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OPTIMAL POWER FLOW AND TRANSIENT STABILITY ANALYSIS OF A POWER SYSTEM

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Abstract — The power flow analysis is used to determine the power flow of the system and also to determine the voltage drop across each buses. By determining the voltage drop of each buses, FACTS devices can be placed across those buses and the system efficiency can be increased and also the cost of the system can be reduced. There are a variety of formulations with different constraints, different objective functions, and different solution methods that have been labeled optimal power flow. FACTS devices has been proposed as the better alternative to overcome this, as in addition to improving system performance, reliability, quality of supply and also provide environmental benefit. For determining that optimal location power world simulator is used here. The continuation power flow is an accurate method for estimating the maximum loading margin and determined the 'weakest bus'. when the voltage collapse occurs. The advantage of this simulated method is to develop a simple, fast, and convenient procedure which can be applied effectively .Effectiveness of the proposed system is tested on IEEE-30 bus systems using power world simulator.

INTRODUCTION

The electric energy is generated, transmitted and distributed in the form of alternating current. The term "transfer capability" refers to the amount of electric power that can be passed through a transmission network from one place to another. The concept of transfer capability is useful for several reasons. A system, which can accommodate large inter-area transfers, is generally more robust and flexible than a system with limited ability to accommodate inter-area transfers. Thus, transfer capability can be used as a rough indicator of relative system security. Transfer capability is also useful for comparing the relative merits of planned transmission improvements. A transmission expansion that increases transfer capability between two areas of the grid might be more beneficial for increasing both reliability and economic efficiency than an alternate improvement that provides a lesser increase in transfer capability. Along similar lines, transfer capability can be used as a surrogate for more specific circuit modeling to capture the gross effects of multi-area commerce and provide an indication of the amount of inexpensive power likely to be available to generation deficient or high cost regions. Transfer capability computations facilitate energy markets by providing a quantitative basis for assessing transmission reservations.Power flow analysis is the backbone of power system analysis and design. They are necessary for planning, operation, economic scheduling and exchange of power between utilities. Transmission line is characterized by resistance, inductance, and capacitance. This will result in losses. These losses cannot be eliminated but it can be reduced. Voltage collapses typically occurs on power systems that are heavily loaded, faulted and/or have reactive power shortage. The only way to prevent the occurrence of voltage collapse is either to reduce the reactive power load or to provide the system with additional supply of reactive power before the system reaches the point of voltage collapse. In recent years, deregulation of electricity has emerged for its huge demand. Due to the deregulation of the electricity market, study regarding this matter has become imperative. Various initiatives are taken to overcome that, but utilization of FACTS device attracts everyone's attention. FACTS devices are being played a vital role for better utilization of the existing power system with the increased demand On the other hand, transmission and distribution orientation has become more severe due to the lack of proper arrangement. The major power loss occurs for system loss which is increasing day by day around the world and has emerged as a challenge for the developing countries to run with limited resources. To minimise this transmission power losses and ensure optimal power flow, FACTS is introduced in power system. Different parameters and variables of the transmission line such as line impedance, terminal voltages and voltage angle can be controlled by FACTS devices in a fast and effective way.

I. OPTIMAL POWER FLOW

The Optimal power flow (OPF) is the most important tool for power system planning, operation and control. The OPF problem is a nonlinear optimization problem. The OPF has been usually considered as the Minimization of an objective function representing the generation cost and/or the transmission loss minimization of the total voltage deviation at all load buses.Optimization is a mathematical tool to find the maximum or the minimum of a function subject to some constrains. Using lose function as objective function subjected to generator MW, transformer tapping, reactive power injection and controlled voltage as constrains. Using this we get optimal value for bus parameters such that transmission losses are minimum.

