DOCKET NO. 160061-EI
FILED MAR 15, 2016
DOCUMENT NO. 01382-16
FPSC - COMMISSION CLERK

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March 15, 2016

-VIA ELECTRONIC FILING-

Ms. Carlotta S. Stauffer
Division of the Commission Clerk and Administrative Services
Florida Public Service Commission
2540 Shumard Oak Blvd.
Tallahassee, FL 32399-0850

Re: Docket No. 160___-EI

Dear Ms. Stauffer,

Pursuant to Florida Public Service Commission Rule 25-6.0342, Florida Administrative Code, enclosed for filing is Florida Power & Light Company's ("FPL's") 2016-2018 Storm Hardening Plan ("the Plan"), together with FPL's petition seeking approval of the Plan and the supporting testimony and exhibits of FPL witness Manny Miranda.

If there are any questions regarding this transmittal, please contact me at (561) 304-5639.

Sincerely,

/s/ John T. Butler

John T. Butler

Enclosure

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: **Petition for approval of Florida Power & Light Company's 2016-2018 Storm Hardening Plan pursuant to Rule 25-6.0342, F.A.C.**	Docket No. ________________________ March 15, 2016

PETITION OF FLORIDA POWER & LIGHT COMPANY
FOR APPROVAL OF STORM HARDENING PLAN

Florida Power & Light Company ("FPL") hereby requests approval by the Florida Public Service Commission ("Commission") of its 2016-2018 Electric Infrastructure Storm Hardening Plan (the "Plan") attached hereto as Exhibit 1, which is submitted in compliance with Rule 25-6.0342, Florida Administrative Code ("F.A.C."). The pre-filed direct testimony and exhibits of FPL witness Manuel B. Miranda are being filed with this Petition and are incorporated herein by reference.

FPL's transmission and distribution ("T&D") electrical grid is viewed as one of the most storm-resilient and reliable in the nation. This has been achieved through the development and implementation of its forward-looking storm-hardening, grid modernization and reliability initiatives and investments, combined with the use of cutting-edge technology and strong employee commitment. While FPL's storm hardening initiatives to date have produced a more storm resilient T&D electrical grid, a significant amount of the distribution system has yet to be storm-hardened. With the Plan, FPL is committed to continue FPL's industry-leading initiatives to further strengthen the T&D infrastructure, developing a system even more capable of meeting future increasing needs and expectations.

For Distribution, upon completing all critical infrastructure and community project feeders in 2016, FPL's next proposed phase of hardening addresses the remaining feeders in its system by targeting feeders with the largest disparity in current strength vs. extreme wind loading criteria, and substations without any hardened feeders. Upon completion of the Plan, approximately 800 additional feeders will be strengthened to EWL. Additionally, to further expand the benefits of hardening throughout its distribution system FPL will begin its lateral hardening initiative in 2018. For Transmission, efforts will continue to focus on replacing all remaining wood transmission structures. By year-end 2018, less than 5,000 wood structures will still be in place, resulting in a transmission structure population that is 93 percent steel and concrete. In total, by 2018 a much more substantial part of FPL's total system will have been hardened, extending the improved storm resiliency and reliability benefits of hardening to more customers.

In further support of this Petition, FPL states as follows:

I. Background

1. FPL is a corporation with headquarters at 700 Universe Boulevard, Juno Beach, Florida 33408. FPL is an investor-owned utility operating under the jurisdiction of the Commission pursuant to the provisions of Chapter 366, Florida Statutes. FPL is a wholly-owned subsidiary of NextEra Energy, Inc., a registered holding company under the federal Public Utility Holding Company Act and related regulations. FPL provides generation, transmission, and distribution service to more than 4.8 million retail customer accounts.

2. Any pleading, motion, notice, order or other document required to be served upon FPL or filed by any party to this proceeding should be served upon the following individuals:

Kenneth A. Hoffman
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850-521-3919
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John T. Butler, Esq.
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3. This Petition is being filed consistent with Rule 28-106.201, F.A.C.. The agency affected is the Florida Public Service Commission, located at 2540 Shumard Oak Blvd, Tallahassee, FL 32399. This case does not involve reversal or modification of an agency decision or an agency's proposed action. Therefore, subparagraph (c) and portions of subparagraphs (e), (f) and (g) of subsection (2) of such rule are not applicable to this Petition. In compliance with subparagraph (d), FPL states that it is not known which, if any, of the issues of material fact set forth in the body of this Petition, or the Plan, may be disputed by others planning to participate in this proceeding.

4. Subsection (2) of Rule 25-6.0342 requires each Florida investor-owned electric utility such as FPL to file an updated detailed storm hardening plan every 3 years.

5. Subsections (3), (4) and (5) of Rule 25-6.0342 set forth the required elements of storm hardening plans. The FPL Plan contains all of the required elements. With respect to the deployment strategy contemplated by subsection (4), the Plan contains a detailed description of FPL's deployment plans including a description of the facilities affected; technical design specifications, construction standards and construction methodologies to be employed; the communities and areas where the infrastructure improvements are to be made; the extent to which the improvements involve joint use facilities; FPL's estimated costs and benefits, including the effect on reducing storm restoration costs and customer benefits; and the estimated

costs and benefits obtained from third-party attachers, including the effect on reducing storm restoration costs and customer benefits.

6. As contemplated by subsection (5) of Rule 25-6.0342, the Plan also continues to provide the FPL standards and procedures applicable to joint users and third-party attachers. These standards and procedures are intended to ensure that attachments do not interfere with or degrade the storm resilience achieved by FPL's storm hardening initiatives.

7. As contemplated by subsection (6) of Rule 25-6.0342, FPL has sought input from joint users and third-party attachers. On February 19, 2016, FPL sent a detailed information package on its Plan to representatives of all known attachers, including all individuals whose contact information had been provided to FPL pursuant to subsection (6) (See attacher distribution list). The cover letter for the information package invited comments by March 4, 2016. Additionally, in order to implement subsection (4)(e) of Rule 25-6.0342, the cover letter also solicited input from attachers on what the costs and benefits of FPL's storm hardening plans will be for them. As of March 9, FPL received no comments/concerns from attaching entities that required FPL to modify its Plan. Additionally, no attaching entity provided information related to their costs and benefits associated with the Plan. For further detail concerning attacher comments, see Section 8.2 (Input from Attaching Entities) and Section 11.1 (Costs) and Section 11.2 (Benefits) of the Plan.

8. Since 2007, FPL has been implementing approved Commission plans to strengthen its infrastructure with particular emphasis on infrastructure that serves critical facilities and other essential community needs, such as hospitals, 911 centers, police and fire stations, grocery stores, gas stations and pharmacies.

9. Two key conclusions drawn from forensic data analysis associated with the 2004 and 2005 extraordinary storms seasons serve as the central basis for FPL's storm hardening efforts. These conclusions are:

a. The predominant root cause of distribution pole breakage was "wind only"; and,

b. FPL's transmission poles, already built to the National Electrical Safety Code ("NESC") extreme wind loading criteria ("EWL"), performed well overall.

In short, during severe weather events, infrastructure built to higher construction standards performed better, reducing overall restoration times. Additionally, FPL has learned that hardened feeders provide overall day-to-day reliability benefits, as they perform approximately 40 percent better than non-hardened feeders.

10. FPL must continue its efforts to storm-harden its T&D electrical grid. Tropical storms remain a constant threat. During 2013-2015, there were 32 named storms in the Atlantic. The 30-year average for named Atlantic storms in a year is 12. Also, Florida remains the most hurricane-prone state in the nation and, with its significant coast-line exposure, FPL is the most susceptible electric utility to storms within Florida. While we have been fortunate that FPL's service territory has not been recently heavily impacted by named storms, we cannot reasonably rely upon continuing good fortune to shield us from major storm impacts in the future.

II. FPL's 2016-2018 Plan

11. For Distribution, executing the Plan will result in 100% of FPL's feeders serving critical infrastructure ("CIF") (e.g., hospitals, 911 centers, police/fire stations), and Community Projects (e.g., gas stations, grocery stores, pharmacies) being hardened by year-end 2016.

Completing these feeders in 2016 is consistent with FPL's commitment in its approved 2013-2015 Storm Hardening Plan. Targeting CIF and Community Projects feeders has been an important first step, providing not only increased storm resilience but also significant day-to-day reliability benefits. Upon completing all CIF and Community Projects feeders in 2016, FPL's next step is to move forward with the task of hardening the approximately 60% of FPL's system-wide feeder network that will remain to be hardened and therefore is at a greater risk of incurring storm damage until hardening is complete. Broadening the scale and scope of feeder hardening to expeditiously address all feeders within FPL's system is appropriate and necessary because it:

- helps to address customers', public officials' and other stakeholders' expectations for increased storm resiliency, fewer outages and prompt service restoration, as evidenced by recent storm events (e.g., Hurricane Sandy in the northeast);
- is aligned with the goals of the U.S. Department of Energy, e.g., developing a more resilient and reliable system to meet future demands; and
- expands the benefits of hardening, including improved day-to-day reliability for all customers throughout the system.

12. Beginning in 2016, FPL's next proposed phase of hardening addresses the remaining feeders in its system by targeting: (1) feeders with the largest disparity in current strength vs. EWL (referred to as "wind zone" hardening); and (2) substations without any hardened feeders (referred to as "geographic" hardening). Upon completion of FPL's 2016-2018 Plan, approximately 800 additional feeders will be strengthened to EWL. While 40% of FPL's feeder system will still need to be addressed after 2018, a much more substantial part of FPL's

total system will have been hardened by then, extending the improved storm resiliency and reliability benefits of hardening to more customers. Additionally, to further expand the benefits of hardening throughout its distribution system FPL will initiate its lateral hardening initiative in 2018. While hardening feeders (the backbone of the distribution system) has been and continues to remain the highest priority for hardening, as improving their storm resiliency provides the largest initial benefit for customers, the full benefits of a hardened electrical grid cannot be realized without the hardening of laterals. Laterals, which tap off of feeders, are the final step in the distribution primary voltage delivery system. As laterals make up a significant portion of the overhead miles in FPL's distribution system, hardening laterals is necessary to provide the full benefits of a hardened distribution system to all customers.

13. FPL will also continue to implement its Design Guidelines, which require applying EWL to the design and construction of new pole lines and major planned work, including pole line extensions and relocations and certain pole replacements.

14. Total estimated distribution feeder hardening costs for 2016 are estimated to be approximately $360 million. A listing of the 121 feeders, 16 "01" switches and two highway crossing projects for 2016 is included in the Appendix to Exhibit 1.

15. In 2017 and 2018, FPL will continue with its Wind Zone and Geographic feeder and highway crossing EWL hardening initiatives, targeting 250-300 circuits annually, 5-20 "01" switches and 1-5 highway crossings annually. Additionally, in 2018, FPL will initiate its EWL lateral hardening initiative and plans to harden 850-950 laterals. The total projected annual costs for this work are estimated to be $490 million for 2017 and $750 million for 2018. In addition to completing all CIF and Community Project feeders in 2016, the Plan will also provide a system-wide feeder network that is 60 percent storm-hardened/underground at year-end 2018.

16. For Transmission, efforts will continue to focus on replacing all remaining wood transmission structures. By year-end 2018, less than 5,000 wood structures will still be in place, resulting in a transmission structure population that is 93 percent steel and concrete. Total 2016-2018 annual transmission hardening costs are estimated to be $46-$51 million.

17. Consistent with FPL's previously submitted and approved plans (Docket Nos. 070301-EI, 100266-EI and 130132-EI), FPL's Plan is intended to reduce storm damage to its electrical infrastructure, resulting in fewer outages and less restoration time and costs. For example, for future storm events, FPL expects that hardened feeder pole failure rates and associated restoration times will be reduced, and therefore provide restoration cost savings. More generally, all of FPL's approved initiatives, including its storm hardening plan, pole inspection programs and increased vegetation management activities, can be reasonably expected to reduce future storm restoration costs compared to what they would be without those initiatives. It is important to note that, despite the implementation of these initiatives, outages will occur when severe weather events impact the state. However, the identified initiatives will mitigate the impact.

18. While there are clear benefits from FPL's storm hardening and preparedness initiatives, it still remains nearly impossible at this time to estimate the full extent of the benefits with any precision. No two storms are exactly alike. However, a more storm-resilient infrastructure will perform better and provide for quicker and less expensive restoration than one which has not been hardened. The analyses and forensic observations performed after Hurricanes Katrina and Wilma continue to serve as the central foundation for FPL's hardening efforts. As additional storm experience (e.g., Hurricane Sandy), more and better data, and new improved processes, products and materials become available, even better and more targeted

hardening solutions will be implemented. In the meantime, FPL believes that continuing to implement its current hardening approach represents obvious and important initiatives that should be timely completed and are in the best interest of FPL's customers and the State of Florida.

19. FPL expects a reduction in storm as well as non-storm (day-to-day) restoration costs ("Restoration Cost Savings") as a result of its planned hardening activities. Of course, no one is in a position to know for sure how frequently FPL's service territory will be impacted by strong hurricanes. Based on a long-term historical average, this will occur once every five years. However, as was experienced in the 2004-2005 hurricane seasons, strong hurricanes can periodically occur more frequently. Moreover, while FPL has avoided direct strikes in recent years, the storm seasons continue to be active. The estimate of cumulative Restoration Cost Savings over time will be directly affected by how frequently storms hit FPL's service territory.

20. Taking these uncertainties into account, FPL has estimated that, over an analytical study period of 30 years, the net present value of Restoration Cost Savings per mile of hardened feeder would be approximately 45 percent to 70 percent of the cost to harden that mile of feeder for future major storm frequencies in the range of once every three to five years. Of course, it is possible that FPL will face major storms more frequently than that, as it did in the 2004-2005 hurricane seasons. If that were the case, then the net present value of Restoration Cost Savings likely would exceed the hardening costs.

21. It is also important to note that, in addition to Restoration Cost Savings, customers will benefit substantially, in many direct and indirect ways, from the reduced number and duration of storm and non-storm outages resulting from the planned hardening activities. FPL expects that they vary substantially from customer to customer, and FPL is not in a position

to assign a monetary value to them. Therefore, FPL has not attempted to reflect the customer benefits in its quantitative cost-benefit analysis.

22. Under the Commission's storm hardening rule, the criterion by which the plans are to be judged for approval is whether they are "cost-effective" (*see* Rule 25-6.0342(2), F.A.C.). FPL's storm hardening plan is highly cost-effective, at many levels. It has been and remains focused on targeted hardening activities where the most customers will receive the most benefits as quickly as possible, which FPL believes is the most cost-effective approach to hardening.

23. Today's digital society, economy, national security and daily life are more dependent on reliable electric service than ever before. FPL's initiatives to strengthen its T&D electric system are consistent with the U.S. Department of Energy's "Grid Modernization Initiative" ("GMI"), issued in March 2015, and its November 2015 "Grid Modernization Multi-Year Program Plan" ("MYPP"), which recognize that "the grid we have today does not have the attributes necessary to meet the demands of the 21st century and beyond" and that the future grid will need to "deliver resilient, reliable, flexible, secure, sustainable, and affordable electricity to consumers." To date, FPL's hardening efforts have already provided significant direct benefits to customers, and our nation-leading initiatives have positioned us well to achieve future grid strengthening objectives.

III. Conclusion

24. In conclusion, FPL's Plan is appropriate, necessary and crucial to our efforts to continue to develop the future electric grid – one that has a greater capability to meet the ever-increasing needs and expectations of customers - today and in the future.

WHEREFORE, FPL respectfully requests the Commission to approve FPL's Storm Hardening Plan attached hereto as Exhibit 1.

Respectfully submitted,

R. Wade Litchfield
Vice President & General Counsel
John T. Butler
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By: *s/ John T. Butler*
John T. Butler
Florida Bar No. 283479

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

FLORIDA POWER & LIGHT COMPANY

DIRECT TESTIMONY OF MANUEL B. MIRANDA

DOCKET NO. 160___-EI

MARCH 15, 2016

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Manuel B. Miranda. My business address is Florida Power & Light Company, 700 Universe Boulevard, Juno Beach, Florida 33408.

Q. By whom are you employed and what is your position?

A. I am employed by Florida Power & Light Company ("FPL" or the "Company") as the Senior Vice President of Power Delivery.

Q. Please describe your duties and responsibilities in that position.

A. As the Senior Vice President of Power Delivery, I am responsible for the planning, engineering, construction, operation, maintenance and restoration of FPL's transmission and distribution ("T&D") electric grid. This includes the systems, processes, analyses, and standards utilized to ensure that FPL's T&D facilities are safe, reliable, secure, effectively managed and in compliance with regulatory requirements.

Q. Please describe your educational background and professional experience.

A. I have a Bachelor of Science in Mechanical Engineering from the University of Miami and a Master in Business Administration from Nova Southeastern University. I joined FPL in 1982 and have more than 33 years of technical, managerial and commercial experience gained from serving in a variety of positions within Customer Service, Distribution and Transmission. Over the last 10 years, I have held several vice president positions within Distribution and Transmission, including my current position.

Q. Are you sponsoring any exhibits in this case?

A. Yes. I am sponsoring the following exhibits:

- MBM-1 FPL's Electric Infrastructure Storm Hardening Plan ("Plan")
- MBM-2 Percentage of FPL Feeders Hardened/Underground

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to: (1) present and provide an overview of FPL's 2016-2018 Plan (attached as Exhibit MBM-1): (2) demonstrate that FPL's 2016-2018 Plan complies with the National Electrical Safety Code ("NESC") and appropriately adopts the NESC's extreme wind loading standards ("EWL") for FPL's distribution system; and (3) present FPL's 2016-2018 deployment strategy, including the facilities affected, the location of those facilities (for 2016), an estimate of FPL's costs and benefits (including the effect on reducing storm restoration costs and customer outages) and input received, including costs and benefits, from third-party attachers. My testimony shows that FPL's 2016-2018 Plan complies with Rule 25-6.0342, Florida Administrative Code ("F.A.C."), and should be approved by the Florida Public Service Commission ("FPSC" or "Commission").

Q. Please provide some historical perspective and an overview of FPL's overall hardening strategy.

A. FPL has created a transmission and distribution ("T&D") electrical grid that is one of the most storm-resilient and reliable in the nation. We have achieved this through the development and implementation of our forward-looking storm-hardening, reliability and grid modernization initiatives, combined with the use of cutting-edge technology and strong employee commitment. With these industry-leading initiatives and our proposed 2016-2018 Plan, FPL will further strengthen its infrastructure, improve overall system reliability and develop a system even more capable of meeting ever-increasing needs and expectations.

It is well documented that Florida is impacted by hurricanes more than any other state. Additionally, with its significant coast line exposure and the fact that the vast majority of FPL's customers live within 20 miles of the coast, FPL is the most susceptible electric utility to storms within Florida. This was clearly demonstrated when, in 2004 and 2005, FPL's service territory was impacted by seven named storms. With the experience gained from this onslaught of storms, FPL and the Commission recognized that significant changes were required to construct an electrical grid that would be more storm-resilient. As a result, industry-leading initiatives were undertaken to improve storm resiliency, including the implementation of storm preparedness, cyclical infrastructure inspections, and vegetation management programs. In addition to providing increased storm resilience, FPL's hardening initiatives also provide our customers with improved day-to-day reliability. For example, day-to-day, storm-hardened feeders perform approximately 40% better than non-hardened feeders.

