ENERGY CONTROL & MONITORING SYSTEM IN STEEL PLANT USING SCADA

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ABSTRACT

In this modern world of Industrialization and automation, energy plays a major role in the growth of any organization. The utilization of energy plays an impacting and direct role in the growth of organizations like Visakhapatnam Steel Plant. Steel plants require continuous monitoring and inspection of critical parameters like gas flow, pressure rate, liquid flow, etc.., at regular intervals. There are possibilities of errors at measuring and various stages involved with human workers. So a reliable monitoring system is necessary to avoid catastrophic failure, which is achieved by Remote Terminal Unit & Supervisory Control and Data Acquisition system. In order to automate a power plant and minimize human intervention, there is a need to develop a SCADA (Supervisory Control and Data Acquisition) system that monitors the plant and helps reduce the errors caused by humans. While the SCADA is used to monitor the system, RTU (Remote Terminal Unit) is also used for the internal storage of instruction for the implementing function such as logic sequencing, timing, counting and arithmetic to control through digital or analog input/output modules various types of machines processes. Systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation.

Keywords: Steel plant, Energy parameters, Remote terminal unit(RTU), Supervisory Control and Data Acquisition system(SCADA).

1. Introduction

Efficient energy management is the potential area for cost reduction in integrated steel plants. Signals for a plant unit will normally be concentrated in the control room of the unit from where the unit is being operated. RTU'S of the SCADA will be installed in these main control rooms and the tele - transmission signals identified for the units will be wired to the RTU'S. The RTU'S are microprocessor based intelligent units responsible for acquisition of inputs from the plant units and convert them in to analog or digital code for Tele - transmission to the master station computer SCADA. If few signals are available for Tele - transmission , a junction box will be installed in the control room (instead of RTU'S) & connected to the nearest RTU'S through the multi – core control cables. RTU'S are located in different parts are connected to the center master station through modems. It acquires various electrical & utility parameters for effective monitoring & control operation. It is located in the telecommunication centre of the Visakhapatnam Steel Plant will acquire all information through RTU and LAN and process the information for displays and report generation .

The major functions for the monitoring system are:-

- Centralized data acquisition and integrated monitoring of fuel gases and utilities for all major generating and consuming plants/ shop units.
- To maintain gas supply versus demand based on current allocation and any future requirements.
- To maintain "gas balance" with any dynamic changes of operational scenario of management reporting.

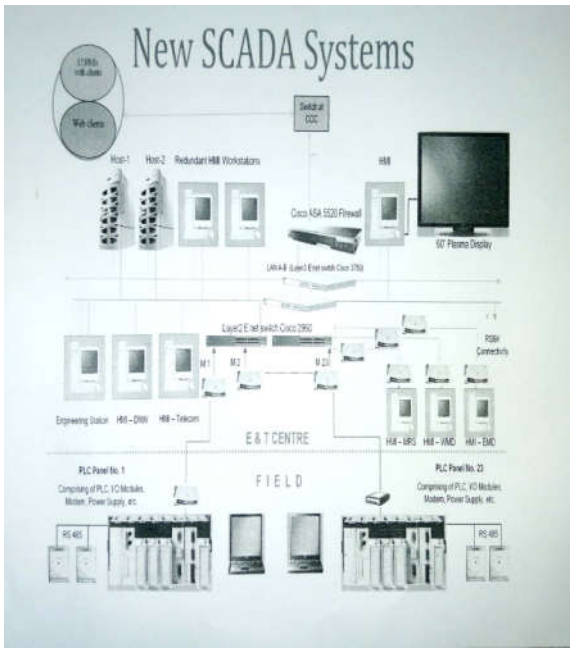
2. Existing System Vs Recent Upgradation

Previously, Conventional PID control is being used for Energy monitoring and Control. These conventional controllers in power plants are not very stable when there are fluctuations and, in particular, there is an emergency occurring. Continuous processes in power plant and power station are complex systems characterized by nonlinearity, uncertainty and load disturbances. The conventional controllers do not work accurately in a system having nonlinearity in it.

In present situation an intelligent control using RTU & SCADA is developed to meet the nonlinearity of the system to monitor the accurate values of energy parameters like Gas flow, Temperature, Pressure Level, Water level etc. The RTU will be connecting in the signals from the instrumentation and electrical systems and transmitting to the Master station. The RTUs are connected to the master station by underground telephone cables. RTUs will be installed in these main control rooms and the Tele - Transmission signals identified for the units will be wired to the RTUs. RTU and SCADA are interfaced via communication cables where the continuous process is easy, with more accuracy and also improves stability of the system.

