Pumped storage hydro power plant and its parameter monitoring

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Abstract – *Pumped hydroelectric storage (PHS) is the latest technology. This is the most widely utilized form of large-scale electrical energy storage (EES). The energy is stored as the potential energy of water raised against gravity.*

Most renewable resources (ex. wind, solar, and nuclear) cannot fulfill their output to match changing power demands, there is an increasing need for lager amount of electricity storage due to the calls to mitigate global warming. This entry introduces the PHES technology [1].

1 INTRODUCTION

Definition of pumped storage is a hydroelectric plant that generates electric energy to get peak load using water that was already pumped into an Upper Reservoir during off-peak periods. The basic definition will be expanded and developed for better understanding of technical and economic principles related with the pumped storage concept [1].

The original concept of Pumped Storage plants was the conversion of low cost, low demand, base-load energy generated in thermal or nuclear plants into high value, on-peak power. Now until the day there are no of problems that have reduced first costs, simplified pump starting, improved efficiency and improved provision of ancillary system support services. Generally, when the periods of low power demand, typically overnight, inexpensive electricity produced by base load power plants was used to pump water from the Lower Reservoir to the upper reservoir. This water was used during peak power demand periods, which delivers more valuable electricity to the grid Pumped storage projects that use conventional hydro units, with a pumped-storage cycle. "Pump-back" projects use two reservoirs on the same river located in tandem. They operate as a regular hydro plant part of the time, but when water flows are low, or when peak demand is high, then the project can operated as the pumped storage. Since this project contains normal river flow, they are subject to various mandated water flows, navigation and environmental problems. Such problems are often onerous and so, the "pump-back" concept is usually not the preferred for energy storage projects [2].

Table -1: PHES power plants in India

SR NO.	LOCATION	CAPACITY (MW)
1	NAGARAJUNSAGAR	700
2	PAITHAN	12
3	KADAMPARAI	400
4	KADANA	240
5	PANCHET (DVC)	40
6	UJJAIN	12
7	BHIRA	150
8	SRISAILAM	900
9	SARDA SAROVAR	1200
10	PURULIA	900
11	GHATGHAR	250
	TOTAL	4804

2 SYSTEM ANALYSIS

The original idea cause the development of PS plants was the conversion of low cost, low demand, base-load energy generated in thermal or nuclear plants into high value, on-peak power. In today's world of electricity markets, one can refer to this as a "time shift of energy" accomplished by an electricity storage technology. The ability of the pump and turbine to operate alternately provides flexibility in the plant's operation. The flexibility of the plant is also improved by having the pump and turbine separate.

The pumped storage hydro power plant produces electricity to supply peak demands by moving water between the reservoirs at different elevations. At the time of load demand of electricity, the excess electricity is used to pump the water in to the higher reservoir, which is released back in to the Lower Reservoir through turbine at the time of

higher demand. The pump storage scheme improves the daily load factor of generation system.[3]

