

POWER **PRESCRIPTION** *for Health Care*

Volume I, Issue I

Spring 2002

Welcome to the Health Care Initiative

Global Energy Partners (Global) welcomes our new and returning customers of the Health Care Initiative (HCI) to the first issue of *Power Prescriptions*, the newsletter of the HCI. As most of you know, we have been talking with HCI customers to solicit ideas for a final project agenda for 2002. If we have not yet heard from you, we would like to as soon as possible. In the interim, because of the positive feedback we have been receiving about this newsletter, we have moved ahead with this first issue.

We very much want this to be your newsletter, with articles that are relevant to you and to your health care customers. We have put a great deal of thought into selecting topics for this first issue and will continue to do so. More importantly, we would like to know what you would like to see in the coming issues.

- Are there new or emerging health-related technologies that you would like to know more about?
- Is there a health care facility in your service territory that has made significant accomplishments in energy efficiency, combined heat and power, or environmental stewardship that you would like to see highlighted in the newsletter?
- Are you interested in new standards for infection or pathogen control that might create sales opportunities for your company?



If you have an idea, please drop me an email at ghirsch@gepllc.com or give me a call at 360-754-2567. The more we know about what you need, the better we will be able to meet your needs.

We are looking forward to a very successful year. We have established a valuable partnership with the American Society for Healthcare Engineering (ASHE) that we expect will help us all better understand the concerns of health care engineering directors. In the very near future, as a result of work by the HCI in 2001, we expect the Environmental Protection Agency to have up and running an Energy Star® benchmarking tool to allow your health care customers benchmark their energy use against other similar facilities. Look for more information on EPA's benchmarking program in this newsletter.

Once again, welcome. We look forward to hearing from you.

Gary Hirsch
Vice President
Global Energy Partners, LLC

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The State of the Health Care Facility in 2002

By Bill Okleshen

2001 was a wake up call for us all! The attacks of September 11 showed hospital and health care facility management where they stood with regards to disaster preparedness. Luckily, most facilities had the basics covered and were somewhat able to gear up for the emergency. For years, health care facilities have had to have disaster plans in place. However, they never anticipated a situation like 9-11. At present, health care facilities are reassessing and implementing plans to meet their communities' medical care needs should another crisis occur.

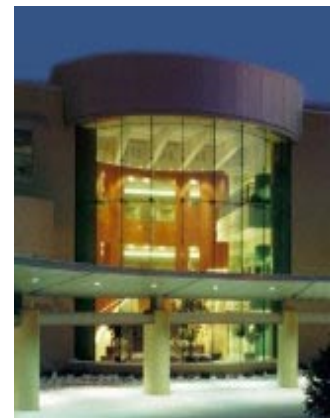
In addition to emergency planning, health care management is also looking at the survival of their facility. Do you know what hazards your local community and large urban research hospitals face? Quality and cost-effective patient care is number one and has always been. However, emergency preparedness has now become a much larger issue than in the past. Competition for insurance, Medicaid, and Medicare dollars continues to be the heart of the chief executive officer's mission while the facility manager is tasked with how to operate an aging facility with fewer dollars.

As we begin with "The State of the Health care Facility in 2002," we start with a brief history of the life and times of the facility manager. Facility managers are constantly under the scrutiny of two groups. The first is the federal government and its oversight body the Centers for Medicare and Medicaid Services (formerly called the Health Care Finance Administration). The second is a private accrediting organization known as the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO). These two organizations probably cause more anxiety and unforeseen expenses for the facility manager than even the gas and electric bills. The endorsements of these two groups give the facility authorization to receive insurance and public funds. If a facility does not comply with Centers for Medicare and Medicaid Services (CMS) regulations, then it cannot receive Medicaid or Medicare dollars. This is serious, since for many health care facilities over 50 percent of the annual budget comes from Medicaid and Medicare.

Unfortunately, the public's perception of the hospital typically involves only the clinical side. Like in the Wizard of Oz, a patient or visitor sees only the magical show and not the inner workings that allow the show to go on. Since it is a resource-based organization, the HCI works to identify problems with the inner workings facing health care facility management and create appropriate technology solutions.

Technology solutions are often created in response to the standards and regulations maintained and enforced by CMS and JCAHO. For over eight years, the HCI has responded with technology-based solutions to issues such as life safety, infection control via airborne and waterborne modes, hazardous materials, green buildings, energy efficiency, power quality, medical wastes, tuberculosis, and emergency management. It is through a utility's membership in the HCI, that both the utility and its health care customers have an invaluable resource recognized by many, including the ASHE and the United States Environmental Protection Agency.

