PRAIRIE POWER INC.
A Touchstone Energy® Cooperative

RELIABILITY PLANNING CRITERIA

Version 6 | 2/20/2018

REVISION HISTORY

Date	Rev. No.	Individual Making Edits	Reason / Comments
07/01/2013	1	J. Johnson	Initial document
06/06/2014	2	R. Chapman	Document review; revised document Purpose paragraph to further define document review parameters.
08/15/2014	3	R. Chapman/ J. Robinson	Revised the minimum document review period from two years to three years, or as needed; updated references to NERC, SERC and MISO guidelines; Revised Guideline for Seasonal Assessment Studies section, verified IEEE, RUS and MISO Planning references.
01/10/2016	4	K. Kohlrus	Periodic review; edited all references NERC TPL standards to reflect change to TPL-001-4; inserted new Appendix I/Table 1; edited references from seasonal ratings to summer ratings in Sections III and IV; revised references from SPS to RAS and updated applicable SERC guidelines in Section V;
07/20/2017	5	K. Kohlrus	Periodic review; edits made throughout. Added transmission switching to 3.3% voltage change criteria. Specified power factor criteria for wind and solar farms. Added TPL-001-4 P6 N-1-1 at 60% load criteria.
02/20/2018	5	K. Kohlrus	Document review. Verified IEEE, RUS, MISO, SERC and NERC guidelines. Incorporated new criteria based on Good Utility Practice. Added planning criteria for non-integrated system.

I. Introduction

Prairie Power, Inc (PPI), a member-owned, not-for-profit cooperative, operates an electric generation and transmission utility. The PPI engineering department maintains the reliability of the PPI transmission system by developing and complying with the PPI Reliability Planning Criteria.

II. Purpose

The PPI engineering department developed the PPI Reliability Planning Criteria over time to accurately assess the PPI transmission system. The PPI Reliability Planning Criteria were developed as a reference for the PPI engineering department, management, and other entities. The PPI Reliability Planning Criteria also acts as a guide for PPI engineers and operations personnel. This document provides the standards to which the PPI transmission system should be planned. This document is permanent and will be reviewed by the PPI engineering department every three years, at minimum, or as needed.

III. Reliability Criteria

The principal function of the PPI engineering department is to plan and maintain a robust and reliable transmission system. The following criteria will be applied in order to maintain reliable transmission service.

The PPI transmission system consists of 34.5 kV, 69 kV, and 138 kV voltage levels. PPI applies these planning criteria to each voltage level in its integrated transmission system in which PPI has the complete responsibility of serving its load.

A. Voltage Criteria

Voltage criteria are used to assess the reliability of the transmission system during normal or contingency conditions. The response of the transmission system to various contingencies, whether steady-state or transient, may be assessed based on the criteria below in addition to other criteria. These criteria are applied by the PPI engineering department through computer simulations in order to determine the level of reliability of the transmission system. Transmission operators may also use these criteria to ensure the safe and reliable operation of the transmission system.

1. Transmission Voltage Levels and Limits

The transmission system should be planned to have sufficient reactive capacity and adequate control to assure that system voltages will be within set limits at all times. Taking into consideration variables such as function of the circuitry, effects on member loads, and equipment tolerances, general voltage limits for the transmission system have been developed.

PPI's individual member co-ops are responsible for specifying voltage requirements at the secondary (low voltage) side of distribution and bulk substation transformers connected to the PPI transmission system. The substation distribution transformers and/or voltage regulators provide for +/- 10% voltage changes. Customer level voltages are typically maintained between 113V (0.9417 p.u.) and 127V (1.0583 p.u.) based on 120 volts nominal. The following transmission system voltage criteria have been developed considering these voltage requirements to identify locations that may need further study.

PPI's planning criteria for voltage are as follows:

- Voltages should be between 0.95 and 1.05 per unit under normal and contingency conditions
- Maximum voltage level of 1.08 per unit is permitted under minimum[1] load conditions with all facilities in service (P0).
- Maximum voltage level under minimum load single contingency emergency conditions is 1.10 per unit (P1).
- A voltage drop of greater than 5% should not occur under a single contingency (P1).
- Capacitor bank switching should not result in a voltage fluctuation of more than 3.0% of nominal under normal conditions and 5.0% of nominal under contingency conditions (IEEE Standard 1453). PPI also applies this voltage fluctuation to all live line switching.

