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POWER SYSTEM STABILITY BY USING TCSC

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ABSTRACT

The loss of transient stability in a power system is caused by overloading of some lines (or severe line faults), as a result of other lines tripping off as a result of faults or significant load loss. FACTS technology may improve power control, boost power transfer capacity, reduce line losses, raise power system damping, and improve the stability and security of the power system by allowing quick and flexible control of ac transmission parameters and network structure. The major goal is to use MiPower software to construct a multi-machine system with TCSC (Thyristor Controlled Series Capacitor) controllers.

Keywords -Transient Stability, Tripping Off, FACTS , TCSC, Mi Power Software

I. INTRODUCTION

The major goal of the study is to use a Thyristor Controlled Series Capacitor to preserve system stability. A power electronics-based Flexible AC Transmission System (FACTS) gadget is the rationale for employing TCSC Thyristor Controlled Series Capacitor (TCSC). TCSCs are used to increase the amount of power flowing through a line by efficiently correcting the line's reactance. A TCSC differs from a regular series capacitor in that it may change its compensation dynamically, whereas a standard series capacitor has a fixed compensation. As illustrated in Fig. 1.1, the basic conceptual TCSC module consists of a fixed series capacitor, C1, a fixed parallel capacitor, C2, and a thyristor-controlled reactor, L. A real TCSC module, on the other hand, incorporates safety gear.

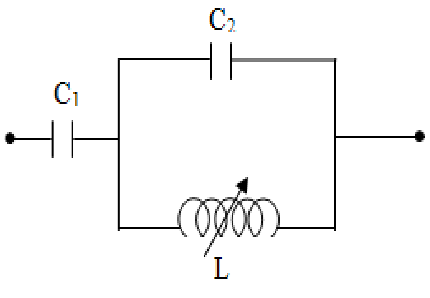

Fig. 1.1 Equivalent Circuit

II. 5-BUS SYSTEM STABILITY

A five-bus system is depicted by a single line diagram with two generating units and seven lines. On a 100 MVA basis, per-unit transmission line series impedances and shunt susceptances are presented. The table shows real power generation, real and reactive power loads in MW and MVAR.

With TCSC, the power flow over line 3-4 may be increased to 21 MW. Assume the bus's base voltage is 220 kV and the system frequency is 60 Hz.

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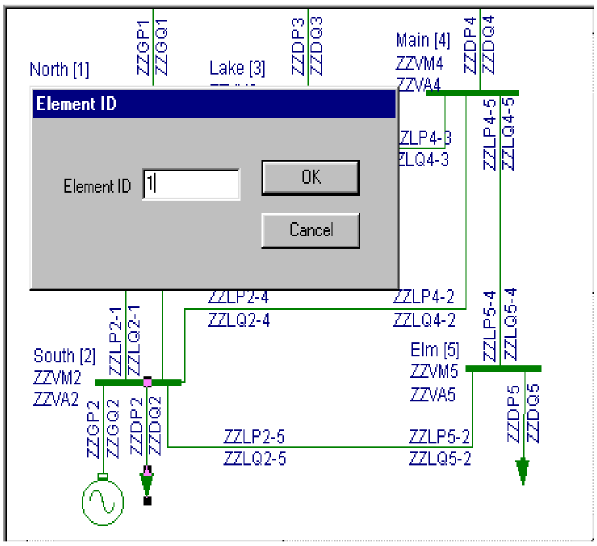
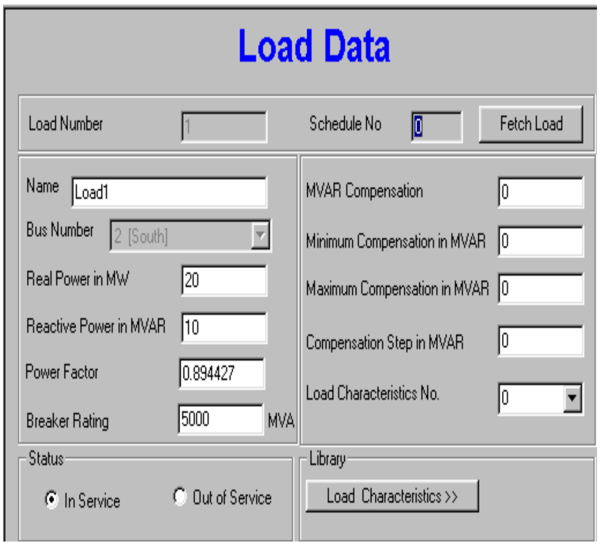
Transmission Line Data in per unit		
Bus code From – To	**Impedance R+jX**	**Line charging B/2**
1-2	0.02+j0.06	0.08+j0.24
1-3	0.08+j0.24	0.0+j0.025
2-3	0.06+j0.18	0.0+j0.02
2-4	0.06+j0.18	0.0+j0.02
2-5	0.04+j0.12	0.0+j0.015
3-4	0.01+j0.03	0.0+j0.010
4-5	0.08+j0.24	0.0+j0.025

