

NRC Staff Preliminary Assessment of Snow Loads and High Winds Associated with Review of Natural Hazards other than Flooding and Seismic



Background

Fukushima Dai-ichi lessons learned developed and prioritized in a three-tiered approach (see SECY-11-0093 and SECY-11-0137)



Tier 3

- Require further staff study to support a regulatory action
- Requires completion of a shorter-term action to inform a longer-term action
- Dependent on availability of critical skill sets
- Dependent on the resolution of NTTF Recommendation 1

Tier 2

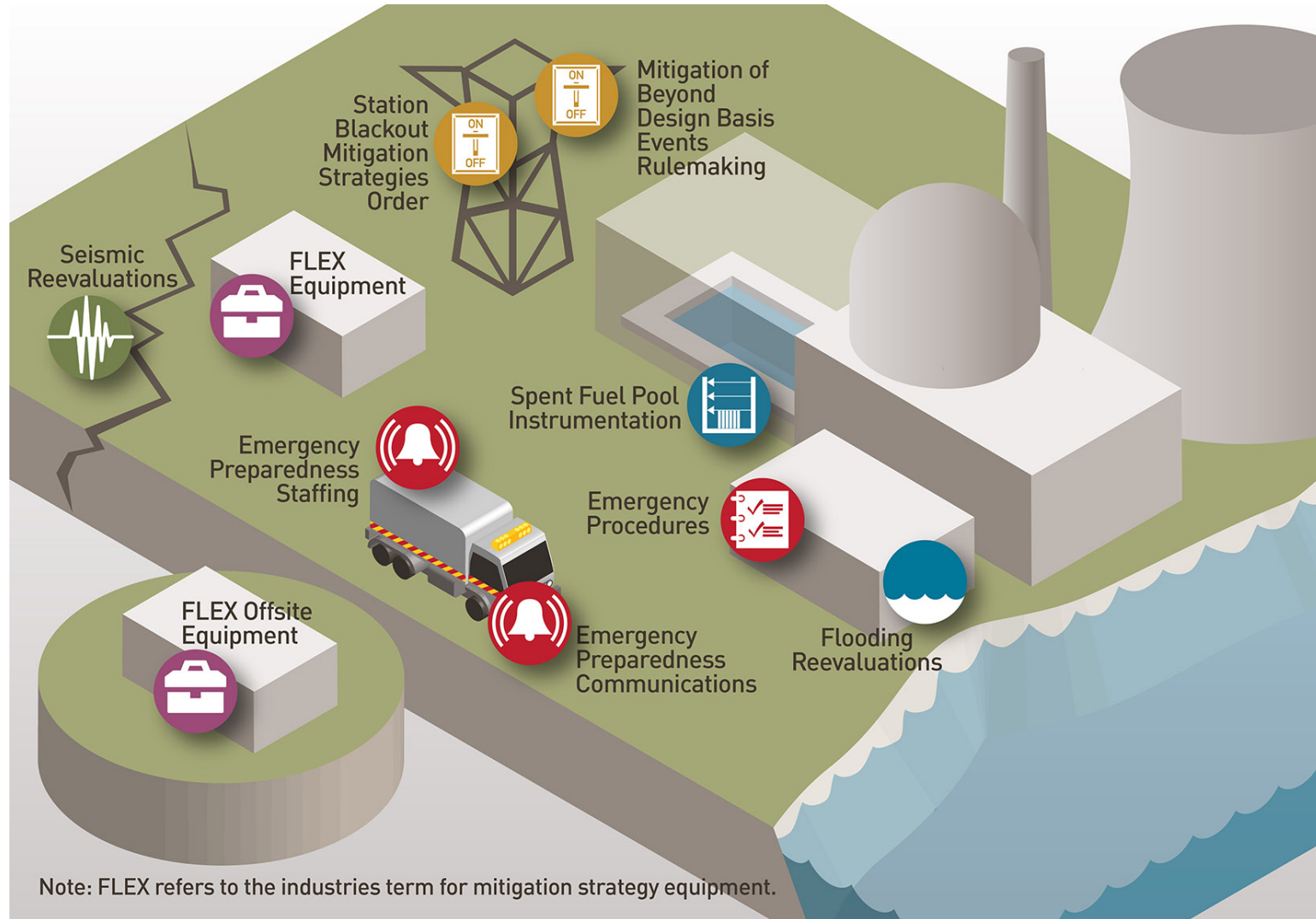
- Could not be initiated in the near term
- Need further technical assessment and alignment
- Depend on Tier 1 issues or availability of critical skill sets.
- Do not require long-term study

