THOMSON REUTERS ENDNOTE

[Khadanga*, 5(3): March, 2016] ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

MAINTAINANCE OF KAPLAN TURBINE TO ENHANCE THE EFFICIENCY

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ABSTRACT

Hydro power plant is the source of renewable energy which leads to reduction in burning of fossil fuels. So the environment is no longer polluted. This project depicts how sediment erosion occurs in Kaplan turbine and the various components of Kaplan turbine where actually erosion takes place. It reduces efficiency [7] and life of hydro power turbine but also causes problems in operations and maintenance. We conducted some necessary test on Kaplan turbine in fluid power laboratory. We are doing this experiment to know about the possible problems and errors which can appear during the mechanical analysis of low head Kaplan turbine with view of the runner draft interaction. Turbine flows have been focused earlier we have also concentrated on blade operation. This paper gives report on unsteady pressure measurement in runner blade of Kaplan turbine .We also analyse torque and load bearing measurement on corresponding prototype when operated at best possible efficiency.

KEYWORDS: Kaplan Turbine, Bearing Bush, Erosion, Cavitation, Efficiency,Venturimeter.

INTRODUCTION

Hydraulic Kaplan turbine are used in various working condition throughout the world. Hydro power plant generates one fifth of the total electrical power produced in the world. The Kaplan turbine is a propeller type water turbine which has adjustable blades. Its invention allowed efficient powerproduction in low head application. That was not possible with Francis turbine. The efficiency of the hydro power depends on number of parameter such as turbine efficiency, draft tube efficiency, generator efficiency for increasing the efficiency of the plant. But a good generator design is not enough if the different pipe lines, venturimeter, valves, draft tubes, runner-blades and modified then also efficiency can be improved.

KAPLAN TURBINE

The modern Kaplan turbine is situated in the hydraulic machinery laboratory in the mechanical engineering department. It is under continues tested and investigated for getting the result. This turbine is designed for getting the incident power generation.

Table 1. Kaplan Turbine Specification

SIZE	250MM	TYPE	162
HEAD	5MM	DISCHARGE	16000LPM
POWER	3.75KW	SPEED	1500RPM

Table 2. Kaplan Supply Pump Specification

SIZE	250MM	TYPE	MF
HEAD	8.5M	DISCHARGE	6000LPM
POWER	15KW	SPEED	1440RPM

Table 3. Induction Motor Specification

VOLT,PHASE AND CYCLE	400,3,50
KW,RPM	20/15,1440
TYPE	TEFC

ISSN: 2277-9655
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COMPONENTS OF KAPLAN TURBINE

1. Spiral casing
2. Distributor assly
3. Shaft and Coupling
4. Runner and Blade regulating system
5. Guide Blade
6. Shaft Gland
7. Draft Tube
8. Mechanical over speed switch assly.
9. Electronic over speed rely.

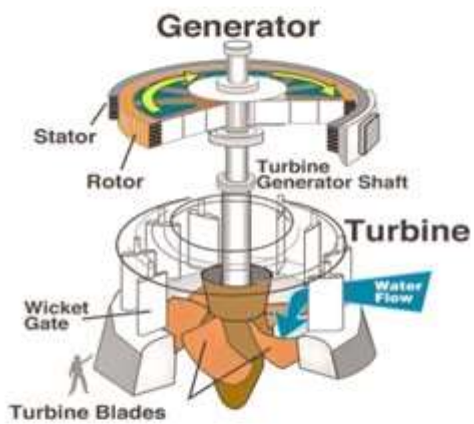

fig.1Common components of Kaplan Turbine.

PROBLEMS FOUND

Venturimeter

Venturimeter consisting of two [11] conical parts with a short portion of uniform cross-section in between. The short portion has minimum area and is known as throat.Our turbine was not in a working condition for a long period, therefore it got eroded and at the time of water flow some bubble formation occurs near the throat which causes major problem to the machinery and it[1] reduces the turbine efficiency, due to unsteady pressure, which is develop due to unsteady flow of water causes major problem to the other parts of turbine.

