Automated Load Shedding Period Control System

(An effective way to reduce human effort)

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Abstract— Energy is the basic necessity for the economic development of a country. Many functions necessary to present-day living grind to halt when the supply of energy stops. It is practically impossible to estimate the actual magnitude of the role that energy has played in building up present-day civilization. In this modern world, the dependence on electricity is so much that it has become a PART & PARCEL of our life. So we need to save more & more electrical power. Hence, the load shedding control system, which was earlier done manually, now-a-days, is controlled by a computer based system, developed to some more extent to direct the society to a more convenient life. This paper focuses on developing a computerized procedure for controlling the load-shedding system where manual work will be minimized by selecting the feeder, substation and duration of shedding time by the user. Simulation results', using the above proposed model, verifies the suitability of choosing such an automated load shedding system.

Keywords- Load Shedding; Energy; Electricity; Computer Based System; Substation; Feeder; Shedding Time.

I. INTRODUCTION

Load-shedding **[1]** is a process by which the electrical authority handles the dearth of the electrical power **[2]** being consumed by the society. Shedding is done to minimize the load being consumed by the society through several substations which are connected to the main power station **[3].** When the frequency of the power generator falls down, it fails to generate the required power. As a result the authority lacks the scheduled amount of power & this leads the authority to perform a shedding. And the main station orders the sub-stations to cut some of the feeders for a certain period of time & thus the shedding procedure continues.

To ensure that the system is stable and available during disturbances, manufacturing facilities equipped with on-site generation, generally utilize some type of load shedding scheme **[4]**. In recent years, conventional under frequency and PLC-based load shedding schemes have been integrated with computerized power management systems **[5]** to provide an "automated" load shedding system. It can provide faster and optimal load relief **[6]** by utilizing actual operating conditions and knowledge of past system disturbances.

The main theme behind the proposed method is to develop a computerized procedure for controlling the load-shedding time period in a systematic way so that in the shedding management process, manual work may be minimized. This computerized shedding scheme will be easy to operate and having fewer complexities with a proper user friendly interface provided with the system.

II. EXISTING LOAD SHEDDING SCHEDULE MANAGEMENT

The function of an electric power system is to connect the power stations to the consumers' loads by means of interconnected system of transmission & distribution networks **[7]**. Therefore an electrical power system consists of three principal components:

1. Power Station
2. Transmission Lines and

3. Distribution Systems.

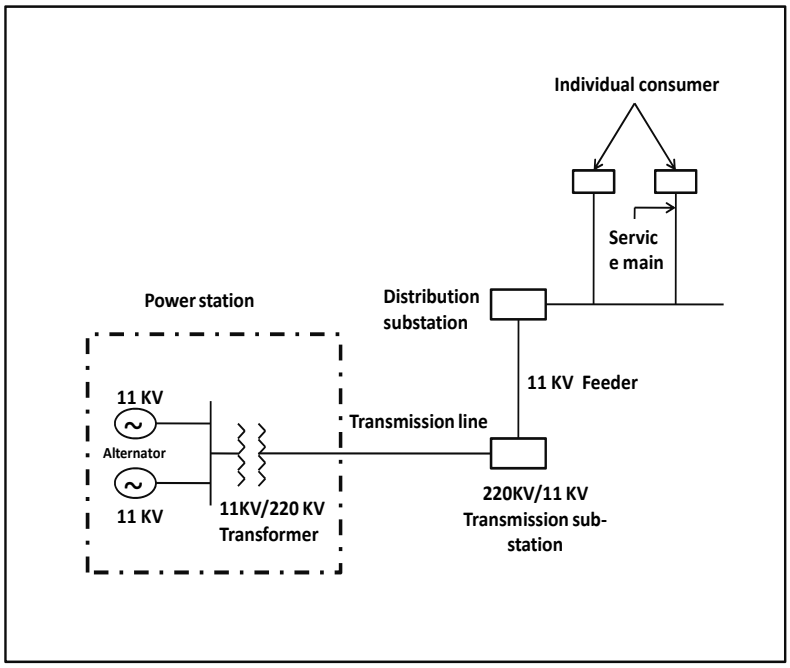

Figure 2.1: Electric flow from power station to consumer

The transmission lines are the connecting link between the power station & distribution systems. A distribution system connects all the individual loads in a given locality to the transmission lines.

