

## **PRISON INDUSTRIES METERING AT THE TEXAS DEPARTMENT OF CRIMINAL JUSTICE: TWO YEARS OF OPERATIONAL EXPERIENCE**

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### **ABSTRACT**

In 2001 the Texas Department of Criminal Justice Utilities and Energy Department (TDCJ-U&E) completed the installation of an extensive energy consumption metering system for their prison industries system. As the second largest state prison system in the nation, TDCJ facilities are scattered over many locations around the state and cover a diversity of prison industries and agricultural operations. The Energy Systems Laboratory (ESL), with New Horizon Technologies, Inc. (NHT) and eComponents Technology, Inc. installed a state-of-the-art sub-metering system with the intent of meeting the needs of the TDCJ-U&E group well into the future. The system uses a web-based data acquisition interface and is capable of near real-time data acquisition and display. Fifteen-minute interval utility and sub-metered energy consumption data have been continuously collected since the system was commissioned. This paper describes the varied applications for these data at the TDCJ-U&E department. Significant improvements in the quality of energy use reporting and unit accountability have been obtained. Prison industries now receive monthly energy consumption reports and are responsible for the cost of their sub-metered energy consumption. Additionally, the operations and maintenance staff have found the data to be very useful for energy systems and equipment operational diagnosis.

### **BACKGROUND AND INTRODUCTION**

The Texas Department of Criminal Justice began the implementation of an enterprise-level energy information system for Texas Correctional Industries (TCI) in May 1999. Initially 45 TCI sites were included in the energy metering system. Data acquisition at the first sites began in May 2000 and commissioning continued through the remainder of the year. Initial software training was provided in November 2000. Continuous data collection from all channels at all sites was ultimately achieved in March 2001.

The TCI facilities are scattered at many locations throughout the state and cover a diversity of prison industries and agricultural operations from meat packing to metal fabrication, furniture restoration,

garment and shoe factories, vehicle restoration, soap and detergent plants, mattress-making, and graphics production that includes sign and license plate manufacturing.

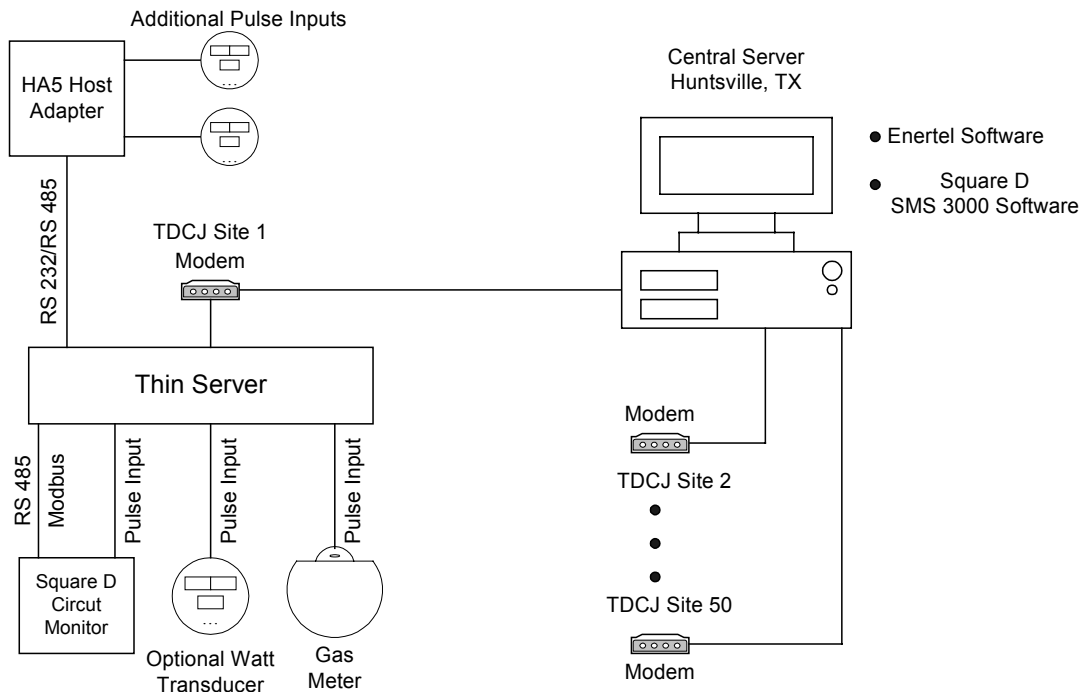
Energy costs are a major component of the Texas Department of Criminal Justice budget. Through responsibility accounting, wardens and other managerial staff are required to account for and justify energy costs for various prison industries and agricultural operations. The initial application of the TDCJ Prison Industries Energy Monitoring System was to measure and correctly allocate energy costs for all of the prison industry facilities. Energy costs had previously been allocated based on square footage or other non-metered metrics. The energy monitoring data has had other uses including helping to identify potential equipment or operational problems with mechanical or electrical equipment at TDCJ industry facilities.