Tier 1

- Start without unnecessary delay
- Sufficient resource flexibility, including availability of critical skill sets



Mitigation of Beyond-Design-Basis Events Rulemaking



Background

- Resolution plan for remaining Tier 2 and 3 activities provided in SECY 15-0137, “Proposed Plans For Resolving Open Fukushima Tier 2 and 3 Recommendations”
- Natural Hazards other than Seismic and Flooding binned as Group #3 activity in SECY 15-0137
 - More detailed assessment and/or justification for resolution being prepared; ACRS/external stakeholder interactions would inform resolution of the recommendation; work to be completed in 2016
- Commission decision on SECY-15-0137
 - Closed Group 1 items
 - Group 2 updated assessment to be provided end of March 2016
 - Other Natural Hazards interim status to be provided end of May 2016
 - Commission directed that the interim status include the results of the staff’s assessment through step 2 of the process outlined in SECY-15-0137



Background

- SECY-16-0074 provided staff assessment of natural hazards other than seismic and flooding
 - Used 4 step process to assess hazards
 - 1) Define natural hazard other than seismic and flooding to determine those hazards that could pose a threat to nuclear power plants
 - 2) Determine and apply screening criteria to exclude certain natural hazards from further generic evaluations, or exclude some licensees from considering certain hazards
 - 3) Perform a technical evaluation to assess the need for additional actions if the hazard or licensee was not screened out generically in Task 2
 - Consider whether a request for information in accordance with 10 CFR 50.54(f) is appropriate (approach taken for seismic and flooding)
 - Enough information at this stage to require action in accordance with 10 CFR 50.109 (backfit process)
 - 4) Based on results of Task 3, determine if additional regulatory actions are needed
 - Screened out natural hazards other than snow loads and high winds



Snow Loads

- DC/COL Interim Staff Guidance 007, “Assessment of Normal and Extreme Winter Precipitation Loads on Roofs of Seismic Category I Structures,” issued July 1, 2009, provides, among other things, guidance for:
 - Calculating 100 year ground and roof snow loads
 - Calculating extreme ground and roof snow loads
 - Combination of 100 year snow load and 48 hour probable maximum winter precipitation (PMWP) event



