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A POWER QUALITY NEWSLETTER

Point of View

Petrochemical manufacturers comprise one of the largest and most significant customer segments of the electric utility industry, consuming more than 225 billion kWh of electricity per year. Understandably, the growth of utility market share in this segment correlates closely to customer plant expansion and profitability. At the same time, petrochemical customers expect their electricity costs to drop as a result of utility deregulation.

Utilities are under increasing pressure to lower their energy rates, enhance marketing and sales efforts, and provide value-added services. One such service is the delivery of top-quality, highly reliable electric power. Petroleum and chemical plants use substantial amounts of electricity to pump, compress, and agitate high volumes of gases and fluids in complex and continuous processes. The smooth operation of these processes depends on electric power supply that minimizes harmonics, transients, and voltage variations.

Care also needs to be taken to ensure that power quality efforts serve two key needs: federally mandated environmental standards and personnel safety requirements. On one hand, manufacturing processes need to be made more robust, so they minimize environmental impacts associated with loss of process

***Point of View**: Continued on back page*

Industry Forum: Power Quality in the Petrochemical Industry

Signature recently spoke with five representatives of the petrochemical industry to gather their insights into the power quality considerations of the industry. Interview participants were Richard Doughty, du Pont; Paul Hamer, Chevron; Paul Myers, BP Chemicals; John Propst, Equilon/Shell Oil; and Rob Stephens, Pennzoil.

Depending on their individual experiences, some expressed the need for greater dialogue with equipment suppliers, while others looked for stronger alliances with utilities. The bottom line, however, was an industrywide need for reliable, high-quality electric power.

Following are interview excerpts:

What are the key power quality needs of the petrochemical industry?

Doughty: To run efficiently and safely, chemical plants like du Pont's require high-quality electric power that is relatively disturbance-free and not interrupted for utility maintenance very often. In the continuous-process plants found throughout the industry, a momentary power disturbance can shut down an entire process for days and cost the manufacturer millions of dollars. Unexpected outages also put the plant into an abnormal operating condition, creating the possibility of safety hazards.

Stephens: The key needs at Pennzoil are clean and reliable power. Many manufacturing processes in the petroleum industry are highly sensitive to voltage sags and harmonics. A 30-cycle sag, for example, can throw an entire process off-spec, so the product is ruined. Not only do these power disturbances impact production and the bottom line, but they can damage equipment. Getting product back on-spec and bringing equipment back on-line can shorten the life of the equipment.

Hamer: The petroleum industry needs equipment that is built to keep harmonics within the limits of Institute of Electrical and Electronics Engineers (IEEE) Recommended Practice 519. We also need equipment that will operate with power supplied within these limits. Tighter restrictions than those presently recommended by IEEE 519 might be necessary for harmonics greater than the 31st and for transient voltage sags lasting longer than a few cycles. Operational problems at Chevron, for instance, frequently involve "unusual" harmonic orders and transients that occur during system short circuits. An ideal power supply would be one that is configured so that motor starter dropouts or motor stalls are avoided during power disturbances.

Myers: There are two areas to address: 1) the quality of incoming power from the utility, and 2) the impact on our system from equipment we install. In terms of incoming power, the primary need at BP Chemical is reliability, or having available power 100% of the time.

***Industry Forum**: Continued on page 5*

Courtesy of Chevron Corporation

In the petrochemical industry, electric power quality is key to energy-efficient processes, plant and personnel safety, environmental protection, utility reliability, and in-spec product.

Improving Process Control Immunity in Petrochemical Plants

by Dave Nichols (John E. Dolan Laboratory) and Hank Miller (Transmission Engineering), American Electric Power Company

