electro**industry**

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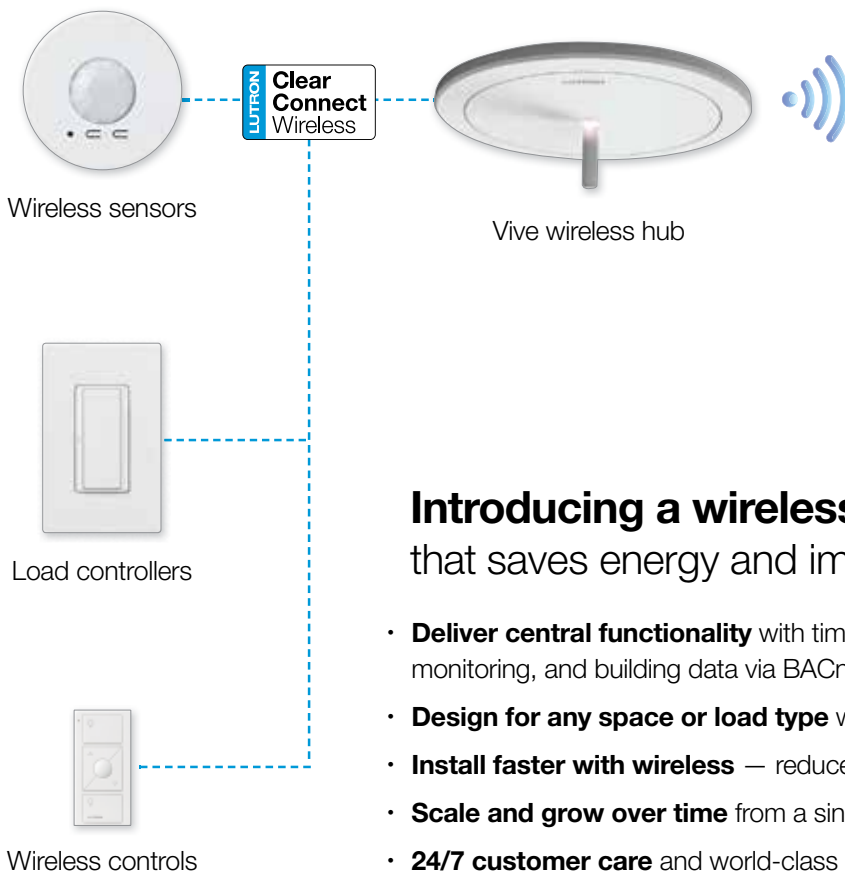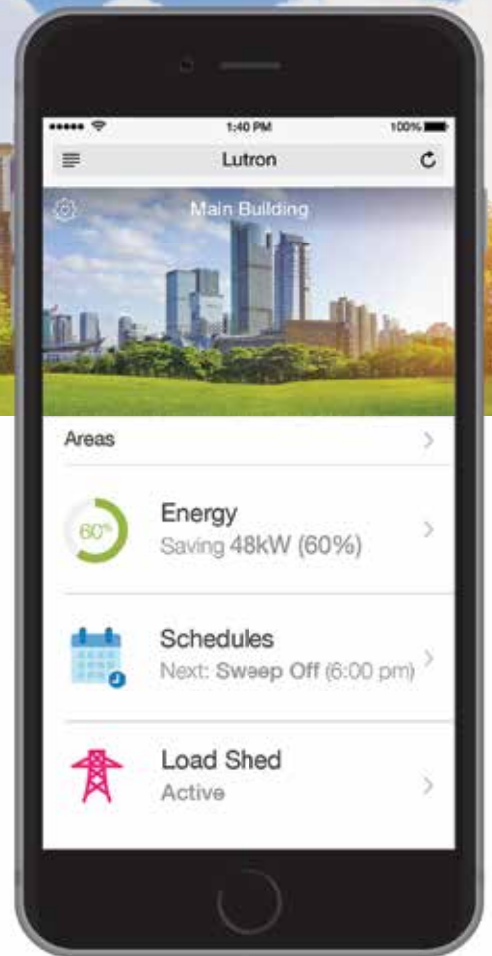
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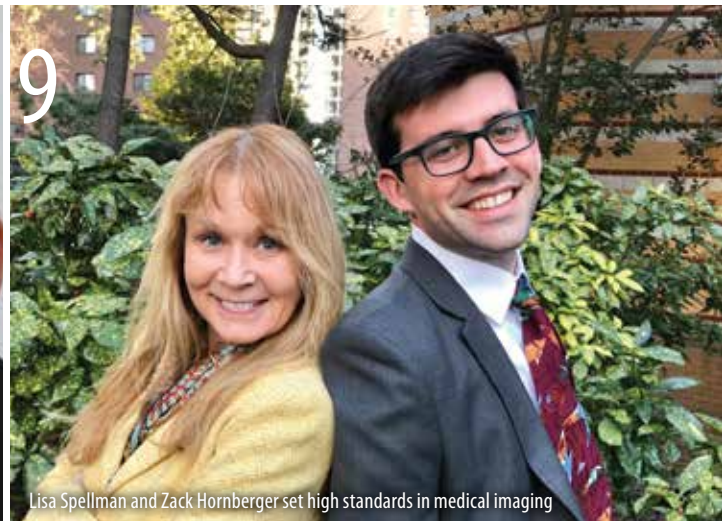
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NEMA has been empowering the electroindustry with digitization since the mid-1990s. The association has been at the forefront of building standards for business-to-business commerce and utilizing more efficient electronic means and technology, rather than manual processes, for more than 20 years.

Some of this digitizing has been referred to in different terms:

- building electronic data interchange standards (EDIPro)
- utilizing barcodes and universal product codes (UPC)
- data transfer via industry data exchange, value add networks (IDX, VAN)
- leveraging data warehouses and connectivity to syndicate content (IDW, GDSN)
- attributed or enriched data and digital assets for online consumption (web content)

The industry has made significant investments through the efforts of countless volunteers from NEMA Members, NAED, EFC, NEMRA, and software companies to create industry standards and coordinate much needed digital building blocks. This collaboration became the springboard for the creation of IDEA (Industry Data Exchange Association) in 1998, as a jointly owned entity by NEMA and NAED.

In the February issue of *electroindustry*, I noted that "using connected-enabled technology to respond dynamically to changing conditions and demands will be one of the defining characteristics of our times." In essence, the industry has been transforming paper, graphics, and manual processes to create the building blocks for the future digital state. Our commitment to digitizing supports a strong, competitive industry position as we migrate to a data-driven/digitally connected ecosystem.

Moving the industry to a digital mindset involves a number of hurdles. We don't have all the data or digital assets needed from the industry, and we are still working through the standardization, interconnectivity, security, and data-mining capabilities of a digital landscape. Building such an ecosystem is not free. It is time-consuming to create and maintain, and without compelling top- or bottom-line impact, may be challenging for the C-suite to embrace. I can attest from my own experience at Hubbell that the runway is long. It requires change management and fortitude to stay the course. Unless this investment is viewed strategically, it can easily be derailed by other priorities.

The cross-section initiatives that are needed to reach consensus decisions and direction can be challenging in NEMA's structure. Supporting the evolution that drives digitization, however, is becoming as important—and perhaps even more important—than the physical products we offer. NEMA's Strategic Initiatives Committee can take the lead in this effort, working across sections to move forward.

The Strategic Initiatives Program was established in 2007 to seize emerging market opportunities and solve impending challenges facing multiple NEMA product sections and divisions. On an annual basis, the NEMA Board of Governors approves a new suite of initiatives. The next leg of the journey starts with NEMA's Members and its leadership. I urge you to visit the Strategic Initiatives website (www.nema.org/si) to see the agenda and how to get involved.

