Guide Vane (Gv) Governor Valve Plta Cikalong Unit 3

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Abstract: Hydro Power Plant or Pembangkit Listrik Tenaga Air (PLTA) is a power plant that uses renewable energy in the form of water. The Hydropower System converts the energy from flowing water into mechanical energy and then into electrical energy. Water flows from the rapid pipe (Penstock) to the waterwheel or turbine where the water will hit the blades causing the waterwheel or turbine to rotate.Guide Vane is part of the turbine which functions to control the water flowing to the turbine. The guide vane opening control is adjusted using the Hydraulic Power Unit. The greater the open percentage of the guide vane, the faster the turbine rotates. The smaller the open percentage of the guide vane, the slower the turbine rotates. The size of the open percentage of the guide vane is regulated by the governor.The governor is a system used to stabilize the turbine rotation at PT. Indonesia Power UP Saguling Sub Unit PLTA Cikalong. The governor control system is carried out using PLC and HMI.

Keywords: PLTA, Guide Vane, Hydraulic Power Unit, Governor

1. Introduction

The increasing demand for electrical energy from the community causes the need for generators capable of generating large amounts of electrical energy. Electrical energy is generated in power generation centers including hydroelectric power plants (PLTA). One of the advantages is that it can respond quickly so that it is very suitable for peak load conditions and when there is a disturbance in the network. This plant converts energy from flowing water into mechanical energy and then into electrical energy. This hydropower system utilizes the flow of water through a rapid pipe through the turbine where the water will hit the blades of the turbine, causing the turbine to rotate. This turbine rotation causes the rotor shaft to rotate in the generator. In this process it generates electricity that is ready to use.

In the electric power generation system, PT Indonesia Power UP Saguling Sub Unit PLTA Cikalong has a variety of regulatory systems from

mechanical and electrical. This generation system serves to maintain operational reliability. One of the existing control systems is the Governor control panel. The Governor control panel is the system used to stabilize the turbine rotation at PT Indonesia Power UP Saguling Sub Unit PLTA Cikalong.

2. General description of the company

PLTA Cikalong as a company organization is one of the power plants which is affiliated with PT. Indonesia Power Generating Business Unit (UP) Saguling. PLTA Cikalong is located in Cikalong Village, Kec. Cimaung, Kab. Bandung.

Image of PT Indonesia Power Logo

PLTA Cikalong is a company that was built in 1957 and started operating in 1961, this development was carried out by the cooperation between Indonesia (PLN) and France which was inaugurated by the President of the Republic of Indonesia, namely Ir. Soekarno. The Cikalong Hydroelectric Power Plant consists of 3 (three)

Generating Units with an installed capacity of each Unit of 6.4 MW and is channeled via a 70 KV transmission to Gitet Cigereleng and GI Lamajan.

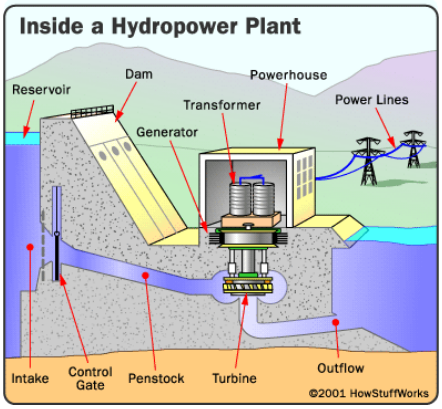
Figure of the CIKALONG hydropower cascade system

3. Basis of theory

3.1 Definition of PLTA

Hydroelectric Power Plant or Pembangkit Listrik Tenaga Air (PLTA) is an electrical energy generator by converting the potential and kinetic energy from water into mechanical energy by a turbine and converted again into electrical energy by a generator by utilizing the height and velocity of the water. The electrical energy generated from this is known as hydroelectricity. There are several main components of hydropower plants, namely reservoirs, dams, powerhouses, and switchyards or transmission units that supply electricity production to consumers.

Figure of Hydropower Image



PLTA is a generator that uses cheap fuel, does not cause pollution and the waste produced (water) can be used for irrigation or irrigation.

