ENTERGY NEW ORLEANS, INC.
CITY OF NEW ORLEANS
Docket No. UD-16-01

Response of: Entergy New Orleans, Inc.
to the Second Set of Data Requests
of Requesting Party: Alliance for Affordable Energy

Question No.: AAE 2-10 Part No.: Addendum:

Question:

Please answer the following:

a. Please list the capability of ENO's distribution system for withstanding wind speeds for each category on the Saffir-Simpson hurricane rating system;

b. Please list the capability of ENO's transmission system for withstanding wind speeds for each category on the Saffir-Simpson hurricane rating system; and

c. Provide all documents, workbooks, and data relied on in answering this question.

Response:

a. ENO designs distribution structures to loads that equal or exceeds the loads given in the National Electrical Safety Code (NESC). ENO notes that it is extremely difficult predict the "capability" of its system (both transmission and distribution) to withstand various wind speeds, as contemplated in this request, because there are numerous factors that must be considered, such as wind direction, the loading on each individual pole, which are loaded to varying degrees.

b. See Company's Response to Subpart (a).

c. See Company's Response to Subpart (a).

Section 25.
Loadings for Grades B and C

250. General loading requirements and maps

A. General

1. It is necessary to assume the wind and ice loads that may occur on a line. Three weather loadings are specified in Rules 250B, 250C, and 250D. Where all three rules apply, the required loading shall be the one that has the greatest effect.

2. Where construction or maintenance loads exceed those imposed by Rule 250A1, the assumed loadings shall be increased accordingly. When temporary loads, such as lifting of equipment, stringing operations, or a worker on a structure or its component, are to be imposed on a structure or component, the strength of the structure or component should be taken into account or other provisions should be made to limit the likelihood of adverse effects of structure or component failure.

   NOTE: Other provisions could include cranes that can support the equipment loads, guard poles and spotters with radios, and stringing equipment capable of promptly halting stringing operations.

3. It is recognized that loadings actually experienced in certain areas in each of the loading districts may be greater, or in some cases, may be less than those specified in these rules. In the absence of a detailed loading analysis, using the same respective statistical methodologies used to develop the maps in Rule 250C or 250D, no reduction in the loadings specified therein shall be made without the approval of the administrative authority.

4. The structural capacity provided by meeting the loading and strength requirements of Sections 25 and 26 provides sufficient capability to resist earthquake ground motions.

B. Combined ice and wind district loading

Four general degrees of district loading due to weather conditions are recognized and are designated as heavy, medium, light, and warm island loading. Figure 250-1 shows the districts where these loadings apply. Warm island loading applies to Hawaii and other island systems located in the range of 0 to 25 degrees latitude, north or south.

NOTE: The localities are classified in the different loading districts according to the relative simultaneous prevalence of the wind velocity and thickness of ice that accumulates on wires. Light loading is for places where little, if any, ice accumulates on wires. In the warm island loading zone, cold temperatures and ice accumulation on wires only occurs at high altitudes.

Table 250-1 shows the radial thickness of ice and the wind pressures to be used in calculating loads. Ice is assumed to weigh 913 kg/m^3 (57 lb/ft^3).

C. Extreme wind loading

If no portion of a structure or its supported facilities exceeds 18 m (60 ft) above ground or water level, the provisions of this rule are not required, except as specified in Rule 261A1c, 261A2e, or 261A3d. Where a structure or its supported facilities exceeds 18 m (60 ft) above ground or water level the structure and its supported facilities shall be designed to withstand the extreme wind load associated with the Basic Wind Speed, as specified by Figure 250-2. The wind pressures calculated shall be applied to the entire structure and supported facilities without ice. The following formula shall be used to calculate wind load.

$$\text{Load in newtons} = 0.613 \cdot (V_{m/s})^2 \cdot k_z \cdot G_{RF} \cdot I \cdot C_f \cdot A(m^2)$$

$$\text{Load in pounds} = 0.00256 \cdot (V_{mi/h})^2 \cdot k_z \cdot G_{RF} \cdot I \cdot C_f \cdot A(ft^2)$$

where

0.613 0.00256	Velocity-pressure numerical coefficient reflects the mass density of air for the standard atmosphere, i.e., temperature of 15 °C (59 °F) and sea level pressure of 760 mm (29.92 in) of mercury. The numerical coefficient 0.613 metric (0.00256 customary) shall be used except where sufficient climatic data are available to justify the selection of a different value of this factor for a design application.
k_z	Velocity pressure exposure coefficient, as defined in Rule 250C1, Table 250-2
V	Basic wind speed, 3 s gust wind speed in m/s at 10 m (mi/h at 33 ft) aboveground, Figure 250-2
G_{RF}	Gust response factor, as defined in Rule 250C2
I	Importance factor, 1.0 for utility structures and their supported facilities
C_f	Force coefficient (shape factor). As defined in Rules 251A2 and 252B
A	Projected wind area, m^2 (ft^2)

The wind pressure parameters (k_z, V, and G_{RF}) are based on open terrain with scattered obstructions (Exposure Category C as defined in ASCE 7-05). Exposure Category C is the basis of the NESC extreme wind criteria. Topographical features such as ridges, hills, and escarpments may increase the wind loads on site-specific structures. A Topographic Factor, K_{zt}, from ASCE 7-05, may be used to account for these special cases.

NOTE: Special wind regions—Although the wind speed map is valid for most regions of the country, special wind regions indicated on the map are known to have wind speed anomalies. Winds blowing over mountain ranges or through gorges or river valleys in these special regions can develop speeds that are substantially higher than the values indicated on the map.

1. Velocity pressure exposure coefficient, k_z

   The velocity pressure exposure coefficient, k_z, is based on the height, h, to the center-of-pressure of the wind area for the following load applications:

   a. k_z for the structure is based on 0.67 of the total height, h, of the structure above ground line.

      NOTE: In Table 250-2, for h ≤ 75 m (250 ft), the structure k_z values are adjusted for the wind load to be determined at the center-of-pressure of the structure assumed to be at 0.67 h. The wind pressure is assumed uniformly distributed over the structure face normal to the wind.

   b. k_z for the wire is based on the height, h, of the wire at the structure.

      In special terrain conditions (i.e., mountainous terrain and canyon) where the height of the wire aboveground at mid-span may be substantially higher than at the structure, engineering judgment may be used in determining an appropriate value for the wire k_z.

   c. k_z for a specific height on a structure or component is based on the height, h, to the center-of-pressure of the wind area being considered.

      The formulas shown in Table 250-2 shall be used to determine all values of k_z.

      EXCEPTION: The selected values of k_z tabulated in Table 250-2 may be used instead of calculating the values.

2. Gust response factor, G_{RF}

   a. The structure gust response factor, G_{RF}, is determined using the total structure height, h. When calculating a wind load at a specific height on a structure, the structure gust response factor, G_{RF}, determined using the total structure height, h, shall be used.

   b. The wire gust response factor is determined using the height of the wire at the structure, h, and the design wind span, L. Wire attachment points that are 18 m (60 ft) or less above ground or water level must be considered if the total structure height is greater than 18 m (60 ft) above ground or water.

In special terrain conditions (i.e., mountainous terrain and canyon) where the height of the wire aboveground at mid-span may be substantially higher than at the attachment point, engineering judgment may be used in determining an appropriate value for the wire G_{RF}.

c. The gust response factor, G_{RF}, to be used on components, such as antennas, transformers, etc., shall be the structure gust response factor determined in Rule 250C2a.

Selected values of the structure and wire gust response factors are tabulated in Table 250-3. The structure and wire gust response factors may also be determined using the formulas in Table 250-3. For values of h > 75 m (250 ft) and L > 600 m (2000 ft), the G_{RF} shall be determined using the formulas in Table 250-3.

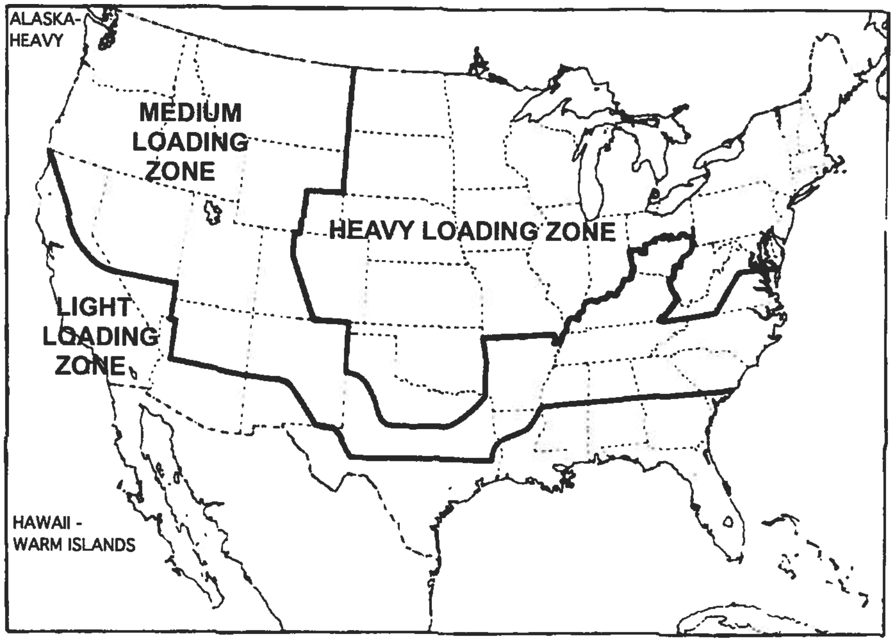
NOTE: Where structure heights are 50 m (165 ft) or less and spans are 600 m (2000 ft) or less, the combined product of k_z and G_{RF} may be conservatively taken as 1.15 if it is desired to simplify calculations.