The Strategic Initiatives Committee has built an annual cadence to review our future challenges. With more involvement by the collective membership, we can forge a better and more profitable journey. Get involved, challenge the status quo, and help NEMA and the *electroindustry* chart a course to better serve the needs of our customers through digitization. ⊕

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Congresswoman Norma J. Torres
D-CA

Advanced Manufacturing— Powering the Nation's Infrastructure

As the country's unemployment rate nears four percent, we have an opportunity to ensure that a full-time job can lead to a middle-class life for all Americans. As one of the fastest-growing fields, manufacturing will be a powerful job creator— but over the next 10 years, more than half of all those new jobs created are expected to go unfilled because of a lack of trained workers.

According to a 2011 survey by Deloitte and the Manufacturing Institute,[1] 83 percent of manufacturers reported a moderate to severe shortage of available skilled positions, with 76 percent anticipating a worsening shortage over the next three to five years. The manufacturing industry contributes $2 trillion to the U.S. economy. It's clear that preparing America's workers for future jobs should be at the heart of any proposed infrastructure plan from Congress.

That's why as chair of the Congressional Hispanic Caucus Budget Task Force and co-chair of the New Democrat Coalition 21st Century Infrastructure Task Force, I'm pushing for policies that bolster the nation's manufacturing industry and create good-paying jobs here in the U.S.

Last year, I embarked on a "Made in the 35th" manufacturing tour of my district to speak directly with local manufacturers. Everywhere I went, I saw businesses that were ready to expand but were unable to find skilled workers to hire. That's where programs like the Industrial Technical Learning Center at Chaffey College in Rancho Cucamonga come in. The learning center partners with California Steel Industries to equip students with the skills and training employers need. The program aids approximately 3,000 students in their pursuit of industry-recognized and nationally portable licenses, certifications, and degrees. It's an important step in the right direction, but we know there's still more we can do to fill the severe employment gap in advanced manufacturing around the country.

Congresswoman Torres, who represents the 35th District of California, chairs the Congressional Hispanic Caucus Budget Task Force and co-chairs the New Democrat Coalition 21st Century Infrastructure Task Force.

One way we can do that is by connecting workers—especially those who are newly displaced—and educational institutions with manufacturers to develop training programs. I introduced the Job Opportunities Between our Shores (JOBS) Act to authorize the secretary of labor to initiate pilot projects between advanced manufacturers and local community colleges, state colleges, and workforce investment boards to facilitate education and training programs in advanced manufacturing.

Partnerships created through the JOBS Act would open the gates for apprenticeships, internships, and other direct hiring pipelines for thousands of businesses and students across the country. These newly trained workers would then be able to find positions in high-demand careers like aerospace, advanced material manufacturing, and robotics. This comprehensive model will help American workers keep up with the demands of the field.

Advanced manufacturing will be the engine powering the nation's infrastructure projects, generating innovation, and creating new careers as the industry expands. As a member of the House Manufacturing Caucus, I know how critical investment in our workforce is to keeping the nation's manufacturing industry strong. I'll keep working to provide America's workers with the tools they need to succeed and compete in our 21st-century economy. ⊕

1   Center for Manufacturing Research, *2011 Skills Gap Report*, www. themanufacturinginstitute.org/Research/Skills-Gap-in-Manufacturing/2011-Skills-Gap-Report/2011-Skills-Gap-Report.aspx

Save the Date

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Electroindustry to Congress: Grid Cybersecurity a Shared Responsibility

NEMA Vice President of Government Relations Kyle Pitsor testified in front of the Energy and Power Subcommittee of the U.S. House of Representatives Energy and Commerce Committee at a March 14 hearing on improving the cyber- and physical-security of the electrical grid.

"Electroindustry manufacturers have made cybersecurity a top priority. As the manufacturers of essential grid equipment, NEMA Members are a key line of defense against both physical- and cyber-attacks on the electricity transmission and distribution system," Mr. Pitsor testified. "However, the responsibility for protecting our nation's electric grid must be shared among the private sector, end users, and government agencies."

NEMA recommended increased public–private collaboration on cybersecurity, possibly including voluntary cybersecurity evaluation of products used in the transmission, distribution, and storage of electricity.

Mr. Pitsor's testimony highlighted NEMA electrical standards, including NEMA CPSP 1-2015 *Supply Chain Best Practices* and its companion document, NEMA CPSP 2-2018 *Cyber Hygiene*, which is scheduled to be published in May. More information is available at www.nema.org/cybersecurity.

The hearing focused on four bills, two of which impact the electroindustry. They are the Cyber Sense Act (HR 5239), which would establish a voluntary program to identify and promote cyber-secure products for use in the bulk-power system, and Enhancing Grid Security through Public-Private Partnerships Act (HR 5240), which would require DOE to provide voluntary physical- and cybersecurity training and technical assistance to utilities; assess DOE cybersecurity priorities, policies, and procedures; and update the Interruption Cost Estimate Calculator.

Both bills are co-sponsored by Congressmen Bob Latta (R-OH) and Jerry McNerney (D-CA), who co-chair the Congressional Grid Innovation Caucus. ⊕

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Book a Speaker—
Speaking of the Electroindustry

NEMA Industry Director Steve Griffith joined experts on the Standards & Architecture Panel at the Industrial Internet of Things Energy Forum in February to discuss what is needed in information management, communication across diverse energy infrastructures, best practices, methodologies, and available technology. He will also provide NEMA's insights on the microgrid market opportunity at the third annual Grid Modernization Forum, May 23 and 24.

Senior Program Manager Brian Marchionini represented NEMA at the Energy Storage Systems Safety and Reliability Forum, sponsored by the U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability, in March. He will address microgrids, resilience, and cybersecurity at the Energy Storage Association's 28th Annual Conference and Expo, April 18–20, as a panel participant on "Your Need-to-Know Guide to Grid Risk Theories and Cyber Security Standards."

For more information, visit www.nema.org/book-a-speaker or contact book-a-speaker@nema.org. ei

Collaborate to Protect Data, Safeguard Privacy

**Witold Bik,
Vice President
of Advanced
Development, S&C
Electric Company**

Mr. Bik has more
than 25 years
of experience
in distribution
automation,
smart grid
technologies, and
communications.

The use, ownership, and privacy of equipment data are the subject of debate, particularly in highly regulated industries.

Responsibilities, beliefs, and practices are highly varied as customers determine whether and how evolving regulations apply to their manufacturing suppliers. This situation can impair collaboration, complicate contracting, and increase costs. Manufacturers with effective data policies, practices, and guidelines will foster effective relationships with their customers and enable those customers to meet their own regulatory and end-customer commitments.

In the ongoing digitization of the world, electromechanical equipment is being rapidly displaced by microprocessor-based, communicating intelligent devices that offer new functionality and generate substantial amounts of data and telemetry. It is becoming more obvious that such data have significant value to various stakeholders, and that leads to a question of ownership.

Ownership of equipment data has been highly debated, but we believe data generated by equipment owned and operated by a customer is owned by that customer. That said, there are notable limitations to ownership.

First, ownership is not a free license to decompile or reverse-engineer equipment, extract source code, or download proprietary information. Second, the data owned by the customer is limited to what we refer to as "published" data, which represent available data officially described and made accessible by means of manufacturer-provided (published) interfaces.

The customer may use the published data under the terms and limitations of contractual agreements and software licenses. In addition to published data, most devices generate and store data not made accessible to the customer, which we call "unpublished" data.

