

الآية

وَلَلَّا يَعْلَمُونَ
وَمَنْ يَعْلَمُ فَإِنَّمَا يَعْلَمُ بِمَا
فِي الصُّدُوقِ

الثوابة (١٥)

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 Abdalla and Mohammed and to my sister Eman for their help and patience, for every period I was away.

TO

the soul of my grandfather (Ahmed), may Allah forgive him and grant him his highest paradise (Ameen).

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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. I also offer my humblest thanks from the deepest core of my heart to the **Holy Prophet MUHAMMAD** (peace be upon him), Who is forever a torch of guidance and knowledge for humanity as a whole.

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Abstract

One of serious problems in power systems that can threaten the concept of power systems reliability and security is voltage instability. Improving the system's reactive power handling capacity via Flexible AC Transmission System (FACTS) devices is a remedy for prevention of voltage instability and hence voltage collapse.

This thesis presents the enhancement of voltage stability and reduced active and reactive power losses on standard IEEE-14 bus system by selecting the optimal size and location of SVC using voltage stability index method (L-index). The bus with the highest L-index value will be the most vulnerable bus in the system, and hence this method helps in identifying the weak areas in the system which its reactive power needs support .

The analysis is carried out using NEPLAN and PSAT software. And the results is discussed.

المستخلص

واحدة من اخطر المشاكل في أنظمة القدرة الكهربائية والتي يمكن أن تهدد أمن وموثوقية نظم القدرة الكهربائية هي عدم استقرارية أنظمة الجهد الكهربائية . لحل عدم استقرارية الجهد يتم تحسين إمداد القدرة الرد فعلية عن طريق أجهزة نظام نقل التيار المتردد المرنة.

في هذا البحث يتم التعرض لتحسين استقرارية نظام الجهد وتقليل مفاسيد القدرة الفعلية والرد فعلية لشبكة IEEE-14 bus المعيارية وذلك بتحديد الحجم والمكان المثاليين لتوصيل معلومات القدرة الرد فعلية باستخدام طريقة مؤشر اسقراirieة الجهد (المؤشر L). قضيب التوزيع الذي يحوي أعلى قيمة للمؤشر L يعتبر هو الأكثر ضعفا في النظام. وبالتالي تساعد هذه الطريقة لمعرفة الأماكن الضعيفة في النظام والتي تحتاج لإمداد بالقدرة الرد فعلية.

هذا التحليل أجري عن طريق برنامجي NEPLAN و PSAT. ثم نوقشت النتائج.

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LIST OF SYMBOLS

α	Thyristor firing angle
B	Susceptance [S]
	Power factor
C	Capacitance [F]
I	Current [A]
L	Inductance [H]
ω_0	Nominal angular frequency [rad/s]
B_L	reactor susceptance
X_C	reactances of the capacitor
X_L	reactances of reactor
I^G	currents at generator
I^L	currents at the load node
V^G	voltages at generator node
V^L	voltage at load nodes
φ	Phase angle between voltage and current [rad]
P	Active power [W]
Q	Reactive power [VAr]
S	Apparent power [VA]
θ	Bus voltage angle [rad]
X	Reactance [Ω]
R	resistance
B_{SVC}	Susceptance
Q_{SVC}	reactive power drawn by SVC.
V_K	voltage at bus k
I_{SVC}	The current drawn by the SVC
ω_r	TSC resonant frequency
λ	loading point

LIST OF ABBREVIATIONS

FACTS	Flexible Alternating Current Transmission System
IEEE	Institute Of Electrical And Electronics Engineers
HVDC	High Voltage Direct Current
ATC	Available Transfer Capability
SSR	Subsynchronous Resonance
SVC	Static Var Compensator
TCSC	Thyristor Controlled Series Capacitor
SSSC	Static Synchronous Series Compensator
STATCOM	Static Compensator
UPFC	Unified Power Flow Controller
LTC	Load Tap Changer
TCR	Thyristor Controlled Reactor
PSAT	Power System Analysis Toolbox
IPFC	Interline Power Flow Controller
VSC	Voltage Source Converter
PS	Thyristor-Controlled Phase Shifter
IPC	Interphase Power Controller
GTOs	Gate Turn-Off Thyristors
IGBTs	Insulated Gate Bipolar Transistors
FC-TCR	Fixed Capacitors & Thyristor Controlled Reactor
TSC-TCR	Thyristor Switched Capacitors & Thyristor Controlled Reactor
GA	Genetic Algorithm
PSO	Particle Swarm Optimization
AVR	Automatic voltage regulator
EHV	Extra High Voltage