Device	% Rated Load	3-Cycle Sag, % Nominal					6-Cycle Sag, % Nominal					30-Cycle Sag, % Nominal				
		60	50	40	30	0	60	50	40	30	0	60	50	40	30	0
Coilock™ Hold-in Device	80	P	P	P	P	F	P	P	P	P	F	--	--	--	--	--
Dip-Proofing Inverter™ 3 kVA	50	P	P	P	P	P	P	P	P	P	P	F	F	F	F	F
Dip-Proofing Inverter™ 250 VA	80	P	P	P	P	P	P	P	P	P	P	--	--	--	--	--
Constant-Voltage Transformer 1 kVA	100	--	--	--	--	--	P	P	F	F	F	P	P	F	F	F
	50	--	--	--	--	--	P	P	P	P	F	P	P	P	F	F
Constant-Voltage Transformer 250 VA	100	--	--	--	--	--	P	P	F	F	F	P	P	F	F	F
	50	--	--	--	--	--	P	P	P	P	F	P	P	P	P	F

Test results show that response characteristics of power conditioning devices vary significantly with load and phase angle. Therefore, it is important to understand the intended application when designing mitigation plans that implement these technologies. (The table illustrates the variation in ride-through capabilities and is not intended as a comparison.) P=Pass, F=Fail, and -- =Not Tested.

Petroleum and chemical manufacturing plants rely upon electrical and electronic control devices in their manufacturing processes to increase energy efficiency and productivity. In many cases, however, these sensitive controls can shut down production in response to a voltage sag, and the manufacturer can lose millions of dollars. Beyond these monetary losses—which come from damaged equipment, out-of-spec product, and lost production—petrochemical plants also must address personnel safety issues and environmental hazards associated with loss of control of sometimes highly volatile chemical reactions.

While electric utilities configure and operate the power system to provide reliable service, the quality of service can sometimes be affected by unavoidable events. Although there is no economically feasible way for utilities to guarantee continuous power supply, opportunities exist to reduce the probability of process interruptions.

John E. Dolan Laboratory at American Electric Power is researching these opportunities through field investigations and laboratory testing. We have found, for example, that petrochemical plants can reduce process downtime susceptibility through regular equipment maintenance and routine process monitoring. In addition, a clear understanding of which process elements are susceptible to voltage sags is essential to hardening the components so they do not interrupt an otherwise immune system.

Susceptibility testing of mitigation devices allows AEP's Dolan Labs to identify appropriate technologies and pinpoint application considerations.

Power Conditioning Solutions

An effective means of enabling ride-through capability is the use of power conditioning technologies at the process control level of critical elements. Dolan Laboratory is working closely with equipment manufacturers, providers of power conditioning devices, and the Power Quality Test Facility at the EPRI Power Electronics Applications Center to 1) identify appropriate power conditioning technologies and mitigation devices, and 2) pinpoint application considerations to help petrochemical customers ride through voltage sags. In this vein, we offer power quality training, power conditioning evaluations, and on-site susceptibility testing using the EPRI Process Ride-Through Evaluation System, or "Porto-Sag."

We are assessing under simulated process conditions the electrical performance of various power conditioning technologies that may include energy storage, control circuitry, and high-speed power electronic components. We have found that thorough qualification testing is necessary to evaluate the interaction of these components before a power conditioning device can be applied at a customer site. Several devices tested in the laboratory have failed to protect typical process equipment.

Cooling water is an example of one particularly troublesome application consideration. Nearly all petrochemical manufacturers use cooling water for temperature control in some aspect of production, but it is a potential process stopper that is often overlooked during power quality investigations. The cooling process generally consists of a series of pumps, fans, and cooling

Petrochemical plants can reduce downtime through regular equipment maintenance and routine process monitoring.

towers with various controls for temperature and flow rate. It may involve adjustable speed drives and almost always uses standard motor control circuitry. It is in this motor control circuitry that we find the best opportunity to turn a weak link into a more robust, sag-tolerant element of the process.

We have tested three products in the laboratory and installed two in the field that are highly effective at sag-proofing motor control circuitry. These products are constant-voltage transformers, Dip-Proofing Inverters™, and the Coilock™ hold-in device for relays and contactors. The table illustrates that the tested devices are capable of keeping process equipment running during moderate sag conditions. While their prices range from thousands of dollars to less than a hundred dollars each, all three solutions have a unique range of applications.

