

Updating ANSI/ANS-2.3-2011

Brad Harvey, CCM
U.S. Nuclear Regulatory Commission

18th Nuclear Utility Meteorological Data Users Group (NUMUG) Meeting
June 26-28, 2017, Indianapolis, IN

Outline

- What is ANSI/ANS-2.3
 - Regionalization of Wind Hazards
 - Wind Speeds at Region I, II, and III Sites
 - Tornado Pressure Drop
 - Tornado and Hurricane Missile Spectrum
 - Basis for ANSI/ANS-2.3-2011 Parameters
- Changes to ANSI/ANS-2.3-2011 References
 - ASCE/SEI 7
 - Tornado Hazard Mapping Project
- Upcoming Standards Activities Related to High Winds

ANSI/ANS-2.3-2011

- ANSI/ANS-2.3-2011, *Estimating Tornado, Hurricane, and Extreme Straight Line Wind Characteristics at Nuclear Facility Sites*
 - Addresses frequency of occurrence and magnitude of rare and extreme wind events
 - Straight-line winds, hurricanes, and tornados
 - Maximum wind speed
 - Maximum atmospheric pressure drop
 - Missile spectrum

Regionalization of Wind Hazards

Redacted:
ANSI/ANS-2.3-2011 Figure 1

Wind Speeds at a Region I Wind Hazard Site

Redacted:
ANSI/ANS-2.3-2011 Figure 2

Wind Speeds at a Region II Wind Hazard Site

Redacted:
ANSI/ANS-2.3-2011 Figure 3

Wind Speeds at a Region III Wind Hazard Site

Redacted:
ANSI/ANS-2.3-2011 Figure 4

Tornado Max Atmospheric Pressure Drop

Maximum Tornado Wind Speed	Maximum Atmospheric Pressure Drop
250 mph (112 m/s)	1.35 psi (9.1 kPa)
200 mph (89 m/s)	0.85 psi (5.8 kPa)
180 mph (80 m/s)	0.70 psi (4.8 kPa)
150 mph (67 m/s)	0.49 psi (3.3 kPa)
140 mph (63 m/s)	0.41 psi (2.8 kPa)
100 mph (45 m/s)	0.20 psi (1.4 kPa)

Missile Spectrum for Tornado and Hurricane-Type Winds

Missile Type	Missile Weight	Horizontal Wind Velocity	Tornado (V) Coefficient k1	Hurricane (V _h) Coefficient k1
<u>Impact type:</u> automobile 20.0-ft ² (2.0-m ²) contact Area	4000 lb (1810 kg)	250 mph (400 km/h)	0.4	0.7
		200 mph (325 km/h)	0.4	0.7
<u>Penetrating-type:</u> Schedule 40 pipe 6.0-in. (150-mm) dia 15-ft (4.58-m) length	287 lb (130 kg)	250 mph (400 km/h)	0.4	0.5
		200 mph (325 km/h)	0.4	0.5
<u>Structural Opening:</u> Solid steel sphere 1.0-in. (25-mm)-dia	0.147 lb (0.0669 kg)	250 mph (400 km/h)	0.1	0.5
		200 mph (325 km/h)	0.1	0.4

Missile velocity = $k_1(V \text{ or } V_h)$

Basis for ANSI/ANS-2.3-2011 Parameters

- Straight-line Wind Speeds
 - ASCE/SEI 7-05, “Minimum Design Loads for Buildings and Other Structures”
- Hurricane Wind Speeds
 - P. J. Vickery et al., “U.S. Hurricane Wind Speed Risk and Uncertainty,” J. Struct. Eng., 135, 301 (2009)
 - ASCE/SEI 7-05, “Minimum Design Loads for Buildings and Other Structures”
- Tornado Wind Speeds
 - J. V. Ramsdell, Jr., “Tornado Climatology of the Contiguous United States,” NUREG/CR-4461, Rev. 2, February 2007
- Missile Spectra
 - Regulatory Guide 1.76, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” Revision 1, March 2007.
 - Draft Regulatory Guide DG-1247, “Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants,” August 2010

Changes to ASCE/SEI 7 Wind Speed Maps

- ASCE/SEI 7-05
 - Single basic wind speed map (50-yr MRI)
 - For each building risk category, an importance factor and wind-load factor are applied to determine the ultimate wind loads
- ASCE/SEI 7-10
 - Three different basic wind speed maps for each building risk category (300-yr, 700-yr, 1,700-yr MRIs)
 - Wind load factor of 1.0
 - New and more complete analysis of hurricane characteristics
- ASCE/SEI 7-16
 - Four different basic wind speed maps for each building risk category (300-yr, 700-yr, 1,700-yr, 3,000-yr MRIs)
 - New contiguous U.S. wind speed maps
 - Complete reanalysis of non-hurricane winds
 - Revised hurricane modeling effecting northeast
 - Revised/corrected special wind regions

Changes to Tornado Hazard Modeling

- NIST/ARA Tornado Hazard Mapping Project
 - Four-year, broadly scoped project
 - tornado climatology
 - multiple databases
 - temporal/spatial variations
 - tornado loads and damage modeling
 - windfield modeling
 - probabilistic methods/simulations
 - map development

NIST/ARA Tornado Hazard Mapping Project

- Topics being addressed include:
 - accounting for tornado database eras, biases, under-reporting, limitations, and uncertainties
 - treating the increased risk of tornado strike/tornado wind speeds on large spatial systems
 - developing engineering-based, probabilistic damage-to-windspeed relationships
 - addressing population (building density) bias and random damage encounters

Upcoming Standards Activities Related to High Winds

- ANSI/ANS-2.3
 - Working Group to be reconstituted in the 2018-2019 time frame
 - Incorporate the results of ASCE/SEI 7-16 and the NIST/ARA Tornado Hazard Mapping Project
 - Contact: Brad Harvey, Brad.Harvey@nrc.gov
- Chapter 32 on Tornado Loads for ASCE 7-22
 - Working Group to be established summer 2017
 - Incorporate the results of ongoing research in developing performance-based tornado-resistant designs
 - Contact: Marc Levitan, Marc.Levitan@nist.gov

QUESTIONS?