Q. How has FPL's hardening strategy been recognized for strengthening and modernizing its electrical grid?

A. During a January 2016 tour of FPL's facilities in Miami-Dade County, U.S. Energy Secretary Ernest Moniz stated that, "Modernizing the U.S. electrical grid is essential to reducing carbon emissions, creating safeguards against attacks on our infrastructure and keeping lights on." He also emphasized that FPL stands out in its innovations to strengthen the grid, when he said, "FPL really is on the cutting edge of addressing a grid for the 21st century and particularly in the area of resilience," and "It's really what we need."

Today's digital society, economy, national security and daily life are more dependent on reliable electric service than ever before. While FPL's efforts to strengthen, modernize and improve the reliability of the electric grid have produced superior results, our work is not done. The demands for safe, reliable and secure electric service are certain to escalate, as evidenced by the U.S. Department of Energy's ("DOE") "Grid Modernization Initiative," issued in March 2015, and its "Grid Modernization Multi-Year Program Plan," issued in November 2015, which recognize that "the grid we have today does not have the attributes necessary to meet the demands of the 21st century and beyond," and the future grid will need to "deliver resilient, reliable, flexible, secure, sustainable, and affordable electricity to consumers." These goals align with those that FPL, with the FPSC's oversight and guidance, has vigorously pursued for more than a decade.

To date, our nation-leading initiatives have positioned us well to achieve these future grid objectives. FPL's 2016-2018 plans and initiatives are appropriate, necessary and crucial to our efforts to continue to develop an electric grid that has a greater capability to meet the ever-increasing needs and expectations of customers -- today and in the future.

Q. Please provide an overview of FPL's 2016-2018 plans for storm strengthening/hardening.

A. FPL is filing its 2016-2018 Plan in compliance with Rule 25-6.0342, F.A.C. For Distribution, executing the 2016-2018 Plan will result in 100% of FPL's system-wide Critical Infrastructure Facilities ("CIF") (e.g., hospitals, 911 centers, police/fire stations) and Community Project (grocery stores, gas stations, pharmacies) feeders being hardened by year-end 2016. Completing these feeders in 2016 is consistent with FPL's commitment provided in its approved 2013-2015 storm hardening plan. Targeting CIF and Community Project feeders has been an important first step towards providing not only increased storm resilience but significant day-to-day reliability benefits.

Upon completion of all CIF and Community Project feeders in 2016, FPL's next step is to move forward with completing the task of hardening FPL's system-wide feeder network. Approximately 60% of the feeder network will remain to be hardened and is at a greater risk of incurring storm damage until that hardening is completed. Broadening the scale and scope of feeder hardening to expeditiously address all feeders within FPL's system is appropriate and necessary because it:

- helps to address customers', public officials' and other stakeholders' expectations for increased storm resiliency, fewer outages and prompt service restoration, as evidenced by recent storm events (e.g. Hurricane Sandy in the northeast);
- expands the benefits of hardening, including improved day-to-day reliability, to all customers throughout the system; and
- is aligned with the goals of the U.S. DOE (i.e., developing a more resilient and reliable system to meet future demands).

Beginning in 2016, FPL's next proposed phase of hardening addresses the remaining feeders in its system by focusing on: (1) "wind-zone hardening" and (2) "geographic hardening." "Wind zone hardening" targets those feeders with the largest disparity in current strength vs. EWL. "Geographic hardening" targets substations without any hardened feeders. Upon execution of FPL's 2016-2018 Plan at year-end 2018, approximately 800 additional feeders will be strengthened to EWL. While 40% of FPL's feeder system will still need to be addressed after 2018, a much more substantial part of FPL's total system will have been hardened, extending the improved storm resiliency and reliability benefits of hardening to more customers. My Exhibit MBM-2 shows the cumulative percentage of feeders hardened/underground by year (2006-2018) for CIF and Community Project feeders and all feeders system-wide.

Additionally, to further expand the benefits of hardening throughout its distribution system, FPL will initiate its lateral hardening initiative in 2018. While hardening feeders (the backbone of the distribution system) has been and remains the highest priority for hardening, as improving their storm resiliency provides the largest initial benefit for customers, the full benefits of a hardened electrical grid cannot be realized without the hardening of laterals. Laterals, which tap off of feeders, are the final step in the distribution primary voltage delivery system. As laterals make up a significant portion of the overhead miles in FPL's distribution system, hardening laterals is necessary to provide the full benefits of a hardened distribution system to all customers.

For transmission, efforts will continue to focus on replacing all remaining wood transmission structures. By year-end 2018, fewer than 5,000 wood structures are expected to be in place, resulting in a transmission structure population that is 93% steel and concrete.

Q. Does FPL's 2016-2018 Plan comply with the NESC, as required by Rule 25-6.0342(3)(a), F.A.C.?

A. Yes. For Distribution, Section 2.0 of FPL's Plan contains a description of the NESC requirements and Section 2.2 of the Plan describes how FPL's Plan complies with these requirements. For Transmission, see Section 2.0 (NESC Requirements and Compliance) of FPL's 2016-2018 Plan.

Q. Does FPL's 2016-2018 Plan address the extent to which the Plan adopts EWL for new construction, major planned work, critical infrastructure and along major thoroughfares, as required by Rule 25-6.0342(3)(b), F.A.C.?

A. Yes. Section 2.1 (Extreme Wind Loading Criteria ("EWL"), Section 3.0 (Infrastructure Hardening Strategy), Section 4 (Extreme Wind Speed Regions for Application of EWL), Section 5 (Application of New Design and Construction Standards), and Section 10 (Underground Distribution Facilities) of FPL's 2016-2018 Plan explain how FPL is adopting/applying EWL to existing and newly installed distribution infrastructure and how distribution underground facilities are designed to mitigate flooding and storm surge. For Transmission, see Section 3.0 of FPL's 2016-2018 Plan.

Q. Does FPL's 2016-2018 Plan explain the systematic approach that FPL will follow to achieve the desired objectives of enhancing reliability and reducing restoration costs and outage times associated with extreme weather events, as required by Rule 25-6.0342(4)(a)-(e), F.A.C.?

A. Yes. Section 6 (Deployment Plans), Section 7 (Design and Construction Standards), Section 8 (Attachments by Other Entities), Section 11 (Projected Costs and Benefits) of FPL's 2016-2018 Plan describe the facilities affected; include technical design specifications, construction standards and construction methodologies to be employed; identifies the communities and areas where the infrastructure improvements are to be made; addresses the extent to which the improvements involve joint use facilities; estimates costs and benefits, including the effect on reducing storm restoration costs and customer benefits; and estimates costs and benefits obtained from third-party attachers, including the effect on reducing storm restoration costs and customer benefits. For Transmission, see Sections 4-6 of FPL's 2016-2018 Plan.

Q. Did FPL seek input from and attempt in good faith to accommodate concerns raised by third-part attachers, as required by Rule 25-6.0342(6), F.A.C.?

A. Yes. On February 19, 2016, FPL sent its draft 2016-2018 Plan to representatives of all known attachers (99 entities), inviting comments and soliciting input (by March 4, 2016) on their costs and benefits resulting from FPL's Plan. As of March 9, FPL received no comments/concerns from attaching entities that required FPL to modify its 2016-2018 Plan. Additionally, no attaching entity provided information related to their costs and benefits associated with FPL's 2016-2018 Plan. See Section 8.2 (Input from Attaching Entities) and Section 11.1 (Costs) and Section 11.2 (Benefits) of FPL's 2016-2018 Plan.

Q. Should the Commission approve FPL's 2016-2018 Plan?

A. Yes. As described throughout my testimony and contained in FPL's Plan, FPL's 2016-2018 Plan meets the requirements set out in Rule 25-6.0342, F.A.C., and, therefore, should be approved by the Commission.

Q. Does this conclude your direct testimony?

A. Yes.

Florida Power & Light Company

Electric Infrastructure Storm Hardening Plan

(Rule 25-6.0342, F.A.C.)

March 15, 2016

FPL 2016-2018 Electric Infrastructure Storm Hardening Plan

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FPL 2016-2018 Electric Infrastructure Storm Hardening Plan

Florida Power & Light Company ("FPL") Electric Infrastructure Storm Hardening Plan

EXECUTIVE SUMMARY

FPL's transmission and distribution ("T&D") electrical grid is viewed as one of the most storm-resilient and reliable in the nation. This has been achieved through the development and implementation of our forward-looking storm-hardening, grid modernization and reliability initiatives and investments, combined with the use of cutting-edge technology and strong employee commitment. While FPL's storm hardening initiatives to date have produced a more storm resilient T&D electrical grid, a significant amount of the distribution system has yet to be storm-hardened. With our proposed 2016-2018 Storm Hardening Plan (the "Plan"), we are committed to continue FPL's industry-leading initiatives to further strengthen the T&D infrastructure, developing a system even more capable of meeting future increasing needs and expectations.

Since 2007, FPL has been implementing approved Florida Public Service Commission ("FPSC" or the "Commission") plans to strengthen its infrastructure with particular emphasis on infrastructure that serves critical facilities and other essential community needs, such as hospitals, 911 centers, police and fire stations, grocery stores, gas stations and pharmacies.

Two key conclusions drawn from forensic data analysis associated with the 2004 and 2005 extraordinary storms seasons serve as the central basis for FPL's storm hardening efforts. These conclusions are:

1. The predominant root cause of distribution pole breakage was "wind only"; and
2. FPL's transmission poles, already built to the National Electrical Safety Code ("NESC") extreme wind loading criteria ("EWL"), performed well overall.

In short, during severe weather events, infrastructure built to higher construction standards performed better, reducing overall restoration times. Additionally, we have learned that hardened feeders provide overall day-to-day reliability benefits, as they perform approximately 40 percent better than non-hardened feeders.

FPL must continue its efforts to storm-harden its T&D electrical grid. Tropical storms remain a constant threat. During 2013-2015, there were 32 named storms in the Atlantic. The 30-year average for named Atlantic storms in a year is 12. Also, Florida remains the most hurricane-prone state in the nation and, with its significant coast-line exposure and the fact that the vast majority of FPL's customers live within 20 miles of the coast; FPL is the most susceptible electric utility to storms within Florida. While we have been fortunate that FPL's service territory has not been recently heavily impacted by named storms, we cannot reasonably rely upon continuing good fortune to shield us from major storm impacts in the future.

For Distribution, executing the Plan will result in 100% of FPL's feeders serving critical infrastructure ("CIF") (e.g., hospital, 911 centers, police/fire stations, and community project ("Community Project) (e.g., gas stations, grocery stores, pharmacies) being hardened by year-end 2016. Completing these feeders in 2016 is consistent with FPL's commitment in its approved 2013-2015 storm hardening plan. Targeting CIF and Community Project feeders was an important first step, providing not only increased storm resilience but significant day-to-day reliability benefits; however, it is only a first step. Upon completion of all CIF and Community Project feeders in 2016, approximately 60% of FPL's system-wide feeder network will remain to be hardened and is at a greater risk of incurring storm damage until the hardening is completed. Broadening the scale and scope of feeder hardening to expeditiously address all feeders within FPL's system is appropriate and necessary because it:

- helps to address customers', public officials' and other stakeholders' expectations for increased storm resiliency, fewer outages and prompt service restoration, as evidenced by recent storm events (e.g. Hurricane Sandy in the northeast);
- is aligned with the goals of the U.S. DOE, e.g., developing a more resilient and reliable system to meet future demands; and
- expands the benefits of hardening, including improved day-to-day reliability for all customers throughout the system.

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Beginning in 2016, FPL's next proposed phase of hardening addresses the remaining feeders in its system by focusing on: (1) "wind zone hardening" and (2) "geographic hardening." "Wind zone hardening" targets those feeders with the largest disparity in current strength vs. EWL. "Geographic hardening" targets substations without any hardened feeders. Upon execution of FPL's Plan, at year-end 2018, approximately 800 additional feeders will be strengthened to EWL. While 40% of FPL's feeder system will still need to be addressed after 2018, a more substantial part of FPL's system will be hardened, expanding the improved storm resiliency and reliability benefits of hardening to more customers. Additionally, to further expand the benefits of hardening throughout its distribution system, in 2018, FPL will initiate its lateral hardening initiative. FPL will also continue with its Design Guidelines, which require applying EWL to the design and construction of new pole lines and major planned work, including pole line extensions and relocations and certain pole replacements.

Total estimated distribution hardening costs for 2016 are estimated to be approximately $360 million. A listing of the 2016 121 CIF, Community Project, Wind Zone and Geographic feeders, 16 "01" switch and two highway crossing projects is included in the Appendix to this filing.

In 2017 and 2018, FPL will continue with its Wind Zone and Geographic feeder and highway crossing EWL hardening initiatives, targeting 250-300 circuits annually, 5-20 "01" switches and 1-5 highway crossings annually. Additionally, to further expand the benefits of hardening throughout its distribution system, in 2018, FPL will initiate its EWL lateral hardening initiative. While hardening feeders (the backbone of the distribution system) has been and remains the highest priority for hardening, as improving their storm resiliency provides the largest initial benefit for customers, the full benefits of a hardened electrical grid cannot be realized without the hardening of laterals. Laterals, which extend off of feeders, are the final step in the distribution primary voltage delivery system. As laterals make up a significant portion of the overhead miles in FPL's distribution system, hardening laterals is necessary to provide the full benefits of a hardened distribution system to all customers. In 2018, FPL plans to harden 850-950 laterals. The total projected annual costs in 2017 and 2018 is estimated to be $490 million and $750 million, respectively. In addition to completing all CIF and Community Project feeders in 2016, the Plan will also provide a system-wide feeder network that is 60 percent storm-hardened/underground at year-end 2018.

FPL's initiatives not only improve the resiliency of FPL's system for future severe weather events, but also provide for an increased level of day-to-day reliability for its customers. The costs and benefits of FPL's plans provided in response to the Commission's 10-point "Storm Preparedness Initiatives" requirements in FPSC Docket No. 060198-EI, which were reviewed and approved in that docket, are incorporated herein by reference. Additionally, as previously mentioned, day-to-day reliability benefits are being realized, as hardened feeders perform approximately 40 percent better than non-hardened feeders. Finally, improved systems and processes, including improved storm forensics, will allow for more and better data to be collected, evaluated and analyzed, so that the effectiveness and efficiency of future storm hardening can be enhanced.

For transmission, efforts will continue to focus on replacing all remaining wood transmission structures. By year-end 2018, less than 5,000 wood structures are expected to be in place, resulting in a transmission structure population that is 93 percent steel and concrete. Total 2016-2018 annual transmission hardening costs are estimated to be $46-$51 million.

Although no electrical system can be made completely resistant to storm and hurricane impacts, FPL believes its proposed hardening plan will mitigate the impact of future storms. Consistent with FPL's previously submitted and approved plans (FPSC Docket Nos. 070301-EI, 100266-EI and 130132-EI), FPL's Plan is intended to reduce storm damage to its electrical infrastructure, resulting in fewer outages and less restoration time and costs. For example, in another Hurricane Wilma-type event, FPL expects that hardened feeder pole failure rates and associated restoration times will be reduced, and therefore provide restoration cost savings. More generally, all of FPL's approved initiatives, including its storm hardening plan, pole inspection programs and increased vegetation management activities, can be reasonably expected to reduce future storm restoration costs compared to what they would be without those initiatives. It is important to note, however, that despite the implementation of these initiatives, when severe weather events impact the state – outages will occur. However, the identified initiatives will mitigate such impact.

While there are benefits from FPL's storm hardening and preparedness initiatives, it still remains nearly impossible at this time to estimate the full extent of the benefits with any precision. No two storms are exactly alike. However, a more storm-resilient infrastructure will perform better and provide for quicker and less expensive restoration than one which has not been hardened. The analyses and forensic observations performed after Hurricanes Katrina and Wilma continue to serve as the central foundation for FPL's hardening efforts. As additional storm experience (e.g., Hurricane Sandy), more and better data, and new improved processes, products and materials become available, even better and more targeted hardening solutions will be implemented. In the meantime, FPL believes that continuing to implement its current hardening approach represents obvious and important initiatives that should be timely completed and are in the best interest of FPL's customers and the State of Florida.

In conclusion, today's digital society, economy, national security and daily life are more dependent on reliable electric service than ever before. FPL's initiatives to strengthen its T&D electric system are consistent with the U.S. Department of Energy's (" U.S. DOE") "Grid Modernization Initiative" ("GMI"), issued in March 2015, and its November 2015 "Grid Modernization Multi-Year Program Plan" ("MYPP"), which recognize that "the grid we have today does not have the attributes necessary to meet the demands of the 21st century and beyond" and that the future grid will need to "deliver resilient, reliable, flexible, secure, sustainable, and affordable electricity to consumers." Also, during a January 2016 tour of FPL's facilities in Miami-Dade County, U.S. Energy Secretary Ernest Moniz emphasized that FPL stands out in its innovations to strengthen the grid. "FPL really is on the cutting edge of addressing a grid for the 21st century and particularly in the area of resilience", he said, "It's really what we need". The U.S. DOE's goals align with those that FPL, with the FPSC's oversight and guidance, has vigorously pursued for more than a decade. To date, FPL's hardening efforts have already provided significant direct benefits to customers, and our nation-leading initiatives have positioned us well to achieve future grid strengthening objectives. FPL's Plan is appropriate, necessary and crucial to our efforts to continue to develop the future electric grid – one that has a greater capability to meet the ever-increasing needs and expectations of customers - today and in the future.

In compliance with Rule 25-6.0342, Florida Administrative Code ("F.A.C."), the following provides details on FPL's electric T&D infrastructure storm hardening plans.

SECTION 1: DISTRIBUTION

1.0 HISTORY / BACKGROUND

Two extraordinary hurricane seasons in 2004 and 2005 made it clear that significant changes were required in the way that Florida utilities design, construct and operate their electrical systems. This is particularly true for FPL's service territory, which during this time frame experienced the direct hit of five hurricanes and the indirect impact of two others. Forensic analyses revealed that standards that previously worked well and provided customers with reliable service needed to be enhanced going forward. During 2013-2015, there were 32 named storms in the Atlantic. The 30-year average for named Atlantic storms in a year is 12. Also, Florida remains the most hurricane-prone state in the nation. Additionally, with its significant coast line exposure, FPL is the most susceptible electric utility to storms within Florida. In fact, the vast majority of FPL's customers live within 20 miles of the coast. While we have been fortunate that FPL's service territory has not been recently heavily impacted by named storms, we cannot reasonably rely upon continuing good fortune to shield us from major storm impacts in the future. The susceptibility to storms and the potential significant damage and resulting impacts on customers associated with storms (e.g., most recently, Hurricane Sandy) are powerful reminders of the importance of moving our storm hardening efforts toward completion with deliberate speed.

Although no electrical system can be rendered fully resistant to hurricane impacts, FPL's storm hardening and preparedness initiatives (including its currently proposed Plan) benefits our customers and communities by providing significant improvements in FPL's system's resiliency to severe storms and overall storm restoration time. Additionally, it will ensure that a critical mass of providers of basic services, essential to the health and safety of communities served by FPL will have electric service as promptly as possible after a hurricane strike.

