الآية

﴿ يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ ﴾

سورة المجادلة الاية رقم(11)

DEDICATION

To

My Dearest Parents who are the part of my soul and whose love, affection and confidence enabled me to achieve this goal.

TO

My brothers Dr. Mossab, Eng. Mohammed, Muslim, to my sisters Dr. Nesreen, Eng. Noha, Ms. Arwa and Dr. Rayan for their help and patience, Despite the distance...

To

My Friends who have encouraged me to complete this work.

To anyone who have supported me with good ideas throughout the project.

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To the Almighty GOD "ALLAH" Who have granted me all these graces to fulfill this work and who blessed and supported me by His power in all my life. Without this guidance I would have never reached this position where I am writing this page. To Him I extend my heartfelt thanks.

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ABSTRACT

Power systems operation becomes more important as the load demand increases all over the world. This rapid increase in load demand forces power systems to operate under heavily stressed conditions, near critical limits due to economic and environmental constraints.

Flexible Alternating Current Transmission System (FACTS) devices are found to be encouraging in improving voltage stability limit of power systems. In this Dissertation steady-state model of Static VAR Compensator (SVC) and Thyristor Controlled Series Compensator (TCSC) for power flow studies has been represented and discussed in details. The SVC is used to control the voltage at which it is connected. In same manner model of TCSC is used to control active power flow of the line to which TCSC is installed.

Sudanese national grid is undergoing changes as a result of constant power demand increase, thus stretching it beyond their voltage and thermal limit. This drastically affects the power quality delivered. Transmission systems should be flexible to respond to generation and load patterns, then incorporate this device in Sudanese grid to enhancement the performance. In addition optimal location and sizing of TCSC and SVC are considered for reducing line losses and improving voltage limit. The optimal locations of SVC and TCSC are chosen using line indices, Fast Voltage Stability Index, Novel Voltage Stability Index, Line Fast Stability Index and line index (FVSI, NVSI and LQP). Simulations are carried out using NEPLAN software. The results obtained showed the effectness of SVC and TCSC on voltage profile, power losses and power transfer through the line in the Sudanese national grid.

المستخلص

أصبح تشغيل نظم القدرة أكثر أهمية مع الزيادة المستمرة في الحمل في جميع أنحاء العالم، هذه الزيادة السريعة في الحمل اجبرت أنظمة القدرة لأن تعمل تحت ظروف تشغيل باجهادات كبيرة، وأن تعمل قرب الحدود الحرجة بسبب القيود الاقتصادية والبيئية.

النظم المرنة لنقل التيار المتردد (FACTS) أصبحت مشجعة في تحسين حدود إستقرارية الجهد في أنظمة القدرة. في هذه الأطروحه تمت مناقشة وتمثيل معوض القدرة الرد فعلية الساكن (SVC) الذي يستخدم للتحكم في الجهد عند ربطه مع الشبكة، كذلك تناولت معوض التوالي المحكوم بالثايرستور الذي يتحكم في إنسياب القدرة في خطوط النقل عند توصيلها معها.

خضعت الشبكة السودانية لتغيرات مستمرة نتيجة للطلب المتزايد علي القدرة، وبالتالي امتدت لتتجاوز حدود الجهد واقصي قدرة منقولة وهذا يؤثر بشكل كبيرعلي جودة القدرة المنقولة حيث أنظمة نقل القدرة يجب ان تكون أكثر مرونة لمجابهة التغيرات في التوليد والحمل. تم ادراج هذه الأجهزة في الشبكة السودانية لتعزيز وتحسين الأداء، مع الأخذ في الأعتبار الموقع الأمثل لربط وضبط متغيرات كل من SVC و TCSC. تم تحديد المواقع المثلى لهذه الأجهزة بإستخدام مؤشرات الخط (FVSI, NVSI وLQP) وتم تنفيذ المحاكاة بإستخدام برنامج NEPLAN. أظهرت النتائج المتحصل عليها فعالية SVC وTCSC في تحسين قيم الجهد، المفاقيد في القدرة وزيادة القدرة المنقولة خلال خط النقل في الشبكة الوطنية السودانية.

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LIST OF ABBREVIATIONS

AC	Alternating current.
FACTS	Flexible AC Transmission System.
SVC	Static VAR compensators.
TCSC	Thyristor Control series Compensator
STATCOM	Static Synchronous Compensator.
SSSC	Static Synchronous Series Compensator.
UPFC	Unified power flow controller.
IPFC	Interline power flow controller.
TCPST	Thyristor Controlled Phase Shifting Transformer
FDLF	Fast Decoupled Load Flow
NR	Newton Raphson
HVDC	High Voltage Direct Current.
TCR	Thyristor controlled reactor.
IGBT	Insulated gate bipolar transistor.
GTO	Gate Turn-Off thyristor.
VSC	Voltage Source Converter.
TCVR	Thyristor Controlled Voltage Regulators.
TCPAR	Thyristor-Controlled Phase Angle Regulators.
PS	Phase shifter.
LTC	Load tap changer
VSI	voltage stability index
VCPI	Voltage Collapse Point Indicators
L_{mn}	Line stability index.

FVSI	Fast voltage stability index.
NVSI	Novel Voltage Stability Index
LQP	Line Voltage Stability Index
GUI	Graphical user interfaces.