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Research Note

REAL TIME WATER WASH SYSTEM OF GAS TURBINE IN POWER PLANT

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Gas turbine compressors consume approximately 60% of the overall cycle energy during operation. The compression cycle consumes large quantities of air and despite intake filtration, small quantities of dust, aerosols and water pass through and deposit onto the blades. These deposits impede air flow through the compressor and over time degrade overall performance of the gas turbine. So a regular washing technique is required for cleaning the turbine. There are two type sof water wash system. Currently, the complete process of handling the valves and acquiring data from sensors is done by Turbine Control Panel. Turbine Control Panel is a DCS that handles lot of skids or systems in the power plant. Complete control and operation by Turbine Control Panel leads to overhead it with unnecessary complications. Any change in the system, such as addition of temperature transmitter or solenoid valves will result in modification of control software in Turbine Control Panel and also needs new cables for interconnection purpose. The above situation can be easily solved by introducing a real time embedded system located in the Water Wash System. The local instruments (temperature transmitters, level switches and solenoid valves) will interact with this local controller and the local controller will be control the valves. The local controller combines the data provided by all the transmitters and along with the process variables the information is send back to the Turbine Control Panel via Fiber Optics or advanced communication protocols for better data transmission. Any addition of instruments will lead to modify only the Real Time Controller application and wiring of the Water Wash System. This ensures better performance and reduces considerable amount of resources.

Keywords: Microcontroller, Rto, Embedded c, Micro plc

INTRODUCTION

Gas Turbine Compressors consume approximately 60% of the overall cycle energy during operation.

This cycle consumes very large quantities of air and although this air is filtered, small quantities of dust, aerosols and water pass through the filters and deposit on the blades.

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These deposits decrease the air flow of the compressor and the overall performance of the gas turbine. Compressor cleanliness can be maintained using a routine program of water washing. There are two water wash maneuvers performed on gas turbines: Off-Line and On-Line. An Off-Line maneuver is conducted with the gas turbine in a cooled state using cranking speed, while an On-Line maneuver is conducted with the machine at operating temperature and uses water only. Both Operations use highly atomized water spray patterns designed to completely enter the compressor core. The Off-Line cleans the entire core and recovers lost performance, while the On-Line cleans the early stages and maximizes the time period between needed Off-Line washing to provide peak availability.

There are two methods used for axial compressor cleaning:

1. ON-LINE WASHING with the machine running at full speed and loaded.
2. OFF-LINE WASHING with the machine on crank.

Cleaning consists of injecting detergents into the inlet following defined procedures. on-line washes alternates with an offline wash. Correct application of this procedure allows the turbine performance loss to be kept close to that due to aging of the machine, identified as non-recoverable degradation.

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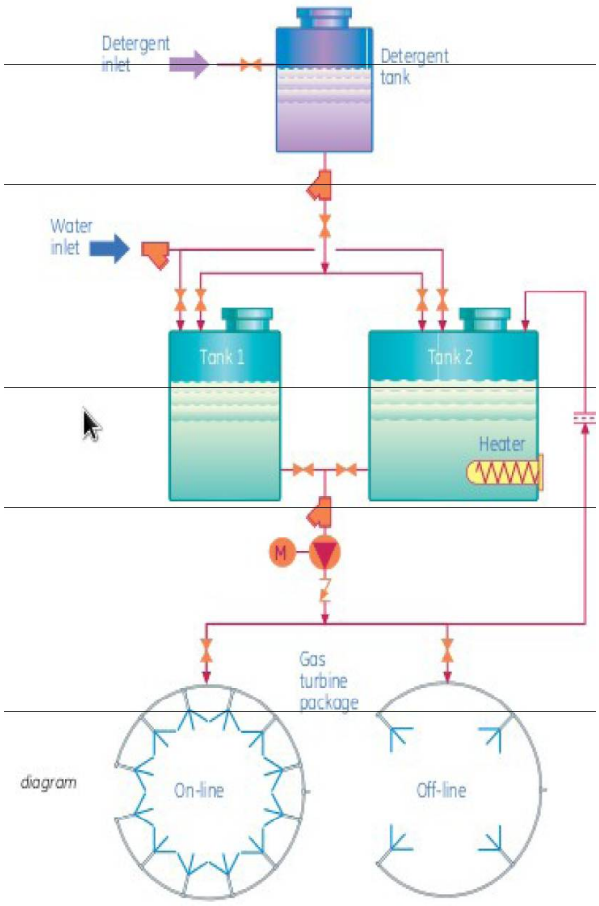
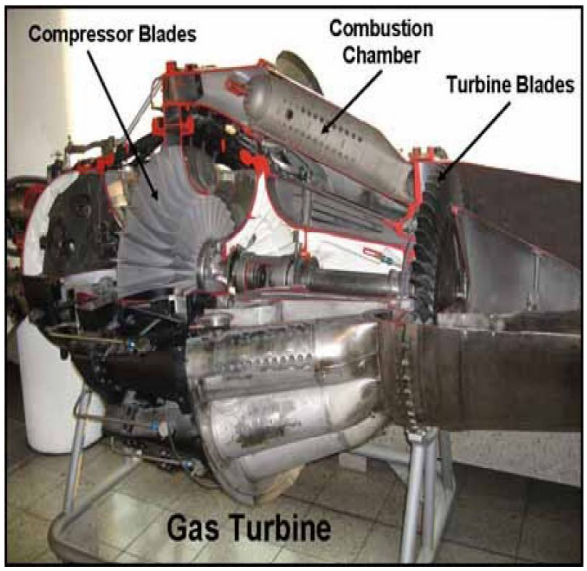
Figure 1: Pictorial Representation of Water Wash System



