



# **SPP 2012 TPL Steady State Report**

December 31, 2012

Engineering

Approved by Transmission Working Group: December 19, 2012

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## Purpose

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To support SPP's compliance, as the Planning Coordinator, with NERC TPL-001-0, TPL-002-0, TPL-003-0, and TPL-004-0 Reliability Standards, the objective of this document is to report findings from the 2012 Compliance Assessment process.

The goals of this assessment are:

1. To identify overloaded branches/transformers (>100% of rate A) under normal conditions. (NERC Category A)
2. To identify potential branch/transformer violations (>100% of rate B) due to the loss of a single element. (NERC Category B)
3. To identify potential branch/transformer violations (>100% of rate B) due to the loss of two elements. (NERC Category C)
4. To identify potential branch/transformer violations (>100% of rate B) due to extreme events. (NERC Category D)
5. To identify voltage performance (0.95 pu - 1.05 pu)<sup>1</sup> under normal conditions. (NERC Category A)
6. To identify potential voltage violations (0.9 pu – 1.05 pu)<sup>1</sup> due to the loss of a single element. (NERC Category B)
7. To identify potential voltage violations (0.9 pu – 1.05 pu)<sup>1</sup> due to the loss of two elements. (NERC Category C)
8. To identify potential voltage violations (0.9 pu – 1.05 pu)<sup>1</sup> due to extreme events. (NERC Category D)

This report focuses on facilities 100 kV or above and summarizes potential violations anticipated by SPP and the mitigation plans developed by SPP member entities and SPP engineering staff.

SPP staff monitored the 69 kV system, but did not require mitigations for violations found on that system.

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## Models

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The 2012 SPP MDWG power flow models reflect system conditions for selected years between year 2013 and year 2023. These models are updated to reflect the most up-to-date information using the Model On Demand (MOD) program. The cases used in the 2012 TPL Compliance Assessments are the SPP 2012 Series MDWG Build 1 Final Powerflow Models according to Table 1.

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<sup>1</sup> Local requirements for individual entity apply in some cases.

Model Scope	Seasonal Assessment	Model Used	Model Released	Assessment Completed
Near Term	2013 Summer Peak	2012MDWGB1_FINAL-13S	April 2012	December 2012
Near Term	2013 Fall	2012MDWGB1_FINAL-13F	April 2012	December 2012
Near Term	2013 Winter	2012MDWGB1_FINAL-13W	April 2012	December 2012
Near Term	2014 Spring	2012MDWGB1_FINAL-14G	April 2012	December 2012
Near Term	2014 Summer Peak	2012MDWGB1_FINAL-14S	April 2012	December 2012
Near Term	2018 Summer Peak	2012MDWGB1_FINAL-18S	April 2012	December 2012
Long Term	2023 Summer Peak	2012MDWGB1_FINAL-23S	April 2012	December 2012
Long Term	2023 Winter	2012MDWGB1_FINAL-23W	April 2012	December 2012

Table 1: Models Used in Assessment

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## Assessment

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### **TPL-001-0 Assessment (N-0)**

The SPP 2012 MDWG B1 Final models used for the compliance assessment have no thermal overloads or potential voltage violations under N-0, or normal system conditions.

### **TPL-002-0 Assessment (N-1)**

The multi-terminal outages (i.e. complex elements) considered for system evaluation under Category B were compiled by SPP-RTO with input from stakeholders and member entities. Additional automatically selected (N-1) elements were chosen according to base voltage in Table 2.

Element	Base kV (low side of transformers)	Source
Complex elements	---	SPP Staff and Member Entities
Branch	100 kV and above	Software Selection
Generator	All	Software Selection
Transformer	100 kV and above	Software Selection

Table 2: N-1 Elements Selected

## **TPL-003-0 and TPL-004-0 Assessments (N-2 and Extreme Events)**

The complex elements considered for system evaluation under Category C and D were compiled by SPP RTO staff with input from stakeholders and member entities. Additionally, the automatically selected (N-1) elements studied for TPL-002-0 were paired to form automatically selected (N-2) contingencies for the TPL assessment. Pairs of automatically selected N-1 elements were chosen according to Table 3.