As health care facility management go through processes such as failure mode analysis and root cause analysis, they look for resources to assist in providing and integrating a course of action that may include technologies. For the sake of health care facility professionals and utility health care account representatives, our focus in *Power Prescription* will be on facility performance and how to improve it beyond what one typically sees as a patient or visitor. Topics in *Power Prescription* will be varied and range from technologies for reducing and eliminating infections, to technologies for reducing energy costs, and on to technologies for improving the facility's ability to become a sustainable environment during good times as well as crises.



"As a resource, EPRI HCI has been extremely successful at creating relationships that go beyond the ordinary."

A knock on the facility manager's door by any utility account representative can lead to opportunities for both parties. No other vendor has as much access to the facility as the utility account representative. This is because the largest expense on the facility manager's budget is utility costs. In addition, an account representative who is able to understand and provide solutions to everything the facility manager faces has a better chance of partnering and aligning their organization with the health care facility. As a resource, the HCI has been extremely successful at creating relationships that go beyond the ordinary. Understanding the problems and issues facing the facility manager is only the first step in the relationship. Taking the extra step and delivering solutions that are not only cost-effective, but also meet the mission or strategic plan of the facility is key to the success of the account representative.

Bill Okleshen provides consulting services to energy companies and their healthcare customers in the area of healthcare facility management. He can be reached by email at wokshn@aol.com or phone at 708-917-2535.

National Energy Performance Rating System

By Clark A. Reed, U.S. Environmental Protection Agency

To help organizations reduce energy use and associated greenhouse gas emissions, the U.S. Environmental Protection Agency (EPA) began developing a national energy performance rating system in 1999 for buildings in the commercial sector. The rating system provides office buildings, K-12 schools, hotels, supermarkets – and most recently hospitals – with a way to compare their energy performance to other similar buildings across the country.

The rating system uses a 1-100 scale to give relative meaning to energy use. Hospitals rating high on the scale are better energy performers (lower energy use) than those with low ratings (higher energy use). A rating of 50 is defined as the industry average. A hospital that rates in the top 25% (75 or higher rating) is considered a "top performer" and eligible to receive EPA's award for superior energy performance, the ENERGY STAR label.

Defining the Model

The national rating system is accessible to the public free-of-charge through ENERGY STAR's website at www.energystar.gov/benchmark. Users create their own private password-protected account in the "Portfolio Manager" benchmarking software tool.

The model underlying the rating system recognizes that energy intensity is a function of the business activity and the weather in addition to how well the energy is managed. Analysis of data obtained from the EPRI's *Energy Benchmarking Survey* (1997) indicates that hospital energy intensity is related to the following key characteristics:

- Hospital type: acute care or children's hospital
- Total campus square footage
- Number of licensed beds
- Number of buildings on campus
- Total number of floors of the tallest building on campus
- Special features such as tertiary care, laboratory, on-site laundry
- Presence of above ground parking



After defining the hospital space, users enter energy consumption data from utility bills or an energy management system. At least 12-months of data are needed to receive a rating and users have the option of baselining even further back in time to see trends in energy performance. Ratings are weather-normalized to account for the year-to-year variations in the weather.

Hospitals Benchmarked to Date

Since the beginning of beta testing in early 2001 and the official launch of the hospital rating system in November 2001, 92 hospitals from around the country have benchmarked their energy performance. For any large portfolio of hospitals, EPA expects to see a rather even distribution of ratings within all four quartiles of the 1-100 scale, with an overall average rating of 50. The benchmarks to date confirm expectations, as seen in Table I.

Understanding your hospital's rating is an essential first step to improving your energy performance and benefiting from the cost savings. Although the national rating system does not identify specific buildings on hospital campuses to upgrade or prescribe specific actions to increase performance, the ratings can provide general recommendations.

Use Ratings to Your Advantage

Low Ratings (1-49) - Greatest Opportunities for Investments

Hospitals with low ratings typically present the greatest potential for financial and environmental improvement and should receive priority for investments to increase energy performance.

Middle Ratings (50-74) - Fine-tune O&M

Hospitals with mid-range benchmarks can increase energy performance through no- or low-cost measures such as re-commissioning, developing and implementing preventative maintenance plans, increasing employee training, or re-assessing incentive, recognition, and reward systems to ensure that they drive energy performance.