As an example, unpublished data may include diagnostics codes, internally computed values, or simply data not visible through the software version or software module licensed to the customer. In this case, the customer is not free to reverse-engineer the product to access and/or share the unpublished data without specific permission from the supplier. Together, the published and unpublished data represent great value to both the customer and the supplier.

As an example, unpublished data may include diagnostics codes, internally computed values, or simply data not visible through the software version or software module licensed to the customer.

Data and the resulting information are valuable not only to customers and suppliers but also to third parties (e.g., consultants and other manufacturers), and each party is interested in getting access to data.

Suppliers can utilize these data to improve products, identify product-performance trends, and offer services to customers to complement their products. Customers can use the data for operational information, operational efficiency improvement, and calculations of long-term benefits. Consultants and other manufacturers can create new products and offer add-on services that further enhance the value of the
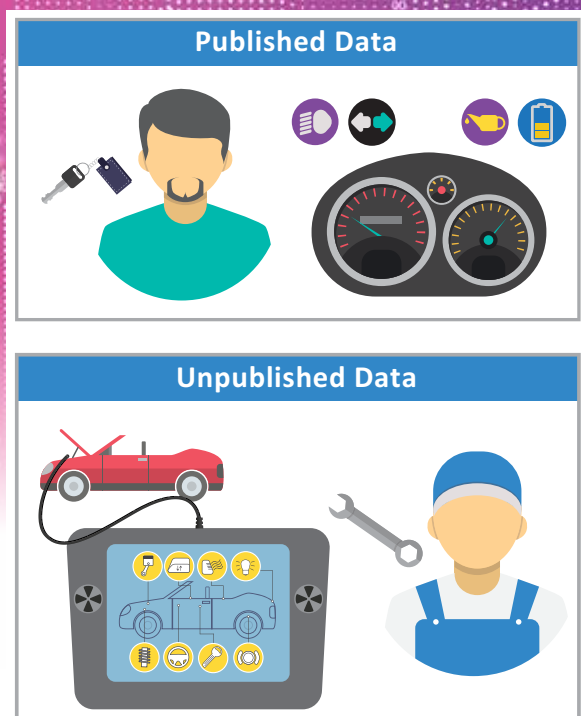
Figure 1. Using car diagnostics as an example, published data is accessible by means of manufacturer-provided interfaces. Most devices also generate and store unpublished data, which is not accessible to the customer. Courtesy of S&C

Manufacturers with effective data policies, practices, and guidelines will foster effective relationships with their customers and enable those customers to meet their own regulatory and end-customer commitments.

product. It is imperative that the customer and the supplier collaborate to maximize the value from all available data.

Negotiating Access and Security

For suppliers to provide support and value-added services, customers must grant them access to equipment data. Unlike consumer electronics—where device data are frequently collected through direct access to the installed applications—gathering industrial data is often more complicated because of restrictions driven by limited access and security concerns. Many modern devices already have built-in communication/networking capabilities that provide remote access to collect data. Instead of expecting customers to create their own tools, leading suppliers provide optional, effective software and data-collection systems to acquire, store, secure, and share equipment data.

Besides offering their customers tools for data collection, suppliers can also obtain access to data by providing services that may include consulting, product support, commissioning, software support, remote monitoring, return-product support, and software- and data-hosting.

Data access raises privacy and confidentiality concerns for customers and suppliers, so both must develop adequate policies to ensure the data are handled properly.

Customers must make sure access to device data is controlled and secure, and that data collection is performed in accordance with applicable software-license and supply agreements. In many cases, customers providing services to their own group of customers must follow their own existing privacy policies to ensure any personally identifiable customer data are protected and remain confidential. Disclosure of such data to third parties must meet the requirements of a customer's internal policies—and when it comes to unpublished data, it must also comply with the manufacturers' software-license and supply agreements.

What data can be shared with third parties can be debated, and while there are diverse views on the topic, no clear standards exist that address all concerns of both parties. It is best that both the customer and the manufacturer agree to limitations of such data transfer or disclosure.

One of the most important things for equipment manufacturers is to develop effective systems and internal practices and publish their data policies. Manufacturers should define how specifically they will use data and reference these policies in supply agreements.

For example, a policy could state that data provided by customers to suppliers are to be used only to

- provide support, design, monitoring, or engineering services to the customer; or
- support product improvement, safety, or research.

Moreover, the policy could state that no data can be shared with third parties without prior customer authorization. Manufacturers also should develop safeguards to maintain data integrity and to protect the information from improper exposure. They should make sure data are properly stored in a secure location, with access limited to authorized users. Data identified by customers as private or sensitive should be anonymized before the information is analyzed or shared.

Unlike consumer electronics users who do not have time or simply do not care about reviewing lengthy agreements, industrial customers are more sophisticated users that often require elaborate arrangements and agreements. Given the potential risk and exposure, industrial applications are more likely to demand more complex, customized agreements and internal policies.

In highly regulated industries, there may be a natural tendency to propose a boilerplate data agreement irrespective of scope and to impose end-customer data regulations on manufacturers. Situations where the customer becomes highly prescriptive regarding a manufacturer's internal data-handling policies should be avoided.

It would be exceedingly expensive for a manufacturer to apply unique and custom data policies for each customer. A well-stated, thoughtful data policy will provide manufacturers with an opportunity to offer an alternative to a customer-imposed boilerplate policy and will help in negotiations in response to overly restrictive terms that would be counterproductive to potential benefits.

In conclusion, customers and manufacturers will both benefit from increased data collaboration. The best approach for manufacturers is to transition from debating data ownership to developing and providing effective data policies and practices. ◉

Digitalized Data Increases Sales

Marjorie Romeyn-Sanabria, Communication Specialist, IDEA

Product data is a key component in fostering business relationships. With more products than ever, the problem is not availability. It is choice, and one of the most powerful benefits of digitalization is increased sales.

According to Rick Fehr at United Electric Supply, a distributor with 21 locations in Delaware and surrounding states, "More product information enables distributors like us to better service the product and our customers." The better the manufacturer can provide product data, he said, "the better we can sell a manufacturer's products."

"Think of it as a digital catalog," said Eric Sywenki of State Electric, a distributor with 43 locations in seven states. "This isn't really a new effort," he said. "It's just available online and updated regularly."

The importance of product information, which has always been a key component of a sale, is magnified with the speed of business today. Online and in distributorships, product data is often a front-line representative for manufacturers. If the data fails to make a good first impression, there may not be a second chance. If the product information is missing or incorrect, then salespeople may not be able to provide it as quickly, resulting in the loss of a sale.

Complete digital product information ensures that the customer selects the right product, eliminating returns, project delays, and wasted labor for time-strapped end users. Product data enables a manufacturer to synchronize its information to multiple trading partners simultaneously and to ensure that products are displayed correctly.

The quality and totality of manufacturers' product data drives business. To distributors, it is one of the most critical issues in the industry. ◉

Cryptojacking: The Dark Side of Blockchain

Cryptocurrencies like bitcoin and the underlying blockchain technologies that power them are enjoying the current digital limelight.

Some experts suggest that blockchain will be a significant enabler of energy innovation, leading many manufacturers, large and small, to explore how the use of blockchain and cryptocurrencies could revolutionize their supply chain management. Unfortunately, there is a dark side to this explosive growth. Cybercriminals have taken to exploiting the eye-watering valuations of many cryptocurrencies through a process called cryptojacking.

Cryptojacking is the subversive use of devices connected to the Internet of Things (IoT) to generate cryptocurrencies through cryptomining. Generating cryptocurrencies can take enormous amounts of power, and many cybercriminals have started to utilize connected devices to do that work for them for free.

