# Planning Methodology

NorthWestern Energy’s Planning Methodology, Criteria and Process are outlined in NWMT’s [Business Practice ETP Methodology, Criteria and Process](http://www.oatioasis.com/NWMT/NWMTdocs/2010_ETP_Method_Criteria_and_Process_BP_07-20-10-color.pdf) dated September 18, 2012 (to be updated to current date as approved).

The remainder of this section summarizes the highlights from this business practice. Also, for all of NWMT's Business Practices and Attachment K related documents, please refer to footnote #1 on page 5.

## NWMT Local Transmission Planning Methodology

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| Table – Planning Methodology |
| 1. Goal & Scenarios |
| 2. Technical Study |
| 3. Decision |
| 4. Reporting |

 NWMT’s methodology includes the four major steps shown in . These steps are 1) Goal and Scenario Definition, 2) Technical Study, 3) Decision, and 4) Reporting. NWMT used scenario planning and not probabilistic planning for developing the electric transmission system plan. Local transmission planning may be confined to a specific geographic area, such as the Bozeman area, or it may be broadened to examine a specific transmission line or lines that extend over a large geographic area, such as NWMT’s BAA. The transmission lines used in a local transmission planning study may range in size from 50 kV to 500 kV and may be networked or radial.

Local transmission planning methodology involves forecasting customer demand, identifying area reliability problems, evaluating possible mitigation options and selecting a solution that solves the area’s transmission needs. Transmission planning evaluates the transmission system reliability up to 15 years in the future. The planning effort considers transmission and non-transmission alternatives to resolve the reliability problem for a specified area. NWMT’s methodology is flexible and is intended to develop a plan that:

* Responds to customers’ needs;
* Is low cost (e.g., Total Present Value Revenue requirement, Rate Impact, etc.);
* Considers non-transmission and transmission alternatives;
* Considers public policy requirements and considerations[[1]](#footnote-1)
* Assesses future uncertainty and risk;
* Promotes NWMT’s commitment to protecting the environment;
* Includes input from the public and other interested parties;
* Provides adequate return to investors;
* Complements corporate goals and commitments;
* Meets applicable NERC and WECC Standards and requirements;
* Meets the Montana Public Service Commission expectations;
* Meets Regional and Interconnection Wide planning requirements;
* Addresses customer and stakeholder concerns in an open, fair, and non-discriminatory manner.
* Satisfies the requirements of applicable FERC and MPSC Orders; and
* Conforms to applicable state and national laws and regulations.

NWMT worked with its Transmission Advisory Committee (TRANSAC) to establish the goal and to provide input throughout the entire Local Transmission System Planning Process. See Attachment A – TRANSAC Charter, and Attachment B – Transmission Advisory Committee.

### Reliability Criteria

Electric transmission reliability is concerned with the adequacy and security of the electric transmission system. Adequacy addresses whether or not there is enough transmission, and security is the ability of the transmission system to withstand contingencies (i.e., the loss of single or multiple transmission elements).

* NWMT Internal Reliability Criteria is a set of technical transmission reliability measures that have been established for the safe and reliable operation of NWMT’s transmission system.
* The FERC approved Standards (consisting of those implemented by NERC and WECC) and WECC Standards set minimum performance standards for voltage excursions and voltage recovery after a credible outage event on the transmission system. Credible outages are those more likely or plausible, and required to be considered by the governing standards.

NWMT uses these criteria in evaluating a change or addition to its electric transmission equipment and/or a change or addition to load or generation. NWMT uses these reliability criteria as needed to fully evaluate the impacts to its electrical system of proposed lines, generation or loads. NWMT augments these criteria with other standards such as, but not limited to, the American National Standards Institute (ANSI) and Institute of Electrical and Electronics Engineers (IEEE) standards.

NWMT planning ensures that any change that either directly or indirectly affects its transmission system will not reduce the reliability to existing customers to unacceptable levels. The NWMT electric transmission system must remain dependable at all times so that it may provide reliable high quality service to customers.

### NWMT Internal Reliability Criteria

NWMT Internal Reliability Criteria are used for reliability performance evaluation of the electric transmission system. Steady state implies the condition on the transmission system before an outage or after an outage and after switching occurs, regulators adjust, reactors or capacitors switch, and the electrical system has settled down (typically three minutes or more). This latter condition is also called post-fault reliability requirements.

NWMT’s criteria include a collection of ANSI standards as well as past and current practices, that when applied with experienced engineering judgment, lead to a reliable and economical electric transmission system. These criteria support the NERC/WECC Standards and WECC Reliability Criteria that disallow a blackout, voltage collapse, or cascading outages unless the initiating disturbance and corresponding impacts are confined to either a local network or a radial system. An individual project or customer load may require an enhanced reliability requirement.

