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Controlling and monitoring of AMF (Auto Mains Failure) S/M using PLC and SCADA

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Research Article

Controlling and monitoring of AMF (Auto Mains Failure) S/M using PLC and SCADA by

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Abstract

This paper focused on the controlling and monitoring of AMF (Auto Mains Failure) S/M using PLC (Programmable Logic Controllers) and SCADA (Supervisory Control and Data acquisition system). Continuity in the power supply is an essential thing, especially in health sectors where ventilators are needed to maintain a person's life and even discontinuity or interruptions in power pause a threat to life and property. So uninterruptable power supply is both essential and vital for many industrial sectors, day-to-day works, health sectors and much more. Earlier, the changeover from one source of supply to another was done manually which was time-consuming and even caused errors. With the advent of ATS (Automatic Transfer Switch), there is an ease of switching from one source to another. With the integration of PLC and SCADA, this changeover was made easy and one can remotely control the entire system.

Key words: Overload, Backup generator, Synchronization

I. Introduction

Power supply interruptions are unavoidable in today's environment. A power system network is extremely prone to large-scale breakdowns nowadays [1]. Low-power consumers, particularly residential domestic loads and small stores can benefit from power inverters and ups to some extent. However, power outages have a greater impact on the industrial sector. Industries have begun to use diesel generator sets in their operations. In the metro cities, even larger societies have begun to install diesel generator sets.

Manually starting the generator takes time and generates panic among those trapped within the lift compartment when the power goes out unexpectedly. As a result, automatic power supply switching significantly lowers this time waste [2].

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When an anomaly such as a voltage decrease, the Automatic Main Failure (AMF) System can immediately move the switch from main to auxiliary power. AMFs are entirely automated, it functions as a switch between the generator, load, and supply. When the supply is available, the AMF connects the load to it, while when the mains supply is unavailable the load is connected to the DG (Diesel Generator) set. We intend to undertake our Project to monitor and regulate AMF function with the help of PLC and SCADA due to deficiencies in the existing working technology. We created a prototype for the above and also integrated solar in this to show that at times DG sources can also feed the load area. This paper is organized as follows:

- Control of AMF
- Practical Considerations
- Implementation
- Conclusion.

II. Prototype components and configurations

In this prototype, we have primarily specified four requirements that satisfy the objectives of

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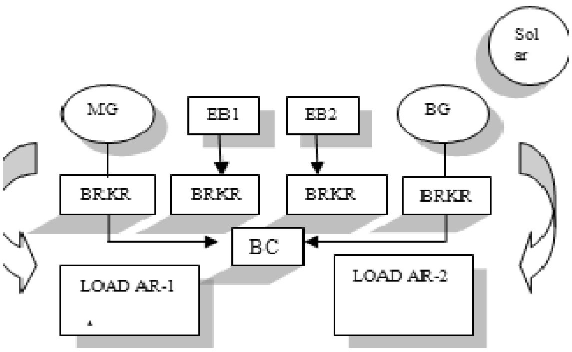
- continuity in power supply
- Time-saving
- Decision of auxiliary power mode
- Remote Monitoring of the S/M

Before analyzing the conditions in detail let's look into the components



Sl. No	Components
1	2 Transformers or EB
2	1 Bus Coupler
3	4 Contactors
4	6 Panel Lights
5	PLC
6	Connecting wires
7	SMPS
8	Cooling fan

The four conditions implemented in this prototype are

- Normal Case
- Failure of any EB
- Overload
- Priority

Since this is a prototype, we have two cooling fans to demonstrate the generator's working.

A bus coupler [BC] is provided to distribute the power supply to the load areas

Load area 1 and load area 2 are indicated by 24 V panel lights.

Solar is represented by an incandescent lamp which is switched on only when needed.

Fig.1 Block diagram of the proposed AMF S/M

During the natural case, the two EBs feed the two load areas through their respective breakers. Failure of any one of the EBs will result in the activation of the bus coupler and the power is feed from the active EB to the load areas through the bus coupler.

Suppose the two EBs fail to provide supply, then the load areas must be fed by auxiliary sources. For this, in our project, we have implemented three main auxiliary sources: the Main generator, the Backup generator, and an additional DG set, which is solar. So, when the EBs failed to feed the load areas automatically the Main generator comes into action and feeds its load area. Now a case arises when the entire load area requirement is exceeding the power rating of the main generator then we will add a backup generator so that the power sharing to the respective load area is done by the respective generators. Note that in this case the bus coupler is turned off. This is the overload criteria set up in the S/M

Now suppose the load requirement of the two load areas is less than the power rating of the main generator then we go for a backup generator to feed the entire load areas. At times solar integration is also possible when the mode is the priority.

