

ห้องสมุดงานวิจัย สำนักงานคณะกรรมการวิจัยแห่งชาติ



E46988

**POWER QUALITY IMPROVEMENT FOR PERMANENT MAGNET PICO-  
HYDRO GENERATOR**

**BENTHILAVANH TESO**

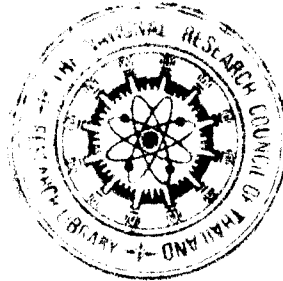
*A Thesis Submitted to the Graduate School of Naresuan University  
in Partial Fulfillment of the Requirements  
for the Master of Science Degree in Renewable Energy  
May 2011  
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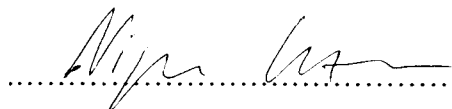
This thesis entitled "Power quality improvement for permanent magnet Pico-hydro generator" submitted by Benthilavanh Teso in partial fulfillment of the requirements for the Master of Science Degree in Renewable Energy is hereby approved.



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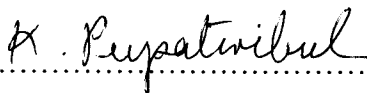


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### ABSTRACT

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In this thesis, the power quality improvement for permanent magnet Pico-hydro generator (PMG) was studied by doing experiment of Pico-hydro generator laboratory with capacity of 1000 W, single phase voltage of 220 V, nominal speed of 1500 RPM and frequency of 50 Hz. Power quality improvement aimed to increase PMG output voltage in case of the output voltage is lower than 220 V and regulate the voltage and the frequency constantly (at EN 50160 standard of Provincial Electricity Authority  $220\text{ V} \pm 10\%$  and  $50\text{ Hz} \pm 0.5\text{ Hz}$ ) during on load operation or household load is varied. It also included 2 main proposes: 1<sup>st</sup> propose is to analyze the electrical characteristics of PMG and 2<sup>nd</sup> propose is to improve the power quality of PMG. Electrical characteristics analysis consists of: analyze the voltage and frequency of PMG during no load operation in the form of increasing frequency or speed to increase the output voltage, variation of voltage and frequency during on load operation, find the output voltage that is dropped or lower than 220 V during full load operation and find the actual capacity or active power, reactive power and apparent power of PMG. Power quality improvement used the data from electrical characteristics analysis to calculate for capacitance and for the setting values of the dummy load controller; power quality improvement consists of: parallel capacitor into the system to increase an output voltage and use dummy load controller (DLC) to regulate the voltage and the frequency constantly (at  $220\text{ V} \pm 10\%$  and  $50\text{ Hz} \pm 0.5\text{ Hz}$ ) during on load operation or household load is varied.

From experimental results found that: during no load operation, output voltage at frequency of 50 Hz was 238 V and the maximum output voltage was 319 V at a maximum frequency of 66.7 Hz. But during on load operation, at frequency of 50 Hz the output voltage was dropped to 192 V (lower than 220 V) because the PMG rotor is a permanent magnet that is unable to increase or decrease an output voltage. During on load operation, the output voltage and the frequency were not constant due to the varied household load. If the output voltage and the frequency were higher or lower than 220 V and 50 Hz such as: at load of 60 W, voltage of 281 V and frequency of 62.2 Hz; at load of 420 W, voltage of 162 V and frequency of 42.9 Hz, such voltage and frequency will affect the lifetime of appliances (lifetime of appliances will be shorter). During full load operation (on load operation at frequency of 50 Hz), actual capacity or active power, reactive power and apparent power were obtained 284 W, 198 VAR and 346 VA.

