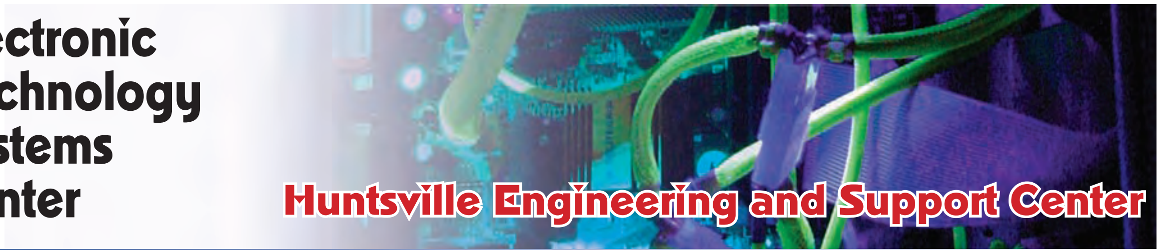
US Army Corps of Engineers

Electronic Technology Systems Center



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Solar panels help cut energy costs at Fort Sam Houston

By Debra Valine, Huntville Center Public Affairs

San Antonio, Texas, gets plenty of sunshine so why not convert that natural power to usable energy? Solar power creates green energy. It's good for the environment and saves money.

Bldg. 1350 at Fort Sam Houston in San Antonio now uses a 180 kilowatt-hour photovoltaic (PV) solar panel system to augment electricity from the power company. It's saving the installation nearly $6,000 a month in energy costs, and provides clean energy, no carbon dioxide emissions and less dependence on foreign oil.

The solar panels produce DC electricity and route it through an inverter where it is turned into AC energy that is accessible to anyone on the power grid in San Antonio. Once on the grid, the solar energy is used just like electricity that comes from the power company; this just comes from the sun. It is seamless to the end user.

The project is part of the Energy Conservation Investment Program (ECIP). Funding comes from Congress through the Military Construction Program. ECIP judges the different projects that installations submit. All the proposals include an economic analysis that includes cost, savings on investment ratio, payback, etc. Other types of projects include increased insulation, high efficiency boilers and motors – basically anything you can replace with a high efficiency device, lighting and direct digital controls.

"ECIP likes funding PV because it is green energy," said Will White, the Lead Program Engineer of the Utility Monitoring and Control System (UMCS) team at the U.S. Army Corps of Engineers, Engineering and Support Center in Huntsville, Ala. "The workmanship and the engineering on this job impressed me. We finished the job on time and within budget. We actually had some contingency funds that we did not use that we will return to the program. It was in all respects one of the most satisfying and successful jobs I've been associated with. No safety violations, no re-submittals, no unhappy customers… the guys just worked hard and did all they promised."

Rob Jay, the installation energy manager at Fort Sam Houston, and Gene Rodriguez, Fort Sam Houston's in-house technical consultant for PV systems, submitted the project to ECIP and it was funded in September 2005. The project was completed seven months later in April 2006.

"Initially our primary objective for going with PV was to try and not exceed the demand charge from City Public Service (CPS), our local utility company," Rodriguez said. "The solar constant is something like 1500 Btu's/sq. ft./ per day. That is a lot of energy going to waste. Our chillers are drawing the most current flow from 3 to 5 p.m., almost matching the peak output of the PV system that it is interfaced with. Due to the reduction in maintenance dollars, a system almost has to be designed for neglect. Our PV system would have to be as close to low maintenance as you can get.

"It hasn't rained much lately in San Antonio, but for the most part an occasional rain is all that's required to keep the collectors clean," Rodriguez said. "But now we're finally starting to pay attention to global warming and national security. Due to soaring oil prices, using a renewable alternate energy source, in this case solar energy that we have in abundance, to achieve energy independence in America not only makes sense but soon may become mandatory. More importantly, this will help procure the long term national security that comes with preserving the environment for our children and grandchildren, and cut our international foreign deficit by keeping our dollars here in America instead of sending them to some Middle Eastern country that doesn't like us and promotes terrorism."

Partners in the project included the installation, the Corps of Engineers Fort Worth District, the Huntsville Center, Williams Electric Company of Fort Walton Beach, Fla., and Meridian Energy Systems of Austin, Texas.

