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ELECTRONIC TECHNOLOGY SYSTEMS CENTER

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SYSTEM MAINTENANCE: KEEPING IT RUNNING

It takes a focused effort to get a system properly designed installed, tested and finally accepted. The cultural changes that accompany the new system may have challenged longstanding facility practices and traditions. Unfortunately, the hard work does not stop there. Now comes maintenance.

Let's make sure we understand some basic terms. Some confuse warranty and maintenance. Warranty related work is that work after installation where the integrator agrees to repair or replace any failed products. This is almost always part of program defined by the equipment manufacturer. The integrator usually offers normal business hours response with no contractual obligation regarding response time or time to repair. Warranty services do not normally include loaner equipment during the time that the component is being repaired.

Maintenance on the other-hand is simply those activities you go through to keep the system running, normally after the warranty expires. You can approach maintenance on a time and material (T&M) basis (i.e., if it takes an hour to fix, you pay the maintenance contractor for an hour's labor plus parts and materials.) or you can negotiate a maintenance contract. This can take many forms but generally involves a negotiated annual fee in return for defined levels of maintenance support. This support can include:

- Warehousing of spares at the maintenance contractor's facility.
- Warehousing of dedicated critical spares at the owner's site.
- Contractually defined response times and repair times.
- Proactive maintenance and inspections at defined intervals during the year. This can include equipment cleaning and adjustments as well as software updates.

A structured and responsive maintenance system is required for the electronic system to maintain a reliable and cost effective contribution to the overall security program. However, experience indicates that very few effective maintenance programs are in place. Here's the empirical data:

- Site survey teams rarely encounter a facility where all of the cameras are working at the time of the site survey.
- Site survey teams are sometimes told that a specific camera is not working; as the team works through the system, they always find more that reportedly just went out.
- Most access control systems have not been backed up within the last thirty days. Many are running two to three software versions behind the current release even though the upgrade is free.
- At least one VCR is either not working or in the shop for repair. If it is not in the shop, it is usually still on the shelf in the control room with a big yellow post-it note saying "Broke."
- Somewhere around 10% of the door contacts will either be hanging by one screw or the signal wires. The number is higher in industrial type facilities.

Maintenance needs to be considered in two areas: preventative and reactive. Preventative maintenance is just like an oil change: you know if you don't do it, something will break later. Hard drives need to be backed up, screws need to be tightened, lenses need to be cleaned. Reactive maintenance is getting the recently discovered inoperable card reader on the high value asset storage room door fixed fast. A key contributor to a good maintenance program is comprehensive testing. Written testing procedures along with a schedule can result in every component of a system being tested every six months or so. Loose screws, dangling wires, and dirty lenses can be noted and in many cases fixed by on site staff. In some cases a local maintenance contractor may need to be called in.

That raises a question that apparently troubles many organizations with security programs: how much maintenance should be done with in house staff and how much should be contracted out. The empirical data on the in house maintenance option is not good. I've been to too many locations where components have been under repair by the in house staff for 4-6 months with no replacement component available even on a temporary use basis.

Here are some key issues to consider regarding maintenance contracts:

- Designate specific individuals who are authorized to request service on your behalf, especially if this service is for some reason not covered by the maintenance agreement.
- Establish escalation procedures with the maintenance contractor just in case your expectations are not met.
- Define service documentation procedures for both parties of the agreement.
- Define hourly rates for non-covered services. Some organizations have negotiated standard rates for equipment as well.
- Require that the service personnel are factory certified on your system.
- Establish billing procedures (i.e. discounted) for those times when the responding technician is not familiar with your site.
- Define how labor will be billed, i.e., portal-to-portal or on-site time only.

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UMCS GRAPHICAL DISPLAYS

It has been exciting to watch the Energy Monitoring and Control Systems (EMCS) of the early 1980s evolve from monolithic, clunky "energy management" mini-computers to today's PC-based Utility Monitoring and Control Systems (UMCS) which include stand-alone distributed and networked direct digital controllers (DDC).

At the 1983 ASHRAE convention, all major control vendors introduced digital controllers that performed energy management functions as well as local loop digital control. When one of the largest control users looked at the digital systems, he commented, *The problem with DDC is that you cannot see the program*. With a comparable pneumatic system, the user could follow the air signal through the control system by observing pressure gauges as the signal progressed from solenoid valves to thermostats to switching relays to limit controllers and to the final valve or damper actuator. With DDC, all he saw was a blinking LED, and often the *programmer* did not speak the HVAC language.

In fact, the DDC program could be seen, observed, and understood; but it was not specified to do so because the engineer-specifier and the DDC system programmer did not understand each other.

Figure 1 below is a display of a steam-to-hot water converter as it appears on a typical UMCS monitor. (Note: Pump on-off status couldbe noted by color change: green = on, yellow = off, red and blinking = alarm.)

Figure 2 is a more meaningful display where one can *see the program* and watch it execute in real time.