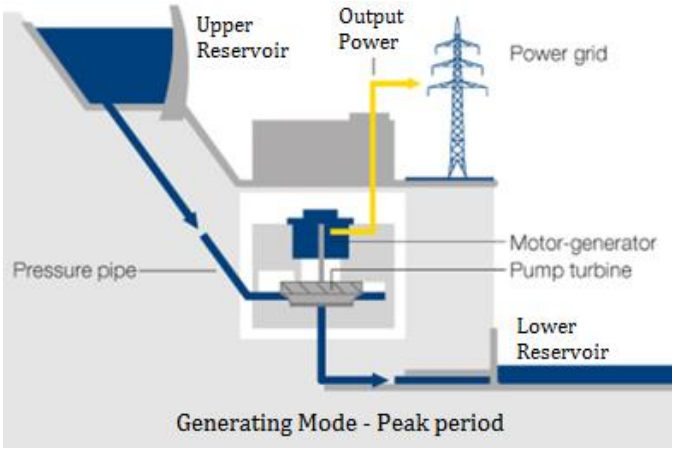


Fig -1 (a): PHES Generating Mode

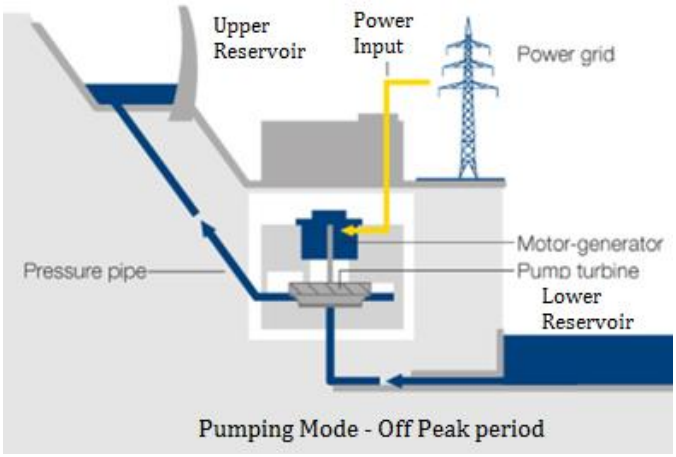


Fig -1 (b): PHES Pumping Mode

In this power plant Upper Reservoir which is used for store the water is nothing but dam. This is mounted at height greater than turbine situated height. Stored water is fall on turbine at high pressure due to that turbine is rotates at higher speed. Because of turbine coupled with generator generates electricity. The water falls on turbine is stored in Lower Reservoir (LR) instead of going to waste and this water transferred through pump in Upper Reservoir (UR) for the water level measurement level sensor are used such as float sensor. And for flow measurement of water which is falls on turbine, flow sensor are used. Measuring equipment's also measures the load [3].

3 METHODOLOGY

Generally the hydro power plant are generates electricity, by using the water for rotation of turbine which is coupled to the generator. In most hydro power plant the water used for rotation of turbine is wasted but in pumped hydro power plant this water can be reused for generation of the electricity [4].

In our model we use two Upper Reservoir (UR) and Lower Reservoir (LR), level of both reservoir is different. We use concept of pumped storage hydro power plant. We use DC power generator for generation of electricity and water is stored in Lower Reservoir (LR). That water is pumped by using AC pump. The generated power is measure and display on PC. Water flow from Upper Reservoir (UR) to Lower Reservoir (LR) is measured by using flow sensor; level of Upper Reservoir is measured by using float sensor

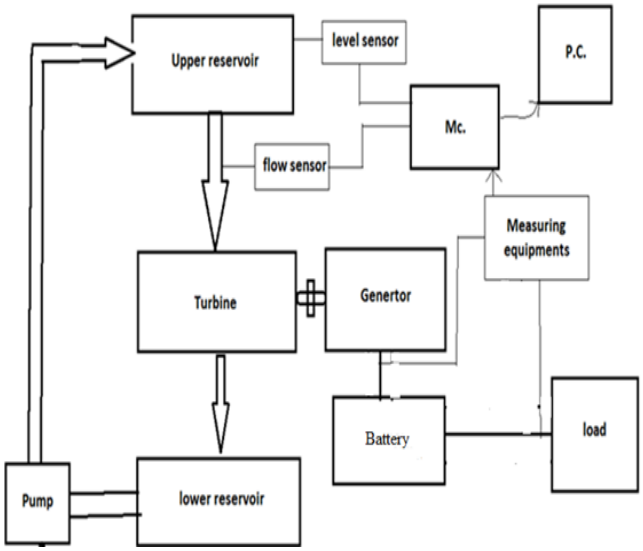


Fig -2: Block diagram of project.

