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HIGH VOLTAGE CONTROL OF POWER SYSTEM BY CHANGING GENERATOR TRANSFORMER TAP POSITION:A CASE STUDY

Surendra Kumar Khichar
Student, M. Tech
SKIT M & G
Jaipur, India
khichar.surendra161@gmail.com

Dr. Prateek Kumar Singhal
Associate Professor
SKIT M & G
Jaipur, India
Prateek.phd@gmaill.com

Dr. M.P. Sharma
Assistant Engineer
RRVPNL
Jaipur, India
mahavir_sh@rediffmail.com

***Abstract*—This paper presents a case study to control high voltage in power system with changing tap position of generator transformer. Rajasthan power system having two 765 kV GSS, twenty one 400 kV GSS and seven thermal plants have been selected to carry out case study and simulated in PSSE software. Simulation model consists of 85 buses, 62 transmission lines and 86 transformers. Total system load is 5656.60 MW & 907.02 MVAR. Five cases have been simulated considering the effect of generator transformer tap position on power system voltage and generator MVAR loading. From simulation studies it is found out that transmission network voltage profile is significantly reduced with increase of generator transformer tap position and injection of reactive power in National Grid is significantly reduced.**

Keywords—Generator MVAR loading; Generator Transformer Tap Setting; Load flow studies; High voltage control.

I. INTRODUCTION

As defined in the IEGC section 5.2 (s) [3] and para 5.3 of the Manual on Transmission Planning Criteria, Jan 2013 [2] the operating range of the voltage at various voltage levels of grid is as follows:

TABLE I VOLTAGE OPERATING RANGE

Voltage in kV (rms)				
	Normal Rating		Emergency Rating	
Nominal	Maximum	Minimum	Maximum	Minimum
765	800	728	800	713
400	420	380	420	372
220	245	200	245	194
132	145	120	145	119
33	36	30	36	30

The maximum and minimum values in the above table are the outer limits and all the constituents would endeavor to maintain the voltage level well within the above limits. Further in the operating procedure of Northern Region [4], it is mentioned that the drawee utilities shall take action in regard to VAR exchange with the grid looking at the topology and voltage profile of the exchange point. The beneficiaries shall endeavor to minimize the VAR drawl at interchange point when the voltage at that point is below nominal value and shall not return VARs when the voltage is above the nominal value. The beneficiaries are expected to provide local VAR compensation so that they do not draw any VARs from the grid during low voltage conditions and do not inject any VARs to the grid during high voltage conditions. In order to improve the overall voltage profile, the generators shall run in a manner so as to have counter balancing action corresponding to low / high grid voltage and to bring it towards the nominal value. In order to achieve the same, all generators shall generate reactive power during low voltage conditions and absorb reactive power during high voltage conditions as per the capability limits of the respective generating units [IEGC 6.6.6] [3]. The Off load tap changers on the generator transformer would also be used to take care of seasonal variations in the voltage profile.

II. OBJECTIVES OF CASE STUDY

The high voltages have been prevailing in Rajasthan power system especially during the night hours when the demand is relatively less than other time of day. To control high voltage, state load dispatch center directs to open lightly loaded transmission lines and switch off shunt capacitor banks. This results increase system losses and also reduce system reliability. In this research paper studies have been carried out to assess the impact of change of generator transformer tap position on transmission voltage profile under prevailing high voltage condition. In power system, power generated by generator is stepped up through transformer which is called as generator transformer. Tap position of generator transformer can be changed through OFF load Tap Changer unit. Taps are provided on high voltage winding. Number of turns in HV winding are reduced with increase of tap position and vice versa. With increase of tap position, system side voltage is reduced as per following equation:-

$$V_2 = \frac{V_1}{N_1} * N_2 \qquad (1)$$

Where

V_1 = LV bus voltage of generator transformer i.e. Generator bus voltage

N_1= Number of turns in LV winding of Generator transformer

V_2 = HV bus voltage of generator transformer

N_2 = Number of turns in HV winding of Generator transformer

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