The central foundation for FPL's detailed distribution hardening plan is still the extensive analyses that FPL conducted either directly, or with the aid of external resources, e.g., KEMA, Inc. These analyses included detailed forensic observations of how the system performed after Hurricanes Katrina and Wilma. One key finding from the Hurricane Wilma forensic data was that "wind only" (as opposed to, for example, trees or other flying debris) was the predominant root cause of distribution pole breakage. This key data and the overall performance of FPL's transmission poles, which are already built to the NESC extreme wind criteria, form the basis for FPL's hardening strategy that certain parts of its distribution system be built to the highest criteria.

Electrical systems are exposed to a variety of different failure modes under the stress of hurricane conditions and typically each specific failure mode only accounts for a portion of the total damage. For example, even if FPL had experienced zero pole failures during the 2004 and 2005 storms, there still would have been millions of customers without power due to damage to other FPL facilities (e.g., wires down or damaged due to fallen trees, flying debris, etc.). However, FPL's hardening initiatives will strengthen the distribution system, reduce pole damage and reduce overall restoration time.

To achieve the most and quickest improvement possible, FPL has carefully developed its programs to focus efforts on those parts of the system where the greatest impacts for a given level of investment can be achieved.

1.1 Hardening Accomplishments to Date

During the period 2006-2015 – FPL hardened approximately 72 percent of its CIF and Community Project feeders. These include feeders that serve acute care facilities, hospitals, 911 centers, special needs shelters, police and fire stations, water treatment facilities, county emergency operation centers as well as other key community needs like gas stations, grocery stores and pharmacies throughout FPL's service territory. Additionally, FPL hardened 120 highway crossings and 270 "01" switches throughout its system. Also, in 2015, FPL completed the installation of submersible equipment to mitigate the impact of significant water intrusion in the 12 Miami downtown electric network vaults that are located just at or within the FEMA 100-year flood elevation levels. Finally, FPL also applied EWL to the design and construction of new pole lines and major planned work, including pole line extensions and relocations and certain pole replacements.

2.0 NATIONAL ELECTRICAL SAFETY CODE (NESC) REQUIREMENTS

The NESC is an American National Standards Institute (ANSI – C2) standard that has evolved over the years. As stated in the NESC, "[t]he purpose of these rules is the practical safeguarding of persons during the installation, operation, or maintenance of electric supply and communication lines and associated equipment." The standards cover a wide range of topics including grounding, overhead lines, clearances, strength and loading, underground, and rules for the operation of lines and equipment. The NESC is currently revised on a 5-year cycle, with the latest edition being 2012. This is the edition presently adopted by the Florida Administrative Code.

The NESC specifies grades of construction on the basis of the required strengths for safety. The relative order of grades of distribution construction is B, C, and N, with Grade B being the highest or strongest. The grade of construction required is determined by the voltage of the circuits involved and what they cross over. Grade C is typically the NESC minimum standard for most electrical distribution facilities. Grade B is only required when crossing railroad tracks, limited-access highways, and navigable waterways requiring waterway crossing permits.

Prior to 2007 and except for the period 1993-2004, FPL designed its distribution facilities based on the loading as specified in the NESC- Rule 250 B - Combined ice and wind loading for Grade B construction. While this has resulted in a very strong and reliable distribution system, the Rule 250 B criterion does not fully protect facilities against the sorts of extreme wind speed that can be experienced in FPL's service territory during hurricanes.

2.1 Extreme Wind Loading Criteria (EWL)

For Florida, EWL is calculated using the wind speeds contained in Figure 250-2(d) of the NESC. The loading increases significantly with an increase in the wind speed, since the wind loading formula uses the square of the wind speed.

Once the load is determined, it is multiplied by the appropriate Load Factor based on the Grade of Construction. This "factored" load is then used to determine the required structure (pole) strength. The strength of various poles is dependent on the material from which they are made. The strength of wood poles is published in ANSI O5. The strength of poles made from other materials is provided by the manufacturer. Once the strength of a pole is known, it is multiplied by a Strength Factor based on the grade of construction and the material from which the pole is made. This "factored" strength then has to be equal to or greater than the "factored" load.

All facilities that are to be attached to the pole must also be accounted for when determining the desired strength of the structure. This includes the wind load on the pole itself, as well as the conductors, transformers, communication cables and other equipment on the pole. The design loading impact to meet EWL usually requires some combination of stronger poles and shorter span lengths (distance between poles) to reduce the wind loading imposed on the conductors and cables.

Today, the NESC requires the use of EWL for facilities that exceed 60 feet above ground or water level – normally transmission level structures. FPL notes that there have been recent proposed modifications to significantly modify the NESC's 60-foot exemption. However, to date, these proposed modifications have not yet received adequate support for adoption, since such a change would cause significant ramifications for the industry. However, as the demands for a more resilient U.S. electrical grid continue to increase, FPL expects discussions to modify the 60-foot exemption to intensify.

2.2 FPL Compliance

Prior to 2007, FPL had generally utilized Grade B construction for all distribution lines, except as previously noted in Section 2.0. Since Grade B is stronger than Grade C construction, FPL's distribution facilities comply with and, in most cases, exceed the minimum requirements of the NESC. FPL's Distribution Engineering Reference Manual (DERM) and Distribution Construction Standards (DCS) are revised as required to ensure compliance with all applicable rules and regulations. For the purpose of implementing its hardening plan, applicable pages of FPL's DERM Addendum and DCS have been updated to include the requirements to meet the NESC EWL.

3.0 INFRASTRUCTURE HARDENING STRATEGY

FPL's distribution infrastructure consists of feeders (main distribution lines) and laterals (fused circuits that run off feeder lines), both of which carry primary voltage, as well as lines that carry secondary voltage (e.g., services). To harden its distribution infrastructure, FPL's 2016-2018 Plan continues with its previously approved three-prong approach: EWL; Incremental Hardening; and revised Design Guidelines. FPL will continue the practice of applying EWL to feeders and any associated laterals directly serving critical customers and certain critical poles. Additionally, in 2016, FPL proposes to apply EWL to further expand its distribution hardening by ensuring that every substation has at least one hardened feeder (Geographic hardening) and by addressing existing feeders with the largest disparity from EWL (Wind Zone hardening). Feeders are the backbone and, therefore, a critical component of FPL's overall distribution overhead system. Feeder reliability can have a substantial impact on overall service reliability to FPL's customers. The next prong, Incremental Hardening, also targets existing feeders with modifications that increase the feeder's wind profile, up to and including EWL. The third prong continues the system-wide implementation of FPL's Design Guidelines, which apply EWL to the design and construction of new pole lines and major planned work, including pole line extensions and relocations and certain pole replacements. This three-prong approach allows FPL to continue to obtain hardening benefits more promptly and cost-effectively across its entire electric system. FPL will continue to evaluate its approach as new products and lessons learned from other storm events become available. The application of this three-prong approach is explained in Section 5.0.

4.0 EXTREME WIND SPEED REGIONS FOR APPLICATION OF EWL

To apply the NESC extreme wind map for Florida (Figure 250-2(d), FPL proposes to continue dividing the application of EWL into three wind regions, corresponding to expected extreme winds of 105, 130 and 145 mph.

By reviewing its practices and procedures, FPL determined the most effective option for implementing the extreme wind map would be by county. By evaluating each of the counties that FPL serves, including each county's applicable wind zones, FPL determined that utilizing three extreme wind regions of 105, 130 and 145 mph for its service territory was best since:

- A smaller number of wind regions generate advantages through efficiency of work methods, training, engineering and administrative aspects (e.g., standards development and deployment);
- Using 105, 130 and 145 mph wind zones is a well balanced approach that recognizes differences in the EWL requirements in the counties within each region.

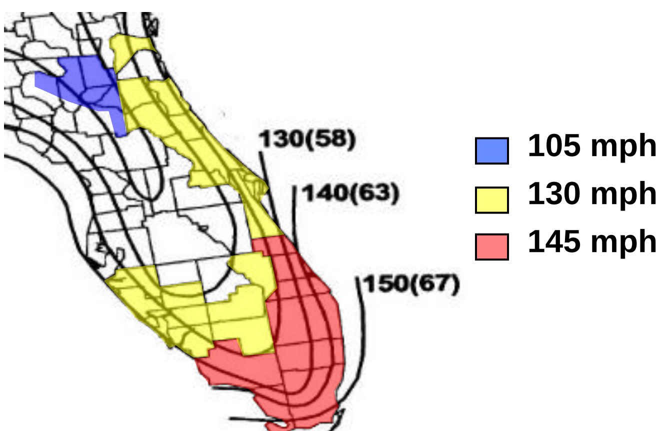


Figure 4-1 FPL Extreme Wind Regions (Meter/Sec)

5.0 APPLICATION OF NEW DESIGN AND CONSTRUCTION STANDARDS

5.1 EWL

Since 2006, FPL has been strengthening its infrastructure, applying the EWL criteria (where feasible, practical and cost-effective) by placing particular emphasis on infrastructure that serves hundreds of critical facilities and other essential community needs, such as hospitals, police and fire stations and grocery stores and critical poles (e.g., highway crossings).

FPL's 2016-2018 Plan continues the strengthening of its electric system by applying EWL to: (1) existing CIF feeders and associated laterals (this initiative is expected to be completed in 2016); (2) Geographic and Wind Zone feeders (both initiated in 2016); (3) certain poles critical to operations and efficient restoration (e.g., highway crossings); (4) certain existing laterals (initiated in 2018); and (5) to the design and construction of new pole lines and major planned work, including pole line extensions and relocations and certain pole replacements (through FPL's system-wide FPL Design Guidelines, which are primarily associated with changes in pole class, pole type and desired span lengths).

5.2 Incremental Hardening

The objective of Incremental Hardening is to optimize the existing distribution infrastructure and cost-effectively increase the overall wind profile of a feeder to a higher wind rating, up to and including EWL. In 2016, the utilization of Incremental Hardening remains unchanged as FPL will continue to apply Incremental Hardening to the few remaining Community Project feeders located throughout FPL's service territory.

5.3 Design Guidelines for New Construction

FPL's Plan continues to utilize the revised Design Guidelines and processes to apply EWL to the design and construction of new pole lines and major planned work, including pole line extensions and relocations and certain pole replacements. Depending on the scope of the work that is performed in a particular project, this could result in the EWL hardening of an entire circuit (in the case of large-scale projects) or in EWL hardening of one or more poles (in the case of small projects) so that the affected circuit will be in a position to be fully EWL hardened in the future. These guidelines are primarily associated with changes in pole class, pole type and desired span lengths to be utilized. Standardization of these processes ensures that the type of construction work aligns with FPL's hardening strategy.

FPL's current pole sizing guidelines provide for a minimum installation of: Class 2 wood poles for all new feeder and three-phase lateral work; Class 3 wood pole for two-phase and single-phase lateral work; and Class 3 wood pole for service and secondary work. For critical poles, FPL is installing concrete poles at accessible locations. These guidelines significantly increase the wind ratings (up to nearly 50 percent) from the Guidelines in place in

2007. FPL's current Distribution Design Guidelines are included in the Appendix, attached to this filing.

5.4 Hardening Existing Facilities

To determine how a circuit or critical pole will be hardened, a field survey of the circuit facilities is first performed. By capturing detailed information at each pole location such as pole type, class, span distance, attachments, wire size and framing, a comprehensive wind-loading analysis can be performed to determine the current wind rating of each pole, and ultimately the circuit itself. This data is then used to identify the specific pole locations on the circuit that do not meet the desired wind rating. Once locations have been identified, recommendations to increase the allowable wind rating of the pole can be made.

FPL plans to continue to utilize its "design toolkit" that focuses on evaluating and using cost-effective hardening options for each location, including:

- Storm Guying – Installing a guy in each direction perpendicular to the line; a very cost-effective option that is dependent on proper field conditions;
- Equipment Relocation – Moving equipment on a pole to a near-by stronger pole;
- Intermediate Pole – Installing a single pole when long span lengths are present, which reduce span length and increases the wind rating of both adjacent poles;
- Upgrading Pole Class – Replacing the existing pole with a higher class pole to increase the pole's wind rating; and;
- Undergrounding Facilities – Utilized if there are significant barriers to building overhead or if it is a more cost-effective option for a specific application.

These options are not mutually exclusive, and when used in combination with sound engineering practices, provide cost-effective methods to harden a circuit.

Design recommendations take in considerations such as hardening, mitigation (minimizing damage), as well as restoration (improving the efficiency of restoration in the event of failure). Since multiple factors can contribute to losing power after a storm, utilizing this multi-faceted approach helps to reduce the amount of work required to restore power to a damaged circuit.

FPL 2016-2018 Electric Infrastructure Storm Hardening Plan

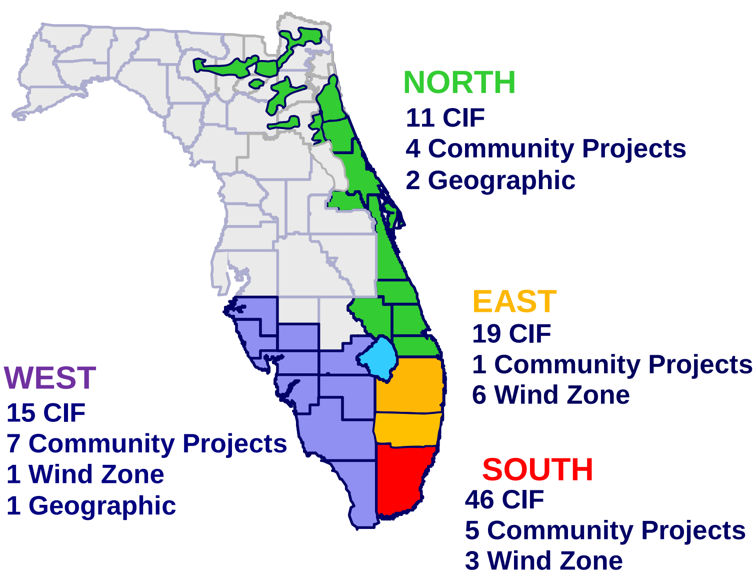
6.0 DEPLOYMENT PLANS

6.1 2016 Deployment Plan

In 2016, FPL plans to complete 108 CIF and Community Project feeders, as well as all remaining prior years' carryover CIF and Community Project feeders. This means, at year-end 2016, all CIF and Community Project feeders throughout FPL's service territory will be completed. Additionally, three Geographic and 10 Wind Zone feeders, 16 "01" switches and two highway crossings are planned to be completed. FPL will also continue to implement EWL hardening criteria for the design and construction of new pole lines and major planned work, including pole line extensions and relocations and certain pole replacements.

A listing of the 2016 121 planned feeder, 16 "01" switches and two highway crossing are included in the Appendix to this filing. The following map indicates, by region across FPL's service territory, where these various projects are located.

Figure 6-1 – 2016 Feeder Hardening Map



Note: Regional counts do not include prior years' carryover projects to be completed in 2016.

6.2 2017 and 2018 Deployment Plans

In 2017 and 2018, FPL will continue with its Wind Zone and Geographic feeder, highway crossing and "01" switch EWL hardening initiatives, targeting 250-300 circuits, 1-5 highway crossings and 5-20 "01" switches annually. Additionally, in 2018, FPL will begin to apply EWL to laterals and plan to harden 850-950 laterals. While hardening feeders (the backbone of the distribution system) has been and continues to remain the highest priority for hardening, as improving their storm resiliency provides the largest initial benefit for customers, the full benefits of a hardened electrical grid cannot be realized without the hardening of laterals. Laterals, which extend off of feeders, are the final step in the distribution primary voltage delivery system. As laterals make up a significant portion of the overhead miles in FPL's distribution system, hardening laterals is necessary to provide the full benefits of a hardened distribution system to all customers. Consistent with the stipulation reached in late 2007 regarding the "Process to Engage Third Party Attachers", FPL will continue to provide a preliminary list of projects in September of each year that it proposes to undertake in the following calendar year, pending final approval. Then, when approved, FPL provides the final project list.

7.0 DESIGN AND CONSTRUCTION STANDARDS

7.1 Distribution Engineering Reference Manual ("DERM")

FPL publishes its DERM to convey the philosophy of distribution design. The DERM provides FPL's designers with a reference for designing distribution facilities and contains background information, engineering considerations, examples of necessary calculations and tables developed from the calculations. The tables are a guide for general applications, whereas, the examples provide the designers with the method to design facilities not included in the Tables. FPL published and issued an "Addendum" to its DERM as a supplemental publication to enable the designers to design distribution facilities based on the 2012 NESC EWL criteria. A copy of the current DERM Addendum is included in the Appendix attached to this filing.

7.2 Distribution Construction Standards ("DCS")

FPL's DCS provides designers and construction crews with specifications needed to build the distribution facilities. Designers use the manual to convey instructions to the field and field crews use the manual to construct distribution facilities. The DCS contains drawings and instructions on clearances, framing (i.e., how facilities will be arranged on the pole), grounding, guying, equipment, and the assembly of various parts.

7.3 Design Guidelines

FPL's Design Guidelines and Quick Reference Guide provide the field designers with simple reference documents when the details provided in the DERM and DCS are not needed to develop the design plan. Information contained in these reference documents are primarily for determining pole class, pole type and desired span lengths for overhead construction. A copy of the current Design Guidelines and the Quick Reference Guide are included in the Appendix.

8.0 ATTACHMENTS BY OTHER ENTITIES

8.1 Attachment Standards and Procedures

There are attachments by other entities to FPL poles throughout its service area. These attachments are made by Incumbent Local Exchange Carriers (“ILEC”), Cable TV Companies (“CATV”), Telecommunication Carriers (“Non-ILEC”) and Governmental Entities. Additionally, FPL attaches to certain ILEC poles. The standards and procedures for these attachments, created to ensure conformance to FPL's standards and hardening plans as required by the FPSC, are attached and included in the Appendix.

8.2 Input from Attaching Entities

On February 19**,** 2016, FPL mailed 99 informational packages regarding its 2016-2018 Plan, including FPL’s “Attachment Standards and Procedures” to all of FPL’s known attaching entities. FPL requested attaching entities to provide their input to FPL by March 4, 2016, including their costs and benefits associated with FPL’s proposed Plan.

As of March 9, FPL received no comments/concerns from attaching entities that required FPL to modify its 2016-2018 Plan. Additionally, no attaching entity provided information related to their costs and benefits associated with FPL’s 2016-2018 Plan.

Five attaching entities (four cities and one county) contacted FPL regarding the Plan. Of the five attaching entities, four requested information on the status of specific hardening projects that have been completed or are planned for the future. FPL has provided, or is in the process of providing, such information to these four entities. The fifth attaching entity believed that FPL included an outdated distribution construction standards manual in its transmittal. In fact, FPL provided the most current construction manual with the Plan. This fifth attaching entity also suggested that, and at a minimum, FPL should be required to design/construct transmission and distribution facilities within its boundaries to meet the Florida Building Code. FPL informed this entity that FPL’s transmission and distribution facilities are designed/constructed to meet the NESC (as required by Florida Statute 366.04(6) and FPSC Rules 25-6.034, 25-6.0342 and 25-6.0345, F.A.C. and that FPL’s transmission and distribution facilities are exempted from the requirements of the Florida Building Code (as provided by Florida Statute 553.73(10)(f)).