Load & Generation Data					
Bus No.	Bus voltage in pu	Generation MW	Generation MVAR	Load MW	Load MVAR
1	1.06+j0.0	0	0	0	0
2	1.00+j0.0	40	30	20	10
3	1.00+j0.0	0	0	45	15
4	1.00+j0.0	0	0	40	5
5	1.00+j0.0	0	0	60	10

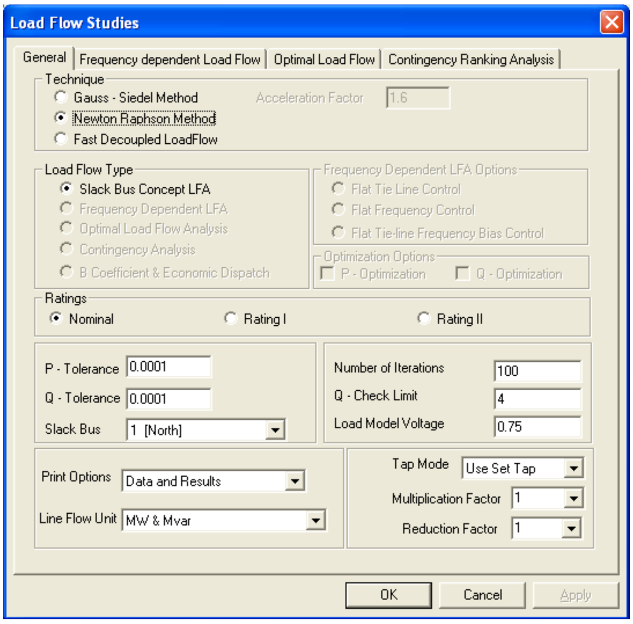
III. LOAD FLOW ANALYSIS





Connect other loads to buses 3, 4 and 5. Enter other load details as given in the following table.