The acceptable voltage range for the transmission system during normal operating conditions is from 95 percent to 105 percent of nominal. Voltages outside this range would still be considered acceptable if they meet the contingency criteria detailed below. The maximum system voltage is 108 percent of nominal under minimum load conditions with all facilities in service. 110 percent of nominal is considered the absolute maximum system voltage under contingency or emergency minimum load conditions.

Voltages of approximately 95 percent of nominal are considered the minimum acceptable level under single (line, transformer, or generator) contingencies. Voltages below this threshold would begin discussions with member co-ops to ensure adequate distribution voltages could be maintained under these conditions.

Under conditions beyond single contingencies, voltages above 105 percent or below 95 percent of nominal may occur. These situations should be studied further to determine what actions, if any, are necessary to prevent widespread outages.

2. Maximum Allowable Voltage Drop Post-Contingency

The system should not experience a voltage drop of greater than 5% under a single contingency. Voltage drops greater than 5% of nominal, post-single contingency will be investigated to determine what actions, if any, are required to prevent widespread outages.

3. Voltage Fluctuation

Based on good utility practice, and as recommended in IEEE standard 1453, capacitor switching should result in a steady-state voltage fluctuation limited to a maximum of 3.0% of nominal during normal conditions and 5.0% of nominal during contingency conditions. PPI also applies these maximum voltage change criteria to all transmission switching. An evaluation should be conducted of single contingency conditions considering the strongest area source element or facility (largest contributor of short circuit current).

[1] Minimum load is defined as the load between the 90th and 100th percentiles on the load duration curve.

4. Harmonics

All connections, generation or load, to the PPI system should conform to IEEE standard 519 with respect to voltage distortion. This standard limits individual harmonic distortion to 1.5% for 69 kV and 138 kV. Total harmonic distortion is limited to 2.5% for 69 kV and 138 kV.

5. Voltage Reactive Control

Generating plants should maintain either a specified voltage or reactive power schedule. Plants with synchronous generators connected to the PPI system are assigned voltage schedules to maintain system voltages at the plant switchyards during steady-state conditions. Voltage schedules are selected to maintain transmission system voltages.

Reactive power schedules may be specified for those plants with non-synchronous generators. Inverter-based plants (e.g. wind and solar farms and battery storage facilities) are required to operate between 95% leading and lagging power factor at the point of interconnection with the transmission system. If the inverter-based facilities are capable of voltage regulation, it would be desirable to assign a voltage schedule similar to those given to synchronous plants.

PPI's voltage schedule at the 138 kV level is determined by PPI's Transmission Operator, Ameren Services Company. It is reviewed on a regular basis and updated in accordance with good utility practice and applicable NERC standards.

B. Thermal Rating Criteria

Thermal rating criteria are used to assess the reliability of the transmission system during normal or contingency conditions. The response of the transmission system to various contingencies, whether steady state or transient, may be assessed based on the criteria below, in addition to others. These criteria are applied by the PPI engineering department through computer simulations in order to determine the level of reliability of the transmission system. Transmission operators may also use these criteria to ensure the safe and reliable operation of the transmission system.

1. Circuit Ratings Based on the Most Limiting Circuit Element

The facility rating of each element of the PPI transmission system shall be equal to the most limiting applicable equipment rating of the individual pieces of equipment that comprise the facility.

Each facility (circuit or branch) rating is defined as the minimum of the ratings of all the series connected elements from bus to bus, or from line tap to bus, for normal and emergency conditions. (NOTE: For PPI, normal and emergency ratings are equal for transmission facilities) This rating represents the maximum current carrying capacity of all series connected electrical equipment including terminal equipment (bus conductor, disconnect switches, circuit breakers, wave traps, current transformers, series reactors, and relay loading limits), line conductors (including minimum ground clearance and thermal limit considerations), and power transformers.

Note that these various pieces of equipment (i.e. breakers, disconnect switches, wave traps, current transformers, and line and substation conductors) comprise a single ‘facility’ when connected electrically in series.