After electrical characteristics were already analyzed, some data from them such as: output voltage of 192 V, active power of 284 W and reactive power of 198 VAR were used to calculate for capacitance and for the setting values of dummy load controller. From the calculation for capacitance, capacitor  $4 \mu\text{F} \pm 5\%$  400 V could increase an output voltage from 192 V to 223 V and reactive power of PMG from 198 VAR to 237 VAR, but such capacitor is a capacitive load that decreases active power of PMG from 284 W to 245 W. When the household load was varied, dummy load controller could regulate the output voltage and the frequency nearly constantly; output voltage from 219 V to 227 V was in the range of  $220 \text{ V} \pm 10\%$  and frequency from 49.2 V to 50.8 Hz was nearly in the range of  $50 \text{ Hz} \pm 0.5 \text{ Hz}$ .

# LIST OF CONTENTS

Chapter	Page
<b>I INTRODUCTION</b> .....	1
Rationale for the study and statement of the problem.....	1
Proposes of the study.....	2
Benefit of the study .....	2
Scope and limitation of the study .....	3
<b>II REVIEW OF RELATED LITERATURE AND RESEARCH</b> .....	4
Overview of Pico-hydro generator .....	4
Power quality.....	8
Permanent Magnet Generator (PMG) .....	9
Electrical characteristics of PMG.....	10
Capacitor .....	14
Dummy load controller .....	19
<b>III RESEARCH METHODOLOGY</b> .....	28
Research instrument .....	28
Methodology .....	33
<b>IV RESULT AND DISCUSSION</b> .....	39
Electrical characteristics analysis.....	39
Power quality improvement .....	42
<b>V CONCLUSION AND RECOMMENDATION</b> .....	45
Conclusion.....	45
Recommendation.....	46
<b>REFERENCES</b> .....	47

## LIST OF CONTENTS (CONT.)

<b>Chapter</b>	<b>Page</b>
<b>APPENDIX</b> .....	50
<b>BIOGRAPHY</b> .....	56

## LIST OF TABLES

<b>Table</b>		<b>Page</b>
1	Efficiency, head and flow rate.....	8
2	Increase of voltage that depends on increase of frequency .....	39
3	Voltage and frequency at on load operation.....	40
4	Result of voltage and frequency after using dummy load controller .....	42

## LIST OF FIGURES

Figure		Page
1	Pico-hydro generator generates electricity for households .....	4
2	Reaction turbines (Francis, Kaplan and Bulb) .....	5
3	Impulse turbines (Pelton, Turgo and Cross flow) .....	6
4	Generator .....	6
5	Rotor and Stator of PMG.....	10
6	Permanent magnet rotates among a coil.....	10
7	Voltage waveform .....	11
8	Voltage is increased due to increase of speed or frequency .....	11
9	Electric circuit of PMG .....	12
10	Relation between active power, reactive power and apparent power .....	14
11	Pure capacitive circuit: capacitor voltage lags capacitor current by 90° ..	15
12	Pure capacitive circuit waveforms.....	15
13	Voltage lags current by 90° in a pure capacitive circuit.....	16
14	Rotor with excitation current.....	18
15	Permanent magnet rotor without excitation current .....	18
16	Capacitor is paralleled into the system.....	18
17	Capacitor consumes active power ( $P_1-P_2$ ) to produce reactive power ( $Q_2-Q_1$ ) .....	19
18	ELC with heater load.....	20
19	Output power is adjusted to supply load to hot water and consumer.....	20
20	Pico-hydro generator laboratory .....	28
21	Electric circuit of control panel .....	29
22	Permanent magnet generator .....	30
23	Bulbs as dummy load .....	30
24	Capacitor.....	31

## LIST OF FIGURES (CONT.)

Figure		Page
25	Dimmer switch .....	31
26	Dummy load controller.....	32
27	Household load.....	32
28	Process of electrical characteristics analysis .....	34
29	V/Hz chart .....	35
30	Variation of voltage and frequency that are not regulated .....	36
31	Process of power quality improvement .....	37
32	Increase of voltage that depends on increase of frequency .....	40
33	Voltage and frequency at on load operation.....	41
34	Active power, reactive power and apparent power at full load operation.....	41
35	Result of voltage after using dummy load controller .....	43
36	Result of frequency after using dummy load controller .....	44