D. Extreme ice with concurrent wind loading

If no portion of a structure or its supported facilities exceeds 18 m (60 ft) aboveground or water level, the provisions of this rule are not required. Where a structure or its supported facilities exceeds 18 m (60 ft) aboveground or water level, the structure and its supported facilities shall be designed to withstand the ice and wind load associated with the Uniform Ice Thickness and Concurrent Wind Speed, as specified by Figure 250-3. The wind pressures for the concurrent wind speed shall be as indicated in Table 250-4. The wind pressures calculated shall be applied to the entire structure and supported facilities without ice and to the iced wire diameter determined in accordance with Rule 251. No loading is specified in this rule for extreme ice with concurrent wind loading for warm islands located from 0 to 25 degrees latitude, north or south.

Ice is assumed to weigh 913 kg/m^3 (57 lb/ft^3).

1. For Grade B, the radial thickness of ice from Figure 250-3 shall be multiplied by a factor of 1.00.
2. For Grade C, the radial thickness of ice from Figure 250-3 shall be multiplied by a factor of 0.80.
3. The concurrent wind shall be applied to the projected area resulting from Rules 250D1 and 250D2 multiplied by a factor of 1.00.



The Warm Island Loading District includes American Samoa, Guam, Hawaii, Puerto Rico, Virgin Islands, and other islands located from 0 to 25 degrees latitude, north or south.

Figure 250-1—General loading map of United States with respect to loading of overhead lines

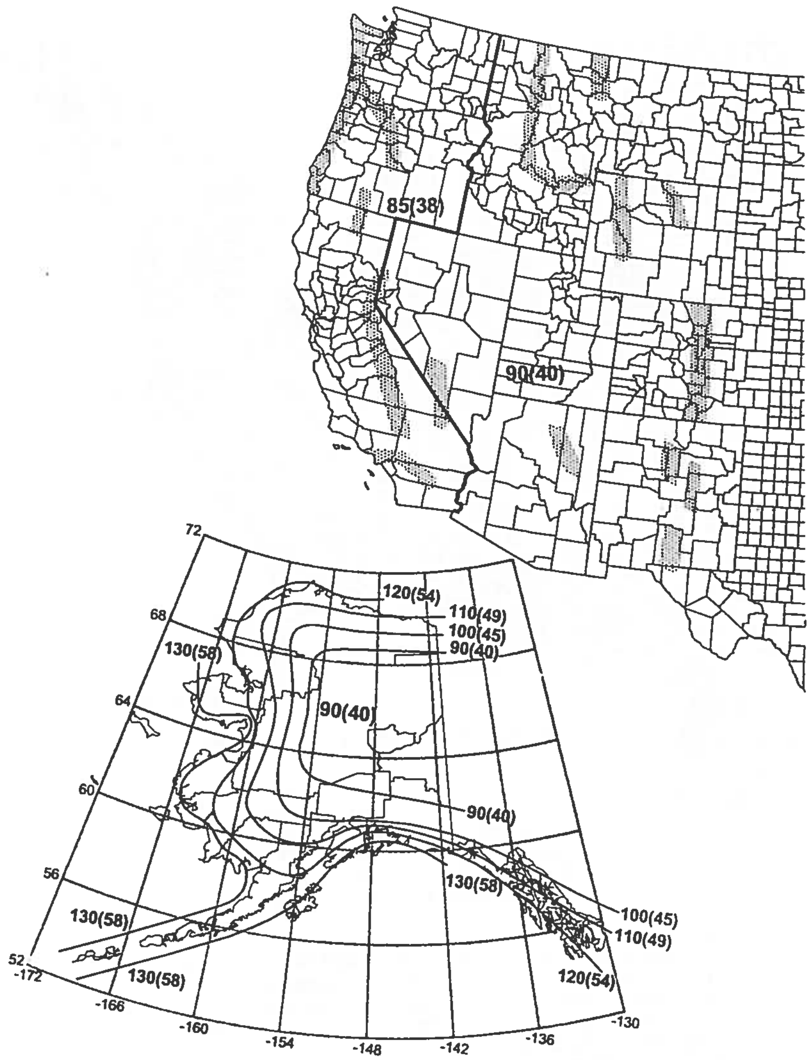


Figure 250-2(a)—Basic wind speeds

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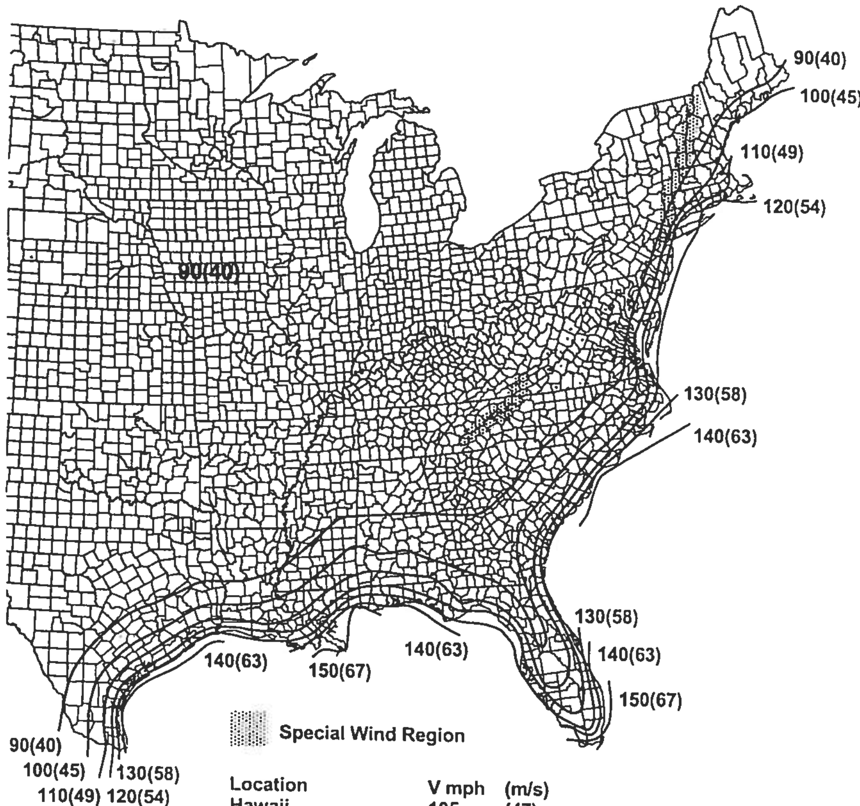

Location	V mph	(m/s)
Hawaii	105	(47)
Puerto Rico	145	(65)
Guam	170	(76)
Virgin Islands	145	(65)
American Samoa	125	(56)

Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

Figure 250-2(b)—Basic wind speeds

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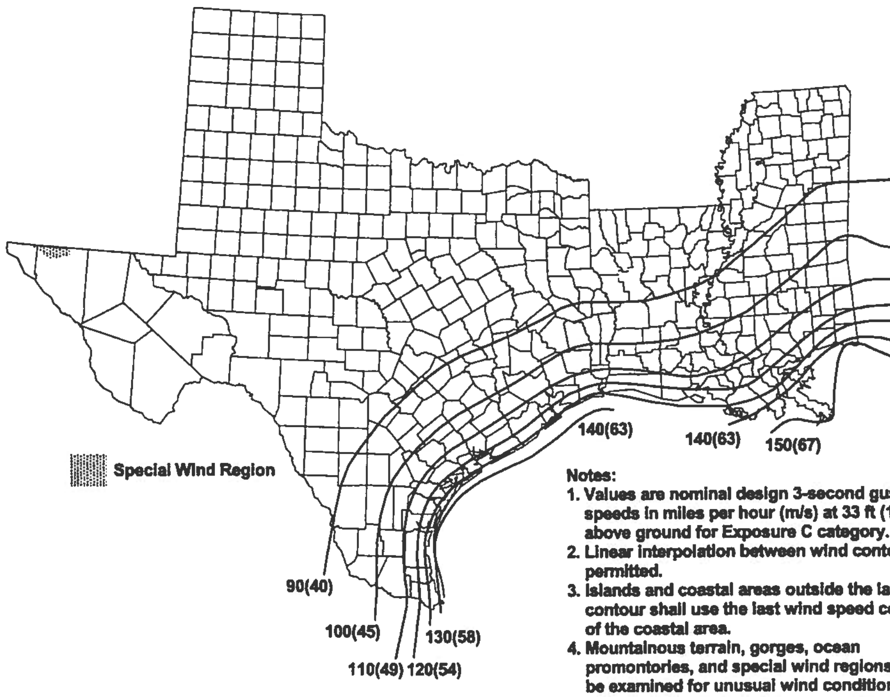

Figure 250-2(c)—Western Gulf of Mexico hurricane coastline

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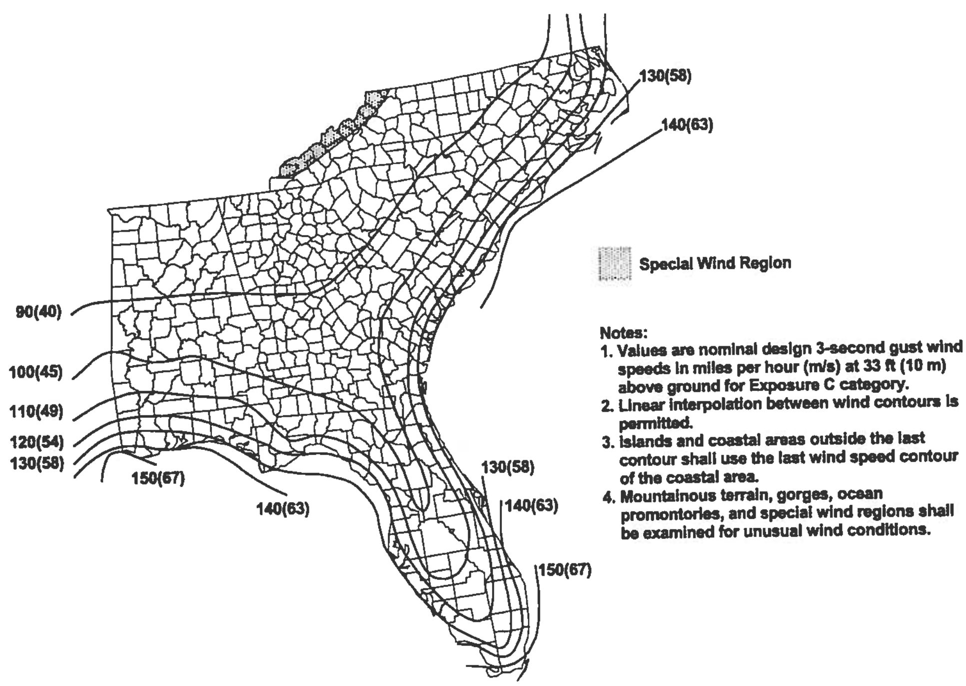

