Electric Infrastructure Hardening

Rebuilding Utility Infrastructure
LSU Center for Energy Studies

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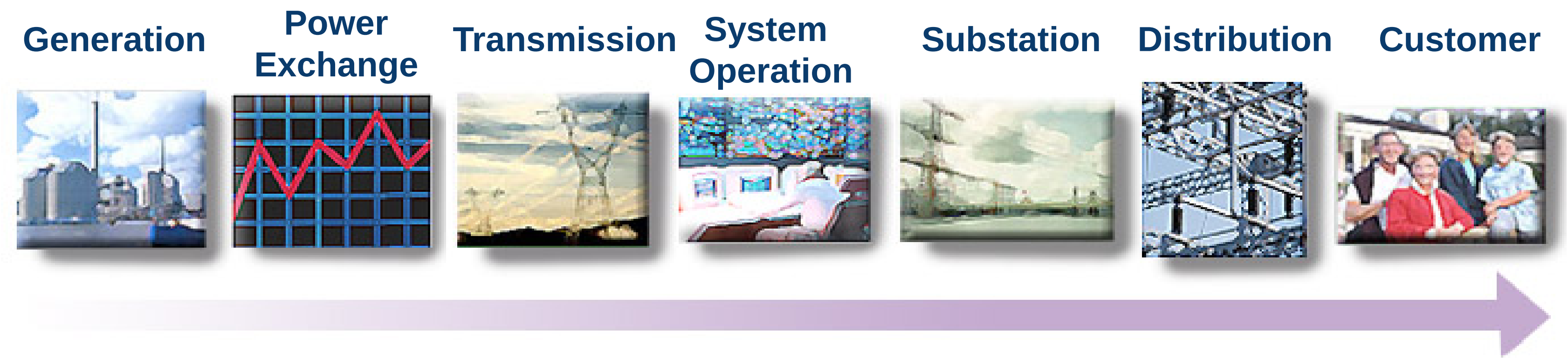
The Depth and Breadth of KEMA

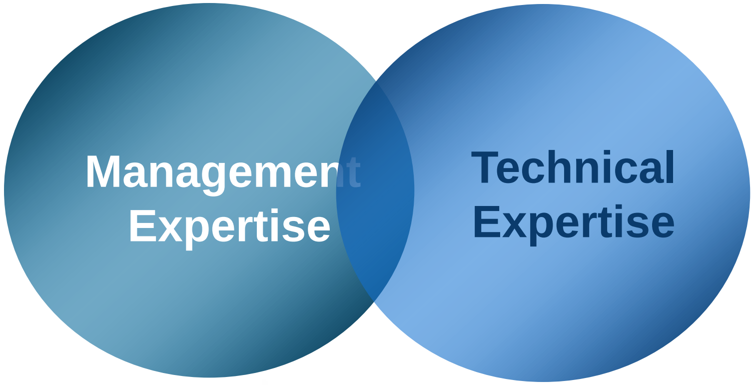


From the Generator to the Consumer
Serving The Diverse Needs of the Energy Marketplace

KEMA

Who We Are

- Independent and impartial
- Recognized in Core Areas
  - Transmission and Distribution
  - Information technology and automation implementation and integration
  - Power Generation
  - Renewable Energy
  - Energy demand side management
  - Management Consulting
  - Supply Chain Management
  - Energy market restructuring
  - Power equipment testing
  - Quality Certification
  - Unique Power Labs