Steps to sag-proofing the production process can range from increasing the immunity of a sensitive contactor in a motor control circuit to supplying a parallel feeder to the entire plant for redundant interruption protection. They can also include the application of custom-power products such as distribution static compensators, solid-state transfer switches, dynamic voltage restorers, flywheels, and superconducting magnetic energy storage (SMES) devices.

These products have significant costs, however, and may introduce new reliability concerns since their failure can result in loss of production or other plant outages. In addition, the devices are often complex and have not been thoroughly tested due to significant power requirements. Our strategy, which has yielded excellent results, is to conduct extensive field tests to verify that a device performs as expected and then follow up with continued long-term monitoring of electrical performance.

Work for the Future

Regardless of the application, preliminary analysis is critical to determining whether or not a proposed solution will work. Effective ride through of the cooling water process is just one step toward process control immunity in the petrochemical industry. Dozens of other process elements need to be scrutinized if these customers are to withstand power system faults.

There is a real need to bring together the collective knowledge of electric utility and petrochemical process engineers. This kind of collaborative effort will encourage the sharing of success stories as well as the development of standardized methods for safely and effectively applying process immunization technologies. It is our responsibility as an industry to find the means for meeting these challenges. ■

EPRI R&D Corner

Recognizing the need for more standardized approaches to power quality in the petrochemical industry, EPRI has launched the Power Quality Initiative for the Petrochemical Industry. As a task of the System Compatibility Research Project at the EPRI Power Electronics Applications Center (PEAC), the initiative targets the following three areas:

1. ***Power Quality Forums***. EPRI-sponsored conferences bring utility and petrochemical industry representatives together, providing the opportunity to identify and prioritize the most critical and cost-sensitive manufacturing processes and to strategize on important issues. Two recent conferences—cosponsored by Public Service Electric & Gas in Newark, New Jersey, and FirstEnergy in Cleveland, Ohio—drew 150 participants.

2. ***On-Site Investigations***. Engineers from PEAC visit and assess petrochemical customer sites—sometimes performing equipment susceptibility testing—to determine weak links in the manufacturing process. They team with plant electrical personnel and safety coordinators to identify and implement the most cost-effective solutions.

3. ***Technology Transfer and Training***. EPRI develops and provides utilities and their petrochemical customers with technical briefs, application notes, and equipment specification criteria. Training for utility personnel and petrochemical engineers focuses on the power quality needs of the petrochemical industry, available solutions, and specific application methods.

Utilities participating in the initiative obtain petrochemical industry-specific knowledge and expertise for use in enhancing their customer relationships. Petrochemical manufacturers benefit by minimizing production downtime, equipment damage, and product losses caused by power quality variations. For more information, contact Gene Sitzlar at 423-974-8314 or *gsitzlar@pqac.com* by e-mail.

Standards Update

by Tom Key, EPRI PEAC

This column serves as an open forum on power quality standards activities and developments. Please send your comments to *tkey@pqac.com* by e-mail.

Few industries compare with petrochemical manufacturing in terms of the number of motors used or the need for continuous, coordinated plant operation. Petrochemical manufacturers have had to devise ultra-reliable process controls, and they usually demand the best plant power distribution available. It is no wonder, then, that the petrochemical industry has made major contributions to standards addressing electric power system compatibility, and industrial process and motor control equipment.

Today, the growing use of electronic equipment and controls in the industry creates a prime opportunity for petrochemical manufacturers to collaborate with utilities in the development of premium- and enhanced-service standards. Such a partnership would be of value to both parties—improving operations and productivity for petrochemical manufacturers, while enhancing customer relations and market position for utilities.

Power Quality Credentials

The petrochemical industry has many well-established practices for in-plant electrical safety, electrical service entrance, and power distribution. For example, dual transformers—or double-ended substations—were perfected in petroleum and chemical plants. The practice of using steam turbines to back up electric motors driving critical pumps was also developed in these plants. In addition, motor control techniques—such as time delay-off and maintain-on arrangements and synchronous motor transfer to an alternate power source—are routinely applied to enhance power quality in the power-intensive processes of the plants.