In the shedding process, under a main power station there are several sub-stations who perform power-cut for a certain period of time to control the shortage of electrical energy used by the people of the locality **[8]**.

Workers form the electrical authority are engaged in the substations who attend the calls and directions from the main power station & as per the upper levels direction, power system of some area are cut down by the workers for a period of time. And then after the completion of those areas' shedding some other areas are cut-off. In this way the shortage of electrical energy is covered up by the electrical authority.

III. PROPOSED SYSTEM ARCHITECTURE

Advancement in computational technologies has opened the door for fast Load Shedding Controller (LSC) **[9]** designs with low cost, convenience, scalability, and remote access capability. This paper deals with designing such a computerized LSC which will reduce manual effort for controlling the load shedding time interlude **[10]** in a systematic way. For this, the following requirements are there:

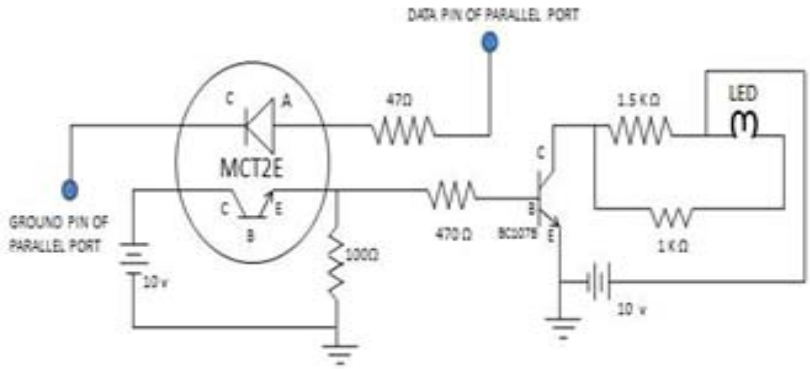

Figure 3.1: Circuit diagram for proposed system.

A. Hardware Components

1) Photo transistor optocouplers MCT2E*:*

The MCT2E is optically coupled isolator consisting of a Gallium Arsenide infrared emitting diode and an NPN silicon phototransistor mounted in a standard 6-pin dual-in-line package where Surface-Mount option is available. All electrical parameters are 100% tested by manufacturing. Specifications are guaranteed to a cumulative 0.65% AQL of Standard Single Channel Phototransistor Couplers.The MCT2/ MCTE family is an Industry Standard Single Channel Phototransistor. Each opto coupler consists of gallium arsenide infrared LED and a silicon NPN phototransistor.

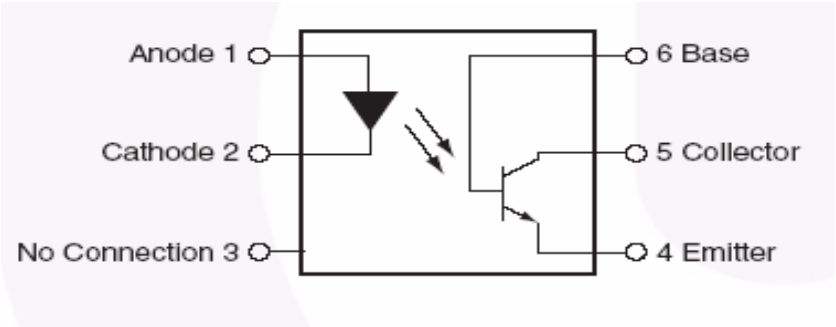

Figure 3.2: - Schematic diagram of MCT2E.

2) BC107B NPN Transistor:

BC107B are widely used "Industry Standard" **NPN** transistors in a **TO18** type case designed for applications such as medium–speed switching and amplifiers from audio to **VHF** frequencies. Its prime features are Low Collector Saturation Voltage: 1V (Max) and High Current Gain–Bandwidth Product: fT = 150MHz (Min) @ Ic 2mA.

The first letter B is for silicon, A is for germanium (rarely used now). The second letter indicates the type; for example C means low power audio frequency; D means high power audio frequency; F means low power high frequency. The rest of the code identifies the particular transistor. There is no obvious logic to the numbering system. Sometimes a letter is added to the end (eg BC108C) to identify a special version of the main type, for example a higher current gain or a different case style. If a project specifies a higher gain version (BC108C) it must be used, but if the general code is given (BC108) any transistor with that code is suitable.