As the outside air temperature drops to 57ºF, the pump will start, subject to an on-off-auto software function. The leaving hot water temperature setpoint will vary from 130º to 195ºF as the outside air temperature varies from 60º to -5ºF. On this display, the calculated setpoint is 173ºF, and the leaving water temperature is 173ºF. Both 1/3- and 2/3-size valves are at 67% open. The hex symbols with a slash denote commandable points. Placing the cursor on commandable points allows the operator to make adjustments. The outside air reset schedule and the pump start temperature may be adjusted, and the pump may be placed in the on, off, or auto mode. The *sequence of operation* box implies that the hot water converter sequence of operation may be displayed by selecting the box with the cursor. (This may be difficult for some vendors.)

Another excellent way to present certain *programs* to HVAC system operators is via a *dynamic sequence* where the sequence is presented with all variable values imbedded in their appropriate positions as indicated in figure 3.

Data on UMCS monitors can consist of any combination of text, data points, and artwork. This allows current systems to display DDC system data in intuitive and meaningful formats if the graphic designer understands the needs of the operating personnel.

The control system design process has always (long before DDC) started with a sketch of the particular HVAC unit (such as a fan system) with elements to be monitored and controlled. Actuators are then added to valves and dampers. Sensors are then added in locations requiring control. The sequence of operation is then written defining the relationships between the input sensors and the output actuators. The simple thing to do then is to specify that the sequence of operation, along with the sketch including desired setpoints, as a required system graphic.

Today's UMCS can present control sequences in very clear terms to system operators resulting in more efficient system operation. To accomplish this, graphic designers need to consider and understand operator needs when designing the operator interface.

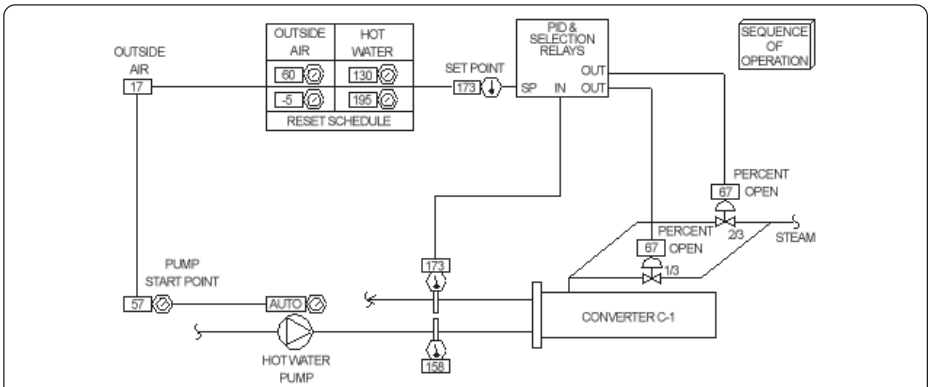

Figure 2. UMCS display showing program with system configuration

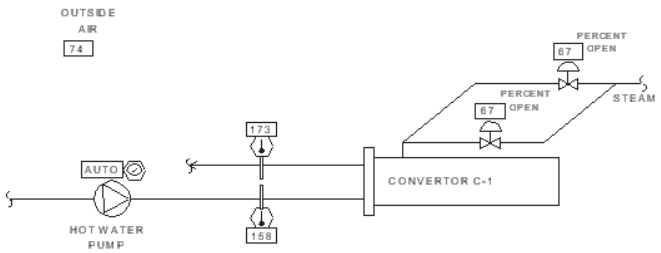

Figure 1. Typical UMCS Display

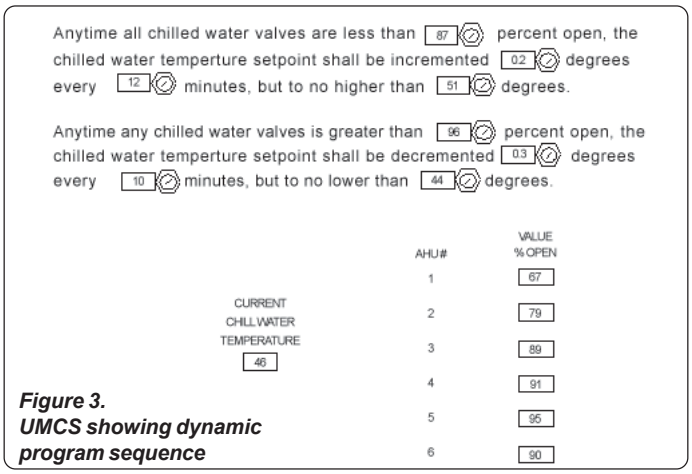

Figure 3. UMCS showing dynamic program sequence

FACILITY MANAGEMENT VIA THE INTERNET

The decreasing cost and capability to embed microprocessors in a wide range of devices has led to the increased use of smart devices in buildings, machines, and other aspects of our daily lives. The growth of Internet usage and capability makes large-scale interconnectivity of these devices economically possible. If these devices can be connected, managed, and remotely controlled over the Internet, they can provide users with dramatic new facility management services and capabilities. New facility management systems are currently being developed and released which are Java™-based platforms, developed to solve problems with interoperability between device protocols and the Internet, and between those devices and enterprise business management systems. Serious consideration must be given to utilizing the Internet as the backbone for future facility management systems.