Water Wash System. The local instruments (temperature transmitters, level switches and solenoid valves) will interact with this local controller and the local controller will be control the valves. The local controller combines the data provided by all the transmitters and along with the process variables the information is send back to the Turbine Control Panel via Fiber Optics or advanced communication protocols for better data transmission. Any addition of instruments will lead to modify only the Real Time Controller application and wiring of the Water Wash System. This ensures better performance and reduces considerable amount of resources.

Figure 2: Fig of a Gas Turbine



PROPOSED SYSTEM

A real time water wash system has been devlouped for monitoring and controlling the flow of detergent, fluid, etc.

Using this system we can manage the solenoid to manage the flow.

By this system if any a the turbine can be washed as required.

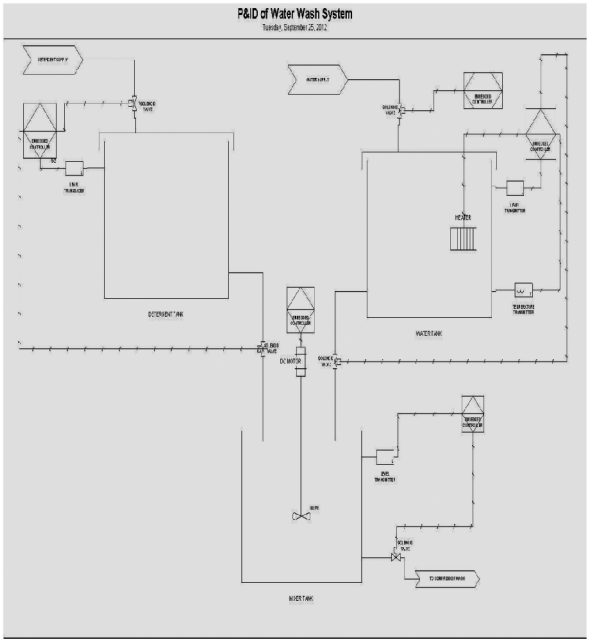
It will cut off the cost of the process by reducing cost of devlouping new software if any thing new is introduced to the system. And it also reduces the complication and cost of the wiring, etc.

About million of rupees can be saved using this project.