KEMA

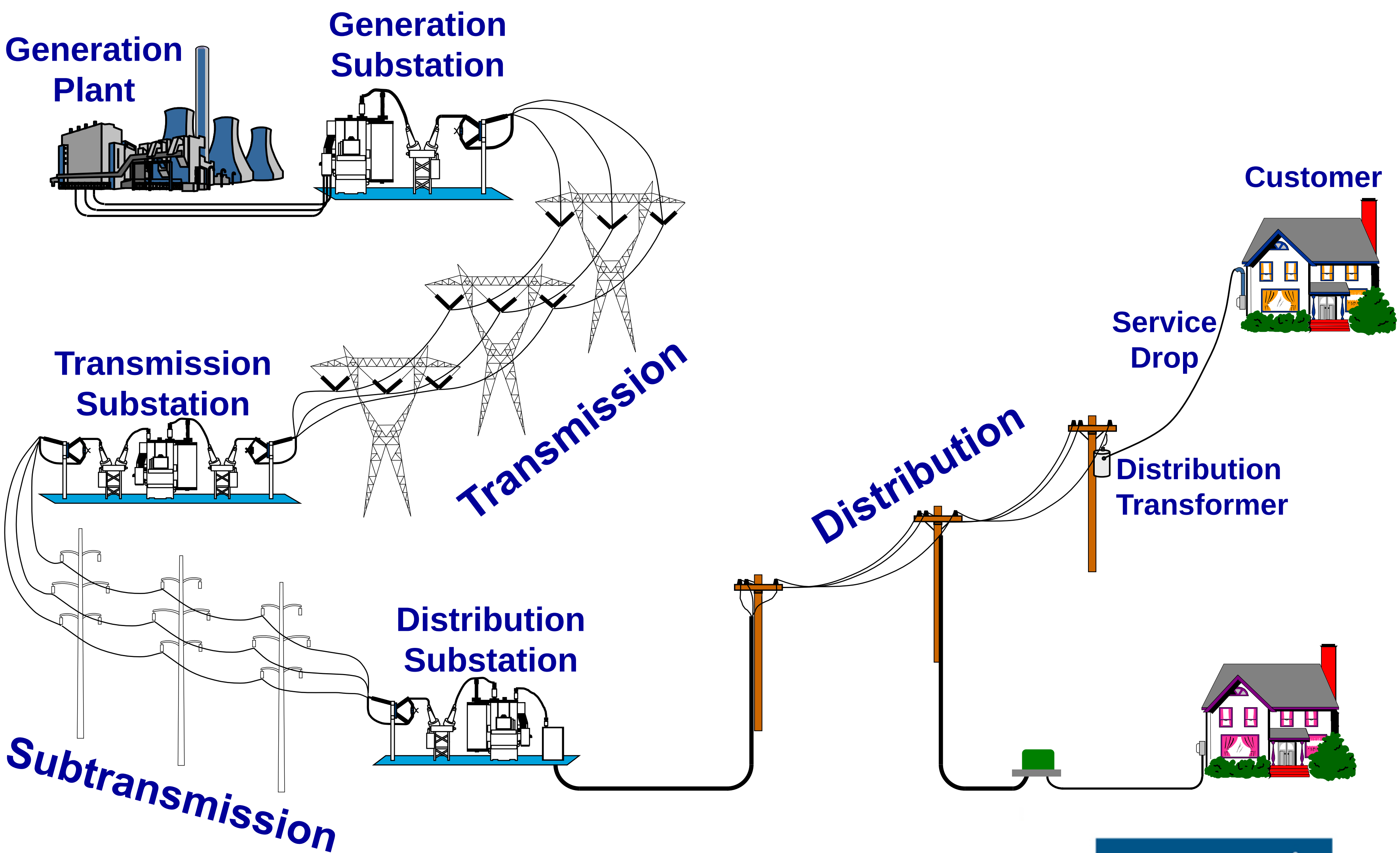
Agenda

- Hurricanes
- Design criteria
- Hardening concepts

Disclaimer: The views expressed are those of DOUG

(Dumb ol' utility guy)

Power Systems



Should a system be designed to withstand this?

Hurricanes

Damage

- Wind only
- Trees
- Debris
- Flooding

Wind Only

Trees

Debris

Flooding

Underground

Underground

Design Criteria

- National Electrical Safety Code (NESC)
  - Grades of Construction
  - Combined ice and wind loading
  - Extreme Wind Conditions
- Reliability
  - Sometimes set by regulators
  - Sometimes set by utilities
- Economic
  - Improve spending efficiency
  - Spend money to save money

NESC for Distribution Poles

- NESC specifies two grades of construction:
  - Grade C – most commonly used, minimum standard
  - Grade B – requires stronger poles
- Freeway crossings "Grade B"
- Railroad crossings "Grade B"
- Most other locations"Grade C"