Figure 250-2(d)—Eastern Gulf of Mexico and southeastern U.S. hurricane coastline

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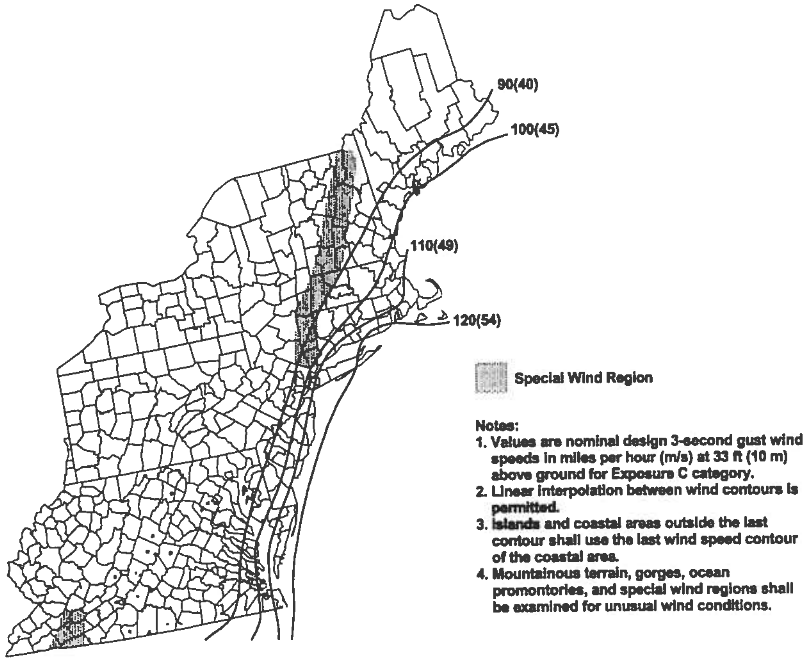

Figure 250-2(e)—Mid and northern Atlantic hurricane coastline

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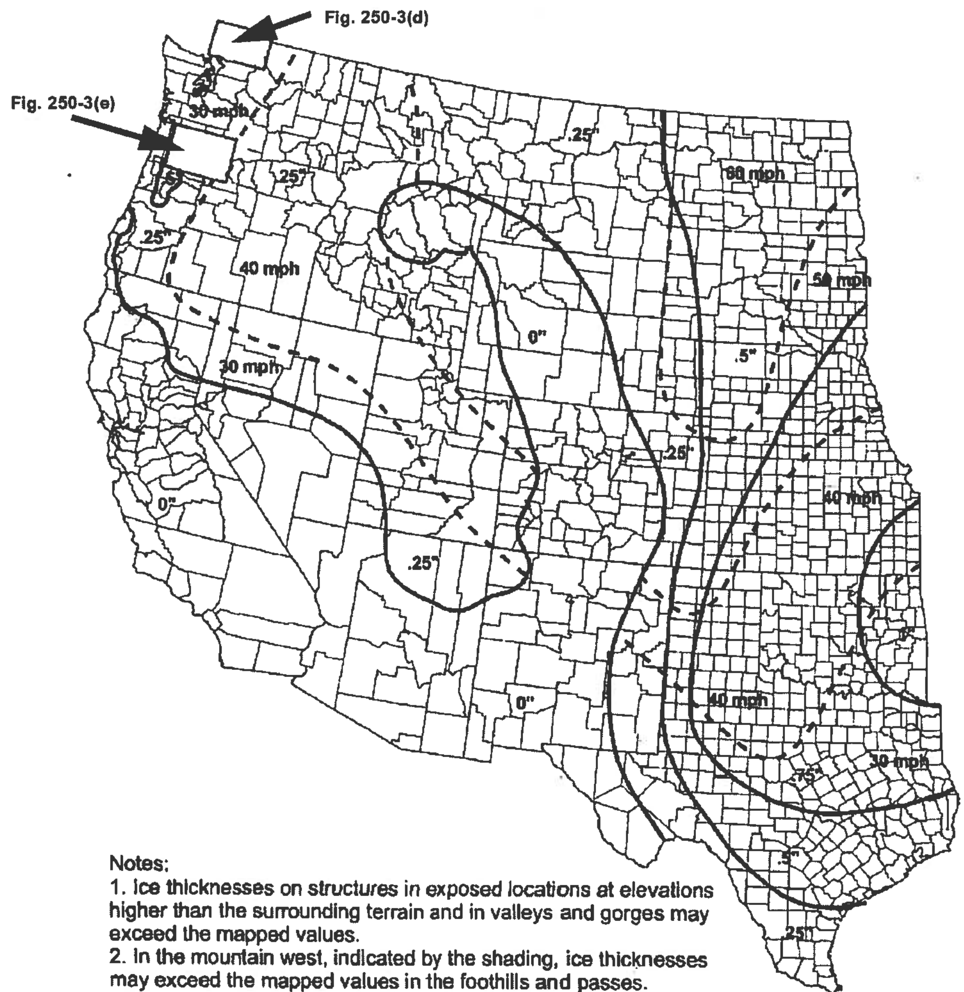

50-YEAR MEAN RECURRENCE INTERVAL UNIFORM ICE THICKNESSES DUE TO FREEZING RAIN WITH CONCURRENT 3-SECOND GUST SPEEDS: CONTIGUOUS 48 STATES.

Figure 250-3(a)—Uniform ice thickness with concurrent wind

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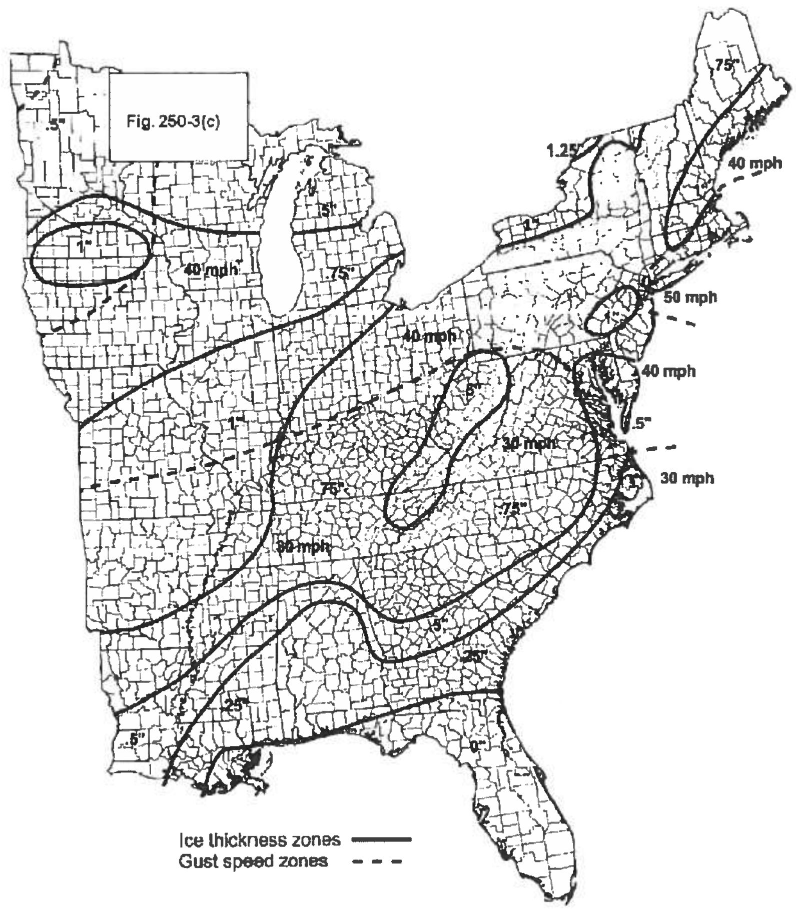

50-YEAR MEAN RECURRENCE INTERVAL UNIFORM ICE THICKNESSES DUE TO FREEZING RAIN WITH CONCURRENT 3-SECOND GUST SPEEDS: CONTIGUOUS 48 STATES.

