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Rural Load Management using Information Technology

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Abstract

The mismatch between the generation and demand for electrical power is increasing at an alarming rate. This is mainly due shortage of conventional resources, use of appropriate technology for alternate energy sources and lack of awareness about energy conservation. Power supply to domestic, commercial and industrial consumers is a difficult task to the utilities controlled by the government. In rural India, irrigation pump sets are the major loads. The technical aptitude, attitude and co operation of the consumers helps a lot in energy management. The strategic power supply is affected if the consumers are not complying with the norms. A strategy is framed to provide power to domestic appliances around the clock and agricultural consumers on time division basis. But the local technicians play a corruptive role to violate this which is leading to overloading/failure of the distribution transformers frequently. Here, an attempt is made to devise a method to overcome the problem of agricultural consumers who are getting power on time division basis. A control unit is installed at each distribution station to automatically monitor and control the power supply to domestic and agricultural consumers as per the pre defined schedule. This paper explains the use of electronics and information technology in rural areas for better management of the power supply and consumption. The unauthorized connection leading to failure of distribution transformers is also taken care.

Keywords: *power, irrigation pump sets, rural load management unit, information technology tools, energy management*

1. Introduction

During the past two decades, as a result of industrial development and new agricultural practices, the demand for electric power has grown exponentially. Consequently the distribution network has become too vast in reaching and meeting the requirements of consumers [1]. However, power utilities are neither able to generate to meet the demand nor upgrade their transmission and distribution system due to lack of sufficient budgetary support and also non availability of natural resources required for generation. The exponential growth in demand from agricultural sector and also due to state Govt. policies, it is impracticable for the utilities to expand and maintain the system at the desired level to supply the quality power. Karnataka state in India is having approximately 15 lakhs consumers with irrigation pump sets that consume 1/3rd of the state's consumption without satisfactory financial return.

Consequent to the mismatch that is prevailing in the state, power companies are providing only few hours 3- phase power supply and remaining hours single phase supply to rural areas. Due to restricted number of hours of power supply [2], most of the feeders are over loaded because of no diversity in agricultural load resulting in higher distribution losses, poor voltage regulation and increased incidence of distribution transformer failure. Further, due to illegal way of running the motors using phase converters during single phase hours is also observed. This leads to frequent failure of distribution transformers. Thus to reduce the subsidy burden and to make utilities economically sustainable, the information technology can be used in power sector effectively to resolve many problems. One such information technology solution for the said problem is automatic rural load management scheme.

The scheme was implemented by awarding contract to ABB Company to develop Rural Load Management Unit (RLMU) and accordingly came out with the said unit. The same is

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experimented by installing the unit over quite a good number of feeders. The total number of irrigation pump sets are divided in to three groups and the function of the unit is to monitor and connect the supply system these groups on time division basis i.e. 8 hours to each group on cyclic basis. The local technicians started misguiding the formers and prompted them to by pass the connection and get power even when their turn is not there. This has lead to overloading of feeders and distribution transformers. Many transformers damaged due to this and the supply company suffered losses. To overcome this, an attempt is made here by using microcontroller to avoid damage to the transformers by turning of the supply to all the loads thereby making the consumers to realize the mischief that is being played.

2. Principle and Working

The rural loads are split into zones and each zone is supplied with 3-phase power for Irrigation pump sets for predefined number of hours [3, 4]. However, single phase power is supplied round the clock for domestic consumers. Domestic loads are continuously supplied whereas Irrigation Pump sets are supplied on time division basis. But it was observed that the irrigation pump sets are being run during the unscheduled period using single phase supply employing phase converters. In the proposed method, microprocessor and suitable hardware circuit is used to supply power as per the schedule. The schematic of the proposal is as shown in Figure 1. The schedule is programmed using microprocessor chip. By switching ON and OFF the contactors C_1 and C_2, load on the distribution transformer is controlled thereby giving the selectivity between the categories of consumers. The programming of the schedules is such that any loss in the power supply for various reasons shall be equitably compensated by switching ON the contactors, feeding the circuits that have lost the power as per the predefined schedule. The total number of hours of power supply provided to each circuit is on daily or weekly basis. This facilitates timely energy audit of the transformer by communicating and acquiring the necessary data from the energy meter.