3.2 Governor

A governor is a mechanical device that functions to regulate the rotation of an engine (turbine) by regulating the amount of fluid (water) entering the turbine. To control the amount of energy generated by the generator, the amount of fluid entering the turbine must be controlled. The amount of fluid entering, depends on the valve opening (valve), where this valve is controlled by the Governor. To determine the size of the valve opening, the governor will get an input signal in the form of setting power (Preff), the actual power output of the generator (P), frequency (f), or turbine rotation (w). The types of governors include MHC (Mechanic Hydraulic Control) and EHC (electric Hydrolic Control

Figure of HPU GV

4. Analisys

4.1 Hydraulic Power Unit System

The oil tank can be equipped with a PLC system, which controls all internal hydraulic functions and generates signal exchange and control room. By means of a control element such as a reversing valve, the high pressure oil is pressed into the tank, or the high pressure oil is removed from the tank.

Under normal circumstances, the oil pump will flow oil to the system. If the supply oil is less than the specified pressure, the oil pump will automatically start to maintain the pressure value of the system and allow the valve to reach the locking position of the control valve. The ideal pressure value on the HPU governor is 100 bar.

When working, the hydraulic actuator is driven by a command signal from the system, will control the oil pressure and energy release from the energy accumulator, so that it can control the sliding tube valve to move the valve through the mechanical transmission mechanism, to carry out fast closing, normal opening and closing, and control. . And the excess hydraulic oil will be returned to the hydraulic oil tank again.

4.2 Governor of PLTA Cikalong

The governor functions as a regulator of the output power generated by the turbine rotation so that it is always constant even in changing loads. By increasing the output power of the turbine, the turbine rotation will change as well. If the load on the generator increases, the turbine rotation will automatically decrease. This turbine rotation is detected by a speed sensor which is then controlled in the system to open the valve which is driven by the servo to adjust the guide vane opening. This guide vane opening arrangement is carried out by the Hydraulic Power Unit which is connected to the PLC. The opening of the guide vane which is moved by the servo will be controlled by the governor to stabilize the frequency.

The turbine rotation at the Cikalong hydropower plant is 750 rpm, from the number of poles of 8 pairs obtained from the formula

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Information:

N = Turbine rotation

F = Frequency

P = Number of pairs of generator poles

$$N = \frac{120 \cdot F}{P}$$

5.3 Control of Hydraulic Systems

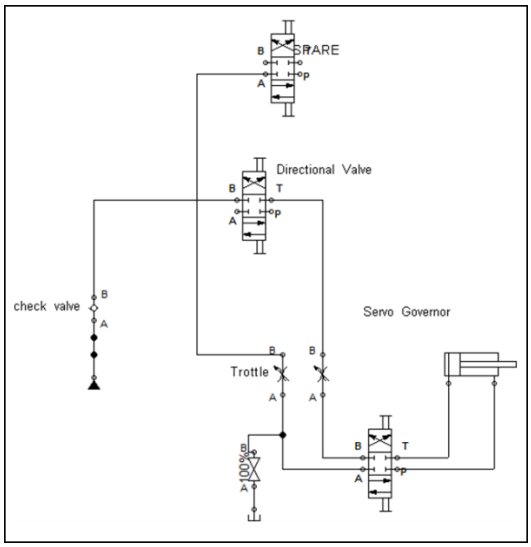

Figure diagram of the hydraulic system governor of the Cikalong hydropower plant

This system itself consists of a distributor for the governor, check valve, throttle, pump and servo from the governor. In the distributor governor valve, there is a coil when it is energized, this coil will push the distributor valve to move the oil flow to a different space in the governor distributor valve. There are 2 valves, each of which works alternately. The output of oil flow from the chamber on the governor distributor valve will create two different servo governer conditions, namely the push and pull positions. This position then becomes the opening of the governor used. The servo from the governor is then connected to the guide vane, where the opening of the guide vane will affect the discharge of water that enters and rotates the turbine. The servo governor has two hoses, which work alternately. If the hose is in the front position with oil, then the governor is pulled backwards, and if the hose in the rear position is supplied with oil, then the governor will be pushed forward. The head of the servo itself is connected to the connector of the guide vane.