Thus, through this way, we can take a decision on the auxiliary mode of supply.

III. Practical considerations

Some practical considerations should be taken into account when AMS systems are utilized in real aspects such as:

a. Voltage: The voltage regulation of the backup source should be within the allowable ranges. This could be fulfilled using an automatic voltage regulator (AVR) unit to automatically control the excitation of the generator, hence the output voltage. In the UPS, the DC to AC inverter is controlled to match voltage requirements.

b. Frequency: The generator frequency is determined by the speed of the driving engine, which is provided by a closed-loop speed control system to supply the electrical loads with the standard frequency. The UPS normally operated at a fixed output frequency (50 Hz or 60 Hz according to the country's standards).

c. Synchronization: In case of the utilization of more than one backup source, such as two emergency generators or the main itself consisting of the main transformer and main generator, synchronization conditions (same voltage, frequency, phase sequence and phase shift) should be considered before transferring the power through the ATS.

IV. Plc [programmable logic controllers] architecture

A PLC scans a program over and over again. This scan cycle can be broken down into three distinct phases. There are usually more than three, but we may concentrate on the most crucial ones and ignore the others. Others are usually inspecting the system and updating the internal counter and timer values. The PLC returns to step one after the third step and repeats the steps indefinitely. One scan time is the time it takes to complete the three stages listed below.

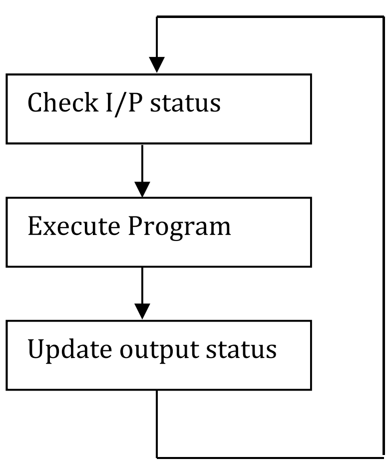


Fig 2 Scan time

The PLC chosen for the proposed system is of TMT221C16R architecture

Fig 3 plc tmst221c16r

The programming is done in ladder logic and is implemented with the help of a PC.

The PLC programming has been done in Schneider Electrical Software-Ecotexture

There are 5 input modules and 7 output modules

The abbreviations for the Fig 4 shown aside are given below

Sl. No	Abbreviation	Expanded form
1	EB	Electric Board
2	MG	Main Generator
3	BG	Backup Generator
4	BRKR	Breaker
5	BC	Bus Coupler

Table-1 Terms used in the proposed PLC S/M.

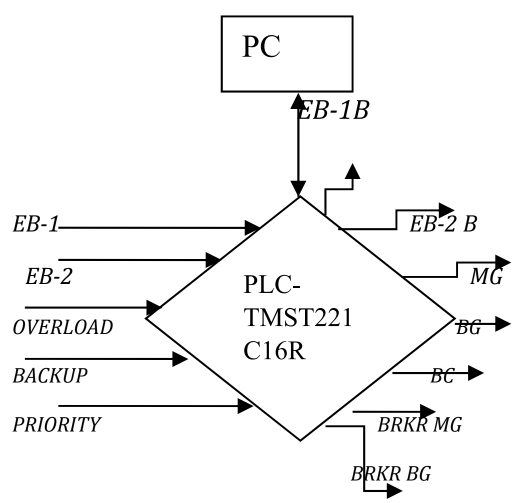


Fig 4 the proposed plc system

Software configuration, programming, and commissioning are accomplished with the EcoStruxure Machine Expert

The power supply of the TM221M Logic Controller is 24 V DC

The subsequent communication ports are existing on the face panel of the controller, depending on the controller reference: l Ethernet, USB Mini-B l, SD Card l, Serial Line 1 l ,Serial Line 2 .

V. Circuit design and implementation

The steps in designing and executing a digitally controlled industrial system are as follows:

1. Specify system general requirements.
2. Confirm the components.
3. Link the power and control circuits together.
4. Make a list of the software algorithm.
5. Put the entire system to the test.

System Requirements

The proposed system's primary duty is to transfer loads to the generator in the event of a main failure, then back to the main in good working order. The procedure can be summarized as follows:

- In case of mains power failure start the generator unit
- If the main is restored and stable, disconnect the loads from the generator and reconnect them to the main.
- Identify the need for a backup generator and solar.
- Ensure that the controlling is done through SCADA.

