

PLC based Microgrid Controller for Disaster Management: A Case in Kodagu

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Abstract— Post Kodagu landslide disaster during 2018 and 2020, the convention Energy based resources such as solar, wind and diesel based integrated microgrid is considered to be an alternate source to reinforce the blackout power supply through the grid. The challenge is to restore the power from grid to islanded mode within less time of after blackout operation using distributed generators. A Programmable logic controller based quality microgrid is proposed in this research work.

Index Terms—Distributed Generators (DG), microgrid (MG), MPPT based Solar PV, Programmable logic controller, Power management.

I. INTRODUCTION

The Primary power system along with the backup related equipment, supporting structures, transmission and distribution lines were flooded. Ten electricity poles of 11KV truck lines were completely damaged. Complete Kodagu was under blackout due to damage of 66KV line coming from Kushalnagar to Kodagu. After this massive nature disaster, the realization to provide an alternate source of onsite power supply and adaptation of different strategies to strengthen the power supply was considered, a 66KV station has been chosen in this work as test station for further research work.

Microgrid enables a clean and reliable power supply which increases the societal values highly. When the lights go off for an extended period it causes inconvenience to the citizen. The current electricity supply system depends on the centralized power plants located far from the consumer. The energy generated energy is transmitted through radial network the end user. Any problem in the network –it will take many days to bring back electricity system back online. This situation can be overcome by the Microgrid, which enables islanding capability by which customer can customize their level of reliability.

II. MICROGRID CONFIGURATION FOR DISASTER MANAGEMENT

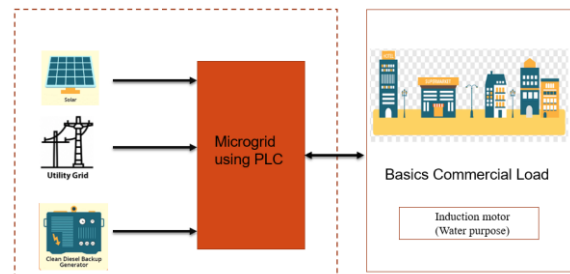
A microgrid has a unique set of capabilities, it can be used during critical loads that will shift in time, space and size and it can provide the ability to meet residential loads of disaster place for longer duration without increasing in fuel storage. The following information need to be considered to design a microgrid.

1. Duration of time that loads should be able to island
2. Flexibility needed in islanded mode to manage the load shifts
3. Critical load identification for design of microgrid control

The Block diagram of the project aimed is as shown below, the shelter will be powered with the quality power through the microgrid designed using the PLC. The microgrid has hybrid power generated inputs from solar, grid and diesel engine.

The loads connected to the microgrid are the n number of shelter, induction motor for water pumping.

Each shelter will have a basic requirement such as one living room and bath room, which shall have three lamps (two inside and one outside), one switch board for charging the mobile and an induction stove for cooking. The common water supply shall be provided by the induction motor.



This effort helps understand the behaviour of the overall system along with the system architecture.

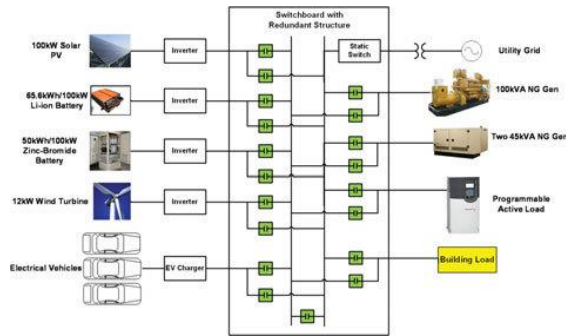


Fig 7: Block diagram of UWM AC microgrid system

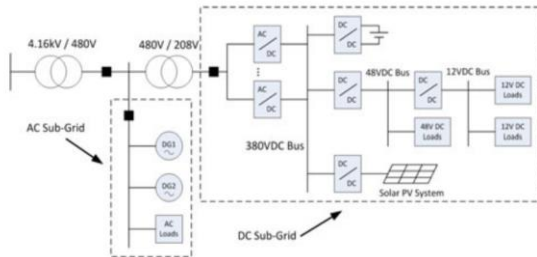


Fig 1: Block diagram of a hybrid microgrid.