### **DESCRIPTION OF EXISTING UTILITY MONITORING SYSTEM**

A generic schematic drawing of the TDCJ Utility Monitoring System is shown in Figure 1. The central element of the monitoring system is a "ThinServer." The ThinServer, in essence, is a single-board computer with an embedded Linux operating system, pulse counting channels and several communications ports. These communications ports support 10baseT Ethernet as well as RS-232 and RS-485 communications. The system includes telephone-based modem communication and supports TCP/IP Internet protocol.

Each ThinServer can support up to 67 channels of data collection. The current base monitoring system includes service entrance level electricity and natural gas metering at each industry site. Limited sub-metered is also included at some sites. A maximum of 21 data points is collected at a single site.

The TDCJ Utility Monitoring System is operated through a central server located at the TDCJ Utility and Energy offices at the system headquarters in Huntsville, Texas. The server operates Square D SMS 3000® and EnerTel® software. EnerTel,



**Figure 1. TDCJ Industries Energy Monitoring System**

developed by New Horizon Technologies and eComponents Technology is an enterprise-level, server-based, integrated data acquisition, data visualization and database management software package. The EnerTel software system can operate in a dial-in mode, as is the case in the TDCJ Industries project due to prison security constraints. The system can also provide internet-based data delivery using push technology and File Transfer Protocol (FTP) in a dial-out modem mode or Ethernet-based communications over Local or Wide Area Networks. The EnerTel software system can provide data updates on a last-interval basis, but in the TDCJ Industries project, daily polling meets program requirements. The EnerTel software package also provides real-time data display for all pulse output data collected, alarming capability based on threshold meter measurement levels, and sophisticated energy cost allocation and rate structure modeling capability.

The Square D SMS 3000 software system provides real-time access to Square D Circuit Monitors that are installed at the electric service entrance at each of the industry facilities. The Circuit Monitor is a sophisticated electronic meter that measures over 100 different electric variables including several power quality measurements. It has

waveform capture capability and real-time data display. The Circuit Monitors are accessed from the central server through the individual “ThinServers” that are located at each facility and operate in a pass through mode.

#### **INITIAL SYSTEM EXPANSIONS**

Since the initial implementation at Texas Correctional Industries, the Texas Department of Criminal Justice Utilities and Energy division has expanded their Utility Monitoring System into several additional facilities and undertaken new applications for the sub-metering system. Descriptions of these expansions follow.

#### **High Security Units**

In 2001 TDCJ installed utility monitoring systems at the Estelle, Smith, Clements, Allred and Lewis High Security Units. Each of these \$36 million, 660 bed units were essentially identical in construction. They vary only in geographic location. The Estelle Unit was built first; the others were built later. It was anticipated that advanced commissioning techniques would result in roughly 20 percent utility cost savings in the four later installations over the original “benchmark” Estelle Unit. Using the Utility Monitoring System, electricity and natural gas consumption at the service

entrance were metered at each of these high security facilities. The Utility Monitoring System data were used for energy savings verification and to identify operations and maintenance issues during the unit commissioning process. Since the five units were essentially identical, anomalous energy consumption patterns could be identified and the cause of the variations resolved.

### **Teleford Unit**

The Teleford Unit is a new TDCJ Prison Industries site at New Boston, Texas. The TCI facility at Teleford is a window manufacturing plant operated by a private company to produce products for sale outside the Texas correction system. Electricity and natural gas are monitored at the industry facility service entrance. The Utility Monitoring System is currently used to properly allocate prison industry energy costs to this “free world” plant operator.

### **Amarillo Unit**

In its first major sub-metering application, TDCJ installed a detailed sub-metering system at a 2,250 bed high security unit at Amarillo, Texas. The main individual buildings at the facility and two large individual chillers were sub-metered. A total of 16 electric metering points and 5 natural gas metering points are included in the system. Data are collected in two ThinServers that serially communicate with one another. Communication with the central data station in Huntsville, Texas is through a single modem. The existing telephone system at the facility was used for internal data communication between the ThinServers.

The Utility Monitoring System at Amarillo will be used for operation and maintenance problem identification, building commissioning, monitoring and verification (M&V) and cost allocation. This intensive monitoring system will be a prototype for other high security units in the Texas Prison System.

## **CURRENT METERING SYSTEM APPLICATIONS**

### **Cost Allocation**

Every month, every TCI unit receives an energy bill. These bills are generated by the EnerTel energy-costing module and are based on the actual utility rate structure pertaining to the TDCJ facility. This system allows individual wardens and industry managers to track their utility costs and appropriately budget for energy costs. Most of the individual industries now have over two years of baseline data so that benchmarking of individual facilities and specific

categories of facilities is possible. Most noticeable has been the wide variation of industry utility costs based on the industrial process undertaken at the facility. Some industries are very energy-intensive (meat packing, metal fabrication, etc.) while others are of a more clerical nature with energy intensities comparable to typical office facilities. Energy cost allocation on a square-foot basis clearly was inadequate. The Utility Monitoring System provided the tool for TDCJ and the Texas Correctional Industries to impose a much more realistic energy allocation system and for the individual managers to reasonably assume much more responsibility for their facilities' energy costs.

