Colorado Springs Utilities
Transmission Planning Process and Guidelines
Transmission Planning for Categories A & B

April 9, 2009
NERC Standard TPL-001-0
NERC Standard TPL-002-0

Approval _____
Signature

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Printed Name

Effective Date 4/09/2009

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1.0. INTRODUCTION

1.1. These guidelines are used by Colorado Springs Utilites' (CSU's) Transmission Planning Department in performing assessments of CSU's Bulk Electric System (BES). This process will result in an assessment that is compliant with the following North American Electric Reliability Corporation (NERC) Standards:

- TPL-001-0
- TPL-002-0

1.2. In preparation for this study, the CSU Electric Planning Department will consult with the CSU Operations Department to identify any issues observed on the system by the System Operators. The CSU Planning Department will incorporate established normal (pre-contingency) operating procedures into the planning process (TPL-001-0_R1.3.4). Prior to final study approval, the report will be submitted to the Operations Department for review. Upon approval, the Operations Department Manager or Superintendent will sign off in the designated area on the approvals section of the report.

1.3. The CSU Electric Planning Department is responsible for reviewing this procedure annually and keeping the procedure and associated documentation current.

2.0. PLANNING METHODOLOGY

2.1. CSU plans and operates its system in accordance with NERC Standards, and the Western Electricity Coordinating Council (WECC) Reliability Criteria (NERC / WECC Criteria). The NERC Standards are available at http://www.nerc.com/page.php?cid=2. The WECC Reliability Criteria are available at http://www.wecc.biz. In addition, CSU has a Facility Ratings Methodology (FAC-008, FAC-009) (Common Engineering Documents Tab B) that defines ratings and operating limits for CSU's owned and operated BES elements.

2.2. Annual Review Process

CSU performs an annual review (TPL-001-0,TPL-002-0,TPL-003-0_R1.1, TPL-004-0_R1.1) of its transmission system performance over a ten-year planning horizon (years 1-5, 6-10) (TPL-001-0,TPL-002-0,TPL-003-0_R1.2) unless changes to system conditions do not warrant such analyses (TPL-001-0, R1.3.2, TPL-002-0, R1.3.3, TPL-003-0, R1.3.3, TPL-004-0, R1.3.3). This results in a schedule for new facilities and upgrades to existing facilities to ensure adequate transmission capacity for the Bulk Electric System. The annual review will ensure that the system is planned such that the network can be operated to supply project customer demands

and projected firm (non-recallable reserved) transmission services at all demand levels of the range of forecasted system demands for the conditions defined in NERC Categories A, B and C (TPL-001-0,TPL-002-0,TPL-003-0_R1). The annual review will also evaluate the risks and consequences of a number of extreme contingencies that are listed under NERC Category D (TPL-004-0_R1). Category D contingencies will only be conducted for the near-term, years one through five (TPL-004-0_R1.2).

CSU's BES Transmission System is designed to:

- Provide adequate Import Capability to CSU load customers.
- Accommodate new generation resources.
- Accommodate long-term firm transmission requests.

2.3. Ten Year Plan

- This planning process will result in CSU's Ten Year Plan which is updated annually. This plan is not directly submitted to the WECC (RRO) at the direction of the WECC {see Email for R3 TPL – 001 to 004 from WECC (Common Engineering Tab I)}, but is used in participating in several of the WECC processes:

    - Presenting the assessments and corrective plans in conjunction with compliance audits
    - Participating in the WECC base case development process
    - Participating in the WECC/NERC seasonal and ten-year assessments
    - Other "one-time" WECC assessment requests outside of the normal PCC data requests

2.4. Planning Studies for Period after Ten Years

Colorado Springs Utilities performs system improvement sensitivity studies looking beyond the ten-year planning horizon on an as needed basis to ensure the economic viability of selected alternatives from the long-range planning process. Due to the nature of Springs Utilities' system, lead times for projects required for compliance with Standards have never exceeded the ten-year planning horizon.

2.5. Regional Planning

2.5.1. Western Electricity Coordinating Council

WECC is responsible for coordinating and promoting electric system reliability. In addition to promoting a reliable electric power system, WECC will support efficient competitive power markets, assure open and non-discriminatory transmission access among members, provide a forum for resolving transmission access disputes, and provide an environment for coordinating the operating and planning activities of its members as set forth in the WECC Bylaws.[1]

CSU is a member of WECC and participates in several WECC Committees, Subcommittees, Work Groups, and Task Forces. Including the WECC Planning Coordination Committee, and the Transmission Expansion Planning Policy Committee.

