DOE Office of Electricity TRAC

Peer Review
PROJECT SUMMARY

MASTERRI

Merging power flow simulations, probabilistic risk assessment, and resilience metrics
PRINCIPAL INVESTIGATORS
Dr. Bjorn Vaagensmith, Power Systems Researcher, INL
Shawn West, Senior Power Systems Researcher, INL

WEBSITE
www.INL.gov
The Numbers

DOE PROGRAM OFFICE: OE – Transformer Resilience and Advanced Components (TRAC)

FUNDING OPPORTUNITY: XXX

LOCATION: Idaho Falls, Idaho

PROJECT TERM: 01/20/2020 to 09/30/2021

PROJECT STATUS: Completed

AWARD AMOUNT (DOE CONTRIBUTION): $500,000

AWARDEE CONTRIBUTION (COST SHARE): $XXX,000
Primary Innovation

- Combining power flow simulations with probabilistic risk assessment
  - quantify event severity and likelihood of occurrence
Impact/Commercialization

Impact
• Identified issues on the power grid and their likelihood of occurrence
  • Results validated by utility power engineers
• Aids engineers in deciding what system upgrades are most impactful or the best reconfiguration to avoid negative consequences
• Aids engineers in communicating to non-engineering management.

IP STATUS/Commercialization
Patent App. PCT/US19/4253
Innovation Update

• Adaptive capacity resilience metrics did not provide clear actionable results
  • Grouped components by bus resulted in little to no changes in adaptive capacity
  • New grouping mechanisms or new metrics are needed

• Technology commercialization funding was awarded
  • Develop MASTERRI into an easy-to-use software application

• Working with cyber capital partners to help with customer discovery to gauge commercialization potential
## Component likelihood of violation contribution

Ranks components in terms of likelihood (Fussell Vesely) to contribute to a system violation

<table>
<thead>
<tr>
<th>Name</th>
<th>F-V Point Est.</th>
<th>% of Top Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 1</td>
<td>2.06E-01</td>
<td>61.65%</td>
<td>AVERAGE LENGTH 200-499 KV LINE, 19.01 MI</td>
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<td>Line 1000000</td>
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<tr>
<td>Line 1.5</td>
<td>1.27E-01</td>
<td>61.65%</td>
<td>###.### MILE 230 KV LINE</td>
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<tr>
<td>Line 4</td>
<td>1.27E-01</td>
<td>61.65%</td>
<td>###.### MILE 230 KV LINE</td>
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<tr>
<td>Line 23</td>
<td>9.08E-02</td>
<td>44.08%</td>
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<tr>
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<td>Line 26</td>
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<td>19.61%</td>
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<td>19.61%</td>
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<td>Line 31</td>
<td>1.36E-02</td>
<td>6.60%</td>
<td>8.44 MILE 230 KV LINE</td>
</tr>
<tr>
<td>Line 32</td>
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<td>6.60%</td>
<td>8.44 MILE 230 KV LINE</td>
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<tr>
<td>Transformer 1</td>
<td>1.91E-04</td>
<td>0.09%</td>
<td>TRANSFORMER XXXX FAILURE</td>
</tr>
</tbody>
</table>
Ranks component combination failures in terms of likelihood that are most likely to result in a system violation.
Probability of occurrences contingency ranking

**TABLE INFORMATION:**
MASTERRI can rank

- Contingency scenarios
  - Under different grid configurations
- Contingency scenario pairs
- Compute the overall likelihood the system will experience a violation

![Contingency Likelihood Graph](image)
Summary

MASTERRI provides the likelihood and impact of power grid violations
• Components most likely to contribute to a system violations
• Component combinations most likely to contribute to a system violation
• Contingencies most likely to contribute to a system violation
• Overall likelihood the system will experience a violation

Future work
• Advance data visualization methods
• Frequency consequence curves
• Reevaluate resilience metrics
• Dynamic analysis
MASTERRRI:
• Modeling And Simulation for Targeted Reliability and Resilience Improvement
F-V
• Fussell Vesely
THANK YOU