



All Projects model analysis

The load flow models built for the 10-Year Assessment are specially built models used exclusively for the Assessment. Projects are purposely left out of these models in order to verify system problems exist and which ones get worse over time. After the 10-Year Assessment analysis is completed, models are built that include all planned, proposed and some provisional projects. These new models are called “All Projects” models and are more indicative of the expected system configurations for 2010, 2014 and 2019 study years. These models are more appropriate for internal planning studies performed throughout the year. As part of the 10-Year Assessment, zone planners perform system intact and required Reliability Standard contingency analyses on each of the “All Projects” models. The contingency analysis includes systematically removing each line, generator, transformer, and modeled bus ties individually to determine the affect on the transmission system. The analysis will verify whether all of the planned, proposed, and provisional projects will resolve issues revealed in the Assessment process.

The zone analysis discussions presented in this Assessment provides a list of reinforcements that are beginning to optimize our reinforcement plans, at least at the one- or maybe two-zone level.

Three important questions regarding this plan include the following:

- How do the reinforcements for all the zones perform together?
- Does applying a solution in one zone create a problem that was not seen before in another zone?
- Are some zone solutions redundant when all the solutions are applied to the system?

As we did in previous Assessments, this year we have tried to address the first two questions. We have built year 2010, 2014 and year 2019 models that include reinforcements reflecting our best thoughts on all of the most likely planned, proposed, and provisional projects to deal with the identified issues. These projects are those identified in the project tables for this Assessment with specific in-service dates. First contingency analysis was performed on these two new models, including selected outages on neighboring systems. This analysis showed that the reinforcements in total did indeed deal with the issues identified and did not create any new issues to be resolved. Some details for each zone are summarized below.

Zone 1

In the 2010, 2014 and 2019 summer peak “All Projects” models, most of the system overloads or low voltages in Zone 1 are addressed although a few issues still exist under single contingency conditions in our 2014 and 2019 models. The system issues remaining in the 2014 and 2019 “All Projects” models are:

- The Petenwell transformer is overloaded in the 2014 model under system intact conditions. The transformer is not overloaded in the 2019 All Projects model.
 - The issue can be addressed by redispatching the Big Pond generator.
- The Castle Rock – McKenna 69-kV circuit is overloaded in the 2014 model for the various 69-kV line outages.
 - The issue can be addressed by redispatching the Castle Rock generator.
- The system intact voltage for the Council Creek 161-kV bus is nearing the low voltage threshold in the 2014 and 2019 models.



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- Voltage can be improved by including the two Xcel Energy proposed capacitor bank projects at Monroe County and La Crosse Substations.
- Low voltages exist at the Sigel and Lakehead Vesper substations for the Arpin–Sigel 138-kV circuit outage in the 2019 model.
 - Voltages can be substantially improved by including the recently announced load reductions in the Wisconsin Rapids area.

Zone 2

With all projects in the 2010, 2014 and 2019 summer peak models, most of the system overloads and low voltages in Zone 2 are addressed, although system problems still exist under single contingency conditions in all three study years. The system issues remaining in the 2010, 2014 and 2019 all project models are:

- Low voltages at the Engadine, Newberry, and Roberts 69-kV buses are observed for various 69-kV line outages
 - These violations can be mitigated by running the Newberry Village and Dafter diesel generators.

Zone 3

With all projects in the 2010, 2014 and 2019 summer peak models, most of the system overloads and low voltages in Zone 3 are addressed, although several system problems still exist under single contingency conditions in 2010, 2014 and 2019. The system issues remaining in the 2010, 2014 and 2019 all project models are:

- The Verona-Oregon 69-kV line overloads and low voltages for the loss of Stoughton-Aaker Road 69-kV line. (2010)
 - Load bridging capability between Stoughton and Aaker Road substations can address this overload. The transmission solution for this problem is to rebuild the Verona-Oregon 69-kV line in 2011.
- The Fitchburg-Royster 69-kV line overloads for the loss of either end of the line (2010)
 - These violations will be also addressed by local load bridging. The transmission solution for this problem is to uprate Fitchburg-Nine Springs and Royster-Pflaum 69kV lines, move AGA to Femrite-Royster line and install Nine Springs Cap Bank.
- The Huiskamp-Mendota-Ruskin 69-kV line overloads for the loss of the North Madison-Vienna 138-kV line in the 2010 70 percent peak all project model (2010)
 - The short term mitigation plan is to bypass the line switch at Mendota. The long term transmission solution for this problem is to remove the line switch at Mendota tap by 2011 with the Mendota substation retirement project.
- The Darlington-North Monroe 138-kV line overload for the loss of the Paddock 345/138-kV transformer in the 2014 70 percent peak all project model (2014)
 - Possible mitigation plan is to dispatch Riverside generation.
- The Verona 138-kV bus is slightly below 90 percent for the loss of Oak Ridge-Verona 138-kV line in the 2019 summer peak all project model (2019).
 - Possible mitigation plan is to adjust the Verona 138/69-kV transformer to boost the 138-kV bus as necessary.



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- ❑ One East Campus-Walnut 69-kV line is overloaded for the loss of the second East Campus-Walnut 69-kV line in the 2019 summer peak all project model (2019).
 - Possible mitigation plan is to redispatch West Campus, Nine Springs, Fitchburg and Sycamore generation.
 - This potential issue was mainly caused by the provisional West Middleton-Blount 138-kV project. Considering the on-going major D-T load development in Madison area, no project is created at this point to address this overload due to the uncertainty of the need year for the West Middleton-Blount 138-kV project.
- ❑ Low 138-kV voltages at Hubbard and Hustisford for the loss of Rubicon-Hustisford
 - Possible operating procedure is to adjust the 138/69-kV Hubbard transformer load tap changer setting to boost the 138-kV bus voltage. The proxy transmission solution to this issue is to construct a Horicon-East Beaver Dam 138-kV line in 2019.

Zone 4

A contingency analysis was performed on the 2010, 2014, and 2019 “All Projects” models. With all of the planned, proposed, and some provisional projects modeled, no new Zone 4 facility overloads or voltage problems occurred.

Zone 5

A contingency analysis was performed on the 2010, 2014, and 2019 “All Projects” models. With all of the planned, proposed, and some provisional projects modeled, no new Zone 5 facility overloads or voltage problems occurred. Low bus voltage issues persist in Waukesha and Washington Counties. The expected addition of capacitors at Summit, Mukwonago, and Bluemound Substations is improving the situation. Running generation at Concord and Germantown also rectifies the situation. Further system improvements are still needed and under investigation.

Conclusion

We recognize that we need to continue to develop our reinforcement optimization processes. The analyses described are not the only methods we use to optimize our plans and do not begin to address the third question. Also, access-driven reinforcements, (with the exception of the second Paddock-Rockdale 345-kV line) were not included in this analysis as we await more definition of the most likely projects. However, our project development process, including development of the access projects, does look to optimize the projects that are finally built.