بسم الله الرحمن الرحيم

وَالْعَصْرِ (1) إِنَّ الْإِنْسَانَ لَفِي خُسْرٍ (2) إِلَّا الَّذِينَ آمَنُوا وَعَمِلُوا الصَّالِحَاتِ وَتَوَاصَوْا بِالْحَقِّ وَتَوَاصَوْا بِالصَّبْرِ (3)

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Abstract

The thesis first presents the basics influences of wind power on the power system stability and quality by pointing out the main power quality issues of wind power in a small-scale case and following, the expected large – scale problems are introduced. Secondly, a dynamic wind turbine model that supports power quality assessment of wind turbines is presented. Third, an aggregate wind farm model that support power quality and stability analysis from large wind farms is presented. The aggregate wind farm model includes the smoothing of the relative power fluctuation from a wind farm compared to a single wind turbine. Finally, applications of the aggregate wind farm model to the power systems are presented .The power quality and stability characteristics influenced by large- scale wind power are illustrated with one case.

In this thesis, special emphasis has been given to appropriate models to represent the wind acting on wind farms. The wind speed model to a single wind turbine includes turbulence and tower shadow effects from the wind and the rotational sampling turbulence due to the rotation of the blades. The wind speed model to the wind farm includes the spatial coherence between different wind turbines in some type of scale. Here the wind speed model is applied to a constant rotational speed wind turbine/farm, but the model is suitable to variable speed wind turbine/farm as well.

The case presented here illustrates the influences of the wind power on the power system quality stability. The flicker and frequency deviations are the main power quality parameters presented. The power system stability concentrates of voltage stability and on the power system oscillations.

From the case studied, voltage and the frequency variations were smaller than expected from the large-scale wind power integration due to the low spatial correlation of the wind speed.

Concerning the stability analysis, the study cases showed that large-scale wind power modifies the voltage stability of the power system and can cause power oscillations. It is showed here that the reactive power from the wind farms is the key factor on the voltage stability problem. During continuous operation, the distributed wind power variations did not give any problems to the power system stability concerning the power oscillations.

مستخلص

في بداية هذا البحث تم استعراض أساسيات انسياب طاقة الرياح على أنظمة القدرة من حيث الاستقرارية والجودة. ولقد تم تطبيق هذه الأساسيات على وحدات صغيرة ثم أخرى كبيرة لمعرفة حجم المشاكل والمعوقات التي تواجهه هذه القدرة لإدخالها في شبكات القدرة. لإكمال هذه الدراسة كان لزاماً ان يتم تشكيل نموذج لمولد طاقة الرياح وذلك للمساعده على تمثيل هذ المولد داخل الشبكة المستهدفة.

ولقد تم ايضا تجهيز النموذج وادخاله على الشبكة تمت دراسة الجهد والترد والقدرة الفعالة والقدرة غير الفعالة، وعموماً تم استبعاد تحليل التردد وذلك لتطابقه تماماً مع المنحنى المنتج بواسطة الجهد لذا ينطبق تحليل الجهد والتردد.

أخيراً تم في هذا البحث كيفية اجراء المعالجات لمشاكل ادخال وحدات التوليد بواسطة طاقة الرياح، لشبكة القدرة الرئيسية، وذلك عبر اختيار نوعية المولد والموقع مع استخدام التقانات الحديثة في توجيه مراوح المولدات بحيث تعطي أكبر استقرارية في التوليد.

وفي الخلاصة تم تحليل منتجات البحث في حالة الاستقرار وحالة الأعطال ،ولقد تم اخراج بعض التوصيات.

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