Well-publicized incidents of cryptojacking focus mainly on JavaScript and web browsers, but it is equally possible for attackers to hijack any number of connected devices directly with botnets, a network of interconnected devices infected with malicious software and controlled as a group without the owners' knowledge. Just recently, a security company discovered cryptojacking malware in the operational devices of a water utility in Europe.

Manufacturers across every industry, and especially those that work in electrical manufacturing, must be aware of this risk and its three key threats:

1. Cryptojacking takes computing power. And it takes a lot of it. That translates into increased power consumption and reduced system performance for any affected device. On the manufacturing floor, that can translate both to increased operating costs and reduced equipment efficiency.
2. A manufactured product that is infected by cryptojacking malware can have those same effects on the customer environment. That can mean increased support costs and unhappy customers. When those environments are critical infrastructure like electric grids and hospitals, it can lead to catastrophe.

3. Mining processes open up another attack channel for other criminals to exploit. This creates vulnerabilities where devices might otherwise be hardened.

Manufacturers must be aware of these problems as they plan for the future. It will become ever more important to monitor systems for irregular power consumption and rogue processes. Continuing to harden their products and software and making customers aware of what normal operations look like will help to prevent botnets. Finally, it must be understood that passive cyberattacks, like cryptomining, can pose just as great a threat as active attacks like ransomware, and this should factor in to risk assessments as a key element.

Botnets are nothing new. Mirai and Reaper, two high-profile examples, made industries and government aware of their dangers. A preliminary report by the National Security Telecommunications Advisory Committee (NSTAC) to the president on internet and communications resilience released in January highlights the pressing need for action.[1]

It would be a mistake to view botnets solely in terms of distributed attack networks. As the cryptocurrency economy evolves, many hackers will be looking to remain under the radar indefinitely, happy to line their own pockets siphoning power and resources that someone else is paying for. ⓔ

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1 https://www.ntia.doc.gov/files/ntia/publications/eo_13800_botnet_report_for_public_comment.pdf

Zack Hornberger, Director of Cybersecurity & Imaging Informatics, Medical Imaging & Technology Alliance (MITA)

SPOTLIGHT
We Are NEMA/MITA/DICOM

We are NEMA/MITA/DICOM because we are relentless optimists who collaborate with others to make good outcomes happen for medical imaging manufacturers, healthcare workers, and patients through the development and maintenance of standards. ⓔ

Lisa Spellman, General Secretary, DICOM, and Zack Hornberger, Director of Cybersecurity & Imaging Informatics, MITA. Photo by Pat Walsh

Data Centers Take the Plunge with
Digitization

**Dave Sterlace,
Global Head of Data
Center Technology,
ABB Inc.**

Mr. Sterlace advises a diverse data center client base on digitalization strategy.

Digital operations may reduce the number of control wires by more than 80 percent, reducing wiring complexity and resulting risks for operations and maintenance personnel. Photo courtesy of ABB

In the past 20 years, the data center industry has grown from single server rooms to one million square-foot buildings with tens of thousands of servers connected to the grid at transmission-level voltages that use 100-plus megawatts of power—and this new scenario is only a beginning.

This growth is due in great part to the transition from analog to digital techniques and devices. The internet, with its ubiquitous high-speed connections, has become an indispensable facet of everyday life. Some analysts anticipate more than 20 billion connected devices by 2020.[1] The proliferation of web-enabled and web-connected devices allows relationships and insights that were previously impossible. This Internet of Things (IoT) will require additional data centers and new ways of connecting them.

On a very basic level, the mere connection of a device to the internet is useful only if you're able to benefit from that link. For example, if I need only certain real-time data, without archiving or acting upon it, then why bother with an internet connection? If a circuit breaker is not connected, we know only if it's on or off. Additional data may tell us why it's on or off. Thus, a connected device may troubleshoot problems or optimize processes.

New techniques and devices that are behind this connectivity explain why this is such an exciting time to be a part of the electrical industry.

Concerns with Digitization

Digitization is not without legitimate concerns. Taking industrial controls designed for closed loop communications and exposing them to the internet presents a security risk. In order to be connected to the internet, a device needs a media access control (MAC) address, which is typically assigned by a gateway. It may work as a bridge between an in-house industrial network like ModBus and a transmission control protocol/internet protocol (TCP/IP) network.

1   "IoT Connected Devices to Reach 20.4 billion by 2020, Says Gartner," *Which-50*, February 8, 2017, https://which-50.com/iot-connected-devices-reach-20-4-billion-2020-says-gartner

One concern is that existing control networks either have no security or only minimal security built into them. *Ars Technica* recently reported the cyber vulnerability of a major manufacturer's programmable logic controllers (PLCs).[2] Direct web-connected devices (especially on the consumer side) raise serious questions, like how much cybersecurity do you think you'll get with a $79 webcam?

Another consideration is how to communicate. The various industrial protocols all have their merits, but many are either proprietary or hierarchical. The ideal would be something that was open and able to communicate peer to peer in order to reduce latency issues. One solution that seems to be emerging as a frontrunner is the IEC 61850 standard, which was initially developed for smart grid applications. It offers open protocol, peer-to-peer communications, and growing acceptance by industry.

One benefit of digitization is the repeatability, transportability, and consistency of signals. For a control system, circuit protection, or process automation, this is very beneficial. For repeatability in overcurrent settings, most data centers use microprocessor-based trip units on their power circuit breakers. Analog signals also decay over longer distances, making them hard to transmit across a large industrial plant or data center. With digital signals, transmission isn't limited by distance. Finally, the widespread use of TCP/IP networks allows plug-and-play compatibility for ease of troubleshooting and upgrading systems.

Safer, Smaller Infrastructure

In the case of data centers, operators are also concerned about exposing personnel to hazardous energy levels. An industry estimate puts the electrical density of a data center between 30 and 100 times the energy per square foot (or meter) of a commercial building, resulting in more switchboards and switchgear as well as higher fault levels.

Many clients use medium voltage (MV) deep within their data centers rather than just at service entrances. This creates situations where operations personnel are exposed to more MV and higher energy equipment than ever before. Digital intelligent electronic devices (IEDs) make it possible to change settings easily, even remotely. Furthermore, within the low-voltage control compartment of MV switchgear, digitization allows

the standard copper control wiring to be replaced with low-energy and fiber-optic circuits, nearly eliminating hazards to maintenance personnel. A further benefit of using IEDs in control systems is that they signal when there is a breakage, so no "false positives" when it comes to safety.

Because of IEDs' flexibility and use of process signals, they are significantly smaller than traditional wound potential transformers (PTs) and current transformers (CTs) for instruments/relay controls. An MV breaker is just a switch and needs relays (e.g., overcurrent) in order to function, unlike low voltage, where the sensing is built into the breaker. IEDs are also more configurable. Each PT or CT must be manufactured for the specific voltage and current involved. When applied to traditional current and voltage sensing applications, ABB found that variations range from 5,700 (i.e., the result of calculating all the possibilities) to seven. Imagine what that can do for lead times, troubleshooting, and critical spare parts. For example, in weight alone, transitioning from traditional PTs and CTs to process-level digital sensors can save more than 300 pounds per use and reduce the entire switchgear lineup by almost 30 percent versus a traditional drawout-style construction of 15kV class switchgear.

Flexible, Predictive Operations

One of the lofty goals of the electrical system in a data center is to be scalable like the IT equipment. Of course, with hard-wired equipment, this presents a considerable challenge. However, the communications capability, as well as some new approaches in power protection and control, can begin that journey.