2. Coordinated Circuit Ratings of Jointly Owned Facilities and Tie Lines

The circuit or branch rating of each jointly owned facility or tie line is defined as the minimum of the ratings of all the series connected elements for normal and emergency conditions, as specified by the owner(s). Verification and agreement of all owners shall be required prior to changing ratings of jointly owned facilities.

3. Thermal Rating of Equipment

Normal ratings are used for conditions when all facilities are in service, or the assumed base operating state of the system, and are typically considered continuous ratings. Emergency ratings are used for conditions when single or multiple contingencies are in effect. Note there is no limit to the duration of the contingency. These ratings are applicable in both the operating and planning horizons. Short-term emergency and limited-life ratings are used in the operating horizon only on a case by case basis, as needed.

PPI’s general loading philosophy is such that the equipment would be loaded below safe loading limits (i.e., the limit to which a particular element can be loaded so that, if another facility is suddenly outaged, the facility would load to no higher than its emergency rating) under normal condition, and up to emergency ratings during contingency conditions. In those cases where normal ratings are less than safe loading limits, facilities would be maintained at or below the normal ratings for conditions with all facilities in service.

Typically, equipment ampacity ratings act a proxy for maximum equipment operating temperatures based on an assumed set of ambient conditions. Therefore, ampacity ratings may be adjusted in the operating horizon if ambient conditions vary from the design ratings. With consideration of actual ambient conditions versus the system design temperatures used in development of longer-term ratings, ampacity ratings may be developed so as not to exceed established equipment operating temperatures, loss of life or strength concerns, or violate ground clearances.

Typically, PPI electrical substation equipment uses manufactures’ nameplate ratings for all conditions with no consideration of variance in seasonal ambient temperatures, unless otherwise stated.

The PPI engineering department would use manufacturer’s nameplate ratings of any new equipment not currently addressed in this document to be installed on the PPI system in the future during all simulated conditions to assess the reliability of the system, unless specific values have been provided by substation design and/or system protection engineers.

PPI line conductor rating assumptions are based on RUS (Rural Utilities Service) Bulletin 1724E-200, page D-2, Table D-1, Ampacity of ACSR conductors.

4. Normal Ratings

Normal ratings are typically continuous ratings that are used when the system is in a state of normal conditions. Normal ratings are applied to equipment for those conditions when all facilities are in service, or the assumed base operating state of the system for the current time period, including planned equipment outages for maintenance and/or construction. Normal ratings are used unless the system is in an emergency state of operation. PPI bases its year-round normal transmission conductor ratings on summer ambient temperature conditions.

5. Emergency Ratings

Emergency ratings are typically continuous or maximum design ratings that are used when the system is in a contingent state, or under emergency operation. These ratings are applied for the period of time following the forced outage of one or more transmission elements. Emergency ratings should be used until the system is restored to normal operation, and are typically based on an eight-hour duration.

6. Short Term Emergency Ratings

Equipment specific short-term emergency ratings are typically for use in the operating horizon (less than one year) to provide flexibility in system operation on a case-by-case basis. Facilities with operating guides or Remedial Action Schemes (RAS) installed to maintain loading within emergency ratings may need short-term emergency ratings until the operating guide can be implemented or the RAS can be activated. Short-term emergency ratings expand the threshold of safe-loading, as they allow time for operator remedial action to redispatch generation or perform transmission system switching on a post-contingency basis without sacrificing safety or reliability. Short-term emergency ratings should have a duration of up to thirty (30) minutes.

Short-term emergency ratings for specific pieces of equipment should take into consideration its loading and performance history, as well as that of similar equipment, manufacturer information and agreements, industry standards, thermal time constants, general design specifications, and remedial diagnostics to assess the equipment's capability following a thermal loading event.

7. Limited-Life Equipment Ratings

Equipment that is scheduled for replacement within one year may have a limited-life rating assigned in the operating horizon on a case-by-case basis. Limited-life ratings allow some use of the remaining capability of equipment in service, with the understanding that it will be replaced within one year and not reused. Operating temperatures may be increased and long-term loss of life or strength concerns may be reduced while still meeting all code and/or safety requirements. PPI applies a 1% loss of life allowance in a 24 hour period for limited-life ratings.

