

Importance of TSU participating in the industry 4.0 on the measurement systems of CFE**Importancia de la participación del TSU en la Industria 4.0 en Sistemas de Medición de CFE**

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Abstract

The project herein demonstrates the participation of the "Técnico Superior Universitario (TSU)" [Senior Technician, University Level (TSU)] in the solution of the problem in measuring energy consumption (in kilowatts per hour - kWh), measured by the "Comisión Federal de Electricidad (CFE)" [Federal Electricity Commission] in the estates located outside the urban setting such as ranches and populations in highlands, due to them being difficult to access and posing insecurity problems. In this specific case, the problem is present in the "Servicios Agrícolas" [Agricultural Services department] towns Cd. Aldama, El Sauz, El Oasis municipality in Ojinaga -all located in the state of Chihuahua- which do not have a trustworthy system to invoice such services. In order to offer a solution to this problem, it is advised to implement a telemetry communication system in the radio wave frequencies, by allowing the reading and capturing of data remotely with plug and play (PnP) devices. Which is why it is necessary to replace the conventional monitoring devices of the Agricultural Services department for the previously described PnP devices with the purpose of having remote access to the readings of electrical energy consumption and to successfully invoice the kWh consumption in a safely and reliable manner, without the necessity of physically attending the consumers' premises, this to speed up the reading and invoicing process in an automatic and reliable fashion.

Invoicing, Telemetry, Electrical energy consumption

Resumen

El presente proyecto muestra la participación del Técnico Superior Universitario (TSU) en la solución del problema que se presenta en la medición del consumo de energía eléctrica (Kwh) por parte de Comisión Federal de Electricidad en los predios que se localizan fuera de la mancha urbana como ranchos, poblaciones serranas por estar ubicados en lugares de difícil acceso, además de presentar problemas de inseguridad. En este caso en específico al no contar con un sistema fiable de facturación en los Servicios Agrícolas ubicados en Cd. Aldama, El Sauz, El Oasis municipio de Ojinaga todos ubicados en el estado de Chihuahua. Para dar solución a este problema se decide implementar comunicación por telemedición con radiofrecuencia utilizando medidores de lectura remota con dispositivo de desconexión y conexión, por lo que es necesario reemplazar los medidores convencionales del Servicio Agrícola por medidores de lectura remota con el objetivo de tener el acceso a la información del consumo de energía eléctrica y así realizar la facturación en Kilowattthora(KWH) de una manera segura y confiable, sin tener la necesidad de ir físicamente a las instalaciones del consumidor, agilizando el proceso de lectura y facturación de forma automática y confiable.

Facturación, Telemedición, Consumo de energía eléctrica

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Introduction

To respond to the era of industry 4.0, the productive sector has increased the demand for professionals who are familiar with new technologies such as artificial intelligence, 3D printing, the internet of things IoT and demand for technology 4.0. It is also necessary that teachers are updated to provide students with the necessary tools and respond to the new demands of the productive sector such as the I 4.0. Nowadays it is important that our professionals of the Industrial Maintenance major acquire the necessary skills to analyze data in real time and be able to make decisions in solving problems.

This project is carried out with the advice of the academic group of Management of Technological Education and the direct participation of the students of the Industrial Maintenance major in the measurement department of the Comisión Federal de Electricidad (CFE) [Federal Electricity Commission]. This project aims to solve the problem of taking distance readings by implementing a measurement system by telemetry with frequency in order to have safe and reliable access to information on the consumption of electrical energy in Kilowatt/hour (KWH).

Background

The problem is presented in rural areas in the municipalities of: Aldama, Oasis and El Sauz, where meters which lack the appropriate technology to obtain remote communication from Servicios Agrícolas [Agricultural Services department] or telecommunication for the collection of reading data are installed.

In addition, access to the facilities of the Agricultural Services is limited since the geographical conditions are difficult to access. Another problem that arises when taking the reading is data capture, since the operator captures the measurement data manually, this means with pen and paper, generating human error from capture to billing.

There are also inconveniences from the point of view of insecurity due to the social problems in the area, which result in people avoiding the taking of readings.

Analysis of the current situation

An analysis of the reasons which cause non-technical power losses is carried out in the area of Chihuahua (Aldama, Oasis and El Sauz), the most relevant being the following:

- Irregular settlements
- Direct services without contract
- Intervention of measurement equipment
- Illicit uses
- Hidden derivations

The causes for which non-technical power losses have continued to increase can be classified as:

- a. Difficulty to make the previous cut due to lack of payment.
- b. Manual and poorly taken reading by staff.
- c. Inefficiency in the process due to the human factor.
- d. Measurement equipment manipulation (altering the operation, removing the meter to prevent recording).
- e. Increase in non-technical power losses due to incorrect billing.

The root cause of the problems found in the process of taking readings are:

1. Ranches with closed door.
2. Workers do not finish their workday.
3. The insecurity in any sector in the area of Chihuahua, Chih.

Problem Statement

The reading is incorrect in agricultural services; in addition, the great distances from one service to another generate billing errors, as well as power and economic losses for CFE.

Advanced measurement technologies

The Advanced Measurement Infrastructure (AMI) is the infrastructure that allows bidirectional communication between users and network operators.