### **Utility Bill Verification**

In situations where the main service entrance for the entire prison is monitored, the system can be used for utility bill verification. While this application is currently limited because of the focus on industry rather than unit metering, its use will likely grow as deregulation unfolds in Texas and the functions of supply and distribution utilities are separated.

### **O&M Problem Identification**

The system has also been used to identify operations and maintenance problems and to flag component failure or troubleshooting issues. For example, the electrical monitoring and power quality information collected by the Circuit Monitors has proven very valuable in identifying and troubleshooting electrical distribution problems within the individual industry facilities.

### **Unit Benchmarking and Energy Savings Verification**

The Utility Monitoring System has been particularly useful in benchmarking energy consumption of similarly constructed facilities. As part of the initial Utility Monitoring System deployment, five nearly identical, newly constructed, high security facilities were metered. It was anticipated that the final four of the five facilities would have energy consumption approximately 20 percent lower than the first prototype unit due to advanced commissioning and diagnostics. Initial analysis showed that three of these four facilities met that goal but one unit had energy consumption about 15-20 percent higher than even the prototype unit. Based on the data from the Utility Monitoring System, an investigation was conducted and several operation and maintenance problems were identified and corrected at the outlier unit bringing energy consumption in line with the comparable facilities.

## **FUTURE APPLICATIONS**

The TDCJ Utility Monitoring System was implemented in part in anticipation of utility deregulation in Texas. The prison system will be able to collect detailed load profile data from their monitored units and provide that data to power marketers to help negotiate favorable utility rates. This load profile information will help reduce uncertainty on the part of suppliers. It will be particularly useful for load aggregation purposes.

The Utility Monitoring System also has several features that are especially useful in a deregulated utility environment. The ThinServer system has extensive alarming capability including software to be released shortly that will permit remote Web browser-based alarm setting and manipulation. Alarms can be used to identify peak load threshold conditions and precipitate load control and shedding actions.

In conjunction with alarms, the Utility Monitoring System can provide basic control output signals. The software system of the ThinServer supports a digital output module that supplies control outputs for applications such as load shedding and motor and lighting control. When a certain threshold electricity or natural gas consumption level is reached, EnerTel software activates a digital output control signal. This signal can be acted upon by a lighting control panel or energy management system. This functionality is particularly useful under peak load or time-of-day utility rate structures when nearly immediate response to load control situations is required.

The TDCJ Utility Monitoring System will also be an important tool to support facility commissioning. Commissioning has been an important component of the TDCJ Utilities and Energy's mission for several years. The Utility Monitoring System will provide a tool for managers to document existing conditions and benchmark buildings against appropriate standards. Commissioning has the potential to save significant tax dollars within the TDCJ system and the results of commissioning could ultimately pay for the cost of the monitoring system.

## **FUTURE SYSTEM EXPANSION**

Significant expansion of the TDCJ Utility Monitoring System is planned. Several new "free world" prison industry facilities are planned or operational. As those facilities are commissioned, utility monitoring will be incorporated. All private

sector prison industries will be billed for actual utility costs rather than estimates.

TDCJ also operates a legacy Utility Monitoring System that collects hourly energy consumption data but has no real-time functionality. These data acquisition systems are currently polled by the Utility Monitoring System central server. As these units fail or are taken out of service, they are being replaced by "Thin Server"-based components.

Finally, the Utility Monitoring System is scheduled for expansion to permit individual unit metering. Many TDCJ units are co-located with utility revenue metering at a single point prior to distribution to the individual units. These individual units will be sub-metered and incorporated into the Utility Monitoring System. Individual wardens will then be responsible for their individual utility costs. This expansion will involve high voltage electric metering and potentially, wireless data communication. It will be a major expansion to the existing Utility Monitoring System.

## **SUMMARY AND CONCLUSIONS**

The Texas Department of Criminal Justice Utility Monitoring System has now been operational for two years. While the initial installation was challenging, the start-up phase is over and the benefits of the system are now becoming apparent. The system is meeting the users' expectations and providing the data necessary to permit energy accountability in the TCI (1). The system has been expanded to other prison components and future additional expansions are planned. Through the implementation of this system, the Texas Department of Criminal Justice has become a national leader in the use of energy metering to promote cost-effective prison operation.

## **REFERENCES**

1. John A. Bryant, John McBride, Tom Merka, "State-of-the-Art Energy Sub-metering Texas Department of Criminal Justice Industries," Proceedings of the 1<sup>st</sup> International Conference on Enhanced Building Operations, Austin, Texas, July 2001.