"We competed the job between our UMCS ID/IQ contractors and received price proposals from three of them," White said. "All the pricing came within 2-3 percent; however, due to the pressure of increased demand for PV panels from higher oil prices, they were all over the government amount allocated. We had to go back to ECIP for more money. Hank Gignilliat at Headquarters in Washington, D.C., was instrumental in getting the additional funding for the project."

The system is fully integrated through controls to produce power onto the energy grid. It is metered and monitored separately from the power provided by the local electric company. The power that is generated from the sun is metered separately and the cumulative kW and dollar savings are displayed on the monitor in the master control room of the Energy Monitoring and Control System (EMCS). It is helping to reduce the demand cost and base utility cost while helping to meet Army energy goals.

"What is great about the use at Fort Sam Houston is that it provides additional energy for cooling during the peak demand periods," White said. "You get more kilowatts of

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ETSC Points of Contact

Contact-ESC@hnd01.usace.mil
Phone 256-895-1740

Solar panels cont.

energy from the solar panels when the sun is the brightest. The solar energy powers the chillers in classrooms, barracks, etc.

"We had a challenge with the panels because from the time the contractor put in the bid to the time he wanted to buy the panels, the price had gone up due to rising costs and demand," White said. "The contractor honored their proposed price and we ended up using a different source for the panels, but the panels were just as good."

It was a team effort that turned out well," White said.

What Would Your Building Tell You? If it Could Talk!

The Corps of Engineers has developed facility criteria and guide specifications for direct digital controls for HVAC and utility monitoring and control systems (UMCS), using LonWorks®-based communications technology. The building industry has also incorporated LonWorks®-based communications into many other systems which will allow these systems to provide large amounts of valuable monitoring and control data. Government agencies designing new facilities or going through major renovations, should strongly consider how they can create better integrated facility systems by specifying components with imbedded LonWorks®-based communications.

Chances are your new facility will have a multitude of systems or equipment installed that could provide you with very useful information... with just the click of a mouse. Asset management, fire/life safety, hospital equipment, circuit breakers, meters, Human-Machine Interfaces, unitary HVAC equipment, multitudes of sensors, lighting controls, actuators, occupancy sensors, central plant equipment, and motor controls are some of the more common systems that have factory installed microprocessor-based controls that utilize the LonWorks® open protocol.

Are We There Yet?

The current guide specification used by the Corps of Engineers for HVAC controls is *UFGS-23 09 23 – DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS.* UFGS-23 09 23 is to be used in conjunction with *UFGS-25 10 10 – UTILITY MONITORING AND CONTROL SYSTEM (UMCS).* This guide specification covers the computer servers and software for operator interface, and other LAN hardware necessary to connect buildings designed by UFGS-23 09 23 .

These specifications address the control and monitoring systems and related installation, but do not necessarily close the loop. The end use application layer device (i.e., chiller, boiler, VAV terminal, etc.) must also be specified with the appropriate LonTalk Communication Interface to access the imbedded technology of that particular device.
A typical Lon network is shown in Fig. 1.

Many times the controls contractor will be required to provide redundant data when such information is already imbedded in the equipment controller and can be readily accessed by specifying the appropriate LonTalk Communication Interface for that controller. Sometimes information (such as refrigerant pressures) is not typically provided by the controls contractor, but could be easily accessed through imbedded technology.

For example, if a designer specifies a LonWorks® communications interface to a major manufacturer's centrifugal water chiller, the UMCS will have access to over 40 pieces of control monitoring information on the chiller, and 7 control variables to the chiller. At the same time, 5-10 external hardwired points can be eliminated, saving the installed and operating costs of those points. Table 1 below provides an example of one manufacturer's available LonWorks® network variables.

By being aware of the possibilities, the project specifier can reduce the total cost of installed controls, while at the same time enhancing the overall functionality of the installed control system. From an Operation and Maintenance perspective, this has the potential for considerable cost savings by providing device status, runhour trending data, and diagnostic tools to the Facilities Group.