Why Facility Management via the Internet?

The future suggests that there maybe millions of new smart devices that will be integrated into an single network providing communication across a global network. As smart devices become more integrated across the Internet, a wealth of new information about machine status, equipment performance, energy usage, human habits, and many other factors will be available to the world. To take advantage of this magnitude of data, new approaches to software and network solutions will need to evolve. Utility Monitoring and Control Systems (UMCS) will be based on Internet-enabled distributed architecture for real-time access, automation, and control of embedded devices. The same UMCS will also connect legacy systems, open systems, the Internet, and enterprise information systems.

The ability to move around and through Web explorer software will almost become second nature. From the time people are old enough to click a mouse and move through a child's Web site, they will know how to deal with "Web-based" graphical information, move through Web pages, and search the Internet for information.

In the world according to Bill Gates, there will be fewer electronic devices. Items that will survive include the PC, the digital set-top box, the cellular phone with screen, the electronic book, and Web pads with wireless connections. Just consider how Web-enabled cell phones will change our lifestyles. Using cell phone-based Web page, individuals will be able to perform simple to complex facility management functions. Using a cell phone over the Internet, individuals will be able to turn on the lights, change a temperature setpoint, not to mention the ability to check the status of chillers, electrical generators, and production, and monitor energy usage.

Operations and maintenance departments, maintenance and service contractors, and the like, will have much broader capabilities to remotely monitor and control facilities. Alarms will come to service groups as e-mails from chillers. Service orders could come from tenants as forms submitted via Web pages.

Instead of having one or two expensive facility management graphic workstation software platforms per office or company, all computers in the company that are connected to the intranet or Internet could provide access to data and equipment for service technicians. The cost to outfit whole service companies or maintenance departments with graphical workstations to perform facility management and view equipment will be limited to computers and network connections only, not by the cost of graphical workstation software.

Who Will Benefit From Facility Management Via The Internet?

As the Internet becomes the definite delivery medium of real-time information, it will put power and options in the hands of the user.

It allows operators, maintenance personnel, management, tenants, production control, field engineers, test-and-balance technicians, and systems integrators to control and monitor wide ranges of networked embedded control devices.

Summary

Just a few years ago, building automation consisted of a handful of separate systems that operated independently from one another, each with its own dedicated and proprietary interface and cabling system. Today, the latest generation of facility management systems is being designed and built around the use of the Internet as the infrastructure over which data is transmitted.

The Internet is a comfortable environment; everyone knows how to use it and is very familiar with it. Web-based cell phones could be a new standard for operator interface for facility management via the Internet.

Facility management and building automation has been transformed from mainframe computers in the 1970s to mini-computers in the 1980s to PC Windows-based systems in the 1990s. The Internet may increasingly become the communication standard for emerging systems.

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- Designate what spares are required, who stores them and where, and how they are to be billed (when received or when installed).
- Be sure and perform regularly scheduled audits to verify costs and performance.
- Define monetary penalties for non-performance or excessive downtime.
- Negotiate a reasonable cancellation clause with defined implementation parameters.
- Make sure the contract does not automatically renew.

Now for some opinions:

- Maintenance contract customers get priority service over non-contract maintenance customers. When schedules get tight, the maintenance contractor will usually dispatch to contract customers first; the T&M customers are at the bottom of the list.
- 24/7 response is unnecessary unless you are responsible for a nationally critical facility. This raises the cost of the maintenance contract by somewhere between 20 and 30%. Most owners like to be present when work is being done but don't like to be there at midnight.
- Assuming that you do not lose an expensive piece of hardware, an owner can save money by simply going with the T&M approach. The annual negotiated maintenance contract fees always have contingency built in to cover large equipment loss. The T&M approach avoids this contingency. With this approach, the owner shoulders some additional responsibility such as purchasing and storing a few critical, long lead spares (panels, cameras, card readers) to have on hand when one fails. The owner also takes responsibility for proactive inspections and cleaning as well as software upgrades.
- A good rule of thumb for an annual maintenance budget is on the order of 10% of the installed equipment and software cost. For example, if the installed equipment cost was $100,000, plan on annual maintenance costs over the life of the system of around $10,000. The actual number will be much lower the first year because of standard warranty provisions and somewhat higher during the latter stages of the system lifecycle.

The optimum maintenance program is always facility and organization specific. The best approach depends on the skill set of the security staff, the availability of in house support and the level of involvement desired by site management.