- Grade B is 50% stronger than Grade C

Pole Strength

Load factor x Load $\leq$ Strength factor x Resistance

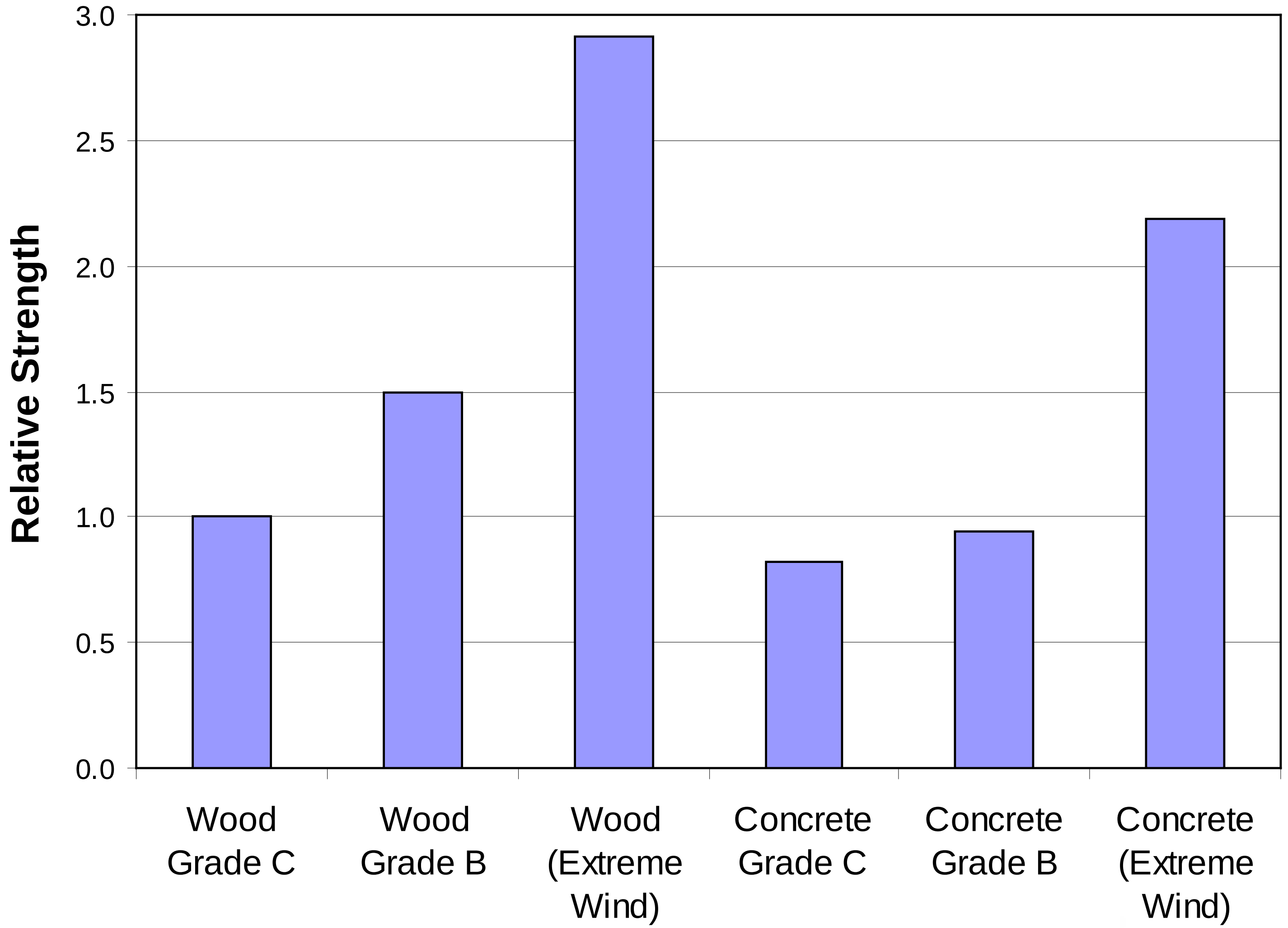
Load = the force applied to pole by weight of conductors, weight of attachments, wind force

Resistance = strength rating of the pole

Strength factor = “derating” factor for pole material to allow for deterioration over life of pole or lack of uniformity of material.

Load factor = “overload factor” varies by type of construction and storm design.