<b>Element</b>	<b>Selection Rule</b>	<b>Source</b>
Complex elements	---	SPP Staff and Member Entities
Branch-Branch*	Same Zone	Software Selection
Generator-Branch*	Same Area	Software Selection
Generator-Generator	All	Software Selection

\*Branch represents both branch and transformer elements

*Table 3: N-2 Elements Selected*

### **Simulation**

Physical and Operational Margins (POM) software was used to screen not only the Category B, C, and D lists developed by SPP engineering staff and by member entities, but to also run automatically selected (N-k) contingency analysis based on the selection criteria described above. Power System Simulation for Engineering (PSS/E) was used as a supplementary tool for analysis and verification. SPP presented to member entities for review all potential violations along with proposed mitigations produced by Optimal Mitigation Measures (OPM), which is a tool used to automatically apply mitigation techniques based on operating measures handled by SPP Operations in real-time, and verified by the SPP members.

### **Mitigations and Member Review**

All of the potential violations were sent to the members for review. Each member was asked to review each of their respective potential violations and automatically (OPM) mitigated violations and to provide an alternate mitigation if it did not agree with the automatically selected mitigation.

While SPP's simulations monitored the SPP footprint transmission system for 60 kV and above potential violations, this report only summarizes violations on 100 kV and above buses. Members had the opportunity to provide or verify OPM mitigations for 60 kV – 100 kV potential violations.

## Entities Involved

The following entities registered with the SPP Regional Entity were included in these studies.

<b>Entity Name</b>	<b>Registered Function</b>
Arkansas Electric Cooperative Corporation (AECC)	DP,GOP,GO,LSE,PSE,RP,TO
American Electric Power (AEPW)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
East Texas Electric Cooperative (ETEC)	DP,GO,LSE,PSE,RP,TO,TP
Tex-La Electric Cooperative of Texas, Inc (TEXL)	DP,LSE,PSE,RP,TO,TP
Board of Public Utilities (BPU)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
City Utilities of Springfield, MO (SPRM)	BA,DP,GOP,GO,LSE,RP,TO,TP
Cleco Corporation (CLECO)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP,TSP
Grand River Dam Authority (GRDA)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
Independence Power & Light (INDN)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
ITC Great Plains, LLC (ITCGP)	TOP,TO
Kansas City Power & Light Company (KCPL)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
KCPL - Greater Missouri Operations (KCPL-GMO)	BA,LSE,PSE
Lafayette Utilities System (LAFA)	BA,DP,GOP,GO,LSE,PSE,TO,TP
Louisiana Energy & Power Authority (LEPA)	BA
Lincoln Electric System (LES)*	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
Midwest Energy, Inc (MIDW)	DP,LSE,PSE,TO,TP
Nebraska Public Power District (NPPD)*	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP,TSP
Oklahoma Gas & Electric Company (OKGE)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
Oklahoma Municipal Power Authority (OMPA)	DP,LSE,PSE,RP
Omaha Public Power District (OPPD)*	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
Southwestern Power Administration (SWPA)	BA,PSE,RP,TO,TP,TSP
Southwestern Public Service Company (SPS)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
Sunflower Electric Power Corporation (SECI)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
The Empire District Electric Company (EDE)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
Westar Energy, Inc (WR)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP
Western Farmers Electric Cooperative (WFEC)	BA,DP,GOP,GO,LSE,PSE,RP,TO,TP

BA: Balancing Authority  
 DP : Distribution Provider  
 GOP: Generator Operator  
 GO: Generation Owner  
 LSE: Load Serving Entity  
 PSE: Purchasing-Selling Entity

RP: Resource Planner  
 TOP: Transmission Operator  
 TO: Transmission Owner  
 TP: Transmission Planner  
 TSP: Transmission Service Provider

\*Midwest Reliability Organization (MRO) is the Regional Entity for these entities.

## Results

The mitigations for the potential violations range from new transmission facilities or upgrades to existing transmission facilities to operating measures based on real-time operations by SPP RC. These operational measures include actions such as redispatching generation, changing system topology, cap bank switching, and removing load from the system<sup>2</sup>.

### **TPL-001-0 Assessment (N-0)**

The SPP 2012 MDWG B1 Final MOD base case models used for the TPL compliance assessment have no thermal overloads or voltage violations under N-0, or normal system conditions.

### **TPL-002-0 Assessment (N-1)**

Table 4 shows a summary of potential violations found using the Category B complex element assessment list and the automatically selected N-1 list by POM. These numbers include the violations which were mitigated by SPP members and SPP engineering staff. SPP verified the mitigations were effective to relieve violations.