a. Turbine

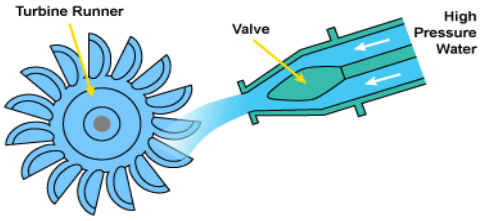


Fig -3: working of Turbine

Water turbine is a rotating machine that converts kinetic energy of water into mechanical energy. Water turbines were developed in the 19th century and were large amount of used for industrial power prior to electrical grids. Now they are largely used to electric power generation. Water turbines are mostly found in dams to produce electric power from water energy. Flowing water is directed on to

the blades of a turbine machine, produce force on to the blades. Since the runner in run mode, the force acts through a distance. In this way, energy is transferred from the water flow to the turbine Water turbines are divided into two groups; reaction turbines and impulse turbine .The precise shape of water turbine blades is a function of the supply pressure of water, and the type of Impeller selected.[5]

b. DC Generator

A DC generator produces direct power. These generators generate electrical power, based on same fundamental principle of Faraday's law of electromagnetic induction. According to this law, when a conductor moves in a magnetic field it cuts magnetic lines of force, due to which an EMF is induced in the conductor. The magnitude of this induced Electro Magnetic Force (EMF) depends upon the rate of change of flux linkage with the conductor. This EMF will cause a current to flow if the conductor circuit is closed.

c. Flow Sensor

Water flow sensor used to measure the flow of liquids in water form, it consists of a plastic valve body, a water turbine and a hall-effect sensor. When water flows through the turbine, turbine rotate. Its speed changes with different rate of flow. The hall-effect sensor outputs the corresponding pulse Signal.

Fig -4: Flow sensor

d. PIC 18F4550

A PIC18F4550 has 256 bytes of EEPROM. It consists of up to 13 channels for analog to digital converter to 10-bit to convert analog to digital signal. The frequency limit for a PIC18F4550 is from 31 KHz to 48 MHz [6].

e. level sensor

It is used to indicate the level of upper reservoir. It is a magnetic float switch.

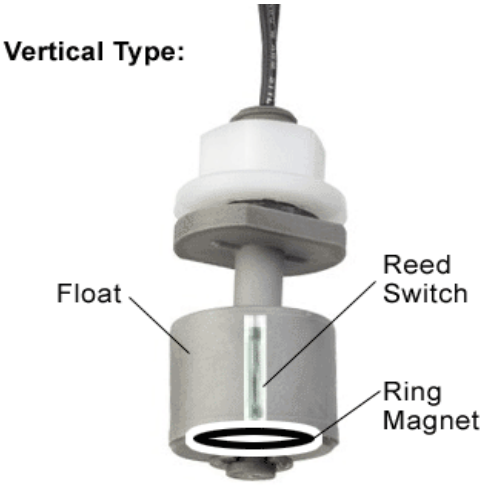


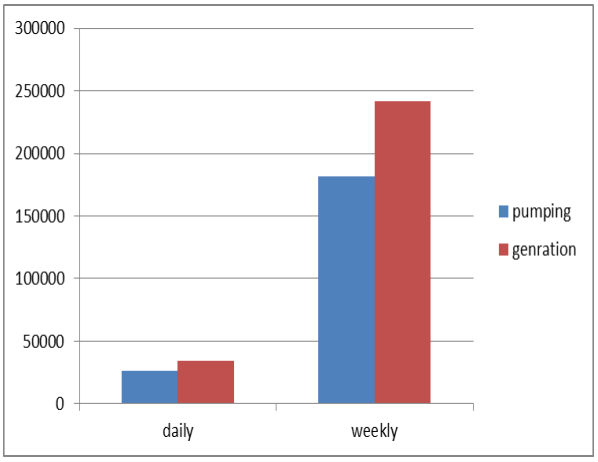
Fig -5 : construction of level sensor

4 RESULT &CONCLUSIONS

The model of Pumped storage hydro power plant requires water which is specified in liters,

- Daily Water requirement for generation of electricity is 34560 liters.
- Daily pumping of water is 25920 liters.
- Weekly water requirement for generation is 241920 liters.
- Weekly pumping of water is 181440 liters

Chart -1: water requirement of pumping and generation



Pumped storage hydro power plant represents a technology of storing energy during period of low demand this technology is viable, since it uses electricity in low demand hours to pump the water and used it in hours of high demands. Due to use of concept of ABT, economy increase and overall efficiency also increases by re using water, so overall system very economical.

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BIOGRAPHIES

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