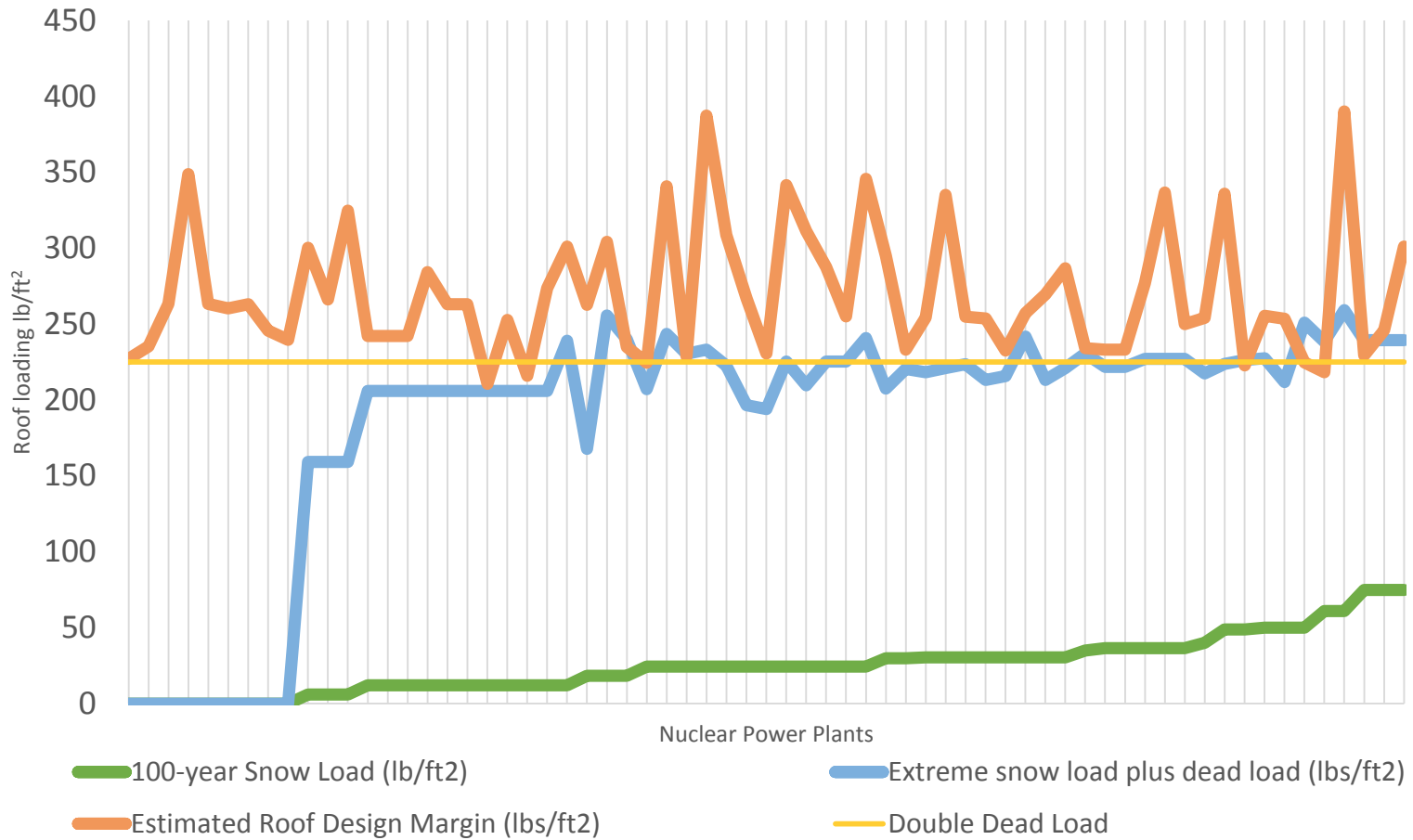
Snow Loads

- Preliminary Assessment

- DC/COL ISG-007 guidance consistent with 1975 version of the SRP and branch technical position with additional clarifications
- 100 year roof snow load typically bounded by plant design or structural margin associated with design
- Staff performed a deterministic screening evaluation of 65 sites (some dual unit sites split if licensing basis is different (e.g., Nine Mile Point 1 and 2))
 - Screened out sites whose 100 year roof snow load is zero inches based on ASCE-7 (10 southern and western sites)
 - Screened out sites whose 48 hour PMWP in inches of water was greater than snow in inches (12 additional southern sites)
 - Performed structural assessment
 - Compared extreme roof snow load to double dead load of representative roof
 - Compared extreme roof snow load to earthquake load
 - Staff identified 4 northern sites for additional screening



Snow Loads



Snow Loads

- Preliminary Assessment
 - Staff reviewing snow procedures for four northern sites.
- Qualitative risk insights include:
 - Deterministic evaluation shows extreme roof snow loads either not applicable, or there is sufficient structural margin such that there is low likelihood of failure of roof due to extreme roof snow loads
 - For some northern sites where structural margin is not as high staff is reviewing procedures to confirm that licensees take action to address roof snow loads
 - A structural failure of a roof does not necessarily lead to loss of cooling to spent fuel pool or the core
 - Unlikely that a roof collapse would disable multiple trains (at different physical locations) of safety related systems



Snow Loads

- Snow loads (continued)

- Summary:

- Based on preliminary assessments, the staff believes that there is sufficient structural margin at many sites to prevent collapse of roofs under snow loads
 - Staff reviewing severe weather procedures for some northern sites to provide additional confidence that roof failures due to snow loading does not warrant additional regulatory action



High Winds

- Wind and missile loads from hurricanes and tornadoes
 - New guidance documents recently issued
 - Regulatory Guide 1.76 Revision 1 on design-basis tornadoes and tornado missiles issued in March 2007
 - Regulatory Guide 1.221 on design-basis hurricanes and hurricane missiles issued in October 2011
 - RG 1.76 Rev 1 tornado wind speeds generally went down
 - Different missile spectrum from 1975 version of standard review plan
 - Automobile missile speeds for same weight automobile went up in some areas



High Winds

- Wind and missile loads from hurricanes and tornadoes (continued)
 - RG 1.221 hurricane
 - Hurricane wind speeds generally bound by tornado wind speeds for a given site
 - Hurricane missile speeds higher than comparable tornado for sites susceptible to hurricanes
 - Hurricane-generated missile has longer time in hurricane wind field than tornado wind field
 - Staff assessment consists of:
 - Evaluation of Pre-General Design Criteria Plants
 - Plants evaluated against 1975 version of the standard review plan