9.0 RESEARCH AND DEVELOPMENT

Design and construction to NESC EWL involves more than just engineering reference manuals and construction standards. FPL has made efforts to seek out and evaluate new products, work methods, and construction techniques that may enable FPL to more cost-effectively build to this increased standard. Concurrently, FPL also continues to evaluate its existing construction practices to ensure they are adequate to meet EWL. Examples of these efforts include:

- FPL's evaluations of different pole technologies, e.g., steel, iron, several formulations of concrete, wood and composite materials. The evaluations confirmed that FPL has good economical vendors for wood and concrete poles, and so far, the other pole technologies have very limited applications and higher cost.
- An FPL evaluation that resulted in the use of heavy-duty field equipment that allows for the installation of heavier concrete poles without the use of costly cranes when field conditions are acceptable. At the same time, FPL and their concrete pole manufacturers jointly developed a stronger and lighter weight concrete pole.
- Utilizing lessons learned from previous storms, FPL made changes to streetlight brackets, implemented use of cross-arm braces for steel cross-arms on wood distribution poles, strengthened the method of attaching riser shields to poles, implemented improved guidelines for the use of slack span construction and verified the strength of current methods used for attaching wire to insulators.
- As part of FPL's efforts to strengthen existing installations, specification and application guidelines were written to use a pole reinforcement method called the ET Truss. This enables a pole to be strengthened cost-effectively, avoiding a pole replacement.
- For underground facilities, FPL piloted the use of the stainless steel Vista switchgear, below-grade and pad-mount versions, designed to withstand flooding and intermittent shallow immersion. The pad mounted switch has a lower profile than the conventional switchgear, is preferred over the below-grade version due to operational and access factors, and is suitable for floodplains not expected to experience direct storm surge. The Vista switchgear became an FPL standard option provided to customers considering underground projects.
- Collaborative research efforts continue with all Florida investor-owned utilities, Co-ops, Municipalities and the Public Utilities Research Center ("PURC"). This research, which began in 2007, has resulted in greater knowledge about wind conditions and the effects of vegetation management during storm and non-storm, as well as the development of hurricane and damage modeling that can assist in further understanding the costs and benefits of undergrounding.

10.0 UNDERGROUND DISTRIBUTION FACILITIES

10.1 Underground Systems

FPL's current underground construction systems include the following design applications:

- Pad-mounted, above-grade transformers and switch gear for typical Underground Residential Distribution ("URD") subdivisions and small commercial areas.
- Concrete encased duct and manhole systems with above-grade vaults in designated areas of high load density, where it is feasible, practical and cost-effective. For example, this application has been used in portions of Miami, Miami Beach, Fort Lauderdale, West Palm Beach and Sarasota.
- Secondary network systems and vaults with redundant throw-over, as utilized by FPL in the downtown Miami area.

FPL's current distribution system has approximately 68,000 total miles of distribution lines, of which nearly 38 percent (approximately 26,000 miles) are underground.

10.2 Equipment Technologies

The standard equipment (pad-mounted transformers, switch cabinets, etc.) for FPL URD construction is stainless steel, or in combination with mild steel. Stainless steel equipment is more resistant to weathering and corrosion.

10.3 Installation Practices

FPL complies with existing local ordinances when constructing underground systems. Generally, municipalities base their local ordinances on the Federal Emergency Management Agency's 100-year flood criteria.

10.4 Hardening and Storm Preparedness

Approximately 20 percent of FPL's underground distribution infrastructure is within the Category 1 - Category 3 floodplain as defined by the Florida Department of Community Affairs. Historically, FPL has not been as severely impacted by flooding and storm surge from hurricanes as it has been by wind. However, storm surge damage, when it does occur, can result in significant outages and long restoration times, as most recently experienced in the Northeast with Hurricane Sandy. As a result of the lessons learned in 2014 and 2015, FPL implemented and completed a storm surge initiative that utilized the installation of submersible equipment to strengthen the 12 above-grade vaults in its downtown Miami distribution network system that were more susceptible to storm surge/flooding. Additionally, FPL has guidelines in place for the prompt post-storm inspection and mitigation of damage to equipment exposed to flooding or storm surge. These guidelines include the necessary steps to purge any sand and water that has invaded the equipment and to restore it to service.

Recognizing that underground equipment is less impacted by predominantly wind events, FPL provides incentives (e.g., FPL's Governmental Adjustment Factor ("GAF") tariff) to promote conversion of electric facilities from overhead to underground. Through these incentives, FPL invests up to 25 percent of the total cost for qualified conversion projects.

11.0 PROJECTED COSTS AND BENEFITS

11.1 Costs

FPL

In 2016, FPL plans to complete the hardening of all remaining CIF and Community Projects (which include the 108 2016 projects and the prior years' carryover projects), the 13 Geographic and Wind Zone feeders as well as the two highway crossings and 16 "01" switches. Total distribution hardening costs for 2016 are estimated to be approximately $360 million. FPL will also continue to implement EWL hardening criteria for the design and construction of new pole lines and major planned work, including pole line extensions and relocations and certain pole replacements. The incremental costs of hardening associated with these activities are not specifically tracked.

In 2017 and 2018, FPL will continue with its Wind Zone and Geographic feeder and highway crossing EWL hardening initiatives, targeting 250-300 circuits, 1-5 highway crossings and 5-20 "01" switches annually. Additionally, in 2018, FPL will initiate its EWL lateral hardening initiative and plans to harden 850-950 laterals. Total projected annual cost for this work is estimated to be $490 million and $750 million, for 2017 and 2018, respectively. These estimates are based upon current work methods, products, and equipment and assume the necessary resources will be available to execute the plan.

The 2016-2018 Plan's proposed projects/funding levels should allow FPL to complete the hardening of all CIF and Community Projects in 2016 and provide a system-wide feeder network that is 60 percent storm-hardened/underground by year-end 2018.

Attaching Entities

As of March 9, 2016, no information regarding attaching entities' costs has been received.

11.2 Benefits

FPL

With its 2016-2018 Plan, FPL expects to complete the hardening of all CIF and Community Projects in 2016 and provide a system-wide feeder network that is 60 percent storm-hardened/underground by year-end 2018.

FPL expects a reduction in storm as well as non-storm (day-to-day) restoration costs ("Restoration Cost Savings") as a result of its planned hardening activities.

FPL has conducted an analysis to determine the relationship between the expected Restoration Cost Savings from the planned hardening activities, and the estimated cost of those activities. This analysis looks at the average Restoration Cost Savings per mile of feeder for all planned hardening activities, rather than at each activity separately, since FPL does not have sufficient information at this time to distinguish between the benefits attributable to one type of hardening activity versus another. Moreover, the Restoration Cost Savings have to be expressed as a range because of the substantial uncertainties inherent in estimating them based on current information. While there are numerous areas of uncertainty, two are particularly important. First, neither FPL nor the utility industry generally has much experience with hardened distribution facilities. Therefore, there is little directly measured data on the improved resilience, and hence reduced Restoration Cost Savings, resulting from hardening such facilities. FPL has relied primarily upon four sources of data for estimating the improved resilience of hardened distribution facilities. The data sources are:

- Experience from the 2004-2005 hurricane seasons, which provided substantial insight into the specific causes of pole failures (and hence both the nature and magnitude of potential improvements in storm resilience that could result from addressing those causes).
- The work performed by KEMA, Inc. for FPL following the 2005 storm season which addressed the potential storm-resilience improvements that could be expected from hardening activities.
- A comparison in performance during the strong winds of hurricane Wilma between FPL's transmission poles (which were designed to EWL standards and generally fared very well) and its distribution poles (which generally were not designed to EWL standards and experienced a significant number of "wind only" failures).
- An independent analysis prepared by Davies Consulting, Inc., in February 2006 that addressed the impact of hurricanes with varying strengths on pole replacements for FPL and ten other utilities. This report showed that there is a strong correlation between the percentage of poles requiring replacement and the strength of storms

and that FPL's pole replacement rates were lower than those of other utilities for storms of comparable strengths. It is important to note that most of the other utilities in this analysis build their distribution systems to meet Grade C construction, while FPL's standard was Grade B construction, which seems to confirm that the strength of the system, i.e., Grade C vs. Grade B vs. EWL, does have an impact.

Of course, no one is in a position to know for sure how frequently FPL's service territory will be impacted by strong hurricanes. Based on a long-term historical average, this will occur once every five years. However, as was experienced in the 2004-2005 hurricane seasons, strong hurricanes can periodically occur more frequently. Moreover, while we have avoided direct strikes in recent years, the storm seasons continue to be active. The estimate of cumulative Restoration Cost Savings over time will be directly affected by how frequently storms hit FPL's service territory.

Taking these uncertainties into account, FPL has estimated that, over an analytical study period of 30 years, the net present value of Restoration Cost Savings per mile of hardened feeder would be approximately 45 percent to 70 percent of the cost to harden that mile of feeder for future major storm frequencies in the range of once every three to five years. Of course, it is possible that FPL will face major storms more frequently than that, as it did in the 2004-2005 hurricane seasons. If that were the case, then the net present value of Restoration Cost Savings likely would exceed the hardening costs.

It is also important to note that, in addition to Restoration Cost Savings, customers will benefit substantially, in many direct and indirect ways, from the reduced number and duration of storm and non-storm outages resulting from the planned hardening activities. As a result of the discussions with the Commission about storm hardening following the 2005 storm season, FPL understands that the Commission considers these customer benefits to be important. However, FPL expects that they vary substantially from customer to customer and FPL is not in a position to assign a monetary value to them. Therefore, FPL has not attempted to reflect the customer benefits in its quantitative benefit/cost analysis.

Under the Commission's storm hardening rule, the criterion by which the plans are to be judged for approval is whether they are "cost-effective" (see Rule 25-6.0342(2), F.A.C.). FPL's storm hardening plan is highly cost-effective, at many levels. It has been and remains focused on targeted hardening activities where the most customers will receive the most benefits as quickly as possible.

For the facilities that will be hardened to EWL standards, each pole location is evaluated to determine how it can be strengthened to meet those standards at the least cost and with the least disruption. Finally, customers are also receiving day-to-day reliability benefits, as hardened feeders perform 40 percent better than non-hardened feeders.

Attaching Entities

As of March 9, 2016, no information regarding attaching entities' benefits has been received.

SECTION 2: TRANSMISSION

1.0 HISTORY / BACKGROUND

While FPL's transmission facilities were also affected by the 2004 and 2005 storms, the damage experienced was significantly less than the damage sustained by distribution facilities. A primary reason for this is due to the fact that transmission structures are already constructed to meet EWL. However, FPL implemented two transmission storm hardening initiatives (also included in Storm Preparedness Initiative No. 4, previously approved by the Commission as part of FPL's "Storm Preparedness Initiatives" in Order No. PSC-06-0781-PAA-EI, Docket No. 060198-EI and in Order No. PSC-11-0082-PAA-EI in Docket No. 100266-EI, and also reported on in FPL's annual March 1 compliance filings): (1) replacement of wood transmission structures (which accounted for nearly 70 percent of all transmission structures requiring replacement during the 2004-2005 storm seasons) with steel or concrete; and (2) replacement of ceramic post insulators on concrete poles (which accounted for nearly 70 percent of all the insulators replaced as a result of the 2004-2005 storm seasons) with polymer post insulators. This initiative was completed in 2014.

Also, in response to lessons learned in 2012 from Hurricane Sandy in the Northeast, FPL initiated in 2013 several transmission storm surge/flood initiatives to better protect certain transmission facilities and expedite restoration of service to customers. This included water intrusion mitigation and the installation of real-time water level monitoring systems and communication equipment inside 223 substations in FPL's system that are more flood prone. This initiative was completed in 2014.

2.0 NESC REQUIREMENTS AND COMPLIANCE

FPL transmission line structural designs are mandated by Florida Statute Section 366.04, which requires that all high voltage transmission structures satisfy the requirements specified by the NESC. EWL criteria contained in NESC Rule 250C covers all wind sensitive factors and wind related effects that need to be considered in the design calculations. FPL transmission structures are designed to meet EWL under NESC Rule 250 C and are constructed to meet Grade B Construction under NESC Sections 25 and 26.

3.0 DETERMINATION OF EXTREME WIND SPEEDS FOR APPLICATION OF EWL

For transmission structures, FPL interpolates the NESC wind load contours (NESC Figure 250-(2d) into 5 mph intervals. Based on the global position system (GPS) coordinates, transmission structures are designed for the upper wind speed of each interpolated 5 mph wind contour interval.

4.0 DESIGN AND CONSTRUCTION STANDARDS

FPL's transmission and substation system is already designed for EWL using the following design standards:

NESC

- As required by Florida Statute Section 366.04.

American Society of Civil Engineers (ASCE)

- Minimum Design Loads for Buildings & Other Structures "ASCE/SEI 7-05"
- Design of Steel Transmission Pole Structures "ASCE/SEI 48-05"
- Manual No. 74: Guidelines for Electrical Transmission Line Structural Loading
- Manual No. 91: Design of Guyed Electrical Transmission Structures
- Manual No. 123: Pre-stressed Concrete Transmission Pole Structures: Recommended Practice for Design and Installation

Institute of Electrical and Electronics Engineers ("IEEE")

- IEEE Standard 751 – 1990, IEEE Trial-Use Design Guide for Wood Transmission Structures

FPL's transmission construction standards are incorporated into the following two books as summarized below:

Transmission Structure Standards ("TSS")

The TSS includes drawings showing the framing and configuration of both current and historical transmission structures. Each structure standard drawing includes dimensions, material lists, and any applicable transmission installation specification ("TIS") standards.

Transmission Installation Specification ("TIS")

The TIS includes installation and testing procedures for various transmission components. The book contains the following sections:

1. Anchors & Foundations
2. Bonding & Grounding
3. Conductor & Conductor Fittings
4. Poles & Structures
5. Right-of-Way Items
6. Insulator & Arrester
7. Fiber Optics

Construction or installation specifications that are unique to a particular location and not incorporated in either standard referenced above are incorporated in the construction package for the individual project.

5.0 DEPLOYMENT STRATEGY

With FPL's Plan for 2016-2018, which results in the replacement of approximately 1,400-1,800 poles annually, FPL expects that less than 5,000 wood transmission structures (7 percent of its total transmission structure population) will remain to be replaced at year-end 2018. FPL will continue prioritizing existing transmission storm hardening initiatives based on factors including proximity to high wind areas, system importance, customer count, and coordination with the distribution CIF storm initiative. Other economic efficiencies, such as performing work on multiple transmission line sections within the same corridor, will also be considered.

6.0 COSTS AND BENEFITS

Total 2016-2018 annual costs of replacing wood transmission structures are estimated to be $46-51 million.

Eliminating wood transmission structures from FPL's system removes a "weak link" identified in the 2004 and 2005 storms and further strengthen an already storm-resilient system, reducing similar occurrences in future storms, preventing or mitigating damage, outages and restoration costs.

2016 CIF Feeders

	County	Feeder	Substation	Type of Project	Project Address
1	Broward	700133	SISTRUNK	Police	1300 W BROWARD BLVD # POLICE
2	Broward	700234	HOLLYWOOD	Other	545 N PARK RD #WELL
3	Broward	700537	POMPANO	Other	1351 NW 27TH AVE #CONTE
4	Broward	701231	PLAYLAND	Other	4300 SW 42ND AVE # FED FM PT2
5	Broward	701833	ROCK ISLAND	Other	1725 NW 31ST AVE
6	Broward	701837	ROCK ISLAND	Police	2150 NW 26TH AVE # EMS TOWER
7	Broward	703133	RAVENSWOOD	Police	5301 SW 31ST AVE
8	Broward	703638	PALM AIRE	Other	3401 W PROSPECT RD # WELLFLDS
9	Broward	703732	CRYSTAL	Other	3900 N POWERLINE RD # JAIL
10	Broward	704665	SPRINGTREE	Other	5703 NW 94TH AVE # SCHOOL
11	Broward	709431	ANDREWS	Other	1550 BLOUNT RD # MAINT
12	Miami-Dade	800331	BUENA VISTA	Other	3601 NW 10TH AVE # WP3038
13	Miami-Dade	800631	LITTLE RIVER	Police	1050 NW 62ND ST #POLICE
14	Miami-Dade	800633	LITTLE RIVER	Police	550 NW 62ND ST # MIAMI EDISON SR
15	Miami-Dade	800634	LITTLE RIVER	Other	911 NW 67TH ST # WP 3039
16	Miami-Dade	800738	HIALEAH	Police	201 WESTWARD DR #CH & POLICE
17	Miami-Dade	801231	OPA LOCKA	Other	3199 NW 135TH ST # SEWER
18	Miami-Dade	801235	OPA LOCKA	Police	2495 ALI BABA AVE
19	Miami-Dade	801837	BISCAYNE	Fire	650 NW 131ST ST
20	Miami-Dade	802835	ARCH CREEK	Fire	13000 NE 16TH AVE
21	Miami-Dade	803034	TROPICAL	Fire	9361 SW 24TH ST
22	Miami-Dade	803434	MIAMI SHORES	Fire	9500 NE 2ND AVE
23	Miami-Dade	803932	SUNNY ISLES	Fire	175 172ND ST #FIRESTATIO
24	Miami-Dade	804133	GARDEN	Fire	18805 NW 27TH AVE # MAINT BLDG
25	Miami-Dade	804336	KENDALL	Fire	7825 SW 104TH ST
26	Miami-Dade	804931	OJUS	Fire	2270 NE 186 ST
27	Miami-Dade	805035	UNIVERSITY	Police	5601 PONCE DE LEON BLVD #FLIPSE BLDG
28	Miami-Dade	805132	LAWRENCE	Police	2200 W FLAGLER ST # POLICE
29	Miami-Dade	805233	NATOMA	Other	2660 BRICKELL AVE #HOSP OUTPATIENT CNTR
30	Miami-Dade	805331	KEY BISCAYNE	Fire	2 CRANDON BLVD
31	Miami-Dade	805433	DADE	Police	6498 NW 38TH TER #POLICE DEPT
32	Miami-Dade	805635	MILLER	Other	10355 SW 76TH ST # WW3051
33	Miami-Dade	806034	GOLDEN GLADES	Fire	15250 NW 27TH AVE
34	Miami-Dade	806035	GOLDEN GLADES	Police	1020 NW 163RD DR
35	Miami-Dade	807162	PENNSUCO	Police	10200 NW 116TH WAY
36	Miami-Dade	807231	MERCHANDISE	Other	1 NORTHWEST BLVD # SRM187
37	Miami-Dade	807339	GOULDS	Fire	11855 QUAIL ROOST DR # NURSING
38	Miami-Dade	807835	WESTON VILLAGE	Fire	575 NW 199TH ST # IVES FIRE
39	Miami-Dade	808162	MILAM	Police	8074 NW 29TH ST
40	Miami-Dade	808163	MILAM	Other	9300 NW 36TH ST
41	Miami-Dade	808169	MILAM	Police	2990 NW 75TH AVE # A
42	Miami-Dade	808534	SEMINOLA	Fire	780 W 25TH ST # FIRE STA-6
43	Miami-Dade	809761	SWEETWATER	Fire	12700 SW 6TH ST # FIRESTATI
44	Miami-Dade	810162	SEAGULL	Other	5901 NW 136 AVE #WW3053
45	Miami-Dade	811162	SPOONBILL	Other	3330 W 76TH ST # SP418
46	Miami-Dade	811432	WATKINS	Fire	7050 NW 36TH ST
47	Palm Beach	400132	WEST PALM BEACH	Other	1009 BANYAN BLVD # WATER PLANT
48	Martin	401131	STUART	Police	830 SE MARTIN LUTHER KING JR BLVD #P SFT
49	Martin	401134	STUART	Other	1301 SE PALM BEACH RD # LODGE
50	Martin	401135	STUART	Police	1 S SEWALLS POINT RD # TOWN HALL
51	Highlands	401231	BRIGHTON	Other	20179 STATE ROAD 70 W
52	Okeechobee	401636	OKEECHOBEE	Police	825 SW 28TH ST #OSCEOLA MIDDLE
53	Palm Beach	402531	BELVEDERE	Other	1300 PERIMETER RD # HSE
54	Palm Beach	403037	MILITARY TRAIL	Other	50 S MILITARY TRL
55	Palm Beach	403232	ATLANTIC	Other	1351 NW 2ND AVE #PMP STA2
56	Palm Beach	404731	HILLSBORO	Other	1531 W PALMETTO PARK RD # HOSP
57	Palm Beach	405334	BEELINE	Other	4325 HAVERHILL RD N # REGIONAL TREATM
58	Indian River	405762	SEBASTIAN	Other	810 BAILEY DR # TOWER
59	Okeechobee	406062	SHERMAN	Fire	30086 HIGHWAY 78 W #Fire
60	Okeechobee	406063	SHERMAN	Other	4350 SE 74TH TRL # STN 500-7