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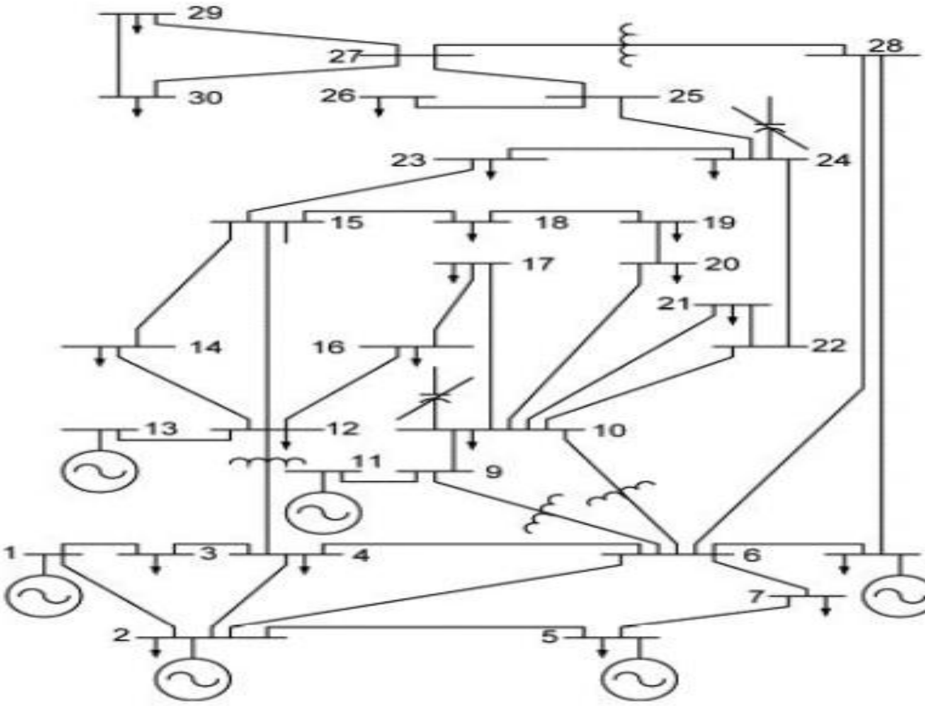
II. PROPOSED SYSTEM

It is proposed to incorporate FACTS in the power system. The FACTS alters the reactance of the transmission line thereby controlling the real power flow in the transmission lines. The standard 30 bus system is used for analysis and the FACTS are connected in transmission lines where costs and losses are reduced.



This figure shows the one line diagram of IEEE standard 30 bus system.

III. LOAD FLOW STUDY

A Power Flow study(load-flow study) is a steady-state analysis hose target is to determine the voltages, currents, and real and reactive power flows in a system under a given load conditions.The purpose of Power Flow studies is to plan ahead and account for various hypothetical situations. For example, if a transmission line is to be taken off line for maintenance, can the remaining lines in the system handle the required loads without exceeding their rated values.Each bus in a power system can be classified as one of three types.

3.1 LOAD BUS(P-Q bus)

A bus at which the real and reactive power are specified, and for which the bus voltage will be calculated. All busses having no generators are load buses. In here, V and magnitude are unknown.

3.2 GENERATOR BUS(P-V bus)

A bus at which the magnitude of the voltage is defined and is kept constant by adjusting the field current of a synchronous generator, We also assign real power generation for each generator according to the economic dispatch. In here, Q and magnitude are unknown.

3.3 SLACK BUS(Swing bus)

A special generator bus serving as the reference bus. Its voltage is assumed to be fixed in both magnitude and phase.

