

Plc-Based Starter Generator Set Automation Simulation

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ABSTRACT

Maintenance of the generator set is very influential on the performance of an electric power supply. Especially in a vital institution such as a hospital. The existence of a generator is very necessary as an anticipation if the electricity supply from PLN experiences a trip. Limited time and energy are the main factors underlying the lack of generator maintenance, so generators often fail when needed. Starting from the limited time and energy, the idea emerged about the need for a software that is able to control the system automatically so that it can heat up the generator engine at any given time. Programmable logic controller (PLC) is a program that is used to operate an automatic generator set system. The command made in the form of an image that can be interpreted as a logic circuit command is called a ladder diagram. The command taken from the input signal is a switch and the output signal command is a load. The output signal in this machine is a motor which is analogous to a generator, based on the logic in the generator. When input 0001 is turned on, the timer 001 will count down 25 seconds. Once fulfilled it will start the motor, if for 3 seconds the motor does not start, it will activate the 004 team as a delay before the system starts trying to start again. If in 3 times the motor is started it still won't turn on, it will activate address 1004. Address 1004 itself is an alarm that will give a warning if the system cannot function normally and must get further checks. According to the results above, the use of software using CPM 1A can be said to have been successfully applied to simulations, but there will be significant shortcomings if it is applied for public use, due to the maximum time setting of only 16 minutes, while public use requires flexibility in the application of appropriate time settings. with the field of application. Based on the observations, it can be concluded that the initial purpose of the concept of making tools is fulfilled by the realization of a simulation. The use of PLC is very suitable to be applied to automating generator sets, but the simulation performance has not been maximized due to limited capabilities in developing PLC software timer applications. however, there will be significant drawbacks if applied for public use, due to the maximum time setting of only 16 minutes, while for public use requires flexibility in the application of time settings according to the field of application. Based on the observations, it can be concluded that the initial purpose of the concept of making tools is fulfilled by the realization of a simulation. The use of PLC is very suitable to be applied to automating generator sets, but the simulation performance has not been maximized due to limited capabilities in developing PLC software timer applications. however, there will be significant drawbacks if applied for public use, due to the maximum time setting of only 16 minutes, while for public use requires flexibility in the application of time settings according to the field of application. Based on the observations, it can be concluded that the initial purpose of the concept of making tools is fulfilled by the realization of a simulation. The use of PLC is very suitable to be applied to automating generator sets, but the simulation performance has not been maximized due to limited capabilities in developing PLC software timer applications. while the use for the public requires flexibility in the

PLC Based Generator Set Starter Control Automation Simulation.

Zaenal Mahasin

Page 8 of 7

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Keywords:

Programmable logic controller, Simulation, Automation, Starter control, Generator Set

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INTRODUCTION

The development of science and technology (IPTEK) today is very rapid, especially in the field of electronic technology resulting in several effects that affect people's lives to move forward (modernization), think practically and simply. This kind of thing requires supporting facilities that are simple, practical and high-tech. It can be seen that the manufacture of fully automatic equipment that overrides the role of humans as the subject of work has been found[1]. To meet this need for automation, control equipment is needed that can meet these needs. These control devices include microcontroller-based control devices, automatic switches, and Programmable Logic Control (PLC).[2].

In a factory or agency, of course, a back-up feeder system is needed. The backup feeder system is called a generator set or commonly called a generator. Generators are usually used as a backup system that will have to supply electric current when the supply from PLN experiences a trip, so that the work process of machines in factories or institutions such as hospitals can continue. In this case, prime and maintained generator conditions are needed so that whenever needed, the generator is able to supply electric current[3]. For this reason, continuous maintenance is needed, especially the classic problems that usually occur in engines that run on oil, namely engine delays due to disturbed lubrication, so a system that can automatically heat the engine at any given time so that the process of circulating fuel and lubricating oil pumps is needed. on the generator is not disturbed[4]. The reason for using PLC as a controller is solely because of the effectiveness of the tool so that it is expected to be able to streamline work in factories or agencies.[5].

