ANALYSIS OF POWER QUALITY ISSUES DUE TO THE 
PROPOSED SOLAR POWER PLANTS IN 
HAMBANTOTA

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December 2014
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Sri Lanka

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DECLARATION

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Signature of the supervisor       Date:
(Prof. J. P. Karunadasa)
ABSTRACT

Solar power plants, despite their high initial investment are fast spreading in Asian countries owing to the availability of higher solar radiation throughout the day time. In Sri Lanka, two grid connected small scale solar power plants of 737 kW, 500 kW are already in operation located in Baruthankanda, Hambantota.

Three private developers have made proposals for another 30 MW solar plants, (each 10 MW) near the existing plants which would be directly connected to 33kV Bus at Hambantota GSS. However, unpredictable variations in the source of energy and power electronic converters of such a large solar power plant can create a significant impact on the existing power system in power quality point of view.

This thesis describes the details of a study carried out on the probable impacts on power quality at the GSS due to random fluctuation of solar radiation level for different system-design options of the proposed 30 MW plant. Standards IEEE 519-1992 and IEEE 1547-2003 were used in the power quality check-up.
First, I pay my sincere gratitude to Prof. J.P. Karunadasa who encouraged and guided me to conduct this investigation and on preparation of final dissertation.

I extend my sincere gratitude to Prof. M. P. Dias, Head of the Department of Electrical Engineering and all the lecturers and visiting lecturers of the Department of Electrical Engineering for the support extended during the study period.

I would like to thank Dr. Sugathapala, Director General (SEA), Mr. Nadeera, and Mr. Athula from sustainable energy authority who gave me the extreme support and opportunity to gather required information & data of the existing solar power plants.

I also thank to Mr. L. D. J. Fernando, DGM (P&D)-DD4, Mr. R. S. Wimalendra, CE (P&D)-DD4 who encouraged me and provided required resources to carry out this study.

The support given by the technical staff attached to solar power plants at Baruthankanda, Hambantota and the developers of proposed power plants was remarkable.

I would like to take this opportunity to extend my sincere thanks to Mr. Chintaka Kumara Area Engineer (Hambantota), Mr. Lakshitha Wisumperuma, Electrical Engineer (Meter Lab)-DD4, Ms. Charitha Dissanayakage, EE (Maint.)-Hambantota, Ms. N.R. Ramasinghe, Electrical Engineer (Planning) –SP, Mr. Hettige, ES (Hambantota), Mr. Buddhika, ES (Hambantota) and all the colleagues of Ceylon Electricity Board who gave their cooperation to conduct my investigation work successfully.
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<td>Ceylon Electricity Board</td>
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<tr>
<td>SEA</td>
<td>Sustainable Energy Authority</td>
</tr>
<tr>
<td>PSCAD</td>
<td>Power Systems Computer Aided Design</td>
</tr>
<tr>
<td>P&amp;D</td>
<td>Planning &amp; Development</td>
</tr>
<tr>
<td>EE</td>
<td>Electrical Engineer</td>
</tr>
<tr>
<td>ES</td>
<td>Electrical Superintendent</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical &amp; Electronic Engineers</td>
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<tr>
<td>TDD</td>
<td>Total Demand Distortion</td>
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<tr>
<td>NCRE</td>
<td>Non- Conventional Renewable Energy</td>
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<td>GSS</td>
<td>Grid Sub Station</td>
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<td>PV</td>
<td>Photo Voltaic</td>
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<td>DC</td>
<td>Direct Current</td>
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<td>AC</td>
<td>Alternative Current</td>
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<td>STC</td>
<td>Standard Test Conditions</td>
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<td>MPPT</td>
<td>Maximum Power Point Tracking</td>
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<tr>
<td>IC</td>
<td>Incremental Conductance</td>
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<tr>
<td>P&amp;O</td>
<td>Perturb &amp; Observe</td>
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<td>THD</td>
<td>Total Harmonic Distortion</td>
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<td>PCC</td>
<td>Point of Common Coupling</td>
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<tr>
<td>DR</td>
<td>Distributed Resource</td>
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<tr>
<td>RMS</td>
<td>Root Mean Square</td>
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<tr>
<td>DDLO</td>
<td>Drop Down Lift Off</td>
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<tr>
<td>ABS</td>
<td>Air Break Switch</td>
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<tr>
<td>EMTDC</td>
<td>Electro Magnetic Transients including DC</td>
</tr>
<tr>
<td>IGBT</td>
<td>Insulated gate Bipolar Transistor</td>
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<td>PWM</td>
<td>Pulse Width Modulation</td>
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