International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 04 | April -2020 ISSN: 2582-3930

ENERGY SAVING THROUGH SPEED ADAPTATION BY USING OPTIMISED GEAR STAGE IN VARIABLE SPEED HYDRO COUPLINGS (VOITH)

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In a power plant approximately 8-9% of the power produced is consumed by the utility itself for running its auxiliary equipments.

Boiler Feed Pump is singled out as the major auxiliary power consumer in a power plant, consuming around 25% of the total auxiliary power consumed by the utility.

Though the drive mechanism of Boiler Feed Pumps in Thermal Station is of geared variable speed hydro coupling with a design slip of 1.8% , the actual operating conditions vary at site as the pumps are designed to operate at MCR conditions, where as in reality the operating speed of the pump is found to be lesser by over 10-12% which amount to considerable energy loss.

Following the mantra‘ “Energy saved is Energy produced”, in this PPT an attempt is made to present the study report carried out on variable speed hydro couplings employed in Thermal Power Station, to minimize the energy loss through speed adaptation by adopting optimized gear stages in the existing hydro couplings of Boiler Feed Pumps.

Energy saving in BFP drive by change of gear stage in Hydraulic couplings is one of the proven methods to reduce the APC%

The maximum speed requirement of Boiler Feed Pumps for continuous operation at full load is around 4950 rpm only against a design maximum output speed of 5440 rpm, which reveals that the present operating slip is around >10 % against the design slip of 1.8 %

Necessary data collected from various BFPs at full load is displayed in the table below

A sample calculation was made out of the observed data from BFP 1A on 24.03.2017 for normal operating data at full load (300 MW) is displayed below;

Design power of the pump (P1) : 4515 KW

Input speed (motor) : 1490 rpm

Design speed of pump (N1) : 5531 rpm

Observed speed (N2) : 4922 rpm

Motor current : 435 amps

Power consumed by motor = 1.732 X V X I X PF = 1.732 X 6.6 X 435 X 0.9 = 4475 KW

Power consumption of pump at speed 4922 = P1/P2 = (N1/N2)3 = 4515 / (5531/4922)3

P2 = 4515/1.419 = 3181 KW

Power loss with present gear stage = 4475-3181 = 1294 KW ------------ (1)

Since the hydro coupling's primary speed is designed based on pump's design speed, this power loss can not be minimized unless the primary speed of hydro coupling is suitably optimized based on the actual operating conditions of the pump.

In order to reduce the primary speed of the hydro coupling, the existing gear ratio needs to be redesigned.

So, A viable option is replacing the existing gear stages with an optimized gear stage.

Since, only the primary speed of the hydro coupling needs to be reduced in accordance with the maximum speed attained by the pump during normal operation, replacing the existing gear wheels with new ratio is expected to give the desired results.

Cost Economics: Energy saved per pump = 650 KW

Energy savings per pump per annum = 650 * 24 * 365

= 5694000 KWHr

Energy cost per unit = 3:00 INR

Cost savings per pump per annum = 5694000 * 3

= 1,70,82,000 INR

Cost savings for Four pump per annum = 6,83,28,000 INR

(Six Crore Eighty Three Lacks Twenty Eight Thousand)

Pump	BFP 1A	BFP 1B	BFP2A	BFP 2C
Unit Load	300	300	293	293
Discharge Pressure	194	194	187	187
Discharge Flow	451	447	490	488
Scoop Position	57%	53%	54%	47%
Motor Current	435	432	430	427
Pump Speed	4922	4884	4885	4858
Slip	11.01%	11.5%	11.6%	12.1%

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