SYSTEM DESCRIPTION

This system mainly consist of solenoind valve, micro plc made of microprocessor, I.C 7408, etc. This process will contol the flow of detergent and fulid. In this process there are three tank the 1st one contains water, other

Figure 3: Block Diagram



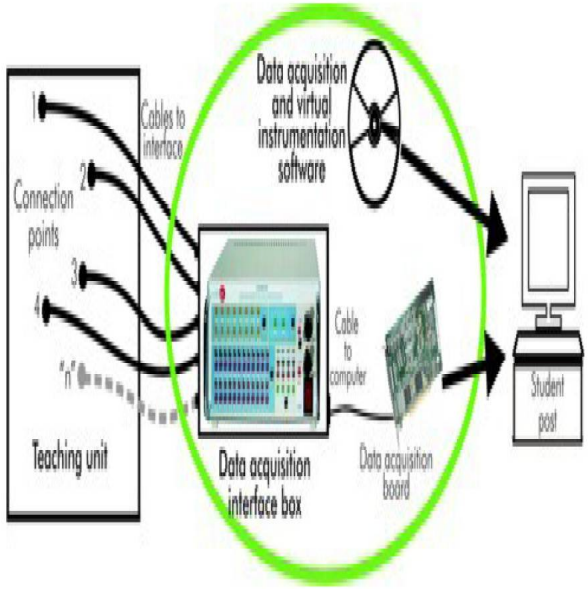
contain detergent and the 3rd for mixing both of that. A hetter is applied to the tank cantaining water. Till the water gets heated till 120 °C. For standard process. To know the wheather the water temperature has reache the set point or not a temperature sensore is applied to the water tank. As the temperature reaches the set point, the solenoid valve gets opened and hence the water from the water tank is realeased. And the detergent from the other tank is also realesed. As both the liquid flow to the mixing tank and hence mixed. From there another solenoid valve allows the flow of th fluid to the compressor and then tu th turbine. Using RS232 cabel the process is connected to the micro plc. And hence using virtual instrumentation the process is crarried out.

VIRTUAL INSTRUMENTATION

Virtual instrumentation is the use of customizable software and modular

measurement hardware to create user defined measurement systems, called virtual instruments. Traditional hardware instrumentation systems are made up of predefined hardware components, such as digital multimeters and oscilloscopes that are completely specific to their stimulus, analysis, or measurement function. Because of their hard-coded function, these systems are more limited in their versatility than virtual instrumentation systems. The primary difference between hardware instrumentation and virtual instrumentation is that software is used to replace a large amount of hardware. The software enables complex and expensive hardware to be replaced by already purchased computer hardware, e.g., analog-to-digital converter can act as a hardware complement of a virtual oscilloscope, a potentiostat enables frequency response acquisition and analysis in electrochemical impedance spectroscopy with virtual instrumentation.

Figure 4: Prototpe of Virtual Instrumentation



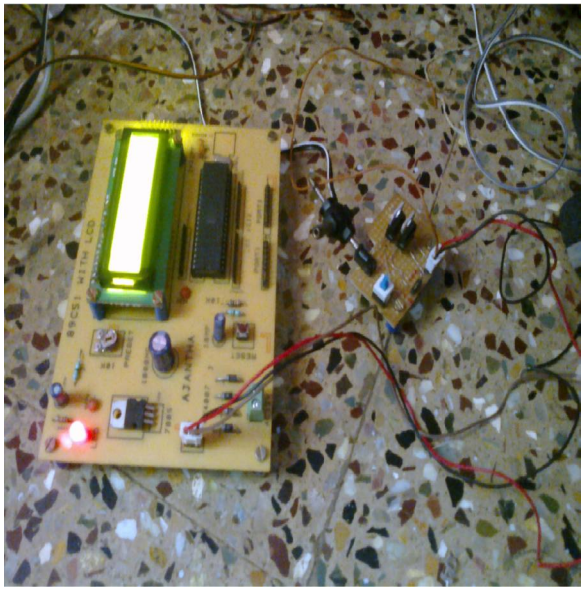
What is rto os (real time operating system)?

In general, an Operating System (OS) is responsible for managing the hardware resources of a computer and hosting applications that run on the computer. An RTOS performs these tasks, but is also specially designed to run applications with very precise timing and a high degree of reliability. This can be especially important in measurement and automation systems where downtime is costly or a program delay could cause a safety hazard.

Why to rto os?

The main point is that, if programmed correctly, an RTOS can guarantee that a program will run with very consistent timing. Real-time operating systems do this by providing programmers with a high degree of control over how tasks are prioritized, and typically also allow checking to make sure that important deadlines are met.