FPL's 2016 Distribution Hardening Projects

61	Martin	407163	CRANE	Other	4310 SW MALLARD CREEK TRL
62	Palm Beach	407235	JOG	Fire	405 PIKE RD # PBCFR 1
63	Palm Beach	407667	LOXAHATCHEE	Other	1630 RYE TER # PUMP
64	Martin	408333	MONTEREY	Other	2401 SE MONTEREY RD # CNTY ADMIN
65	St Lucie	411963	TESORO	Other	3721 SW DARWIN BLVD # WP WWTP
66	Volusia	100832	PORT ORANGE	Other	544 RUTH ST
67	Volusia	101036	HOLLY HILL	Police	1065 RIDGEWOOD AVE
68	Volusia	101037	HOLLY HILL	Other	901 6TH ST
69	St Johns	102635	LEWIS	Police	4455 AVENUE A #911
70	Volusia	107162	HIGHRIDGE	Fire	2302 BELLEVUE AVE # FAA TOWER
71	Seminole	201436	GRANDVIEW	Other	WYLLY AVE #SANFORD AIRPORT GATE 16
72	Brevard	201834	MINUTEMAN	911	2 S ORLANDO AVE # CITY HALL
73	Brevard	201933	COURTENAY	Police	2575 N COURTENAY PKWY
74	Brevard	203032	FRONTENAC	Other	N HIGHWAY 1 # CC PLANT
75	Seminole	207931	RINEHART	Other	5651 LAKE GUSSIE CIR #WTP2
76	Brevard	208162	HIELD	Other	3400 RANCH RD
77	Sarasota	500135	SARASOTA	Other	2090 MAIN ST # PRI MTR
78	Manatee	500234	BRADENTON	Other	1801 5TH ST W # 911 TOWER SERVER
79	Manatee	500239	BRADENTON	Other	202 6TH AVE E
80	Sarasota	500335	VENICE	Other	200 WARFIELD AVE # RO
81	Lee	501134	FT MYERS	POLICE	1700 MONROE ST # NEW JUSTICE CTR
82	Collier	501237	NAPLES	Other	777 9TH ST N
83	De Soto	501431	ARCADIA	Other	223 S PARKER AVE # SEWAGE PLANT
84	Charlotte	501537	PUNTA GORDA	Police	1410 TAMIAMI TRL #FIRE/SAFE
88	Charlotte	503765	HARBOR	Other	1050 LOVELAND BLVD
86	Lee	503965	ESTERO	Other	10900 EVERBLADES PKWY # LIFT STATION
87	Manatee	504662	CASTLE	Other	3331 LENA RD # SE WWTP
88	Lee	505062	JETPORT	Fire	16000 AIRPORT HAUL RD # VLT 187 CONC B
89	Lee	507266	SAN CARLOS	Fire	13500 SOPHOMORE LN # FIRE DEPT
90	Collier	507762	RATTLESNAKE	911	8075 LELY CULTURAL PKWY
91	Charlotte	507961	MCCALL	Other	12770 GULFSTREAM BLVD #SUN TOWER

2016 COMMUNITY PROJECT FEEDERS

	County	Feeder	Substation	Type of Project	Project Address
1	Broward	700444	OAKLAND PARK	Community	NE 38th Street
2	Broward	700535	POMPANO	Community	N Powerline Road
3	Broward	706167	HOLLYBROOK	Community	S Hiatus Road
4	Miami-Dade	808267	LINDGREN	Community	SW 137th Ave
5	Miami-Dade	806533	SUNILAND	Community	69th Avenue Road
6	Palm Beach	404037	WESTWARD	Community	Okeechobee Boulevard
7	Volusia	100931	SOUTH DAYTONA	Community	US Highway 1
8	Volusia	103835	WILLOW	Community	S Clyde Morris Boulevard
9	Brevard	202132	INDIAN RIVER	Community	Cheney Highway
10	Brevard	205533	DAIRY	Community	Palm Bay Road NE
11	Manatee	500232	BRADENTON	Community	US Highway 41
12	Manatee	502532	PALMA SOLA	Community	1st Avenue W
13	Sarasota	503036	PHILLIPPI	Community	Proctor Road
14	Collier	506768	VANDERBILT	Community	Livingston Road
15	Lee	507662	GLADIOLUS	Community	Winkler Road
16	Lee	507664	GLADIOLUS	Community	Gladioulus Drive
17	Collier	504063	CAPRI	Community	Capri Boulevard

FPL's 2016 Distribution Hardening Projects

2016 Wind Zone Feeders

	County	Feeder	Substation	Type of Project
1	Broward	702239	MARGATE	Wind Zone
2	Broward	702263	MARGATE	Wind Zone
3	Broward	704933	LAKEVIEW	Wind Zone
4	Palm Beach	404740	HILLSBORO	Wind Zone
5	Palm Beach	402635	JUNO BEACH	Wind Zone
6	Palm Beach	400139	WEST PALM BEACH	Wind Zone
7	Palm Beach	400236	DATURA ST	Wind Zone
8	Palm Beach	407733	SQUARE LAKE	Wind Zone
9	Palm Beach	405468	CLINTMOORE	Wind Zone
10	Collier	503137	SOLANA	Wind Zone

2016 Geographic Feeders

	County	Feeder	Substation	Type of Project
1	Brevard	208633	TULSA	Geographical
2	Volusia	104431	NOVA	Geographical
3	Sarasota	508631	LIME	Geographical

	2016 01 Switches		
	County	Substation	Feeder
1	Broward	CHAPEL	706961
2	Broward	TRAIN	706534
3	Broward	SISTRUNK	700131
4	Miami-Dade	HOMESTEAD	803233
5	Miami-Dade	RAILWAY	800832
6	Miami-Dade	MASTER	805532
7	Miami-Dade	COUNTRY CLUB	805934
8	Palm Beach	DELTRAIL	405862
9	Palm Beach	ROEBUCK	406335
10	Volusia	ORMOND	101132
11	St Johns	RIVERTON	105761
12	Brevard	COX	207061
13	St Lucie	EDEN	411033
14	Collier	NAPLES	501240
15	De Soto	CARLSTROM	505963
16	Sarasota	AUBURN	505763

	2016 Highway Crossings			
	County	Substation	Feeder	Highway
1	Miami-Dade	Little River	800633	I-95
2	Miami-Dade	Little River	800633	I-95

Distribution Engineering Reference Manual

Section 4 – Overhead Line Design

(REV. March 9, 2010)

Distribution Engineering Reference Manual (DERM)

Section 4 – Overhead Line Design

ADDENDUM FOR EXTREME WIND LOADING

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Storm Secure

Distribution Overhead Line Design for Extreme Wind Loading

ADDENDUM TO DISTRIBUTION ENGINEERING REFERENCE MANUAL (DERM)

Introduction

In 2006, FPL introduced the concept of "STORM SECURE". One part of this concept is to harden the electrical system by adopting new standards based on extreme wind velocity criteria. The Florida Public Service Commission and the Florida Administrative Code have adopted the 2007 NESC for the applicable standard of construction.

FPL designs its distribution facilities based on the loading as specified in the 2007 National Electrical Safety Code (NESC) using Grade B Construction. The NESC specifies three weather conditions to consider for calculating loads:

Rule 250 B. Combined ice and wind loading (FPL standard construction prior to 2007)
Rule 250 C. Extreme wind loading (FPL current standard construction)
Rule 250 D. Extreme ice with concurrent wind loading (this is a new loading condition in the 2007 NESC that will not impact FPL).

Prior to the hardening effort, FPL has been designing overhead distribution using the loads calculated under Rule 250 B. This addendum provides the designers the information needed to design projects using Rule 250 C, grade B (extreme wind loading) to calculate the loads, when it is determined that the particular pole line is to be designed to meet extreme wind loading (EWL) requirements. The NESC extreme wind map identifies 7 Basic Wind Speeds throughout Florida. In order to minimize the design effort to accommodate these 7 wind speeds, FPL has created 3 wind regions with designated wind speeds of 105 mph, 130 mph, and 145 mph. The Map shown in Figure 4.2.2-1 identifies the counties within our service territory that fall into the 3 wind regions. Whenever extreme wind designs are deployed, they will be designed to the identified wind speed for the location of the work to be done.

4.2.2 Poles Structures and Guying

A. Poles, General Information

1. *Pole Brands*

The pole brand includes the pole length & class, the type of treatment, the manufacturer, the date the pole was manufactured and FPL.
Wood Poles –This brand is located at 15' from the bottom of the pole.
Square (cast) Concrete poles – the brand up until 2007 was located 15' from the bottom. New specifications now require the brand to be at 20' from the bottom of the pole.
Distribution Spun Concrete poles – The brand information is on a metal tag that is located 20' from the bottom of the pole.

2. *Design Specifications*

The NESC specifies 3 Grades of construction: Grade B, Grade C, and Grade N with Grade B being the strongest of the three. These grades of construction are the basis for the required strengths for safety. FPL uses Grade B Construction for all distribution facilities. This means that the calculated loads must be multiplied by "Load Factors" and the calculated or specified strength of structures must be multiplied by "Strength Factors". The Strength multiplied by the Strength Factor (SF) must be equal to, or greater than the Load multiplied by the Load Factor (LF).

Equation 4.2.2-1

Strength x Strength Factor ≥ Load x Load Factor

Table 4.2.2 – 1 below lists the Load Factors and Strength Factors for Grade B Construction from NESC Table 253-1 and Table 261-1A.

Table 4.2.2 - 1 Extreme Wind
Strength Factors & Load Factors

Strength of	Strength Factor
Wood Poles	0.75
Concrete Poles	1.00
Composite Poles	1.00
Support Hardware	1.00
Guy Wire	0.90
Guy Anchor and Foundation	1.00
	Load Factor
Extreme Wind Loads	1.00

ADDENDUM FOR EXTREME WIND LOADING

FPL uses the NESC Extreme Wind Loading for its design criteria. As such, identify the wind speed for the job location and determine the load based on the following formula.

Equation 4.2.2-2

$$\text{Load in pounds} = 0.00256 \times (V_{mph})^2 \times k_z \times G_{RF} \times I \times C_f \times A(ft^2)$$

Where,

0.00256 - Velocity-Pressure Numerical Coefficient
V -Velocity of wind in miles per hour (3 second gust)
k_z -Velocity Pressure Exposure Coefficient
G_{RF} -Gust Response Factor
I -Importance Factor, 1.0 for utility structures and their supported facilities.
C_f - Force Coefficient (Shape Factor)
For Wood & Spun Concrete Poles = 1.0
For Square Concrete Poles = 1.6
A - Projected Wind Area, ft^2.

The NESC provides formulas for calculating k_z and G_{RF}. However, Tables are also provided and Table 4.2.2-2 below shows the values needed for most distribution structures.

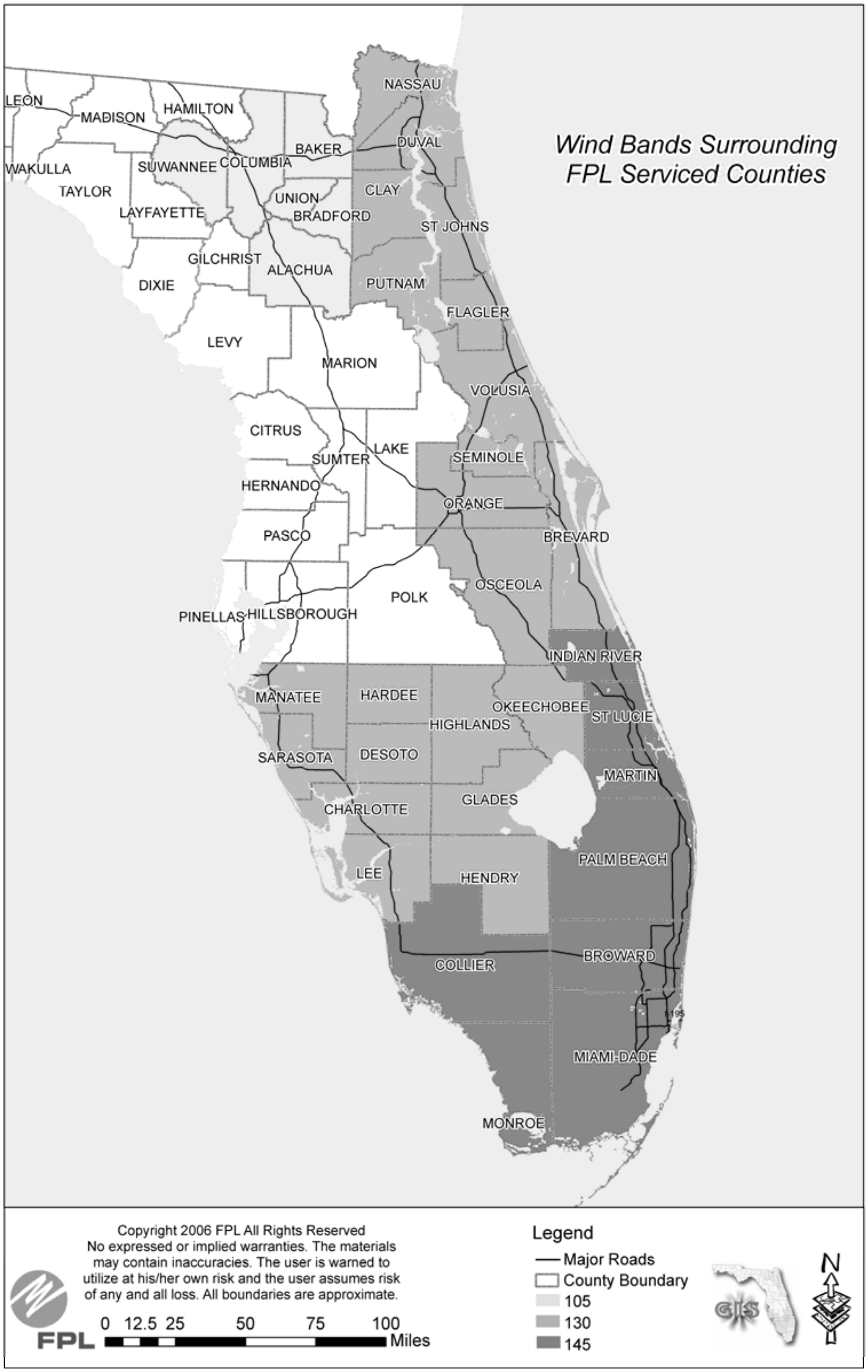
Table 4.2.2-2 Velocity pressure Exposure coefficient (k_z) and Gust Response Factors (G_{RF})

	Structure		Equipment		Wire		
Height (h)	k_z [1]	G_{RF} [4]	k_z [2]	G_{RF} [5]	k_z [3]	G_{RF} [4] (L ≤ 250 ft)	G_{RF} [4] (250 < L ≤ 500 ft)
≤ 33	0.9	1.02	1.0	1.02	1.0	0.93	0.86
>33 to 50	1	0.97	1.1	0.97	1.1	0.88	0.82
>50 to 80	1.1	0.93	1.2	0.93	1.2	0.86	0.80

1. h for the pole k_z is to be the height of the pole above ground
2. h for the equipment k_z is the height of the center of the area of the equipment above ground
3. h for the wire k_z is the height of the wire above ground
4. h for the G_{RF} is the height above ground for the structure and the wire
5. h for the G_{RF} for the equipment is based on the height of the structure above ground
6. L = design wind span (average of span on both sides of structure)

The wind speeds to be used are shown in Figure 4.2.2 – 1

Figure 4.2.2 –1 Wind Regions by County



3. Wood Pole Strength

The strength of wood poles is specified in the American National Standard – ANSI O5.1-2002. In addition to strength of wood poles, this standard specifies dimensions, shape, sweep spiral grain, knots, and many other characteristics of wood poles.

A change from previous calculations shown in the DERM for allowable pole strength is that the circumference to be used is now considered to be the ground line circumference rather than the "fixity" point circumference. Another change is the strength factor to be used. For extreme wind the strength factor for wood poles is 0.75 (see Table 4.2.2-1)

Example 4.2.2-1:
Determine the pole strength for wind loading on a 45'/2 wood pole that is set 7 feet.

Equation 4.2.2-3 $M_r = 0.000264fC^3$

Where

M_r	=	Moment (ultimate or long term bowing) measured in foot-pounds
f	=	Fiber Stress (8000 or 1000 psi for Southern Yellow Pine)
C	=	Circumference at ground Line

From Table G (DERM 4.2.2) circumference at Ground line = 40.1 inches

$M_r = 0.000264 \times (8{,}000) \times (40.1)^3 = 136{,}184$ ft.-lbs.

This is the strength for the 45'/2 wood pole. However for design, apply the NESC Strength Factor of 0.75.

The strength of the 45'/2 wood pole = 136,184 x 0.75 = 102,138 ft.-lbs.

4. Concrete Pole Strength

The strength of concrete poles is based on the application of a designated load at a specified location on the pole. This load is measured in KIPS = 1,000 pounds per KIP. A 5 KIP pole is rated based on applying 5,000 pounds of load at two feet below the top of the pole. Most distribution poles are rated by applying the load at two feet down from the top. However, for the type "O", "S", and "SU" poles, this load is applied at one foot down from the top. Like wood poles, concrete poles have a continuous rating (loads that are always on the pole) and a temporary rating (wind loads that come and go). Spun concrete poles (unlike other FPL distribution concrete poles) are designated by their KIP rating rather than a type (i.e., O, S, SU, III, III-G, III- H). Table 4.2.2-3 List the ratings (in KIPS) for the various concrete poles.