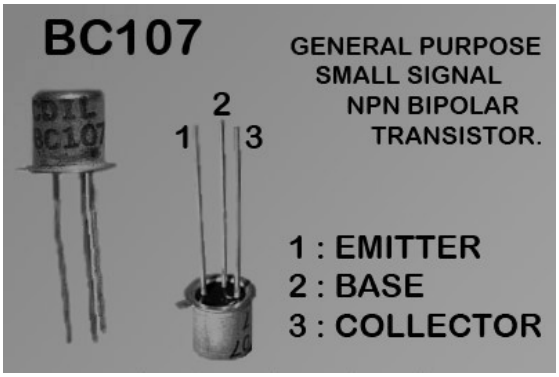

Figure 3.3: Schematic diagram of used NPN transistor

3) Resistor:

A **resistor** is a two-terminal electronic component that produces a voltage across its terminals that is proportional to the electric current through it in accordance with Ohm's law:

V = IR

Resistors are elements of electrical networks and electronic circuits and are ubiquitous in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel-chrome).

In precision applications it is often necessary to minimize electronic noise. As dissipative elements, even ideal resistors will naturally produce a fluctuating "noise" voltage across their terminals. This Johnson–Nyquist noise is a fundamental noise source which depends only upon the temperature and resistance of the resistor, and is predicted by the fluctuation–dissipation theorem. For example, the gain in a simple (non-) inverting amplifier is set using a voltage divider. Noise considerations dictate that the smallest practical resistance should be used, since the Johnson–Nyquist noise voltage scales with resistance, and any resistor noise in the voltage divider will be impressed upon the amplifier's output.

4) Protective relay mechanism & Manometer:

The detection of a fault & disconnection of a faulty section or apparatus can be achieved by using fuses or relays.

A protective relay **[11]** is a device that detects the faults & initiates the operation of the circuit breakers to isolate the defective element from the rest of the system.

The relay **[12]** detects the different under normal & fault conditions. Having detected the faults, the relay operates to close the trip circuit of the breaker. This results in the opening of the breaker & disconnection of the faulty circuit.

When the short circuit **[13]** occurs at point F on the transmission line, the current flowing in the line increases to a enormous value resulting a heavy current flow through the relay coil, causing the relay to operate by closing its contacts. This in turn closes the trip circuit **[14]** of the breaker, making the circuit breaker open & isolating the faulty section from the rest of the system. Thus the relay ensures the safety of the circuit equipment from damage.

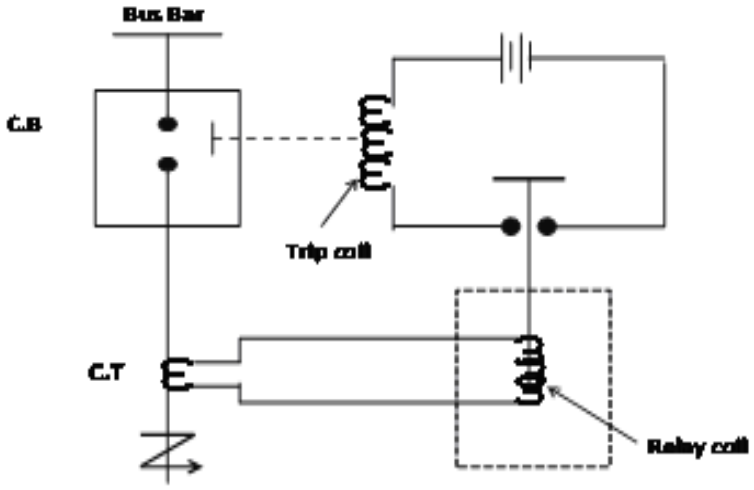

Figure 3.4:- Typical Relay Circuit.

The relay circuit connection may be divided into three parts:

First part is a primary winding of a current transformer which is connected in series with the line to be protected.

Second part consists a secondary winding of C.T. & the relay coil.

Third part is the tripping circuit **[15]** which may be either A.C. or D.C. It consists of a source of supply, the trip coil of the circuit breaker & the relay stationary contacts.