Figure 5: Model Kit



Solenoid Valve

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a twoport valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

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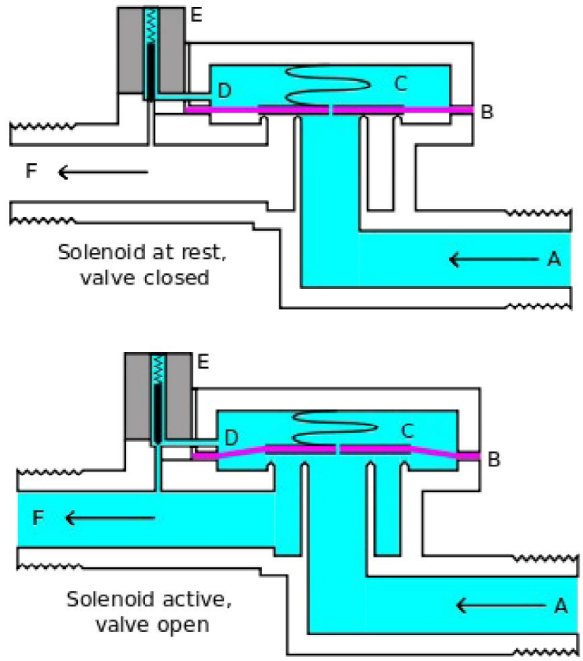
Applications

- Used in power plant to reduce cost.
- Use of real time system in process.

Figure 6: Solenoid Valve Working



- Quick reponse of the system.
- Deacrease complexity.
- Deacrease engineering errors.

CONCLUSION

In a devlouping country like India ,money is one of the greatest factor for the devloupment. Our project is mainly concerned to reduce the cost of the process. Our process has many benefits like Recoverable losses account for 70% to 85% of the performance losses. On-line compressor washing can maintain compressor efficiency. Off-line systems can clean heavily fouled compressors. Fouling can be minimized by maintaining inlet filtration system and inlet evaporative coolers. Periodic inspection and prompt repair of compressor blades help control fouling. Quality of intake air affects the performance of a gas turbine. Airborne contaminants in a compressor can cause:

Erosion

Corrosion

Fouling

The operating environment and filtration level of a compressor determine the type and rate of fouling. To minimize fouling:

Reduce oil leaks and ingestion of oily constituents.

Filter the incoming air

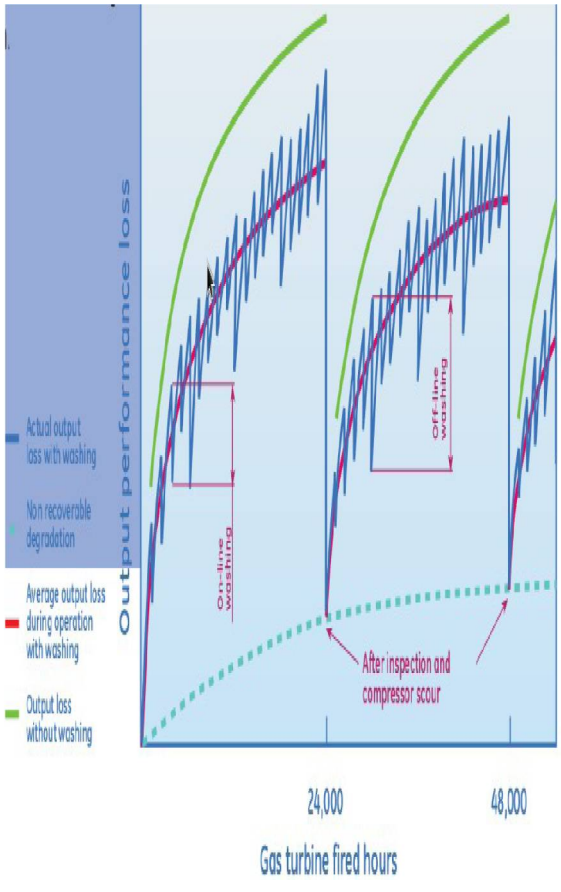
Use compressor washing to:

Slow down corrosion

Reduce the formation of fouling deposits

Maintain compressor performance

Figure 7: Graphical Repesentation



Hece at last I would like to conclude that our project will reduce cost, of the process, will maintain better facility, reduce the need of human interfernce, etc.

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