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Uprating and refurbishment of Hydro Generators

(Rotor Uprating)

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Abstract:

Age has an effect on the working and efficiency of generators in a Hydro Power plant. While we discuss about refurbishment of a Hydro Power Plant, we can plan to refurbish, uprate and modernization of generators. Stator and rotor are the main component which can be refurbished and upgraded in order to increase efficiency. In the case of "Bassi" Hydro Power Plant, we planned to refurbish the all four generators. In this paper we are focusing on rewinding of rotor and results thereof.

While planning of refurbishment of a Hydro Power Plant, it can be discussed that generators can be refurbished completely or partly depending upon the condition of the generators. Among these two options time constraint and loss in power production are also taken into consideration. In the case of "Bassi Power Plant" there are four generators. Power plant cannot be stopped for refurbishment so it is decided to refurbish these generators one by one. Again a major issue to decide is whether go for complete replacement of Generators or refurbish them partially. In the case of complete refurbishment of generators a cost worth Rs 420 Crore was required and time taken was estimated to be 36 months. Whereas partial refurbishment by replacing all those parts which had deteriorated badly needs less amount of finance required that is Rs 300 crore and time taken is 24 months. Complete refurbishment was planned since Power Plant is 37 years old. The Power Plant was commissioned in the year of 1970 and it needs to be refurbished for increased installed capacity and to achieve more efficiency. After considering all parameters it was decided that rewinding of stator is more beneficiary.

Refurbishment of Rotor

Site Responsibility: Work on the site was undertaken by M/S Andritz Hydro Private Ltd. with the help of Power Plant staff the erection of the rotor was complete.

ROTOR is the largest and heaviest generator component (in large machines the total diameter may be 15m and weight may be 1000 ton). The rotor houses the DC excitation winding and consists of rim, silent poles, spokes and a hub. Earlier, the excitation was commonly supplied by small DC generators driven through pilot exciters from the turbo generator shaft but the recent generators frequently use static excitation systems.. Rewinding of exciter poles has been done. The Exciter current has been changed from 950 A to 1172 A. There is also change in exciter voltage from 65V to 80V. The size of conductor has been increased. In turbines there is some increase in number of brushes per collector, in place of 18 brushes now there are 19 brushes per collector. Rewinding was done with the replacement of Insulation too.

Earlier Class B insulation was used, now it has been changed by Class F insulation for more reliability. Bearing is one of the most complex and critical part of the generator. It takes up and transmits the load imposed by rotating parts. The bearing performance is improved by load equalization. Mainly three types of bearing namely Generator bearing of plate type, Turbine bearing of shell type and Thrust bearing of plate type are used for improving performance. Thickness of inner turns is 0.25mm. Cross sectional area of copper in field winding is (312+374) mm^2 . There is also change in weight of copper in field winding per pole upto 250 kg(approx) and maximum current density in rotor winding is 3.5 A/mm^2. The resistance of field winding is 0.0478Ω at 20℃. Power plant was in function with other generators while rewinding of one was undergoing. Time given to Andritz for complete refurbishment of plant was 36 months, but it took 48 months practically. Refurbishment was started In year 2007 and it was completed in 2011.

Result achieved by rotor winding replacement:

Power production with old winding 15x4= 60MW

Power production after winding replacement 16.5x4=66MW

Increase in Power generation=6MW.

THREE PHASE SYNCHRONOUS GENERATOR	
NO. OF UNITS INSTALLED IN PLANT OF SAME RATING	4
TYPE	Ssv 298 /12 - 120
SERIAL NO	C260/191/R
YEAR OF MANUFACTURER	2011
TYPE OF CONSTRUCTION	IM 8510
TYPE OF PROTECTION	IP 44
CONNECTION	STAR. 6 - PARALLEL
MAX. COOLING AIR TEMPERATURE	40 DEGREE CELSIUS
MAX. COOLING WATER TEMPERATURE	30 DEGREE CELSIUS
RATED OUTPUT S1 KVA	183333
TEMP RISE STATOR / ROTOR	85/90 K
RATED POWER FACTOR	0.9
RATED VOLTAGE	11000 V
RATED CURRENT	962.2 A
RATED FREQUENCY	
RATED SPEED	500 RPM
DIERCTION OF ROTATION	CLOCKWISE
RATED FIELD CURRENT	1172 A
RATED FIELD VOLTAGE	80
MANUFACTURER	ANDRITZ HYDRO PRIVATE Ltd. D - 17 MPAKVN INDUSTRIAL AREA MANDIDEEP

Conclusion

Complete replacement of winding in stator and rotor gave a high efficiency and increased power generation. Complete refurbishment of all the generators was done in time. With Rewinding of stator and other refurbished component a increase of 6 MW is achieved.

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