When the short circuit occurs at point on the transmission line, the current flowing in the line increases to a enormous value resulting a heavy current flow through the relay coil, causing the relay to operate by closing its contacts. This in turn closes the trip circuit of the breaker, making the circuit breaker open & isolating the faulty section from the rest of the system. Thus the relay ensures the safety of the circuit equipment from damage.

IV. HOW THE PROPOSED METHOD WORKS

For the successive execution of the proposed system, some step by step procedure or algorithm is used to incorporate the load shedding scheme. This is as following:

Step – 1: Select Substation from the grid present.

Step– 2: Select the feeder from the substation equipment list.

Step – 3: Make choice of whether to turn it on or off.

Step – 4: For a particular feeder the choice of switching it on/off after specified duration is also possible.

Step – 5: Make final confirmation on the choice made.

The full working principle may be depicted in a nutshell by the following Data Flow Diagram of Level 0 and Level 1:

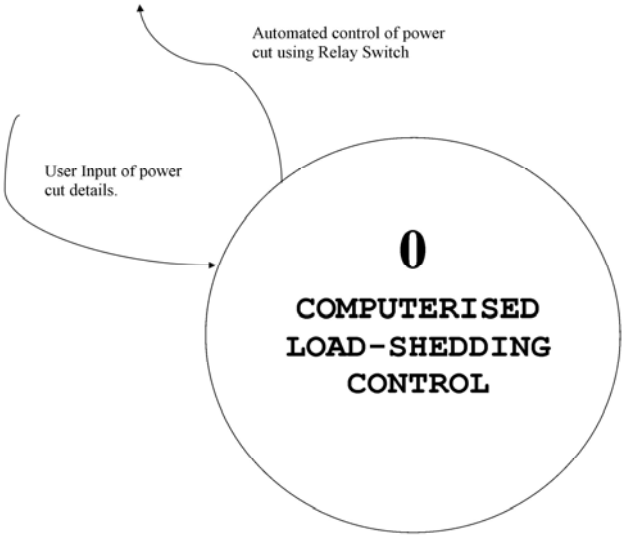

Figure 4.1: Context Diagrm

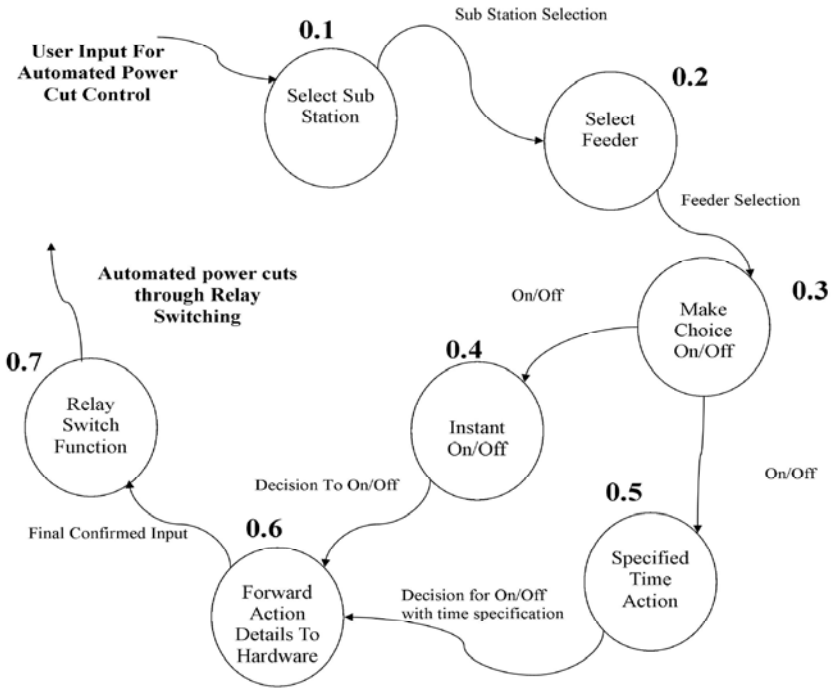

Figure 4.2: Level 1 DFD for the proposed system

V. SIMULATION USED TO DEPICT THE SCHEME

In the paper, the full programming simulation is being done using simple C Programming.

Below some of the snapshots are given from the C Program which controls the load shedding scheme as a simulator:

The electrical circuit arrangements, which are being done, can be attached with the parallel port of the computer and with the help of C program the Electrical Circuit can be controlled by the Computer **[16].** Therefore, once input data (feeder, substation, time period of power cut etc.) will be selected with the help of

programming interface, automatically the whole setup will be controlled by the software written in C language. The program will then control the whole load shedding scheme.