Top Performers (75-100) - ENERGY STAR

Hospitals within this range are among the highest energy performers in the country and may be eligible to receive the ENERGY STAR label award. To apply, a professional engineer must verify the data and eligibility requirements and confirm that indoor air quality meets industry standards. For more information, see the [Professional Engineer's Guide to the ENERGY STAR Label for Buildings](#) on the EPA's ENERGY STAR website.

Table I. ENERGY STAR Hospital Benchmark Ranking Summary

Energy Performance Rating	Count	Recommendations	
100	100 – 75	26	Apply for the ENERGY STAR label
50	74 – 50	24	Fine Tune O&M procedures
	49 – 25	21	Good opportunities for investment and returns
1	24 – 1	21	Greatest opportunities for investment and returns
		92	Total Hospitals Benchmarked (as of November 2001)



Clark Reed is the National Healthcare Manager for ENERGY STAR. He can be reached by email at reed.clark@epa.gov or phone at 202-564-9146.

Ultraviolet Germicidal Irradiation (UVGI) Systems for Health Care

By Neil Podkowsky, Global Energy Partners, LLC

Ultraviolet (UV) light has been proven an effective means of reducing exposure to transmittable airborne pathogens. UV germicidal irradiation (UVGI) systems can help prevent the transmission of disease-causing bacteria in buildings such as homeless shelters, hospitals, prisons, and morgues. In these settings, people can become infected with airborne diseases such as include tuberculosis, measles, and influenza.

The susceptibility to UV has been measured for a number of different species of bacteria, but because *M. tuberculosis* – the organism that causes tuberculosis – is one of the most resistant airborne pathogens to UV, it is frequently used as the reference organism when considering

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UV exposure requirements for practical applications to limit disease transmission in indoor spaces (First et al. 1997). Tuberculosis (TB) is an infectious disease, generally transmitted from one person to another through the air. Infection can occur when the bacterium or droplet nuclei containing one or more bacteria are inhaled. Airborne microbes can infect without personal contact and pose a serious health threat, particularly from new strains that are immune to multiple antibiotics.

Technology Description

Ultraviolet is part of the non-visible electromagnetic spectrum described by wavelengths of 100-400 nanometers (nm) or billionths of a meter. UV wavelengths are shorter than those in the visible light spectrum and are longer than X-rays. Ultraviolet wavelengths are generally classified into three wavelengths:

- UV-C (short ~ 100-290 nm),
- UV-B (medium ~ 290-320 nm), and
- UV-A (long ~ 320-400 nm) (First et al. 1997).

Wavelengths of the shorter UV-C band, most notably the 253.7 nm wavelength, have the greater disinfecting capabilities (see Figure 1).

Experiments have shown that the potential for infection by an airborne pathogen is directly related to the exposure time of an individual to infectious droplet nuclei. Increased ventilation can reduce the risk of infection by diluting the infectious droplet nuclei. As ventilation increases, greater dilution occurs, and the probability of infection is reduced. For a ventilation system to remove one infectious droplet nucleus from 10,000 cubic feet (cf) of room air, 10,000 cf of heated or air-conditioned room air must be changed (Nardell and Chaisson 1995). Such large ventilation increases would likely produce unacceptable drafts and would be very expensive (Riley and Nardell 1995).

The ability of a UV system to disinfect the air of microorganisms is quantified in terms of equivalent air changes. Equivalent air changes provided by a UV air disinfecting system contribute additively to the room air changes already present through ventilation and similarly reduce the degree of exposure and resulting probability of infection (Riley and Nardell 1989). In addition, the UV system's ability to mitigate necessary air changes reduces air conditioning costs.

Figure 2 shows the reductions in bacterial colonies caused by a 17-Watt UV fixture plus two air changes per hour compared to the air changes without UV. The rate at which bacterial colonies were eliminated by the addition of the UV is equivalent to adding 10 air exchanges of outdoor air ventilation. Such decay curves indicate that one 30-Watt fixture (approximately two 17-Watt fixtures) provides the equivalent of 20 air exchanges of outdoor air (Riley and Nardell 1989). Based on these results, the recommendation of installing one 30-Watt UV fixture for each 200 square feet of floor area was developed.

UVGI System Designs

In general, there are two methods used in UV air disinfecting systems: passive and non-passive. The key design criterion for both methods is to provide enough UV output to disinfect the air in the upper room while minimizing the UV-C levels in the occupied part of the room, particularly at eye level.