Load Details			
Load No	Bus No	MW	MVAR
2	5	60	10
3	3	45	15
4	4	40	5

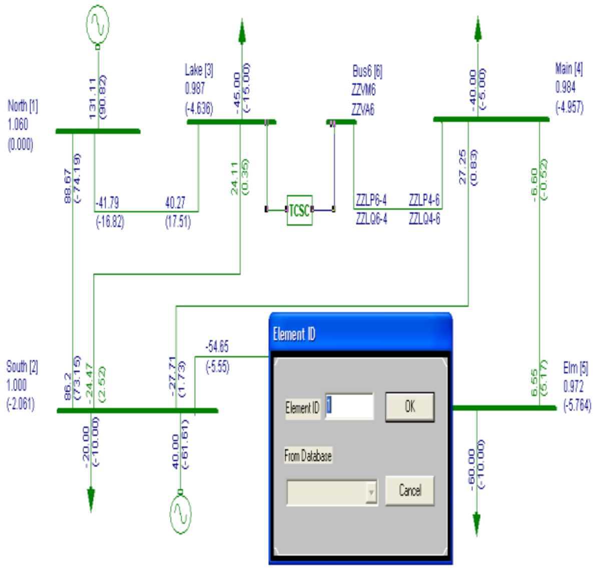


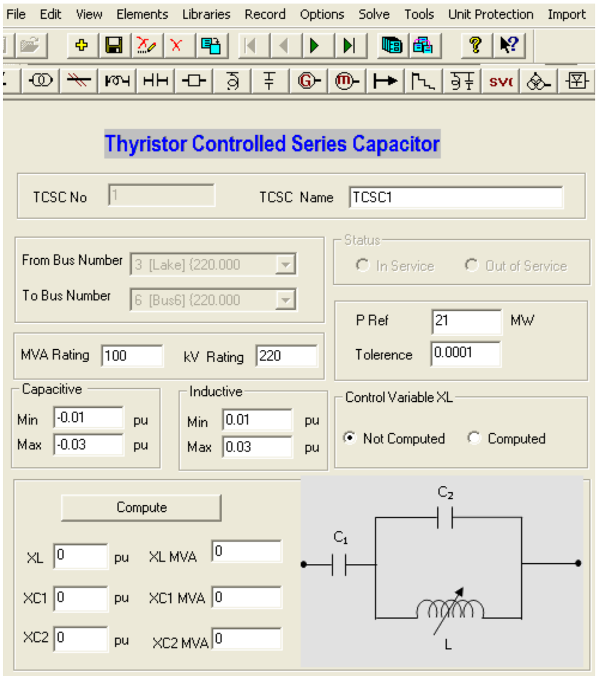
To view the report, run the load flow analysis and then select Report on the load flow analysis window. The following is a portion of the report below.

```
--------------------------------------------------------------------------------
BUS VOLTAGES AND POWERS

NODE FROM         V-MAG  ANGLE       MW      MVAR        MW      MVAR      MVAR
NO.   NAME         P.U.  DEGREE      GEN      GEN       LOAD     LOAD      COMP
---- --------    ------ ------  -------- --------  -------- --------  --------
   1     North   1.0600   0.00   131.122   90.816     0.000    0.000     0.000 #>
   2     South   1.0000  -2.06    40.000  -61.593    20.000   10.000     0.000
   3      Lake   0.9872  -4.64     0.000    0.000    45.000   15.000     0.000
   4      Main   0.9841  -4.96     0.000    0.000    40.000    5.000     0.000
   5       Elm   0.9717  -5.76     0.000    0.000    60.000   10.000     0.000
--------------------------------------------------------------------------------
NUMBER OF BUSES EXCEEDING MINIMUM VOLTAGE LIMIT (@ mark) :    0
NUMBER OF BUSES EXCEEDING MAXIMUM VOLTAGE LIMIT (# mark) :    1
NUMBER OF GENERATORS EXCEEDING MINIMUM Q LIMIT (< mark)  :    0
NUMBER OF GENERATORS EXCEEDING MAXIMUM Q LIMIT (> mark)  :    1

--------------------------------------------------------------------------------
LINE FLOWS AND LINE LOSSES

SLNO CS FROM FROM       TO TO              FORWARD              LOSS           %
        NODE NAME     NODE NAME          MW      MVAR        MW      MVAR LOADING
---- -- ---- -------- ---- -------- -------- --------  -------- -------- -------
   1  1    1    North    2    South   89.331   73.995    2.4859   1.0868  109.4@
   2  1    1    North    3     Lake   41.791   16.820    1.5178  -0.6922   42.5^
   3  1    2    South    3     Lake   24.473   -2.518    0.3595  -2.8708   24.6&
   4  1    3     Lake    4     Main   19.386    2.865    0.0401  -1.8230   20.2&
   5  1    4     Main    5      Elm    6.598    0.518    0.0431  -4.6525    8.6&
   6  1    2    South    5      Elm   54.660    5.558    1.2150   0.7287   54.9$
   7  1    2    South    4     Main   27.713   -1.724    0.4609  -2.5545   27.8^
```

IV. APPLICATION OF TCSC

The goal of joining TCSC is to increase power flow in line 3-4 from 19.38 MW to 21 MW. Line 3-4 is disconnected/made out of service/deleted before connecting to the TCSC, and a new bus (Bus6) is added between Bus3 and Bus4. Between Bus6 and Bus4, connect a transmission line with the same specifications as line 3-4. Connect the TCSC symbol in the power system tool bar to Bus3 and Bus6, just like the other series parts are linked. Give the ID number 1 and click OK. The TCSC form will pop up.