Upon request, limited-life ratings would be developed by the PPI engineering department in conjunction with operations and maintenance groups to provide flexibility in system operation. Consideration for developing limited-life ratings of particular pieces of equipment in question would include the physical condition, loading and performance history and that of similar equipment, manufacturer information and agreements, industry standards, general design specifications, and remedial diagnostics to assess equipment capability following a thermal event.

C. Facility Condition Criteria

The facility condition criteria to be utilized by PPI for system planning purposes will include:

1) Any transmission line on structures that are beyond their design life, has exhibited below average availability, or has required above average maintenance will be considered a candidate for replacement. Consideration will be given to other needs in the area of the candidate line to determine whether rebuilding the line to a higher voltage would benefit the area.
2) Any substation bus that is beyond its design life, has exhibited below average availability, or has required above average maintenance will be considered a candidate for rebuilding or redesign. Consideration will be given to candidate substations, including consideration of the plan for the area.
3) Any substation whose design or configuration prevents maintenance in a safe manner on substation equipment or transmission lines terminating at the substation will be considered a candidate for rebuilding, redesign, or reconfiguration. Consideration will be given to potential expansion at the candidate substation including likely expansion in the area.
4) Any underground cable that is beyond its design life that has exhibited below average availability, or has required above average maintenance will be considered a candidate for replacement. Consideration will be given to other needs in the area of the candidate line to determine whether rebuilding the line to a higher voltage would benefit the area.

D. Economic Criteria

PPI will conduct appropriate economic analyses when evaluating transmission additions, modifications, or replacements. The criteria to be used in such analyses for system planning will include the following:

1) Terrain, geology, and land will be considered in developing screening level capitol cost estimates for line and substation projects.
2) A sufficient number of power flow cases will be developed to cover a reasonable range of load conditions from which to assess system losses. Additionally, the value of losses should be projected based on energy futures markets or on a creditable energy price forecast.
3) A sufficient number of power flow cases will be developed using historical system loading and Locational Marginal Price (LMP) values may be used to determine the economic value of new projects. LMP is the marginal cost of supplying, at least cost, the next increment of electric demand at a specific location (node) on the electric power network, taking into account both supply (generation/import) bids and demand (load/export) offers and the physical aspects of the transmission system including transmission and other operational constraints.
4) Every transmission project has both reliability and economic benefits. In some cases, economics may be the primary driver behind a project. Additionally, economic analysis may be used in the prioritization and staging of projects. An attempt will be made to capture all relevant factors for consideration in determining the economic benefit of a project.

E. Maximization of Existing Right-of-Way

PPI will attempt to maximize existing right-of-ways. Existing electric transmission, gas pipe line, railroad, and highways corridors will be identified in all comparisons of alternatives and utilized where possible. Environmental features will also be considered.

F. Other Criteria

Aside from NERC-based planning criteria, PPI also employs good utility practice to develop the following Planning Objectives:

- **No more than one substation on a radial feed**
  Multiple substations on the same radial feed can limit the ability to backfeed during an outage (depending on the distribution system's backfeeding capability). It also constrains PPI's ability to perform maintenance or upgrades on the transmission lines feeding these stations.

- **No more than four distribution substations between breaker stations**
  Limiting the number of substations between breaker stations reduces the amount of load lost during a single contingency and reduces line exposure.

- **Have a breaker station at the junction of three-terminal lines with sources**
  Three-terminal lines with sources at each terminal make proper relaying extremely difficult. Radial taps to a distribution substation do not typically warrant a breaker station.

- **The MW-mile value of a radial circuit should not exceed 100 MW-miles**
  The MW-mile value is the sum of all the loads (or generation) in MW on the radial circuit multiplied by the total line length in miles[2]. This criterion is a method to quantify the risk of both load and line exposure on radial circuits, i.e. comparing a long radial with a low load and a short radial with a high load.

- **Each breaker-to-breaker segment of the system shall maintain a power factor between 0.95 leading and lagging**
  The power factor is the aggregate of the load, generation, and reactive resources on the segment of the system. Low lagging power factors lead to increased losses, voltage drop, and the potential for voltage collapse. Leading power factors may lead to increased losses and potential for system instability.

[2] For example, a 10-mile long radial line carrying a combined load of 8 MW has a value of 80 MW-miles.

