Addressing Energy Management Challenges in the Automotive Industry

Two major energy challenges facing manufacturers in general are power quality and energy efficiency. With high competition, pressure from consumers for innovation and energy saving vehicles, increasing government regulation intended to reduce carbon footprint, and the high cost of energy, automotive manufacturers, in particular, have many reasons to invest in a comprehensive energy management system. "Obtaining and maintaining in-depth energy-related process knowledge is an essential prerequisite for energy optimisation [sic] and energy-efficient planning and operation of all factories and production systems."[i] An energy management system enables the auto manufacturer to address and prevent power quality problems and to optimize their energy usage by ensuring their efficient use of energy. In this paper, we'll explore how an energy management system consisting of advanced power quality meters, high accuracy submeters, and energy management software, can improve both power quality and energy efficiency for automobile manufacturers.

Power Quality

Ever since manufacturing of automobiles became automated, the need for reliable energy to power the assembly line has been of utmost importance. Today's automotive manufacturing plants are particularly susceptible to power quality issues that can cause unplanned downtime, damage to expensive equipment, and higher electricity bills**.** Like most modern manufacturing facilities, they are highly automated and use large numbers of variable speed drives, programmable logic controllers and equipment with embedded microprocessors. These kinds of devices can all produce harmonic pollution that leads to nuisance breaker trips, device malfunction, data loss, and premature equipment failure.

Avoiding downtime and damage to equipment due to power quality issues is crucial for an automobile manufacturer to remain competitive and generate profit. As stated in a report from Microgrid Knowledge, "Consider a car manufacturer that makes about 1,200 cars a day: The cost for each car is roughly $50,000. That means just one day offline costs the factory $60 million."[ii] Automotive manufacturers must pay close attention to power quality monitoring and take immediate steps to address power quality issues before they escalate and cause equipment damage and revenue-reducing downtime.

Energy Efficiency

An important consideration for automotive manufacturers is cutting costs to maximize profits. One of the most important contributors to costs is energy. Increasing efficiency of the power used leads to less consumption and greater overall profitability. "Recent studies suggest that the energy required to produce a typical passenger vehicle is 41.8 megajoules per kilogramme [sic](MJ/kg). To provide some context, that's almost 40 times the amount of energy used to run a household washing machine with an average consumption of 1.08 MJ/kg."[iii] With that much power being consumed, it is critical for auto manufacturers to ensure they are not wasting any of it.

An important measure of energy efficiency is power factor (PF). The main contributors to lower PF in manufacturing are inductive loads such as heaters, welders, lighting, and motors. Left uncorrected, poor PF causes higher surcharges and costly penalties on monthly electricity bills. It can also cause damage to equipment.

Solutions

Power Quality meters allow access to both real time power quality issues, such as harmonics, and advanced power quality analysis, e.g., waveform analysis. Installing a power quality meter at the point of common coupling with the utility helps the plant engineer understand the quality of power received from the utility. Additionally, installing a power quality meter wherever relays are installed lets plant operators monitor these protective devices. Any substations in the automotive manufacturing plant should also be equipped to monitor the power quality of the feeders and to protect their costly assets, such as power transformers.

Energy management software that gives the ability to set alarms on programmable power quality limits, such as harmonics or voltage sags/swells, enables timely action to prevent problem escalation. For example, a voltage sag lasting longer than three cycles can cause problems with sensitive equipment such as microprocessor-based devices. Being able to program an email alarm when the voltage drops below a set level lets system operators respond quickly to fix the problem. Software that supports real time polling, trending logs, and comparison usage dashboards gives the plant engineer both real time and post-event analysis. And having post-event analytic capability lets the auto manufacturer discover whether the fault occurred in their electrical system or in that of the utility.