Distribution Pole Strength*



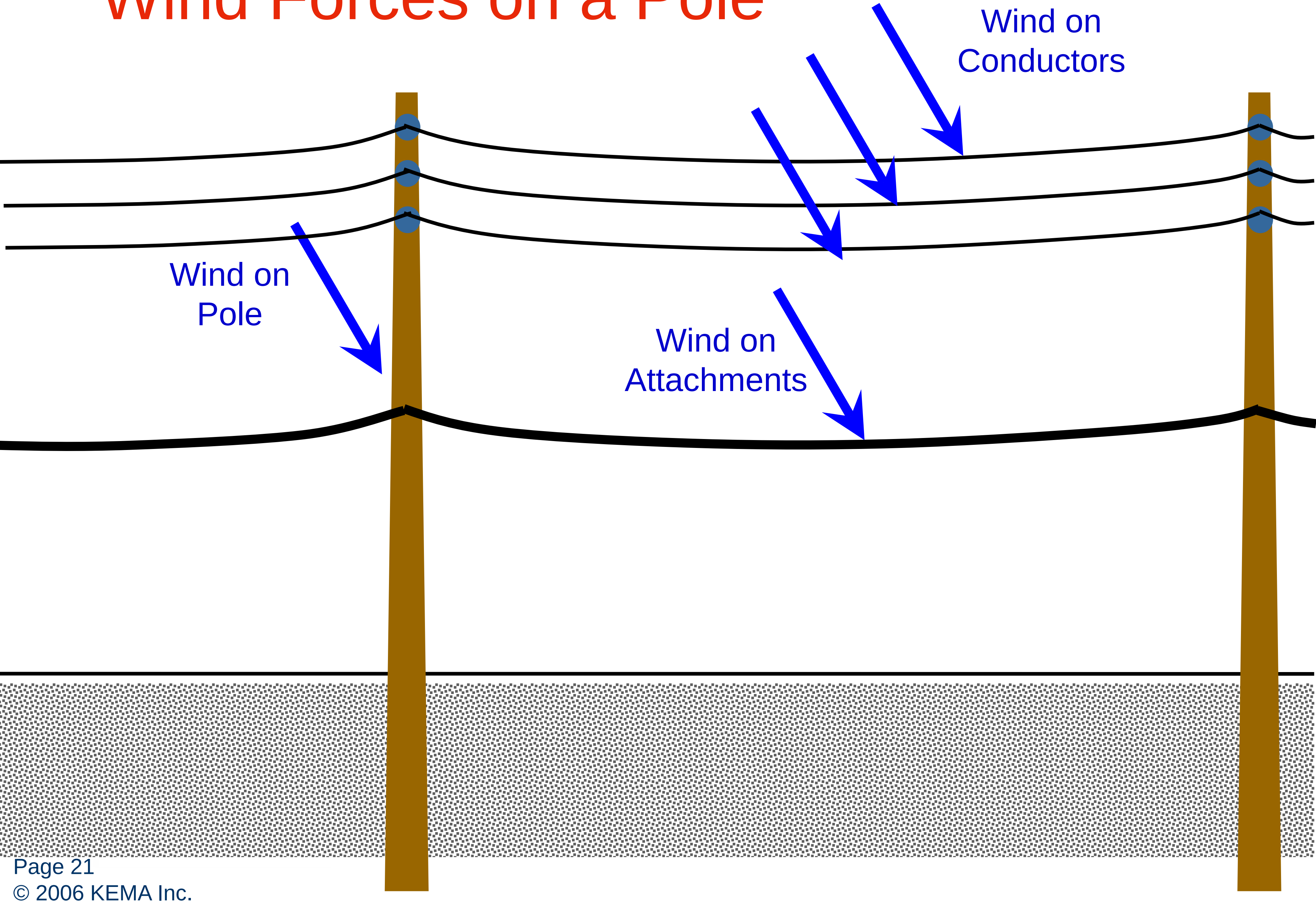
* Grade C is the minimum requirement for most distribution poles. Extreme wind based on 145 mph gusts.

