



SPP 2013 TPL Steady State Report

December 18, 2013

Engineering

Approved by Transmission Working Group: 12/18/2013

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Purpose

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 2013 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)¹ under normal conditions. (NERC Category A)
6. To identify potential voltage violations (0.9 pu – 1.05 pu)¹ due to the loss of a single element. (NERC Category B)
7. To identify potential voltage violations (0.9 pu – 1.05 pu)¹ due to the loss of two elements. (NERC Category C)
8. To identify potential voltage violations (0.9 pu – 1.05 pu)¹ 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.

¹ Local requirements for individual entity apply in some cases.

Models

The 2013 SPP MDWG power flow models reflect system conditions for selected years between year 2014 and year 2024. These models are updated to reflect the most up-to-date information using the Model On Demand (MOD) program. The cases used in the 2013 TPL Compliance Assessments are the SPP 2013 Series MDWG Build 1 Final Powerflow Models according to Table 1.

Model Scope	Seasonal Assessment	Model Used	Model Released	Assessment Completed
Near Term	2014 Summer Peak	2013MDWG_FINAL-14S_May2	April 2013	December 2013
Near Term	2014 Fall	2013MDWG_FINAL-14F_May	April 2013	December 2013
Near Term	2014 Winter	2013MDWG_FINAL-14W_May	April 2013	December 2013
Near Term	2015 Spring	2013MDWG_FINAL-15G_May	April 2013	December 2013
Near Term	2015 Summer Peak	2013MDWG_FINAL-15S_May	April 2013	December 2013
Near Term	2019 Summer Peak	2013MDWG_FINAL-19S_May	April 2013	December 2013
Long Term	2024 Summer Peak	2013MDWG_FINAL-24S_May	April 2013	December 2013
Long Term	2024 Winter	2013MDWG_FINAL-24W_May	April 2013	December 2013

Table 1: Models Used in Assessment

Assessment

TPL-001-0 Assessment (N-0)

The SPP 2013 MDWG B1 Final models were assessed for Category A, or system intact potential violations.

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 Assessments (N-2)

The complex elements considered for system evaluation under Category C 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.

Element	Selection Rule	Source
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

TPL-004-0 Assessments (Extreme Events)

The complex elements considered for system evaluation under Category D were compiled by SPP RTO staff with input from stakeholders and member entities. Table 4 below shows how the extreme events were determined for assessment of TPL-004-0.

Element	Selection Rule	Source
Extreme Events	---	SPP Staff and Member Entities

Table 4: Extreme Events 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.

Entity Name	Registered Function
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
 GOP: Generator Operator
 LSE: Load Serving Entity
 RP: Resource Planner
 TO: Transmission Owner
 TSP: Transmission Service Provider

DP : Distribution Provider
 GO: Generation Owner
 PSE: Purchasing-Selling Entity
 TOP: Transmission Operator
 TP: Transmission Planner

*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 system².

TPL-001-0 Assessment (N-0)

Table 5 shows a summary of potential violations analyzed under Category A, or system intact, conditions. These numbers include the potential 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
2014 Summer	0	0	0	0	0	0
2014 Fall	0	0	0	0	0	0
2014 Winter	0	0	0	0	0	0
2015 Spring	0	0	0	0	0	0
2015 Summer	0	1	0	1	1	0
2019 Summer	0	1	0	0	0	0
2024 Summer	0	2	3	5	5	0
2024 Winter	0	6	0	6	6	0

Table 5: TPL-001 Potential Violations by Season

TPL-002-0 Assessment (N-1)

Table 6 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.

² As allowed under TPL Standards

Season	High Voltage	Low Voltage	Thermal Overloads	Total	Mitigated Findings	Remaining Violations
2014 Summer	141	67	39	247	247	0
2014 Fall	118	25	3	146	146	0
2014 Winter	151	55	5	211	211	0
2015 Spring	122	22	6	150	150	0
2015 Summer	109	40	23	172	172	0
2019 Summer	63	103	133	299	299	0
2024 Summer	68	93	153	314	314	0
2024 Winter	53	198	18	269	269	0

Table 6: TPL-002 Potential Violations by Season

TPL-003-0 Assessments (N-2)

Table 7 displays a summary of potential violations found using the Category C and 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 in real-time, and verified by the SPP members. SPP verified the mitigations were effective to relieve violations.