NWMT plans for a transmission system that provides acceptable voltage levels during system normal conditions and outage conditions. Areas of the NWMT system that are served by radial transmission service are excluded from single contingency evaluation, due to economic considerations.

#### Steady State and Post Fault Voltage Criteria for 230 kV and Below

The steady state voltage criteria listed in the tables below are based on the assumption that all switching has taken place, all generators and transformer Load Tap Changers (LTCs) have regulated voltages to set values, and capacitors or reactors are switched. The basis for the percent voltages is the designed operating voltage.

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| Table – Maximum Upper Voltage CriterionAt Unregulated Load-Serving Bus |
|  | Upper Operating Limit |
| Voltages | 105% |

As shown in Table 2 – Maximum Upper Voltage Criterion, the recommended upper voltage limit for a load-serving bus is 105% unless equipment rating dictates a different limit. For example, equipment used on 100 kV systems is typically rated for a nominal voltage of 102 kV or higher, so 107 kV or 107% of 100 kV nominal is permitted on 100 kV systems. NWMT follows the limit as outlined in the ANSI standards (i.e., ANSI C84.1). It is possible that a load-serving bus voltage may exceed the table value if conditions allow a higher voltage without harm to NWMT or customer equipment.

The allowable minimum percent voltage for any load-serving bus that is within a network configuration is shown in Table 3 – Minimum Allowable Percent Voltage at NWMT Unregulated Load-Serving Bus. It is possible that a load-serving bus voltage may fall below the table value if conditions allow a lower voltage without harm to NWMT or customer equipment. This table considers FERC/NERC and WECC criteria as applied to the bulk electric system busses (100 kV and above). This table is also applied on lower voltage transmission busses that are not part of the bulk electric system (50 kV and 69 kV).

The minimum allowable percent voltage for a load serving bus that is on a radial transmission system for an event on the radial line must only meet the existing system performance (N-0) shown in Table 3 – Minimum Allowable Percent Voltage at NWMT Unregulated Load-Serving Bus. Any unacceptable voltage performance must be mitigated in accordance with the criteria described below. The use of a Special Protection Scheme (SPS)[[2]](#footnote-2) is evaluated on a case-by-case basis, with no assurance that NWMT will accept or use a SPS. The values in Table 3 – Minimum Allowable Percent Voltage at NWMT Unregulated Load-Serving Bus assume that all other methods to control voltage have been explored (such as capacitors, reactors, and line switching, etc.).

Under emergency conditions, bus voltage between 90% and 110% of nominal are permitted for up to 30 minutes.

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| Table – Minimum Allowable Percent Voltage at NWMT Unregulated Load-Serving Bus |
| Nominal Voltage | Existing System (N-0) | First Contingency (N-1) | Second Contingency (N-2) |
| 230 kV and 161 kV | 95% | 95% | 93% |
| 115 kV and 100 kV | 95% | 93% | 90% |
| 69 kV and 50 kV | 93% | 93% | 90% |
| Note:1. Percent voltage is measured from the nominal voltage.
2. 50 kV and 69 kV and radial 100 kV segments are not bulk electric system elements.
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#### Steady State and Post Fault Voltage Criteria for 500 kV

The allowable operating voltage range for the 500 kV transmission system is 100% to 110% of nominal, or 500 to 550 kV. This range is different from other voltage levels because equipment used on the 500 kV system is nominally rated at 525 kV +/-5%. This criterion applies to both steady state and post fault conditions.

#### Thermal Ratings

Transmission conductor continuous summer rating is based on 25°C (77°F) ambient air at 1.4 mph (2 ft/sec), 50°C conductor temperature rise, and 75°C (167°F) maximum operating temperature unless conditions dictate otherwise (e.g., some conductors and lines may be specifically designed for higher operating temperatures). Winter transmission conductor continuous thermal ratings are 125% of the summer rating, during the winter months November - February, or any time ambient temperatures are below 0°C (32°F). This rating is entered as Rate A in the powerflow base cases. Unacceptable conductor loading can be mitigated by system improvements or, in some cases, an Overload Mitigation Scheme (OMS) that changes system conditions to mitigate the overload. The use of an OMS is evaluated on a case-by-case basis, with no assurance that NWMT will accept or use an OMS.

Emergency ratings for transmission conductors are developed on a case by case basis, and are dependent on conductor size, line voltage and available ground clearance under elevated conductor temperature conditions. Under emergency conditions for standard conductors (e.g. not "high temp" conductors), conductor temperatures are limited to 100°C (212°F) or less, and thermal ratings are limited to 125% of the seasonal rating for up to 30 minutes.