Recent Survey

- 12 utilities with service territories from W. VA to Texas
- 2 reported using Grade B construction as their standard, all others Grade C
- All observe the 60 foot extreme wind exemption
- These companies have approx. 12.5 million poles in service
- 93% wood, 5% concrete, 2% other
- 59% creosote treated, 33% CCA, 8% Penta

Hardening

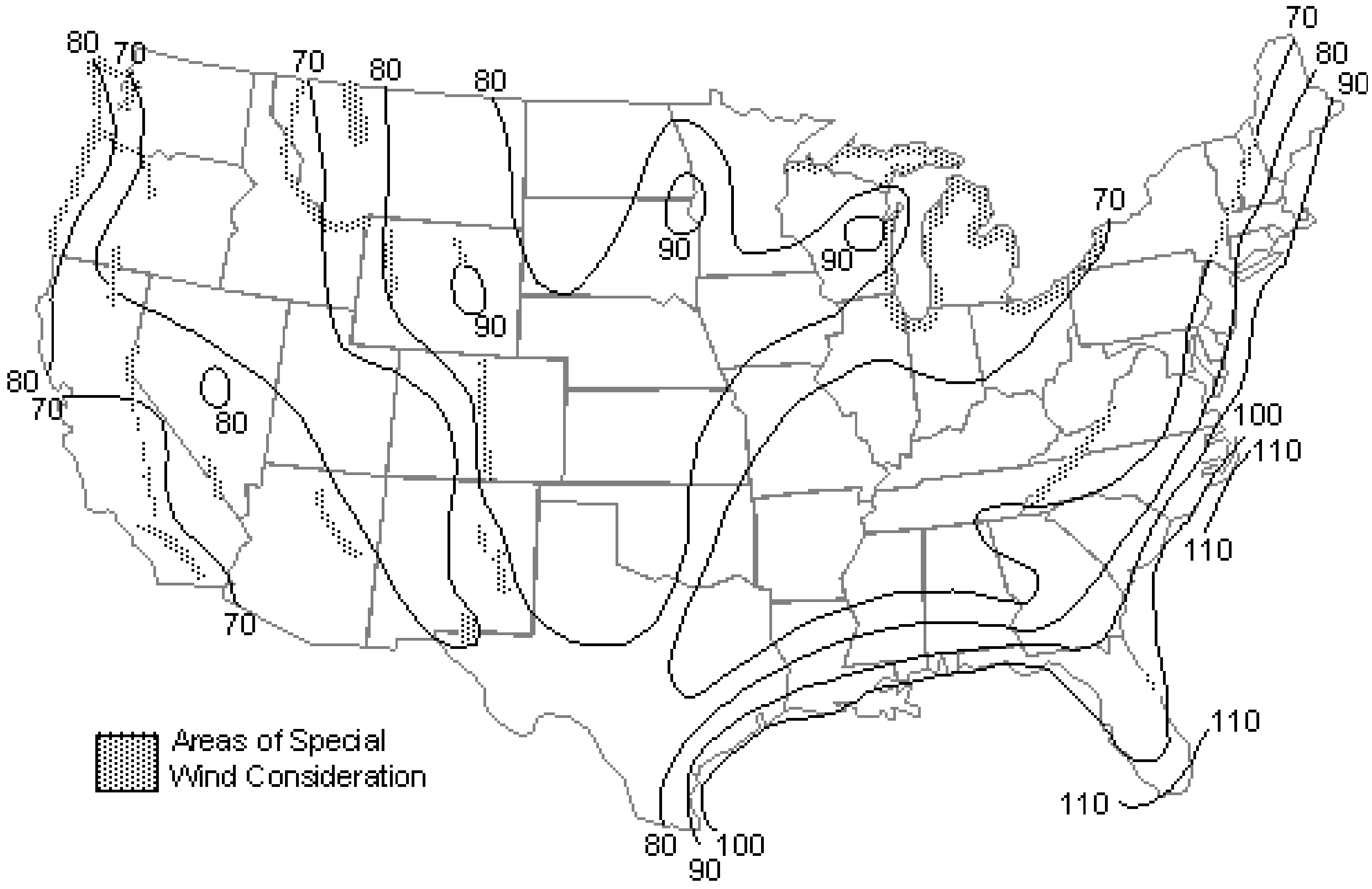
Wind Forces on a Pole



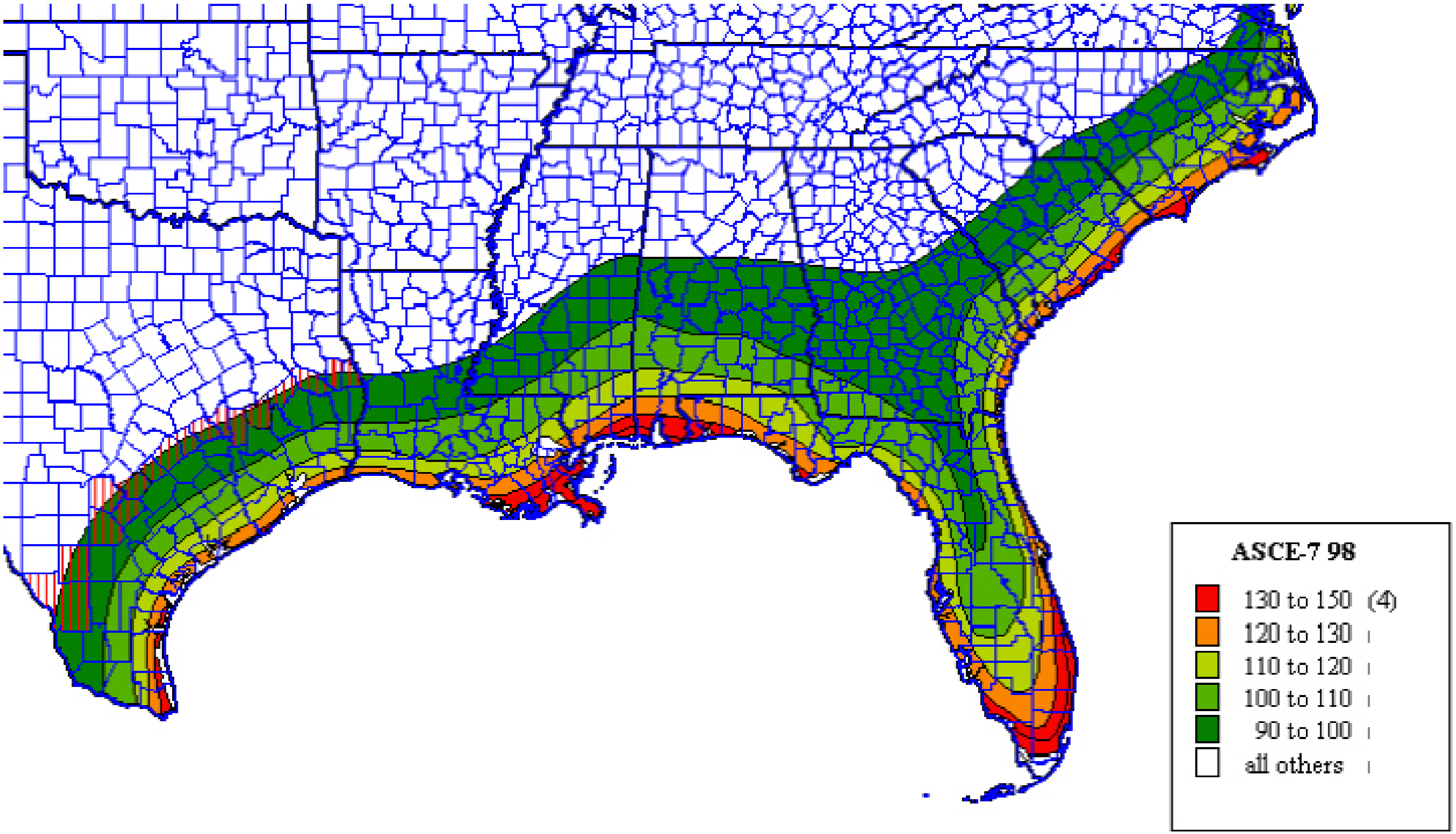
Design for Extreme Winds

- Based on 3-second gusts
- Extreme wind rating (equivalent)
  - Grade B 104 mph
  - Grade C 85 mph
- Louisiana extreme winds
  - Southeast Coast 145 mph
  - Central 95 mph

