TURBINE SUPERVISORY INSTRUMENTS FOR MONITORING AND SYSTEM PROTECTION

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Abstract — ***A Steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft to generator producing electricity. In this thermal plant turbine is one of the major part in power generator. When turbine is rotating due to some vibration and temperature developed in turbine casing to damage Turbine system these can overviewed by Sensors. The main objective of this project is to supervise the turbines and to protect the system. By using vibrating sensors in turbine to monitor and supervision of an essential part of the turbine day-to-day running of any power plant. There are many potential faults such as cracked rotors and damaged shafts, which result from vibration and expansion. These sensors can be monitor and find problems at different parts of the turbine. Then monitored data will be given as input to TCS. The data will be send to DCS(Distributed Control System).***

keywords: Transducer, Vibration Sensors, Turbine protection system, system configuration, Turbine lubricating oil protection, Relief valve in exhaust.

I INTRODUCTION

Every In order to meet the growing electricity demand in the state of Andhra Pradesh neighbouring states, the Andhra Pradesh Power Generation Corporation (APGENCO), a generating company formed out of the Andhra Pradesh State electricity board proposes to add power generation capacity by setting up a 2x800MW coal based thermal power station in the coastal region of krishnapatnam, Which is 25 kms from Nellore Town and 150 Kms from the city of Chennai. The power generation will be evacuated at the 400 KV level to the state of APTRANSCO and to the southern grid. This power station would be the first of its kind in India in terms of unit size of 800 MW. The project development has been entrusted to Andhra Pradesh Power Development Company Limited (APPDCL), a joint venture company constituted with equal holding by APGENCO and Infrastructure Leasing and financial Service Limited (IL&FS**).**

The Turbine protection system(TPS) will be provided to assure safe operation of the steam turbine.[1] It provides an additional independent protection function for the steam turbine and generator. The TPS detects undesirable operating conditions and initiates trips to avoid damaging the steam turbine[2]. When turbine is rotating with high speed due to some vibration and temperature developed in turbine causing to damage the system. The TPS is an electrical control and field sensor modernization package designed to replace the existing legacy protection system on steam turbines. The TPS can enhance turbine availability with features of 2-out-of-3 voting for pressure and speed sensors. The redundant testable trip device(below) combines vacuum, thrust, low bearing oil pressure, and trip block configuration in one freestanding unit. The TPS is available for high pressure hydraulic systems and low pressure hydraulic system. Generation of fire is done with the help of oil and lighters.

Oil is sprayed from four corners of the furnace with the help of oil guns and lighters at four ends of the furnace release sparks. This sparks make the oil to catch fire. Now coal is carried from Pc Bunkers with the help of PA Fan. Coal is kept hot i.e. at a temperature around 70degreeC for effective burning of coal. This temperature is maintained with the help of hot air from PA fans and secondary air.

Coal is released from four diagonal corners of the boiler continuously to maintain the temperature through PC injectors. In case of drop of temperature at any corner more amount of coal is dropped at that end through adjustment. The implementation of the process is given in fig1.

II IMPLEMENTATION PROCESS

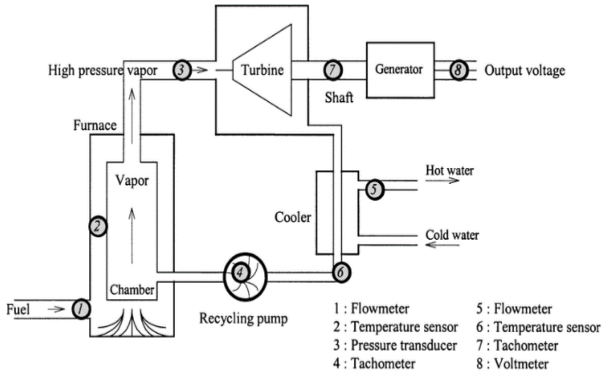

Fig.1 Shows the block diagram

1. TRANSDUCER

A transducer is a device that converts one form of energy into another. It plays a very important role in any instrumentation system. An electrical transducer[2] is a device which is capable of converting the physical quantity into proportional electrical quantity such as voltage and electric current as shown in fig2. Hence it converts any quantity to be measured into usable electrical signal. This can be used to control the physical quantity

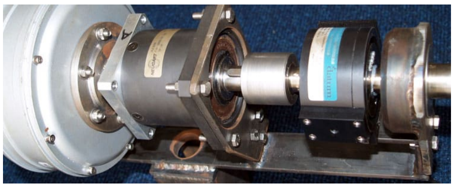

Fig.2 Transducer

2. VIBRATION SENSORS:

Despite the advances made in vibration monitoring and analysis equipment, the selection of sensors and the way they are mounted on a machine remain critical factors in determining the success of any monitoring program and vibrating sensors[4] are shown in the below fig3.