3. Architecture Of Scada

In VSP, the system comprises of based Master station equipment with supervisory controls and mimic panels located in the energy and telecom building and 23 RTUs installed in different plant units and 3 local RTUs for driving the mimic panel in the energy centre. The RTUs will be connecting in the signals from the instrumentation and electrical systems and transmitting to the Master station when polled by the latter. The RTUs are connected to the master station by underground telephone cables. The maintenance of RTUs mimic panel and the cable network between the field / local RTUs & modem panel in the Master station is carried out by the telecom department .



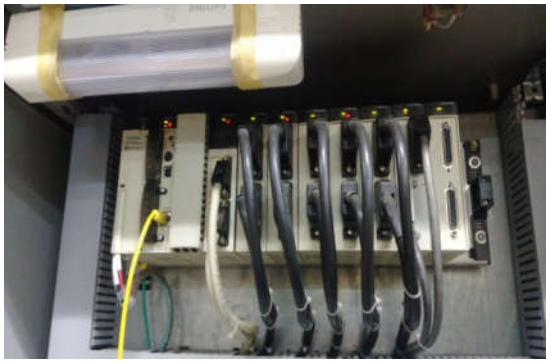
SCADA system consists of

- One or more RTU'S which interface to field sensing devices and local control switch boxes and valve actuators.
- A communication system like radio, satellite, telephone, cable etc., are used to transfer data between field data interface devices and control units and the computers in the SCADA central host.
- HMI(Human Machine Interface) systems are used to provide the remote control over the SCADA central host and located field interface devices.
- These systems encompass the transfer of the data between the SCADA central host and the RTU'S.

4. Hardware Components

4.1 REMOTE TELEMETRY UNIT (RTU):

The micro processor based RTU s are installed at various plant Units. The RTUs will be collecting the signals from the local Instrumentation & Electrical systems and transmit to the Main Station.



4.2 RTU Contents:

- RTU cabinet
- Gland plates / field cables
- I/O Tier
- Power Supply Arrangement
- Basic Modules

4.2.1 RTU Cabinet :

The RTUs are houses in standard fabricated steel cabinets of Rugged construction.
The RTU cabinet has an internal structure for:

- Routing the field cable to the terminations.
- Mounting the terminations and interprosing relays.
- Routing the I/O cables from the termination and interposing relays to the electronic tires.
- Mounting the electronics comprising PCCs fitted in tire.
- Mounting the Power supply unit for providing the logic supplies to all cards.

4.2.2 Gland Plates / Field Cables :

All external connections to the RTU enter the cabinet through Gland plates. The external connections are communications connection, Power connection and mainly the field cable connecting to the plant Instrumentation.

4.2.3 Input / Output Tier:

The input/output tier is fitted below the basic tier and can Accommodate up to 19 input / output cards.

4.2.4 Power Supply Arrangements:

All RTUs are provided with 230KV AC operation. The RTU Power supply unit operates on 24V DC input and generates all logic Supplies +5V, +12V and -12V required for the operations of the RTU. The input 24V DC is derived from local mains power supply with a Battery back-up provision with maintenance free sealed lead acid batteries for 8 hours.

4.2.5 Basic Modules :

Analog/Digital Module:

- Inputs : 16
- Input range : 0-20mA ,0-5v
- Dimensions : 74mm*124mm*45mm
- Environment : 5%-95% RH
- Operation : -40 to 70 deg C
- storage : -40 to 85 deg C

5. Software Requirements

Unity Pro is the software used to program the PLC/RTU.

5.1 Capabilities of Unity pro:

5.1.1 Software Packages:

The following software packages are available:

- Unity Pro S
- Unity Pro M
- Unity Pro L
- Unity Pro XL
- Unity Pro XLS
- Unity Developers Edition (UDE)

5.1.2 Hardware Platforms:

Unity Pro supports the following hardware platforms:

- Modicon M340
- Premium
- Atrium
- Quantum

5.1.3 Programming Languages:

Unity Pro provides the following programming languages for creating the user program :

- Function Block Diagram FBD
- Ladder Diagram (LD) language
- Instruction List IL
- Structured Text ST
- Sequential Control SFC

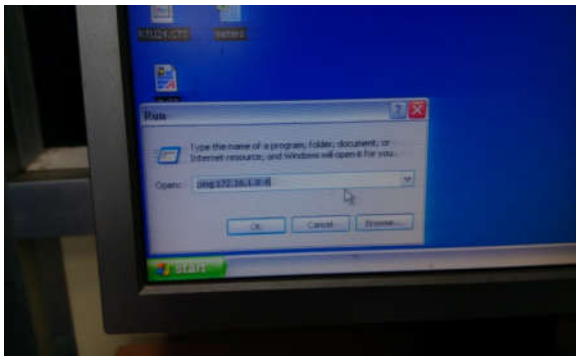
Unity Pro XL is the package used for programming with platform Atrium. The programming language used to program the PLC/RTU is Ladder Diagram. LD sections have a background grid that divides the section into lines and columns. The LD programming language is cell oriented, i.e. only one object can be placed in each cell.

