

**Palo Verde to Westwing Double Line Outage Probability Analysis
SRP**

FILED
February 04, 2016
Data Center
Missouri Public
Service Commission

Tatyana Len Dhaliwal tldhaliw@srpnet.com <<mailto:tldhaliw@srpnet.com>>

Executive Summary

This report details the mitigating factors and a double contingency outage analysis of the Palo Verde to Westwing lines 1 and 2. This outage is considered of such low probability of occurrence and recurrence, that it warrants submittal to the WECC Phase I Probabilistic Based Reliability Criteria (PBRC) Performance Category Evaluation (PCE) Process. Under this process, a project with an accepted Mean Time Between Failure (MTBF) in the range of 30 to 300 years may be adjusted to Category D, but with the added condition of "no cascading" allowed. A project with a MTBF in excess of 300 years is considered an "Extreme Event" in the same sense as all other events in the NERC Category D.

This report follows the Probability Reliability Evaluation Work Group (RPEWG) recommended steps provided in Appendix I, Figure 10 RPEWG Recommended Analysis Steps.

Analysis of the Palo Verde to Westwing Lines 1 and 2 double contingency (N-2) qualifies to be moved to Category D based on the following statistical analysis and mitigating factors:

- 1) An MTBF estimated by a traditional statistical reliability analysis method is on average once in 2824 years.
- 2) In the 11 years of accurately recorded outage history in electronic format, there has never been a double contingency outage of the Palo Verde to Westwing lines. Evidence suggests that since both lines were in service, this outage has not ever occurred.
- 3) Both Westwing and Palo Verde switchyard use breaker and a half arrangement.
- 4) As a result of the Rudd line installation, the Palo Verde to Westwing lines 1 and 2 outage is **no longer** the most critical outage.
- 5) According to UFSAR, the failure of this line at the crossing over the PV-WW 1 and 2 is no longer postulated under the revised 10CFR50.59 rules. Therefore grid studies need not address this scenario.
- 6) The Robust design features are overhead ground wires, lines are built 130 feet apart (centerline to centerline) with towers designed to fail in the middle. The failure and fall of one tower does not jeopardize the continued safe operation of the other tower.

Staff Exhibit No. 61
Date 1-26-16 Reporter TR
File No. EA-2015-0148

- 7) Palo Verde to Westwing 500kV lines are located outside the areas of consideration for air traffic. The elevation of the lines is beyond and beneath the criteria FAA defines for consideration as an obstacle or hazard.
- 8) The isokeraunic level near Palo Verde and Westwing is one of the lowest in the Western US, ranging from 1.0 strikes per square mile per year near Palo Verde to 2.5 strikes per square mile per year near Westwing switchyard.
- 9) The risk of earthquakes in Maricopa County is the lowest in the Western US.
- 10) The risks of flood, snow, and fire are negligible.
- 11) The PV-WW foundations are over designed in the range of 137 to 199%.
- 12) The lattice tower design is conservative for weather related loads.
- 13) Lines are designed with state of the art spacer dampers to control conductor motion.
- 14) The insulation level exceeds EPRI's guidelines.
- 15) Electronic protection is provided by redundant microprocessor based technology with communication via fiber optics and digital microwave systems on independent paths. A third microprocessor based relay system operating in current differential scheme is provided for backup protection.
- 16) SRP aggressively maintains the lines with twice yearly patrols, bird guard systems in place, an insulator-washing program, and a spacer damper replacement program.

In summary, based on an MTBF estimated by traditional statistical reliability analysis of 2824 years and excellent design and maintenance practices, it is recommended that this N-2 outage be moved to Category D (Extreme Events) with no other conditions or requirements.