By utilizing a system that uses automatic control devices in this case PLC, it is hoped that an automatic control device can be created that can meet these expectations. PLC (Programmable Logic Control) can be imagined like a conventional personal computer (the internal configuration of the PLC is very similar to the internal configuration of a personal computer)[6][7]. However, in this case the PLC is designed for the manufacture of electrical panels (for strong currents). So it can be considered PLC is a computer electrical panel. There are also those who call it a PC (Programmable Controller). PLC is widely used in industrial applications, for example in the packaging process, material handling, automatic assembly and so on[8]. In other words, almost any application that requires electrical or other electronic control.

Thus, the more complex the processes that must be handled, the more important it is to use PLCs to simplify these processes (and at the same time replace some of the necessary tools). In addition, the conventional process control system has several weaknesses, including:

- a. It takes hard work when wiring.

- b. Difficulty with replacement and repair.
- c. Difficulty tracking errors.
- d. When a problem occurs, the waiting time is erratic and usually long.
- e. Hard-wired Program .
- f. Specific purposes and applications.[9]

Meanwhile, the use of a PLC controller has several advantages compared to conventional process control systems, including:

1. Compared to conventional process control systems, the number of cables required is minimized
2. PLC consumes less power compared to conventional (relay-based) process control systems.
3. The diagnostic function on a PLC controller allows easy and fast fault detection.
4. Changes to the operational sequence or processes or applications can be done easily, simply by changing or replacing the program, either through the console terminal or PC computer.
5. Does not require a lot of spare parts, simple controller device.
6. Cheaper than conventional systems, especially in the case of the use of I/O instruments that are quite a lot and the operational functions of the process are quite complex.
7. PLC resistance is much better than auto-mechanical relays.
8. System drawing documentation is simpler and easier to understand.
9. Control system standardization is easier to implement.
10. Powerful programming and stored in memory
11. Universal application because a program is defined by the functions available.
12. Commissioning and trouble shooting is easier by using the provided functions.
13. The program can use both text and graphics.
14. Can accept harsh environmental conditions.

The use of PLC as a control tool for several automation systems has been widely used because PLCs can be given input commands that allow them to be applied in an automatic generator starter control system.[10]. The generator can be set to "maintain" itself by activating the automatic starter mode to warm up the engine every certain time so that the reliability of the electric power supply system can be maintained.[11].

METHOD

This simulation design is used to describe the generator engine logic device that is adjusted to the actual conditions. While the notion of simulation is an imitation of something real, the surrounding circumstances (state of affairs), or processes. The act of simulating something generally represents a key characteristic or behavior of abstract or physical systems. In designing this generator engine simulation, there are things that need to be prepared to make it easier to manufacture, including:

- a. Draw in detail every logic flow that exists on the actual generator engine.
- b. Designing the circuit flow that will be used as a moving circuit, also placing the components installed in the simulation
- c. Calculate and adjust the amount of voltage source that will be used to supply the motor used to run the simulation

The tools used are combination pliers, razor pliers, cutting pliers, soldering iron, wood saw, hacksaw, cutter, scissors, hammer and multimeter. The list of materials to be used is

Table 1. List of Ingredients

No	Material Name	Material identification	Amount
1	PLC CPM 1 A	20 CDR	1 unit
2	DC Motor	12 Volts	1 unit
3	Limit switches	1 A 100 Volt	1 piece
4	Led	1 A 24 Volt	4 pieces

6	Cable	Hair	2 meters
7	On/off switch	2 A 240 V	1 piece
8	plywood	3 mm	1 m2
9	Nail	1 cm	ounce
10	Transformer	220 volts/ 3 A	1 unit
11	PCB	5 x 10 cm	1 piece
12	wood frame	2 x 3 cm	2 sticks

The power supply used is (input) 12 volts, used to supply voltage to the simulated motor.

