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ND STATE LAND DEPARTMENT
Helping to Fund Education

Gary D. Preszler, Commissioner

August 17, 2005

NORTH DAKOTA PUBLIC SERVICE COMMISSION
ATTENTION ILLONA JEFFCOAT-SACCO
600 E BLVD DEPT408
BISMARCK ND 58505-0480

Re: PPM Energy, Inc. 230 KV transmission line corridor of compatibility application:
Case No. PU-05-305

Dear Ms. Jeffcoat-Sacco:

On July 29, 2005, I attended the hearing concerning the above-described PPM 230 KV transmission line routing request. We did not testify at the hearing but have been working with PPM on the transmission line routing. In fact, as stated in PPM's testimony, we support the wind farm and have several tracts which are located within the wind farm area.

Prior to the hearing, Timothy Sect, Sarah Emery (both with PPM energy), and I inspected the proposed transmission line route across school trust land in the NW4 Section 22, T157N, R72W, Pierce County. My comment in the field was that we would like to consider locating the line at 100 feet from the existing Xcel Energy centerline. We believe that 100 feet would provide adequate fall down distance and protection from induction for power line workers.

In 2003, we hired SSR engineering to review issues associated with the separation between two electrical transmission lines. One of the lines was a steel tower 230 KV WAPA electrical transmission line with 3 circuits and two static lines which were also sized to carry higher loads. The other line was a 115 KV Capital Electric transmission line. The major concerns were spacing between the lines considering issues of induction and safety for power line workers, line sway, and fall down distance. The legally allowable minimum distance between centerlines was much less than the distance that would be acceptable from a practical point of view considering safety and maintenance (letter enclosed). We ultimately agreed on a separation of 100 feet between centerlines. One hundred feet was very satisfactory to both Capital Electric and WAPA. A point worth noting is that if a pole falls, it doesn't simply fall to its full length to the side, it may break off some distance above ground and will still have wires attached and will swing around or in some cases it will be suspended between the still standing adjacent poles.

Considering our experience with both WAPA and Capital Electric and fall down distances, we request that routing for PPM's transmission line be between 100 and 150 feet from the centerline of the Xcel transmission line. We believe that would be more than adequate for any issues that may arise, including fall down of either line, and would provide the flexibility to consider distances less than the 120-150 feet requested by PPM in their application.

This letter is being sent with full knowledge and concurrence of PPM and their counsel. If you have any questions, please call me at 701-328-1918.

Sincerely,

Michael D. Brand, Director
Surface Management Division

Cc: Lawrence Bender
Pearce and Durick

Enc: SSR Engineers study dated June 27, 2003

MDB/mg
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ssr
engineers

June 27, 2003

Mr. Michael D. Brand, Director
Surface Management Division
ND State Land Department
1707 North 9th Street
P.O. Box 5523
Bismarck, ND 58506-5523

Re: Capital Electric Cooperative Transmission Line
Right-of-Way Calculations

Dear Mr. Brand:

We have completed our calculations for the minimum right-of-way width required for the proposed Capital Electric Cooperative transmission lines on State land.

The calculations were based upon the following information and assumptions:

1. Both lines are 115 kV horizontal post insulator construction with a 5 foot insulator length.

2. Maximum pole height is 75 foot.

3. Conductor for both lines is T2 Penguin at 30% ultimate tension.

4. 2002 NESC code requirements were followed.

5. Maximum span length is 250 feet.

Attached is our calculation summary which shows the minimum legal full right of width to be 27.51 feet or 13.76 feet on either side of the transmission line centerline.

In your letter to us, two questions were requested to be answered. Our responses are the following:

Question 1

The legal minimum separation between the WAPA lines and Capital lines would be based upon the right-of-way calculation. A rounded up right-of-way width of 30 feet, 15 feet on either side of the centerline, would be minimum and it would adjoin the WAPA right-of-way line but not encroach into the WAPA right-of-way.

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The minimum separation distance for safety reasons between the WAPA lines and the proposed Capital Electric lines with operation and maintenance safety being taken into account is an arbitrary number dependent upon a number of factors. These factors are right-of-way accessibility, utility equipment available, utility work practices, safety procedures and policies, future plan upgrade, adjacent structure proximity, desired reliability of the transmission line, and potential liabilities in alternate choices. Therefore, we cannot specify this distance and it must be a negotiated value between the utilities.

Question 2

The minimum right-of-way width necessary for the construction, maintenance and operation of the proposed Capital Electric lines is again based upon the right-of-way calculation. We rounded our calculation up to 30 feet but that number does not take into consideration the utilities operation and maintenance concerns as described in the above paragraph or the constructability of the new proposed line adjacent to existing WAPA facilities. These concerns and additional distances must be negotiated and agreed to by the utilities.

If you have any additional questions or require additional information, please let me know.

Sincerely,

Wayne Bauer

Wayne K. Bauer, P.E.

Enclosure
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NORTH DAKOTA STATE LAND

RIGHT OF WAY WIDTH CALCULATIONS

115KV TRANSMISSION LINE

NESC CLEARANCE

Horizontal clearance required for vertical construction to maintain required clearance for conductor blowout.

Total horizontal clearance from point of attachment to object:

$y = (Li + Sf) \text{ SIN } A + x + s$

- Li = insulator string length (0 for post insulators)
- Sf = conductor final sag at 60° F with 6 lb./sq. ft. wind.
- A = conductor swing out angle in degrees under 6 lb./sq. ft. of wind at 60° F.
- x = clearance required per 2002 NESC.
- y = total horizontal distance from insulator suspension point (conductor attachment point for post insulators) to object.
- s = structure deflection with a 6 lb./sq. ft. wind.