2.5.2. Colorado Springs Utilities is a member of or participates in the planning activities for the following regional planning organizations:

COLORADO COORDINATED PLANNING GROUP (CCPG): Joint, high voltage transmission system planning forum for the purpose of assuring a high degree of reliability in the planning, development, and operation of the high voltage transmission system in the Rocky Mountain Region, in accordance with the Joint Transmission Access Principles and the Electric Transmission Service Policy Statement, dated December 16, 1991. The CCPG provides the technical forum required to complete reliability assessments, develop joint business opportunities, and accomplish coordinated planning, under the single-system planning concept in the Rocky Mountain Region of the Western Electricity Coordinating Council.

WESTCONNECT TRANSMISSION PLANNING GROUP: While not a signatory to the WestConnect Project Agreement for Subregional Transmission Planning , Colorado Springs Utilities transmission system is contained within the footprint of the WestConnect subregional planning area. The subregional transmission planning is performed by Southwest Transmission Planning Group (SWAT), the Colorado Coordinated Planning Group (CCPG) and any other subregional transmission planning (STP) groups that forms and makes up the WestConnect planning area. Annually a ten year integrated regional transmission plan is derived from their efforts that coordinate all transmission plans

[1] http://www.wecc.biz

across the WestConnect planning area. CSU participates in these planning efforts directly and through the CCPG, and the results of its planning efforts are contained within and coordinated through WestConnect.

COLORADO LONG-RANGE TRANSMISSION PLANNING GROUP (CLRTPG): Initiated in January 2004 as a sub-committee of the CCPG. The purpose is to facilitate open discussion and joint planning efforts for the transmission in the Rocky Mountain Region (primarily Colorado and Wyoming). The purpose of the CLRTPG is to provide a forum for electric load-serving entities in the State of Colorado to jointly explore the potential for the development of a coordinated transmission network.

3.0. STUDY ASSUMPTIONS AND METHODOLOGY

3.1. Study Years

CSU's long-range transmission planning covers current year (year N) extending through a ten-year planning horizon (year N+11) (TPL-001-0_R1.3.1,R1.3.3, TPL-002-0_R1.3.2,R1.3.4). Since CSU's long-range budgeting process extends ten years beyond the following annual budget cycle, a planning horizon of year N+11 is used for transmission planning purposes. Planning begins with the development of a year N+11 base case typically developed from a WECC approved base case for year N+10 with CSU loads and resources for year N+11. Base load projections as well as high and low load growth forecasts are modeled in the horizon year. Alternative sets of projects are identified to satisfy the planning criteria under each load and resource scenario. Interim year cases (between years N and N+11) are then used to identify the timing for system enhancement to be in-service to satisfy the planning criteria. Interim years are chosen based on availability of recent WECC approved base cases, known significant regional system generation or topology changes, or other considerations pertinent to establishing the in-service dates for planned system enhancements.

System planning studies are typically conducted using heavy summer cases and conditions. In addition to these, off peak/off season cases are developed for sensitivity analysis to verify that identified system enhancements using heavy summer analysis satisfy planning criteria under off peak/off season conditions.

3.2. Contingencies

For Category B contingencies, CSU evaluates all CSU owned and operated BES transmission elements using load flow analysis for Category A and B performance (TPL002-0_R1.5). A list of contingencies for the annual review are developed based on the results of load flow analysis for further examination for Category B performance. Included in the list are all 230kV and 115kV busses, and all generator busses. All other busses owned and operated by CSU are load serving busses and are not included unless load flow analysis indicates a need for further study. System performance for Category B are only evaluated for Category B contingencies that produce more severe system results or impacts (TPL-002-0_R1.3.1).

The Category B contingencies will be studied as follows:

3.2.1. Category B Contingencies

3.2.1.1. Loss of any single CSU-owned and -operated BES transmission line or transmission transformer.

3.2.1.2. Loss of any tie line or tie transformer with a neighboring utility.

3.2.1.3. Loss of a generator.

3.3. Power Flow Studies

3.3.1. Power flow analysis is performed to find thermal overloads and identify potential voltage stability or voltage limit problems during normal and emergency operation based on the NERC / WECC Criteria.

3.3.2. CSU evaluates system performance under normal (NERC Category A) conditions and for the following NERC / WECC Category B contingencies. The annual review will demonstrate that the system performance meets Table 1 from the NERC standards (Transmission System Standards – Normal and Emergency Conditions) for Category A and B contingencies (TPL-001-0_R1.3.7, TPL-002-0_R1.3.7).