A clear benefit of the IEC 61850 digital communications standard is the ability for communications between peers. Many control systems are hierarchical and don't scale well enough to the demands of the hyperscale data centers. Because of the peer-to-peer nature, timely decision-making can be kept at a local level and more critical systemwide decisions can be done at a super- or hypervisory level. This also frees up network traffic for the more critical/impactful decisions. Data from individual devices can also be shared across the network for analysis and archival purposes. If cloud connected, this can be a very powerful tool across a fleet of devices, systems, and sites.

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2 Sean Gallagher, "Vulnerable industrial controls directly connected to Internet? Why not?" *Ars Technica*, January 25, 2018, https://arstechnica.com/information-technology/2018/01/the-internet-of-omg-vulnerable-factory-and-power-grid-controls-on-internet

This affects power distribution. If the digital devices can be configured remotely, in near real time, that can allow a dynamic load shed/add capability to the switchgear. While this may have been done in the past, with digital control it can be done within the trip unit of the circuit breaker, without the complexity of additional PLCs and hard-wiring, and it can be reconfigured as necessary or desired. Some relay and protection operations in MV switchgear, using the benefits of fiber-optic connections, have been able to reduce the number of control wires by more than 80 percent!

If data gathered from the IEDs is archived in a central location, you can begin building a data "lake" in order to gain insight into your operations. A current example is using sound to understand when a motor bearing is about to fail. The scenario plays out like this: a motor emits X sound at Y frequency; by analyzing data over hundreds of installations, the motor has a 90 percent chance of failure within Z days. This can change maintenance from a break/fix or calendar-based model to a more proactive one, while not replacing items that aren't in danger of failing. Similar data can be collected from circuit breakers and other electrical devices. A recent example from Facebook and Schneider Electric reports using IoT temperature sensors to ensure the bolts of a busway system remain within tightness specifications.[3]

VR, AR, AI, and the Future

Although technology is advancing at a tremendous pace, one sure way to be wrong is to predict the future. However, some newer technologies that are not yet in widespread use are certainly worth considering, and their impact will be tremendous.

Virtual reality (VR), for one, is coming to maturity in the industry. It allows a technician to assess, diagnose, configure, and repair a system in a setting where real practice (e.g., a nuclear plant) may be cost- or safety-prohibitive. A technician can become a subject matter expert without ever leaving his or her desk.

Augmented reality (AR), where images are projected in a heads-up display over reality, can help complete the task. Interestingly, some of the DIY companies are looking at this as a major differentiator to help their customers install a faucet, for example.

Finally and famously, Google turned its considerable artificial intelligence (AI) engine on its HVAC system at a data center as part of a 20 percent project.[4] The savings in energy was 40 percent without doing anything else to the system.

With data center infrastructure employing innovative techniques and devices, it has certainly moved into the digital age. ⊕

3 "Facebook: Open Sharing Was Key to Addressing Arc Flash Incidents," *Data Center Frontier*, https://datacenterfrontier.com/facebook-open-sharing-was-key-to-addressing-arc-flash-incidents

4 "Google's DeepMind trains AI to cut its energy bills by 40%," *Wired*, July 20, 2016, http://www.wired.co.uk/article/google-deepmind-data-centres-efficiency

Protecting Digitized Assets

Danny Abbate, Industry Director, Building Infrastructure Division, NEMA

Digitized devices and complex electronic circuits are vulnerable to circuit threats like surges (also called transients), electrostatic discharges, and power quality disturbances. They can damage, degrade, or destroy sensitive electronic equipment in data centers, businesses, and industrial centers, resulting in equipment damage, equipment downtime, lost revenues, and productivity losses due to downtime.

Surge protection is a cost-effective solution to prevent downtime, improve system and data reliability, and eliminate equipment damage due to transients and surges for both power and signal lines. It is suitable for any facility or load (1,000 volts and below). Typical applications within industrial, commercial, and residential include:

- Power distribution, control cabinets, programmable logic controllers, electronic motor controllers, equipment monitoring, lighting circuits, metering, medical equipment, critical loads, backup power, UPS, HVAC equipment

- Communication circuits, telephone and facsimile lines, cable TV feeds, security systems, alarm signaling circuits, entertainment center and stereo equipment, kitchen and household appliances

NEMA's Surge Protection Institute offers guidance materials and practical resources designed for engineers, contractors, and inspectors at www.nemasurge.org. ⊕

Medical Imaging Depends on IoT for Automation and Operational Analytics

Over the past decade, healthcare providers such as hospitals, outpatient clinics, imaging centers, and physician groups have been merging and consolidating to prepare for increases in the size of the covered population and other expected difficulties with care delivery. There is a consensus that healthcare costs are too high and healthcare delivery practices need improvement.[1]

One proposed healthcare business model focuses on fee-for-value versus the traditional fee-for-service model. By consolidating different healthcare providers through mergers or acquisitions in an integrated delivery network (IDN), opportunities exist to realize cost savings through economies of scale and implement quality improvement programs across the IDN.

Automating Medical Imaging

While the IDN model is a holistic strategy for healthcare organizations, outcomes are based on the sum of all the parts. Radiology is one of these parts, i.e., the imaging service line (ISL).

In an IDN, the individual radiology departments in the different hospital locations ideally follow the same standardized workflow processes. Staff can easily move—physically and virtually—between locations without site-specific workflow training. Patients may schedule their appointments at locations convenient to them.

ISL fleet management is the art of centrally managing utilization of all imaging equipment in the IDN's different facilities. HIPAA-enabled and designed with cybersecurity provisions, Siemens developed an Internet of Things (IoT) standards-based analytical system. It collects operational data for the entire scanner fleet in an IDN, including patients' exposure levels to ionizing radiation doses as well as usage information such as computed tomography (CT) scans per day.

Automated analytical reporting shows service line managers (SLMs) where workflows need optimization, e.g., when a certain scanner has lower productivity than the rest of the fleet.

In the IoT, machines can communicate which each other without human interaction. DICOM, the Digital Imaging and Communications in Medicine

global information technology standard developed by NEMA, ensures the interoperability to produce and process medical images.[2] In this example, the imaging modality, a computer tomography (CT) scanner sends DICOM images from the patient automatically to the radiologist's diagnostic reading applications over the intranet as soon as the scan is completed. The diagnostic reading applications then send a DICOM message back to the scanner that the image transfer was successful and the next patient can be scanned.

Simultaneously, the DICOM 3.0–formatted CT images are automatically anonymized, encrypted, and transmitted over the IoT to a cloud-based analytic application.

Information about the image scan is derived from DICOM metadata and is used by the application to auto-analyze operational imaging equipment parameters. The results are then automatically forwarded to a dashboard on the SLM's fixed or mobile display device. The SLM doesn't need to manually query the information.

The ionizing radiation dose dashboard shown in Figure 1 allows the SLM to monitor institutional-specific dose reference levels as well as nationally defined targets. Any CT scanner in the IDN's multisite hospitals operating outside of these levels can be identified in almost real time and corrective action taken.

The dashboard provides easy access to ISL scores and trends. From a daily overview of system scores to the detailed analysis of utilization trends, it allows seamless access to ISL performance and the number of patients examined on a specific scanner. This helps the SLM improve ISL productivity and efficiency.

Utilizing such IoT technology and cloud-based applications enables IDNs to improve quality of care and lower costs by automation and resource optimization. ⬤

Henri "Rik" Primo, Director, Strategic Relationships, Digital Health Services, Siemens Healthineers

Mr. Primo is a member of the NEMA Internet of Things Council.