Season	High Voltage	Low Voltage	Thermal Overloads	Total	Mitigated or Assessed Findings	Remaining Violations
2014 Summer	643	2914	1978	5535	5535	0
2014 Fall	1045	1532	356	2933	2933	0
2014 Winter	1269	2343	430	4042	4042	0
2015 Spring	1004	1085	417	2506	2506	0
2015 Summer	894	3062	1782	5738	5738	0
2019 Summer	416	3127	2881	6424	6424	0
2024 Summer	394	3290	3280	6964	6964	0
2024 Winter	776	3322	661	4759	4759	0

Table 7: TPL-003 Potential Violations by Season

TPL-004-0 Assessments (Extreme Events)

Table 8 displays a summary of potential violations found using the Category D complex element assessment list created by SPP and its member entities. These numbers include the violations which were provided to 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 in real-time, and verified by the SPP members. For the Category D events, members reviewed the potential violations and had an opportunity to review the automatically mitigated OPM mitigations. It should be noted that Category D events are only for assessment purposes and do not require mitigation.

Season	High Voltage	Low Voltage	Thermal Overloads	Total
2014 Summer	11	115	64	190
2014 Fall	133	52	20	205
2014 Winter	92	30	16	138
2015 Spring	28	42	28	98
2015 Summer	12	128	48	188
2019 Summer	10	74	93	177
2024 Summer	12	87	104	203
2024 Winter	45	19	23	87

Table 8: TPL -004 Potential Violations by Season

Totals by Model Area

Below is Table 9 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, and the member submitted Category B, Category C, and Category 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.

Southwest Power Pool, Inc.

Member	Area Number	Automatically Selected	Category B	Category C	Category D	Total	Mitigated Findings	Remaining Violations
Cleco Corporation	502	1042	2	2	1	1047	1047	0
Lafayette Utilities System	503	12	0	0	0	12	12	0
Louisiana Energy & Power Authority	504	118	16	0	0	134	134	0
Southwestern Power Administration	515	252	4	1	0	257	257	0
American Electric Power	520	7951	88	181	44	8264	8264	0
Grand River Dam Authority	523	128	0	38	15	181	181	0
Oklahoma Gas & Electric Company	524	2197	5	176	17	2395	2395	0
Western Farmers Electric Cooperative	525	193	0	5	0	198	198	0
Southwestern Public Service Company	526	8284	35	19	0	8338	8338	0
Oklahoma Municipal Power Authority	527	79	0	0	0	79	79	0
Midwest Energy, Inc.	531	726	0	3	32	761	761	0

Member	Area Number	Automatically Selected	Category B	Category C	Category D	Total	Mitigated Findings	Remaining Violations
Sunflower Electric Power Corporation	534	3858	9	11	146	4024	4024	0
Westar Energy, Inc.	536	3658	5	315	418	4396	4396	0
KCPL - Greater Missouri Operations	540	577	0	9	6	592	592	0
Kansas City Power & Light Company	541	1043	0	16	39	1098	1098	0
Board of Public Utilities Kansas City	542	4	0	0	0	4	4	0
The Empire District Electric Company	544	325	0	2	0	327	327	0
Independence Power and Light	545	26	0	11	2	39	39	0
City Utilities of Springfield, MO	546	16	0	2	0	18	18	0
Nebraska Public Power District	640	8057	228	355	484	9124	9124	0
Omaha Public Power District	645	195	0	29	76	300	300	0
Lincoln Electric System	650	1	0	0	0	1	1	0

Table 9: Potential Violation Totals by Model Area

Summary

The MDWG models developed by SPP and member entities represent the power system for the SPP footprint. The potential violations presented in this report were mitigated by operating procedures, capital projects or modeling corrections determined by SPP entities and staff. 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 A, 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.