Power Conservation and Control in Base Transceiver Station Towers using SCADA

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Abstract - Presently BTS (Base Transceiver Station) towers are powered from grid. In off grid sites and during power failure Diesel Generators (DG) are used as an alternative. Using DG as the backup source increases the cost of fuel and carbon emissions. To overcome this drawback and for effective power utilization renewable energy source (SOLAR) is implemented in this project. In existing system the BTS towers are maintained and controlled manually. In this project, a centralized monitoring and control system for Telecom Power System is done using SCADA (Supervisory Control and Data Acquisition). This system has the transfer of data linking a SCADA innermost host computer and a number of Remote Terminal Units (RTU) and/or Programmable Logic controllers (PLC). For simulation purpose Step7 Simatic Manager Software is used. In WinCC. Soft PLC method used to create the Tags to link with Simatic Manager. Ladder Programming technique used to program the PLC.

Index Terms - Programmable Logic controllers, SCADA, RTU, Base Transceiver Station

I. INTRODUCTION

The minimization of energy costs and quality of power system for Telecommunication companies is essential for their business, as it has direct effect on their overall profit and quality of the network. Wire line and wireless Telecommunication operators are always looking for ways to optimize and decrease power asset capital and Operational expenditures. The Telecommunication Operator companies in order to optimize their capital investments share their operations with the infrastructure management Companies. There are so many challenges in power system for the infrastructure management in Companies as well as Telecommunication operators. The aim of this project is provide a solution for power energy cost reduction and quality of power system for the mobile Telecommunication industry through the SCADA system application. Solar powered cell phone tower using solar is not yet implemented in National Level. Also many researchers using Homer Software, only simulation results were obtained. No power quality issues were not considered. Using Homer software only required power from solar is designed.

The Mobile work station unit consists of Base Transceiver Subsystem (BTS), Power System equipments and other associated equipments. A centralized Operation and Maintenance centre – Radio (OMCR) system is available to monitor and to provide software controls to the BTS. The BTS software can be configured using OMCR server from remote end. OMCR provides all the information about BTS status, real time information, both current and history of Alarms and performance reports. The Infrastructure status also can be extended to OMCR server via BTS. The status of the infrastructure extended in the form of Alarms using alarm cable interface to the External Alarm cards available in BTS. Depending on the make and break contacts of the BTS alarm cable, these alarms extended to the OMCR. But the nature of fault and localization of real fault cannot be monitored in OMCR for Infrastructure elements.

The following are the drawbacks in the existing System

- Centralized monitoring and control System available only for BTS not for Power System Elements.
- Hardware control not possible.
- Poor Service quality.
- Hard to localize faults.
- Engine Alternator Auto mode based on Time delay only.
- No fool proof for security of Assets.

The solution to overcome the drawbacks in the existing system is a centralized monitoring and control system for the Mobile work station including all the elements in the work station. Remote monitoring and control can be done in many ways. There are so many automation technologies available for remote monitoring and automation systems. Some of the remote monitoring and Automation systems are listed below.

- Supervisory Control And Data Acquisition (SCADA)
- Distributed Control System (DCS)
- Management Information System (MIS)
- Programmable Logic Controller (PLC)
- Programmable automation controller (PAC)
- Human Machine Interface (HMI)

- Manufacturing Execution System (MES)

II. PROBLEM STATEMENT

The major challenges in Telecommunication Power system on which Telecommunication Operators and infrastructure companies face are:

- Monitoring and Managing Telecommunication sites.
- Remote side control of power system elements and other equipments.
- Gathering accurate data on a common platform (Software).
- Making availability of information to all the concerned in the “Real Time”.
- To keep track of alarm and Site Status..
- Control over outage of cell sites.
- Scheduled maintenance and break down maintenance.
- Management of energy source.

Here in this paper, Telecommunication Mobile Work station unit is considered as the application area to provide the solutions for the above problems.

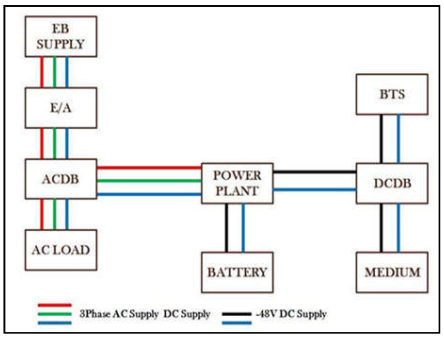


Figure.1 Telecommunication Power System

Telecommunication Power System (Figure. 1) consists of Tower, BTS, Medium (To link the BTS to its next core switching station), Power Plant (Provides the require -48V DC supply to the Telecommunication equipments and incoming voltage is stepped down to 48V), Battery (to provide the power back up to the equipments. The capacity of each cell is -2V), Engine Alternator (EA) which act as stand by source for AC power supply and AC distribution box which distributes (ACDB) the available AC source effectively to all AC loads.