BUS VOLTAGES AND POWERS

NODE NO.	FROM NAME	V-MAG P.U.	ANGLE DEGREE	MW GEN	MVAR GEN	MW LOAD	MVAR LOAD	MVAR COMP
1	North	1.0600	0.00	131.127	90.937	0.000	0.000	0.000 #>
2	South	1.0000	-2.04	40.000	-61.802	20.000	10.000	0.000
3	Lake	0.9870	-4.73	0.000	0.000	45.000	15.000	0.000
4	Main	0.9844	-4.81	0.000	0.000	40.000	5.000	0.000
5	Elm	0.9718	-5.70	0.000	0.000	60.000	10.000	0.000
6	Bus6	0.9876	-4.46	0.000	0.000	0.000	0.000	0.000

NUMBER OF BUSES EXCEEDING MINIMUM VOLTAGE LIMIT (@ mark) : 0
NUMBER OF BUSES EXCEEDING MAXIMUM VOLTAGE LIMIT (# mark) : 1
NUMBER OF GENERATORS EXCEEDING MINIMUM Q LIMIT (< mark) : 0
NUMBER OF GENERATORS EXCEEDING MAXIMUM Q LIMIT (> mark) : 1

LINE FLOWS AND LINE LOSSES

SLNO	CS	FROM NODE	FROM NAME	TO NODE	TO NAME	FORWARD MW	FORWARD MVAR	LOSS MW	LOSS MVAR	% LOADING
1	1	1	North	2	South	88.676	74.188	2.4704	1.0405	109.1@
2	1	1	North	3	Lake	42.451	16.749	1.5554	-0.5783	43.1^
3	1	2	South	3	Lake	25.503	-2.695	0.3905	-2.7769	25.6^
4	1	4	Main	5	Elm	7.137	0.413	0.0487	-4.6377	9.0&
5	1	2	South	5	Elm	54.103	5.606	1.1911	0.6565	54.4$
6	1	2	South	4	Main	26.600	-1.566	0.4246	-2.6642	26.6^
7	1	6	Bus6	4	Main	21.008	2.509	0.0465	-1.8049	21.7&

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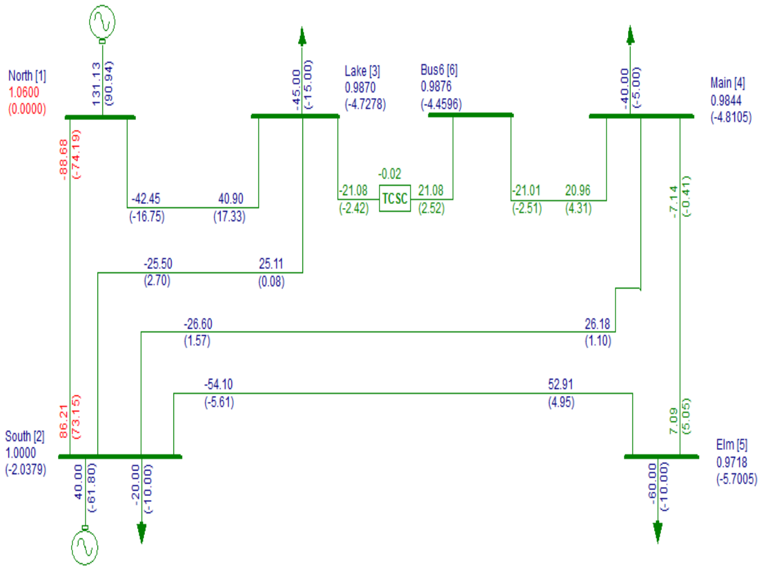
TCSC POWER FLOWS

SLNO	FROM NODE	TO NODE	FORWARD (MW)	FORWARD (MVAR)	LOSS (MVAR)	TCSC REACT.	Final XL_Value
1	3	6	21.08	2.42	-0.10	-0.0216	-

The power flow via the line is enhanced to 21 MW after attaching the TCSC, and the TCSC reactance is capacitive with a magnitude of 0.0216 per unit.