Season	High Voltage	Low Voltage	Thermal Overloads	Total	Mitigated Findings	Remaining Violations
2013 Summer	103	205	39	347	347	0
2013 Fall	224	92	2	318	318	0
2013 Winter	347	19	5	371	371	0
2014 Spring	122	25	0	147	147	0
2014 Summer	104	127	31	262	262	0
2018 Summer	159	183	46	388	388	0
2023 Summer	96	239	98	433	433	0
2023 Winter	140	161	17	318	318	0

*Table 4: TPL-002 Potential Violations by Season*

### **TPL-003-0 and TPL-004-0 Assessments (N-2 and Extreme Events)**

Table 5 displays a summary of potential violations found using the Category C and D complex element assessment list and the automatically selected N-2 list by POM. These numbers include the violations which were mitigated by SPP members in addition to the violations which were automatically mitigated by Optimal Mitigation Measures (OPM), which is a tool used to automatically apply mitigation techniques based on operating measures handled by SPP Operations

<sup>2</sup> As allowed under TPL Standards

in real-time, and verified by the SPP members. SPP verified the mitigations were effective to relieve violations. For the Category D events, members reviewed the potential violations and had an opportunity to review the automatically mitigated OPM mitigations.

Season	High Voltage	Low Voltage	Thermal Overloads	Total	Mitigated or Assessed Findings	Remaining Violations
2013 Summer	505	4877	1899	7281	7281	0
2013 Fall	1069	2730	319	4118	4118	0
2013 Winter	1042	2739	548	4329	4329	0
2014 Spring	1143	1040	94	2277	2277	0
2014 Summer	969	3964	1934	6867	6867	0
2018 Summer	939	3130	1783	5852	5852	0
2023 Summer	682	4182	2538	7402	7402	0
2023 Winter	894	3429	681	5004	5004	0

Table 5: TPL-003 and TPL -004 Potential Violations by Season

### **Totals by Model Area**

Below is Table 6 that summarizes the potential violations by modeling control area. The results show the breakout based on the automatically selected contingencies in the POM software, which include both Category B and C events, the member submitted Category B events, and the member submitted Category C and D events.

Note that several entities mentioned above in the Entities Involvement Section do not have unique model control areas as their facilities are embedded in others’ control areas.

Member	Area Number	Automatic ally Selected	Category B	Category C and D	Total	Mitigated Findings	Remaining Violations
Cleco Corporation	502	1175	2	7	1184	1184	0
Lafayette Utilities System	503	125	0	0	125	125	0
Louisiana Energy & Power Authority	504	25	4	0	29	29	0
Southwestern Power Administration	515	422	14	4	440	440	0
American Electric Power	520	7982	67	125	8174	8174	0
Grand River Dam Authority	523	220	3	10	233	233	0
Oklahoma Gas & Electric Company	524	2436	2	105	2543	2543	0
Western Farmers	525	233	0	7	240	240	0



Electric Cooperative							
Southwestern Public Service Company	526	10784	162	103	11049	11049	0
Oklahoma Municipal Power Authority	527	104	0	0	104	104	0
Midwest Energy, Inc	531	1265	0	69	1334	1334	0
Sunflower Electric Power Corporation	534	4851	12	119	4982	4982	0
Westar Energy, Inc	536	4464	17	160	4641	4641	0
KCPL - Greater Missouri Operations	540	454	0	18	472	472	0
Kansas City Power & Light Company	541	491	0	7	498	498	0
Board of Public Utilities Kansas City	542	3	0	0	3	3	0
The Empire District Electric Company	544	228	0	1	229	229	0
Independence Power and Light	545	3	1	0	4	4	0
City Utilities of Springfield, MO	546	29	0	2	31	31	0
Nebraska Public Power District	640	8805	296	369	9470	9470	0
Omaha Public Power District	645	165	2	89	256	256	0
Lincoln Electric System	650	15	0	0	15	15	0

Table 6: Potential Violation Totals by Model Area

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## Summary

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The MDWG models developed by SPP and member entities represent the power system for the SPP footprint. These models have no voltage or thermal potential violations for normal (N-0) operation under Category A. Complex element lists were developed by SPP and entities to simulate selected Category B, C, and D events. These events were simulated by SPP along with Automatically Selected (N-k) contingency lists. All potential Category B and C violations found by SPP assessments were mitigated by operating procedures developed or approved by SPP entities and staff, and all potential Category D violations were evaluated and reviewed by SPP entities and staff.