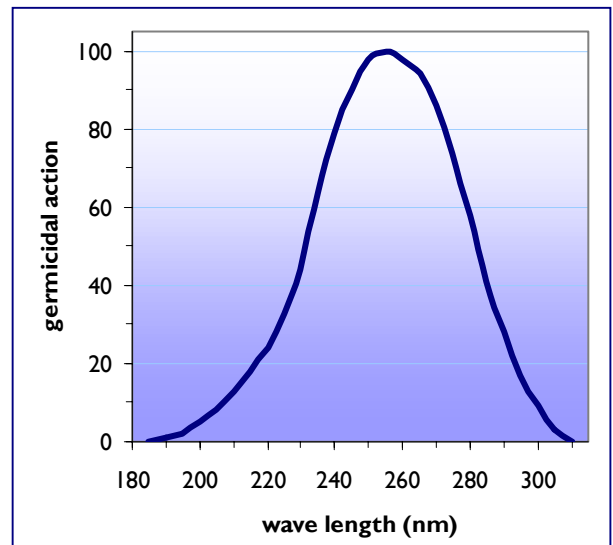


Figure 1. Germicidal Effectiveness of Various UV Wavelengths

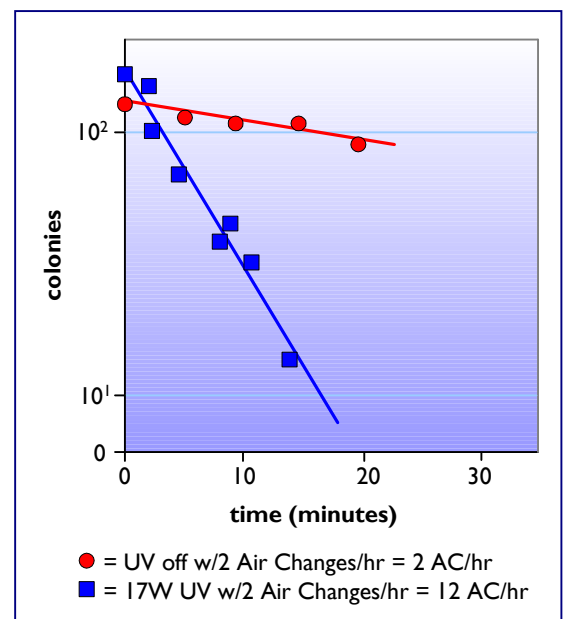


Figure 2. The Effect of UV Radiation on Aerosolized Bacilli

Passive Systems

Passive UV systems use UV-C emitting lamps housed in a fixture mounted in the upper part of a room. A horizontal zone of disinfection is created at or near ceiling level, hence the phrase “upper room UV” or “upper room disinfection,” by which this method is more commonly known. This method is termed passive because its design does not include an air-moving device. It relies on air movements already present due to convection and ventilation to deliver the room air to the UV disinfecting zone.

Upper room UV fixtures are designed to accommodate a variety of room sizes, shapes, ceiling heights, and mounting options. The main components include a fixture casing, ballast, one or more UV-C emitting lamps, a safety cut-off switch, and wiring. Modern upper room fixtures employ horizontal louvers to direct the output of the lamps along a horizontal beam. The louvers concentrate the output and make certain that elevated levels of UV do not occur in the lower room.

Non-Passive Systems

Non-passive UV systems use UV-C emitting lamps housed in existing ventilation ducts, stand-alone fan units, and in combination with high-efficiency particulate air (HEPA) filters. In a non-passive design, the UV lamps are completely enclosed within the unit. Non-passive systems rely on an air-moving device, such as fan units or forced air movement provided by a ventilation system, as in UV duct systems, to deliver room air to the UV disinfecting zone.

Non-passive UV systems are typically used only when upper room UV is not feasible, such as in rooms with ceiling heights of less than eight feet. Passive upper room UV systems are favored over non-passive systems because the latter tend to be less effective in providing equivalent air changes to a room.

Functional Applications

The danger of airborne disease exists primarily in facilities where infected people are likely to mingle with uninfected, susceptible people. The protection provided by UV is influenced by room ventilation, but experiments have shown significant reduction in the risk of transmission even in rooms where there is no mechanical air movement.

Where to install UV fixtures depends on where the hazard of airborne disease exists. The optimal settings for passive UV air disinfection generally have the following characteristics:

- Indoors, where there is a high risk of infection among occupants that cannot be controlled by more conventional means,
- A low risk for the occupants of acquiring the same infection outside of the proposed area,
- Sufficiently high ceilings are in place,
- Acceptance of UV by occupants is established, and
- A means of measuring the benefit from UV air disinfection is established (Riley and Nardell 1989).