3.3.3. Normal Conditions

Normal conditions are with all CSU owned and operated BES transmission elements in service.

Normal conditions will model established pre-contingency operating procedures.

3.3.3.1. Voltage Profile

- The acceptable voltage profile on the CSU transmission system is .95 to 1.05 per unit under normal conditions.
- Voltages shall be within applicable ratings.

3.3.3.2. VAr Output and Flow Requirements

- CSU's generators are modeled under system intact conditions as producing approximately one-half of the VAr consumption of the generator-step-up transformer. VAr flows at tie lines are kept near zero for system intact conditions.

3.3.3.2.1. Generator VAr Output

CSU's generators are modeled according to the data listed in the generator ratings data spreadsheet (Common Engineering Documents, Tab R).

3.3.3.2.2. Static VAr Compensator Output

CSU does not own or operate any Static VAr Compensators, nor has it identified the need for any through its planning studies.

3.3.3.3. Line and Transformer Loading

Loading on all transmission lines and non-distribution transformers must be at or below the continuous rating assuming all lines in service or following system adjustment.

3.3.4. Contingency Conditions

CSU evaluates system performance for single and multiple contingencies. Section 3.2 describes the Category B contingencies evaluated by CSU.

3.3.4.1. Voltage Requirements

- The acceptable voltage profile on the CSU transmission system is .95 to 1.05 per unit under contingency conditions.
- Voltages shall be within applicable ratings.

3.3.4.2. Line and Transformer Loading

Loading on all transmission lines and non-distribution transformers must be at or below the emergency rating following the contingency but prior to system adjustment.

3.3.4.3. Direct Load-Tripping

Direct load-tripping is not allowed to meet the voltage and loading requirements for Category B contingencies.

3.3.5. Special Protection Systems / Remedial Action Schemes

CSU has no Special Protection Systems or Remedial Action Schemes.

3.4. Transient Stability Studies

3.4.1. Transient stability studies are conducted for normal conditions and on selected contingencies. The selected contingencies include NERC / WECC Category B contingencies.

3.4.2. CSU has no Special Protection Systems or Remedial Action Schemes.

3.4.3. Fault Simulation

Typical clearing times for faults on CSU's transmission system are less than 4 cycles. A maximum clearing time based on pessimistic protection system performance of 6 cycles is used for Category B fault simulation. Since three phase faults are known to be greater stressors to system stability than single line to ground faults, only three phase faults are analyzed to demonstrate stability under three phase and single line to ground contingencies.

3.4.4. System Stability

The system will be considered stable if it meets the following:

Must meet all NERC/WECC criteria for stability.

Criteria specific to the WECC:

Under Category A: System models must initiate properly and exhibit pre-disturbance stability.

For Category B: Transient voltage dips must not exceed 25% at load busses or 30% at non-load busses, and must not exceed 20% for more than 20 cycles at load busses. Minimum transient frequency must not be below 59.6 Hz for 6 cycles or more at a load bus. Post transient voltage deviation must not exceed 5% at any bus.

3.5. Reactive Margin Studies

3.5.1. Reactive margin studies are conducted as needed to demonstrate voltage stability.

3.5.2. CSU performs reactive margin analysis for Category C contingencies. Providing all Category C outages meet NERC/WECC/CSU criteria, no additional studies are performed for Category A or B conditions.

3.6. Loads

3.6.1. System wide load forecasting is done at the corporate level for CSU. National and State demographic data is used as well as regional data collected from the Pikes Peak Area Council of Governments. The corporate forecast is adjusted for purchases/sales, imports and exports, transmission customer loads (wheeling), off system loads, and small hydro generation (<7MW netted into loads) to produce a total forecasted transmission system load. In parallel development with the overall corporate load forecast, a distribution feeder forecast is made. The distribution feeder forecasts are rolled up into distribution bus forecasts, and then rolled up again to a system wide forecast broken down by transmission load serving busses. This system wide forecast is then normalized to match the overall adjusted corporate forecast to create a coincidental peak load forecast for each load serving transmission bus. Power factors for each bus are determined through actual year data for each transmission load serving bus, and are proportionately projected with load growth into future forecasted bus loads.

Assessment studies will be performed for selected demand levels over the range of forecast system demands (TPL-001-0_R1.3.6, TPL-002-0_R1.3.6).

3.7. Resources and Firm Transfers

3.7.1. CSU resources are dispatched such that all firm power resources and contracts are modeled and such that all firm transfers are modeled (TPL-001-0_R1.3.5, TPL-002-0_R1.3.5).

