# الآية

قال تعالى:

﴿وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ وَسَتُرَدُّونَ إِلَىٰ عَالِمِ الْغَيْبِ وَالشَّهَادَةِ فَيُنَبِّئُكُم بِمَا كُنتُمْ تَعْمَلُونَ﴾. صدق الله العظيم

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# DEDICATION

To our great parents, who never stop giving us themselves in countless ways.

To our dearest friends, who leads us through the valley of darkness with light of hope and give us encourage and support.

To our beloved brothers and sisters who stands by us when things look bleak.

To all our family, the symbol of love and giving.

To all the people in our life who touch our heart, we dedicate this research.

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We owe a deep debt of gratitude to our university for giving us an opportunity to complete this work.

We grateful to some people, who worked hard with us from the beginning till the completion of the present research particularly our **supervisor,**

**Ust: Almubarak Mohammed Mohammed Shamouq** who has been always generous during all phases of the research and we totally sure that this work would have never become truth, without His guidance.

And we highly appreciate the efforts expended by **Eng. Abdulla Eidab** the manager of network analysis department (SETCO) who never stingy us by his knowledge and always help us.

We would like to take this opportunity to say warm thanks to all my beloved friends, who have been so supportive along the way of doing our thesis.

# ABSTRACT

Power flow analysis is important in steady state stability analysis of power system, operation and planning stages of new networks or addition to existing ones like adding new generator sites, meeting increase load demand and locating new transmission sites.

Power flow analysis needs restricted the limits of active and reactive power of generation, transformer capacity and transmission line capacity.

Power flow analysis is also important to identify the capability of network to operate with maximum load without effecting in system stability.

In this thesis a part of Sudanese electric transmission network was analyzed, representing in high voltage transmission line (500-220-110)kv through two loops, first loop include (Merowe, Atbara, Garry, Eid Babiker, Kilo 10, Alroseires, Rabak, Almarkhiyat, and Merowe) and other Loop include (Merowe, Atbara, Alkabashi, Eid Babiker, Kilo 10, Alroseires, Rabak, Almarkhiyat, and Merowe).

It was found there was some bus voltages out of tolerance such as kilo-x bus was less than permissible level. To regain the voltage level at all buses, the network was compensated using SVC.

Some contingences had been studied by opening the line between (Merowe-Atbara) and adding a load of (200MW) for future planning in Kabashi sub station.

# مستخلص


يعتبر تحليل انسياب القدرة الكهربائية ذات اهمية في تحليل الاداء المستقر لمنظومة القوى الكهربائية و في الدراسات الخاصة بالتشغيل والتخطيط المستقبلي لنظم القوى الكهربائية.

وعميلة تحليل انسياب القدرة الكهربائية تحتاج الي تحديد بعض القيود مثل: الحد الأدني والأقصي للقدرة الغير فعالة ومدي نسبة التغير في المحولات وعدم تجاوز القدرة الفعالة المتفق علي نقلها علي سعة خطوط النقل.

أيضا تعتبر عملية تحليل نظم القدرة الكهربة ذات أهمية كبيرة في معرفة مدى تحمل الشبكة عند إضافة أحمال جديدة دون أن يؤدي ذلك الى حدوث أي خلل في منظومة القدرة الكهربائية.

في هذا المشروع تم تحليل جزء من شبكة النقل متمثل في خطوط النقل ذات الجهد العالي(500-220-110) كيلوفولت متمثلة في حلقتين: الأولى(مروي-عطبرة -قري- عدبابكركيلوعشرة-الروصيرص-ربك- المرخيات- مروي) والثانية (مروي-عطبرة- الكباشي - عدبابكر- كيلوعشرة- الروصيرص-ربك- المرخيات- مروي).

ووجد أن هنالك إنخفاض في جهد مجمع الكيلوعشرة العمومي, الذي كان مستوى الجهد به اقل من المستوى المسموح به.

تم عمل تعويض للشبكة بإستخدام مكثفات (SVC) لحل مشكلة انخفاض الجهود. كما تمت دراسة تحليل الاحداث بخروج خط (مروي-عطبرة), و كذلك إضافة حمل مستقبلي (200 ميقاواط) مأخوذة من محطة الكباشي.

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# LIST OF SYMBOLS

| | |
|---|---|
| \|V\| | Voltage Magnitude |
| P | Real Power |
| Q | Reactive Power |
| δ | Power Angle |
| $S$ | Apparent Power |
| $Ybus$ | Bus admittance matrix |
| $[Y]$ | Elements of the bus admittance matrix |
| $[V]$ | Bus voltages matrix. |
| $[I]$ | currents injected at each node |
| θ | Admittance Angle |

# LIST OF ABBREVIATIONS

| | |
|---|---|
| Bus | Busbar |
| P-Q | Load Bus |
| P-V | Control Bus |
| SLFE | Static Load Flow Equation |
| GS | Gauss-Seidel |
| NR | Newton-Raphson |
| FDLF | Fast Decoupled Load Flow |
| ETAP | Electrical Transient Analysis Program |
| AC | Alternating Current |
| DC | Direct Current |
| OLD | One-Line Diagrams |
| OLV | One-Line View |
| IEC | International Electrical Commission |
| ANSI | American National Standard Institute |
| SETCO | Sudanese Electricity Transmission Company |
| MWP | Merowe Power Station |
| ROS | Alroseires |
| RBK | Rabak |
| GER | Garry |
| ATB | Atbara |
| KAB | Alkabashi |
| IBA | Eid Babiker |
| KLX | Kilo 10 |
| MAR | Almarkhiat |