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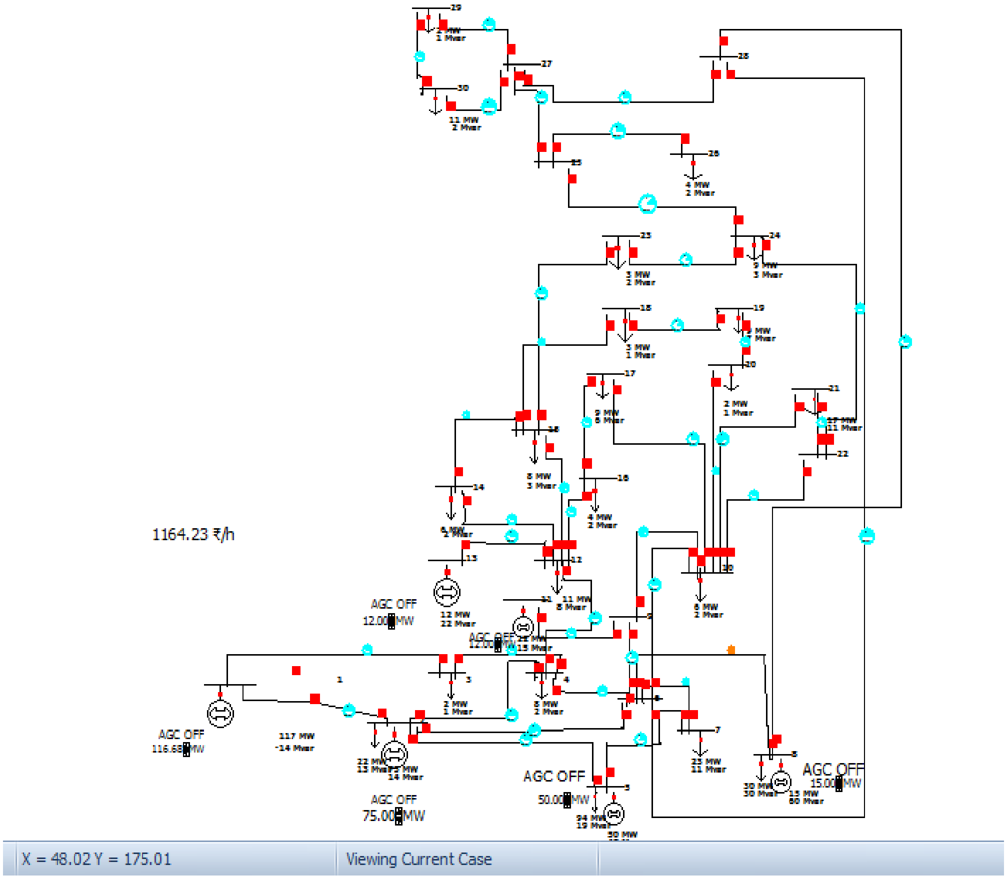
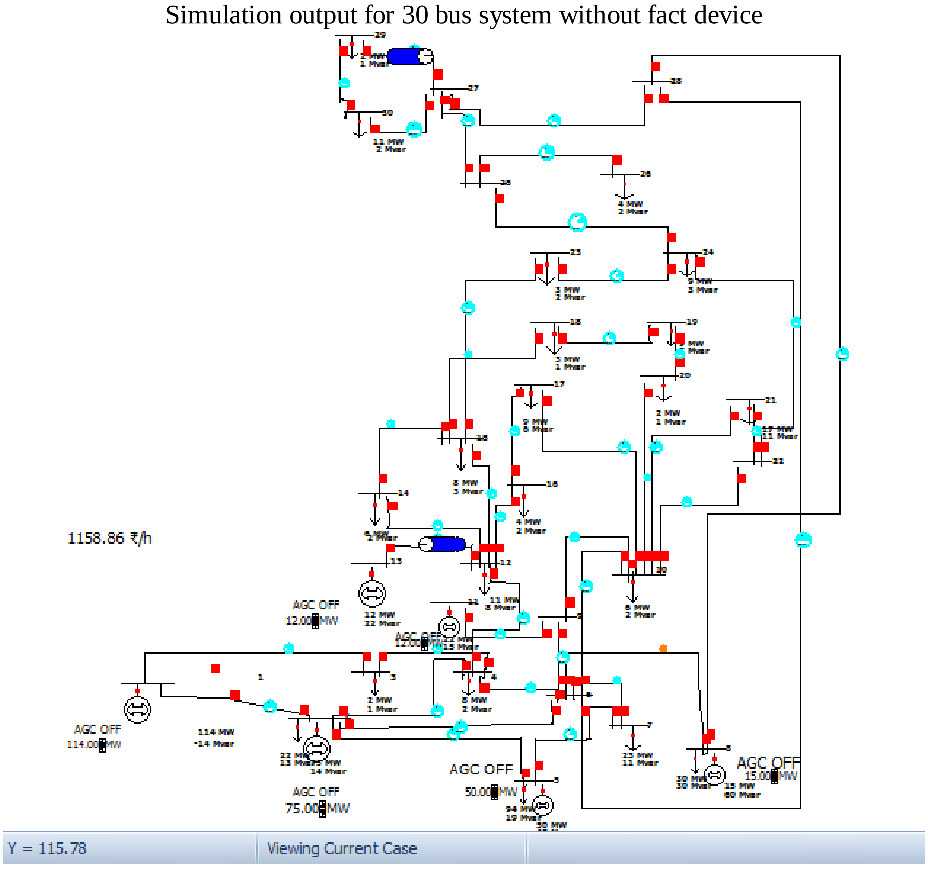
IV.SIMULATION OUTPUT