3.8. Data Sources

3.8.1. WECC approved power flow and stability models are used for CSU planning and operating studies.

3.9. Shunt Capacitors, Shunt Reactors and Voltage Support Devices

3.9.1. CSU's transmission shunt capacitors are tabulated in the Ratings – Substation Capacitor Bank spreadsheet (Common Engineering Documents, Tab T). CSU's voltage support devices are modeled as indicated in this spreadsheet. CSU does not own or control any shunt reactors or other voltage support devices.

3.9.2. The annual review will include reactive power resources to ensure that adequate reactive resources are available to meet system performance criteria (TPL-001-0_R1.3.9, TPL-002-0_R1.3.9)

3.10. Phase Shifting Transformers

3.10.1. CSU uses the WECC approved base case representation for all phase shifting transformers.

3.11. Shunt Capacitor and Reactor Modeling

3.11.1. CSU's transmission shunt capacitors are tabulated in the Ratings – Substation Capacitor Bank spreadsheet (Common Engineering Documents, Tab T). CSU's voltage support devices are modeled as indicated in this spreadsheet. CSU does not own or control any shunt reactors or other voltage support devices.

3.13. Automatic Capacitors and Reactor Control

3.13.1. All capacitors on CSU's transmission system are under manual control by the system operators.

3.14. Automatic Transformer Tap Changer Adjustment

3.14.1. All transformer tap changers on CSU's transmission system are under manual control by the system operators.

3.15. Standard Conductors

3.15.1. CSU will design any proposed upgrades using its standards for design and conductor sizes.

3.16. Substation Design

3.16.1. CSU will design any proposed substations using its standards for substation design.

3.17. Load Margins

3.17.1. CSU models both a high and low forecasted demand for its system loading.

3.18. Facilities

3.18.1. The model will include all existing facilities and planned facilities with an in-service date prior to the year being evaluated (TPL-001-0_R1.3.8, TPL-002-0_R1.3.8). The assessment shall address any planned upgrades needed to meet the performance requirements of Categories A, and B (TPL-001-0_R1.4, TPL-002-0_R1.4).

3.19. Protection Systems and Control Devices

3.19.1. Contingencies will take into account the effects of existing and planned protection systems or control devices, including any back-up or redundant systems (TPL-002-0_R1.3.10, R1.3.11).

3.20. Planned Outage Studies

3.20.1. Planned outages are evaluated during the Operations horizon as needed.

3.20.2. In addition, the annual review will include planned outages (including maintenance) of any bulk electric equipment (including protection systems or their components) at demand levels for which such planned outages would be System Performance. (TPL-002-0, R1.3.12)

4.0. REPORT

4.1. A final report will document the results and corrective plans from the analyses conducted as required by this document. This report will address any upgrades required to meet Category A and Category B performance measures of the NERC / WECC / CSU Internal Criteria. A schedule will be included for any upgrades or new projects that will include at a minimum the design/construction start date and the expected in-service

date. These dates will consider lead times necessary to implement the planned project. These plans will be reviewed in subsequent annual assessments. This final report will be communicated to WECC, as required by WECC (TPL-001-1, TPL-002-0) per the directions provided by WECC (Email for R3 TPL – 001 thru 004 from WECC, Common Engineering Documents, Tab I).

4.2. In addition to the final report, CSU will provide updates to WECC via Annual Progress Reports to the WECC Staff and to the WECC Technical Studies Subcommittee and by submitting Significant Additions to the WECC Staff. Additional information will be provided to WECC as requested. (TPL-001-0_R3, TPL-002-0_R3)

5.0. METHODOLOGY DISTRIBUTION AND COMMENTS

5.1. Upon initial approval the CSU Planning Process and Guidelines will be posted on the CSU OASIS at http://www.oatioasis.com/csu/index.html. The posting will be updated following any changes. In addition it will be distributed to the following:

5.1.1. Each adjacent Planning Authority (PA)

5.1.2. Any PA that indicates it has a reliability-related need for this methodology

5.1.3. Each Reliability Coordinator and Transmission Operator that operates any portion of the CSU PA Area.

5.1.4. Each Transmission Planner in the PA.

5.2. Any recipient of this document that provides documented comments regarding this methodology will be provided a documented response within 45 calendar days of receipt of the comments. The response will indicate if a change is being made or the reason no changes will be made.

6.0. VERSION HISTORY TRACKING

Version	Date	Action	Change Tracking
0			New