September 2011 10-Year Assessment
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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, all project-deficient models are updated to include all planned, proposed and most provisional projects. These new models are called “All Projects” models and are meant to test the combined effect of all solutions during the 10-Year Horizon, specifically in the 2012, 2016 and 2021 study years. 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, shunt devices and modeled bus ties individually to determine the effect on the transmission system. The analysis will verify whether the included 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 performed in previous Assessments, this year an attempt was made to address the first two questions. All project models were built for years 2012, 2016 and 2021 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 the 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 2012, 2016 and 2021 summer peak All Projects models, all system overloads and low voltages in Zone 1 have been addressed by planned, proposed, and provisional projects as well as appropriate system adjustments.

Zone 2

With all projects in the 2012, 2016 and 2021 summer peak models, most of the system overloads and low voltages in Zone 2 are addressed, although a few system limitations still exist under single contingency conditions in all three study years. The system issues remaining in the 2012, 2016 and 2021 "All Projects" models are:

- Low voltages at the Mead, Gladstone, North Bluff, and Bay View 69-kV buses are observed under certain contingency conditions in 2012.
    - These limitations will be eliminated once the Chandler 138/69-kV transformer is in service in late 2011. Dispatching local generation will be required to mitigate the constraints until then.
- Thermal overloads exist at the Chandler-Masonville 69-kV line under certain contingency conditions in 2012.
    - These limitations will be eliminated once the Chandler – 18th Road line project is in service in 2014. Dispatching local generation will be required to mitigate the constraints until then.
- Low voltages at the Newberry, Lou Pac, Newberry Hospital, Newberry Village and Roberts 69-kV buses are observed under certain contingency conditions in 2021.
    - Dispatching local generation can mitigate these voltage issues until approximately 2025. Additional analyses will be run to determine any future projects that could address these limitations in the future.

Zone 3

With all projects in the 2012, 2016 and 2021 summer peak and various sensitivity models, most of the system overloads and low voltages in Zone 3 are addressed, although several system problems still exist under system intact or single contingency conditions in 2012, 2016 and 2021. The system issues remaining in the 2012, 2016 and 2021 "All Projects" models are:

- The Pflaum-Royster 69-kV line overloads under certain contingency conditions in the 2012 summer peak model.
    - This limitation will be addressed by a short-term operation procedure including potential load bridging. The transmission solution is to uprate the Fitchburg-Nine Springs and Royster-Pflaum 69-kV lines, move AGA to Femrite-Royster line and install Nine Springs capacitor bank in 2013.
- The Huiskamp 138-kV bus voltage can be lower than 90 percent under certain contingency conditions in both the 2012 summer peak model and the 2016 increased load model.
    - This limitation will be addressed by adjusting the Huiskamp138/69-kV transformer tap settings.

- The Albany, North Monroe, Darlington and Hillman 138-kV bus voltages can be higher than 105 percent under system intact condition in the 2012 minimum load model.
    - This limitation will be addressed by adjusting the North Monroe and Darlington138/69-kV transformer tap settings and turning off South Monroe 69-kV cap banks.
- The Verona, Huiskamp, Albany, North Monroe and Bass Creek 138-kV bus voltages can be higher than 110 percent under certain contingency conditions in the 2012 minimum load model.
    - This limitation will be addressed by adjusting the Verona, Huiskamp, Bass Creek, North Monroe and Darlington138/69-kV transformer tap settings and turning off South Monroe 69-kV cap banks.
- The Verona 138-kV bus voltage can be lower than 90 percent under certain contingency conditions in both the 2016 summer peak model and the 2016 increased load model.
    - Possible mitigation plan is to adjust the Verona 138/69-kV transformer to boost the 138-kV bus as necessary.
- The Huiskamp 138-kV bus voltage can be higher than 110 percent under certain contingency conditions in the 2016 light load model and 2021 minimum load model.
    - This limitation will be addressed by adjusting the Huiskamp138/69-kV transformer tap settings.
- The Royster-Sycamore 69-kV line overloads under certain contingency conditions in the 2016 increased load model.
    - Potential mitigation plan is to uprate the Royster-Sycamore 69-kV line.
- The Verona 138-kV bus voltage can be higher than 110 percent under certain contingency conditions in the 2021 70% shoulder load / 3000 MW import model and the 2021 65% load/West-East bias model.
    - This limitation will be addressed by adjusting the Verona 138/69-kV transformer tap settings.
- East Campus-Walnut 69-kV line overloads under certain contingency conditions in the 2021 90% load/East-West Bias model.
    - The limitation will be addressed by reducing West Campus generation and increasing Blount and Sycamore generation.
- Low 138-kV voltages at Hubbard and Hustisford under certain contingency conditions.
    - These low voltages are mitigated by adjusting the Hubbard 138/69-kV transformer load tap changer setting to boost the 138-kV bus voltage. The proxy transmission solution to this issue is to construct the Hubbard-East Beaver Dam 138-kV line which currently has a 2022 in-service date.

Zone 4

With all appropriate projects included in the 2012, 2016 and 2021 summer peak models, nearly all of the overloads and low voltages within Zone 4 are addressed. System problems still exist under single contingency conditions in the 2021 study year. The system issues remaining in the All Projects models are noted below:

- The Glenview – Gravesville 69-kV circuit overloads under certain contingency conditions.
    - As described in the Zone 4 – 2021 study results section, a project to address this limitation has already been issued and it was completed in April 2011. Thus this limitation can now be considered addressed.
- Additional limitations showed up in the All Projects 2016 and 2021 off peak sensitivity models. The expectation for these modeling scenarios is that the limitations can be addressed by re-dispatching generation since they did not show up in the summer peak All Project results.

Zone 5

With all appropriate projects included in the 2012, 2016 and 2021 summer peak models, the majority of the system overloads and low voltages in Zone 5 are addressed, although system issues still exist under single contingency conditions in all three study years. The system issues remaining in the 2012, 2016 and 2021 All Projects models are:

- The Bain 345/138 and Oak Creek 345/230-kV transformers overload under certain contingency conditions.
    - As described in the Zone 5 – 2012 study results write-up, circuit breaker outages are low probability events that we do not plan reinforcements for unless the consequences are extremely severe. Loading relief can be achieved by backing down local generation. In addition, the Bain transformer outage will be resolved once the Pleasant Prairie bus is reconfigured in 2013.