Many practices of the petrochemical industry have been incorporated into Institute of Electrical and Electronics Engineers (IEEE) standards. This is apparent in the participant and reference lists of several IEEE recommended practices for industrial plant power distribution, protection, emergency power, and grounding. Industry-specific standards also have been written and are contained in the *IEEE Petroleum and Chemical Applications Standards Collection*. These standards address specific application areas, including electric resistance heat, electrolytic cell lines, severe-duty motors, and pipeline skin effect heating. They can be found at *http://standards.ieee.org/catalog/petroleum.html* on the World Wide Web.

The Petroleum and Chemical Industry Committee (PCIC), as part of the IEEE Industrial Applications Society, is one of the most active industry committees of IEEE. The mission of the committee is to provide an international forum for the exchange of electrical applications technology relating to the petrochemical industry, to sponsor IEEE standards activity for the industry, and to provide opportunities for professional development.

Most PCIC activities center on the committee's annual meeting, which has been held since the early 1950s in cities with large industrial bases throughout the United States. The September 1998 meeting in Indianapolis included sessions on system issues for large motors and drives, overvoltage protection, ground fault detection, power disturbances, and other topics related to power quality. Details on the meeting can be found at *http://www.ewh.ieee.org/soc/ias/pcic/* on the Web.

PCIC introduced many of the first technical papers published by IEEE on techniques to improve motor performance during source voltage variations. Examples include K. Carrick, et al., "Voltage dip protection with dc-motor starter coil," from the 1973 PCIC meeting; and C. Becnel, "Maintaining process continuity during voltage dips," from the 1981 PCIC meeting. This kind of output from PCIC has provided inspiration for such recent power quality standards as IEEE 1100 and IEEE 1346.

Clearly, the petrochemical industry is well-versed in power system design. It is a leader in the areas of service enhancements and techniques to avoid plant upset due to momentary power disturbances. As electric utilities look for ways to increase their competitiveness in a deregulated market, collaboration with the petrochemical industry could provide valuable tools for success in the future. ■

Conference Notes

PQA'99 North America will be held May 24-27, 1999, at the Marriott City Center in Charlotte, North Carolina. The conference, "First to the Line: Power Quality Taking the Winner's Circle," is cosponsored by EPRI and Duke Power. It focuses on strategies for utilities to use in forming successful partnerships with their customers—alliances for taking them to the winner's circle.

At the conference, participants will hear case studies of unique power quality challenges and innovative solutions. They will learn how to help customers put power quality into their continuous improvement processes. They will also receive tools to help calculate the customer cost of power quality problems, specify equipment for performance, and measure the effectiveness of the selected power quality solution.

For more information, contact Megan Boyd at 650-855-7919 or *mboyd@epri.com* by e-mail.

Industry Forum: Continued from page 1

As deregulation unfolds and a variety of power producers enter the marketplace, displacing traditional generation, we are concerned about what's going to happen to the rolling power reserve.

In terms of equipment impacts, our greatest concern is whether we can install a piece of equipment without going through a large evaluation to assess its harmonic impact on the system. I prefer a "plug and play" attitude when installing large-power semiconductor devices, adjustable speed drives (ASDs), and uninterruptible power supplies (UPSs). Time constraints force me to take this approach. It is worth a small, maybe a medium, premium to have equipment that meets IEEE 519 recommended harmonic requirements.

Propst: The key need at Shell is reliability of incoming power supply to our process units. Voltage sags lasting more than about 10 cycles will interrupt production. Most sags last less than 10 cycles, however, and we have designed our equipment to include dc power supplies or UPSs that allow the units to ride through these events. This works out fairly well, giving the utility time to clear faults and other power disturbances.

As far as noise and harmonics, we haven't experienced these problems, even though we use a lot of ASDs in our facilities. During design, we analyze the harmonic content of the drives and put in the necessary filters.

What commitment to power quality do you expect from equipment suppliers, utilities, and your internal systems?

Hamer: We expect equipment suppliers to make us aware of possible application problems and solutions. We also need them to build equipment that operates properly when exposed to system voltages with harmonics within IEEE 519 recommended limits. We look to utilities to uphold harmonic distortion standards. Internally, we use harmonic filtration for some applications.