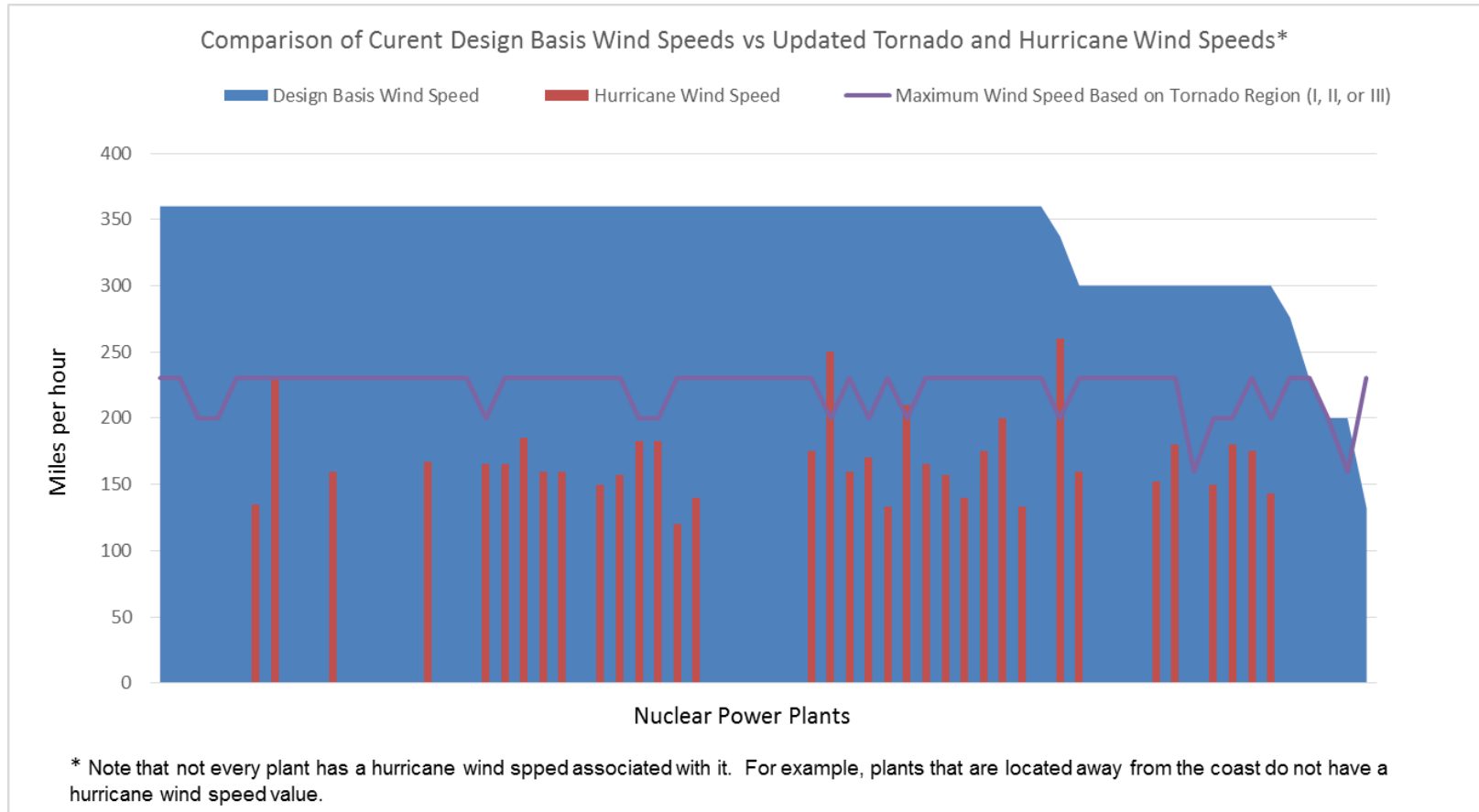
High Winds

- Wind and missile loads from hurricanes and tornadoes (continued)
 - Insights from RIS 2015-06 and Enforcement Guidance Memorandum (EGM) 15-002
 - Tornado missile protection design-basis requirements are conservative
 - Staff using existing processes to ensure licensees continue to meet requirements in this area
 - EGM 15-02 provides a basis for enforcement discretion noting that tornado missile scenarios that lead to core damage are very low probability events



High Winds

- New wind load guidance for majority of sites generally bound by current plants design basis