Ladder diagram can be designed using Contacts and Coils.

- A contact is an LD element that transfers a status on the horizontal link to its right side. This status is the result of a Boolean AND operation on the status of the horizontal link on the left side with the status of the relevant Boolean actual parameter. The actual parameters are Boolean Variables, Boolean Constants, Boolean Addresses.
- A coil is an LD element which transfers the status of the horizontal link on the left side, unchanged, to the horizontal link on the right side. The status is stored in the respective Boolean actual parameter. The actual parameters are Boolean Variables and Boolean Addresses.

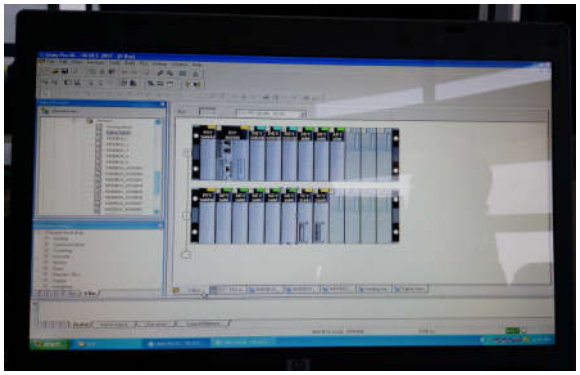
6. Results & Discussion

Before the RTU's connected with system, it is connected to modems. Each RTU has separate modem with unique IP address under the same server.



After the modems are connected, RTU's are connected to system with the help of the IP address given to it. Those IP address are pinged in Run program before the Unity Pro software starts running.

Interfacing of RTU with System : RTU's connected via modem are interfaced using RS 232/484 cables or Modbus to the main or sub systems. Then the Unity Pro software is opened and program is loaded in RTU and results are taken. We can use different RTU's in the different fields at the same time and parameters can be note at the same time.

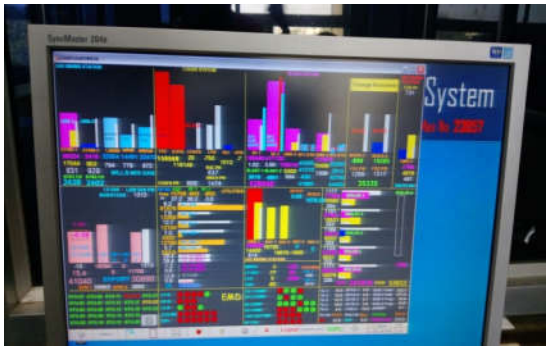


After the interfacing the results are shown in the Unity Pro software like above picture shown.

7. Conclusion

Supervisory control and data acquisition system is a versatile network of intelligent sub systems, which has brought revolution in the field of monitoring and controlling systems. Earlier due to lack of sophisticated equipment it was very difficult to predict whether the channel corrupted the data coming to the monitoring station or it is the date pertaining to a functional error in a particular department. Further it was a very time consuming process to undo the effect causing the problem (only after making sure the data received is correct). In the mean time a lot of energy is waste and sometimes even unacceptable hazards also used to take place. Also there was no privilege to track the position that is responsible for the error.

The supervisory control and data acquisition system over comes all the above bottlenecks. It has host computer in the master station to store the data for a long period of time so that it can be sued to take strategic decisions sat the time of crisis. The proposed SCADA System for Visakhapatnam Steel Plant shall acquire various electrical and utility parameters for effective monitoring and control operations. The various parameters acquired shall be such as electric power, voltages, currents, etc. under electrical monitoring and parameters such as flows, temperatures pressures, etc. under utility monitoring.



These parameters are logged into the system using a suitable database management system. The data is processed and presented in the plant to the concerned officials and operators using user-friendly graphical interfaces.

8. Advantages

- Greater life and Reliability
- Energy Saving
- In case of emergency alarm was energized and automatic check valves are opened to avoid catastrophic failure.

9. Applications

- Gas Monitoring
- Energy Management
- Power Monitoring
- Water Management

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