Transformer rating is based on the following:

* For standard service conditions (24-hour average ambient air temperature of 30°C or 86°F, or less), the continuous rating is 100% of the highest operational nameplate rating. This rating is entered as Rate A in the power flow base case.
* For winter service conditions (November - February, or any time 24-hour ambient air temperature is less than 0°C, or 32°F,) loading to 125% of the standard service condition rating may be allowed.
* Under emergency operating conditions, loading to 125% of the standard service condition rating may be allowed for up to 30 minutes during any season. Note this is the same as the winter rating, and under winter conditions this load level is permitted continuously.

Unacceptable transformer loading can be mitigated by transformer replacement, system improvements or, in some cases, an OMS that changes system conditions to mitigate the overload. The use of an OMS is evaluated on a case-by-case basis, with no assurance that NWMT will accept or use an OMS.

#### General Minimum Equipment Specifications

The general minimum specifications for North Western Energy Transmission and Substation equipment are listed in . This table also summarizes the MVA or capacity, voltage, current, equipment Basic Impulse Level (BIL), Maximum Continuous Over Voltage (MCOV) for lightning arresters, and interrupt ratings of equipment as applicable and associated grounding requirements.

Table – T&S Equipment: General Minimum Specifications

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| **Transmission and Substation Equipment: General Minimum Specifications** |
|  | Nominal System voltages - kV |
|  | 230 kV | 161 kV | 115 kV | 100 kV | 69 kV | 50 kV |
| MVA and Current Ratings \*(1) | As Req’d | As Req’d | As Req’d | As Req’d | As Req’d | As Req’d |
| Equipment BIL (kV) \*(2) | 900 | 750 | 550 | 550 | 350 | 350 |
| Maximum Design Voltage (kV) \*(3) | 242 | 169 | 121 | 121 | 72.5 | 72.5 |
| Breaker Interrupt Current (kA) | 40 | 40 | 40 | 40 | 40 | 40 |
| Breaker and Switch Continuous Current (A) \*(4) | 1200 | 1200 | 1200 | 1200 | 1200 | 1200 |
| Arrester Duty Rating/MCOV (kV) \*(5) | 172/140 | 120/98 | 90/70 | 90/70 | 54/42 | 39/31.5 |
| Substation Insulator Class | TR-304 | TR-291 | TR-286 | TR-286 | TR-216 | TR-214 |
| Transmission Line BIL, wood (kV) \*(6) | 1105 | 780 | 610 | 525 | 440 | 355 |
| Transmission Line BIL steel (kV) \*(7) | 1265 | 945 | 695 | 610 | 525 | 440 |
| Notes:1. Project and equipment specific as required to avoid thermal overloads
2. 1050 kV BIL is also used on some 230 kV equipment
3. At least 5% over nominal
4. 2000 amp equipment is used in some applications
5. For effectively grounded systems
6. Insulator support hardware ungrounded
7. Insulator support hardware grounded
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Voltage criteria for 500 kV, General Minimum Equipment specifications, Transmission Equipment Rating and Loading, Special Protection Scheme (SPS) and Overload Mitigation Scheme (OMS) Application, Voltage Ride Through, Harmonics, and Subsynchronous Resonance, are outlined in [NWMT’s Business Practice ETP Methodology, Criteria and Process (Effective 9-25-12)](http://www.oatioasis.com/NWMT/NWMTdocs/ETP_Method_Criteria_and_Process_BP_Approved_09-18-12.pdf), which is posted on NWMT's OASIS website.

## Study Criteria

* System Normal and Outage conditions were modeled and studied for adequacy and system security.
* Segment or element thermal loads >85% of seasonal ratings were noted under these conditions; loads above 100% of the seasonal ratings were noted as overloads.
	+ Overloaded segments were “tripped” per standard relaying practice (100% - 150% thermal on lines, 125% minimum thermal on transformers) to check for “cascading” outages except as noted below per new NERC requirements;
		- 230 kV lines are not tripped below 150% thermal per requirements of NERC PRC-023.
		- May apply to path lines or other system lines and elements deemed critical.
* Voltages outside of NWMT planning criteria were noted (93% and 95%low voltage limit depending on line voltage; 105% high voltage limit).
	+ Load-serving bus voltages may fall above or below the tabled value if conditions allow a higher/lower voltage without harm to NWMT or customer equipment.
	+ Certain equipment ratings may dictate different limits.
* Existing OMS or SPS schemes were considered.
1. Public policy requirements are established by local, state, or federal laws or regulations, meaning enacted statues (i.e., passed by the legislature and signed by the executive) and regulations promulgated by a relevant jurisdiction. Public policy considerations are not driven by local, state or federal law or regulations. [↑](#footnote-ref-1)
2. Also known as Special Protection System (SPS) [↑](#footnote-ref-2)