Towards a SMART Network in a Business District: Combining dispersed UPS with distributed generation

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Power Supply. City of Zurich.

Total energy output ewz 5314 GWh
Total power consumption Zurich 3077 GWh
Maximum load - peak power ewz 608 MW
Maximum load - peak power Zurich 512 MW

150-kV-sub-transmission network in kilometers 155
EHV/HV substations Zurich 4
HV/MV substations Zurich 15
MV cables in kilometers 850
LV cables in kilometers 2000
MV stations Zurich 882

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Continuity of Supply.

High-end Customers

Uninterrupted Power Supply

Local Solution

Possible Alternative

UPS System

Secondary Network from DSO

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Standard Network Solutions.

Second power supply from same substation

Second power supply from another substation

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Secondary Network.

- Substation - substation path
- Independent MV network

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Reliability. Standard network solution.

ewz Reliability-Calculation-Tool

<table>
<thead>
<tr>
<th>Variable</th>
<th>Without blackout risk</th>
<th>With blackout risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection to standard network (variant 0)</td>
<td></td>
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<tr>
<td>outage rate H (#/Jahr)</td>
<td>0.080</td>
<td>0.130</td>
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<tr>
<td>outage time T (h)</td>
<td>0.727</td>
<td>1.216</td>
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<tr>
<td>outage probability P (h/Jahr)</td>
<td>0.058</td>
<td>0.158</td>
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Self-contained power supply with UPS (variant 1)

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<thead>
<tr>
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<tbody>
<tr>
<td>outage rate H (#/Jahr)</td>
<td>0.0096</td>
<td>0.0165</td>
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<tr>
<td>outage time T (h)</td>
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<tr>
<td>outage probability P (h/Jahr)</td>
<td>0.0003</td>
<td>0.0005</td>
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Second power supply to another substation (variant 2)

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<tbody>
<tr>
<td>outage rate H (#/Jahr)</td>
<td>0.0086</td>
<td>0.046</td>
</tr>
<tr>
<td>outage time T (h)</td>
<td>0.0798</td>
<td>2</td>
</tr>
<tr>
<td>outage probability P (h/Jahr)</td>
<td>0.0007</td>
<td>0.092</td>
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</tbody>
</table>

UPS with larger battery capacity than in variant 1

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Reliability. Secondary network.

ewz Reliability-Calculation-Tool

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<th>Variable</th>
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<th>With blackout risk</th>
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</thead>
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<tr>
<td></td>
<td>H=0.05 #/a, T=2h</td>
<td></td>
</tr>
<tr>
<td>Outage rate H (#/Jahr)</td>
<td>0.0086</td>
<td>0.046</td>
</tr>
<tr>
<td>Outage time T (h)</td>
<td>0.0798</td>
<td>2</td>
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<td>Outage probability P (h/Jahr)</td>
<td>0.0007</td>
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</tr>
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Secondary network (variant 3)
Reliability indices equivalent to variant 2

Secondary network with backup generator (variant 4)
Backup generator in substation to cover blackout risk

UPS with smaller battery capacity than in variant 3 and 2

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Costs.

- Interruption costs for high-end customers can exceed several 100’000 €
- Variant 4) is a good alternative to a self-contained power supply
Integration of Distributed Generation.
Use synergies of secondary network and distributed generation

- Unchanged operation of standard network
- Better control of voltage quality
- Use of distributed generation as backup
- Specific requirements limited to 2nd network

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Future Prospects.

- ewz will pass from planning to realization of the secondary network in 2009
- Future research and technical analyses on:
  - Integration of distributed generation
  - Embedding of storage devices

SMART-Network