

Thermal power plant status monitoring using GPRS

P. Krishna Gandhi¹, M. Naveen², A. Praveen Kumar³, K. Kings⁴, Shine Ebison⁵

¹ Asst. Prof., Department of EEE, Nandha Engineering College, Erode, India

² UG scholar, Department of EEE, Nandha Engineering College, Erode, India.

EMAIL: krishneceee@gmail.com

ABSTRACT

Wireless communication is one of the most active areas of technology development of our time. General Packet Radio Service (GPRS) is a packet-based wireless data communication service designed to replace the current circuit-switched services available on GSM and TDMA networks. An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. Embedded technology is a part of a complete device often including hardware and software. The Thermal Power Station is a coal-fired electric power station. The main purpose of the power station is to generate electrical power. Here, we are using embedded technology with GPRS to automatically monitor the power plant status.

KEYWORDS

GPRS, Generator load protection, Temperature Protection, Thermal Power Plant

I. INTRODUCTION

The thermal power plant has the main function of generating the electricity. In this process, Boiler performs the vital role of production of saturated steam by burning the coal which is given as input. Here, our technology deals with the control of the functions of boiler, turbine, generator, drum level using PIC microcontroller to enhance the safety of the plant. The thermal power station can mainly be divided into four areas: Coal Handling Plant, Boiler, Turbine, Generator.

Coal Handling Plant: Coal is used as a main fuel in thermal power station. Coal is brought to power station by three means of coal transportation i.e. roadways, railways and ropeways. This coal is then feeded on coal conveyor belt through vibrating feeder. By the various combinations of conveyor belts, coal is conveyed to the surge hopper of a crusher house. Before the coal comes to the crusher house, the ferrous material which comes along with the coal is taken out with the

help of suspended and rotating type magnetic separators. From surge hopper, coal is fed to the coal crusher through mechanical feeder. Here coal is crushed to the size of 20-25 mm. This sized coal is then sent to coal bunkers through various belts and finally coal trippers and stored for further processing of coal for combustion in boiler furnace. This cycle is known as bunkering cycle. **Boiler:** Boiler is a device for generation of steam for power G generation. In thermal power stations water tube boilers are used. Feed water is fed to the boiler drum through economizer. Water then enters in bottom ring header through six numbers of down comers. In boiler furnace, coal is fired with fuel oil. The heat energy developed by combustion of coal in furnace is utilized for the evaporation of water in water walls. As the density of steam is lower than water, this water steam mixture enters in boiler drum without help of any pump. This is called natural circulation. Steam that comes out of boiler is called saturated steam. This saturated steam is then passed through number of super heaters i.e. primary, platen and final for superheating of steam to a temperature of 540°C. When coal is burned in the boiler furnace, hot flue gases passes through the first pass and then to the second pass to the exit of boiler. Economizer and primary super heaters are placed in second pass one above the other, economizer being placed at the exit. Fly ash along with the flue gases goes through ESP where fine ash is taken out and sends to the ash handling plant for further processing to the ash bunds. Boiler drum, superheated and repeaters are fitted with safety valves for safety against the high pressures of the steam. Water at temperate system is provided for controlling the temp. of main and reheat steam. Burner tilting arrangement is also provided to control the temp of steam. Soot blowers are provided at different location of boiler to clean the boiler tubes. **Turbine:** The HPT comprises of 12 stages, the first stage being governing stage. The steam flow in HPT being in reverse direction, the blades in HPT are designed for anticlockwise rotation, when viewed in the direction of steam flow. After passing through HP turbine, steam flows to boiler for reheating and reheated steam comes to the intermediate pressure turbine (IPT) through two-

interceptor valves (IV) and four control valves mounted on IPT itself. The rotors of IP & LP turbine are connected by a semi flexible coupling. The direction of rotor is clockwise when viewed from the front bearing and towards generator. The three rotors are supported on five bearings. The common bearing of HP & IP rotor is a combined journal and redials thrust bearing. In order to heat the feed water in the regenerative cycle of the turbine, condensate from the hot well of condenser is pumped by the condensate extraction pumps, and supplied to the deaerator through ejectors, gland steam cooler, four numbers of LP heaters, and gland cooler. From deaerator the feed water is supplied to boiler by boiler feed pump through three numbers of HP heaters. Extracted steam from various points of turbine is utilized to heat the condensate in these heat exchangers.

Generator: Boiler produces super heated steam of pressure 138 Kg/cm² & 540 °C temp. This steam enters in steam turbine and due to the heat energy of steam; turbine rotates at about 3000 rpm. The turbine is directly coupled to the generator rotor. Electricity is generated as per the "Faradays Law" in generator. In alternator time varying magnetic field is produced by rotating field winding with help of turbine. Field windings are wound over rotor of the alternator and rotor is coupled to the turbine. Field windings are connected to the excitation system through slip rings. From excitation circuit, D.C. current is allowed to pass through the field windings and produces a magnetic field. So when the rotor rotates, D.C. current carrying field winding also rotates and produces a time varying magnetic field. This time varying magnetic field is cut by the stator windings of the alternator and emf is induced in it of the order of 15.75 KV as per the "Faradays Law". Electricity produced in the stator is then passed through bus ducts to the generator transformer. GT increases the voltage level from 15.75 KV to 230 KV. This transformer is connected to 230 KV buses in switchyard through isolators and a circuit breaker. Various 400 KV lines are connected to this bus through isolators and breakers. Through different HT lines electricity thus generated is then transmitted to the complete grid systems.