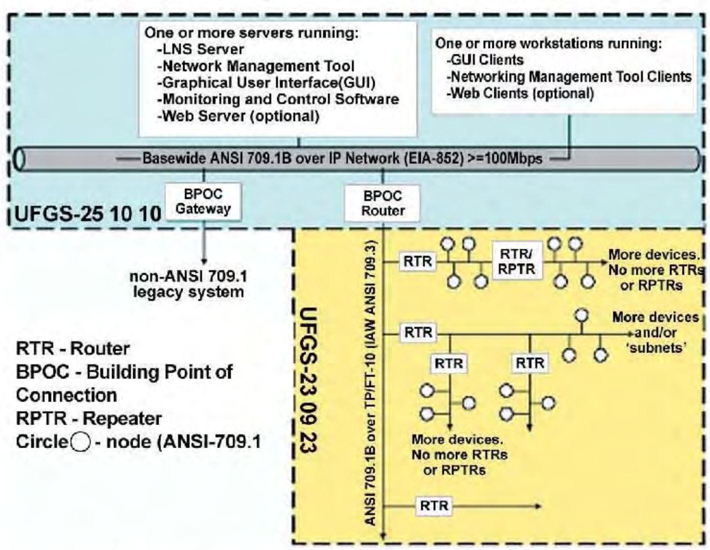

Figure 1. Typical Network Architecture

Equipment… Something Old, Something New

Thus far, over 625 devices have been successfully tested and certified by the LonMark International organization. By specifying your new facility's major equipment or devices with a LonTalk Communication Interface and making the connection to your network, you can fully access and utilize a wealth of available data through your UMCS. Additionally, existing buildings may have equipment which can be accessed by making the appropriate field modifications to add LonTalk communication interfaces.

On Your Next Project

So, on your next project, utilize LonMark certified application level devices and networking for your lighting controls, motor controls, central plant equipment, fire/life safety controls, and HVAC components and unitary devices to get the best system for your project budget.

Chiller Data Variables
Inputs – 7 variables
Chiller Enable/Disable Command
Chiller Mode (i.e. Heat, Cool, Free Cool, Ice)
Base Loading Auto/On Request
Base Loading Setpoint Input
Chilled Water Setpoint
Current Limit Setpoint
Heating Setpoint
Outputs – 40 variables
Evap & Cond, Water Pump Request, Flow Status, Flow Rate
Evaporator & Cond, Ent & Leaving Water Temperature
Evaporator Refrigerant Temperature & Pressure, per circuit
Condenser Refrigerant Temperature & Pressure Per Circuit
Active Chilled Setpoint, Current Limit Setpoint, Load Setpoint
Alarm Description
Run Modes (i.e. Off, Starting, Running, Shutting Down)
Operating Modes (i.e. Heat, Cool, Free Cool, Ice)
State (alarm, Run Enabled, Local Control, Limited)
Base Loading
Actual Capacity (Percent Rated Load Amps), current & voltage per phase
Unit Power Consumption (kW)
Oil Temperature Per Compressor
High Side & low side Oil Pressure Per Compressor
Other chiller status

Table 1.Chiller LonWorks® Network Variable

Probability of Detection and Level of Confidence

Probability of Detection (Pd). Pd is one measure of the effectiveness of a sensor (nuisance alarm rate (NAR) and vulnerability to defeat are two others). Typically, there are (at least) two ways of establishing a reasonably accurate Pd of a sensor; 1) Conduct one very large test – in terms of the number of "test events" or "samples" used – and declare that the system's accuracy is the measured accuracy of the test; or, 2) Conduct many smaller tests and declare that the system's accuracy will lie somewhere within a range defined by the highest and lowest measured accuracy values obtained in these small tests.

There are some problems associated with the two methods described above:

> What is a "very large test" in terms of the number of test sets used?
> How many "smaller tests" should be performed and how many test sets should be in each small test?

Problems associated with testing, like the ones above, have always existed; however, testing techniques have been investigated by math scholars and resulting concepts have been proven over time. The result has been a concept that defines the required sample size of a test depending on a desired *Level of Confidence (LOC)* in the test and the desired Pd (i.e., 95%) that is acceptable to the responsible agent. By using these concepts and assuming the sensor being tested has reasonable levels of consistency and repeatability, the range of accuracy values resulting from successive tests of the system can be predicted by performing a single test. Thus, we can avoid "very large tests" and an unknown quantity of "smaller" tests while achieving the same results.

Restated another way, levels of confidence are applied to help define sample sizes (number of intrusion test events) based upon the amount of risk a decision maker is willing to accept. Basically, to assure Pd test results are real, repeatable and within the range of risk a decision maker is willing to accept, a LOC is applied.