Table 4.2.2-3 Concrete Pole Ratings

Pole Type	Temporary Ratiing	Continuous Rating
O	0.85	0.26
S & SU	0.90	0.30
III	1.30	0.56
III-A	1.30	0.60
III-G	2.40	0.90
III-H 6 KIP	4.20	1.20
III-H 8 KIP	6.00	2.40
12 KIP Square	8.40	4.20
Spun Concrete		
4.0 KIP	NO LONGER USED	
4.7 KIP	4.70	1.73
5.0 KIP	5.00	2.00

To calculate the strength of the pole use the following:

For O, S, SU,

M_r = Rating (Table 4.2.2-3) x (Pole Length – setting depth - 1 foot)

Example: 35' Type SU for extreme wind loading

M_r = 0.9 KIPS x (35 – 7.5 - 1) = 23,850 ft-lbs

For III, III-A, III-G, III-H

M_r = Rating (Table 4.2.2-3) x (Pole Length – setting depth - 2 feet)

Example: 50' Type III-H (6 KIP) for extreme wind loading

M_r = 4.2 KIPS x (50 – 11.5 – 2)) = 153,300 ft-lbs

For Spun Concrete

M_r = Rating (Table 4.2.2-3) x (Pole Length – setting depth - 2 feet)

Example: 50'/ 4.7 KIP for extreme wind loading

M_r = 4.7 KIPS x (50 – 11 - 2) = 173,900 ft-lbs

For pre-stressed concrete poles, the NESC extreme wind strength factor = 1.0. The values calculated above will be the correct strength for concrete poles.

B. Wind Loading

1. *Wind Loading on poles.*

To calculate the wind load on the pole (see DERM 4.2.2 C3.a):

a. Calculate the area of the pole exposed to the wind

Equation 4.2.2-4 $$A = H_1\left(\frac{a+b}{2}\right)\left(\frac{1}{12}''\right)$$

A = projected area above ground line in square feet.
H_1 = the pole's height above the ground line in feet.

For wood and spun concrete poles,
a = diameter at top of pole in inches.
b = diameter of pole at ground line in inches.

For square concrete poles, dimensions a and b are the widths of one face at top and ground line respectively.

b. Calculate the center of the area.

Equation 4.2.2-5 $$H_{CA} = \frac{H_1(b+2a)}{3(b+a)}$$

H_{CA} is used to calculate the ground line moment due to the wind force.

c. Calculate the wind force acting on the area (see Equation 4.2.2-2 with explanation of terms)

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

<u>Example Calculation for Wood Pole</u>

Pole Length/Class = 45'/2
Setting depth = 7' (from DCS D-3.0)
Wind Region = 145 mph

ADDENDUM FOR EXTREME WIND LOADING

$$Projected\ Area.\ A = H_1(ft.)\, x\, \frac{1\ ft}{12\ in}\, x \left[\frac{a + b(inches)}{2}\right]$$

$$From\ Table\ G,\ Page\ 71,\ the\ circumference\ at\ the\ top\ of\ a\ 45'/2\ pole\ is\ 25'',$$

$$a = \frac{25''}{\pi} = 7.96''$$

$$The\ circumference\ at\ 38\ ft.\ below\ the\ pole\ top\ 40.1'',\ b = \frac{40.1''}{\pi} = 12.76''$$

$$A = \frac{38}{12}\, x \left[\frac{7.96 + 12.76}{2}\right] = 32.81\, sq.\ ft.$$

$$Height\ of\ center\ of\ area,\ H_{CA} = \frac{H_1(b + 2a)}{3(b + a)} = \frac{38(12.76 + 15.92)}{3(12.76 + 7.96)}$$

$$H_{CA} = Moment\ Arm = 17.53\ ft.$$

Wind Load on Pole =

0.00256 x $(145)^2$ x 1.0 x 0.97 x 1.0 x 1.0 x 32.81 = **1713 lbs**
Where:
k_z is based on h = 38'; k_z = 1.0
G_{RF} is based on h = 38'; G_{RF} = 0.97
C_f = 1.0 for wood and spun concrete poles
C_f = 1.6 for square concrete poles

This load must then be multiplied by the Load Factor, which for extreme wind equals 1.0 and the moment arm to obtain the Ground Line Moment (M_P) of the wind acting on the pole only.

Equation 4.2.2-6

M_P = Wind Load x Load Factor x Moment Arm.
M_P = 1713 lbs x 1 x 17.53 ft. = 30,030 ft. lbs.

The strength of this pole, previously calculated is 102,138 ft.-lbs. The pole itself has used up 29% (30,030/102,138) of its capacity for 145 mph extreme wind. Subtracting the wind load from the strength leaves 72,108 ft-lbs (102,138 – 30,030) for conductors and other attachments.

Example Calculation for Square Concrete Pole

Pole Length/Class = 50'/III-H
Setting depth = 11.5' (from DCS D-3.0)
Wind Region = 145 mph

$$Projected\ Area.\ A = H_1(ft.)\,x\,\frac{1\,ft}{12\,in}\,x\left[\frac{a+b(inches)}{2}\right]$$

From Table H, the width of the pole at the top a = 9.00"
The width at ground line, b = 15.24"

$$A = \frac{38.5}{12}\,x\left[\frac{15.24+9.00}{2}\right] = 38.89\,sq.\,ft.$$

$$Height\ of\ center\ of\ area, H_{CA} = \frac{H_1(b+2a)}{3(b+a)} = \frac{38.5(15.24+18.00)}{3(15.24+9.00)}$$

$$H_{CA} = Moment\ Arm = 17.6\ ft.$$

Wind Load on Pole =
0.00256 x $(145)^2$ x 1.0 x 0.97 x 1.0 x 1.6 x 38.89 = **3248 lbs**
Where:
k_z is based on h = 38.5'; k_z = 1.0
G_{RF} is based on h = 38.5'; G_{RF} = 0.97
C_f = 1.0 for wood and spun concrete poles
C_f = 1.6 for square concrete poles

This load must then be multiplied by the Load Factor, which for extreme wind equals 1.0 and the moment arm to obtain the Ground Line Moment (M_P) of the wind acting on the pole only.

M_P = Wind Load x Load Factor x Moment Arm.
M_P = 3248 lbs x 1 x 17.6 ft. = 57,163 ft. lbs.

The strength of this pole, previously calculated is 153,300 ft.-lbs. The pole itself has used up 37% (57,163/153,300) of its capacity for 145 mph extreme wind. Subtracting the wind load from the strength leaves 96,137 ft-lbs (153,300 – 57,163) for conductors and other attachments.

Example Calculation for Spun Concrete Pole

Pole Length/Class = 50'/4.7 KIP
Setting depth = 11' (from DCS D-3.0)
Wind Region = 145 mph

$$Projected\ Area.\ A = H_1(ft.)\,x\,\frac{1\ ft}{12\,inc.}\,x\left[\frac{a+b(inches)}{2}\right]$$

From Table H, the diameter of the pole at the top a = 9.55"
The diameter at ground line, b = 16.57"

$$So\ A = \frac{39}{12}\,x\left[\frac{9.55+16.57}{2}\right] = 42.45\,sq.\ ft.$$

$$Height\ of\ center\ of\ area, H_{CA} = \frac{H_1(b+2a)}{3(b+a)} = \frac{39(16.57+19.1)}{3(16.57+9.55)}$$

$$H_{CA} = Moment\ Arm = 17.75\ \ ft.$$

Wind Load on Pole =
0.00256 x $(145)^2$ x 1.0 x 0.97 x 1.0 x 1.0 x 42.45 = **2,216 lbs**
Where:
k_z is based on h = 39'; k_z = 1.0
G_{RF} is based on h = 39'; G_{RF} = 0.97
C_f = 1.0 for wood and spun concrete poles
C_f = 1.6 for square concrete poles

This load must then be multiplied by the Load Factor, which for extreme wind equals 1.0 and the moment arm to obtain the Ground Line Moment (M_P) of the wind acting on the pole only.

M_P = Wind Load x Load Factor x Moment Arm.
M_P = 2,216 lbs x 1 x 17.75 ft. = 39,341 ft. lbs.

The strength of this pole, previously calculated is 173,900 ft.-lbs. The pole itself has used up 23% (39,341/173,900) of its capacity for 145 mph extreme wind. Subtract the wind load from the strength leaves 134,559 ft-lbs (173,900 – 39341) for conductors and other attachments.

Table 4.2.2-4 Lists the allowable groundline moments for various pole sizes.

Table 4.2.2-4 Allowable Ground Line Moments

Wood Poles (in earth)				
Pole Size	Setting Depth	Allowable Moment for Attachments at Designated Wind Speeds		
		105 mph	**130 mph**	**145 mph**
35/5	6	32178	28738	26324
35/4	6	42429	38656	36007
40/5	6.5	36936	31956	28460
40/4	6.5	48263	42812	38986
40/3	6.5	61567	55646	51489
40/2	6.5	76998	70607	66119
45/3	7	66363	58624	53190
45/2	7	86391	78000	72108
50/2	7	93535	82611	74941
55/2	7.5	99693	86174	76682
60/1	8	131634	113020	99951

Table 4.2.2-4 Allowable Ground Line Moments (cont.)

Square Concrete Poles (in earth)				
Pole Size	Setting Depth	Allowable Moment for Attachments at Designated Wind Speeds		
		105 mph	**130 mph**	**145 mph**
35/Type O	7	15426	11417	8602
35/SU	7.5	15323	10778	7588
35/III-G	9	48907	44275	41022
40/III-A	10	23777	17050	12327
40/III-G	9	56781	49950	45154
40/III-H (6 KIP)	11.5	96450	88537	82981
40/III-H (8 KIP)	11.5	144214	136334	130802
40/12 KIP	13	191480	181610	174681
45/III-A	10	24142	14146	7127
45/III-G	9	62676	52592	45511
45/III-H (6 KIP)	11.5	110053	98198	89874
45/III-H (8 KIP)	11.5	166860	155062	146779
45/12 KIP	13.5	222175	208520	198933
50/III-A	10	24111	10635	1173
50/III-G	9.5	67701	54539	45297
50/III-H (6 KIP)	11.5	123164	107106	95831
50/III-H (8 KIP)	11.5	189028	173056	161842
50/12 KIP	13.5	252789	233067	219219
55/III-G	9.5	72176	55004	42947
55/III-H (6 KIP)	12	133764	113283	98902
55/III-H (8 KIP)	12	207792	187431	173135
55/12 KIP	14	280155	254873	237121
60/III-H (6 KIP)	12	144138	117993	99637
60/III-H (8 KIP)	12	227254	201278	183040
60/12 KIP	14	308835	276454	253719
65/III-H (6 KIP)	12	149613	115197	91032
65/III-H (8 KIP)	12	241862	207685	183688

Spun Concrete Poles (in earth)				
Pole Size	Setting Depth	Allowable Moment for Attachments at Designated Wind Speeds		
		105 mph	**130 mph**	**145 mph**
50/4.7 KIP	11	153270	142277	134559
55'/4.7 KIP	12	167116	153482	143910
60'/5.0 KIP	12.5	190953	171477	157803
65'/5.0 KIP	13	202928	177845	160233
70'/5.0 KIP	13.5	214369	183392	161642

2. ***Wind Loading on conductors.***

The wind loading on conductors is calculated in a similar method to the wind loading on the pole. The load in pounds per conductor uses Equation 4.2.2-2 with the appropriate factors for the attachment heights a shown in Table 4.2.2-2.

To calculate the wind load on the conductor:

a. Determine the wind region (105 mph, 130 mph, or 145 mph)
b. Calculate the attachment height to determine the k_z *and* G_{RF} (Table 4.2.2-2)
c. The Importance Factor (I) and the Force Coefficient (C_f) are both equal to 1 for conductors.
d. Calculate the area per foot of conductor
e. Calculate the wind load per foot of conductor
f. Calculate the total wind load on the conductor for the length of conductor exposed to the wind (Average of the Spans on either side of the pole).

Example:
Determine the wind load on a 170 foot length [(180'span + 160'span)/2] of 568.3 ACAR conductor that is attached at 30 feet above the ground in the 145 mph wind region.
From Table 4.2.2-2:

$K_z = 1.0$
$G_{RF} = 0.93$

Calculate the area per foot of conductor
Diameter = 0.879 inches (ref DCS F-7.0.0)

For a 1 foot length of conductor:
Projected Area.

$$A = 1(ft.) x \left[\frac{Conductor\ Diameter(inches)}{12(inches/\ ft)} \right]$$

$$A = 1(ft.) x \left[\frac{0.879(inches)}{12(inches/\ ft)} \right]$$

A = 0.073 Square Ft. for each foot of span length

The wind load in pounds per foot of span length (from Equation 4.2.2-2) is

Load in pounds $= 0.00256 \times (Vmph)^2 \times k_z \times G_{RF} \times I \times C_f \times A(ft^2)$

Load in pounds = 0.00256 x $(145)^2$ x 1 x .93 x 1 x 1 x .073
Load = 3.667 pounds per foot

Total Load	=	Length of conductor x Load per foot of conductor
	=	170 x 3.667
Total Load	=	623.3 pounds

This is the load that the wind exerts on the conductor attached at 30 above ground. This load will have to be applied to the pole to determine if the pole has the strength to support the load.

The wind load per foot of conductor for the three wind regions can be found in Table 4.2.2-5, Table 4.2.2- 6 and Table 4.2.2-7.

3. ***Wind Loading on equipment.***

The wind loading on equipment is calculated in a similar method to the wind loading on the pole and the conductors. The load in pounds uses Equation 4.2.2-2 with the appropriate factors for the attachment heights a shown in Table 4.2.2-2 and the area of the equipment.

To calculate the wind load on the equipment:

a. Determine the wind region (105 mph, 130 mph, or 145 mph)
b. Calculate the attachment height to determine the k_z (Table 4.2.2-2) (For equipment, use the top mounting hole of the equipment bracket.)
c. Use the height of the pole above ground to determine G_{RF} (Table 4.2.2-2)
d. The Importance Factor (I) is equal to 1.
e. The Force Coefficient (C_f) is equal to 1.0 for cylindrical equipment and 1.6 for rectangular equipment.
f. Calculate the area of the equipment
g. Calculate the wind load on the equipment

Example:
Determine the wind load on a 50 kVA transformer mounted at 28 feet on a pole that is 38 feet above the ground in the 145 mph wind region.

From Table 4.2.2-2:

K_z = 1.0 (Equipment ≤ 33' above ground)
G_{RF} = 0.97 (Equipment based on Pole height > 33' to 50' above ground)
C_f = 1.0
A = 4.44 square feet

The wind load in pounds from Equation 4.2.2-2 is

Load in pounds $= 0.00256 \times (V_{mph})^2 \times k_z \times G_{RF} \times I \times C_f \times A(ft^2)$

Load in pounds = $0.00256 \times (145)^2 \times 1 \times .97 \times 1 \times 1 \times 4.44$
Load = 231.8 pounds

This is the load that the wind exerts on the transformer attached at 28 feet above ground. This load will have to be applied to the pole to determine if the pole has the strength to support the load.
The wind load on equipment for the three wind regions can be found in Table 4.2.2-5 (105 mph), Table 4.2.2- 6 (130 mph) and Table 4.2.2-7 (145 mph).

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-5 Wind Force on Conductors & Equipment

Wind Speed = 105 mph
CONDUCTORS

		Force in pounds per foot Conductor Height Above Ground		
Conductor	Diameter	≤33'	>33' to 50'	>50' to 80'
568.3 MCM ACAR	0.879	1.923	2.001	2.134
3/0 AAAC	0.502	1.098	1.143	1.218
1/0 AAAC	0.398	0.871	0.906	0.966
#4 AAAC	0.250	0.547	0.569	0.607
3/0 TPX	1.238	2.708	2.819	3.005
1/0 TPX	1.026	2.244	2.336	2.490
6 DPX	0.496	1.085	1.129	1.204
CATV				
Feeder w/1/4"Msgnr	0.750	1.641	1.708	1.820
Trunk w/1/4"Msgnr	1.000	2.187	2.277	2.427
Telephone				
100 pr (24 GA BKMS) Self-Support	0.960	2.100	2.186	2.330
600 pr (24 GA BKMA w/3/8" Msgnr	2.295	5.020	5.225	5.571

Wind Speed = 105 mph
EQUIPMENT

		Pole Height in same range as Equipment Force in pounds at top mounting Bolt Height Above Ground			Pole height >33' to 50' Equipment Ht
Transformers	Sq. Ft.	≤33'	>33' to 50'	>50' to 80'	≤33'
25	3.75	108.0	112.9	118.1	102.7
50	4.44	127.8	133.7	139.9	121.6
75	4.81	138.5	144.9	151.5	131.7
100	6.55	188.6	197.3	206.3	179.3
167	10.83	311.8	326.1	341.1	296.5
Capacitors					
Switched (1)	19.91	573.2	599.6	627.1	545.1
Fixed (1)	16.89	486.2	508.6	532.0	462.4
Reclosers					
1 phase	4.00	115.2	120.5	126.0	109.5
3 phase (1)	16.89	486.2	508.6	532.0	462.4
Automation Switches					
Joslyn	8.89	255.9	267.7	280.0	243.4
Cooper	10.56	304.0	318.0	332.6	289.1
S&C	15.60	449.1	469.8	491.4	427.1
Riser - PVC U-Guard		Force in pounds per foot of riser Height Above Ground			
2" U-Guard	0.19	5.4	5.6	5.9	5.1
5" U-Guard	0.46	12.8	13.8	14.4	13.2

(1) The 1.6 C_f factor for rectangular shape is included in the Area shown for Capacitors and 3 Phase Recloser

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-6 Wind Force on Conductors & Equipment

Wind Speed = 130 mph
CONDUCTORS

		Force in pounds per foot Conductor Height Above Ground		
Conductor	Diameter	≤33'	>33' to 50'	>50' to 80'
568.3 MCM ACAR	0.879	2.947	3.068	3.270
3/0 AAAC	0.502	1.683	1.752	1.868
1/0 AAAC	0.398	1.334	1.389	1.481
#4 AAAC	0.250	0.838	0.872	0.930
3/0 TPX	1.238	4.151	4.321	4.606
1/0 TPX	1.026	3.440	3.581	3.817
6 DPX	0.496	1.663	1.731	1.845
CATV				
Feeder w/1/4"Msgnr	0.750	2.515	2.617	2.791
Trunk w/1/4"Msgnr	1.000	3.353	3.490	3.721
Telephone				
100 pr (24 GA BKMS) Self-Support	0.960	3.219	3.350	3.572
600 pr (24 GA BKMA w/3/8" Msgnr	2.295	7.695	8.009	8.539