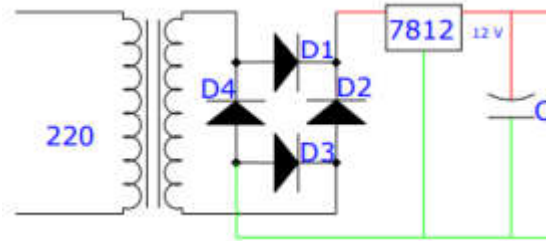


Figure 1. Power Supply Circuit

Input commands such as ON, OFF, Reset and Limit Switch are connected to the PLC. These commands are used as an operating manual which will later be designed into a series using a ladder diagram in a computer. The command in the form of a ladder diagram is used as a liaison between input commands and output commands on the PLC. The PLC output is connected to a relay which is used to run a 12 volt electric motor. This output is also used to operate the ON, OFF, Reset . indicators

Making PLC programs, including: determining the number of inputs and outputs, making ledder diagrams, determining the address list of mnemonic programs and entering and testing programs to the PLC. Designing simulation tools include:

1. Make a tool plan drawing
2. Determining the size of the simulation tool
3. Determine the location of the motor and limit switch
4. Determining the position of the input terminal
5. Buying calculated hold
6. Check the materials that have been purchased and make sure they function properly
7. Prepare tools and materials before starting work
8. Assemble the ingredients that have been prepared
9. Press the tool when it is assembled correctly
10. Checking the simulation tool that has been made
11. Testing the simulation tool
12. Make a test result report.

RESULTS AND DISCUSSION

Before testing the Penstarter Genset simulation tool, it would be nice to first check both hardware and software. Checking this hard ware and software needs to be done because it avoids fatal errors on the machine. Besides that, we also have to ensure that all components that have been installed function properly and run properly so that in drawing conclusions or analyzing the tool we get maximum results.

The checks carried out are:

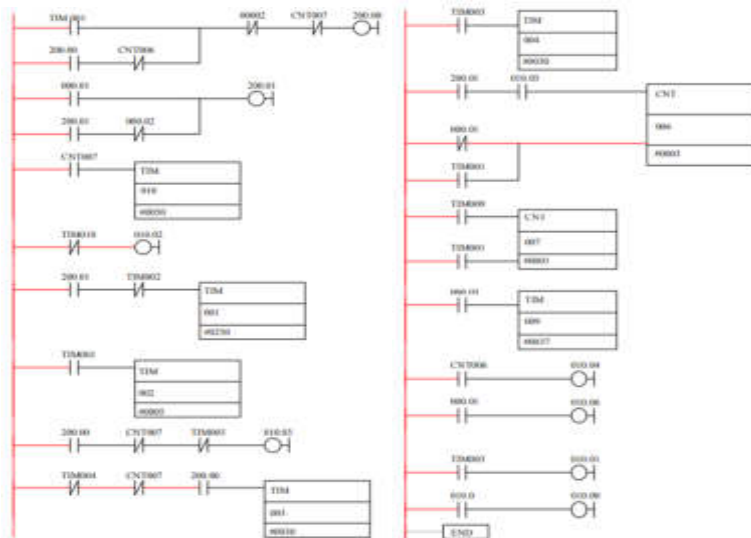
- a. Checking the input voltage source used for the power supply, 220 Volt
- b. Output check on power supply, 12 Volt
- c. Checking the input voltage source on the PLC, 220 Volt
- d. Check output on PLC, 24 Volt
- e. Checking on the motor used to run the simulation

f. Checking Limit Switch, whether it can read the motor rotation

The workings of this simulation tool are as follows: The simulation tool is analogous to a generator engine, with reference to the logic in the generator engine which includes the minimum requirements to start the engine, namely fuel conditions and diesel engine conditions. In the simulation tool, these two logics are applied to two switches, each of which will produce a value of 1 or on if the logical conditions are met and will be 0 or off if the logic is not met. The PLC program or its software is made based on the condition of the machine failing to work.

The sequence of work processes is as follows:

1. The on switch is pressed, the first thing that works is a timer that will count down for 25 seconds, after that it will activate a relay that will flow current to the motor which is analogous to a generator. Startup will be allocated 3 seconds
2. When the generator fails to operate for 3 seconds of starting, the PLC will stop the start with a time delay of 3 seconds. Then the PLC will try to restart with the same pattern.
3. If the second, the generator engine still fails to work, the third process will be repeated with the same pattern as well.
4. If the third process still fails, the PLC will activate a buzzer or alarm as a signal that the entire system requires further handling.



