parts like the generator poles are less instrumented today, even though they are critical parts of the equipment.

Monitoring, collecting and managing reliable data with a small RFID TAG is a major technical challenge because of the brute force of the operating equipment. One of them comes specifically from the high currents and related electromagnetic fields inside the enclosure where is the RFID chip in the generator: any loop in such fields can turn into unwanted currents with potential short circuits in either the chip or the printed circuit board.

SOLUTION

With specifications in mind, GE Hydro partnered with Asygn, a developer and semiconductor integrated device manufacturer (IDM), to use AS3211 IC that was meeting all of GE Hydro's requirements. But to create an industrial-grade solution, the entire system would also need a properly tuned antenna within the RFID bandwidth capable to power the complete acquisition chain and components of the chip. GE Hydro also specified a full system to be attached to the rotating parts where the distances and the transit time would be close to 4 meters and 10 milliseconds respectively.

Asygn had already been working with HID Global as a TAG provider for the UHF condition monitoring sensors they developed over the past decade. So, enlisting HID Global to solve GE Hydro's challenge was a clear choice.

Integrating the TAG antenna with the RFID chip was critical to ensure the antenna's reliability and integrity during the massive radial acceleration of the hydro turbines.

Adding to the complexity, GE Hydro needed to measure external deformations in quarter and half-bridge strains by using a silicon gauge bonded directly to the structure. HID Global's engineering team was able to offset the TAG's thickness to maintain the antenna's performance even if in close proximity with metallic conductive surfaces.

"What made the collaboration with HID Global and the project great was that GE focused on the constraints, the context of usage and the data handling and modelling while HID focused on the TAG form factor necessary to fulfill GE Hydro's requirements in terms of performances and integrity in very harsh environments."

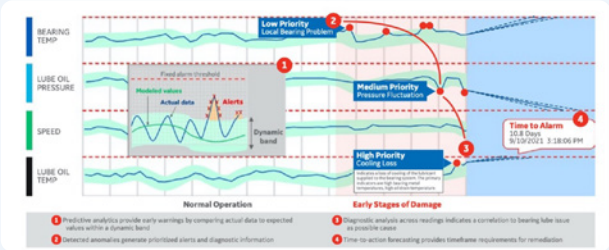
Vincent Bouillet
In charge of IIoT and advanced technologies development at GE Renewable Energy Hydro Organization

HID

Picture 1: High temperature robust sensor tag manufactured by HID for GE Renewable Energy

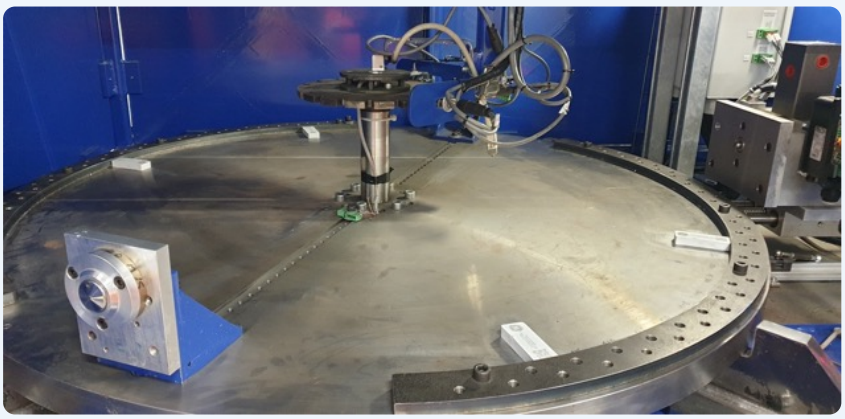
The solution encompasses Asygn's chip, which captures temperature and strain measurements when the HID's TAG antenna forwards that data to an RFID reader. The RFID reader works as an intelligent gateway capable of calibrating, collecting, filtering, averaging and transmitting data locally.

Data aggregation and modeling happens through GE Hydro's Asset Performance Management (APM) platform. The software uses machine-learning analytics with local context and parameters such as ambient and startup temperatures, or seasonal effects to avoid any false positive and push erroneous standardization in the model itself.



Picture 2: GE Hydro's APM Cloud modelling with time-to-action forecast

Because high radial acceleration is a major challenge, two tests were performed on an overspeed test bench where GE Hydro's overspeed security devices for hydro turbines are tested and validated. This bench is certified for rotating speed up to 800 rpm with a significant level of safety and speed accuracy.



Picture 3: Overspeed Test Bench with rotating TAGs at GE Hydro Grenoble facility, France

THE BENEFITS

To be able to measure temperature and deformation with a good accuracy with no wires and no battery is critical for GE Hydro's customers. The TAG's lightweight and innovative design, which is insulated and resistant to extremely high voltages, makes the solution ideal for hydropower applications. Specifically, the TAGs can now improve cyber-physical models associated to generator cooling and hydraulic efficiency, an important requirement for mean generator enclosure temperature and shaft line torque measurements.

The risks of major failures due to copper fusion in a rotating machine are now drastically minimized. Additionally, it is now possible to push the hydropower equipment to the limits and enhance network power factor and voltage regulation which are critical today with intermittent renewable energy sources from wind and solar plants.

The temperature and strain data are sent to the APM and GE Expert platforms, where data can be monitored and interpreted for real-time machine availability. The new addition of time-to-action analytics informs when an equipment anomaly will reach an alarm limit and require immediate action. Equipped with this knowledge, operational managers and maintenance engineers can optimize maintenance prioritization and scheduling to keep operations running with a cohesive workflow plan in place.

GE Hydro plans to install pilots all over the world and collect data on customer sites, and provide associated services for machine eligibility, RFID integration, bonding, and data collection.

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