Wind Speed = 130 mph
EQUIPMENT

		Pole Height in same range as Equipment Force in pounds at top mounting Bolt Height Above Ground			Pole height >33' to 50' Equipment Ht
Transformers	Sq. Ft.	≤33'	>33' to 50'	>50' to 80'	≤33'
25	3.75	165.5	173.1	181.1	157.4
50	4.44	195.9	205.0	214.4	186.3
75	4.81	212.3	222.0	232.2	201.9
100	6.55	289.0	302.4	316.3	274.9
167	10.83	477.9	499.9	522.9	454.5
Capacitors					
Switched (1)	19.91	878.6	919.1	961.3	835.5
Fixed (1)	16.89	745.3	779.7	815.5	708.8
Reclosers					
1 phase	4.00	176.5	184.7	193.1	167.9
3 phase (1)	16.89	745.3	779.7	815.5	708.8
Automation Switches					
Joslyn	8.89	392.3	410.4	429.2	373.1
Cooper	10.56	466.0	487.5	509.9	443.2
S&C	15.60	688.4	720.1	753.2	654.7
Riser - PVC U-Guard		Force in pounds per foot of riser Height Above Ground			
2" U-Guard	0.19	8.3	8.7	9.1	7.9
5" U-Guard	0.46	20.2	21.2	22.1	19.2

(1) The 1.6 C_f factor for rectangular shape is included in the Area shown for Capacitors and 3 Phase Recloser

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-7 Wind Force on Conductors & Equipment

Wind Speed = 145 mph
CONDUCTORS

		Force in pounds per foot Conductor Height Above Ground		
Conductor	Diameter	≤33'	>33' to 50'	>50' to 80'
568.3 MCM ACAR	0.879	3.667	3.816	4.069
3/0 AAAC	0.502	2.094	2.180	2.324
1/0 AAAC	0.398	1.660	1.728	1.842
#4 AAAC	0.250	1.043	1.085	1.157
3/0 TPX	1.238	5.164	5.375	5.731
1/0 TPX	1.026	4.280	4.455	4.749
6 DPX	0.496	2.069	2.154	2.296
CATV				
Feeder w/1/4"Msgnr	0.750	3.129	3.256	3.472
Trunk w/1/4"Msgnr	1.000	4.171	4.342	4.629
Telephone				
100 pr (24 GA BKMS) Self-Support	0.960	4.005	4.168	4.444
600 pr (24 GA BKMA w/3/8" Msgnr	2.295	9.573	9.964	10.623

Wind Speed = 145 mph
EQUIPMENT

		Pole Height in same range as Equipment Force in pounds at top mounting Bolt Height Above Ground			Pole height >33' to 50' Equipment Ht
Transformers	Sq. Ft.	≤33'	>33' to 50'	>50' to 80'	≤33'
25	3.750	205.9	215.4	225.3	195.8
50	4.440	243.8	255.0	266.7	231.8
75	4.810	264.1	276.2	288.9	251.1
100	6.550	359.6	376.2	393.4	342.0
167	10.830	594.6	622.0	650.5	565.4
Capacitors					
Switched (1)	19.910	1093.1	1143.4	1195.9	1039.5
Fixed (1)	16.890	927.3	970.0	1014.5	881.8
Reclosers					
1 phase	4.000	219.6	229.7	240.3	208.8
3 phase (1)	16.890	927.3	970.0	1014.5	881.8
Automation Switches					
Joslyn	8.890	488.1	510.6	534.0	464.1
Cooper	10.560	579.7	606.5	634.3	551.3
S&C	15.600	856.4	895.9	937.1	814.5
Riser - PVC U-Guard		Force in pounds per foot of riser Height Above Ground			
2" U-Guard	0.188	10.3	10.8	11.3	9.8
5" U-Guard	0.458	25.2	26.3	27.5	23.9

(1) The 1.6 C_f factor for rectangular shape is included in the Area shown for Capacitors and 3 Phase Recloser

The methodology to determine if a pole has the strength for a specific design or to determine the maximum span distance a specific size pole can support for framing, is the same as shown in the DERM 4.2.2 pages 12-15. The examples shown below show the calculations based on using the new tables for extreme wind loading. Note that the ground line is now the point used for the calculations rather than the “fixity” point.

Example:

Conductor: 3-568.3 MCM ACAR and #3/0 AAAC - Neutral

Framing: DCS page E-5.0.0 (Modified Vertical) and I-41.0.1 (for single phase transformer)

Transformer: 50 kVA

CATV: Trunk

Telephone: 1-600 pair, 24 gauge, BKMA

Average Span Length = 150 feet

Attachment heights must be calculated using the framing identified and the pole setting depths as shown in the Revised DCS page D-3.0.0

Case I: Determine if a 45'/2 wood pole is strong enough for this design.

Calculate the moments on the pole.

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	150	x	39	=	22324
568	1	x	3.816	x	150	x	36.6	=	20950
568	1	x	3.816	x	150	x	33.9	=	19404
Neut., Sec., St Lt									
3/0	1	x	2.094	x	150	x	28.8	=	9046
CATV - PROPOSED									
Trunk	1	x	4.171	x	150	x	25.4	=	15892
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	150	x	24.4	=	35037
			TOTAL MOMENT DUE TO CONDUCTORS					=	122653
EQUIPMENT			Wind Load Force in lbs				Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)								
1 Phase	50 KVA		231.8		x		29.9	=	6931
			TOTAL MOMENT DUE TO EQUIPMENT					=	6931 ft.-lb.
45'/2 Wood Pole					**TOTAL ALL MOMENTS**			**=**	**129,583 ft.-lb.**

From Table 4.2.2-4, the allowable moment for attachments to a 45'/2 wood pole in a 145 mph wind region is 72,108 ft-lbs. A 45'/2 wood pole cannot be used.

Case II: Determine if a 50'/III-H square concrete pole is strong enough for this design

DCS D-3.0.0 shows a revised setting depth for square concrete poles. The new setting depth is generally 5 feet deeper than previous. A 50'/III-H square concrete pole is set 11.5 feet deep.

Re-calculate the moments based on attachment heights.

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	150	x	39.5	=	22610
568	1	x	3.816	x	150	x	37.1	=	21236
568	1	x	3.816	x	150	x	34.4	=	19691
Neut., Sec., St Lt									
3/0	1	x	2.094	x	150	x	29.3	=	9203
CATV - PROPOSED									
Trunk	1	x	4.171	x	150	x	25.4	=	15892
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	150	x	24.4	=	35037
			TOTAL MOMENT DUE TO CONDUCTORS					=	123668
EQUIPMENT			Wind Load Force in lbs				Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)								
1 Phase	50 KVA		231.8		x		29.9	=	6931
			TOTAL MOMENT DUE TO EQUIPMENT					=	6931 ft.-lb.
50 III-H Square Concrete Pole							**TOTAL ALL MOMENTS**	=	**130,599 ft.-lb.**

From Table 4.2.2-4, the allowable moment for attachments to a 50'/III-H 6 KIP square concrete pole in a 145 mph wind region is 95,831 ft-lbs and cannot be used. The allowable moment for attachments to a 50'/III-H 8 KIP square concrete pole in a 145 mph wind region is **161,842 ft-lbs** and can be used.

Case III: Determine if a 50'/4.7 KIP spun concrete pole is strong enough for this design.

DCS D-3.0.0 shows the setting depths for spun concrete poles. A 50'/4.7 KIP spun concrete pole is set 11 feet deep.

Re-calculate the moments based on attachment heights.

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	150	x	40	=	22896
568	1	x	3.816	x	150	x	37.6	=	21522
568	1	x	3.816	x	150	x	34.9	=	19977
Neut., Sec., St Lt									
3/0	1	x	2.094	x	150	x	29.8	=	9360
CATV - PROPOSED									
Trunk	1	x	4.171	x	150	x	25.4	=	15892
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	150	x	24.4	=	35037
			TOTAL MOMENT DUE TO CONDUCTORS					=	124684
EQUIPMENT			Wind Load Force in lbs				Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)								
1 Phase	50 KVA		231.8		x		29.9	=	6931
			TOTAL MOMENT DUE TO EQUIPMENT					=	6931 ft.-lb.
50' - 4.7 KIP Spun Concrete Pole									
			TOTAL ALL MOMENTS					=	**131,615 ft.-lb.**

From Table 4.2.2-4, the allowable moment for attachments to a 50'/4.7 KIP spun concrete pole in a 145 mph wind region is 134,559 ft-lbs. A 50'/4.7 KIP spun concrete pole can be used.

Using similar calculations from DERM 4.2.2 page 13, the maximum span distance for each of the poles above can be determined.

Determine the moment due to 1 foot of conductor moments
Subtract the moment due to the transformer from the total allowable moment
Divide the remaining allowable moment by the total 1 foot conductor moments.

ADDENDUM FOR EXTREME WIND LOADING

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	1	x	39	=	149
568	1	x	3.816	x	1	x	36.6	=	140
568	1	x	3.816	x	1	x	33.9	=	129
Neut., Sec., St Lt									
3/0	1	x	2.094	x	1	x	28.8	=	60
CATV - PROPOSED									
Trunk	1	x	4.171	x	1	x	25.4	=	106
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	1	x	24.4	=	234
			TOTAL MOMENT DUE TO CONDUCTORS					=	818

EQUIPMENT		Wind Load Force in lbs		Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)					
1 Phase	50 KVA	231.8	x	29.9	=	6931
		TOTAL MOMENT DUE TO EQUIPMENT			=	6931 ft.-lb.

45'/2 Wood Pole

TOTAL ALL MOMENTS = 7,749 ft.-lb.

Maximum Allowable Moment on 45'/2 pole =	72108
Transformer Moment =	6931
Available for Conductors =	65177
Conductor Moments per foot of span =	818
Maximum Span Distance =	**80 FT**

FPL

DISTRIBUTION ENGINEERING REFERENCE MANUAL

DATE:
March 9, 2010

PREPARED BY:
Distribution Product Engineering

ADDENDUM FOR EXTREME WIND LOADING

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	1	x	39.5	=	151
568	1	x	3.816	x	1	x	37.1	=	142
568	1	x	3.816	x	1	x	34.4	=	131
Neut., Sec., St Lt									
3/0	1	x	2.094	x	1	x	29.3	=	61
CATV - PROPOSED									
Trunk	1	x	4.171	x	1	x	25.4	=	106
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	1	x	24.4	=	234
			TOTAL MOMENT DUE TO CONDUCTORS					=	824
EQUIPMENT			Wind Load Force in lbs				Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)								
1 Phase	50 KVA		231.8		x		29.9	=	6931
			TOTAL MOMENT DUE TO EQUIPMENT					=	6931 ft.-lb.

50 III-H Square Concrete Pole

TOTAL ALL MOMENTS = 7,755 ft.-lb.

Maximum Allowable Moment on 50/IIIH 6 KIP p	95831
Transformer Moment =	6931
Available for Conductors =	88900
Conductor Moments per foot of span =	824
Maximum Span Distance =	**108 FT**

Maximum Allowable Moment on 50/IIIH 8 KIP p	161842
Transformer Moment =	6931
Available for Conductors =	154911
Conductor Moments per foot of span =	824
Maximum Span Distance =	**188 FT**

ADDENDUM FOR EXTREME WIND LOADING

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	1	x	40	=	153
568	1	x	3.816	x	1	x	37.6	=	143
568	1	x	3.816	x	1	x	34.9	=	133
Neut., Sec., St Lt									
3/0	1	x	2.094	x	1	x	29.8	=	62
CATV - PROPOSED									
Trunk	1	x	4.171	x	1	x	25.4	=	106
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	1	x	24.4	=	234
			TOTAL MOMENT DUE TO CONDUCTORS					=	831

EQUIPMENT		Wind Load Force in lbs		Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)					
1 Phase	50 KVA	231.8	x	29.9	=	6931
		TOTAL MOMENT DUE TO EQUIPMENT			=	6931 ft.-lb.

50' - 4.7 KIP Spun Concrete Pole

TOTAL ALL MOMENTS = 7,762 ft.-lb.

Maximum Allowable Moment on 50/4.7KIP pol	134559
Transformer Moment =	6931
Available for Conductors =	127628
Conductor Moments per foot of span =	831
Maximum Span Distance =	**154 FT**

Maximum span distances for Modified Vertical Framing with various pole sizes and types, conductor sizes, CATV and Telephone Cables are listed in Table 4.2.2-8 (105 mph), Table 4.2.2-9 (130 mph), and Table 4.2.2-10 (145 mph). These Tables are for reference only. New computer programs are available that provide a more detailed analysis and can be used in lieu of the tables. The span distances shown were calculated using 95% of the span distance calculated using the KEMA" Pole Design Calculation Toolkit" program. This will allow for slight variation in field conditions and rounding of values. Using the calculations described in this document may be slightly different than the table values. In some cases, the limiting factor is not the wind loading, but the required clearance above the ground and above other conductors or cables. For all joint use clearance calculations, the top joint user is considered to be attached at 23 feet above ground. When clearance is the limiting factor, the maximum span length for a specific pole is shown in bold italics. In some cases, the joint use clearance criteria cannot be met using the pole height indicated.

One other criterion incorporated in the tables is a maximum design span of 350 feet. Longer spans may be achieved, but need to be addressed on an individual basis.

Table 4.2.2-8

Transverse Pole Loading due to Extreme Wind - 105 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors		Wood Pole Height and Class					
		40/3	45/3	45/2	50/2	55/2	60/1
3-568 ACAR & 3/0 AAAC-N	**FPL Only**	296	281	350	342	324	350
	FPL With						
	1-100 pair	*100*	211	*250*	275	259	307
	1-600 pair	*100*	165	216	200	191	223
	1-CATV	*100*	209	*250*	273	257	304
	1-100 pair & 1 CATV	*100*	176	230	213	202	255
	1-600 pair & 1 CATV	*100*	144	188	174	166	194
3-568 ACAR & 3/0 AAAC-N & 3/0 TPX	**FPL Only**	206	195	273	256	224	283
	FPL With	(2)					
	1-100 pair		*150*	*150*	202	191	224
	1-600 pair		137	*150*	166	158	184
	1-CATV		*150*	*150*	200	190	222
	1-100 pair & 1 CATV		144	*150*	175	166	194
	1-600 pair & 1 CATV		123	*150*	148	142	164
3-3/0 & 1/0 N	**FPL Only**	350	350	350	350	350	350
	FPL With						
	1-100 pair	*100*	*250*	*250*	350	350	350
	1-600 pair	*100*	223	*250*	290	276	322
	1-CATV	*100*	*250*	*250*	350	350	350
	1-100 pair & 1 CATV	*100*	*250*	*250*	350	300	350
	1-600 pair & 1 CATV	*100*	186	*250*	283	215	268
3-3/0 & 1/0 N & 3/0 TPX	**FPL Only**	*250*	299	350	350	344	350
	FPL With	(2)					
	1-100 pair		*150*	*150*	*250*	276	323
	1-600 pair		*150*	*150*	212	201	234
	1-CATV		*150*	*150*	*250*	275	320
	1-100 pair & 1 CATV		*150*	*150*	225	214	268
	1-600 pair & 1 CATV		143	*150*	172	164	190

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-8

Transverse Pole Loading due to Extreme Wind - 105 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors		Wood Pole Height and Class					
		40/3	45/3	45/2	50/2	55/2	60/1
3-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	*100*	*250*	*250*	350	350	350
	1-600 pair	*100*	*250*	*250*	325	311	350
	1-CATV	*100*	*250*	*250*	350	350	350
	1-100 pair & 1 CATV	*100*	*250*	*250*	350	340	350
	1-600 pair & 1 CATV	*100*	205	*250*	265	237	295
3-1/0	**FPL Only**	*250*	348	350	350	350	350
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		*150*	*150*	*250*	311	350
	1-600 pair		*150*	*150*	232	220	275
	1-CATV		*150*	*150*	*250*	308	350
	1-100 pair & 1 CATV		*150*	*150*	*250*	236	295
	1-600 pair & 1 CATV		*150*	*150*	199	189	219
2-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	*150*	350	350	350	350	350
	1-600 pair	*150*	290	350	350	333	350
	1-CATV	*150*	350	350	350	350	350
	1-100 pair & 1 CATV	*150*	322	350	350	350	350
	1-600 pair & 1 CATV	*150*	214	301	284	266	308
2-1/0	**FPL Only**	*300*	350	350	350	350	350
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		*200*	*200*	*300*	333	350
	1-600 pair		198	*200*	262	229	285
	1-CATV		*200*	*200*	*300*	331	350
	1-100 pair & 1 CATV		*200*	*200*	281	265	308
	1-600 pair & 1 CATV		167	*200*	204	193	224
1-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	*250*	350	350	350	350	350
	1-600 pair	*250*	306	350	350	350	350
	1-CATV	*250*	350	350	350	350	350
	1-100 pair & 1 CATV	*250*	345	350	350	350	350
	1-600 pair & 1 CATV	235	218	307	291	274	317
1-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
& 3/0 TPX	1-100 pair	*150*	*250*	*250*	*300*	350	350
	1-600 pair	*150*	202	*250*	268	234	294
	1-CATV	*150*	*250*	*250*	*300*	350	350
	1-100 pair & 1 CATV	*150*	220	*250*	290	273	317
	1-600 pair & 1 CATV	*150*	168	219	207	194	226

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-8

Transverse Pole Loading due to Extreme Wind - 105 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SQUARE CONCRETE POLE HEIGHT AND CLASS				
		45IIIG	**45IIIH**	**50IIIH**	**55IIIH**	**60IIIH**
3-568 & 3/0 N	FPL Only	274	350	350	350	350
	FPL With					
	1-100 pair	208	*100*	*250*	350	350
	1-600 pair	165	*100*	*250*	305	289
	1-CATV	206	*100*	*250*	350	350
	1-100 pair & 1 CATV	176	*100*	*250*	325	307
	1-600 pair & 1 CATV	144	*100*	*250*	266	235
3-568 & 3/0 N & 3/0 TPX	FPL Only	192	*250*	*300*	350	339
	FPL With	(2)	(2)			
	1-100 pair			*150*	*250*	289
	1-600 pair			*150*	237	223
	1-CATV			*150*	*250*	287
	1-100 pair & 1 CATV			*150*	*250*	235
	1-600 pair & 1 CATV			*150*	211	200
3-3/0 & 1/0 N	FPL Only	350	350	350	350	350
	FPL With					
	1-100 pair	*200*	*100*	*300*	*350*	*350*
	1-600 pair	*200*	*100*	*300*	*350*	*350*
	1-CATV	*200*	*100*	*300*	*350*	*350*
	1-100 pair & 1 CATV	*200*	*100*	*300*	*350*	*350*
	1-600 pair & 1 CATV	187	*100*	*300*	*350*	325
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	297	*250*	350	350	350
	FPL With		(2)			
	1-100 pair	*100*		*150*	*250*	350
	1-600 pair	*100*		*150*	*250*	305
	1-CATV	*100*		*150*	*250*	350
	1-100 pair & 1 CATV	*100*		*150*	*250*	325
	1-600 pair & 1 CATV	*100*		*150*	*250*	266
3-1/0 & 1/0 N	FPL Only	350	350	350	350	350
	FPL With					
	1-100 pair	*200*	*100*	*300*	350	350
	1-600 pair	*200*	*100*	*300*	350	350
	1-CATV	*200*	*100*	*300*	350	350
	1-100 pair & 1 CATV	*200*	*100*	*300*	350	350
	1-600 pair & 1 CATV	*200*	*100*	*300*	350	350
3-1/0 & 1/0 N & 3/0 TPX	FPL Only	350	*250*	350	350	350
	FPL With		(2)			
	1-100 pair	*100*		*150*	*250*	350
	1-600 pair	*100*		*150*	*250*	350
	1-CATV	*100*		*150*	*250*	350
	1-100 pair & 1 CATV	*100*		*150*	*250*	350
	1-600 pair & 1 CATV	*100*		*150*	*250*	297