III. PROGRAMMABLE LOGIC CONTROLLER

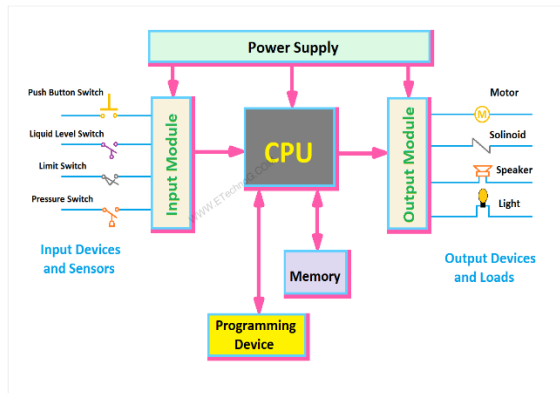


Fig 9: Processing part of PLC

3.4.1 COMPONENTS OF PLC

The basic sections of PLC are the following

1. Processor section (CPU)

The processor part, which includes RAM, ROM, a logic solver, and user memory, is the brain of the PLCT he heart of a PLC is the central processing unit. The CPU controls, monitors, and supervises all PLC operations. Based on the programmer’s instruction in memory, the CPU takes decisions and executes control instructions.

2. Input and output module

The input module acts as a link between input devices and the central processing unit (CPU), which converts analogue to digital signals. The output module acts as a link between the output devices and the central processing unit (CPU), converting digital signals to analogue signals

3. Power supply

Power Supply is provided to the processor unit, input and output module unit. Power supply may be integral or separately mounted unit. Most of the PLC operates on 0 volts DC and 24 volts.

4. Memory section

Data and information are stored and retrieved in the CPU’s memory region. Data Memory stores numerical data for math calculations, bar code data, and other applications. The user’s application programmer is stored in the memory of the user.

5. Analog Output/ Digital output

An analogy output is an output signal that has a continuous signal. Typical outputs may vary from 0 to 20mA, 4 to 20mA or 0 to 10V

The state of a discrete output is either ON or FF. Devices connected to the discrete or digital output include solenoids, contactors, coils, and lamps

6. Programming device

Programming devices are dedicated devices that are used to load user programs into program memory, edit them, and monitor the PLC’s program execution. It’s also used to troubleshoot the ladder logic program on the PLC. Most PLCs use programming devices such as a hand-held terminal (HHT), a specialized terminal, or a personal computer.

IV. SOFTWARE IMPLEMENTATION

4.1 SOFTWARE GP Pro EX 4.09

The simulation software in this project is GP-Pro EX V4. Dedicated and Open HMI (PC-based) solutions are supported by this HMI Development Software. GP-Pro EX is the easy-to-use development software for pro-face HMI and IPC units. It is compatible with previous data and has a number of functionalities that minimize development time. GP-Pro EX can handle the most demanding HMI applications because to its extensive set of application development tools, improved diagnostic capabilities, and simulation

capabilities. This software is capable of decreasing application development time as well as data collection and monitoring without the need for programming. The GP-Pro Ex software allows for the building of HMI applications, the collecting of a wide range of device data, and remote monitoring and control. In addition, there is software available that is ideal for your application, such as SCADA software that may be used to analyse quality-related data.

