Security of electricity supply - analysis tools

Power system simulations, power market analysis as well as power system security and reliability analysis are fundamental analysis tasks in power system planning and operation.

The SAMREL concept provides an integration of the power market simulator (EMPS) and a newly developed methodology for reliability and interruption cost assessment (OPAL) with power flow models. Such an integration is required to provide a comprehensive and consistent methodology for security of electricity supply analysis.

The SAMREL concept provides:
- A consistent methodology for the chain of analyses from power market analysis to reliability of supply analysis
- Improving both market simulations and reliability assessment
- Based on a modular structure and defined interfaces
- Fundamental tool for security of supply and vulnerability analysis on a regional, national and Nordic level
Ongoing work:
First phase suitable for planning purposes (EMPS, OPAL)

Further work:
Development of modules and interfaces, for more applications such as online operation

Prospective applications:
- Estimation of reliability and security of supply (SoS)
- Investment analysis
- Maintenance planning and coordination
- Estimation of future energy prices, marginal losses, load limits etc.
- Implementation of risk based power system operation

Such analyses are demanded by:
- Transmission system operators
- Authorities
- Regional grid utilities
- Power producers
- Large industrial companies

Case study – reliability of supply for delivery points
- Two delivery points: L1 = 650 MW (centrally located), L2 = 220 MW (single-sided supply)
- Three operational states: Week 4, 16 and 30
- 330 single and 46 double outages were analyzed
- Interruptions due to islanding, overload and voltage deviations

<table>
<thead>
<tr>
<th>Delivery Point</th>
<th>No. of Interruptions per Year</th>
<th>Annual Interruption Duration (hrs/yr)</th>
<th>Energy not Supplied (MWh/yr)</th>
<th>Cost of Energy not Supplied (€/yr) (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 (650 MW)</td>
<td>0.03</td>
<td>0.007</td>
<td>4.55</td>
<td>8000</td>
</tr>
<tr>
<td>L2 (220 MW)</td>
<td>1.35</td>
<td>2.36</td>
<td>919</td>
<td>3 million</td>
</tr>
</tbody>
</table>

Enhanced power system and reliability analysis

1. Power market analysis (EMPS)
2. Contingency analysis
3. Reliability analysis (OPAL)

OPAL
Optimization of reliability of supply in power networks, requirement specification

Contact:
Senior Research Scientist Gerd Kjølle,
Phone: +47 73 59 72 75, gerd.kjolle@sintef.no
Research Scientist Oddbjørn Gjerde
Phone: +47 73 59 72 11, oddbjorn.gjerde@sintef.no