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Plc Based Diesel Generator Automation

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ABSTRACT

In industries, Offices, Hospitals and other large organizations for every process/operation power is necessary. If the power fails or there is a break down in the power supply, the process/operation/work stops causing a huge loss for the organizations. So it is necessary for the use of backup in the power supply. For backing up the power supply many use large capacity UPS or Inverters. The UPS and Invertors are capable of providing supply for about 20-60 minutes based on capacity. So for the continuous supply of power it is necessary to use diesel generators in large organizations. In the use of diesel generator sets, one should manually on and off the diesel generator sets. So it is necessary to automate the Diesel generators

Keywords: Programmable Logic Controller (PLC), Supervisory Control and Data Acquisition (SCADA), Diesel Generator (DG)

I. INTRODUCTION

The PLC is an industrial computer. Automation is a processing of achieving task without human intervention. The idea of automating the diesel generators is by using programmable logic controller (PLC) and supervisory control and data acquisition (SCADA).

A programmable logic controller (PLC) is a special form of microprocessor-based controller that uses programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting, and arithmetic in order to control machines and processes. It is capable of storing instructions to implement control functions such as sequencing, timing, counting, arithmetic, data manipulation and communication. The term logic is used because programming is primarily concerned with implementing logic and switching operations. Before the PLC, control, sequencing, and safety interlock logic for manufacturing automobiles was accomplished using hundreds or thousands of relays, cam timers, and drum sequencers and dedicated closed-loop controllers. The process for updating such facilities for the yearly model change-over was very time consuming and expensive, as electricians needed to individually rewire each and every relay. In the past the movements of industrial machines were controlled by relay circuits. These relay-controlled systems were replaced by PLC. The primary function of the PLC was to perform the sequential operations that were previously implemented with relays. Ladder diagram is the graphical programming language used for program.

SCADA stands for “supervisory control and data acquisition”. It generally refers to a control system: a computer system monitoring and controlling a

process. Supervisory control means monitoring & controlling the parameters of equipment. Previously without SCADA software, an industrial process was entirely controlled by PLC, CNC, PID & micro controllers having programmed in certain languages or codes. These codes were either written in assembly language or relay logic without any true animation that would explain the process running. It is always easy to understand the status of the process if it is shown with some animations rather than written codes. Hence SCADA software came to existence and with some exclusive features it became internal part of automation system.

II. METHODOLOGY AND DESCRIPTION

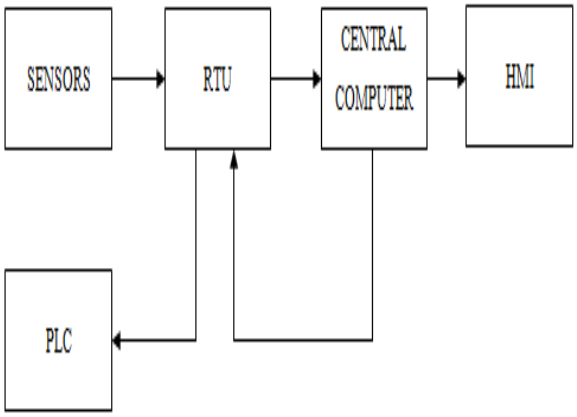

Figure 1. Block Diagram of Process Control

In the study of project for automating, the Diesel generator sets, the main idea is to identify the areas of automation i.e., identifying the areas were the automation is necessary and automation is possible.
The identified and possible areas of automation as per the study of the project:

1. Electric Board Breaker Close/Open.
2. Start and Stop of Diesel generators.
3. Bus Coupler Close/Open.
4. Neutral logic control.
5. DG Breaker Close/Open.
6. Synchronization between Diesel generators.
7. Master DG assigning.
8. Load Sharing and Management.
9. Load dependent Start and Stop of Diesel generators.

Based on the above mentioned automation areas the Ladder Logic is developed and verified.

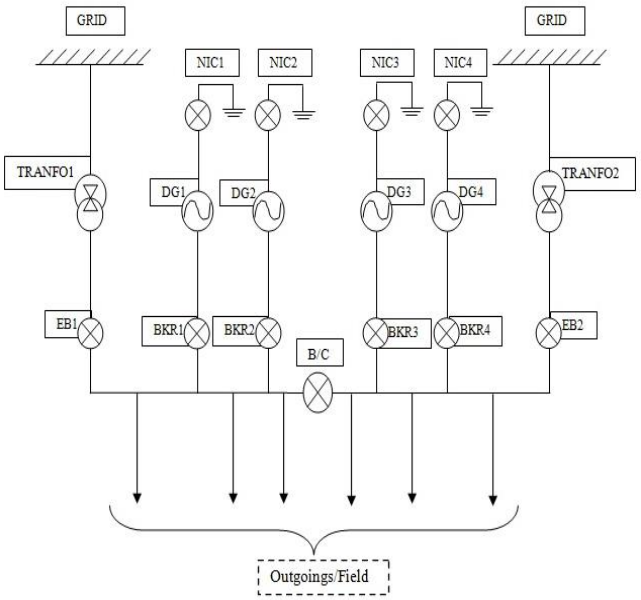

Figure 2. Single Line Diagram of 4 DG sets

The Single Line Diagram of the Diesel Generator Automation Set is shown in figure 2. The system consists of four sets of diesel generators divided into two units each with two diesel generators. The sequences of operation of diesel generators are as follows:

Condition 1: If both EB_LVM-1 and EB_LVM-2 are healthy.