Figure 250-3(b)—Uniform ice thickness with concurrent wind

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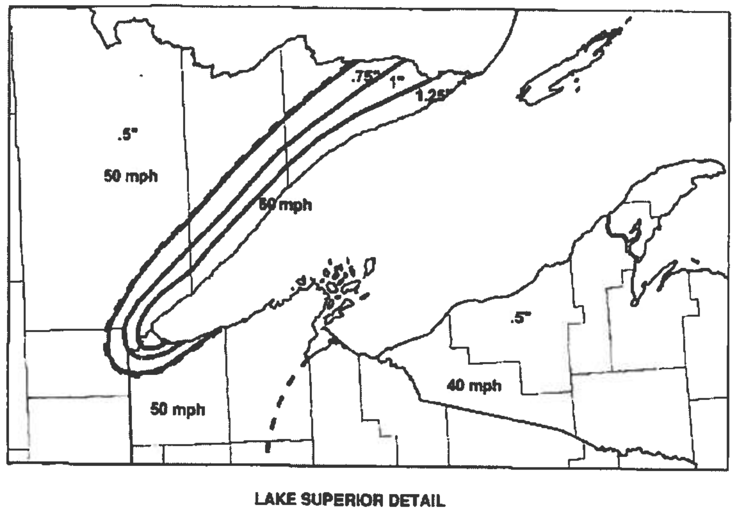

Figure 250-3(c)—Uniform ice thickness with concurrent wind

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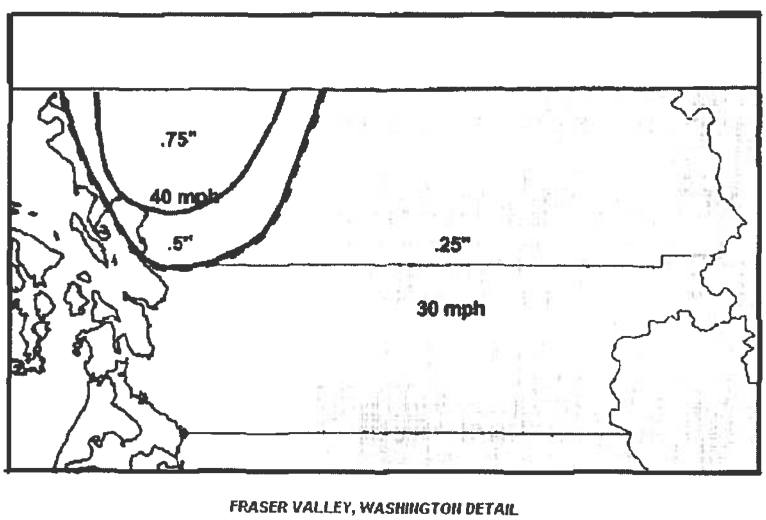

Figure 250-3(d)—Uniform ice thickness with concurrent wind

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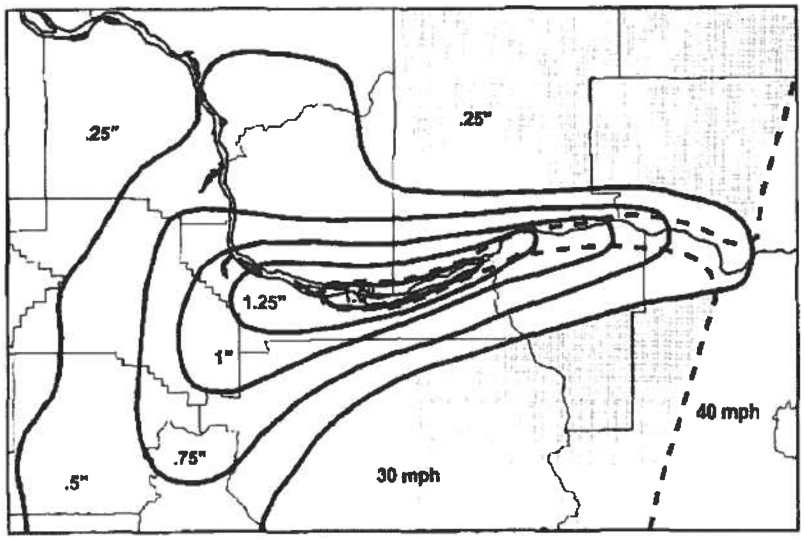

Figure 250-3(e)—Uniform ice thickness with concurrent wind

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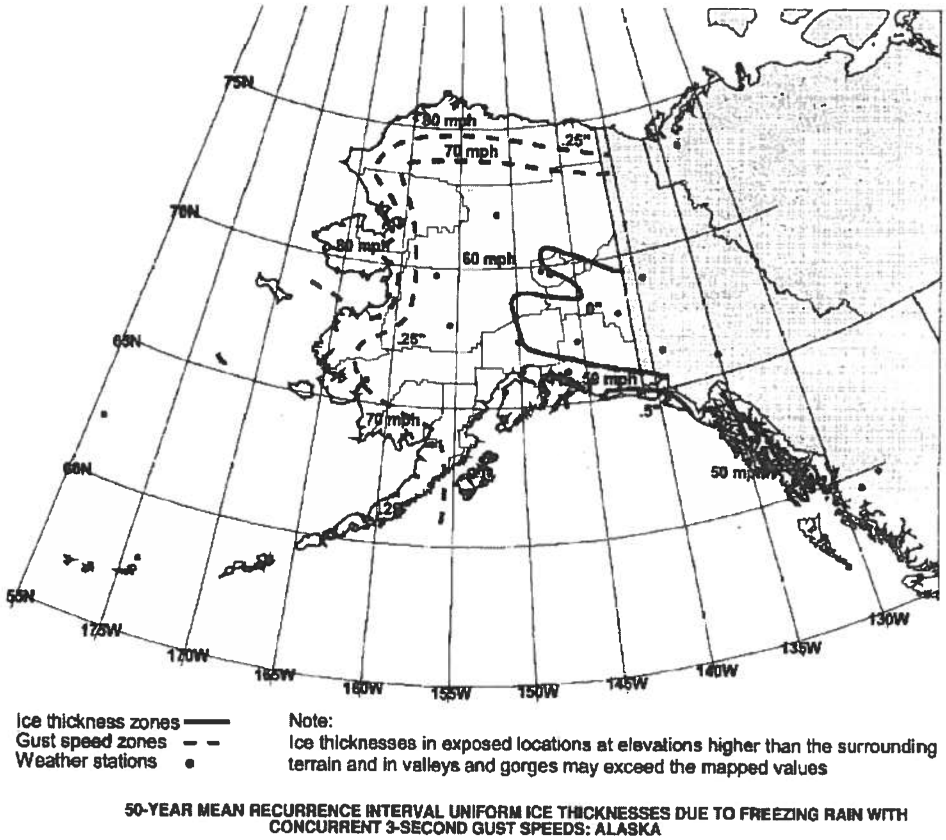

Figure 250-3(f)—Uniform ice thickness with concurrent wind

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Table 250-1—Ice, wind pressures, and temperatures

	Loading districts (for use with Rule 250B)					Extreme wind loading (for use with Rule 250C)	Extreme ice loading with concurrent wind (for use with Rule 250D)
	Heavy see Figure 250-1	Med-ium see Figure 250-1	Light see Figure 250-1	Warm islands located at 0 to 25 degrees latitude ①			
				Altitudes sea level to 2743 m (9000 ft)	Altitudes above 2743 m (9000 ft)		
Radial thickness of ice							
(mm)	12.5	6.5	0	0	6.5	0	See Figure 250-3
(in)	0.50	0.25	0	0	0.25	0	See Figure 250-3
Horizontal wind pressure							
(Pa)	190	190	430	430	190	See Figure 250-2	See Figure 250-3
(lb/ft^2)	4	4	9	9	4	See Figure 250-2	See Figure 250-3
Temperature							
(°C)	–20	–10	–1	+10	–10	+15	–10
(°F)	0	+15	+30	+50	+15	+60	+15

①Islands located at 0 to 25 degrees latitude include American Samoa (14°S), Guam (13°N), Hawaii (22°N), Puerto Rico (18°N), and Virgin Islands (18°N).

Table 250-2—Velocity pressure exposure coefficient k_z

Height, h (m)	Height, h (ft)	k_z (structure)	k_z (wire, specified height on the structure, and component)
≤ 10	≤ 33	0.9	1.0
> 10 to 15	> 33 to 50	1.0	1.1
> 15 to 25	> 50 to 80	1.1	1.2
> 25 to 35	> 80 to 115	1.2	1.3
> 35 to 50	> 115 to 165	1.3	1.4
> 50 to 75	> 165 to 250	1.4	1.5
> 75	> 250	Use formulas	Use formulas

Formulas (metric):

Structure	$k_z = 2.01 \cdot (0.67 \cdot h/275)^{(2/9.5)}$ $k_z = 1.85$	$h \le 275$ m $h > 275$ m
Wire, specified height on the structure, and component	$k_z = 2.01 \cdot (h/275)^{(2/9.5)}$ $k_z = 2.01$	$h \le 275$ m $h > 275$ m

Formulas (customary):

Structure	$k_z = 2.01 \cdot (0.67 \cdot h/900)^{(2/9.5)}$ $k_z = 1.85$	$h \le 900$ ft $h > 900$ ft
Wire, specified height on the structure, and component	$k_z = 2.01 \cdot (h/900)^{(2/9.5)}$ $k_z = 2.01$	$h \le 900$ ft $h > 900$ ft

h = Structure, specified height on the structure, and component and wire height as defined in Rule 250C1

Minimum $k_z = 0.85$

Formulas are for Exposure Category C, ASCE 7-05.

NOTE: Calculations in this table are based on the maximum values in the stated ranges.

m

Table 250-3—Structure and wire gust response factors, G_{RF}

Height	Structure	Wire G_{RF}, span length, L (m)						
h (m)	**G_{RF}**	**≤75**	**75<L≤150**	**150<L≤225**	**225<L ≤300**	**300<L ≤450**	**450<L ≤600**	**L >600**
≤ 10	1.00	0.91	0.86	0.79	0.75	0.72	0.69	①
> 10 to 15	0.96	0.87	0.82	0.76	0.73	0.70	0.67	①
> 15 to 25	0.93	0.85	0.80	0.75	0.71	0.69	0.66	①
> 25 to 35	0.89	0.82	0.78	0.73	0.70	0.68	0.65	①
> 35 to 50	0.86	0.81	0.77	0.72	0.69	0.67	0.64	①
> 50 to 75	0.83	0.79	0.75	0.71	0.68	0.66	0.63	①
> 75	①	①	①	①	①	①	①	①

Formulas:

Structure $G_{RF} = [1 + (2.7 \cdot E_s \cdot B_s^{0.5})]/k_v^2$

Wire $G_{RF} = [1 + (2.7 \cdot E_w \cdot B_w^{0.5})]/k_v^2$

$E_s = 0.346 \cdot [10/(0.67 \cdot h)]^{1/7}$

$E_w = 0.346 \cdot (10/h)^{1/7}$

$B_s = 1/(1 + 0.56 \cdot (0.67 \cdot h)/67)$

$B_w = 1/(1 + 0.8 \cdot L/67)$

Where:

E_w =Wire exposure factor

E_s = Structure exposure factor

B_w = Dimensionless response term corresponding to the quasi-static background wind loads on the wire

B_s = Dimensionless response term corresponding to the quasi-static background wind loads on the structure

$k_v = 1.43$

h = Structure or wire height, as defined in Rule 250C2, in meters

L = Design wind span, in meters

Formulas are for Exposure Category C, ASCE 7-05.