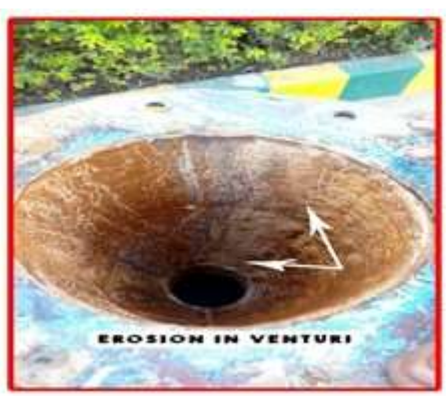

Fig.2: Erosion in Venturi

Butterfly valve

Butterfly valves [11] are used as safety hydraulic systems for low or medium pressure with minimum head loss when the water is passing through the rotor. They are used as gates and emergency devices at the turbine inlet or at the intakes.Due to not in regular[7] use and improper maintainance different parts of valves gets eroded and causes a number of leakages in joints, due to which it was not working properly causing a discontinued flow of water through it.

Fig.3: Erosion in Butterfly Valve

Casing

Casing [11] may be said to an enclosing shell, tube, or surrounding material.Due to improper flow of water in venturimeter as well as through valve and due to surface roughness, there is a development of the scales on the surface of the interior parts of the turbine causes the irregular flow of water inside the casing which causes leakages in casing[4] and hence reduces the efficiency of the turbine.

Fig.4: Erosion in the Turbine Casing

Vane Blades and Wicket Gates

Hydraulic turbine blades are essential part of large hydropower equipment's. Accurate[6] measurement of the blade has crucial impact on the overall operational efficiency and services. Vane blades get damaged due to continuous striking of high pressurised water. This high pressure of water cannot be known with accuracy because of improper working of various parts of turbine. Hydrodynamic load on blades developed unwanted stress which results blades gets damaged.

Fig.5: Erosion in the gate

Draft tube

A draft tube at the end of the turbine [11] increases the pressure of the exiting fluid at the expense of its velocity. Draft tube is present closer to runner and will be exposed to the highest velocity because of high absolute velocity of water coming out of runner and due to this some erosion effect can be anticipated. Due to surface roughness and discontinuous flow of water the local absolute pressure falls below the saturated vapour pressure of the water at that temperature. The height of the[5] draft tube is a main parameter to avoid cavitation and due to the roughness of surface and the scrap on the machine part surfaces it decreases and causes the decreasing the efficiency of the turbine.

Bearing Bush

Since the shaft is not moving properly therefore the gap between the bearing bush and the shaft decreases which results in unwanted noise and hence the efficiency of the [8] turbine decreases.

Fig:6Wear in the bearing

REMEDIES

Cavitation

It is formation of vapour bubbles in the liquid flowing through any hydraulic turbine. Cavitation [2] occurs when the static pressure of the liquid falls below its vapour pressure. We have maintained the pressure in such a way that it does not fall below the vapour pressure of liquid.Cavitation is most likely to occur near the fast moving blades of the turbine and in the exit region of the turbine.

Water Seal and Air seal

We have to maintain the water seal in such a way that there is no water leakage around the water seal. Also we have to verify that there is no excessive [9] splashing and water level to not raise in top cover. We have to regularly check the water pressure under sealing.

Erosion Due to Silt

Erosion of turbine runners [3], guide vanes and other under water part is a serious problem. The rivers water carries silt it with and this cause's serious damage to the turbine parts and water passage. Excessive wear and [10] damage often occurs in runners, seals, guide vanes, butterfly valves, shaft seals and draft tubes. We have to control the silt in water so that we can reduce the wear in different parts in turbine.

CONCLUSION

From the above it can be concluded that:

- Investigation of the problems associated with theoperation of Kaplan Turbine has been identified; the losses and cause for such losses has been described.The remedy to such problem has been compared withthe Current technology introduced.
- To facilitate the task of enhancing efficiency,Methodology [10] is prepared which follows through all the important losses which occur in turbine.Approximation of possible increase in efficiency isincluded for each separate part.
- To speed up the estimation and improvement ofefficiencies the Optimum area of project has been discussed.

- Among the suggested area for project, the bearingbush has been found to be feasible which can be doneby fatigue analysis with other material and suggestingthe optimum bearing bush.

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