Meeting the Challenge of the Digital Age: Electric Power Shortfalls and New High Tech Solutions by Ed Badolato, President, IIA, Inc.

***Coping with Rolling Blackouts*.** Learning to cope with electricity shortfalls has been a costly reality in California as a string of power disturbances and outages disrupted the lives of millions of people and thousands of businesses.

Department of Energy spokesmen have announced that the potential for blackouts around the country could be even greater than what we have seen in California. DOE has also released a study warning that increased electricity usage and an aging infrastructure were stressing the system to the point of disrupting service, and the report recommended on site systems as one way to help utilities meet growing power demand.

Utilities responded to the DOE study by stating that they had made new investments and would be ready for the hot weather. But the Electric Power Research Institute, which estimates that power outages and fluctuations already cost the economy up to $50 billion annually in lost production, argues that the electricity system is in its worst condition since 1965.

In addition to the DOE warnings, an Associated Press survey of power officials in all 50 states found that the 2001 summer power supply is expected to be tight in some Western states, and there are serious concerns about utilities being able to deliver enough electricity in other states in the Midwest and Northeast if demand is extremely high and transmission logjams develop.

Businesses are learning about the cost of "unreliable power." Our modern electricity network is revealing vulnerabilities that call into question our ability to meet the needs of America's new information and network-centric society. California's power failures highlighted several decades of utility under investment in local distribution relative to generation. The threat of continued outages reveal a number of weaknesses in the system, but the key issue is not about generating enough power as much as being able to deliver power at the desired levels of reliability and quality.

The vulnerability of local distribution systems points not merely to the need to spend more on upgrading power lines and transformers, but also to the value of small generators that, by producing power within the local system, can lighten loads on distribution equipment. US transmission and distribution expenditures have exceeded those of generation since 1994, and now stand at more than $10 billion annually. According to a report prepared for the Energy Foundation, "between $800 million and $2.5 billion of these expenses could be profitably diverted to small scale generators and improved energy efficiency given the financial benefits of avoiding power outages and spending more on grid upgrades."

The Powercell solution for providing high quality, uninterruptable power. High quality, uninterruptable distributed power is especially valuable for high tech industries such as computer chip and semiconductor manufacturers, pharmaceuticals, chemicals, and biotechnology, which rely on computerized manufacturing applications, and are vulnerable to even slight power interruptions. The byproducts of distributed power can be useful resources, such as cogeneration of electricity. For example, high tech manufacturing facilities may employ their own power

generators as a source of reuseable steam as well as reliable power.

Powercell Corporation of Burlington, Massachusetts, has developed a unique technology to not only store, but manage, power in order to provide quality and reliable electricity. The company's flagship product, called PowerBlock, is an electrochemical storage device that has the ability to not only store significant amounts of power, but also to ensure that customers receive an electrical waveform with a constant magnitude and frequency. PowerBlock provides effective large scale energy management and power quality solutions to meet the urgent needs of the new high tech economy.

PowerBlock can be used to improve an inter-connection with the power grid by placing the PowerBlock system at the end-user's site at the connection to the power grid. It will maintain reliable, high quality power for an end-user's critical operations. For example, grid-supplied electricity can be stored in PowerBlock, ready for instantaneous "zero cycle loss" dispatch should the power grid be interrupted. Typical applications for PowerBlock include data centers, telecom facilities, and "power critical facilities," such as computer chip and semiconductor manufacturers, pharmaceuticals, chemicals, biotechnology centers, hospitals, etc.

Linking Powercell's high quality, uninterruptable power solutions with an enabling microturbine technology. Powercell has chosen to use the OPRA Microturbine Generator, manufactured by the OPRA Corporation as the enabling microturbine generator technology for its unique product to provide a distributed generation capability**.** Engineered at the upper edge of the technical range for microturbines, OPRA Turbines (short for Optimal Radial Turbines) produces gas turbines at 500kW and 1.5MW output. . The company is run by Jan Mowill, a Norwegian engineer, and is setting up the major portion of its operations with Powercell in the United States.

OPRA is the only low-emissions dual fuel microturbine engine in development at this time, and OPRA is credited with developing a new type of combustor in which the fuel/air mixture is controlled over the entire operating range. By regulating the air mass entering the combustor, and by cycling this air through and around the combustor to provide cooling for the combustor and the turbine blades, OPRA attains higher efficiency and lower emissions across all loads. The engine also runs at lower gas pressure ratios, and the lean fuel mixture it creates allows for a lowflame temperature and hence low emissions and lower operating costs.

Without requiring water injection or exhaust cleanup, OPRA is far more "environmental friendly" than anything on the market today--a real plus for building designers and managers. It is also flexible with the single-fuel nozzle capability to accommodate both natural gas and diesel fuel. The mechanical simplicity of OPRA allows it to have approximately 30% fewer parts than other microturbines and a lower overall initial purchase, operating and life cycle maintenance cost.