①For heights greater than 75 m and/or spans greater than 600 m, the formulas shall be used.

ft

Table 250-3—Structure and wire gust response factors, G_{RF}

Height	Structure	Wire G_{RF}, span length, L (ft)						
h (ft)	G_{RF}	≤250	250<L ≤500	500<L ≤750	750<L ≤1000	1000<L ≤1500	1500<L ≤2000	L> 2000①
≤ 33	1.02	0.93	0.86	0.79	0.75	0.73	0.69	①
> 33 to 50	0.97	0.88	0.82	0.76	0.72	0.70	0.67	①
> 50 to 80	0.93	0.86	0.80	0.75	0.71	0.69	0.66	①
> 80 to 115	0.89	0.83	0.78	0.73	0.70	0.68	0.65	①
> 115 to 165	0.86	0.82	0.77	0.72	0.69	0.67	0.64	①
> 165 to 250	0.83	0.80	0.75	0.71	0.68	0.66	0.63	①
> 250	①	①	①	①	①	①	①	①

Formulas:

Structure $G_{RF} = [1 + (2.7 \cdot E_s \cdot B_s^{0.5})]/k_v^2$

Wire $G_{RF} = [1 + (2.7 \cdot E_w \cdot B_w^{0.5})]/k_v^2$

$E_s = 0.346 \cdot [33/(0.67 \cdot h)]^{1/7}$

$E_w = 0.346 \cdot (33/h)^{1/7}$

$B_s = 1/(1 + 0.56 \cdot (0.67 \cdot h)/220)$

$B_w = 1/(1 + 0.8 \cdot L/220)$

Where:

E_w = Wire exposure factor

E_s = Structure exposure factor

B_w = Dimensionless response term corresponding to the quasi-static background wind loads on the wire

B_s = Dimensionless response term corresponding to the quasi-static background wind loads on the structure

$k_v = 1.43$

h = Structure or wire height, as defined in Rule 250C2, in feet

L = Design wind span, in feet

Formulas are for Exposure Category C, ASCE 7-05.

①For heights greater than 250 ft and/or spans greater than 2000 ft, the formulas shall be used.

Table 250-4—Wind speed conversions to pressure
To be used only with the extreme ice with concurrent wind loading of Rule 250D and Figure 250-3.

Wind speed (mph)	Horizontal wind pressure	
	Pascals	lb/ft^2
30	110	2.3
40	190	4.0
50	310	6.4
60	440	9.2

251. Conductor loading

A. General

Ice and wind loads are specified in Rule 250.

1. Where a cable is attached to a messenger, the specified loads shall be applied to both cable and messenger.

2. In determining wind loads on a conductor or cable without ice covering, the assumed projected area shall be that of a smooth cylinder whose outside diameter is the same as that of the conductor or cable. The force coefficient (shape factor) for cylindrical surfaces is assumed to be 1.0.

   EXCEPTION: The force coefficient (shape factor) of 1.0 may be reduced for the bare conductor (without radial ice) if wind tunnel tests or a qualified engineering study justifies a reduction.

   NOTE: Experience has shown that as the size of multiconductor cable decreases, the actual projected area decreases, but the roughness factor increases and offsets the reduction in projected area.

3. An appropriate mathematical model shall be used to determine the wind and weight loads on ice-coated conductors and cables. In the absence of a model developed in accordance with Rule 251A4, the following mathematical model shall be used:

   a. On a conductor, lashed cable, or multiple-conductor cable, the coating of ice shall be considered to be a hollow cylinder touching the outer strands of the conductor or the outer circumference of the lashed cable or multiple-conductor cable.

   b. On bundled conductors, the coating of ice shall be considered as individual hollow cylinders around each subconductor.

4. It is recognized that the effects of conductor stranding or of non-circular cross section may result in wind and ice loadings more or less than those calculated according to assumptions stated in Rules 251A2 and 251A3. No reduction in these loadings is permitted unless testing or a qualified engineering study justifies a reduction.

B. Load components

The load components shall be determined as follows:

1. Vertical load component

   The vertical load on a wire, conductor, or messenger shall be its own weight plus the weight of conductors, spacers, or equipment that it supports, ice covered where required by Rule 250.

2. Horizontal load component

The horizontal load shall be the horizontal wind pressure of determined under Rule 250 applied at right angles to the direction of the line using the projected area of the conductor or messenger and conductors spacers, or equipment that it supports, ice covered where required by Rule 250.

NOTE: The projected area of the conductor or messenger is equal to the diameter of the conductor or messenger, plus ice if appropriate, multiplied by the span length (see Rule 252B4). See Rule 251A2 for force coefficient values of different surface shapes.

3. Total load

The total load on each wire, conductor, or messenger shall be the resultant of components 1 and 2 above, calculated at the applicable temperature in Table 251-1, plus the corresponding additive constant in Table 251-1. In all cases the conductor or messenger tension shall be computed from this total load.

Table 251-1—Temperatures and constants

	Loading districts (for use with 250B)					Extreme wind loading (for use with Rule 250C)	Extreme ice loading with concurrent wind (for use with Rule 250D)
	Heavy (see Figure 250-1)	Medium (see Figure 250-1)	Light (see Figure 250-1)	Warm islands located at 0 to 25 degrees latitude ① — Altitudes sea level to 2743 m (9000 ft)	Warm islands located at 0 to 25 degrees latitude ① — Altitudes above 2743 m (9000 ft)		
Temperature							
(°C)	–20	–10	–1	+10	–10	+15	–10
(°F)	0	+15	+30	+50	+15	+60	+15
Constant to be added to the resultant (all conductors) ②							
(N/m)	4.40	2.90	0.73	0.73	2.90	0.0	0.0
(lb/ft)	0.30	0.20	0.05	0.05	0.20	0.0	0.0

① Islands located at 0 to 25 degrees latitude include American Samoa (14°S), Guam (13°N), Hawaii (22°N), Puerto Rico (18°N), and Virgin Islands (18°N).

② For cable arrangements supported by a messenger using spacers or rings and where each conductor or cable is separately loaded with ice and wind as described in Rule 251A3b (as opposed to being analyzed with the ice and wind applied to a hollow cylinder touching the outer strands of the conductors as described in Rule 251A3a, the constant specified here shall be added to the resultant load of each component conductor and the messenger.

252. Loads on line supports

A. Assumed vertical loads

The vertical loads on poles, towers, foundations, crossarms, pins, insulators, and conductor fastenings shall be their own weight plus the weight that they support, including all wires and cables, in accordance with Rules 251A and 251B1, together with the effect of any difference in elevation of supports. Loads due to radial ice shall be computed on wires, cables, and messengers, but need not be computed on supports.

B. Assumed transverse loads

The total transverse loads on poles, towers, foundations, crossarms, pins, insulators, and conductor fastenings shall include the following:

1. Transverse loads from conductors and messengers

The transverse loads from conductors and messengers shall be the horizontal load determined by Rule 251.

EXCEPTION: In medium- and heavy-loading districts, where supporting structures carry ten or more conductors on the same crossarm, not including cables supported by messengers, and where the horizontal pin spacing does not exceed 380 mm (15 in), the transverse wind load may be calculated on two-thirds of the total number of such conductors if at least ten conductors are used in the calculations.

2. Wind loads on structures

The transverse load on structures and equipment shall be computed by applying, at right angles to the direction of the line, the appropriate horizontal wind pressure determined under Rule 250. This load shall be calculated using the projected surfaces of the structures and equipment supported thereon, without ice covering. The following force coefficient (shape factors) shall be used.

a. Cylindrical structures and components

Wind loads on straight or tapered cylindrical structures or structures composed of numerous narrow relatively flat panels that combine to form a total cross section that is circular or elliptical in shape shall be computed using a force coefficient (shape factor) of 1.0.

b. Flat surfaced (not latticed) structures and components

Wind loads on structures or components, having solid or enclosed flat sided cross sections that are square or rectangular, with rounded corners, shall be computed using a force coefficient (shape factor) of 1.6.

c. Latticed structures

Wind loads on square or rectangular latticed structures or components shall be computed using a force coefficient (shape factor) of 3.2 on the sum of the projected areas of the members of the front face if structural members are flat surfaced or 2.0 if structural surfaces are cylindrical. The total, however, need not exceed the load that would occur on a solid structure of the same outside dimension.

EXCEPTION: The force coefficient (shape factor) listed under Rules 252B2a, 252B2b, and 252B2c may be reduced if wind tunnel tests or a qualified engineering study justifies a reduction.

3. At angles

Where a change in direction of wires occurs, the loads on the structure, including guys, shall be the vector sum of the transverse wind load and the wire tension load. In calculating these loads, a wind direction shall be assumed that will give the maximum resultant load. Proper reduction may be made to the loads to account for the reduced wind pressure on the wires resulting from the angularity of the application of the wind on the wire.

4. Span lengths

The calculated transverse load shall be based on the average of the two spans adjacent to the structure concerned.