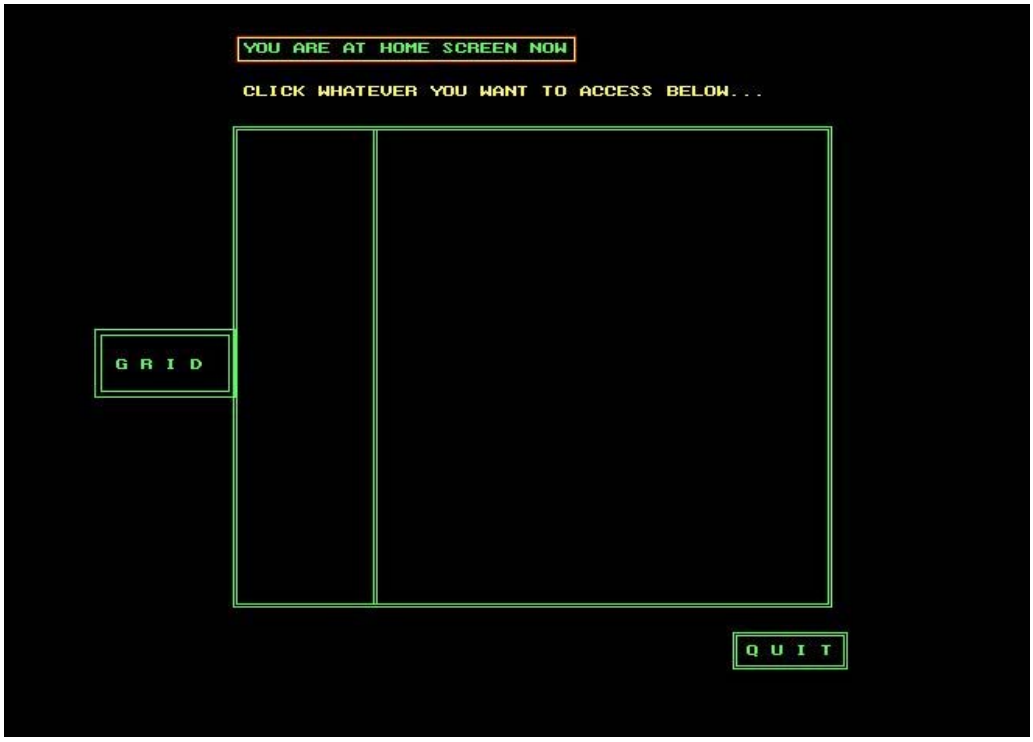

Figure 5.1: Selection of Input

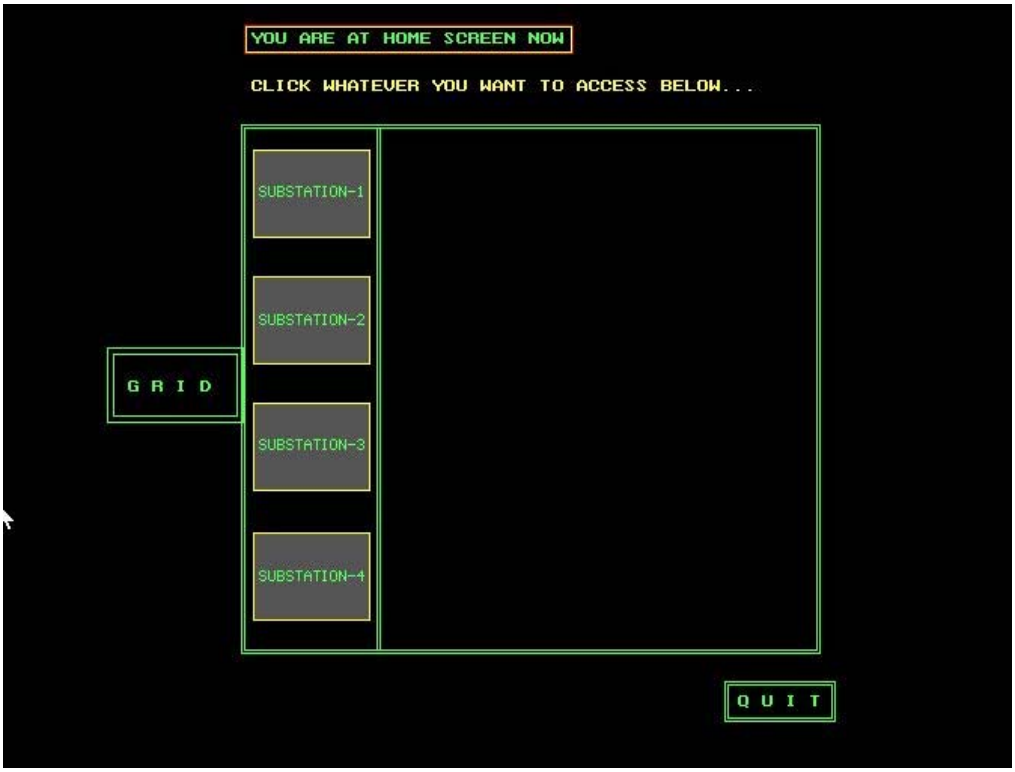

Figure 5.2: Selection of Substation

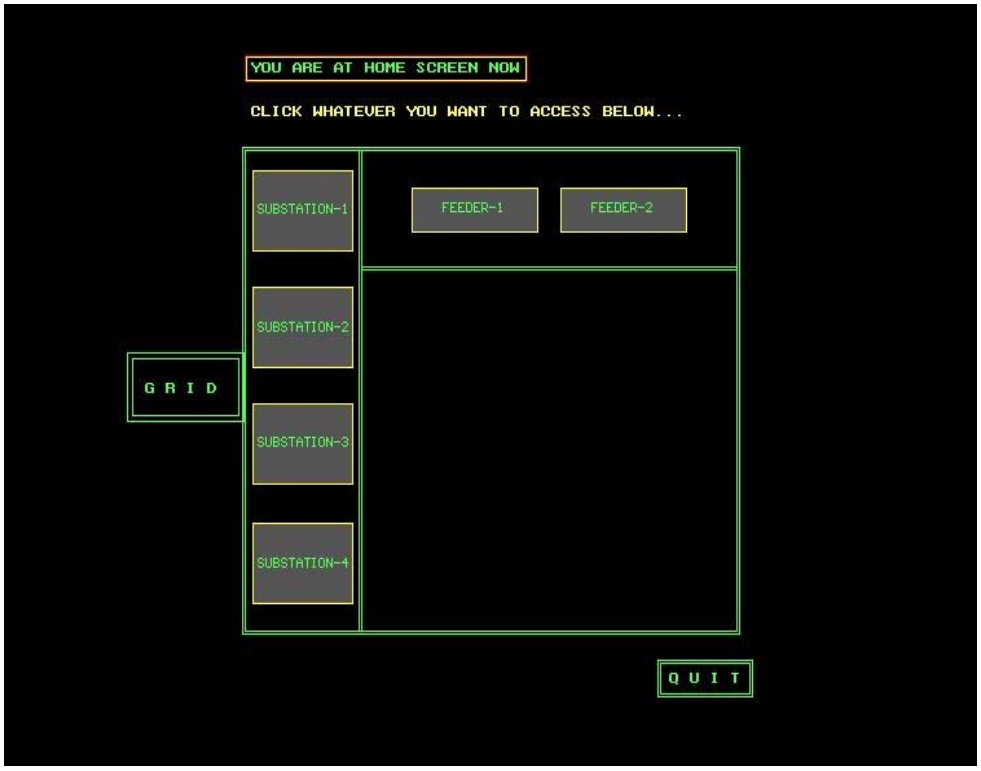

Figure 5.3: Selection of Feeder

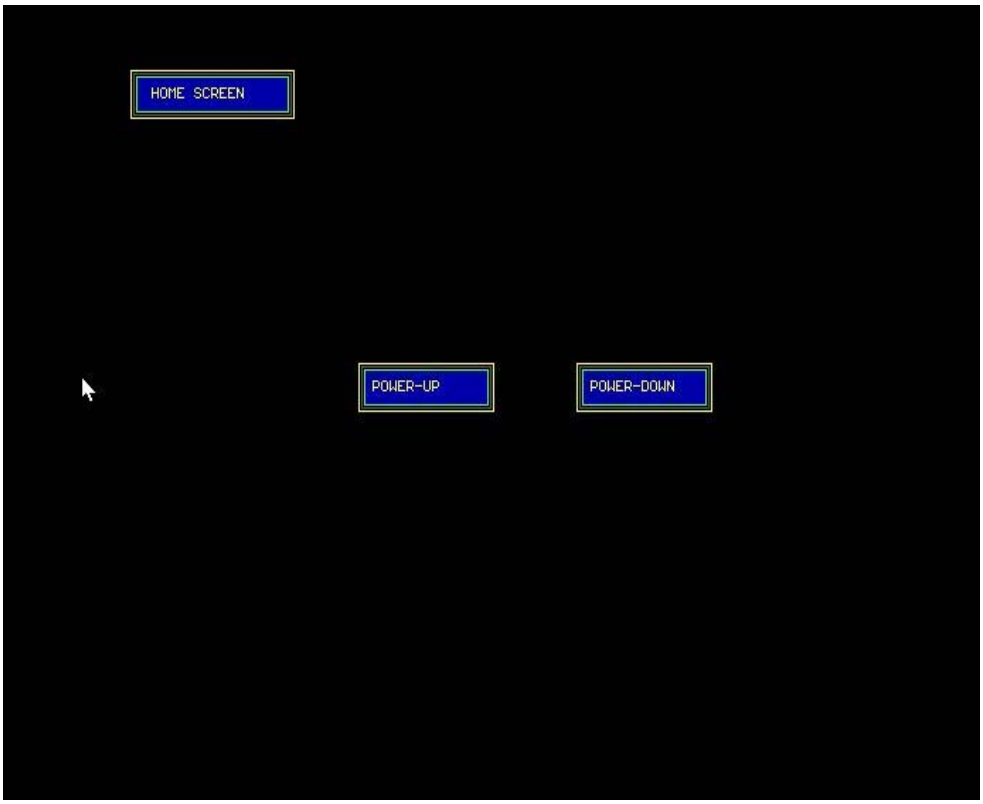

Figure 5.4: Selection of Power ON/OFF

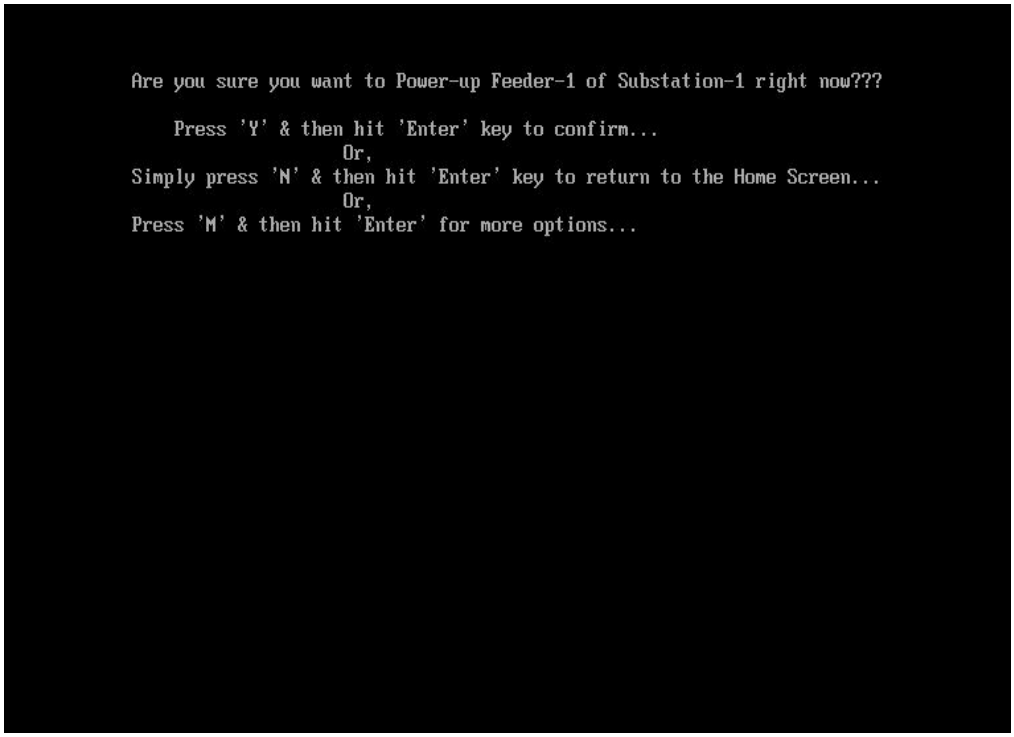