Fig. 3 Vibration sensors

3. TBS(Turbine Protection System):

The system configuration of protection systems is present in multiple process station that calculates the interlock logic is triplicated. [6]Sensors used for protection are basically triplicated and each sensor signal is divided and input to each MPS.2 out of 3 logic for triplicated digital signals will be calculated in each CPU of MPS. As a result of interlock logic calculation in each CPU, if an interlock condition occurs, each MPS will output Turbine Trip[5] command to close the solenoid valves. Turbine Trip commands from each MPS are wired in 2 out of 3 relay circuit. The steam turbine can be protection from many ways. A reliable overspeed protection system is indispensable for turbo machinery. For gas and steam turbines, this means reliable detection

The system protection bloc diagram I

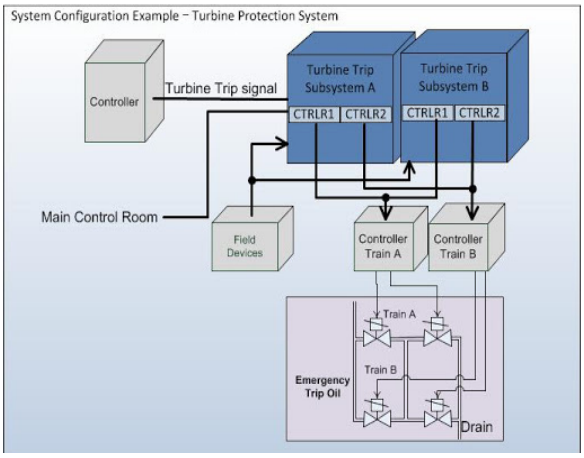

Fig. 4 Protection system block

4. TURBINE LUBRICATING OIL PROTECTION:

A steam turbine lubricating oil system should be designed to supply clean oil at the correct temperature and pressure to all bearings, control equipment and seals, under the reasonably adverse condition those results in the largest drop in system pressure[4].

Turbines subject to damage from coast down without lubrication require a backup or emergency lubrication source and is shown in the below fig5

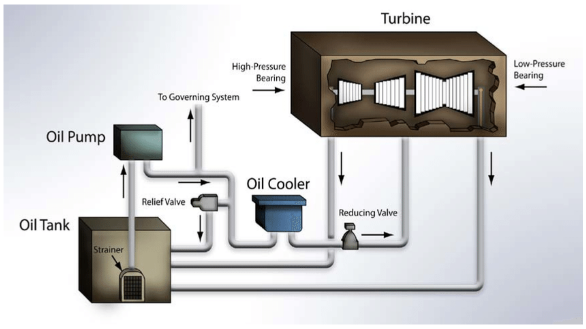

Fig. 5 Turbine oil lubricating

Turbine supervisory instrument in super critical thermal power plant is supervised for the healthiness, protection and proper working of the turbine system without any damages, faults and failures of the system .This improves the life time period of the turbine and this are supervised with the help of Vibration sensor. So here following the advantages in the turbine supervisory instruments for monitoring and system protection

III SYSTEM CONFIGURATION:

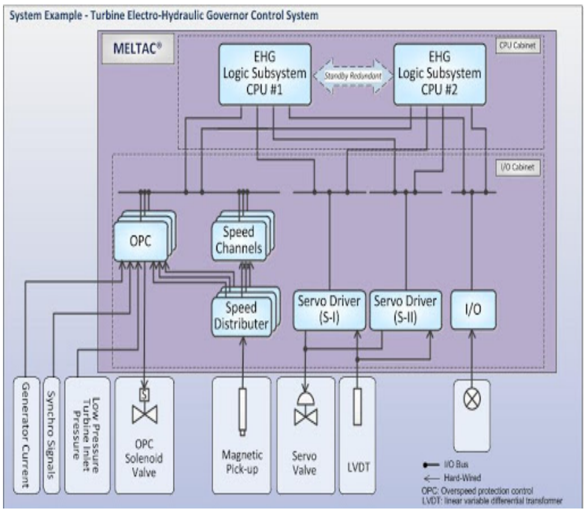

Fig. 6 shows the circuit

The System configuration of the Protection Systems as shown in fig.6 is in MPS (Multiple Process Station; CPU and I/O) that calculates the interlock logic is triplicated[3]. Sensors used for protection are basically triplicated and each sensor signal is divided and input to each MPS. 2 out of 3 logic for triplicated digital signals will be calculated in each CPU of MPS[5]. We are a reliable partner to manufacturers and operators of turbo machinery in all international markets. The control technology has proven its value in tens of thousands of applications in power plants around the world and ensures economical, reliable operation of gas turbines, steam turbines and compressors. The Overspeed system shall include but not limited. One is Electronic overspeed detection system. And other is Mechanical overspeed detection system[2]. "A" or "B" trip signal is seen, then the turbine trips and "A" or "B" loss of signal or power, an alarm is given but the turbine remains running. A and B loss of signal or power, the turbine trips[1]. It is the simplest system that can be used for a special purpose steam turbine. This system is adequate if the loss of the turbine and the equipment driven by the turbine[10] dose not result in a significant upset and/or pose safety hazard damage the environment. Id turbine is determined to be in critical service, a fault tolerant overspeed trip system should be utilized.