IV. Equipment Ratings

A. Transmission Transformer Ratings

Transmission transformers tie different transmission voltage levels together (i.e. 138 kV to 69 kV). Typically, these transformers take the top nameplate MVA as their rating. Ratings different from nameplate may be used if an appropriate agreement is obtained from the transformer manufacturer. If no manufacturers data is available, the Electrical Transmission and Distribution Reference Book by Central Station Engineers of the ABB (formerly Westinghouse Electric Corporation), Copyright 1964, Fourth Edition, Fifth Printing will be used to determine emergency ratings. Under this reference, a transformer shall be capable of being loaded beyond nameplate rating with no more than a 1% sacrifice of normal life, under a set of assumed conditions.

PPI's general loading philosophy for transmission transformers is such that the loading would be below safe loading limits during normal conditions and up to top nameplate rating during emergency conditions.

B. Transmission Line Ratings

Ratings of transmission lines or circuits take into account the minimum capabilities of the line conductor, hardware, and terminal equipment, in addition to ground clearance limits based on ambient summer conditions.

PPI uses RUS Bulletin 1724-200 Design Manual for High Voltage Transmission Lines Revised May 2009, along with Table D-1 in RUS Bulletin 1724E-200, to determine conductor ampacities of newer lines. .

PPI's general loading philosophy for transmission circuits is such that the loading would be below safe loading limits during normal conditions. In those circumstances where the normal ratings are less than safe loading limits, facility loading would be maintained at or below the normal ratings under normal conditions, i.e. with all facilities in service.

C. Transmission Line Conductor

Due to the difficulty of establishing capabilities above nameplate ratings for transmission line terminal equipment, transmission conductor ratings are considered separately from circuit ratings. Conductor ratings are based solely on thermal limits associated with current carrying capability, assuming specific ambient conditions without accounting for ground clearances or terminal equipment limitations.

PPI uses conductor ratings based on R.U.S. Bulletin 1724E-200, Page D-2, Table D-1, Ampacity of ACSR Conductors. This table assigns seasonal conductor ratings based on allowable conductor temperature. See Appendix I. PPI bases its transmission conductor ratings year-round on summer ambient temperature conditions.

D. Minimum Clearances for Transmission Lines

Clearance ratings for transmission lines are assigned based on the minimum allowable clearances as specified by the National Electrical Safety Code (NESC) or other governing body in effect at the time of construction, or by PPI transmission line design criteria.

E. Line Hardware

The PPI engineering department will select appropriate line hardware to meet or exceed the operating temperature requirements of the selected line conductors. PPI uses hardware that is designed according to NEMA standards, such that the hardware is designed by the manufacturer to have less temperature rise than that of the conductor it is designed to work with. This being the case, the rating of the hardware shall be the same as the rating of the conductor for normal and emergency conditions. Unless the engineering department has reviewed the line equipment and construction adequacy for operation at 100°C, all ACSR lines shall be limited to a maximum operating temperature of 75°C.

F. Disconnect and Line Switches

Disconnect and Line switches are rated at their manufacturer's nameplate continuous current rating for all conditions, unless specific values have been provided by the engineers. No allowance is made for seasonal temperature variance or emergency operation, even though most disconnect switches have some additional capacity during winter conditions, or temperatures less than 40°C. If no manufacturer's data is available, ANSI/IEEE C37 for Circuit Breakers, Switchgear, Relays, Substations, and Fuses may be used as a guide in developing ratings.

G. Substation Equipment Ratings

Ratings for equipment in substations consider the minimum capacities of the substation conductors, substation and terminal equipment, and relay limits based on seasonal ambient conditions. Manufacturer's nameplate continuous ratings are typically used to rate substation transmission level equipment.

The PPI philosophy for loading substation equipment typically follows the same philosophy as transmission lines and transformer loading.

H. Substation and Bus Conductor Ratings

Ratings for the various types of substation conductors used in PPI substations are determined based on the Electrical Transmission and Distribution Reference Book by Central Station Engineers of the ABB (Westinghouse Electric Corporation), Copyright 1964, Fourth Edition, Fifth Printing, for strung conductors. For rigid conductors, the reference book Technical Data: A reference for the Electrical Power Industry, Hubbell Anderson Power Systems AEC-41 3M796LM is used. The ratings developed based on these two references will serve as both the normal and emergency ratings.

