Generation loss source location for grid operations with synchrophasor data

Tariq Rahman
San Diego Gas & Electric®

Jared Bestebreur
Schweitzer Engineering Laboratories, Inc.
Frequency response to generation loss

The graph shows the frequency (Hz) over time (s) following a generation loss event. The frequency drops significantly between 1,880 and 1,890 seconds, reaching a minimum around 1,890 seconds, and then gradually increases back to a stable value.
SDG&E® mission control room

Primary video wall

Secondary video wall (Synchrowave Operations*)

Operator desk

Operator desk

Shift supervisor desk

*SEL-5702 Synchrowave® Operations Software
SDG&E primary video wall
SDG&E secondary video wall
SDG&E secondary video wall

What is this?

and this...

and this...
Why start with generation loss events?

- It is hard to detect location by simply looking at frequency data on video walls
- System events are often significant
- Generation loss events are common in WECC

20 generation loss events were detected in 2-week period between September 1 and September 15, 2021
Out-of-system generation loss
Substation X
Detecting generation loss

Preprocessed signals

Event detection

Event onset

Time (s)

Frequency (Hz)
Determining source

Preprocessed signals

Sort by time

Frequency (Hz)

Time (s)
Challenges determining location

- Lower PMU data rate
- PMU data quality
- PMUs that filter differently
- Generation trip detection
- Onset detection
- Inertia
WECC synchrophasor data help determine location
## WECC generation loss events and results

<table>
<thead>
<tr>
<th>Date (2021)</th>
<th>Generation loss (MW)</th>
<th>Public location</th>
<th>Algorithm results (proximity to actual location)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 20</td>
<td>1,460</td>
<td>Coal/steam in Montana</td>
<td>✔</td>
</tr>
<tr>
<td>Sep 8</td>
<td>420</td>
<td>Hydro in Northeast Washington</td>
<td>✔</td>
</tr>
<tr>
<td>Sep 13</td>
<td>1,030</td>
<td>Hydro in British Columbia</td>
<td>✔</td>
</tr>
<tr>
<td>Nov 15</td>
<td>470</td>
<td>Hydro in Northeast Washington</td>
<td>✔</td>
</tr>
<tr>
<td>Dec 4</td>
<td>620</td>
<td>Hydro in North Central Washington</td>
<td>✔</td>
</tr>
</tbody>
</table>
Coal/steam in Montana

WECC GENERATION LOSS EVENT 1
Out-of-system generation loss Montana
Hydro in Northeast Washington

WECC GENERATION LOSS EVENT 2
Out-of-system generation loss
Northeast Washington
Hydro in British Columbia

WECC GENERATION LOSS EVENT 3
Out-of-system generation loss
British Columbia
Hydro in Northeast Washington

WECC GENERATION LOSS EVENT 4
Out-of-system generation loss
Hydro Northeast Washington
Hydro in North Central Washington

WECC GENERATION LOSS EVENT 5
Out-of-system generation loss
North Central Washington
Questions?