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Optimum Power Evacuation System Planning of MalwaThermal Power Station (Stage –II, 2x660MW)

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Abstract: - In this paper work an excise has been done to design evacuation system for the second phase of Malwa thermal power substation that is 1200MW power in the Madhya Pradesh (M.P) system. there are three alternative routs of transmission system for absorption of 1200 MW addition powers generated at Malwa have been studied. The basic Grid code requirements as per Madhya Pradesh Electricity Regulation Commission (MPERC) have been adopted to ensure that the voltages & reactive flows are with in the specified limits of grid code. In order to meet the criteria framed by Central Electricity Authority (CEA) has been adopted. Once the projections are firmed up for each alternative, losses for each alternative have been workout and on the basis of transmission losses & prediction had been made the most efficient network to evacuate the power for the second phase (2 x 600 MW).
Key word: - Power evacuation PASF software etc**.**

I. INTRODUCTION

The ever-increasing demand of electric power; the electric supply industry is undergoing profound transformation worldwide. This makes the existing power transmission system highly complex. Due to increased demand, the existing transmission system becomes more stressed and there has been substantial growth in demand of electric energy for domestic, industrial, agriculture, and commercial consumption in Madhya Pradesh in the past decade. [1, 2]

The load of M.P increased 7 % annually as per the study of previous data. During the year 2012 the maximum demand recorded 9660MW and in 2016 - 17 this is estimated to be nearly 13892 MW [2]. To meet the increasing demand of electricity in a power system it is essential to increase the transmitted power either by installing new transmission lines or by enhancing the capacity of existing transmission lines by adding FACT devices. To evacuate these generation proper planning and evacuation schemes are required with a view of strengthening the transmission system to meet the increasing load growth [2, 3]. The electrical power generation capacities are to be added and also simultaneous arrangements will have to make for evacuation of this power. The objective of this paper is to find out the alternative transmission routs for transfer and absorption of Malwa thermal power generation stage –II (2x600) MW. Load flow analysis has been done with the help PSAF software and also work out the transmission losses. The main objective of this paper is to found out the optimal routs for transmission of that power; on the basis of transmission losses.

II. LOAD FLOW ANALYSIS

Load Flow Analysis is the most fundamental numerical algorithm approach to know the parameters of a system. In 1967, Tinney and Hart developed the Newton based Load Flow solution method. Later, Stott developed the conventional Newton method, in which the Jacobian matrix is used. Jacobian matrix is used to calculate the incremental correction of the state variables [2].

Importance of Load Flow Study as follows

1. Load Flow studies determine if system voltages remain within specified limits under various contingency conditions, and whether equipment such as transformers and conductors are overloaded.
2. Load-flow studies are often used to identify the need for additional generation, capacitive, or inductive VAR support, or the placement of capacitors and/or reactors to maintain system voltages within specified limits.
3. Load flow studies are made to plan the best operation and control of the existing system as well as to plan the future expansion to keep pace with the load growth.
4. Load flow studies also help in as certain the effects of new loads, new generating station, new lines and new interconnection before they are installed.
5. The principal information obtained from the load flow study is the magnitude and phase angle of the voltage at each bus and the real and reactive power flowing in each line.

Tools are available for simulation Newton Rapson Method., Fast Decoupled Method, and Gauss Seidal Method. In this work Fast Decoupled load flow method is used and load flow analysis is done with the help of PSAF software. The following advantages of the fast decoupled load flow method to the other methods

1. **Geometric Convergence**: the convergence is geometric; 2 to 5 iteration are normally required for practical accuracies.
2. **Time required**: It calculate very efficiently active and reactive power so that the speed for iterations of the FDLF is nearly five times that of the NR and about two to thirds of GS method.
3. **Memory**: storage requirement are around 60 percentage of the formal NR method, but slightly more then decoupled NR method.

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4. **Arithmetic operations**: in the FDLF method less arithmetic operations need to be done in comparison to other methods.

With the help of this method load flow analysis have been done in PSAF software. **PSAF (Power Systems Analysis Framework) is** Canadian Application Software developed for system studies and related works has been extensively used in load flow studies. Power Systems Analysis Framework (PSAF) is a comprehensive suite of integrated software programs that perform the simulations and analyses of transmission or industrial electrical systems. According to the CEA following basic norms and limits have to considered

Table-I
Bus Voltages

Line voltage	Maximum	Minimum
400kV	+ 5%	- 5%
220kV	+ 5%	- 10%
132kV	+ 5%	- 10%

As per the CEA norms the lines should not be loaded beyond the Surge Impedance Loading Limit. The SIL Limit of different Lines per circuit are:

Table-II
Loading of Lines:

Line voltage	P(MW)
765kV	2250 MW
400kV	515 MW
220kV	132 MW
132kV	50 MW

Load forecasting

The load forecasting is the study is to precisely estimate the demand projections which will facilitate the transmission utility to plan & augment the network capacity to meet the expected load growth.