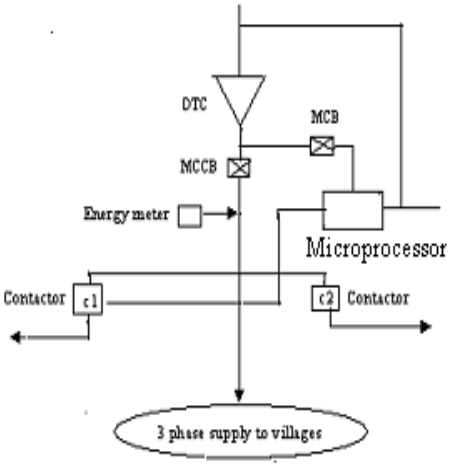

Figure 1. Schematic of the existing scheme

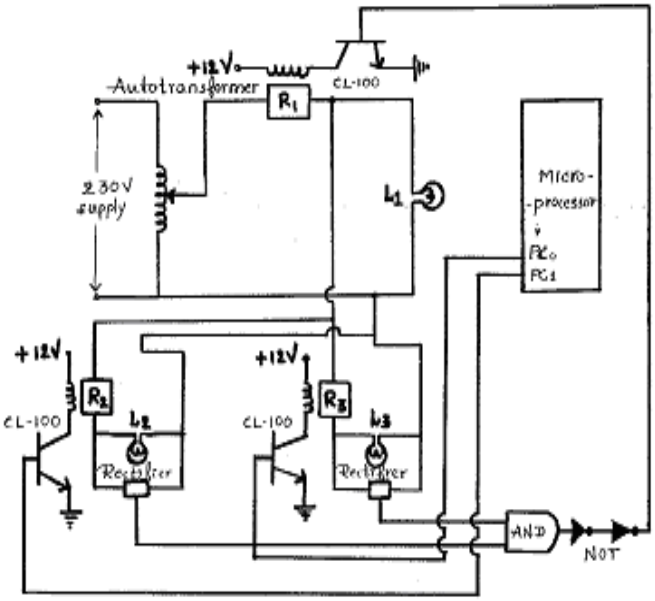

Figure 2. Block diagram of the proposed scheme

This scheme will work satisfactorily as long as the consumers show both moral and legal responsibilities. Unfortunately, local technicians are used to bypass the RLMU (Rural Load Management Unit) and thus disturbing the power supply schedule to a greater extent [5]. This is leading to unbalanced loading of the transformer and creating unwanted problems to the distribution transformer.

3. Proposed Scheme

The consumers who are using power at subsidized rates need to be cooperative in proper usage of power. They are expected to be aware of the present power scenario. Twenty four hours power is supplied for domestic use. To overcome the problem of mischief played by the consumer to get power during non scheduled period for their irrigation pump sets, an additional feature is included in the programming i.e. the unauthorized tapping is identified and input power to that distribution transformer is disconnected. The power is resumed only after clearance of the unauthorized bypass connection. However, the power lost during this period shall not be compensated.