In short, the LOC is the likelihood that the results of a test are real and repeatable and not just random. Again, the LOC tells you how sure you can be that a Pd statement is true. If your level of confidence is 95%, you can objectively state you are 95% certain you will achieve the same Pd results in a repeat of the test.

Now, it is not necessary to pull out your scientific calculators, pencils and paper to determine the number of test events or sample size you need to achieve a specific Pd with a specific LOC. This task has already been done for us. Below is a table that provides the number of test events (sample size) required to determine if a sensor meets a Pd requirement at a specific LOC. For example, if you want to evaluate a fence sensor for climbs and the requirement

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Probability cont.

is a Pd of 95% at a 95% LOC, the minimum sample size (number of successful detections by the sensor) is 59. This means the fence must be climbed 59 times by an individual who represents an intruder and each attempted climb must be detected by the sensor. If one climb is undetected by the sensor, the minimum number of intrusion tests conducted must be 93.

Intrusion Tests Required to Determine Probability of Detection at a Specified Level of Confidence

Pd	90%	90%	95%	95%	
Confidence	90%	95%	90%	95%	
	Minimum Number of Intrusion Tests (Sample Size)				Maximum Number of Undetected Intrusions
	22	29	45	59	0
	38	46	77	93	1
	52	61	105	124	2
	65	76	132	153	3
	78	89	158	181	4
	91	103	184	208	5
	104	116	209	234	6
	116	129	234	260	7
	128	142	259	286	8
	140	154	282	311	9
	152	167	306	336	10
	164	179	330	361	11
	175	191	353	386	12
	187	203	377	410	13
	199	215	400	434	14
	210	227	423	458	15

Layered Protection. It is often stated, and true, that within our industry there is no perfect sensor. Therefore, to achieve assurance of increased levels of detection, sensors of different phenomenology are installed in layers. For example, a fence sensor may be complimented by the installation of a buried line sensor in an adjacent clear zone so that any adversaries attempting to intrude into a protected area must cross both lines of detection. The benefit is the overall system Pd increases through the compilation of the individual sensor probabilities of detection. To demonstrate this concept, consider this example.

- Sensor 1 is a buried ported coaxial cable sensor with a Pd of 95%.
- Sensor 2 is a strain-sensitive cable fence sensor with a Pd of 95%.
- Per sensor, an intruder's chance of success is 5% (.05).

However, by combining the sensors (.05 x .05 = .0025), the intruder success rate is reduced to .25%.

Essentially, by using two sensors you have achieved a system Pd of 99.75%.

Summary. Pd is one measure of the effectiveness of a sensor. To have a specific level of assurance, that a Pd is real and repeatable, apply a level of confidence factor during test design and analysis. This approach helps define a minimum number of test samples (in this case the samples are intrusion attempts), both attempted and successful, that are required to determine a specified Pd with the desired LOC. This method provides an objective degree of assurance, i.e., 95%, that another test (or actual intrusion) will provide the same results. Translated another way, if a sensor is tested and the desired results are achieved, i.e., a Pd of 90% at a 95% LOC, a decision maker can objectively say they are 95% sure that the sensor has a Pd of 90%.

To increase the probability of detecting intruders into a given area or zone, it may be necessary to apply different layers of detection. The benefit of layering detection is the overall "system" Pd increases through the compilation of the individual sensor probabilities of detection.

Updates to recent releases

The Electronic Security Center is currently developing criteria related to wide area sensors, wireless data transmission, and typical electronic security system drawings. Initial drafts of these criteria documents will be released for review during the first quarter of FY07 (Oct-Dec). The goal is to publish each of these documents as a Unified Facilities Criteria (UFC) by the end of FY07. Additional criteria development efforts are expected to begin in FY07.

Training classes

Electronic Security System (ESS) Design Course: One FY07 session is currently confirmed for the week of 12-16 February 2007 to be conducted in Huntsville, AL. Approximately seven additional sessions will be offered in FY07; however, specific dates and locations have not been set. As FY07 sessions are confirmed, they will be added to the calendar published on the ESS Design Course web page: https://eko.usace.army.mil/training/ess/.

Integrated Commercial Intrusion Detection System (ICIDS) Operator Training Course: FY07 training dates have not been set, but, as sessions are confirmed, they will be added to the calendar published on the ICIDS training web page: https://eko.usace.army.mil/training/icids_training/