Figure 1. Ionizing Radiation Dose Dashboard

1 https://www.ama-assn.org/practice-management/physician-payment-delivery-models

2 NEMA holds the copyright to DICOM. It is also known as NEMA PS3 and ISO 12052:2017.

Lighting and the IoT

Photo courtesy of Legrand/Pass & Seymour

Steve Rood, Director, Codes & Standards EWS, Legrand/Pass & Seymour

The growth of the Internet of Things (IoT) presents a new era for the built environment, with the connected-device market in the building sector expected to grow by more than 20 percent a year by 2020. Total spending on IoT solutions is projected to grow to as much as $11 trillion in the next ten years.[1]

In response to these changes, software programs can amplify communications and provide enhanced value for personal and professional customers. One opportunity for leveraging this strategy lies in smart lighting devices and solutions. Recent developments give users a choice between IP networks such as Thread and Wi-Fi.

Partnerships with Samsung, Amazon, Google, and other industry consortiums are also important in order to deliver the most open, secure, and interoperable platforms for connected wiring devices. Security in smart lighting is doubly ensured by using transport layer security and industry-standard cryptographic algorithms to protect communication between devices and the cloud.

Further, devices must be able to receive over-the-air updates to ensure the latest security and interoperability standards. Installation is another key metric: switches, dimmers, and outlets must install easily and adapt quickly to user needs.

The challenge of digitalization and IoT can be daunting, but if your solutions offer enhanced value, ease of use, and respect for the user, then you can ensure that the devices and systems will last long into the constantly shifting future. ⊕

1 Memoori, "The Internet of Things in Smart Buildings 2014 to 2020," 2014, https://www.memoori.com/portfolio/internet-things-smart-buildings-2014-2020

Make the Most of Your Big Data Investments

The world generates more than 2.5 quintillion bytes of data every single day. That's a huge volume of data—and manufacturers are responsible for generating a good chunk of it, both in terms of production and in the sensor data generated by products themselves.

Ani Jain, Senior Product Marketing Manager, MicroStrategy

As data volumes continue to grow, organizations are coming under increasing pressure to come to terms with two big questions: first, what's the best, most economical way to store huge volumes of data? And second, how do you turn all that data into a real-world competitive

advantage? These two questions are the driving force behind a thriving and rapidly evolving ecosystem of big data vendors.

In NEMA's April IoTNOW webinar, "Make the Most of Your Big Data Investments," we will look at how organizations can turn data into actionable business intelligence by finding enterprise-grade tools that empower people to access, explore, and analyze big data sources without limitations. Our speaker is Ani Jain, Senior Product Marketing Manager, MicroStrategy.

Learn more and register at www.IoTNOWwebinars.org.

Missed a previous webinar? Now you can download NEMA's IoTNOW webinars on demand.

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• The public may purchase recordings at www.nema.org/download-on-demand at $79 per person, per download, or $695 per person for 10 downloads.

IoTNOW webinars are approximately one hour in length. Copyright to the recordings of each webinar is held by NEMA and copyright to the presentation materials is held by the speakers and licensed to NEMA. ⊕

Digitalization Lights Up Manufacturing

Because of advancements in light-emitting diodes (LEDs), luminaires can be integrated with smart sensors to capture real-time data related to energy usage, occupancy status, building usage, and equipment tracking. Connected lighting adds to the growing list of everyday products with added networking and sensing features, known as the Internet of Things (IoT).

This prompted Telsmith Inc., a Wisconsin-based manufacturer of equipment for the global mining industry, to improve operating efficiency at its corporate headquarters. Founded more than 100 years ago, the company has a history of innovation.

Using an energy audit from an energy services company, Telsmith decided to optimize its energy costs with an upgrade to an advanced LED-connected lighting system. Beyond the initial energy-efficiency goal, Telsmith also evaluated the performance, color, and quality of LEDs. It replaced outdated high-pressure sodium and fluorescent fixtures.

The lighting system that Telsmith chose includes a network of wireless integrated sensors, which not only meet code for occupancy and time schedules but also track energy usage and overall performance. The new system was installed throughout the headquarters, including the manufacturing plant, offices, conference rooms, and parking lot.

Completed in January 2018, the LED system retrofit resulted in:

- Utility bill savings on lighting of more than 50 percent the first month, which is a 30 percent overall monthly energy reduction/savings
- Estimated yearly lighting maintenance savings of $18,000
- Brighter, more uniform illumination in the office areas

- Customized light levels in private and open offices
- Higher vertical lighting along the walls in manufacturing and warehouse areas
- Energy monitoring of the lighting fixtures with facility-wide dashboards
- Reduction in carbon dioxide emissions of 874 metric tons

"The ability to monitor the energy usage, evaluate and tune the lighting to save on energy costs has been simple and successful," said Nick Lollino, manufacturing engineer at Telsmith. "Using ongoing adjustments, such as dimming the new parking lot fixtures from 100 percent brightness to 50 percent, is saving additional energy costs while improving safety for our employees and buildings."

Joe Bokelman, Marketing Manager, Eaton
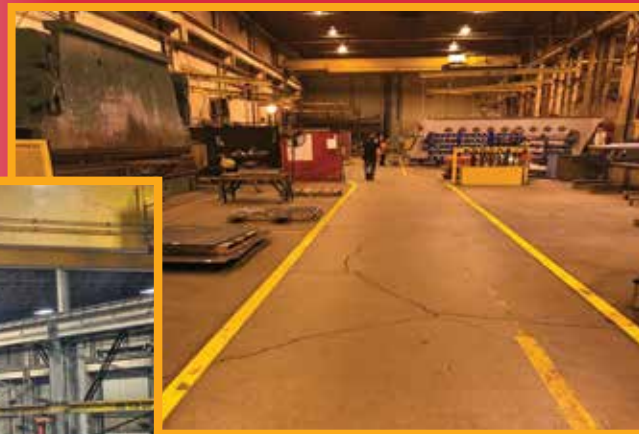
Before (above) and after photos of a Telsmith manufacturing facility demonstrate the impact of an LED system retrofit. Photo courtesy of Eaton

Telsmith and its parent company are examining the results of the new lighting and controls system to use as a template for other facilities. Next, the company is evaluating upgrading its HVAC system with IoT capabilities and integrating the systems together for increased performance. ⬡

Become a smart city

with connected lighting

Philips Lighting CityTouch is a secure, connected lighting platform. It allows cities to adapt public lighting to changing conditions and situations for the best service for citizens while realizing energy and cost savings.

innovation ✦ you

Photo Credit: Darius Kuzmickas

See the full story at:
philips.com/connectedstreetlighting

LED

PHILIPS

Lighting the Way to Smarter Cities

Traditionally, cities' streets and public areas rely almost entirely on conventional lighting that has remained more or less the same for decades. However, with the recent advancement in light-emitting diode (LED) technology and digital light, it is increasingly easy and exceedingly beneficial to improve energy efficiency and reduce operational costs through connected lighting.

With the proliferation of devices connected to the internet, public lighting infrastructure is being transformed into an information pathway to smart city capabilities and services that can realize additional value beyond just illumination. Increasingly, many city councils and municipalities are leveraging the benefits of Internet of Things (IoT) applications to make their cities more livable, resilient, sustainable, and prosperous.

Similar to many other metropolises in the world, Los Angeles contends with pervasive issues that range from constrained budgets and growing populations to aging infrastructure and the accelerating pace of innovation. What sets the city apart, however, is daring to try new things. LA is at the forefront of smart city innovations with a vision for how technology can adapt to the way people and communities interact with their city.