Petrochemical manufacturers consume more than 225 billion kWh of electricity per year.

Stephens: Many times, equipment suppliers will develop a product and say, "Here it is. Take it or leave it." They also focus on building barriers into the equipment as protection against personnel safety issues. Equipment suppliers need to do more talking with their customers, then widen their specifications and make equipment more targeted to our needs. We have found at Pennzoil that power electronic equipment offers many advantages in production, but there is trouble if utility power supply falls outside a very narrow range of voltage and frequency parameters.

Internally, we take a systems integration approach to power quality. We look at the entire system, determine where the weak links are, and integrate the equipment and system so they work well together.

Myers: We expect suppliers to provide equipment that does not impair the power quality of our systems. They could also evaluate equipment placement and perform any necessary modifications to limit system impacts.

BP looks to the future as a changing world with utility deregulation. Ideally, power producers need to be committed to providing sufficient high-quality power to all users. Transmission system operators need to continuously monitor the impact of each power producer, cogenerator, etc. on the power system grid. System operators must have procedures in place to ensure that problems can be addressed when a producer affects power quality through high harmonics, voltage swings, or other negative impacts as determined by the utility. This may include taking individual power producers off-line until their problems are resolved. Of course, the removal in itself may impact power quality by reducing capacity and reserve, so this may not be totally clear-cut.

Manufacturing managers and engineers in the chemical industry are required to commit to providing extremely reliable, high-quality power systems that support plant reliability of 99% and don't have spurious events, such as circuit breaker trips, that are unexplained or difficult to explain. We have responded by tightening up requirements to equipment suppliers.

Propst: We have found that equipment suppliers are more than willing to develop and sell anything they believe we would want to buy.

As far as utilities, we've had very good relationships with them. We establish a dialogue about quality of power as well as routine and preventive maintenance of the power system. We discuss these issues as regularly as once a month in meetings that often include senior management from Shell and the utility. We develop guidelines on what is acceptable and what is not, so there is a clear understanding of our needs. These efforts have had an impact on improving our incoming power quality.

Internally, we have a database that we use to track power disturbances. We apply root-cause analysis to

Industry Forum: Continued on page 6

Industry Forum: *Continued from page 5*

define the problem and find the solution. If there is a problem with voltage sags lasting less than 10 cycles, we try to determine the cause and fix it. We also take proactive steps, simulating events such as hurricanes or floods, and develop plans for managing the end-use impacts on our processes.

Doughty: At du Pont, we expect both the equipment supplier and utility to use the latest available technology to reduce voltage sags and improve power quality. There has been a high commitment from our equipment suppliers, and this probably will not change a great deal. The biggest change will be on the utility side because utilities will have to compete for business as the market is deregulated and independent power providers become available. Internally, we continually evaluate the impact of power quality on our chemical production processes.

What is your perception of the relationships that exist in the petrochemical industry?

Doughty: Power quality has been a buzz-word in the industry for at least 10 years. There are papers on it, training on it. There is more focus on the technology of power quality, and customers are becoming more involved. Equipment suppliers are also marketing new products to control the quality of incoming power. This requires them to establish relationships with end users to improve the marketability of their products.

Myers: There seems to be a reasonable amount of dialogue between equipment suppliers and end users. This is accomplished through the purchasing documents we create and through direct contacts at technology conferences. The IEEE Petroleum and Chemical Industry Committee (PCIC) Conference, for example, has good participation by motor, drive, electrical distribution, and utilization manufacturers.

There are significant discussions between the utility and chemical industries at some level. However, since those discussions generally are not technical interchanges at the plant level, I don't have a clear understanding of the challenges utilities face. Are they coming from me, themselves, someone else?

Propst: The relationship between equipment suppliers and end users takes place each year at the IEEE PCIC Conference. There, papers are presented on significant issues in the industry, the steps being taken to address these issues, and how to apply new and existing technology.