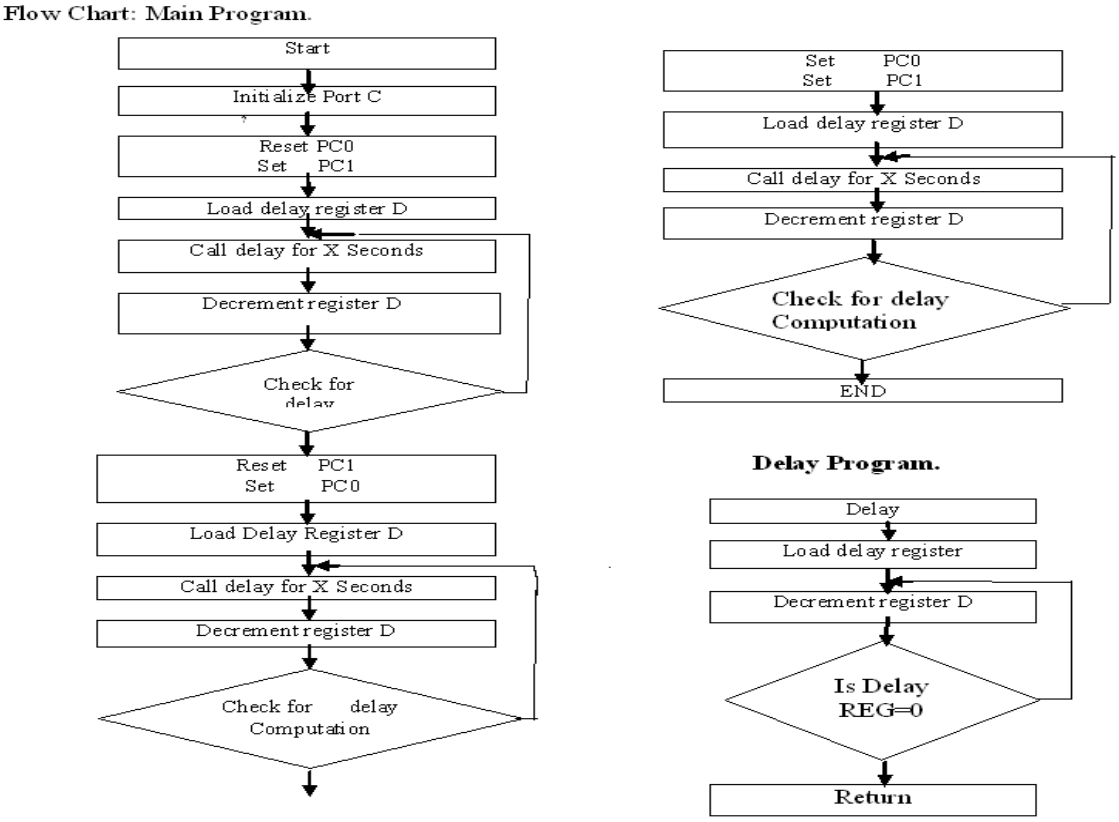

Figure 3. Flowchart the Program

4. Hardware components and circuit

The scheme includes Microprocessor 8085, Relay, Transformer, Transistors, load, Rectifier, Regulator, Power Supply ICs 7408, 7406 ICs etc..The block diagram of the scheme is shown in Figure.2.

The flow chart of the program is shown in Figure 3. The program is written to energize the contactors. The power is supplied to the domestic consumers round the clock. The schedule for supplying irrigation load is loaded in to the respective registers and upon completing the time slot the respective contactor is excited. The time division is obtained by calling a delay program. In case of bypass the program will sense the same and energies all the contactors to disconnect supply to the distribution transformer. Once the bypass is cleared once again the routine monitoring and connection will resume.

5. Test results of the prototype

The prototype is tested for normal and abnormal (mischief) conditions. The results are satisfactory. The power is ON for the scheduled time to respective circuits by closing the contacts of the respective relays. Whenever unauthorized connection is presented, the input to

the transformer is disconnected thereby alerting the domestic consumers about the mischief played. The testing is carried out by changing the schedules in the program for confirming the repetitiveness. The scaled up graph of the prototype performance is shown in Figure 4 (a) through 4 (c).The prototype is tested for a system capacity of 5 KVA. The domestic load is 2 KW and is operating at an average power factor of 0.9. Three irrigation pump sets of capacity 3-HP were connected to the system and each motor was supplied with power for 8 hours. To ensure the safety to the transformer deliberate by pass was created and it is observed that the input to the transformer was disconnected. In the graph shown below, continuous domestic load is nearly 2 KW and when irrigation pump sets are connected, the load is nearly 4.2 KW. Figure 4 (a) shows the total load without using RLMU whereas Figure 4(b) shows the strategic load growth using RLMU unit. The condition of by pass and the way in which the load supply is getting affected is illustrated in Figure 4(c).

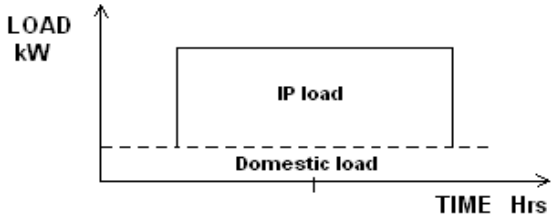

Fig 4(a).Load curve without RLMU

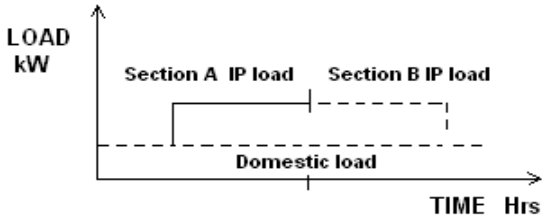

Fig 4(b).Strategic load growth

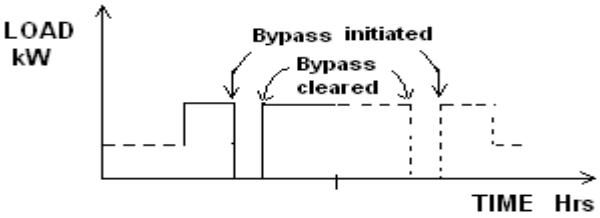

Fig 4(c). Load curve during bypass

6. Conclusion

This method of monitoring and switching of the unauthorized connections ensure safety of the system components like no damage to the distribution transformers, no overloading of feeders etc. and is clear from the results depicted in the respective graphs. By implementing such methods more energy can be saved and also it is more economic. Alternate switching IN and OUT of irrigation pump sets loads is successfully demonstrated by the prototype. Since irrigation pump set loads are highly staggered, manual monitoring is difficult. Thus it is an automated scheme and can be effectively used for rural load management. This will also facilitate energy audit. This will convey the significance of the energy conservation to the former's community in particular and society at large.

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