C. Assumed longitudinal loading

1. Change in grade of construction

The longitudinal loads on supporting structures, including poles, towers, and guys at the ends of sections required to be of Grade B construction, when located in lines of lower than Grade B construction, shall be taken as an unbalanced tension in the direction of the higher grade section equal to the larger of the following values:

a. Conductors with rated breaking strength of 13.3 kN (3000 lb) or less

The unbalanced tension shall be the tension of two-thirds, but not fewer than two, of the conductors having a rated breaking strength of 13.3 kN (3000 lb) or less. The conductors selected shall produce the maximum stress in the support.

EXCEPTION: Where there are one or two conductors having rated breaking strength of 13.3 kN (3000 lb) or less, the load shall be that of one conductor.

b. Conductors with rated breaking strength of more than 13.3 kN (3000 lb)

The unbalanced tension shall be the tension resulting from one conductor when there are eight or fewer conductors (including overhead ground wires) having rated breaking strength of more than 13.3 kN (3000 lb), and the tension of two conductors when there are more than eight conductors. The conductors selected shall produce the maximum stress in the support.

2. Jointly used poles at crossings over railroads, communication lines, or limited access highways

Where a joint line crosses a railroad, a communication line, or a limited access highway, and Grade B is required for the crossing span, the tension in the communication conductors of the joint line shall be considered as limited to one-half their rated breaking strength, provided they are smaller than Stl WG No. 8 if of steel, or AWG No. 6 if of copper.

3. Deadends

The longitudinal load on a supporting structure at a deadend shall be an unbalanced pull equal to the tensions of all conductors and messengers (including overhead ground wires); except that with spans in each direction from the dead-end structure, the unbalanced pull shall be the difference in tensions.

4. Unequal spans and unequal vertical loads

The structure should be capable of supporting the unbalanced longitudinal load created by the difference in tensions in the wires in adjacent spans caused by unequal vertical loads or unequal spans.

5. Stringing loads

Consideration should be given to longitudinal loads that may occur on the structure during wire stringing operations.

6. Longitudinal capability

It is recommended that structures having a longitudinal strength capability be provided at reasonable intervals along the line.

7. Communication conductors on unguyed supports at railroad and limited access highway crossings

The longitudinal load shall be assumed equal to an unbalanced pull in the direction of the crossing of all open-wire conductors supported, where the tension of each conductor is assumed to be 50% of its rated breaking strength in the heavy-loading district, 33-1/3% in the medium-loading district, and 22-1/4% in the light-loading district.

D. Simultaneous application of loads

Where a combination of vertical, transverse, or longitudinal loads may occur simultaneously, the structure shall be designed to withstand the simultaneous application of these loads.

NOTE: Under the extreme wind conditions of Rule 250C, an oblique wind may require greater structural strength than that computed by Rules 252B and 252C.

253. Load factors for structures, crossarms, support hardware, guys, foundations, and anchors

Loads due to the district loads in Rule 250B, the extreme wind loading condition in Rule 250C, and the extreme ice with concurrent wind condition in Rule 250D shall be multiplied by the load factors in Table 253-1.

Table 253-1—Load factors for structures①, crossarms, support hardware ⑧, guys, foundations, and anchors to be used with the strength factors of Table 261-1

Load Factors			
	Grade B	Grade C	
		At crossings ⑥	Elsewhere
Rule 250B loads (Combined ice and wind district loading) Vertical loads ③	1.50	1.90 ⑤	1.90 ⑤
Transverse loads Wind Wire tension	 2.50 1.65 ②	 2.20 1.30 ④	 1.75 1.30 ④
Longitudinal loads In general At deadends	 1.10 1.65 ②	 No requirement 1.30 ④	 No requirement 1.30 ④
Rule 250C loads (Extreme wind) Wind loads All other loads	 1.00 1.00	 0.87 ⑦ 1.00	 0.87 ⑦ 1.00
Rule 250D loads (Extreme ice with concurrent wind)	1.00	1.00	1.00

①Includes pole.
②For guys and anchors associated with structures supporting communication conductors and cables only, this factor may be reduced to 1.33.
③Where vertical loads significantly reduce the stress in a structure member, a vertical load factor of 1.0 should be used for the design of such member. Such member shall be designed for the worst case loading.
④For metal or prestressed concrete, portions of structures, crossarms, guys, foundations, and anchors, use a value of 1.10.
⑤For metal prestressed concrete, or fiber-reinforced polymer portions of structures and crossarms, guys, foundations, and anchors, use a value of 1.50.
⑥This applies only where a line crosses another supply or communication line (see Rule 241C and Table 242-1).
⑦For wind velocities above 100 mph (except Alaska), a factor of 0.75 may be used.
⑧Support hardware does not include insulators. See Section 27 for insulator strength and loading requirements.

ENTERGY TRANSMISSION STANDARDS
TRANSMISSION LINES
DESIGN

Title: **Transmission Line Design Criteria**	Standard No.: **TO0203 R07**	Effective Date: April 15, 2015
By: Ernest Williamson, Staff Engineer	Approved By: Bill Sones Manager, Transmission Line Design	

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REV. NO	1.1.1 Revisions	2.0 DATE	REV. BY	App. by
0	First Issued	4/12/2006	Walker Sullivan	Ron Rowland
1	Rev. 6.5.14, fiber optic requirements to match TF0401		Tim Brister	
2	See section 1.3 for details	8/30/2009	E. C. Williamson	Ron Rowland
3	See section 1.3 for details	2/22/2011	E. C. Williamson	Ron Rowland
4	See section 1.3 for details	10/15/2012	E. C. Williamson	Ron Rowland
5	See section 1.3 for details	12/01/2012	E. C. Williamson	Ron Rowland
6	Update Deflect. Criteria, Rev. ACCC ratings	02/04/2014	E. C. Williamson	Bill Sones
7	ROW, Conductor/SW/OPGW changes, see section 1.3 for detailed descriptions.	4/15/2015	E. C. Williamson	Bill Sones

Table 5.3(a) Load Districts by County – Arkansas and Missouri

State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
AR	Arkansas	100		M		1	LC-2
AR	Ashley	100		M		1	LC-2
AR	Baxter	100			H	1	LC-1
AR	Benton	100			H	1	LC-1
AR	Boone	100			H	1	LC-1
AR	Bradley	100		M		1	LC-2
AR	Calhoun	100		M		1	LC-2
AR	Carroll	100			H	1	LC-1
AR	Chicot	100		M		1	LC-2
AR	Clark	100			H	1	LC-1
AR	Clay	100			H	1	LC-1
AR	Cleburne	100			H	1	LC-1
AR	Cleveland	100		M		1	LC-2
AR	Columbia	100		M		1	LC-2
AR	Conway	100			H	1	LC-1
AR	Craighead	100		M		1	LC-2
AR	Crawford	100			H	1	LC-1
AR	Crittenden	100		M		1	LC-2
AR	Cross	100		M		1	LC-2
AR	Dallas	100		M		1	LC-2
AR	Desha	100		M		1	LC-2
AR	Drew	100		M		1	LC-2
AR	Faulkner	100			H	1	LC-1
AR	Franklin	100			H	1	LC-1
AR	Fulton	100			H	1	LC-1
AR	Garland	100			H	1	LC-1
AR	Grant	100		M		1	LC-2
AR	Greene	100			H	1	LC-1
AR	Hempstead	100			H	1	LC-1
AR	Hot Spring	100			H	1	LC-1
AR	Howard	100			H	1	LC-1
AR	Independence	100			H	1	LC-1
AR	Izard	100			H	1	LC-1
AR	Jackson	100			H	1	LC-1
AR	Jefferson	100		M		1	LC-2
AR	Johnson	100			H	1	LC-1
AR	Lafayette	100		M		1	LC-2
AR	Lawrence	100			H	1	LC-1
AR	Lee	100		M		1	LC-2
AR	Lincoln	100		M		1	LC-2
AR	Little River	100			H	1	LC-1
AR	Logan	100			H	1	LC-1
AR	Lonoke	100		M		1	LC-2
AR	Madison	100			H	1	LC-1

State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
AR	Marion	100			H	1	LC-1
AR	Miller	100		M		1	LC-2
AR	Mississippi	100		M		1	LC-2
AR	Monroe	100		M		1	LC-2
AR	Montgomery	100			H	1	LC-1
AR	Nevada	100		M		1	LC-2
AR	Newton	100			H	1	LC-1
AR	Ouachita	100		M		1	LC-2
AR	Perry	100			H	1	LC-1
AR	Phillips	100		M		1	LC-2
AR	Pike	100			H	1	LC-1
AR	Poinsett	100		M		1	LC-2
AR	Polk	100			H	1	LC-1
AR	Pope	100			H	1	LC-1
AR	Prairie	100		M		1	LC-2
AR	Pulaski	100			H	1	LC-1
AR	Randolph	100			H	1	LC-1
AR	St. Francis	100		M		1	LC-2
AR	Saline	100			H	1	LC-1
AR	Scott	100			H	1	LC-1
AR	Searcy	100			H	1	LC-1
AR	Sebastian	100			H	1	LC-1
AR	Sevier	100			H	1	LC-1
AR	Sharp	100			H	1	LC-1
AR	Stone	100			H	1	LC-1
AR	Union	100		M		1	LC-2
AR	Van Buren	100			H	1	LC-1
AR	Washington	100			H	1	LC-1
AR	White	100			H	1	LC-1
AR	Woodruff	100		M		1	LC-2
AR	Yell	100			H	1	LC-1
MO	Dunklin	100			H	1	LC-1
MO	New Madrid	100			H	1	LC-1
MO	Oregon	100			H	1	LC-1
MO	Pemiscot	100			H	1	LC-1
MO	Stoddard	100			H	1	LC-1
MO	Taney	100			H	1	LC-1