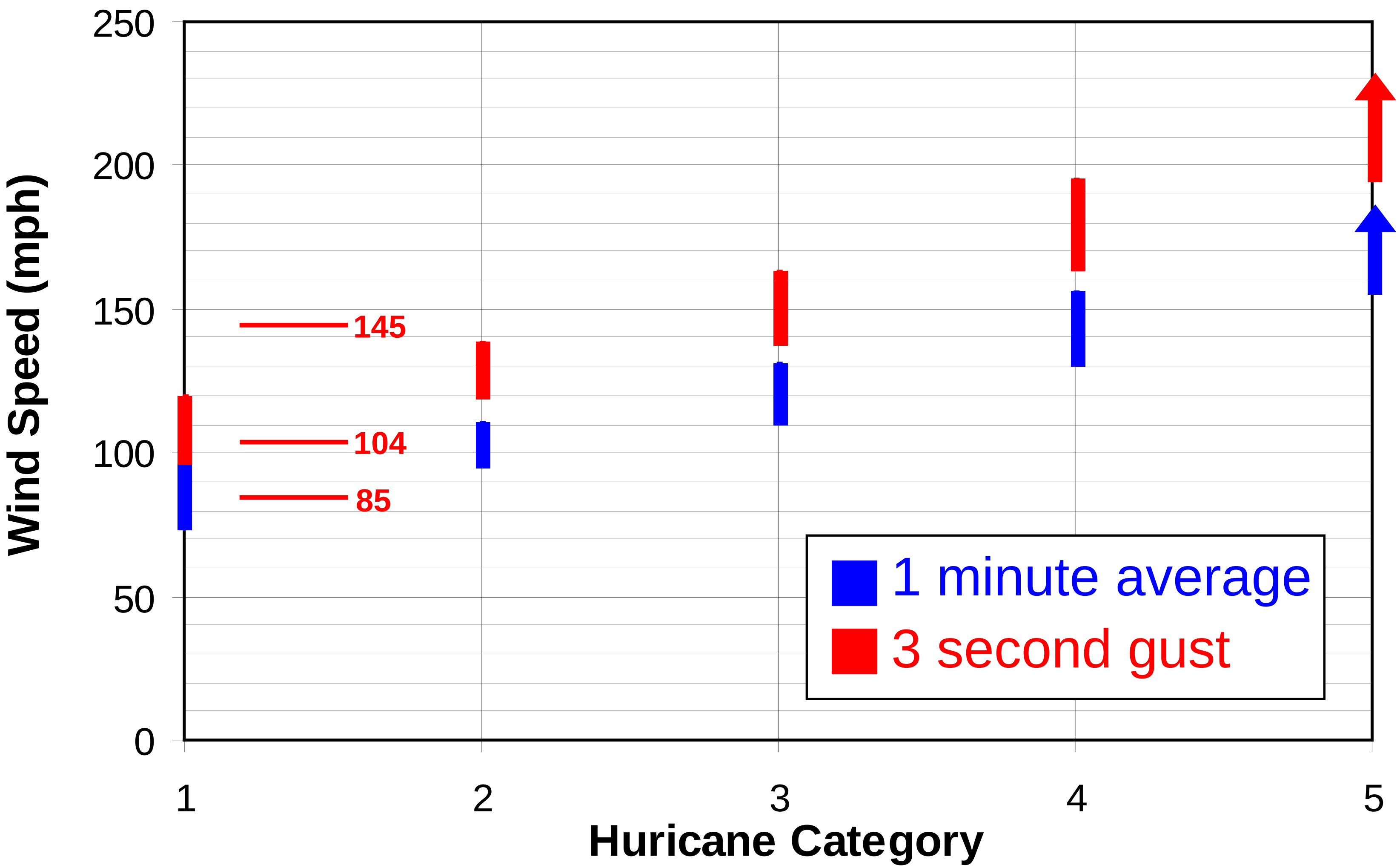
50-year Wind Storm Isoclines



Extreme Wind Speeds (3 second gusts)