High Winds

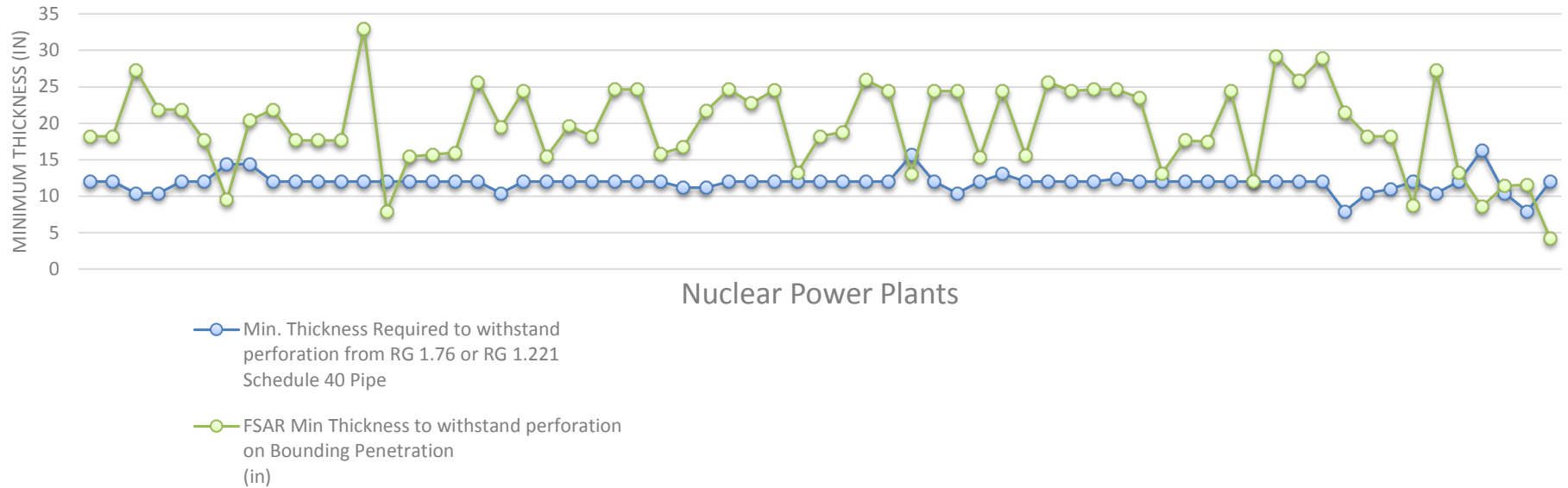
- Wind and missile loads from hurricanes and tornadoes (continued)
 - Hurricane and Tornado missile spectrum chosen to:
 - Assess design of safety-related structures to provide protection against a missile damaging equipment internal to the structure (missile's penetration capability)
 - Assess design of safety-related structures to withstand impact loads (automobile missile)
 - Assess design of safety-related structures to protect against small wind-born missiles
 - Ability of wind-born missiles to penetrate concrete
 - Majority of sites have design-basis missile characteristics that bound missile characteristics found in latest regulatory guidance



High Winds

- Missile penetration depth for majority of sites generally bound by current plants design basis

Minimum Concrete Thickness to Prevent Perforation
When Struck by Schedule 40 Steel Pipe with Updated Hurricane or Tornado Wind Speeds
vs Minimum Concrete Thickness to Prevent Perforation
When Struck by FSAR Design Basis Tornado/Hurricane Generated Missiles