Rarely are all these criteria present. However, most settings generally do exhibit enough of these characteristics to justify use of UV. Besides controlling TB, influenza, and measles, UVGI systems can also be applied in many other settings where the risks of these diseases are known. These include day care centers, transportation systems, auditoriums, jails, airports, and health care facilities.

“Tuberculosis kills 2 million people each year. The global epidemic is growing and becoming more dangerous. The breakdown in health services, the spread of HIV/AIDS and the emergence of multidrug-resistant TB are contributing to the worsening impact of this disease.”

*World Health Organization
Fact Sheet No. 104, Revised
April 2000*

Medical environments have long been recognized as among the most important sites for the transmission of airborne disease. Certain areas of health care facilities are more prone to TB concerns than others, and consequently stand to benefit most from the installation of UV systems. The most vulnerable areas include:

- Respiratory therapy areas
- Bronchoscopy/endoscopy areas
- Operating rooms
- Autopsy rooms
- Laboratories
- Primary-care physician's offices
- Waiting areas
- Isolation rooms (Rousseau 1997)

Summary

Recent outbreaks of multi-drug resistant strains of TB have proven the need for effective disease prevention. To identify potential opportunities for installation of UVGI systems, utility account representatives should look for facilities that house dense populations of individuals typically in poorer health. These facilities often have inadequate ventilation, which promotes the transmission of TB and other airborne contagions. Investments in UV disinfection systems provide the greatest potential benefit in these settings.

Neil Podkowsky is an Analyst with Global Energy Partners. He can be reached by email at npodkowsky@gepllc.com or phone at 925-284-3790.

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Characterizing Electromagnetic Environments in Health Care Facilities: The Effects of Electromagnetic Interference

First in a Three-Part Series

By Philip F. Keebler, M.S.E.E. and Kermit O. Phipps, C.E.T., EPRI PEAC Corporation

Introduction

The electromagnetic environment of a typical health care facility grows more complicated each year. The continual introduction of new, sophisticated biomedical, diagnostic, and therapeutic devices into the health care environment clutters the electromagnetic environment, increases the background level of radiated electromagnetic energy, and may, in some conditions, jeopardize patient safety and the very medical procedures that such devices were intended to facilitate. To manage this complex environment, health care facilities should establish and follow procedures to prevent conditions leading to electromagnetic interference (EMI) and educate staff, patients, and visitors about EMI. Traditionally, management of the environment

requires emissions measurement and characterization equipment, which entails a significant capital equipment investment. Because most spectrum analyzers are so expensive and difficult to program and operate, it is prohibitive for utility and health care professionals to characterize their environments. The use of such equipment is also time-consuming and may interrupt patient services. This article describes the importance of characterizing electromagnetic environments in health care facilities.

This article, the first of three on EMI in health care facilities, begins with a background on EMI in the health care setting. Future issues of *Power Prescription* will continue with discussions on characterizing the electromagnetic environment in a health care facility and applications of EMI measuring equipment.

Background

The electromagnetic environment of a typical health care facility grows more complicated each year. The continual introduction of new, sophisticated biomedical, diagnostic, and therapeutic devices into the health care environment increases the background level of electric field energy in the facility and may, in some conditions, jeopardize the very medical procedures that such devices were intended to facilitate. To manage this complex environment, health care facilities should establish and follow procedures to prevent conditions leading to electromagnetic interference (EMI) and educate staff, patients, and visitors about EMI. The guidelines set forth to manage electromagnetic compatibility should be an integral part of a facility's clinical and administrative activities, thereby enhancing the overall performance of the staff, reducing the number of equipment malfunctions resulting from EMI, and, more importantly, improving the safety and quality of patient care at the facility.

Figure 3 shows an example of an actual EMI problem that occurred in a laboratory where an electroencephalograph (EEG) was being used. The EEG was susceptible to radiated electric fields generated by a cellular telephone. The artifacts that appeared on the EEG – some of which are shown in Figure 3 – resembled actual EEG data. If the electromagnetic environment in the laboratory had been characterized, this problem may have been identified before the malfunctions occurred.

Procedures for preventing conditions leading to EMI and for educating staff, patients, and visitors should be included in a set of guidelines put into place by health care facility managers. Such procedures will depend on information that is already known by the facility staff, biomedical staff, and clinical engineers of the hospital, such as:

- The type of health care services offered at the facility,
- The layout of the facility,
- The type of materials of which the facility is constructed,
- The type of electronic medical equipment used in the facility, and
- The hospital's location.