III. HYBRID RENEWABLE ENERGY SYSTEM

The power supply to the BTS during day is provided by Hybrid Renewable energy system which includes solar, diesel generator and battery as a backup. The solar modules are placed all over the surface of the tower and on the roof of control room which is present at every Base Transceiver station. Since the control room contains various equipments it should be maintained at low temperatures. By placing solar panels on the roof of the control room the temperature in the control room will be reduced to some extent with the reduction in load of the cooling equipments.

IV. PROPOSED METHODOLOGY

The STEP 7 is the model software package used for configuring and programming SIMATIC programmable logic controllers (Figure 2). It is part of the SIMATIC software. The SIMATIC programming languages included in STEP 7 are compliant with EN 61131-3. The SIMATIC manager manages all the data that belong to an automation project regardless of which programmable control system (S7/M7/C7) they are designed for. The tools needed to edit the selected data are started automatically by the SIMATIC manager.

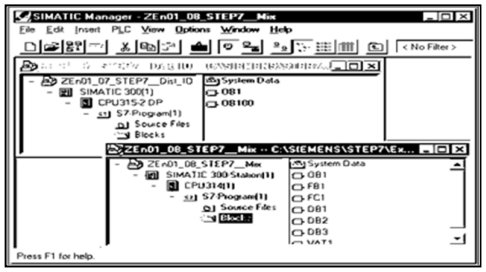


Figure. 2 Simatic Manager Overview

Figure 4 shows the flow chart of the proposed work. Runtime software (Figure 3) provides ready-to-use solutions that can call in user program and is directly implemented in the automation solution. It includes: Controllers for SIMATIC S7, for example, standard, modular and fuzzy logic control, Tools for linking the programmable controllers with Windows applications, A real-time operating system for SIMATIC M7.

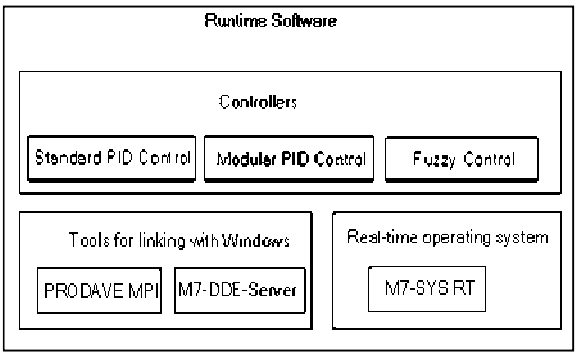


Figure . 3 S7 Software Architecture

V. SCADA FOR TELECOM POWER SYSTEM

The designed SCADA setup for Telecom power system is includes front panel design, Ladder Programming, Alarm Logging feature, Tag Logging and Trend Analysis.

Front Panel Design

Front Panel is the HMI screen for SCADA software. The graphical representation of field devices configured in this screen. Field devices are configured as Tags in SCADA. Figure 6 shows the Solar Panel, Power Plant, EB Supply Power, Power Plant Battery is discharging, DG, Alarm Logging Window and Fuel Display Window. There are three screens designed for this project. They are Main Window, Alarm Log and Tag log.

The main window consists of individual blocks for each field devices. Each block has various field elements. In SCADA those elements are known as Tags. The blocks are EB Panel, DG Panel, Solar Panel, Power Plant, Battery, BTS, Site Label and Screen Label. Alarm Log window shows the current and History of Alarms. Tag Log screen gives the real time values of fuel level and its variation levels using Trend charts.