Hurricane Categories



"Storm Hardening" Toolkit

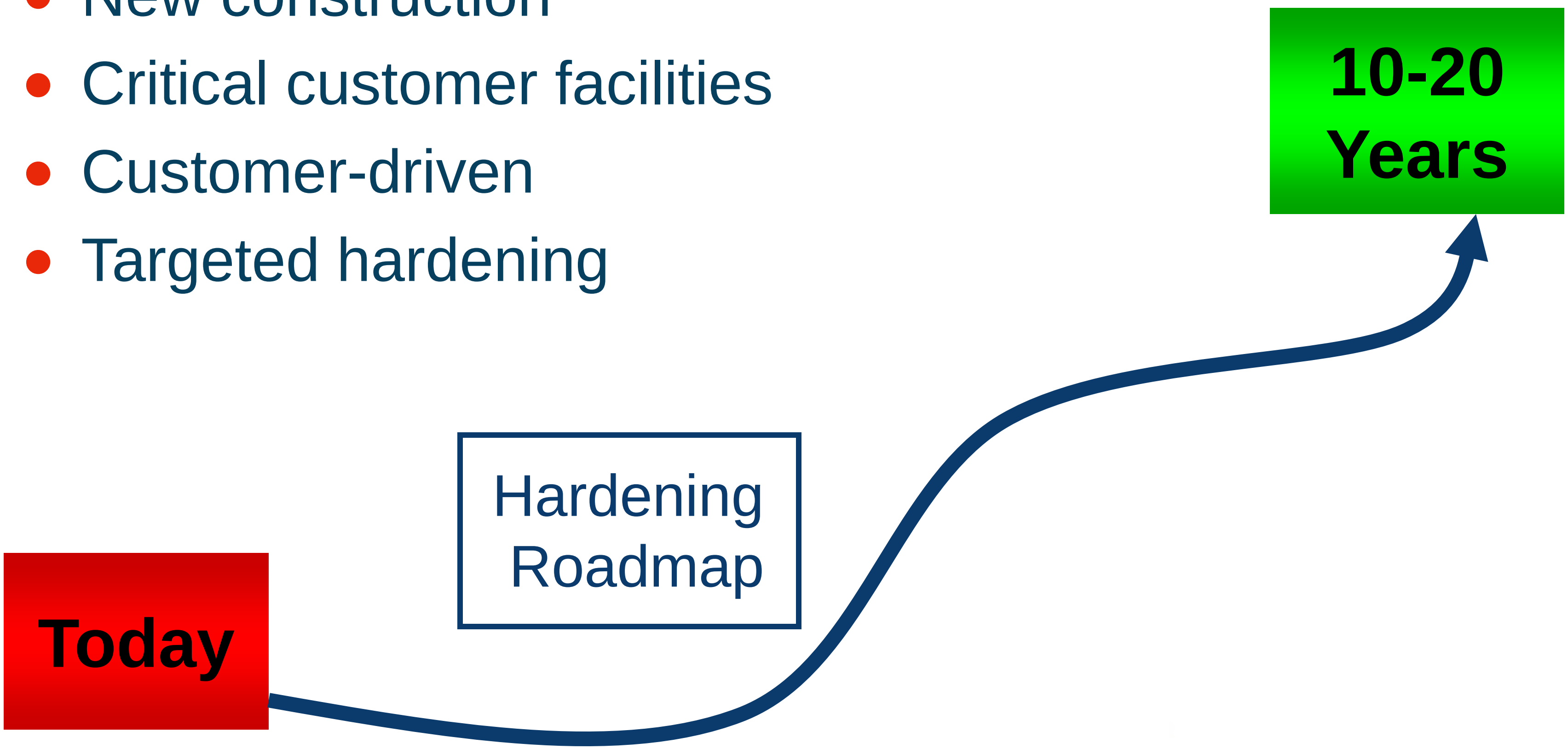
- Stronger poles
- More guying
- Shorter spans
- Anti-cascading
- Conductor size
- Fewer attachments
- Undergrounding
- Vegetation management
- Technology & innovation

Cost of Hardening

- New 3-Phase Construction
  - Typical Overhead: Typical cost
  - Hardened Overhead: 2 to 4 times typical
  - Underground: 5 to 10 times typical
- Existing System
  - Much more expensive
  - Much more complicated
  - Could take 15 to 30 years

Some Hardening Approaches

- Entire system
- New construction
- Critical customer facilities
- Customer-driven
- Targeted hardening



Basic Questions

- What is the critical infrastructure to be protected?
- What are the specific risks to that infrastructure?
- What standards should be adopted to address the risk?
- How and where should new standards be applied?
- When and how will the plan be implemented?

Thank you

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