This infrastructure integrates hardware (advanced meters, routers, concentrators, antennas, among others), software and architectures, and communication networks, which enable the operation of the infrastructure and the management of data of the electrical distribution system.

Objectives of the AMI implementation

- To facilitate energy efficiency schemes, demand response, and hourly rate models
- To improve the quality of service through the monitoring and control of distribution systems.
- To manage the reduction of technical and non-technical losses.

AMI Basic Features

- Storage
- Bidirectional communication
- Cybersecurity
- Synchronization
- Update and configuration
- User Access
- Remote Reading
- Hourly measurement
- Connection, disconnection and limitation
- Bidirectional measurement register
- Quality of service

Description of activities

Introduction to telemetry

We talked to the CFE advisor to gain knowledge about the telemetry project for agricultural services, where its operation, the parts that make up the equipment, some of the most common problems and their solutions were discussed.

Location of meters without communication

An analysis of the meters of the different rural areas in which they are located was carried out with real-time monitoring of their status via the Conexo and Nuggetping program (Internal CFE Network). With it, we can know if the services have communication if they appear in the program with a green ACTIVE and red INACTIVE tag. Subsequently, a visit to the location of the equipment that had the red tag was scheduled to perform a general revision and to know why they were without communication, while making the respective adjustments to the equipment for its correct operation.

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Table 1 Nuggetping program monitoring

Diagnosis of damaged meters

A diagnosis is performed in the area where the meter without communication was located, and then the equipment was checked to define the problem. Some of the problems may be: that the meter is burned, poor contact in the heavy-duty cable of the transformer that energizes the source, broken or disoriented antenna and sometimes obstructed by agricultural walnuts, the configuration of the radio in one of the partitions is incorrect, or that the source is burned or the direct current voltage output is damaged.



Figure 3 Meter diagnosis

Replacement of damaged components

Damaged parts were replaced by new ones or sometimes used pieces of other equipment were used, like antennas, radios, connections, among others.



Figure 4 Replacement of damaged components

Meter reprogramming

Reprogramming of meters was carried out by means of a portable computer, which can be connected via Ethernet network or by means of an optical cable. Network settings were restored and the time zone was reconfigured. Sometimes it was necessary to orient the antenna towards the radius of the nearest collector, since they can be moved by strong winds.



Figure 5 Meter Programming

Oasis Region Firmware Programming

The firmware was reprogrammed, this to correct errors which have happened in the past, since at some point they interrupted the communication. These devices become obsolete and lose coverage when they are not updated, which causes the signal to the collector meter not to be reached at times; so it is required to update the firmware manually every time its monitoring is not correctly performed and it does not update automatically.



Figure 6 Oasis Region Firmware Programming

Installation of reducing transformers in Oasis region – Aldama

The damaged voltage reducing transformers (480v - 220v) were replaced. They feed the Radio Modems that are connected to the Collector Meter; they serve to protect the radios and avoid voltage variations that affect their operation or that can cause burning.



Figure 7 Installation of reducing transformers

Results

We reached the objective of replacing conventional meters of the agricultural service with remote reading meters with disconnection and connection devices, installation and repair of antennas, radios, collector meters for radio frequency (RF) telemetry in the regions of Aldama, Ojinaga and el Sauz. The activities that were carried out are the following:

- We replaced 7 supplies of meters which had the direct current voltage output burnt, it was determined that the damages were caused by a previous installation and/or that they were in bad conditions due to the high alternating current voltage of some facilities.
- We installed 38 omnidirectional antennas in agricultural services that were without an outdoor antenna and therefore without communication.
- The installation of 11 collector meters with their respective antenna was performed, these are located in different strategic points to receive information from up to 30 meters and send it to another collector and so on, until reaching the substation.
- In the Ojinaga agency, 8 radios were programmed in the Oasis region with a manual firmware update, due to an unknown reason that prevented updating from the office in the City of Chihuahua, so a visit to the different radios was scheduled to program them manually.

Acknowledgments

Our recognition to the measurement department of the CFE for the help they provided to our students of the Industrial Maintenance major of the Technological University of Chihuahua and the support they provided to the academic group “Management of Technological Education” for the realization of this project.

Conclusions and Research Contributions

With the completion of this project in CFE, the need for students to get involved in projects where technology 4.0 is used was verified, in order to achieve the necessary competencies and be properly inserted in the productive and service sector that demands this type of knowledge.

The advantages obtained with the implementation of I 4.0 (AMI system) in the billing of electricity consumption in the agricultural regions of Aldama, Oasis and El Sauz are the following:

- It makes work easier
- Fast response in obtaining data
- Reliability in the readings of electric power consumption
- Reduction of economic losses
- Safety of measuring personnel
- Billing of 100% of the energy consumed
- With the interpretation of real-time data they are able to make decisions at the right time to speed up the service if necessary.
- Maintenance resources are optimized.

Findings

For the successful continuity of the project it is necessary that the company take into account the following points:

- Training staff of the different rural agencies, in order to cover the basic needs of the project in these locations, since the current person in charge has to travel great distances to reach the different locations, which generates economic and time losses.
- Having a checklist that contains the parts and /or tools necessary to carry out the work successfully and thus avoid missing tools when performing the task.
- Maintaining the necessary inventory of material and spare parts in the warehouse, since in some cases there is no material in inventory, so they have to buy it at the time, which generates waste of time during the workday.

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