The factor (s) accounts for structure deflection in a 6 lb/sq. ft. wind. It has been calculated using the WPOLE program.

Conductor swing out angle (A) is determined as follows:

$A = \text{atan } [((Dc)(F))/(12\ Wc)]$

- Dc = conductor diameter in inches.
- Wc = weight of conductor in lbs. per foot.
- F = wind force.

CALCULATIONS:

T2-4/0 ACSR 6/1 "PENGUIN"

Conductor swing out angle:

A =	38.3826	degrees.
Dc =	0.922	for T2-4/0 ACSR 6/1 "PENGUIN"
Wc =	0.582	for T2-4/0 ACSR 6/1 "PENGUIN"
F =	6	lb./sq. ft.

Total horizontal clearance:

y =	8.76	feet.
Li =	0	
Sf =	2.83	feet for 250 ft span.
A =	38.3826	degrees.
x =	6.00	for 115KV nominal voltage line to line.
s =	1	feet for 75 foot pole.

This distance is dependant on the conductor sag at the particular point in the span. It is greater at a point near midspan than at a point near a structure where the sag is less.

The distance above is the minimum distance required by these calculations from the conductor attachment point to the edge of the right-of-way.

EXTREME WIND CLEARANCE

An alternate method can be used to determine the minimum width of right-of-way required based on extreme wind conditions. The width of the right-of-way can be determined by allowing the phase conductors to blow out to the edge of the right-of-way during the greatest expected wind, such as the 100 year mean wind. This would mean that any future building built at the edge of the right-of-way would not have code clearance from the transmission line at this condition, and therefore should only be used if there is an extremely low probability of new structures being built near the line.

Amount of conductor blowout and structure deflection during extreme wind: (Extreme wind is 100 mph.)

Total distance from point of attachment to edge of r/w:

$y = (Li + Sf) \text{ SIN } A + s$

Li = insulator string length (0 for post insulators)
Sf = conductor final sag at 60° F with 22 lb./sq. ft. wind.
A = conductor swing out angle in degrees under 22 lb./sq. ft. of wind at 60° F.
y = total horizontal distance from insulator suspension point (conductor attachment point for post insulators) to edge of right-of-way.
s = structure deflection with a 22 lb./sq. ft. wind.

The factor (s) accounts for structure deflection in a 22 lb/sq. ft. wind, and has been calculated using the WPOLE program.

Conductor swing out angle (A) is determined as follows:

$A = \text{atan } [((Dc)(F))/(12\ Wc)]$

Dc = conductor diameter in inches.
Wc = weight of conductor in lbs. per foot.
F = wind force.

CALCULATIONS:

T2-4/0 ACSR 6/1 "PENGUIN"

Conductor swing out angle:

A =	71.0009	degrees.
Dc =	0.922	for T2-4/0 ACSR 6/1 "PENGUIN"
Wc =	0.582	for T2-4/0 ACSR 6/1 "PENGUIN"
F =	22	lb./sq. ft. for 100 year mean wind.

Total horizontal structure and conductor movement.

y =	6.76	feet.
Li =	0	for post insulator.
Sf =	3.98	feet for 250 ft span.
A =	71.0009	degrees.
s =	3	feet for 75 foot pole.

RIGHT-OF-WIDTH

The right-of-way width required needs to be determined in order to maintain adequate clearance to any future buildings that may be built directly at the edge of the R/W. This right-of-way width will insure that the clearance requirements determined previously will be met.

The horizontal clearance required by the 2002 NESC is the greater of the following two conditions:

1. conductor at rest at maximum final sag
2. conductor and pole displaced by a 6 lb./sq. ft. wind

The calculated values for these two conditions are as follows:

(see calculations previously done)

T2-4/0 ACSR 6/1 "PENGUIN"

1. 5.98 feet
2. 8.76 feet

The greater of these two numbers will be used.

Total required right-of-way:

$W = 2 \times y + S$

- W = total right-of-way width
- y = total horizontal clearance required as determined previously.
- S = separation between points of attachment of suspension insulators for outside two phases (between points of conductor attachment for post insulators).

CALCULATIONS:

Required right-of-way:

T2-4/0 ACSR 6/1 "PENGUIN"

W =	27.51	feet.	NESC
y =	8.76	feet.	
S =	10.00	feet.	
		horizontal post insulators	

T2-4/0 ACSR 6/1 "PENGUIN"

W =	23.53	feet.	Extreme wind
y =	6.76	feet.	
S =	10.00	feet.	
		horizontal post insulators	

If this line is built next to a road, there will be no right-of-way required on the road side of the line as long as the required clearances to any existing or future structures on the road side of the line are met.

The required right-of-way for a line built next to a road would then be one-half of the above values from the centerline of the line to the edge of the right-of-way on the field side.

Required right-of-way for line next to a road:

T2-4/0 ACSR 6/1 "PENGUIN"

$W = y + S/2$

W =	13.76	feet	NESC
	11.76	feet	Extreme wind

Width is feet from centerline on the field side of the line.

SUMMARY

Summary of right-of-way widths required for different governing conditions.

The width of right-of-way required would be as follows:

For a full width right-of-way:

$W = 2 \times y + S$ (Varibles as defined previously)

For a right-of-way next to a road:

$W = y + S/2$

Governing condition	y	S	Full r/w	Road r/w
NESC clearances				
T2-4/0 ACSR 6/1 "PENGUIN"	8.76	10.00	27.51	13.76
Extreme wind				
T2-4/0 ACSR 6/1 "PENGUIN"	6.76	10.00	23.53	11.76
RECOMMENDED RIGHT OF WAY	-	-		