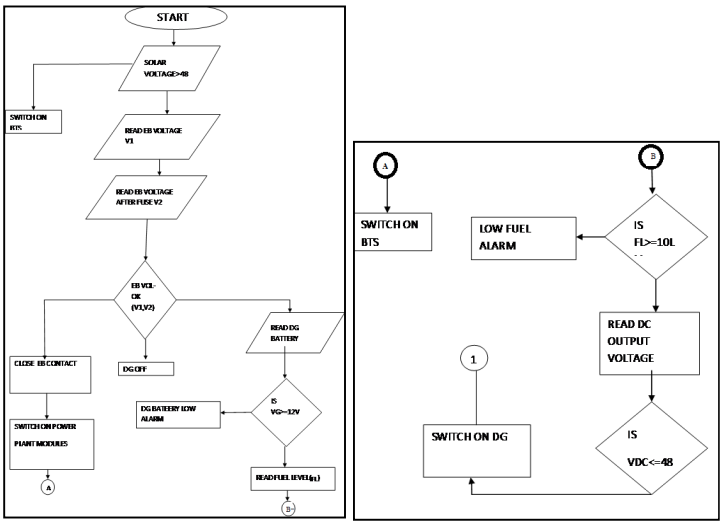


Figure. 4 Flowchart of Proposed Work

VI. RESULTS AND DISCUSSION

For Tag Logging (Figure 5) is used for acquiring data from running processes and for preparing them for display and archiving. The display of the process values is made via the WINCC Online Trend and Table Controls, which display the data in trend and table form, respectively. For simulation purpose Step7 Simatic Manager Software is used. In WinCC Soft PLC method used to create the Tags to link with Simatic Manager Ladder Programming technique used to program the PLC.

S NO	PANEL	TAG NAME	PARAMETER	REMARKS
1	SOLAR PANEL	SOLARDISP	MD60	SOLAR POWER DISPLAY
2	DIESEL GENERATOR	DGBAT	MD10	DG BATTERY STATUS
		DGHMR	MD30	DG HMR OUTPUT
		FUEL	MD40	FUEL VALUE INPUT
		FUEL_LEVEL	MD50	FUEL LEVEL INDICATION OUTPUT
3	DC BUSBAR	BUSBAR	MD0	DC BUSBAR VOLTAGE DISPLAY
4	BATTERY	CELL	MD20	CELL VOLTAGE DISPLAY