TCSC output on the GUI Screen is given below



V. CONCLUSION

The stability of the power system employing TCSC is explained, and the system dynamics are compared during a significant disruption. TCSC is used to increase the amount of power flowing through a line by efficiently adjusting the line's reactance. The system is initially unstable, but following the installation of TCSC, the power flow in line 3-4 improves from 19.38 MW to 21 MW. The data and findings show that the system's overall performance has improved significantly.

REFERENCES

[1] Baker, M. H., September 1995 "An Assessment of FACTS Controllers for Transmission System Enhancement," CIGRE SC 14 International Colloquium on HVDC & FACTS, Montreal.

[2] Miyazaki, Y.Kimura, M.Karube, T.Noro, Y.Takahashi, C. Kishibe, H. 2002"Development and Verification of a FACTS Digital Real-Time Simulator", Proceedings of the IEEE Asia Pacific Transmission and Distribution Conference and Exhibition 2002, (IEEE/PES), Vol.1,pp 324- 329.

[3] N.G Hingorani, L.Gyugyi,2000 "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", IEEE Press, New York.

[4] Patel Ramnarayan, Bhatti T.S, Kothari D.P, 2002"MATLAB/Simulink Based Transient Stability Analysis of Multi-machine Power System" International Journal of Electrical Engineering Education Vol. 39, Issue 4, pp 320-336.

[5] P.M.Anderson, A. A. Fouad,1977 "Power System Control and Stability," Science Press, Ephrata, Pa 17522.

[6] S.Chatterji,C.S. Rao, T.K. Nagasarkar,1996 **"**Applications of FACTS Controllers for Improving Power System Stability", Proceedings of Institution of Engineers National Convention of Electrical Engineers-Power System Management to overcome Power shortage.

[7] Sidhartha Panda, Ramnarayan N.Patel, 2006"Improving Power System Transient Stability with an Off-Centre of Shunt FACTS Devices"'Journal of Electrical. Engineering, Vol 57, Issue 6, pp 365-368,.

[8] T.R.Jyothsna, K. Vaisakh, Dec 2008 "Improving Multi-Machine Transient Stability Using a Non-Linear Power System Stabilizer under Different Operating Conditions," Fifteenth National Power Systems Conference (NPSC).

[9] Y. Pannatier , B.Kawkabani, J.J simond ,2008" Modeling and Transient Simulation of FACTS in Multi-Machine Power Systems" Proceedings of the IEEE International Engineering Conference.

[10] Abdullah Swissi Emhemed, Ryan M. Tumilty, Nand K. Singh,Graeme M. Burtand James R. McDonald,," Analysis of Transient Stability Enhancement of LV-Connected Induction Microgenerators by Using Resistive-Type Fault Current Limiters", IEEE Transactions On Power Systems, Vol. 25, No. 2, MAY 2010.

[11] Ray Daniel Zimmerman, Carlos Edmundo Murillo-Sánchez, and Robert John Thomas," MATPOWER: Steady-State Operations, Planning, and Analysis Tools for Power Systems Research and Education," IEEE Transactions On Power Systems, Vol. 26, N0.1,FEB 2011.

[12] Kavitha R,"Transient Stability of IEEE-30 bus system using E-TAP software", International Journal For Scientific And Engineering Research Volume 3,Issue 12,December 2012.

[13] Mardavij Roozbehani, Munther A Dahleh, and Sanjoy K Mitter, "Volatility of Power Grids under Real-Time Pricing" IEEE Transactions On Power Systems, 2012.

[14] Dr. Tarlochan Kaur and Sandeep Kakran, "Transient Stability Improvement of Long Transmission Line System by Using SVC," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 1,

[15] Issue 4, October 2012.

[16] Changhong Zhao, Ufuk Topcu, Na Li, Steven Low "Design and Stability of Load-Side Primary Frequency Control in Power Systems", IEEE, 2013.