1. Both EB_LVM_BKR_1 and EB_LVM_BKR_2 (incomers) are closed.
2. B/C is in closed condition.
3. All Diesel generators are in OFF condition.
4. All DG_BKR's are in OPEN condition.
5. Since all DG's are in OFF condition, no Master logic and no neutral logic.

Condition 2: When EB_LVM_1 is Unhealthy and EB_LVM_2 is Healthy.

1. EB_LVM_BKR_1 will be opened and EB_LVM_BKR_2 will be in Closed status in healthy condition.
2. B/C will get the OPEN command from PLC.
3. DG_1 and DG_2 will get START command from PLC, DG_3 and DG_4 will be in OFF state.
4. DG_BKR_1 and DG_BKR_2 will get close command from PLC and DG_BKR_3 and DG_BKR_4 will be in open condition.
5. Principle DG will be assigned based on the DG_BKR gets closed.
6. The Master DG's NIC will be closed for grounding protection.

Condition 3: When EB_LVM_2 is Unhealthy and EB_LVM_1 is Healthy.

1. EB_LVM_BKR_2 will be opened and EB_LVM_BKR_1 will be in closed status in healthy condition.
2. B/C will get the OPEN command from PLC.
3. DG_3 and DG_4 will get START command from PLC, DG_1 and DG_2 will be in OFF state.
4. DG_BKR_3 and DG_BKR_4 will get close command from PLC and DG_BKR_1 and DG_BKR_2 will be in open condition.
5. Principle DG will be assigned based on the DG_BKR gets closed.
6. The Master DG's NIC will be closed for grounding protection.

Condition 4: When both EB_LVM_1 and EB_LVM_2 is Unhealthy.

1. EB_LVM_BKR_1 and EB_LVM_BKR_2 will be opened.
2. B/C is in closed condition.
3. All 4 DGs-DG_1, DG_2, DG_3 and DG_4 will get Start command from PLC.
4. All DG_BKRs-DG_BKR_1, DG_BKR_2, DG_BKR_3 and DG_BKR_4 will get close command from PLC.
5. Principle DG will be assigned based on the DG_BKR gets closed.
6. The Master DG's NIC will be closed for grounding protection.

Special condition: In all the above mentioned conditions, Load Management and load Sharing takes place based on the amount of load required and the amount of load generated.

III. RESULTS AND CONCLUSION

The Automated DG sets will automatically Start and Stop when the Power from the grid is failed and can be electrically connected together through the process of synchronization. Bus coupler is the breaker, which divides the whole Diesel generator sets into two sections, and DG Breakers are used to connect the Diesel generators to bus for the flow of power to feeders. Master Diesel generator is the principle generator to which all the other diesel generators must synchronize and Neutral logic is for the purpose of grounding of the master Diesel generator. The PLC keeps track on the amount of load required at the feeders. If the load required is less than the load generated by the diesel generator set the PLC sends the stop command to the least generators to manage the load. If the load required is more than the generated the PLC sends the start command to the next diesel generators based on the load required and also PLC keeps track on the amount of load required and amount of load generated, the GCU's will share the load between the running generators for their higher performance.

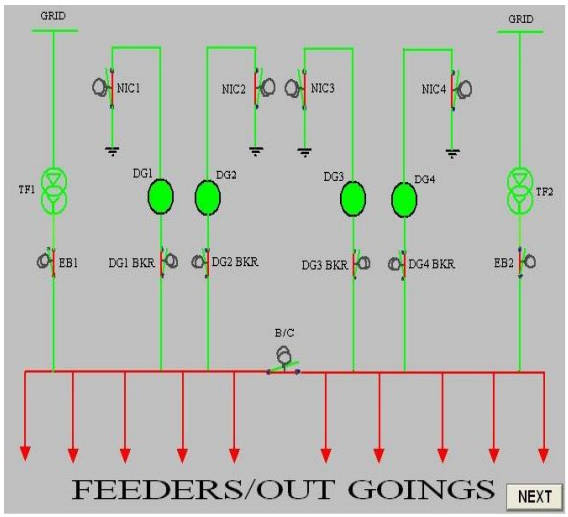

Figure 3

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