To maintain energy efficiency, automobile manufacturers need to monitor their energy usage to learn how and where energy is being used. Installing high accuracy submeters lets plant operators monitor usage in different areas of the auto manufacturing plant, e.g., in painting and in final assembly. By monitoring usage, the operator can be alerted to problems – such as machinery breaking down, indicated by unusual usage. They can also determine which areas may be energy wasteful and take steps to reduce usage, e.g., improving HVAC systems, installing automatic lighting, and switching usage when possible to non-peak times. By using submeters to monitor PF, operators can respond proactively to indications of lowered efficiency.

Energy management software is instrumental in increasing energy efficiency and lowering waste. Real time usage, usage comparisons, usage dashboards, and power factor limit alarms are all ways that a robust energy management software system can lower auto manufacturers' energy costs by increasing their plant's energy efficiency.

Conclusion

The automotive manufacturing industry has extremely high value production processes which are sensitive to power quality events. Additionally, to stay competitive they need to ensure the energy they consume is used efficiently. The installation of advanced Power Quality meters, highly accurate submeters, and robust energy management software lets automotive manufacturers view real time readings, receive limit alarms, monitor trends in the data collected, identify weak points in the system, and plan equipment service and replacement, rather than having to deal with costly and interruptive downtime in the event of a failure.

EIG Solutions

Electro Industries/GaugeTech (EIG) has over 45 years of experience in providing leading-edge power quality and revenue accurate metering products and comprehensive energy management software. Some of our product offerings are listed below. To see more, go to EIG's website:
https://www.electroind.com/power-metering-products/

Power Quality Meters

Nexus® 1500+ Power Quality Meter with Phasor Measurement Unit: a 0.06% revenue accurate, certified IEC 61000-4-30 Class A, Ed. 3, cyber secure meter that is ideal for smart grid, critical metering, and power quality sensitive applications.

Nexus® 1450 Cyber Secure Power Quality Meter with Multiport Communication: a 0.06% revenue accurate, certified IEC 61000-4-30 Class A, Ed. 3, cyber secure meter with advanced HTML5-based web server that offers waveform analysis tools, six communication ports, and wideband frequency support (20-500 Hz).

Submeters

Shark® 200S Multifunction WiFi Electric Submeter: a 0.2 accuracy class submeter with simultaneous WiFi and Ethernet, standard IrDA, and extensive data logging.

ST40 Compact Din Rail Mounted Energy and Power Quality Meter: a 0.2 accuracy class electric submeter with power quality waveform recording; logging; RS485, Ethernet, or BACnet communication port; front panel USB port; and featuring a small footprint ideal for machine-level monitoring.

Energy Management Software

CommunicatorPQA® and MeterManagerPQA® Energy Management Software: an application to program, manage, database, and view logged data, easily manage large fleets of meters, view real time data, perform detailed power quality analysis, quickly configure meters, set up limit alarms, and generate/email customized reports.

EnergyPQA.com® AI Driven Energy Management System: a cloud-based application that provides energy predictions to reduce costs and improve power system reliability. The EnergyPQA.com® system determines the most energy wasteful facilities and circuits to maximize energy efficiency improvements and identifies the least reliable facilities and circuits using deep power quality insights to improve electrical reliability.

NOTES

[i] "Requirements and tasks for active energy management systems in automotive industry," *Science Direct*, Franz, Erler, Langer, Schlegel, Stoldt, Richter, Putz, 2017; accessed 8/25/2023 from
https://www.sciencedirect.com/science/article/pii/S2351978917300288?ref=cra_js_challenge&fr=RR-1

[ii] "What is the Value of Electrical Reliability for Your Operation?", Peter Maloney, May 7, 2018, accessed 8/28/2023 from https://www.microgridknowledge.com/resources/reports/article/11430552/what-is-the-value-of-electric-reliability-for-your-operation

[iii] "Energy consumption in the automotive industry." *Industry News*, September 28, 2022, accessed 8/28/2023 from https://blog.oilandgasjobsearch.com/energy-consumption-in-the-automotive-industry/#:~:text=Recent%20studies%20suggest%20that%20the,consumption%20of%201.08%20MJ%2Fkg.