Moreover, the likelihood for a radiated EMI problem to develop not only depends on immunity of a medical device to radiated emissions but also on the characteristics of the electromagnetic environment inside and near the outside of the facility. These characteristics are not readily available to facility staff but can be determined by identifying specific characteristics of building

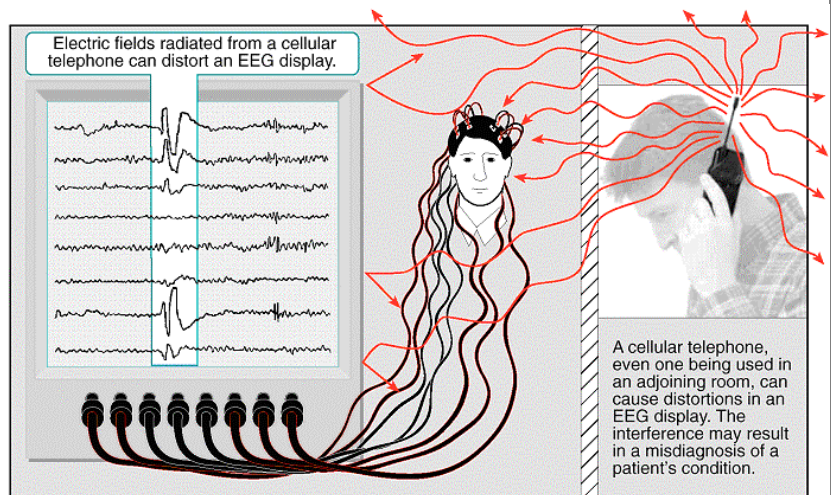


Figure 3. Electromagnetic Interference (EMI) on an Electroencephalograph (EEG) Caused by the Operation of a Nearby Cellular Telephone.

materials used in the facility and from measuring the frequency and strength of radiated emissions in the facility's electromagnetic environment.

Measuring radiated emissions from electric fields in a hospital electromagnetic environment will reveal the magnitude and frequency of the fields that are in the environment. Because the magnitudes and frequencies of these fields are quantities that change with time, measurements should be taken over a long enough period to ensure that the data is representative of the expected field strengths in the environment. The data should include date, time, and period of measurement with minimum, maximum (peak), and average field strengths within the frequency bands of interest.

To carry out automated emissions measurements, specialized EMI measuring equipment must be used. Traditional radiated measurements are usually made with a basic spectrum analyzer and one or more antennae. Most basic spectrum analyzers are not designed to automatically change scanning parameters over a specific time period and require the presence of an equipment operator (usually an EMI engineer) to program the equipment, capture the data, and manage it during the characterization process. Today's modern electromagnetic measuring equipment and software are relieving some of these burdens, thus reducing the manpower and time necessary to take the measurements.

A radiated emissions measurement system may be assembled from several types of components. However, in a health care facility, especially a hospital where floor space and aesthetics are a primary concern, an arrangement that is not obtrusive, physically small, easily moveable, and requires little attendance from an operator would be ideal. Such an arrangement will not only be easier to use but will also minimize the cost of taking the measurements and prevent the interruption of health care services that must continue to take place during the measurements.

The **second part** in the series "Characterizing Electromagnetic Environments in Health Care Facilities" will appear in the next issue of *Power Prescription for Health Care*.

Phillip F. Keebler is an Electrical Engineer, Power Quality with EPRI PEAC and can be reached by email at pkeebler@epri-peac.com or by phone at 865-218-8015. Kermit O. Phipps is a Power Quality and EMC Specialist at EPRI PEAC and can be reached by email at kphipps@epri-peac.com or by phone at 865-218-8021.

Coming in Summer 2002:

- ❖ **Part Two of "Characterizing Electromagnetic Environments in Health Care Facilities," the "Benefits of Characterizing the Electromagnetic Environment."**
- ❖ **"Energy Use by Inpatient Health Care Facilities" – a summary of the soon-to-be released energy consumption and expenditure data from the Energy Information Administration's 1999 Commercial Buildings Energy Consumption Survey.**



*"Meeting the Needs of the
Constantly Changing Energy Industry"*

3569 Mt. Diablo Blvd., Suite 200
Lafayette, CA 94549
Phone: 925-284-3780
Fax: 925-284-3147
Email: globalhq@gepllc.com