Table 5.3(b) Load Districts by Parish – Louisiana

State	Parish	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
LA	Acadia	140	L			0.5	LC-3
LA	Allen	110	L			0.5	LC-3F
LA	Ascension	140	L			0.5	LC-3
LA	Assumption	140	L			0.5	LC-3
LA	Avoyelles	110	L			0.5	LC-3F
LA	Beauregard	110	L			0.5	LC-3F
LA	Bienville	100		M		0.75	LC-2D
LA	Bossier	100		M		0.75	LC-2D
LA	Calcasieu	140	L			0.5	LC-3
LA	Caldwell	100		M		0.75	LC-2D
LA	Cameron	140	L			0.5	LC-3
LA	Catahoula	100	L			0.5	LC-3E
LA	Claiborne	100		M		0.75	LC-2D
LA	Concordia	100	L			0.5	LC-3E
LA	Desoto	100		M		0.75	LC-2D
LA	East Baton Rouge	140	L			0.5	LC-3
LA	East Carrol	100		M		0.75	LC-2D
LA	East Feliciana	110	L			0.5	LC-3F
LA	Evangeline	110	L			0.5	LC-3F
LA	Franklin	100		M		0.75	LC-2D
LA	Grant	100	L			0.75	LC-2C
LA	Iberia	140	L			0.5	LC-3
LA	Iberville	140	L			0.5	LC-3
LA	Jackson	100		M		0.75	LC-2D
LA	Jefferson	150	L			0.5	LC-3D
LA	Jefferson Davis	140	L			0.5	LC-3
LA	Lafayette	140	L			0.5	LC-3
LA	Lafourche	150	L			0.5	LC-3D
LA	Lasalle	100	L			0.75	LC-3C
LA	Lincoln	100		M		0.75	LC-2D
LA	Livingston	125	L			0.5	LC-3B
LA	Madison	100	L			0.75	LC-3C
LA	Morehouse	100		M		0.75	LC-2D
LA	Natchitoches	100		M		0.75	LC-2D
LA	Orleans	140	L			0.5	LC-3
LA	Ouachita	100		M		0.75	LC-2D
LA	Plaquemines	150	L			0.5	LC-3D
LA	Point Coupee	110	L			0.5	LC-3F
LA	Rapides	100	L			0.5	LC-3E
LA	Red River	100		M		0.75	LC-2D
LA	Richland	100		M		0.75	LC-2D
LA	Sabine	100		M		0.75	LC-2D
LA	St. Bernard	150	L			0.5	LC-3D
LA	St. Charles	140	L			0.5	LC-3

State	Parish	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
LA	St. Helena	110	L			0.5	LC-3F
LA	St. James	140	L			0. 5	LC-3
LA	St. John the Baptist	140	L			0.5	LC-3
LA	St. Landry	110	L			0.5	LC-3F
LA	St. Martin, North	140	L			0.5	LC-3
LA	St. Martin, South	140	L			0.5	LC-3
LA	St. Mary	140	L			0.5	LC-3
LA	St. Tammany	140	L			0.5	LC-3
LA	Tangipahoa	125	L			0.5	LC-3B
LA	Tensas	100	L			0.5	LC-3E
LA	Terrebonne	150	L			0.5	LC-3D
LA	Union	100		M		0.75	LC-2D
LA	Vermillion	140	L			0.5	LC-3
LA	Vernon	100	L			0.5	LC-3E
LA	Washington	125	L			0.5	LC-3B
LA	Webster	100		M		0.75	LC-2D
LA	West Baton Rouge	140	L			0.5	LC-3
LA	West Carrol	100		M		0.75	LC-2D
LA	West Feliciana	110	L			0.5	LC-3F
LA	Winn	100		M		0.75	LC-2D

Table 5.3(c) Load Districts by County - Mississippi

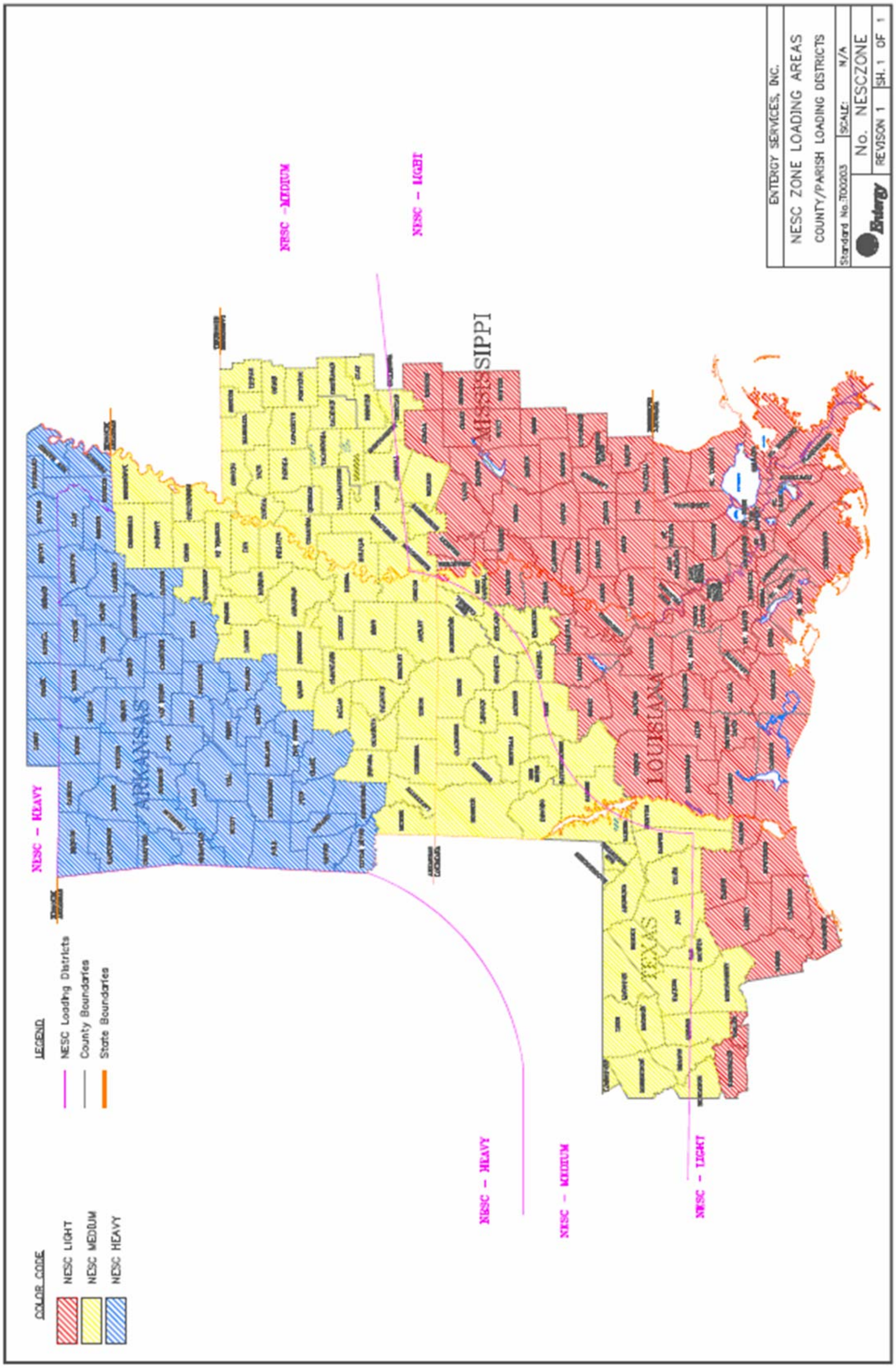
State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
MS	Adams	100	L			0.5	LC-3E
MS	Amite	110	L			0.5	LC-3F
MS	Attala	100	L			0.5	LC-3E
MS	Benton	100		M		1	LC-2
MS	Bolivar	100		M		1	LC-2
MS	Calhoun	100		M		1	LC-2
MS	Carrol	100		M		1	LC-2
MS	Chickasaw	100		M		1	LC-2
MS	Choctaw	100		M		1	LC-2
MS	Claiborne	100	L			0.5	LC-3E
MS	Clay	100		M		1	LC-2
MS	Coahoma	100		M		1	LC-2
MS	Copiah	100	L			0.5	LC-3E
MS	Covington	110	L			0.5	LC-3F
MS	Desoto	100		M		1	LC-2
MS	Franklin	100	L			0.5	LC-3E
MS	Grenada	100		M		1	LC-2
MS	Hinds	100	L			0.5	LC-3E
MS	Holmes	100		M		1	LC-2
MS	Humphreys	100		M		1	LC-2
MS	Issaquena	100	L			1	LC-3G
MS	Jefferson	100	L			0.5	LC-3E
MS	Jefferson Davis	110	L			0.5	LC-3F
MS	Lafayette	100		M		1	LC-2
MS	Lawrence	110	L			0.5	LC-3F
MS	Leake	100	L			0.5	LC-3E
MS	Leflore	100		M		1	LC-2
MS	Lincoln	110	L			0.5	LC-3F
MS	Madison	100	L			0.5	LC-3E
MS	Marion	110	L			0.5	LC-3F
MS	Marshall	100		M		1	LC-2
MS	Montgomery	100		M		1	LC-2
MS	Neshoba	100	L			0.5	LC-3E
MS	Newton	100	L			0.5	LC-3E
MS	Panola	100		M		1	LC-2
MS	Pike	110	L			0.5	LC-3F
MS	Ponotoc	100		M		1	LC-2
MS	Quitman	100		M		1	LC-2
MS	Rankin	100	L			0.5	LC-3E
MS	Scott	100	L			0.5	LC-3E
MS	Sharkey	100	L			0.75	LC-3C
MS	Simpson	100	L			0.5	LC-3E
MS	Smith	110	L			0.5	LC-3F

State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
MS	Sunflower	100		M		1	LC-2
MS	Tallahatchie	100		M		1	LC-2
MS	Tate	100		M		1	LC-2
MS	Tippah	100		M		1	LC-2
MS	Tunica	100		M		1	LC-2
MS	Union	100		M		1	LC-2
MS	Walthall	110	L			0.5	LC-3F
MS	Warren	100	L			0.5	LC-3E
MS	Washington	100		M		1	LC-2
MS	Webster	100		M		1	LC-2
MS	Wilkinson	110	L			0.5	LC-3F
MS	Winston	100	L			0.5	LC-3E
MS	Yalobusha	100		M		1	LC-2
MS	Yazoo	100	L			0.75	LC-3C