For example, its lighting infrastructure is among the largest in the world and one of the city's most valuable assets. By not only converting its street lights to LED but also intelligently monitoring and managing them with a connected lighting control system, street lighting affords more value to citizens, visitors, and local businesses in addition to providing illumination.

LA has expanded its smart city capabilities by leveraging its connected street lighting infrastructure to actively monitor and manage noise levels on the streets. Using pole-mounted sensors and software to collect, share, and analyze the data, the city is taking a qualitative and quantitative approach to help improve public safety and support city services.

Since data is available via the cloud, the power of big data and analytics visualization software creates both real-time and historical timelines, along with map and list views of code violations and alerts.

Such visualizations help the city not only maintain code compliance, assess urban policy, and respond adequately to noise complaints but also facilitate additional dialogue with internal and external domain experts.

Harsha Banavara, Cybersecurity Technical Policy Manager, Philips Lighting

As a result of the efforts underway in LA, these innovations have reduced the city's energy usage for street lighting by over 63 percent, saving at least $9.5 million annually in operational and maintenance costs.

While LA is a great example of the evolving applications that can be delivered through a connected lighting infrastructure, these are just the tip of the smart city and IoT iceberg. Several new innovations and applications are being developed, such as fault monitoring and predictive maintenance, designed to help cities improve safety and livability.

The city is an archetype for other cities to emulate and reflects what is possible when cities invest in and embrace new technologies that enable them to do things that were impossible to imagine even a decade ago. ⊕

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Mike Leibowitz
Program Manager, NEMA

Nanomaterials Standard to Shed Light on Displays

As lighting devices and displays transition from sources based on heated filaments to ones based on solid state lighting (SSL), lamps and luminaires that use light-emitting diodes (LEDs) are providing light in a wide variety of lighting colors.

To address the essential general and optical requirements of monodisperse luminescent nanomaterials used in general lighting and display products, the International Electrotechnical Commission (IEC) Technical Committee 113 (Nanotechnology for Electrotechnical Products and Systems) will soon publish IEC 62565-4-2 *Luminescent nanomaterials—Detail specification for general lighting and display applications.*

In display products such as liquid crystal displays (LCDs), white backlights are used in conjunction with filters to provide red, green, and blue. These backlights are also increasingly leveraging breakthroughs in LED technologies to increase the color gamut.

There are several key drivers for this change, including increased energy efficiency, increased product lifetime, flexibility in colors produced, and good color-rendering properties. For example, SSL sources are able to achieve luminous efficacies that are significantly higher than conventional incandescent lamps.

Since approximately 20 percent of the world's electricity consumption is attributed to providing illumination, the impact of such a large gain in luminous efficacy provided by changing to SSL technologies is significant. Likewise, SSL backlights consume less energy than other backlight technologies, which is especially important in battery-powered portable electronics.

The structures of SSL sources used for general lighting and display backlights often are similar. In a common structure, these devices consist of a blue LED and at least one photoluminescent material to provide one or more additional wavelengths. When energized, some photons emitted by the LEDs are absorbed by the luminescent material and produce secondary photons of different wavelengths through the process of photoluminescence. The light produced by the SSL source is a mixture of the emissions from the blue LED and the photoluminescent material.

Semiconductor nanocrystals like spherical quantum dots, elongated quantum rods, and inorganic nanophosphors are especially advantageous in lighting and display applications because of their broad absorption bands, narrow emission bands, high photoluminescence quantum yields, and excellent photostability.

Generally, luminescent nanomaterials used in lighting and display applications are classified according to excitation spectrum, emission spectrum (including a specific emission peak wavelength and a narrow emission peak shape as measured by the full width at half maximum), quantum efficiency, chemistry, and other factors.

Usually, these properties are achieved in a monodisperse material, with particles of similar sizes. Imparting multiple colors to a lighting or display product may involve the use of nanomaterials of multiple sizes, each of which may be specified individually. As a result of the properties of luminescent nanomaterials, lighting and display devices incorporating these materials can have excellent luminous efficacy and extraordinary color quality.

This new section of the IEC 62565 series of nanomaterial specifications will codify the format for specifying, reporting, and validating the essential properties of luminescent nanomaterials for use in lighting and display products. It will also enable the customer to specify requirements in a standardized manner and to verify through standardized methods that the luminescent nanomaterial meets the required properties.

A bilingual version of this publication may be issued at a later date. ⬡

Joseph Eaves

Director, Government Relations, NEMA

Surging on Capitol Hill

After a successful Hill Day last summer, members of NEMA's Low Voltage Surge Protective Devices Section (5VS) took part in their second such event last month. They were eager to meet with representatives and senators that have 5VS plants or offices in their districts and states.

While the meetings provided opportunities for section members' companies to build relationships with their own elected officials, the Hill Day also allowed them to explain surge protective devices (SPDs) and the impact this technology has on new legislative opportunities.

SPDs limit voltage surges and spikes that occur in the normal electrical system as power is supplied to electric or electronic devices by diverting surge current and limiting unwanted voltages to a level that will not damage equipment.

Devices that switch power on and off are responsible for 60 to 80 percent of surges created within a facility, ranging from a simple thermostat switch operating a heating element to a switch-mode power supply found on many devices. These surges contain limited energy but are often the cause of system upset or cumulative damage to electronics.

Surges that originate outside the facility include lightning and utility grid switching. Although less common, these surges are typically much more severe.

In commercial buildings and data centers, SPDs protect emergency lighting, computer systems, lighting, and electronic equipment. In industrial applications, they protect machinery, control systems, and telecommunications. In the residential space, plug-in SPDs are seen in power strips that protect home offices and entertainment equipment. A new trend in the residential space, especially in areas of major storms, is hard-wired devices that are installed at the electrical panel that protects the electrical system of the whole house.

Learn more at www.nemasurge.org. ⊕

Surging on Capitol Hill were 5VS members (from left) James Mongeau, Space Age Electronics; Bob Harmon, CITEL; Pankaj Lal, Schneider Electric; Chris Martin, ABB; Srdan Mutabdzija, Mersen; Steve Rood, Legrand/Pass & Seymour; and Martin Guy, ABB. Photo by Joseph Eaves

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Alex Boesenberg

Senior Manager of Regulatory Affairs, NEMA

Industry Comments on DOE Process Rule

NEMA and allied manufacturer trade associations submitted recommendations last month to the U.S. Department of Energy (DOE) in response to a Request for Information concerning potential revisions to the Process Improvement Rule of 1996. The rule was developed by industry, environmental groups, and government officials in response to criticisms of DOE's process in fulfilling its duties under the Energy Policy and Conservation Act (EPCA), which set minimum appliance energy conservation standards.

The 1996 process rule was never codified and thus was only a recommendation. Over the years, the application of the process rules varied and the

pace of publication and scope of impact of DOE rulemakings became onerous. All manufacturing sectors reported regulatory fatigue, especially those hit simultaneously by multiple proceedings.

The goal of the submitted recommendations is not only to create greater transparency but also to improve the manner in which DOE determines whether to set or amend appliance standards and test procedures.

The 40-page comments may be found on the NEMA website at www.nema.org/joint-comments-doe.

For more information, email alex.boesenberg@nema.org. ⊕

Design Metrics for Permanent Magnet Motors

Ann Brandstadter
Manager, Standards Publications and Marketing, NEMA

NEMA SM 1-2017 *Guide to General-Purpose Synchronous Motors without Excited Rotor Windings* is a new guide that provides design metrics for polyphase alternating-current permanent magnet motors rated 500 horsepower and less.