Simulation output for 30 bus system without fact device



Simulation output for 30 bus system with fact device

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WITHOUT FACTS DEVICE					WITH FACTS DEVICE				
FROM BUS	TO BUS	REAL POWER (MW)	REACTIVE POWER (Mvar)	APPARENT POWER (MVA)	FROM BUS	TO BUS	REAL POWER (MW)	REACTIVE POWER (Mvar)	APPARENT POWER (MVA)
1	2	63.77	-10.78	64.7	1	2	96.11	-22.17	98.6
1	3	52.94	-3.31	53.0	1	3	57.65	-2.94	57.7
2	4	30.16	0.90	30.2	2	4	32.27	1.51	32.3
2	5	46.77	-9.81	47.8	2	5	56.19	-11.01	57.3
2	6	39.34	-2.24	39.4	2	6	41.35	-2.48	41.1
3	4	49.27	-7.1	49.38	3	4	53.75	-8.30	54.4
4	6	40.54	-13.72	42.8	4	6	40.11	-15.87	43.1
4	12	30.43	5.58	30.9	4	12	37.30	6.36	37.8
5	1	50	46.73	68.4	5	1	34.46	52.7	63
5	7	34.30	10	2.7	5	7	-5.09	18.36	19.1
6	7	21.55	-5.72	38.6	6	7	28.30	-8.11	29.4
6	8	17.75	-20.08	26.8	6	8	17.06	-20.73	26.8
6	9	12.83	5.70	14	6	9	15.16	5.56	16.1
6	10	11.59	6.06	13.1	6	10	12.91	6	14.3
6	28	15.03	-3.17	15.4	6	28	6.80	-2.62	7.3
7	6	-21.42	5.32	22.1	7	6	-28.06	8.02	29.2
8	1	15	30	61.8	8	1	24.29	6	64.7
8	28	2.66	10.04	26.6	8	28	11.26	9.39	14.7
9	10	34.45	18.65	10.4	9	10	36.78	18.38	41.1
9	11	-21.62	13.37	13.9	9	11	-21.62	-13.38	25.4
10	17	5.80	2	39.2	10	17	8.30	2.48	8.7
10	20	-11.50	15.07	25.4	10	20	10.65	2.55	11
10	21	17.24	2.89	6.1	10	21	16.72	9.76	19.4
10	22	12.83	7.78	13.5	10	22	8.22	4.42	9.3
11	1	6.21	11.20	30.6	11	1	21.62	14.8	26.2
12	13	-12	-20.88	24.1	12	13	-1.09	-22.21	22.2
12	14	7.78	2.89	8.3	12	14	7.37	3.05	8
12	15	17.24	8.58	19.3	12	15	15.54	8.90	17.9

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12	16	6.21	4.94	7.9	12	16	4.28	5.30	6.8
13	1	12	21.75	24.8	13	1	1.09	22.94	23
14	1	12	1.60	6.4	14	1	6.20	1.60	7.8
14	15	1.49	1.11	8.2	14	15	1.09	1.27	1.7
15	1	-16.98	2.50	1.9	15	1	8.20	2.50	8.6
15	18	-1.48	2.61	8.6	15	18	4.44	2.86	5.3
15	23	5.49	4.06	18.8	15	23	3.75	4.36	5.8
16	1	4.77	1.80	6.1	16	1	3.50	1.80	3.9
16	17	6.15	-4.81	6.3	16	17	0.73	3.40	3.5
17	1	9	5.80	3.9	17	1	9	5.80	10.7
18	1	-6.37	0.90	7.8	18	1	3.20	0.90	3.3
18	19	2.25	1.62	2.8	18	19	1.21	1.89	2.2
19	1	-2.24	3.40	10.1	19	1	9.50	3.40	10.1
19	20	-7.26	-1.79	7.5	19	20	-8.30	-1.51	8.4
20	1	2.20	0.70	2.3	20	1	2.20	0.70	2.3
21	1	17.50	-9.53	20.8	21	1	17.50	11.20	20.8
21	22	-1.33	-1.67	2.1	21	22	-0.92	-1.75	2
22	24	-7.80	11.20	18.8	22	24	7.24	2.53	7.7
23	1	17.50	-4.20	9.8	23	1	3.20	1.60	3.6
23	24	3.50	2.30	7.5	23	24	0.51	2.69	2.7
24	1	7.12	4.28	6	24	1	8.70	6.70	11
24	25	-3.50	0.90	4.2	24	25	-1.07	-1.63	1.9
25	26	-4.25	-4.20	4.2	25	26	3.55	2.38	4.3
25	27	3.50	-4.25	6.1	25	27	-4.61	-4.02	6.1
26	1	4.29	2.30	19.2	26	1	3.50	2.30	4.2
27	28	-17.63	-7.71	6.4	27	28	-17.99	-7.53	19.5
27	29	6.21	1.71	7.3	27	29	6.21	1.71	6.4
27	30	7.12	1.72	15.2	27	30	7.12	1.72	7.3
29	1	-6.11	0.90	2.6	29	1	2.40	0.90	2.6
29	30	3.71	0.62	3.8	29	30	3.71	0.62	3.8
30	1	-6.93	1.90	10.8	30	1	10.60	1.90	10.8

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CONCLUSION

Power flow analysis is the most significant part in the utility areas. From results of power flow analysis the voltage drops across each buses are calculated and FACTS devices are placed for improving the stability of power system. It is possible to use these devices for the control flows of active and reactive power. It also contributes to improve the limits of static, transient stability and voltage quality. Hence as efficiency increases, the production of the plant also increases.

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