Hamer: Interchange is fairly good at industry committee forums. An example of where the situation could be improved, though, is in cases where equipment suppliers do not fully appreciate the application difficulties of low-voltage, pulse-width modulated drives. Many suppliers prefer to provide these drives with special inverter-duty motors, which are tolerant to the fast rise time and high peak voltages of today's drives. These motors may have problems as they age, however. I would much rather have a drive with a filtered output that can be used with a motor and cable system of conventional design. We have some retrofit opportunities that are being inhibited by these types of application problems, or the potential for problems.

Stephens: We are seeing more of a dialogue between utilities and petroleum customers such as Pennzoil. Forward-thinking utilities like Central & Southwest and Southwest Electric Power Company are starting the dialogue, taking proactive steps. We don't see this happening much with equipment suppliers, though. When we tell them we need the very best ride-through capability we can get, they say, "It's the power that's fluctuating. What do you expect our equipment to do?" While there are many products with restart capabilities available now, ride through is tougher, and you don't see a lot of that yet.

A momentary power disturbance can shut down an entire process for days, costing the manufacturer millions of dollars.

What is the future of power quality in the petrochemical industry?

Propst: Power quality will continue to be an issue, but as we understand what the problems are, we will learn how to build in redundancy and harden equipment. That is already happening with second- and third-generation electronic equipment. We are seeing improvements in reliability, maintainability, and ruggedness in the more sophisticated equipment.

Historically, utilities have had the lead role in the evaluation and use of power electronic equipment as it pertains to the distribution of electricity. For example, they have led the effort to evaluate and define requirements for electronic protective devices. This has probably evolved for two reasons. First, utilities have many more substations for installing and evaluating this type of leading-edge technology. Second, the consequences of failure are oftentimes less than they would be in a petroleum plant. The same holds true for power components such as indoor- and outdoor-vacuum and SF6 circuit breakers. In these areas, we are very interested in using the latest technology, but often cannot take

the risk associated with "proving" new technology.

Stephens: Although we generally purchase our power based on price, we have found that power quality considerations can be significant. Power quality will be of greater concern in the future as more silicon-based equipment and solid-state devices are developed and used in refineries. More electronics means more power quality problems, and utility customers will pay for the increase in problems one way or the other. At Pennzoil, our use of ASDs increases every year. We didn't have many up through the early 1990s, but now there are 20 to 30 in operation.

Also, with approaching deregulation, utilities are facing a tough power market. They will strive to improve their product—to make power that is cheaper, better, and continually improving.

Hamer: Power quality will be of greater concern as utilities become deregulated and as ASDs and other power electronic devices become more widely used. We currently use a relatively small proportion of ASDs at Chevron, but they are installed where there is an economic advantage. Ride-through specifications will be very important for the larger drives on which a whole processing unit may be dependent. Application devices such as solid-state motor starters, protective relays, and circuit breaker trip units also must be able to operate correctly in an environment with poor power quality.

Myers: My hope is that today's manufacturing trends will reduce concerns about power quality in the future. Drives are going to the insulated gate bipolar transistor type, which have less impact on the system from a harmonics standpoint due to the design and control strategies of the manufacturers. Now we need to evaluate the impacts of equipment farther downstream. Concerns are changing from system impacts to more localized impacts on processes driven by or fed from the type of equipment that used to create harmonics for us. In this situation, I am less concerned about power quality and more focused on equipment reliability and usability. Does the equipment function with little or no intervention on my part? Can I utilize a new control or design strategy, or is it so difficult that the benefit gets lost?

Doughty: Power quality may be of less concern in the future than it is today. It may be considered more of a supply requirement. In the future, we hope to spend fewer capital dollars on ride-through equipment to overcome power quality problems at du Pont.

How will collaborative R&D efforts affect the petrochemical industry?

Hamer: Collaborative efforts may result in equipment that is tolerant of a relatively severe environment, electrically and physically. Utility involvement in IEEE power quality standards development has certainly helped guide the petroleum industry on applications and harmonic mitigation requirements. What is needed is an organization to address the "system" issues that a supplier might miss during new product development. It is very costly for users to solve these types of problems.

Courtesy of Chevron Corporation

Although petrochemical manufacturers generally purchase their power based on price, they have found that power quality considerations can be significant.