The connector is part of the guide vane which will move along with the operation of the servo governor. This connector can be drawn down or pushed up, depending on the position of the governor which has worked as the oil enters it.

The pump will run automatically when the required pressure has decreased, which will continue continuously. There is a pressure sensor, which is placed on the hydraulic line just before the distributor valve for the governor. This sensor is then used as a reference for the PLC to run the centrifugal pump, this is where the governor is in the constant load state. If there is a change in load (either reduced or increased), the governor will try to return to the speed desired by the speed limiter, the distributor valve will be controlled automatically until the turbine reaches the speed set point.

4.3 Disturbances in the Governor System

The disturbance that occurs in the governor system is an error in the opening of the guide vane where the lever connected to the guide vane often goes up and down to find the set point (guide vane opening) so that the guide vane opening remains at the number or percentage of the opening that has been previously set to produce a certain power either more than usual or less than normal is generated depending on the volume of water available at KTH. The guide vane opening must be at a certain percentage in order to produce a fixed turbine rotation of 750 rpm, this error causes the directional valve to become hot because it works continuously to find the guide vane opening point at a predetermined set point. The countermeasures from these disturbances is to calibrate the sensor. Or the Cikalong Hydroelectric Power Plant to overcome it by increasing the zero value on the speed sensor from 4 = 0 rpm to 550 = 0 rpm.

The change in numbers was done to trick the engine (speed sensor) so that when the unit is running, the turbine rotation will be at 750 rpm. Where before the zero value has not been changed, the readable rotation has not reached 750 rpm, while the turbine rotation in the field is actually more than 750 rpm and this will cause a disturbance called guide vane hunting. The rotation of the turbine must continue to be 750 rpm because at that rotation the generator will produce a frequency of 50 Hz which is the frequency used in Indonesia. Countermeasures in this way have succeeded in restoring the work of the lever connected to the guide vane which is moved by the governor which flows pressurized oil to adjust the guide vane opening lever, and this

makes the directional valve not working continuously when the unit is run so that the lever connected to the guide vane does not. continuously reaches the set point opening point that has been determined.

5. Closing

5.1 Conclusion

The conclusions that I can take from the practical work that has been carried out at PT Indonesia Power UP Saguling Sub Unit PLTA Cikalong are:

1. Guide vane is a tool that is used to guide the direction of water flow to the turbine.
2. Guide vane works by controlling the water entering the turbine by adjusting the angle of motion of the guide vane by increasing or decreasing the water flow. The size of the guide vane openings is adjusted automatically by the governor system.
3. The increase in load can be done by opening the guide vane which is regulated by the governor system on the turbine. The guide opening which is regulated by the governor system works by maintaining the bearasal pressure of the oil which is assisted by the Hydraulic Power Unit.
4. Governor at PLTA Cikalong works by limiting the rotation of the turbine so that it remains in a stable condition from the specified set point, namely 750 rpm with the number of poles on the generator 8 pairs.
5. The governor used in the Cikalong hydropower plant is an Electro Hydroulic Governor (digital governor), so that control works automatically and only requires operator control either via CCR (Central Control Room) or LCU (Local Control Unit) when raising or lowering loads. Standardized readings to monitor the condition of the oil in the tank using the mechanical governor and HPU.
6. A disturbance in the governor system that occurs because the speed sensor reading is no longer precise in reading the turbine rotation in rotation conditions which can affect the performance of the lever connected to the guide vane. And there are problems in the penstock input section of the guide vane which can cause the guide vane to not work 100%.

5.2 Suggestions

While participating in practical work at PT Indonesia Power UP Saguling Sub Unit PLTA Cikalong I can give a few suggestions as follows:

1. Always control the condition of the guide vane so that it can operate normally and there are no disturbances.
2. Always maintain the Hydrolic Power Unit condition so that it can move normally to control the guide vane openings.
3. Controlling the conditions of the guide vane in the field and adjusted to what is read in the HMI

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