Figure. 5 Analog Tags

Working Model

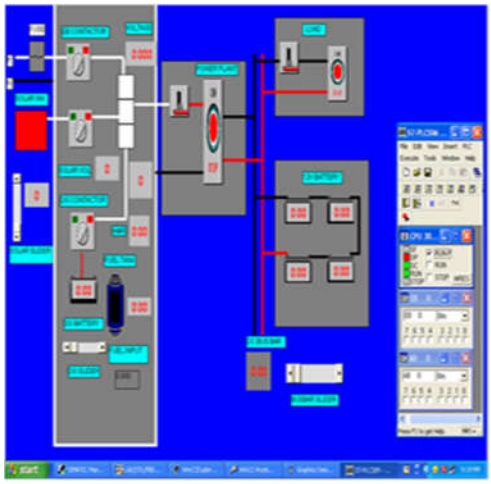


Figure. 6a. Front Panel Design

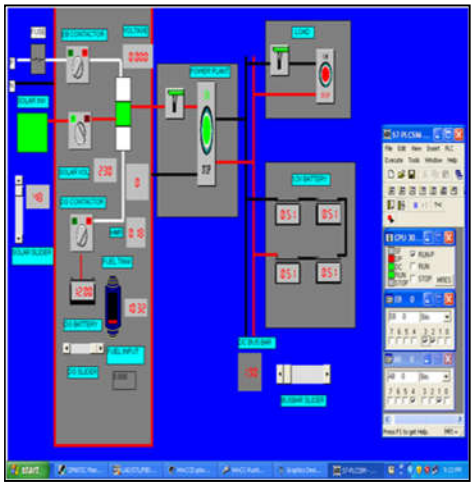


Figure. 6b. Solar Panel is ON

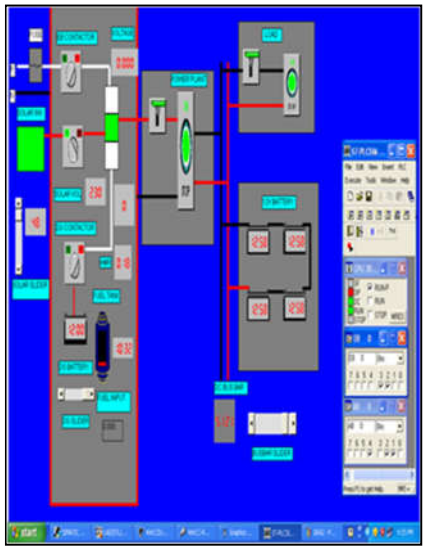


Figure. 6c.Power Plant is ON

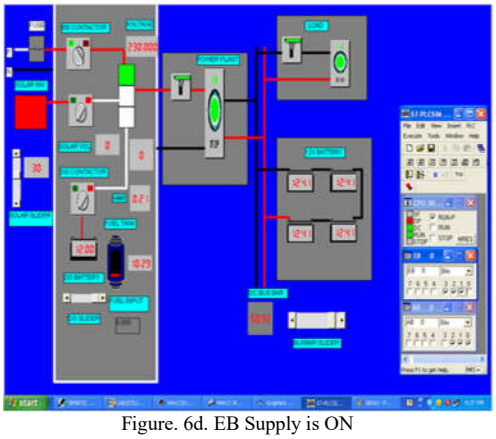


Figure. 6d. EB Supply is ON

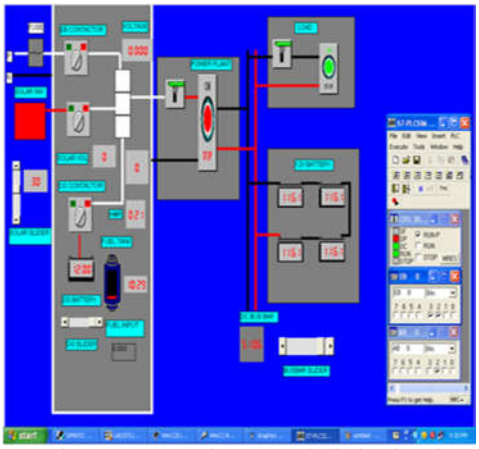
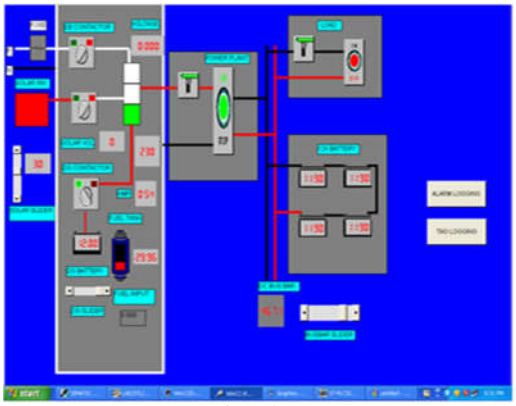


Figure. 6e. Power Plant Battery is discharging Figure.



6f. DG is ON

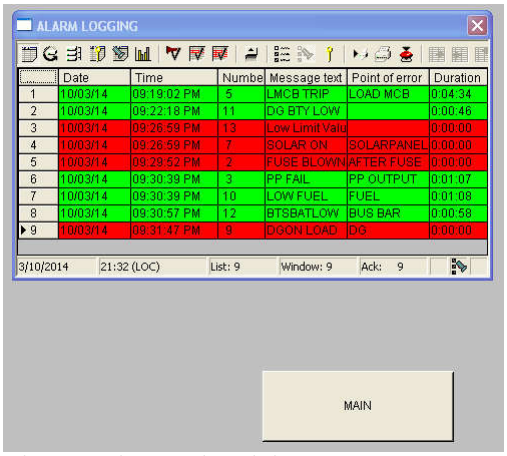


Figure. 6g. Alarm Logging Window

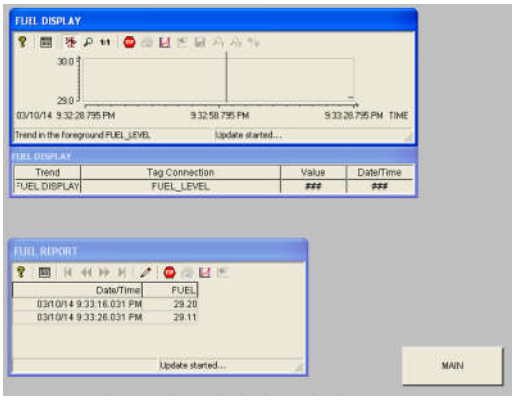


Figure. 6h. Fuel Display Window

VII. CONCLUSION

The front panel is designed in SCADA software for Telecom Power System elements (EB Panel, Engine Alternator, Power Plant and BTS) and for solar power regulator. Using Step 7 SIMATIC Manger, the front panel is designed and tested successfully. For effective power conservation solar power is used as a main source of power supply, which in turn reduces the cost of power consumption from the grid. Alarm logging is used to generate alarms in case of any operation or failure of any of the telecom tower elements. Tag logging is used in order to report the daily usage of fuel consumption in the diesel generator. Thus the entire system helps in the control and monitoring of the telecom tower from the control station. The designed system is very useful for Telecom operators and Infrastructure Management companies to ensure quality of Power system and for effective utilization of power.

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