Distributed Power Systems Connected with Power Grid. The combination of the power grid, a distributed power generation source and a PowerBlock system provides the benefits of quality power for long duration grid failures by allowing peak loads to be served with improved

operation economies for the end user. Applications include power for automated manufacturing and telecommunications facilities, as well as very large data centers and "Tech Hotels."

By allowing millions of customers to operate their own generators, a distributed power network utilizing Powercell-OPRA equipment will be more capable than existing systems for meeting the need for reliable, higher quality electricity. Many analysts argue that an electric power system in which control is more decentralized may prove more reliable and better able to respond to future weather extremes and fluctuations in demand.

There are a number of ways in which Powercell's innovations in power electronics and storage systems can make a distributed network more reliable than existing systems, such as by connecting the PowerBlock system with distributed power generation sources such as microturbines and fuel cells. PowerBlock can also provide distributed power solutions where the power grid is unavailable. This application includes remote locations as well as many areas in underdeveloped economies

At present, communications and power technologies are converging toward what some call an "intelligent" distributed power minigrid that can respond instantaneously to problems and run more efficiently than current mega systems.

The use of Powercell computer based software also benefits the commercial value of distributed power. For example, companies could sell "premium" grades of electrical power to customers seeking high levels of power reliability. For example, a hospital could buy high grade, or ultra reliable, power for its emergency room and other vital operations (and lower grade power for its vending machines), supported by selective employment and emergency backup use of more efficient small scale miniturbine generators.

Avoiding Disruptions to Computer Servers, Network Centric Operations, and High Tech Manufacturing Operations. PowerBlock's high tech storage technology can improve power reliability by enabling greater use of power from intermittent and low quality energy flows. This innovative use of power storage and reliability technology keeps disruptions to the typical flow of e-mail, internet access, financial information, manufacturing processes and vital records to a minimum.

Three common areas of concern in high tech building and business operations include Power Quality; Power Reliability; and Environmental Issues.

Power Quality. Poor quality grid voltage can be converted by PowerBlock into stable, high quality power. Surge suppression is another serious factor in power quality. A coordinated surge suppression system is essential to protect computers, servers, and other sensitive electronic network equipment from power surges. Initial damage to electronic devices and system failure can occur if the power supply is subjected to a large surge.

Harmonics, the presence of higher frequency power components that are multiples of the primary frequency (60 Hertz), can be generated by electronic equipment and can stress the associated power system. Unaddressed, harmonics can cause wiring to overheat and transformers to be

overloaded. It is especially important that electrical systems are properly designed to handle harmonics. Grounding also requires careful attention to the grounding system for the power distribution system, main computer equipment room, telecommunications closets and computer work stations.

Power Reliability. Black-outs and brown-outs (when the voltage drops to an unacceptable level during periods of peak loading and critical load periods, such as hot summer air conditioning periods), can also cause interruption to computers and high tech systems. Solutions to power disruptions include: Protecting main computer rooms by installing PowerBlock to provide emergency power backup. Long term power outages can be addressed with the installation of emergency microturbine generators, such as OPRA, to provide emergency power for life safety systems, critical HVAC or other emergency systems. Traditional generators usually take a few seconds to start, causing breaks in the flow of power. The use of Powercell products provides a "seamless" and constant flow of uninterrupted power during a grid-failure event.

Environmental Issues. HVAC systems are used not only for personal comfort, but to protect the capital investment and increase the system reliability of sensitive operating equipment, computer networks and telecommunications closets. Reliable power for operating a facility's HVAC systems is important for maintaining the required ranges of temperature and humidity that ensures effective operations of sophisticated equipment and also to maintain the positive pressures needed to prevent dust infiltration.

Current emergency back up power generators have specific Federal and State environmental regulations on the placement, fuel use, refueling hazards, and exhaust emissions. The Powercell-OPRA system has definite advantages in these areas. The system's relative lighter weight provides additional placement options, including rooftops, and the exhaust emissions meet or are below even the most stringent standards.

Summary. Powering the New Digital Economy has presented some serious challenges. Heavy growth of data centers, internet service providers and New Digital Economy power consumers require high-reliability, high-quality electricity to assure continuous functioning of their business operations.

The extensive use of microprocessors and sophisticated power sensitive electronics in current manufacturing and business practices heighten the need for reliable, quality power. Power anomalies can cost an automated manufacturer or technology-intensive business millions of dollars in lost work-in-progress, idle labor, and other facility-related downtime charges. New power quality, power reliability and distributed power systems, such as the Powercell-OPRA team are providing solutions for the power supply challenge.