Inside a mechanical overspeed[5] trip mechanism there are four basic components. The internal components consist of two bushings, a plunger, and a spring as shown in below figures. One of the bushing is screwed completely into the overspeed trip body at a set depth[6].

This controls the position when the turbine trip body at a set depth .This controls the position when the turbine is not rotating. Then a bushing is installed over the plunger[8] spring, and then tightened down. The spring pushes against the plunger "stopper disk"[10] and the adjustable bushing where the plunger extrudes from the body. Now the spring is in compression holding the plunger[1] inside the mechanism body. The overspeed trip is then attached, typically bolted, to the outboard end of the rotor. As the speed of the rotor increases, centrifugal force pulls the plunger to the outside, against the spring. As the rotor[4] speed increases the force from the plunger increases on the spring. Once the centrifugal force increases from the speed, rpm, the plunger overcomes the spring force causing the plunger to protrude outward. A stationary lever, set with a relatively tight clearance is positioned such that when the plunger[8] moves out the lever is struck. The lever is integral with the emergency mechanical trip device.

When the mechanical trip [2]is actuated, the hydraulic oil is dumped to the drain, which results in the immediate closing of the valve rack and trip valve. The overspeed trip device is critical to the safety of the turbine without the overspeed protection, the turbine[4] would run to destruction when the load (compressor, pump, or generator) was lost. How fast the turbine accelerates determines how fast the overspeed trip system must respond. If the turbine valves changes their position instantaneously, this measurements of time is now as the time constant (Tc) . The loss of power signal or power of any one of the speed sensor will results in an alarm.

The loss of power or signal of any two of the speed sensors will results in a turbine trip Rotor acceleration[2] is the rate of acceleration of a rotor (rpm/minute) as its speed increases from zero rpm to running speed. The machine operator needs this information to prevent operational errors[9] and to help get the machine up to speed without damage. This measurement is most often used on large turbine generators[3] that require a slow rate of acceleration while machine components expand as they reach operating temperatures . Rotor acceleration is measured by a proximity probe observing a multi-toothed wheel. Rotor acceleration is sometimes used in smaller machines instead of a differential expansion measurement. Following the OEMs rotor acceleration[6] guidelines is essential to assure that the casing and rotor thermal growth rates stay within the OEMs limits during machine startup.

IV RELIEF VALVE IN EXHAUST

Safety relief[3] valve exhaust lines should have a minimal horizontal run projecting from the relief valve outlet flange prior to a 90 degree elbow with one end of the elbow facing upward. From this elbow a short vertical pipe section should be added to help direct the exhaust upward. It is important that this vertical section not have any offsets or bends[8], as this will produce additional thrust reaction loads for which the support system is often not designed. Proper support of this short-vertical-style[7] exhaust line should include a pipe support that extends from the bottom side of the elbow to the top of the header pipe on which the relief valve is located. This support should be welded to the elbow by utilizing a dummy weld connection and also welded to a support plate that conforms to the outside radius of the header pipe.

In the case of insulated header pipes, it will be necessary to remove the insulation to ensure the support plate rests the header pipe[2]. This installation will ensure that when the relief valve discharges, the resulting reaction load is directed downward . There have been several recent instances of the vertical section of steam relief valve exhaust lines separating from the relief exhaust line when the relief valve discharged. Installations that include a drip pan elbow[5] are to have the exhaust stack independently supported in at least two locations as shown in fig7.

Fig.7 Relief valves for intake

In keeping with MECS commitment to provide Total Quality plants and service to our customers, this Technical Brief is intended to serve as a reminder of the importance of ensuring that steam relief vent pipes are properly supported. These parameters can be measured by a variety of motion sensors and are mathematically related (displacement is the first derivative of velocity and velocity is the first derivative of acceleration). They have excellent frequency response with no lower frequency limit and can also be used to provide a trigger input for phase-related measurements.

V ADVANTAGES:

- Safe Operation of Turbine in conjunction with Turbine Stress Evaluator (TSC).
- Excellent Operation Reliability and Depend ability.
- Low transient and steady state speed deviations
- Dependable control during load rejection
- Reliable operation in case of isolated grid
- High accurate

VI CONCLUSION:

A Steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft to generator producing electricity.

The conclusion is on turbine supervisory instrumentation in super critical thermal power plant is supervised for the healthiness, protection and proper working of the turbine system without any damages, faults and failures of the system .

This improves the life time period of the turbine and this are supervised with the help of Vibration sensor. So here following the advantages in the turbine supervisory instruments for monitoring and system protection. Rotors are most generally made from solid forgings of alloy steel.

The forgings must be homogeneous and flawless. Test pieces are cut from the circumference and the ends to provide information about the mechanical qualities and the microstructure of the material. A chemical analysis of the test pieces is subsequently made. One of the most important examinations is the ultrasonic test, which will discover internal faults such as cracks and fissures. So it is best method to supervise turbine.

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