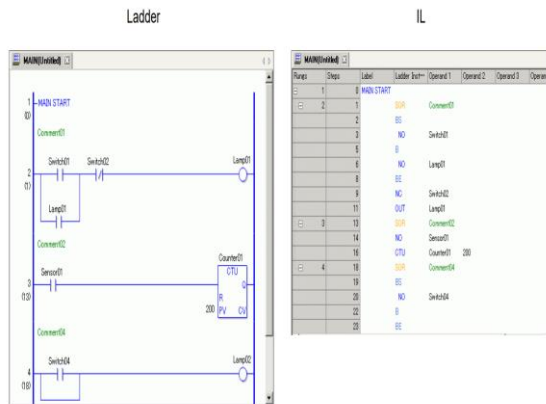


Fig 10: GP Pro Ex 4.09 Software

4.2FUNCTIONAL BLOCK DIAGRAM (FBD)

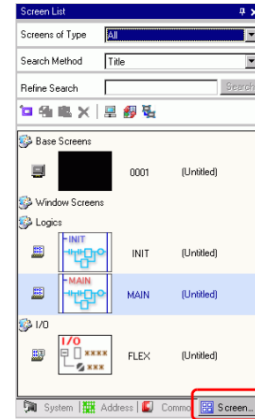
FBD mode allows graphic programming based on the use of predefined function blocks. It offers a large range of basic functions: timer, counter, logic, etc
Logic Program Display:

You can select the type of logic program creation/edit from Ladder and IL (Instruction List). By default, the logic program is shown using ladders.

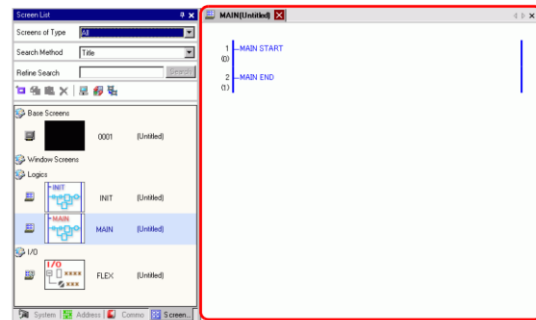


Setup Procedure

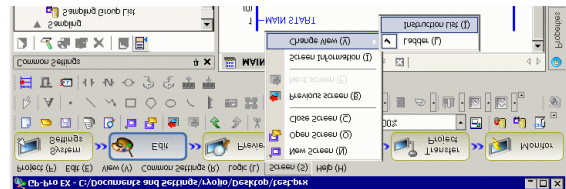
1. Click the [Screen List] tab to open the [Screen List] Window.



2. Double-click the [MAIN] logic screen to display it in the work space.



3. In order to switch between Ladder and IL, click [Instruction List (I)] in [Change View (V)] from the [Screen (S)] menu.



For details on editing the logic program using IL, refer to the following. How to insert an instruction or a branch.

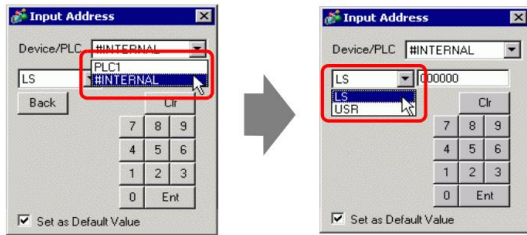
Logic Type

Logic programs consist of the following three types of logic

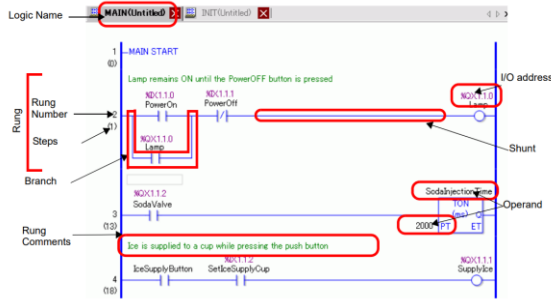
Logic 1 Double-click the operand and click to display the address input box.



In [Device/PLC], select the connection device name and input the address of the model.



- LS Area or User Area Connection Device Name (INTERNAL) Address (for example, LS0000)
- System Area for Memory Link Connection Device Name (MEMLINK) Address (for example, 0000)



V. CONCLUSION

In this work PLC based Microgrid design for disaster management for convention Energy based resources such as solar, wind and diesel based integrated microgrid is considered to be an alternate source to reinforce the blackout power supply through the grid. The challenge is to restore the power from grid to islanded mode within less time of after blackout operation using distributed generators. A Programmable logic controller based quality microgrid is successfully completed.

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