NEMA SM 1-2017 is available in hard copy and as an electronic download for $285.

Other recently published documents include:

NEMA LSD 66-2017 *Understanding the Fluorescent Ballast Rule, EPCA 10 CFR 430* is a white paper that explains the fluorescent ballast rule and associated measurement methods. This revision of LSD 66 contains updated language and is available as an electronic download at no cost.

NEMA VSP 1-2017 *Susceptibility of Electrical and Electronic Components to Surge Damage* is a new white paper that provides an overview of electrical and electronic equipment surge susceptibility. It is available as an electronic download at no cost. ◉

Portable Cells and Batteries Standard to Set Global Protocols

Marc Boolish
Director of Government Affairs, Energizer Brands

Khaled Masri
Program Manager, NEMA

The NEMA/ANSI C18 Dry Battery Section revised ANSI C18.4M *Portable Cells and Batteries—Environmental*. It provides guidance on the proper scientific protocols for testing the environmental performance of batteries; the symbols used to convey messages for collection, recycling, and other ideas; and the aspects and functional unit(s) to be included in assessing the environmental impact of batteries with modern lifecycle analysis techniques.

This revision, which was completed two months ahead of schedule, includes a compliance checklist, extends producer responsibility, and

refines information on U.S. and international requirements for environmental aspects.

ANSI C18.4M is a template for the International Electrotechnical Commission (IEC) standards being harmonized for both primary and rechargeable batteries. When adopted by the IEC later this year or in early 2019, it will be the first global environmental standard on portable cells and batteries.

Mr. Boolish chairs the ANSI C18-4 Subcommittee. Mr. Masri is the secretary of the ANSI C18 Accredited Standards Committee. ◉

Stalled in the Midwest

Don Iverson
Midwest Field Representative, NEMA

Michigan has two adoption tracks for electrical codes: commercial and one- and two-family dwellings.

In Michigan, the 2017 *National Electrical Code®* (NEC) commercial code adoption stalled because of pending legislation (HB 5376). Currently, the state isn't required to appoint committees to review new building codes, so during the 2017 NEC revision, the Bureau of Construction Codes chose to not appoint a committee, raising concerns. If passed, HB 5376 would require the bureau to appoint committees to review building

codes and remove the bureau's ability to handle those tasks on its own behalf.

The bureau also reviewed testimony on updating the current code based on the International Residential Code (IRC) and decided to not move forward at this time.

In Ohio, the state is reviewing its residential code, which is based on the 2015 IRC, with electrical chapters deleted. In February, the Residential Code Advisory Committee began to look at the 2017 NEC to determine if there will be amendments in one-, two-, and three-family dwellings. ◉

Steve Wilcox

Director, Market Research, NEMA

Current Conditions Component Softens, Future Conditions Sentiment Jumps

Some Electroindustry Business Confidence Index (EBCI) panel members noted softer conditions in February relative to the strength of recent months. The share of those reporting worse conditions this month increased while the proportion of "better" responses declined, lending quantitative support to the anecdotal information.

Despite sliding nearly 10 points to 61.8, February's current conditions component remained firmly in expansionary territory. The most recent U.S. Census Bureau data depicted a similar mix for last December, when year-over-year electroindustry shipments grew by almost four percent while new orders ticked down slightly.
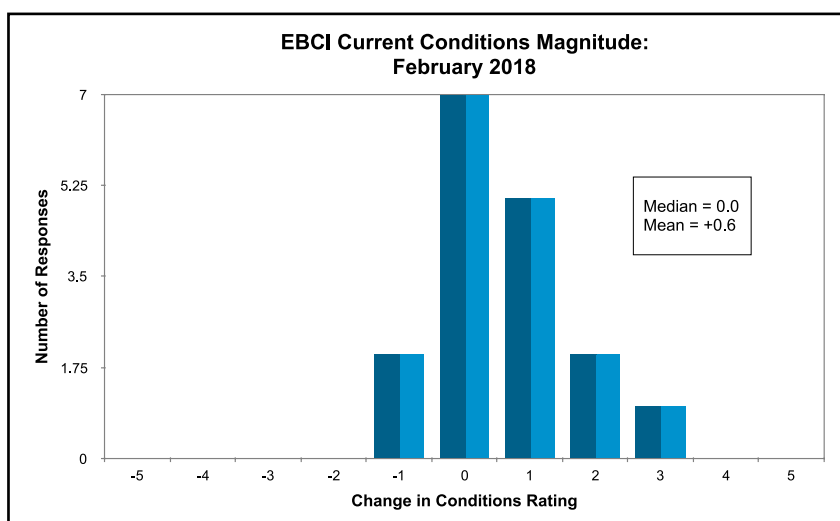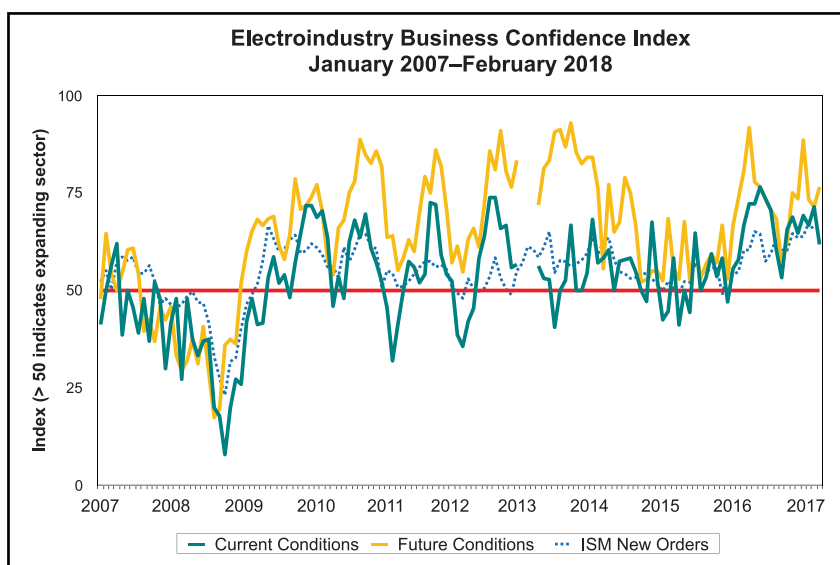
The reported intensity of change in electroindustry business conditions diminished slightly, with the mean value edging back from 0.9 in January to 0.6 in February. Likewise, the median value declined to 0 in the current reading after having reached 1.0 in each of the previous three months. Panelists are asked to report intensity of change on a scale ranging from −5 (deteriorated significantly) through 0 (unchanged) to +5 (improved significantly).

Synchronized global growth, corporate tax reform, and an improved business climate were cited as contributing to respondents' expectations of better conditions in six months as the future conditions component increased from 71.4 last month to 76.5 in February's report.

Although the share of respondents who anticipated worse conditions increased slightly from January, the number of those expecting to see better conditions grew substantially. One commenter sounded a note of caution in the otherwise upbeat outlook by pointing to the potential for increased inflation and interest rates.

Visit www.nema.org/ebci for the complete February 2018 report. ⓔ

	Current Conditions (Compared to Previous Month)		Conditions Six Months from Now (Compared to Current Conditions)	
EBCI	61.8	▽	76.5	▲
% Better	35%	▽	65%	▲
% Worse	12%	▲	12%	▲
% Unchanged	53%	▲	24%	▽

**Electroindustry Business Confidence Index
January 2007–February 2018**

**EBCI Current Conditions Magnitude:
February 2018**

Median = 0.0
Mean = +0.6

PANIC.

There's no back-up plan for picking the wrong microgrid partner.

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