I. Circuit Breakers and Circuit Switchers

PPI shall use the nameplate ratings on its circuit breakers and circuit switchers for operating voltage, continuous current and interrupting current. The continuous current will be used for PPI's normal operating rating. If an emergency rating is not listed in the manufacturer's specifications, ANSI/IEEE C37 for Circuit Breakers, Switchgear, Relays, Substations, and Fuses may be used as an aid in developing ratings. Otherwise, the manufacturer's continuous rating will serve as both normal and emergency ratings.

J. Wave (Line) Traps

Line traps are rated at their manufacturer's nameplate continuous current rating for all conditions. If a specific emergency rating is not included by the manufacturer, then the normal rating will serve as the emergency rating as well.

K. Current Transformers

PPI shall use the manufacturer's nameplate ratings to determine the capacity of its current transformers. If the manufacturer does not include an emergency rating, the normal rating will serve as both the normal rating and the emergency rating with any applicable Rating Factor (RF) applied.

L. Relay Load Limits

PPI will evaluate relay settings to determine if any of these settings prove to be the limiting factor of a facility. The rating based on the settings of a relay will serve as both the normal and emergency rating of the facility. These relays will be subject to periodic tests to ensure that they operate properly and to verify proper settings.

M. Shunt Capacitors

Shunt capacitors are rated at their manufacturer's nameplate rating for all conditions, adjusted for nominal system voltage, unless otherwise noted.

V. NERC Reliability Standards

PPI abides by NERC Reliability Standards. The PPI Reliability Planning Criteria are designed to provide full compliance with applicable NERC Standards.

A. PPI Planning and NERC TPL Reliability Standards

The "General Planning Criteria" listed below have been utilized since the formation of NERC, and were accepted as the industry standard prior to the formation of the NERC Reliability Standards.

B. NERC Standard TPL-001-4

The PPI system will operate in accordance with Appendix 1 (NERC Reliability Standard TPL-001-4 Table 1 – Steady State & Stability Performance Planning Events), as applicable.

C. SERC Regional Criteria and Guidelines

SERC Standing Committee Documents are detailed guidelines describing the process to be compliant with NERC Reliability Standards on a regional level, and will be reviewed to ensure compatibility with PPI's Planning Criteria:

SERC Guideline - Facility Interconnection Requirements (NERC Reliability Standard FAC-001-2)

D. Remedial Action Schemes to Meet NERC Standards

Remedial Action Schemes (RAS) may be used on a temporary basis to alleviate transmission constraints pending the completion of planned and committed network upgrades to meet national and regional standards and local planning criteria. RAS may be used on a long-term basis to protect the system from overloads caused by generation considered to be an energy-only resource. PPI currently has no RAS on its system.

VI. Guideline for Seasonal Assessment Studies

The average compound annual growth rate ("average CAGR") is calculated from data produced from the non-coincident peak forecast prepared to satisfy the MISO Resource Adequacy requirement. The average CAGR (in percent) is calculated according to the following formula:

Average CAGR = {[(Total MWH in Year n / Total MWH in Year 1)(1/n)] – 1} * 100, where

Year 1 is the first year of the forecast period
Year n is the last year of the forecast period (n will typically be 10)

Peak demand is calculated from annual energy use by applying PPI's average annual load factor.

A. Summer Peak

Summer peak demand is forecast by applying a calculated average annual growth rate to the previous year(s) actual and weather-normalized peak demand. Summer peak demand is forecast in such a way that there is an equal probability of falling short or exceeding the forecast when average peak weather occurs.

Distribution loads at various substations are determined from actual metering data.

PPI studies its system at time of peak with all elements in service (P0) to identify any base case voltage violations or overloads. PPI then applies P1, P2, and P7 (N-1) contingencies at peak to identify any deficiencies in the system.

B. Winter Peak

Winter peak demand is forecast by applying a calculated average annual growth rate to the previous year(s) actual and weather-normalized peak demand. Winter peak demand is forecast in such a way that there is an equal probability of falling short or exceeding the forecast when average peak weather occurs.

Distribution loads at various substations are determined from actual metering data.

C. Summer Shoulder Peak

Shoulder peak forecasts will reflect moderate weather. These forecasts are typically 60-80% of summer peak demand.