II. SYSTEM ANALYSIS

A. Existing system

The High Torque motors are very essential to continuous generation of Electrical power. The running status of above HT drives, abnormalities, auto start of stand by HT drive, required steam generation, temperature control, Load generation and load reduction etc.. are very important to monitor the maintenance engineers as well as higher officials in odd hours. Thus the way go for the proposed system to automatically monitor the plant status using GPRS.

B. Proposed system

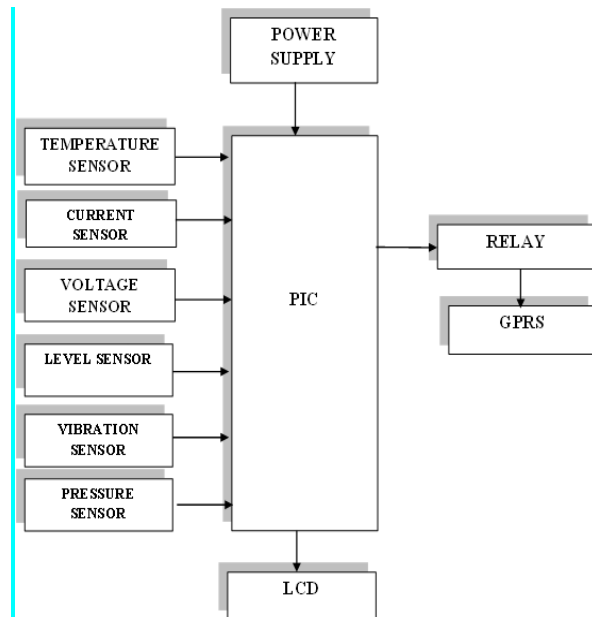
In proposed system, we are using the embedded technology with GPRS, by connecting the some important plant process data and Motor drive status to PIC microcontroller with Hi-

Tech C program and its output will be connected to GPRS modem. The LCD will be provided on local monitoring. The important mobile numbers and Fault message are stored in GPRS modem. For any abnormalities occur in the running power plant the microcontroller will be processed and that corresponding message will be communicated via GPRS modem to the maintenance Engineers and higher officials of Power plant.



Process Inputs

Some of the analog and digital inputs are : (1)Generator load protection, (2)Turbine lubricating oil pressure monitoring, (3)Drum level monitoring, (4)Generator winding temperature protection, (5)Loss of all fuel trip intimation, (6)Damper tank low level intimation, (7)Condenser vacuum very low level intimation, (8)Generator trip intimation.

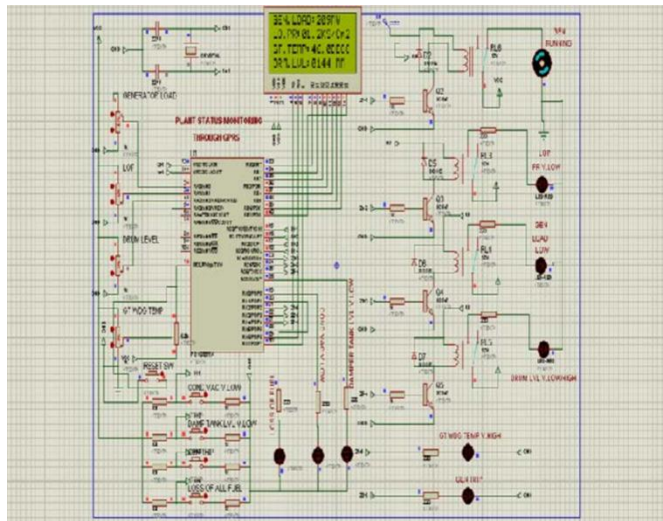


III. SIMULATION AND RESULT

A. Proteus

Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design.

It is developed by Lab center Electronics. Proteus combines advanced schematic capture, mixed mode SPICE simulation, PCB layout and auto routing to make a complete electronic design system. The Proteus product range also includes our revolutionary VSM technology, which allow you to simulate micro-controller based design, complete with all the surrounding electronic.



IV. CONCLUSION

After exhaustive study of literature and present technological advances, several prototype systems were developed for remote monitoring using GPRS technology. In thermal power plant the initial systems were based on manual monitoring and later systems were implemented using linear variable differential transformers. The existing facilities in the plant were not efficient to periodically monitor the generation of electricity by the maintenance engineers as well as higher officials in odd hours. Hence, in these monitoring systems using GPRS technology can help to carry out intimation tasks in an easier manner and faults and abnormal conditions can be brought to the notice of officials instantaneously enabling them to take corrective measures.

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