Energy requirement for year 2017

Electrical power survey has been conducted by Central Electricity Authority (CEA) at national level. CEA have come out with National Electricity Plan for the 12th five year plan i.e. 2017. The CEA report based on electrical power survey of India accepts an annual load growth of around 7% which matches with demand forecasting worked out in this project report.

Based on above consideration and after taking into losses in transmission & distribution networks of MP the demand of projection are shown in Annexure - B. As estimated the energy requirement for FY17 is 77441MU and system demand 13892MW considered the load factor of 63.99%.

Data validation

The system data is collected from the Madhya Pradesh Power Transmission co. limited for the present system during the data collection. All the system parameters are considered to conduct the load flow studies and MPPTCL network modelled with equivalent load at 132 kV level. The data validation is done on the basis of collected field data from generating stations & from all EHV substations on date 21/11/2011 at 20:00 hrs.

The small % variation may be due to reading errors or on account of loss or accuracy of measurement due to ageing of measuring instrument. From the above it is concluded that results obtained from the P-SAF software are valid for the upcoming power evacuation studies.

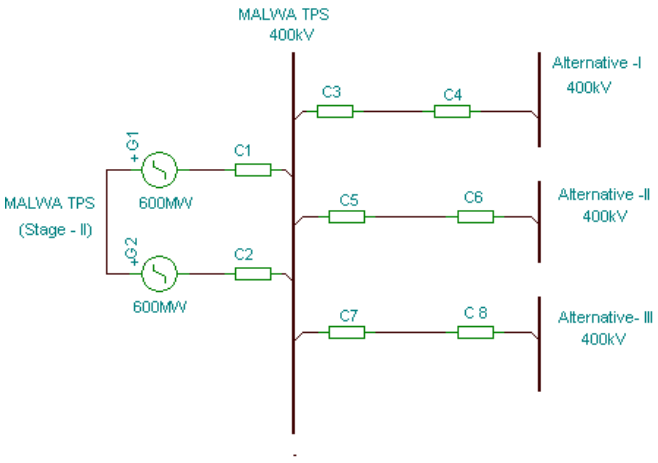
III. SYSTEM UNDER CONSIDERATION

Malwa TPH has been designed for 2400 MW, it is going to be connected in two phase. The project capacity of 1st phase is 2 X 600MW which is already installed and second phase is going to be installed which have the capacity of 1200MW in two units. To evacuation of that 1200MW, we have to identify the network which will be more appropriate on the basis of their transmission losses.

For absorption of this 1200MW power by the distribution a transmission system will have to be established. There can be a number of alternative interconnections for transmission of this 1200MW power to the load centres. For this evacuation, the three alternative networks have been considered for absorption of 1200MW power. By using these three alternatives, study establishes to find out the most efficient alternative on the basis of their transmission losses. These three evacuation systems are as under

1. MalwaTPH to Indore by 400kV interconnection
2. MalwaTPH to Khandwa by 400kV interconnection
3. MalwaTPH to LILO of existing Khandwa – Rajgarh by 400kV line.

Proposed Network



IV. CASE STUDY

Total installed capacity of Malwa TPH is 2400MW getting connected in two phases, 1st phase (1200MW) is already operational in the M.P power network. 2nd phase (1200MW) is going to be installed by year 2017.

At a time only one system will be there it may be Indore. Khandwa or LILO of Khandwa- Rajgarh. Load flow

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analysis of each interconnection one by one is considered for evacuation of 1200MW power.

V. RESULT & DISCUSSION

After simulation of these networks in PSAF software, load flow studies have been carried out & following results have been obtained

Table – III
Simulation results

S no.	Particulates	Alternative I	Alternative II	Alternative III
1.	Energy requirement In MU	77441		
2.	Losses in %	3.3323	3.3504	3.3400
3.	Energy losses in MU	2580.56	2594.58	2586.52

After load flow studies following observation have been made, when we considered Alternative-I, it is observed that the losses for transmission of 1200MW active power in place workout to be 446.26MW and energy loss will be 2580.56MU. Similarly for Alternative-II, losses for transmission of 1200MW active power in place workout 448.69MW & energy loss will be 2594.58MU and for Alternative –III, losses for transmission of 1200MW active power in place workout 447.29 MW & energy loss will be 2586.52MU.

VI. CONCLUSION

From the technical study as discussed above in the previous paragraph, as such the over all annual energy losses (MU) is minimum for Alternative – I , that is 2580.56 MU thus on the basis of transmission losses the most efficient network to evacuate power from Malwa TPH (Stage - II) is Alternative – I that is Indore 400kV D/C interconnection.

The above remarks are concluded for transmission line losses have been done on the basis of energy requirement of FY-17 that is 77441MU. It would be appreciated (in future) the cost of energy loss in the above case studied has been considered for the next classified years.

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