Hardware connections

- Power is taken from an SMPS

  (Switched mode power supply)

- PLC is used to control the entire S/M and the corresponding I/O connections are done
- Controlling and monitoring are done through SCADA via mode bus communication.

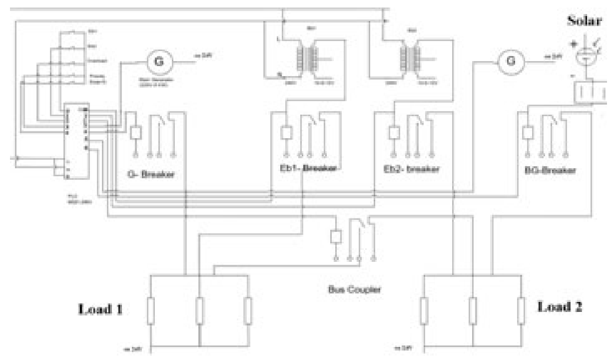


Fig 6 Circuit diagram of the proposed system

Software programming

The sequence of operation for the proposed setup can be summarized as:

- Creating an address of the five inputs
- Setting up of conditions mentioned
- As per the requirement setting up of delay in both ON-timer and Off-timer. [This is to protect the generator winding from sudden increase of current]
- Setting up criteria for the various activities of bus coupler

The ladder program has been developed using Ecotexture software provided with the PLC. The program has been simulated and then downloaded to the PLC using the provided PC program. It should be noted that timer values could be individually set according to system requirements and restrictions.

VI. Experimental setup

The overall setup has been implemented as shown in Fig 7

Fig 7.1 Final setup of the S/M

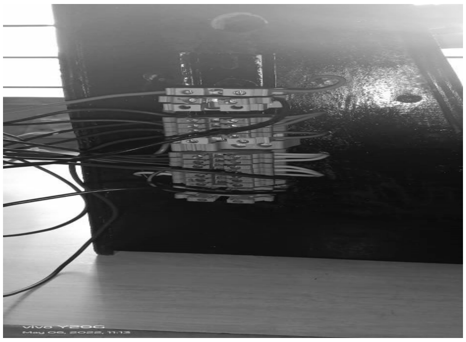


Fig 7.2 Connections are made through Terminal blocks placed in din-rail

Fig 7.3 PLC Connections

It is evident that the planned AMF with the PLC and SCADA has successfully completed the required sequence of operations in order to supply the load with power from two distinct backup sources

The system was implemented as a practical case study during an industrial automation course and was found to be extremely effective and useful not only in training academy students on genuine industrial systems but also in setting a solid example for teaching similar courses. Below is a diagram of the SCADA setup.

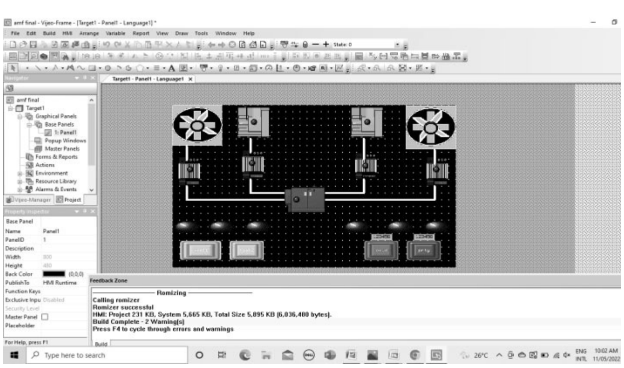


Fig 8 SCADA setup in Vijeo Designer

VII. Conclusions

This study explained how to design and build an automatic mains failure system which can be remotely controlled by SCADA using a programmable logic controller. The overall method has been shown to be straightforward and effective in a variety of educational, commercial, and industrial settings.

Since this is a prototype, this can be set as the basic building idea of any automated failure system existing in the market and even novel integrations can be enabled using PLC ports and SCADA.

References

1] International Journal of Engineering Sciences & Research Technology Analysis of an advanced automatic mains failure panel with diesel generator control, fault detection and Wi-Fi.

2] Automatic Transfer Switch (ATS) Using Programmable Logic Controller (PLC) Dr Hamdy Ashour Arab Academy for Science & Technology Department of Electrical& Computer Control Engineering P.O. 1029 Miami, Alexandria, Egypt.

3] https://www.se.com/ww/en/product/TM221C16R/modicon-m221-logic-controller-16-inputs-outputs-7-relay-outputs-100240-v-ac/