Mitigating Reverse Power Flow Due to Distributed Generation on Networked Secondary Distribution Systems

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Background and Objective

Background
Network protectors are devices that are on the transformers in a secondary network that will disconnect the line if there is reverse power flow. Having customer owned generation could lead to reverse power flow in the secondary network. Our team’s goal was to provide a solution that would allow Avista to have customer generation. Reverse power flow damages a secondary network because all the loads are interconnected.

Objectives for the Project
• Mitigate problems caused by reverse power flow
• Create a model to simulate the design solution in PowerWorld
• Allow multiple DERs in the system

Broader Impacts

Contemporary issues the team found were:
• Batteries are becoming more accessible leading to increase of DERs install.
• Companies are aiming for 100% renewable energy operations
• Japan is launching a pilot project aimed to allow consumers to trade renewable energy

Secondary Network

Simulations

Spot Network with 0.2% sensitivity

Spot Network with 5% sensitivity

Typical Secondary Network with 0.2% sensitivity

Typical Secondary Network with 5% sensitivity

Results

216 V Transformers’ Network Protector Sensitivity

<table>
<thead>
<tr>
<th>CT primary windings</th>
<th>Power Rating</th>
<th>Initial Settings</th>
<th>New Settings</th>
<th>Power Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>800A</td>
<td>299 kW</td>
<td>0.60 kW</td>
<td>14.96 kW</td>
<td>14.36 kW</td>
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<tr>
<td>1200A</td>
<td>449 kW</td>
<td>0.90 kW</td>
<td>22.45 kW</td>
<td>21.55 kW</td>
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<tr>
<td>1600A</td>
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<td>1.20 kW</td>
<td>29.93 kW</td>
<td>28.73 kW</td>
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<tr>
<td>2500A</td>
<td>935 kW</td>
<td>1.87 kW</td>
<td>46.77 kW</td>
<td>44.90 kW</td>
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480 V Transformers’ Network Protector Sensitivity

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<th>CT primary windings</th>
<th>Power Rating</th>
<th>Initial Settings</th>
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<th>Power Increase</th>
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</thead>
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<td>1200A</td>
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<td>4.16 kW</td>
<td>103.9 kW</td>
<td>99.74 kW</td>
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</tbody>
</table>

Future Work

• Perform contingency analysis on how the system responds to DER integration
• Explore other possible solutions for reverse power flow
• Control system to control DERs output
• Battery storage for excess power
• Digital relays with complex fault detection

Glossary

DG – Distributed Generator
DER – Distributed Energy Resource

Acknowledgement

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Team Gerrha