Distribution loads at various substations are determined from actual metering data.

PPI studies its system by applying P6 (N-1-1) contingencies at 60% of peak.

D. Fall/Spring Off-Peak

These forecasts will be representative of a mild weather fall/spring day with no weather sensitive load present on the PPI system.

Distribution loads at various substations are determined from actual metering data.

E. Summer 90/10 Peak

90/10 forecasts will reflect above average summer weather and peak demand conditions. This forecast will be developed such that there is a 90 percent probability of falling short of (i.e. a 10 percent probability of exceeding) the forecast due to weather conditions. PPI assumes that it is acceptable to approximate this forecast by increasing loads by 5%. The ratio of real to reactive power (i.e. power factor) will remain unchanged.

Distribution loads at various substations are determined from actual metering data.

F. Light Load (Minimum April Peak Demand)

Light loading forecasts will be based on PPI's load duration curve minimum load which typically occurs in April.

Distribution loads at various substations are determined from actual metering data.

G. System Operating Limit Methodology

PPI utilizes the methodology located in the MISO Transmission Planning Manual BPM-020 Appendix L: SOL (IROL) Methodology for the Planning Horizon to identify SOLs.

H. Development of Contingency Scenarios

An outage of any PPI facility (transmission element or generator) lasting longer than a month will be modeled as out of service in the base case, except during summer or winter months. PPI will not typically schedule outages for the summer and winter peak seasons since the highest load months are modeled.

VIII. Non-Integrated System

PPI's non-integrated system is the portion of PPI's transmission system which is solely fed by Ameren in which PPI takes delivery to its load at metered delivery points. In the non-integrated system PPI may own radial lines which serve its substations.

The MW-mile value of a radial circuit should not exceed 100 MW-miles

The MW-mile value is the sum of all the loads (or generation) in MW on the radial circuit multiplied by the total line length in miles[3]. This criterion is a method to quantify the risk of both load and line exposure on radial circuits, i.e. comparing a long radial with a low load and a short radial with a high load.

[3] For example, a 10-mile long radial line carrying a combined load of 8 MW has a value of 80 MW-miles.

Appendix I

NERC Standard TPL-001-4

Category	Initial Condition	Event
P0 No Contingency	Normal System	None
P1 Single Contingency	Normal System	Loss of one of the following: 1. Generator 2. Transmission circuit 3. Transformer 4. Shunt Device
P2 Single Contingency	Normal system	1. Opening a line section without a fault 2. Bus section fault 3. Internal Breaker Fault (non-bus tie) 4. Internal Breaker Fault (bus tie breaker)
P3[4] Multiple Contingency	Loss of generator unit followed by system adjustments	Loss of one of the following: 1. Generator 2. Transmission circuit 3. Transformer 4. Shunt Device
P4 Multiple Contingency (Fault plus stuck breaker)	Normal system	Loss of multiple elements caused by a stuck breaker (non-Bus-tie Breaker) attempting to clear a Fault on one of the following: 1. Generator 2. Transmission circuit 3. Transformer 4. Shunt Device 5. Bus Section

[4] PPI's 69 kV generation (Pearl 2) was assumed to be off in the base case, so P3 contingencies were not studied.

Category	Initial Condition	Event
		6. Loss of multiple elements caused by a stuck breaker (Bus-Tie Breaker) attempting to clear a Fault on the associated bus
P5[5] Multiple Contingency (Fault plus relay failure to operate)	Normal system	Delayed Fault Clearing due to the failure of a non-redundant relay protecting the Faulted element to operate as designed, for one of the following: 1. Generator 2. Transmission circuit 3. Transformer 4. Shunt Device 5. Bus Section
P6 Multiple Contingency (Two overlapping singles, N-1-1)	Loss of one of the following: 1. Transmission Circuit 2. Transformer 3. Shunt Device	Loss of one of the following: 1. Transmission Circuit 2. Transformer 3. Shunt Device
P7 Multiple Contingency (Common Structure)	Normal System	The loss of any two adjacent circuits on a common structure

Table 1 – Steady State & Stability Performance Planning Events

[5] Since PPI has backup relays at each of its substations, P5 contingencies are not applicable to PPI facilities.