Doughty: Because chemical manufacturers typically are not members of EPRI due to the high cost of membership, we can't easily access EPRI information. We need utilities or EPRI to develop avenues for sharing collaborative power quality information.

Our needs in the plant are to improve power quality and reduce internal investments. Having EPRI understand these needs and perform research is vital to our success. We need to be able to use the latest technology in a cost-effective way.

Propst: At Shell, we want proven technologies, rather than those at the leading edge. We make money on chemicals and gasoline, not electricity. We tend to be a little behind other industries in applying technology. We don't want to pass up an opportunity, but the leading edge is not where we are for electric applications.

Stephens: The ground-breaking efforts of the EPRI Power Electronics Applications Center (PEAC) to address power quality issues and develop ride-through specifications are like a light at the end of the tunnel for some of us in the petroleum industry. I have attended two PEAC seminars, where I had the opportunity to discuss power quality problems with several PEAC engineers. Now, I am working on a project with PEAC to improve our ability to ride through voltage sags at Pennzoil.

Utilities have heightened our awareness that power quality issues are not just a utility problem. Sometimes we may be introducing harmonics or affecting power factor and, as a result, impacting other customers.

Would you like to issue a challenge to industry stakeholders?

Doughty: The utility monopoly structure has not offered much incentive for utilities to bend to the needs of the customer, so utilities have not been as creative or

Industry Forum: Continued on back page.

Point of View: Continued from page 1

control or complete process stoppage. On the other hand, solutions applied at the plant level must meet strict safety specifications.

To address these challenges, EPRI has spearheaded the Power Quality Initiative for the Petrochemical Industry, which is outlined in *EPRI R&D Corner* on page 3. While some power quality solutions used in petrochemical plants are similar to those of other industrial settings, their applications are for the most part unique. They can be difficult to desensitize, and various off-the-shelf mitigation measures are rarely implemented consistently and effectively in continuous processes. The petrochemical industry can benefit from some of the latest point-of-use mitigation devices being developed by EPRI. Application details to meet environmental and safety requirements, however, still need to be addressed.

So, you see there is still work to be done. EPRI already offers comprehensive power quality auditing services through the Power Quality and the Chemicals, Petroleum, and Natural Gas targets. We hope you will call on us to demonstrate the importance of power quality in the petrochemical industry.

Marek Samotyj, Manager
EPRI Power Quality Product Line

Industry Forum: Continued from page 7

customer-focused as they might have been. My challenge would be to see if utilities can improve du Pont's global competitiveness by providing a high-quality electric power supply that reduces plant outages and the investment required for power ride-through equipment.

Hamer: We purchase power at Chevron mostly on the basis of price, but if performance makes operations unreliable, we will consider alternatives such as self-generated power or a new service configuration. For suppliers of newer technologies such as present-day drives, I would ask them to focus on the needs and challenges of the end user. This requires dialogue at the plant application level.

Myers: The chemical industry is in infancy in the application of power electronic devices, and perhaps it is reaching critical mass. There hasn't been enough of this type of equipment installed in plants to create much demand on suppliers. Our challenge to equipment suppliers is: Give us equipment that creates no negative impacts on the system or downstream. If utilities have a stake in that, then perhaps they should help.

I also would like to see utilities develop a strategy for handling power reliability issues and concerns in a deregulated environment. Questions the utility commissions need to ask as deregulation goes forward are: Who is in control? Who is doing the economic dispatch? Who is responsible for power quality when the producers are so varied?

Propst: At Shell, we have found that developing partnerships with utilities is very important. Utilities have been helpful in gathering reliability information on electric equipment, allowing us to make decisions based on fact rather than off the top of our heads. Utilities have a much better database than petrochemical companies, and their failure and reliability risk assessments are of great value. I would ask utilities to continue providing that kind of support. ■

Richard L. Doughty is a principal consultant in the Electrical Technology Consulting Group of Engineering at E.I. du Pont de Nemours and Company in Wilmington, Delaware. He specializes in the application of electric motors and electric power system design. He has served on numerous committees and working groups in the chemical industry and has received the IEEE PCIC and Industry Applications Society (IAS) Transactions prize paper awards.

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