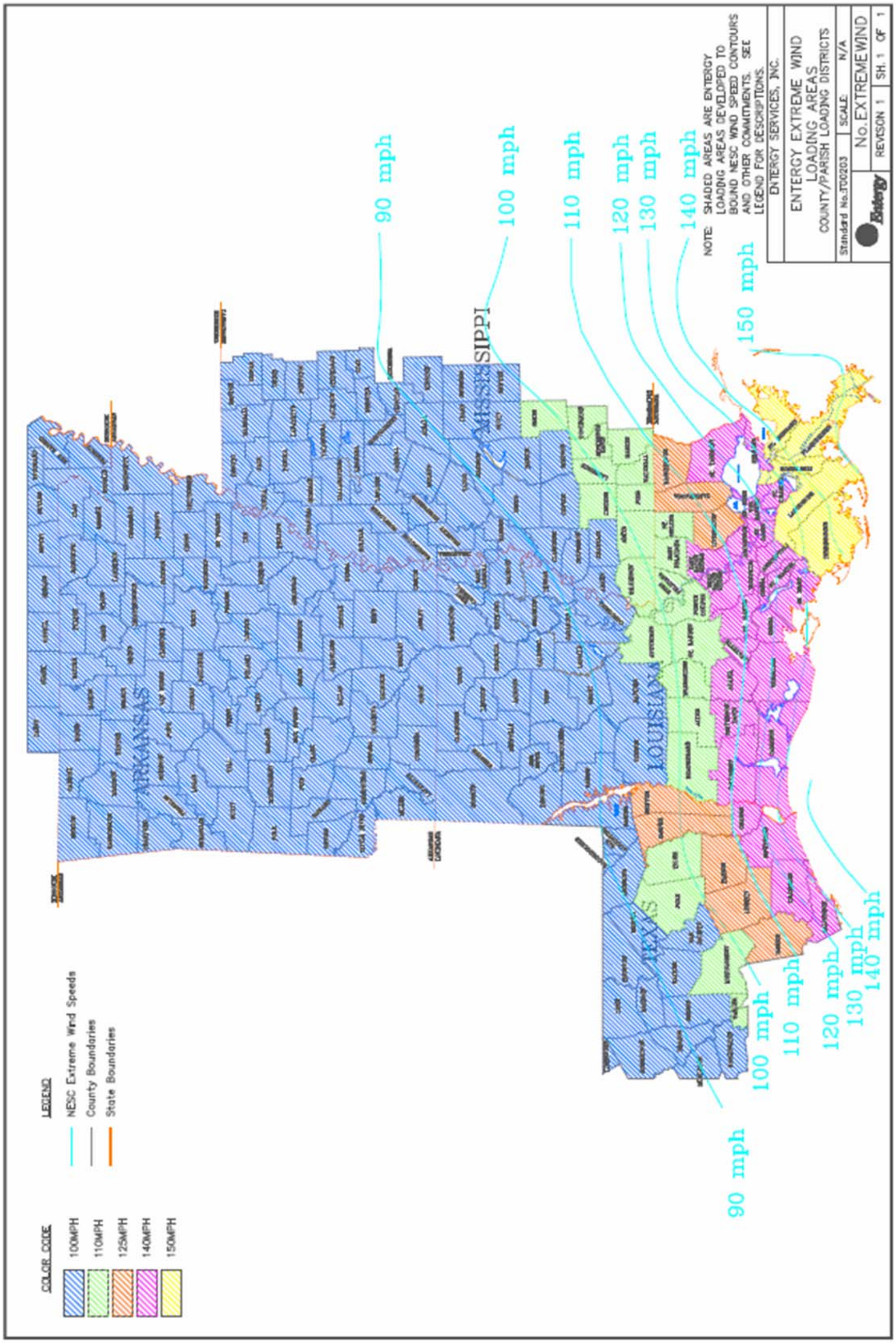
5.3(d) Load Districts by County - Texas

State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
TX	Angelina	100		M		0.75	LC-2D
TX	Brazos	100		M		0.75	LC-2D
TX	Burleson	100		M		0.5	LC-2B
TX	Chambers	140	L			0.5	LC-3
TX	Galveston	140	L			0.5	LC-3
TX	Grimes	100		M		0.75	LC-2D
TX	Hardin	125	L			0.5	LC-3B
TX	Harris	125	L			0.5	LC-3B
TX	Houston	100		M		0.75	LC-2D
TX	Jasper	125		M		0.5	LC-2C
TX	Jefferson	140	L			0.5	LC-3
TX	Leon	100		M		0.75	LC-2D
TX	Liberty	125	L			0.5	LC-3B
TX	Limestone	100		M		0.75	LC-2D
TX	Madison	100		M		0.75	LC-2D
TX	Montgomery	110		M		0.5	LC-2A
TX	Nacoqdoches	100		M		0.75	LC-2D
TX	Newton	125		M		0.5	LC-2C
TX	Orange	140	L			0.5	LC-3
TX	Polk	110		M		0.75	LC-2E
TX	Robertson	100		M		0.75	LC-2D
TX	Sabine	100		M		0.75	LC-2D
TX	San Augustine	100		M		0.75	LC-2D
TX	San Jacinto	100		M		0.75	LC-2D
TX	Trinity	100		M		0.75	LC-2D
TX	Tyler	110		M		0.75	LC-2E
TX	Walker	100		M		0.75	LC-2D
TX	Waller	110	L			0.5	LC-3F
TX	Washington	100	L			0.5	LC-3E

TO0203-A1	Entergy & NESC Loading Areas (3 drawings)	Rev. 07



Reduced Print. See file TMES01, for full size print.



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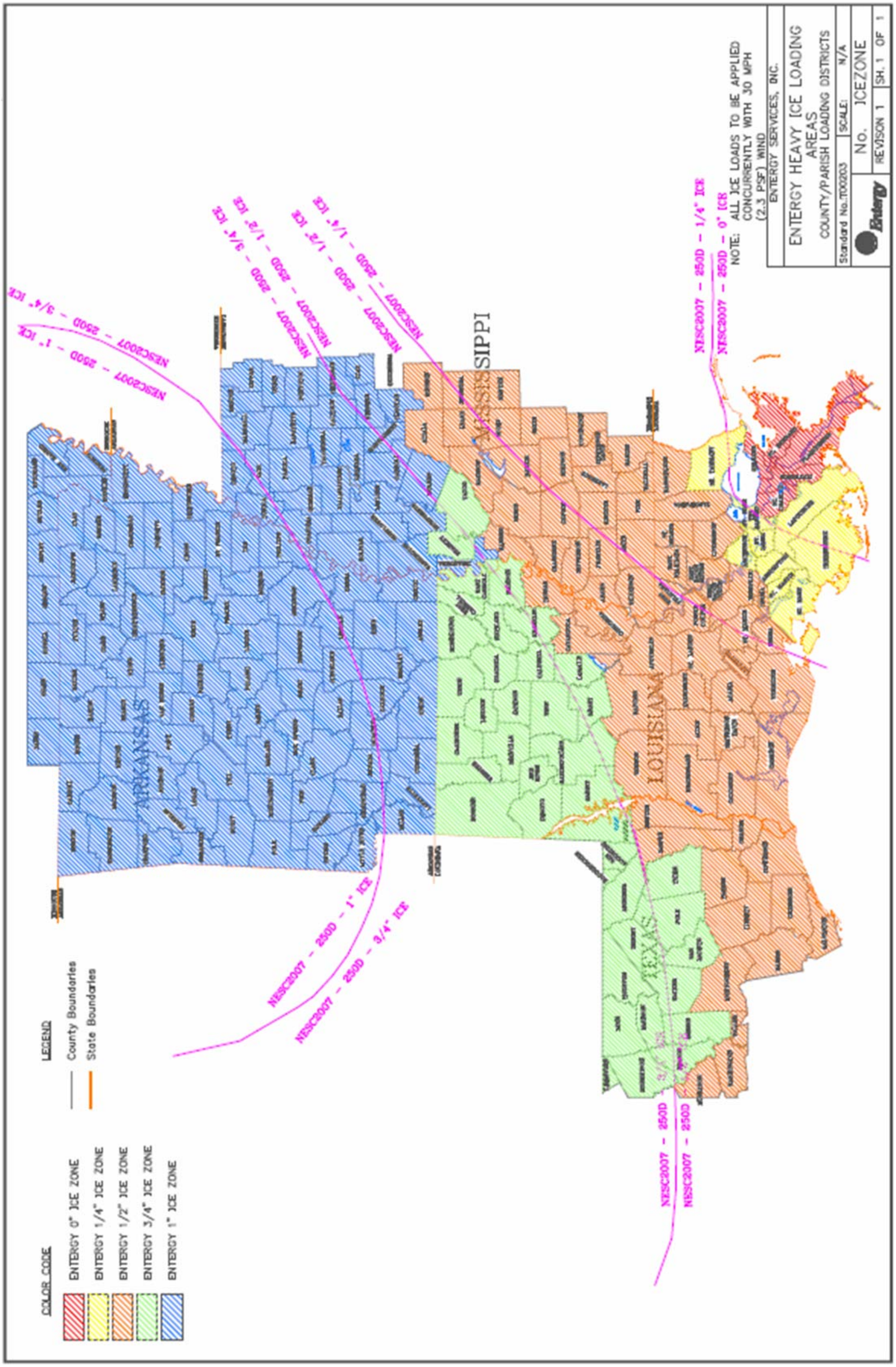
TO0203-A1	Entergy & NESC Loading Areas (3 drawings)	Rev. 07



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