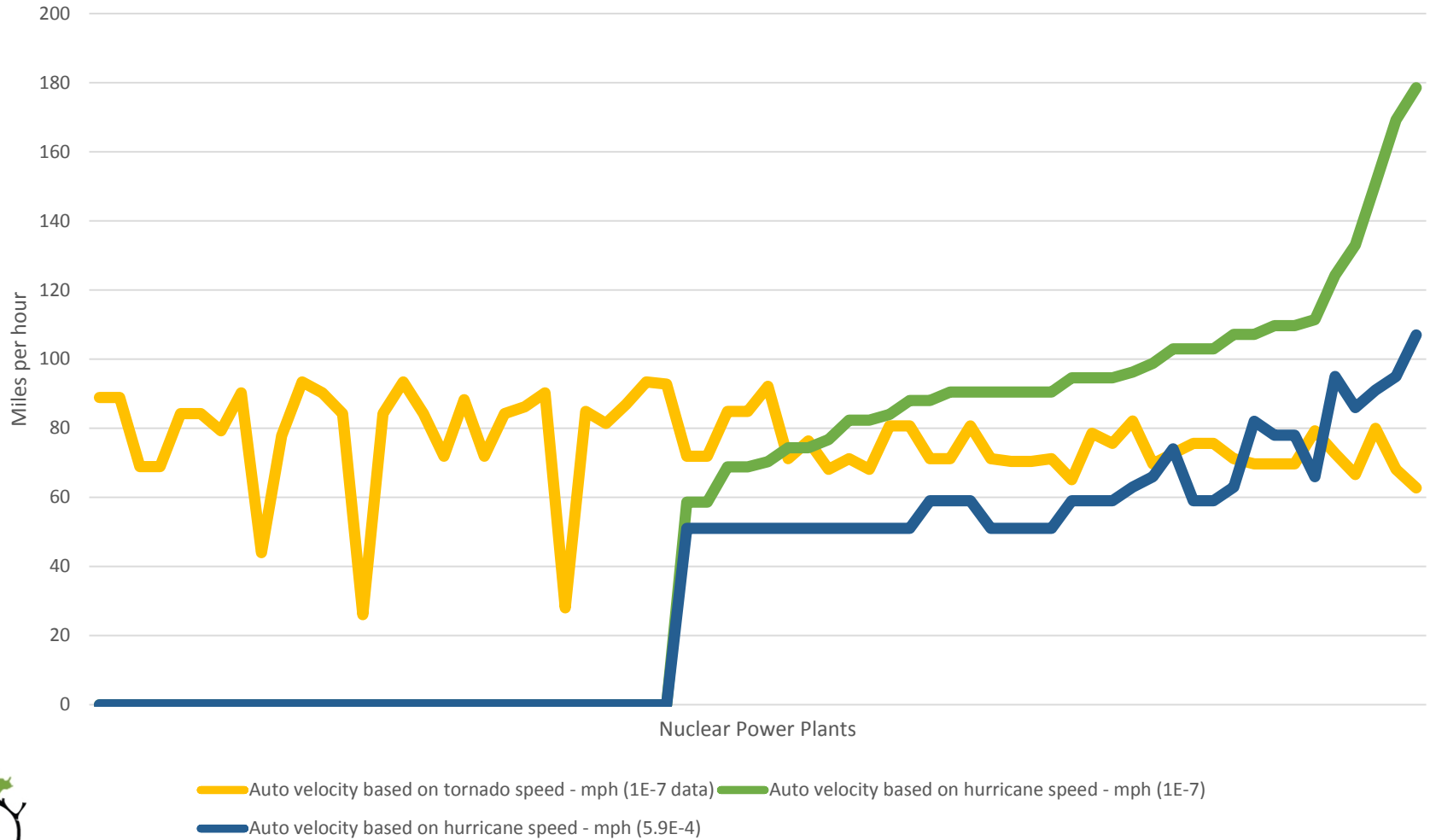


High Winds

- Tornado and Hurricane Impact loads
 - Automobile missile's speed in current guidance for tornadoes and hurricanes higher than that found in current plant updated final safety analysis reports for some sites
 - Automobile Tornado Impact Assessment
 - Staff reaching out to industry to confirm risk insights associated with tornadoes
 - Dominate risk contributors are not from 1E-7 tornadoes but rather from lower frequency tornadoes
 - » Risk profile driven by loss of offsite power and random failures of key systems and components



Tornado and Hurricane Automobile Missile Speeds



High Winds

- Automobile Hurricane Impact Assessment
 - Staff performed deterministic assessment of impact loading comparing licensing basis missiles against hurricane automobile missiles driven by $5.9E-4$ hurricanes
 - Majority of sites have structural margin
 - Staff performed deterministic calculation of representative concrete walls to determine speed at which automobile missile impact loads would exceed structural capacity
 - Speed to exceed ductility of 10 for:
 - 12-inch wall: 110 mph
 - 18-inch wall: 180 mph
 - 24-inch wall: 240 mph
 - Speed to exceed ductility of 30 for:
 - 12-inch wall: 200 mph
 - 18-inch wall: 275 mph
 - 24-inch wall: 360 mph



High Winds

- Automobile Hurricane Impact Assessment (continued)
 - Staff reaching out to industry
 - Understand procedures in place for some sites associated with hurricane preparation
 - Steps taken to reduce chance of crushable missiles before the onset of high winds on site
 - Other risk reduction steps taken prior to hurricane force winds arriving on site
 - Gain insights for sites that are subject to hurricane force winds whether IPEEE insights would be changed based on change in speed of high mass crushable missile.