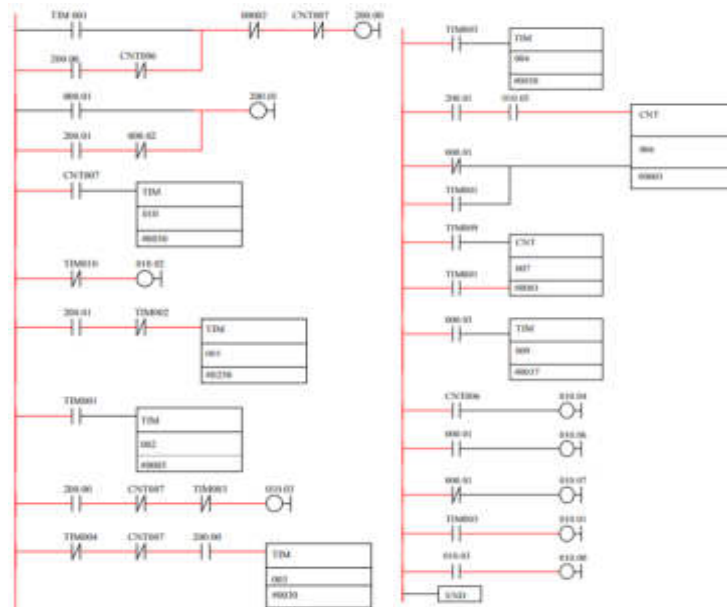


Figure 3. Ladder Diagram After Operation

In this state, the address 200.01 as an auxiliary relay will be On and locked so that it will activate TIM 001 which will count down 25 seconds. After reaching the limit it will trigger TIM 001 on the first busbar and turn on the Auxiliary relay 200.00. When the Auxiliary relay 200.00 is on, it will also start the motor. When the motor is running, TIM 003 will be triggered so that it will count down and will turn off the motor when it reaches the limit point. Simultaneously with the triggering of the TIM 003 limit point, the TIM003 address will flow current to TIM004 so that TIM 004 can work. The function of TIM004 here is to reset TIM003. with the operation of the motor, CNT006 will function to count down. When address 10.03 or the motor is on, the LED with address 10.00 will be on as well. At the end of the process, buzzer with almt 10.

The results of the experiment on the software applied to the simulation obtained the following results:

- a. After pressing the on button, there will be a waiting time of 25 seconds before starting
- b. After the 25 second wait time is met, the system will try to start the generator
- c. The system will restart 3 times to ensure that there are problems that must be resolved on the generator or other systems as a whole.
- d. If in 3 times the generator is not able to work, the buzzer will give a signal about generator failure

Discussion

Of the various kinds of problems or troubleshooting on generator engines based on combustion engines, in general it is on the circulation of liquids that function, among others, as fuel and lubricants. The stability of the combustion engine system is strongly influenced by the lubricant because the combustion engine uses a lot of moving components and tends to rub together. As a solution for the smooth circulation of the generator is to treat it by heating it at a certain time. By heating the engine at a scheduled time will help the reliability of a generator system.

The initial concept was to plan to build software for the public interest with a scheduled time span for the generator to turn on and heat up every 24 hours. However, according to developments, that this software application will be applied to simulation tools which of course require less time, only use one timer address, use PLC Omron CPM 1A with a maximum time for each timer address of 999.9 seconds or 16.6 minutes and give a time setting of 25 seconds.

According to the experimental results above, the software can be said to have been successfully applied to the simulation, but there will be significant drawbacks if it is applied for

public use, because public use requires flexibility in the application of time settings according to the field of application. The problem or weakness that arises from the automation software with CPM 1 A is the limited ability of software development by the author to accommodate the timer. The use of one internal timer address which is only capable of 16.6 minutes will certainly be very far from the initial concept which is expected to also be applied to applications for the public. However, as an application to the simulation, the software is in accordance with the simulation concept.

CONCLUSION

Based on the results of testing and discussion, it can be concluded that the initial purpose of the concept of making the tool is fulfilled by the realization of a simulation and the performance has not been maximized due to limited software development capabilities, especially on the timer.

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