

بسم الله الرحمن الرحيم

قال تعالى

هُوَ الَّذِي جَعَلَ ﴿١٣﴾  
لِلشَّمْسِ ضِيَاءً وَلِلْقَمَرِ  
نُورًا وَقَدَرَهُ مَنَازِلَ  
لِتَعْلَمُوا عَدَدَ ﴿١٤﴾ السِّنِينَ  
وَلِحِسَابِ مَا خَلَقَ ﴿١٥﴾ لِلَّهِ  
ذَلِكَ إِلَّا بِالنَّحْوِ يُفَصِّلُ  
﴿١٦﴾ لآيَاتٍ لِّقَوْمٍ يَعْلَمُونَ ﴿١٧﴾

صدق الله العظيم

سورة يونس

(الآية 5)

# **DEDICATION**

To my parent  
To my family  
And to my friends

## **ACKNOWLEDGEMENT**

First of all Thanks for my God who helped me to complete this project. Also I would like to thank the staff of the Solar Energy Research Institute for its permission to dig into and borrow from their publications, on which this research is almost wholly based.

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## **ABSTRACT**

Renewable energy represents one of the options to replace the fossil fuel. Photovoltaic represents one of the techniques used for converting solar energy into electrical energy. The Photovoltaic system is installed either as stand-alone or connected to network via power electronic converter. The main issues for solar power integration are unit sizing and negative impact mitigation of solar power in the system. The injected solar energy may affect the frequency and voltage of the system. Power storage can be used to facilitate frequency control during solar power integration as seen in this thesis when BESS is connected in the system the frequency is kept within the permissible limit (49.5-50.5Hz) although the significant change in solar power injection.



الطاقات المتجددة تمثل بديلاً مثالياً لوقود الحاراري. والخلايا الشمسية هي واحدة من التقنيات المستخدمة لتحويل الطاقة الشمسية الى طاقة كهربائية. ويمكن إنزالها كمحطات معزولة كما يمكن ربطها مع الشبكة باستخدام معدات إلكترونيات القدرة. المشكلات الأساسية عند بناء محطة شمسية تكمن في كيفية إختيار الحجم المناسب للوحدات وتقليل الآثار السلبية للمحطة على الشبكة الأم عند ربطهما. الطاقة الشمسية المدقونة في الشبكة يمكن أن تؤثر على جهد و تردد الشبكة. يتم استخدام أجهزة تخزين القدرة للمساعدة على التحكم في التردد عند حرق الطاقة الشمسية كما وضح في هذا البحث عندما ساعدت اجهزة تخزين القدرة في حفظ التردد عند القيم المسموح بها تشغيليا (50.5Hz-49.5) رغم التغيير الكبير في حرق الطاقة الشمسية .

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## ABBREVIATION

PV	Photovoltaic.
PSH	Peak sun hour.
H	Solar intensity.
DOD	Depth of discharge.
VSI	Voltage source Inverter.
CSI	Current source Inverter.
PWM	Pulse width modulation.
IGBT	Insulated gate bipolar transistor.
DC	Direct current.
AC	Alternating current.
U	Input vector.
B	Bus bar.
P	Real power.
Q	Reactive power.
PI	Proportional integral.
$V_{B1}$	Voltage at bus 1.
$V_{B2}$	Voltage at bus 2.
$i_{sd}, i_{sq}$	currents through the inverter in the $d-q$ reference frame.
$V_{cd}, V_{cq}$	bus voltage in the $d-q$ reference frame.