Figure 5.5: Confirmation of Power ON/OFF

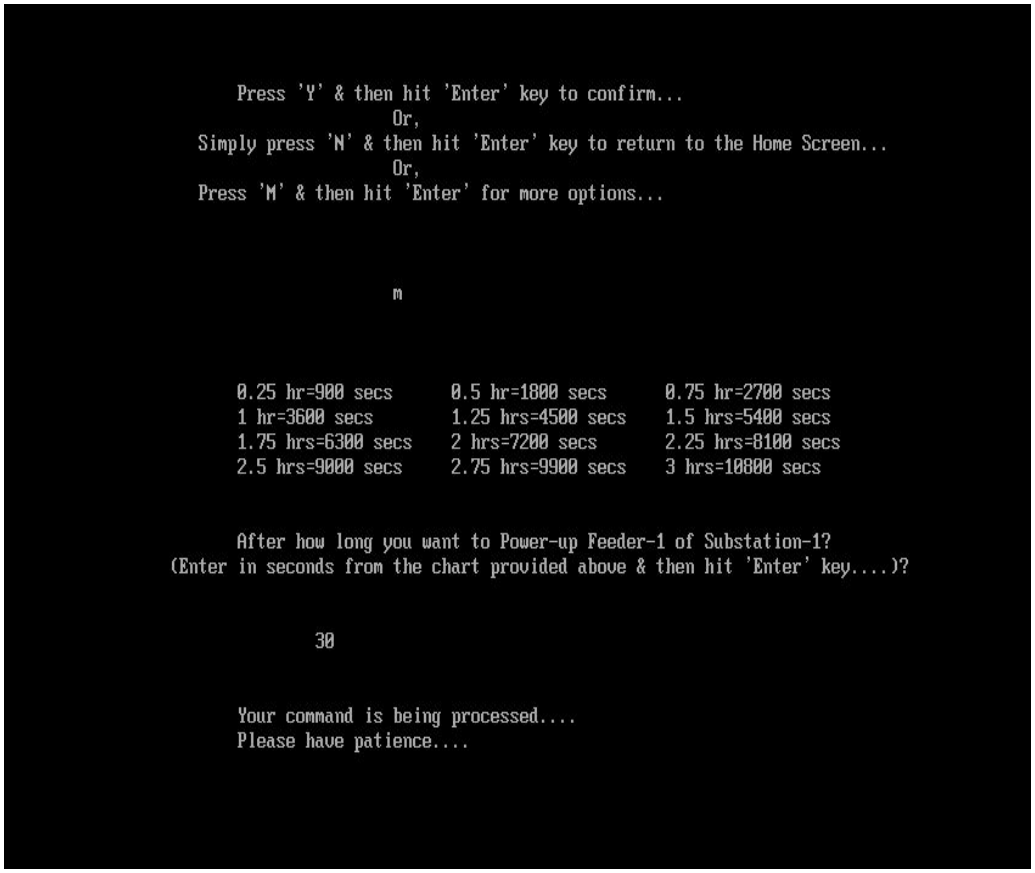

Figure 5.6: Selection of Time Period of Power OFF

VI. FUTURE SCOPE

It may be mentioned that the high speed of wind can cause harmful effects to the devices installed at the substations. When wind speed is very high, the transmission wires can touch one another and can create

short circuits. In future we would like to implement such a system that would disconnect back-transmission of current to the substations using manometer and auxiliary relays whenever there is any chance of natural calamities like wind, rain etc.

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- *www.google.com*
- *www.learn-c.com*
- *www.sourcecodesworld.com*
- *www.wikipedia.com*
- *oreilly.com/pub/topic/cprog*
- *www.programmersheaven.com/tags/Hardware/*
- *www.datasheetcatalog.org/datasheet/fairchild/MCT2E-M.pdf*
- *www.digchip.com/datasheets/parts/datasheet/.../MCT2E.php*
- *en.marketgid.com/goods/1478/*
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