POOR POWER QUALITY
CAUSALITIES AND CASUALITIES

It is said each time engineers solve one problem they create ten more

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1. Introduction

- **AIM:** Assess PQ parameters associated with introduction of DG both on the supply and load (the case of FC of Anglo American in Joburg failed)

- **OBJECTIVE:** Understand dual power flow, plan, design and protect the utility’s grid against potential PQ problems

- **METHODOLOGY:** Reviewed literature on PQ, micro grids, inverters, optimal measurements of network parameters,

- **SELECTION:** Selected similar utilities to the South African situation.

- **CONCLUSION:** Findings and recommendations
Figure 1-11 In the future, small, dispersed-energy-storage-and-generation units attached to a customer’s home, a power distribution feeder, or a substation would require an increasing amount of automation and control. (From [26]. Used by permission. © 1982 IEEE.)
Various forms of DG will be connected with its own unique architecture and has to be modelled and assessed for PQ.
The Transmission and Distribution network service providers shall use reasonable endeavours to furnish the RPP with a reliable and continuous connection for the delivery of electrical energy up to the POC. The network operators do not guarantee that the continuity and voltage quality of the connection will always be maintained under all contingencies. It is therefore incumbent upon the RPP to take adequate measures to protect the RPP facility against any losses and/or damage arising from frequency deviations, connection/supply interruptions, voltage variations (including voltage dips), voltage harmonics, voltage flicker, voltage unbalance, voltage swells and transients, under voltages and overvoltage's in the connection. It is also incumbent upon the RPP to take such necessary measures so as not to cause any damage to the TS and DS.

It’s a requirement that QOS meters are installed at the point of generation of renewables. But what and who monitors that and what are the consequences of exceedance of any of the limits provided in the code?
Power Quality Parameters that needs to be measured

- Voltage unbalance
- Harmonics
- Flicker
- Voltage disturbances
- Rapid voltage change

Dip
Swell
Transient
Spike
Typical DSG simulation to determine PQ parameters likely to be outside the agreed limits

- DCMLI: Diode Clamped Multi Level Inverter.
- DC Motor Synchronous Generator
# Research Findings from Indian Utility on PQ Parameters

## Table V. Power Quality Analysis

<table>
<thead>
<tr>
<th>Factor</th>
<th>Limits</th>
<th>Normal</th>
<th>DCMLI</th>
<th>DCMSG</th>
<th>Superior</th>
</tr>
</thead>
<tbody>
<tr>
<td>THD</td>
<td>5-8 %</td>
<td>9.29 %</td>
<td>4.83 %</td>
<td>4.58 %</td>
<td>DCMSG</td>
</tr>
<tr>
<td>Voltage Imbalance</td>
<td>10 %</td>
<td>7.5 %</td>
<td>3.8 %</td>
<td>1 %</td>
<td>DCMSG</td>
</tr>
<tr>
<td>Over Voltage</td>
<td>10 %</td>
<td>5 %</td>
<td>3 %</td>
<td>2 %</td>
<td>DCMSG</td>
</tr>
<tr>
<td>Under Voltage</td>
<td>10 %</td>
<td>6 %</td>
<td>6 %</td>
<td>2 %</td>
<td>DCMSG</td>
</tr>
<tr>
<td>Voltage Sag</td>
<td>40 %</td>
<td>43 %</td>
<td>47 %</td>
<td>15 %</td>
<td>DCMSG</td>
</tr>
<tr>
<td>Voltage Swell</td>
<td>40 %</td>
<td>20 %</td>
<td>40 %</td>
<td>32 %</td>
<td>Normal</td>
</tr>
<tr>
<td>Flicker</td>
<td>1-3 Pst</td>
<td>19 Pst</td>
<td>7 Pst</td>
<td>10 Pst</td>
<td>DCMLI</td>
</tr>
<tr>
<td>Efficiency</td>
<td>--</td>
<td>97.0 %</td>
<td>97.0 %</td>
<td>91.78 %</td>
<td>DCMLI</td>
</tr>
</tbody>
</table>

Results from MATLAB/Simulink
Conclusion and Recommendations

- Assessment findings show that proliferation (causes) of DSG does not cause power quality problems with the current the assessed micro grid architecture.
- That all PQ parameters are within the NRS 048 and internationally agreed limits (IEC working group limits are still awaited to provide more guidelines on all PQ parameters).
- Casualties, to date have not been found.

- This leaves the industry with a problem. Are measuring what needs to be measured.
- More research still to be conducted on the reality of and impact of PQ parameters if any.
THANK YOU