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-8

Transverse Pole Loading due to Extreme Wind - 105 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SPUN CONCRETE POLE HEIGHT AND CLASS			
		50' 4.7kip	55' 4.7kip	60' 5kip	65' 5kip
3-568 & 3/0 N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*250*	350	350	350
	1-600 pair	*250*	350	350	350
	1-CATV	*250*	350	350	350
	1-100 pair & 1 CATV	*250*	350	350	350
	1-600 pair & 1 CATV	*250*	333	339	321
3-568 & 3/0 N & 3/0 TPX	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*150*	*250*	*300*	350
	1-600 pair	*150*	*250*	*300*	305
	1-CATV	*150*	*250*	*300*	350
	1-100 pair & 1 CATV	*150*	*250*	*300*	321
	1-600 pair & 1 CATV	*150*	*250*	288	272
3-3/0 & 1/0 N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*300*	350	350	350
	1-600 pair	*300*	350	350	350
	1-CATV	*300*	350	350	350
	1-100 pair & 1 CATV	*300*	350	350	350
	1-600 pair & 1 CATV	*300*	429	438	411
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*150*	*250*	*350*	350
	1-600 pair	*150*	*250*	*350*	350
	1-CATV	*150*	*250*	*350*	350
	1-100 pair & 1 CATV	*150*	*250*	*350*	350
	1-600 pair & 1 CATV	*150*	*250*	*350*	334
3-350 CU & 2/0 CU N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*250*	350	350	350
	1-600 pair	*250*	350	350	350
	1-CATV	*250*	350	350	350
	1-100 pair & 1 CATV	*250*	350	350	350
	1-600 pair & 1 CATV	*250*	350	350	350
3-350 CU & 2/0 CU N & 3/0 TPX	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*200*	*250*	*350*	350
	1-600 pair	*200*	*250*	*350*	343
	1-CATV	*200*	*250*	*350*	350
	1-100 pair & 1 CATV	*200*	*250*	*350*	350
	1-600 pair & 1 CATV	*200*	*250*	323	302

(1) Span Lengths Shown in ***Italic*** are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-9

Transverse Pole Loading due to Extreme Wind - 130 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	WOOD POLE HEIGHT AND CLASS					
		40/3	**45/3**	**45/2**	**50/2**	**55/2**	**60/1**
3-568 & 3/0 N	FPL Only	162	151	201	183	170	200
	FPL With						
	1-100 pair	***100***	122	162	147	137	160
	1-600 pair	***100***	95	127	115	107	125
	1-CATV	***100***	121	161	146	136	159
	1-100 pair & 1 CATV	***100***	102	135	123	114	133
	1-600 pair & 1 CATV	91	83	111	100	94	108
3-568 & 3/0 N & 3/0 TPX	FPL Only	122	112	149	137	126	148
	FPL With	(2)					
	1-100 pair		95	127	116	107	125
	1-600 pair		79	105	96	89	104
	1-CATV		95	126	116	107	124
	1-100 pair & 1 CATV		83	110	101	93	108
	1-600 pair & 1 CATV		70	94	86	80	92
3-3/0 & 1/0 N	FPL Only	295	274	364	333	308	350
	FPL With						
	1-100 pair	***100***	181	***250***	219	203	237
	1-600 pair	***100***	128	171	155	145	167
	1-CATV	***100***	179	***250***	216	201	234
	1-100 pair & 1 CATV	***100***	140	186	168	158	182
	1-600 pair & 1 CATV	***100***	107	143	128	121	139
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	175	161	214	198	181	211
	FPL With	(2)					
	1-100 pair		128	171	157	145	168
	1-600 pair		101	134	122	113	131
	1-CATV		127	169	156	143	166
	1-100 pair & 1 CATV		106	143	130	121	139
	1-600 pair & 1 CATV		87	117	105	99	113
3-1/0 & 1/0 N	FPL Only	350	350	350	350	350	350
	FPL With						
	1-100 pair	***100***	214	***250***	278	258	301
	1-600 pair	***100***	144	193	174	163	188
	1-CATV	***100***	211	***250***	275	256	297
	1-100 pair & 1 CATV	***100***	159	212	191	180	207
	1-600 pair & 1 CATV	***100***	118	158	142	133	153

(1) Span Lengths Shown in ***Italic*** are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-9

Transverse Pole Loading due to Extreme Wind - 130 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	WOOD POLE HEIGHT AND CLASS					
		40/3	**45/3**	**45/2**	**50/2**	**55/2**	**60/1**
3-1/0 & 1/0 N & 3/0 TPX	FPL Only	203	186	267	230	211	264
	FPL With	(2)					
	1-100 pair		144	*150*	177	163	189
	1-600 pair		110	146	134	124	143
	1-CATV		143	*150*	175	162	187
	1-100 pair & 1 CATV		118	*150*	143	133	153
	1-600 pair & 1 CATV		94	126	114	106	123
2-1/0 & 1/0 N	FPL Only	350	350	350	350	350	350
	FPL With						
	1-100 pair	*200*	265	*350*	325	298	348
	1-600 pair	170	155	206	192	175	202
	1-CATV	*200*	261	347	318	294	340
	1-100 pair & 1 CATV	189	172	230	213	195	225
	1-600 pair & 1 CATV	136	123	163	153	139	161
2-1/0 & 1/0 N & 3/0 TPX	FPL Only	226	208	298	276	236	296
	FPL With	(2)					
	1-100 pair		155	*200*	191	175	203
	1-600 pair		114	151	142	129	149
	1-CATV		153	204	189	173	201
	1-100 pair & 1 CATV		123	163	151	139	161
	1-600 pair & 1 CATV		96	128	118	109	125
1-1/0 & 1/0 N	FPL Only	350	350	350	350	350	350
	FPL With						
	1-100 pair	*250*	308	*350*	*350*	349	*350*
	1-600 pair	179	163	218	202	186	216
	1-CATV	*250*	348	*350*	*350*	*350*	*350*
	1-100 pair & 1 CATV	222	203	292	271	232	288
	1-600 pair & 1 CATV	147	134	179	166	153	177
1-1/0 & 1/0 N & 3/0 TPX	FPL Only	274	257	341	309	285	333
	FPL With						
	1-100 pair	*150*	166	221	202	187	217
	1-600 pair	126	117	156	143	132	153
	1-CATV	*150*	178	*250*	217	200	233
	1-100 pair & 1 CATV	146	135	181	166	152	177
	1-600 pair & 1 CATV	110	102	135	125	115	133

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-9

Transverse Pole Loading due to Extreme Wind - 130 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SQUARE CONCRETE POLE HEIGHT AND CLASS				
		45IIIG	45IIIH	50IIIH	55IIIH	60IIIH
3-568 & 3/0 N	FPL Only	143	308	290	268	227
	FPL With					
	1-100 pair	115	***100***	216	200	182
	1-600 pair	90	***100***	170	156	143
	1-CATV	114	***100***	215	198	181
	1-100 pair & 1 CATV	96	***100***	181	166	153
	1-600 pair & 1 CATV	79	***100***	148	136	125
3-568 & 3/0 N & 3/0 TPX	FPL Only	105	213	200	186	169
	FPL With	(2)	(2)			
	1-100 pair			***150***	158	143
	1-600 pair			141	130	119
	1-CATV			***150***	157	143
	1-100 pair & 1 CATV			147	137	124
	1-600 pair & 1 CATV			125	116	106
3-3/0 & 1/0 N	FPL Only	259	350	350	350	350
	FPL With					
	1-100 pair	171	***100***	***300***	318	291
	1-600 pair	123	***100***	228	210	194
	1-CATV	169	***100***	***300***	314	287
	1-100 pair & 1 CATV	133	***100***	267	228	210
	1-600 pair & 1 CATV	103	***100***	190	174	162
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	152	***150***	308	286	259
	FPL With	(2)	(2)			
	1-100 pair			***150***	213	194
	1-600 pair			***150***	165	151
	1-CATV			***150***	211	192
	1-100 pair & 1 CATV			***150***	176	161
	1-600 pair & 1 CATV			***150***	143	131
3-1/0 & 1/0 N	FPL Only	332	350	350	350	350
	FPL With					
	1-100 pair	***200***	***100***	***300***	350	345
	1-600 pair	138	***100***	277	236	218
	1-CATV	200	***100***	***300***	350	340
	1-100 pair & 1 CATV	151	***100***	***300***	280	257
	1-600 pair & 1 CATV	113	***100***	210	192	178
3-1/0 & 1/0 N & 3/0 TPX	FPL Only	177	***250***	350	334	302
	FPL With	(2)	(2)			
	1-100 pair			***150***	***250***	218
	1-600 pair			***150***	181	166
	1-CATV			***150***	237	216
	1-100 pair & 1 CATV			***150***	194	178
	1-600 pair & 1 CATV			***150***	155	143

(1) Span Lengths Shown in ***Italic*** are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-9

Transverse Pole Loading due to Extreme Wind - 130 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SPUN CONCRETE POLE HEIGHT AND CLASS			
		50' 4.7kip	**55' 4.7kip**	**60' 5kip**	**65' 5kip**
3-568 & 3/0 N	FPL Only	350	350	350	337
	FPL With				
	1-100 pair	*250*	294	289	270
	1-600 pair	223	214	213	197
	1-CATV	*250*	292	287	268
	1-100 pair & 1 CATV	*250*	227	225	209
	1-600 pair & 1 CATV	195	185	185	170
3-568 & 3/0 N & 3/0 TPX	FPL Only	284	274	269	232
	FPL With				
	1-100 pair	*150*	216	213	197
	1-600 pair	*150*	178	176	162
	1-CATV	*150*	215	211	196
	1-100 pair & 1 CATV	*150*	187	184	170
	1-600 pair & 1 CATV	*150*	159	158	144
3-3/0 & 1/0 N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*300*	350	350	350
	1-600 pair	*300*	310	307	282
	1-CATV	*300*	350	350	350
	1-100 pair & 1 CATV	*300*	336	333	307
	1-600 pair & 1 CATV	270	257	256	219
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*150*	*250*	307	283
	1-600 pair	*150*	226	224	205
	1-CATV	*150*	*250*	305	280
	1-100 pair & 1 CATV	*150*	*250*	256	219
	1-600 pair & 1 CATV	*150*	196	195	178
3-350 CU & 2/0 CU N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*250*	350	350	328
	1-600 pair	*250*	267	266	228
	1-CATV	*250*	350	350	325
	1-100 pair & 1 CATV	*250*	287	284	263
	1-600 pair & 1 CATV	221	211	211	194
3-350 CU & 2/0 CU N & 3/0 TPX	FPL Only	339	328	321	298
	FPL With				
	1-100 pair	*200*	*250*	266	228
	1-600 pair	*200*	201	200	183
	1-CATV	*200*	*250*	262	226
	1-100 pair & 1 CATV	*200*	213	210	194
	1-600 pair & 1 CATV	184	177	176	161

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-10

Transverse Pole Loading due to Extreme Wind - 145 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors		Wood Pole Height and Class					
		40/3	45/3	45/2	50/2	55/2	60/1
3-568 ACAR	**FPL Only**	121	110	150	134	122	143
& 3/0 AAAC-N	FPL With						
	1-100 pair	98	88	121	107	98	114
	1-600 pair	78	69	94	84	77	88
	1-CATV	97	87	120	106	97	113
	1-100 pair & 1 CATV	83	74	101	89	82	94
	1-600 pair & 1 CATV	68	61	83	73	67	77
3-568 ACAR	**FPL Only**	90	82	111	100	90	105
& 3/0 AAAC-N	FPL With	(2)					
& 3/0 TPX	1-100 pair		69	94	85	77	89
	1-600 pair		57	78	69	64	73
	1-CATV		69	94	85	76	88
	1-100 pair & 1 CATV		61	82	73	67	77
	1-600 pair & 1 CATV		51	70	62	57	66
3-3/0	**FPL Only**	203	186	272	226	205	257
& 1/0 N	FPL With						
	1-100 pair	146	131	179	160	145	168
	1-600 pair	105	93	127	113	104	119
	1-CATV	144	130	177	158	143	166
	1-100 pair & 1 CATV	114	102	138	123	113	129
	1-600 pair & 1 CATV	88	78	106	94	86	99
3-3/0	**FPL Only**	130	117	159	143	130	150
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		93	127	114	104	120
	1-600 pair		73	100	88	81	93
	1-CATV		93	126	113	103	119
	1-100 pair & 1 CATV		78	105	95	86	99
	1-600 pair & 1 CATV		64	86	77	70	81

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-10

Transverse Pole Loading due to Extreme Wind - 145 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors		Wood Pole Height and Class					
		40/3	45/3	45/2	50/2	55/2	60/1
3-1/0	**FPL Only**	282	256	348	311	282	330
& 1/0 N	FPL With						
	1-100 pair	*100*	156	212	188	173	200
	1-600 pair	*100*	105	143	126	117	134
	1-CATV	*100*	154	209	186	170	197
	1-100 pair & 1 CATV	*100*	116	157	140	128	146
	1-600 pair & 1 CATV	98	86	117	104	95	108
3-1/0	**FPL Only**	151	136	184	167	151	174
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		105	143	128	117	134
	1-600 pair		80	108	97	89	102
	1-CATV		105	142	127	116	133
	1-100 pair & 1 CATV		86	117	105	95	108
	1-600 pair & 1 CATV		68	93	84	76	86
2-1/0	**FPL Only**	350	334	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	200	180	262	220	199	230
	1-600 pair	126	113	153	140	125	143
	1-CATV	196	177	258	217	195	226
	1-100 pair & 1 CATV	141	125	170	155	140	161
	1-600 pair & 1 CATV	101	89	122	111	100	114
2-1/0	**FPL Only**	168	152	206	187	169	196
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		113	153	140	125	144
	1-600 pair		83	112	103	92	105
	1-CATV		111	151	138	124	143
	1-100 pair & 1 CATV		89	122	110	100	114
	1-600 pair & 1 CATV		70	95	86	78	89
1-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	231	208	305	276	232	288
	1-600 pair	133	119	162	147	133	154
	1-CATV	226	203	297	270	227	282
	1-100 pair & 1 CATV	150	135	182	167	151	174
	1-600 pair & 1 CATV	103	91	124	114	103	118
1-1/0	**FPL Only**	188	174	237	210	191	221
& 1/0 N	FPL With						
& 3/0 TPX	1-100 pair	133	122	164	147	134	154
	1-600 pair	94	86	116	105	94	108
	1-CATV	131	120	162	146	132	152
	1-100 pair & 1 CATV	103	92	125	114	103	118
	1-600 pair & 1 CATV	78	70	96	87	78	90

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-10

Transverse Pole Loading due to Extreme Wind - 145 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SQUARE CONCRETE POLE HEIGHT AND CLASS				
		45IIIG	45IIIH	50IIIH	55IIIH	60IIIH
3-568 & 3/0 N	FPL Only	99	209	193	174	154
	FPL With					
	1-100 pair	80	*100*	155	139	124
	1-600 pair	63	*100*	122	109	97
	1-CATV	79	*100*	154	138	123
	1-100 pair & 1 CATV	67	*100*	129	116	104
	1-600 pair & 1 CATV	55	*100*	105	95	85
3-568 & 3/0 N & 3/0 TPX	FPL Only	73	157	143	130	114
	FPL With	(2)	(2)			
	1-100 pair			122	110	97
	1-600 pair			101	90	81
	1-CATV			121	109	97
	1-100 pair & 1 CATV			105	95	85
	1-600 pair & 1 CATV			90	81	72
3-3/0 & 1/0 N	FPL Only	167	350	349	314	278
	FPL With					
	1-100 pair	119	*100*	230	206	184
	1-600 pair	85	*100*	163	146	131
	1-CATV	118	*100*	227	204	181
	1-100 pair & 1 CATV	92	*100*	178	159	143
	1-600 pair & 1 CATV	71	*100*	136	122	109
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	105	225	204	186	164
	FPL With	(2)	(2)			
	1-100 pair			*150*	148	131
	1-600 pair			127	115	103
	1-CATV			*150*	147	130
	1-100 pair & 1 CATV			136	123	109
	1-600 pair & 1 CATV			111	100	89
3-1/0 & 1/0 N	FPL Only	214	350	350	350	350
	FPL With					
	1-100 pair	142	*100*	294	264	219
	1-600 pair	96	*100*	184	164	147
	1-CATV	140	*100*	290	260	215
	1-100 pair & 1 CATV	105	*100*	202	181	162
	1-600 pair & 1 CATV	79	*100*	150	134	121
3-1/0 & 1/0 N & 3/0 TPX	FPL Only	123	*250*	257	218	191
	FPL With		(2)			
	1-100 pair	96		*150*	167	147
	1-600 pair	73		140	126	112
	1-CATV	95		150	165	146
	1-100 pair & 1 CATV	78		150	135	121
	1-600 pair & 1 CATV	63		121	108	96

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-10

Transverse Pole Loading due to Extreme Wind - 145 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SPUN CONCRETE POLE HEIGHT AND CLASS			
		50' 4.7kip	**55' 4.7kip**	**60' 5kip**	**65' 5kip**
3-568 & 3/0 N	FPL Only	291	276	267	227
	FPL With				
	1-100 pair	217	205	200	181
	1-600 pair	170	161	157	143
	1-CATV	215	203	198	181
	1-100 pair & 1 CATV	181	171	166	151
	1-600 pair & 1 CATV	148	140	137	124
3-568 & 3/0 N & 3/0 TPX	FPL Only	200	192	184	168
	FPL With				
	1-100 pair	*150*	162	157	143
	1-600 pair	141	134	130	118
	1-CATV	*150*	162	156	142
	1-100 pair & 1 CATV	147	141	137	124
	1-600 pair & 1 CATV	125	120	116	105
3-3/0 & 1/0 N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*300*	328	317	288
	1-600 pair	229	217	212	191
	1-CATV	*300*	324	314	285
	1-100 pair & 1 CATV	267	235	230	207
	1-600 pair & 1 CATV	191	180	177	158
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	309	296	283	257
	FPL With				
	1-100 pair	*150*	219	212	191
	1-600 pair	*150*	170	165	148
	1-CATV	*150*	218	210	189
	1-100 pair & 1 CATV	*150*	181	176	158
	1-600 pair & 1 CATV	*150*	147	143	128
3-350 CU & 2/0 CU N	FPL Only	350	350	341	313
	FPL With				
	1-100 pair	*250*	269	259	220
	1-600 pair	198	187	182	165
	1-CATV	*250*	266	257	219
	1-100 pair & 1 CATV	212	200	196	177
	1-600 pair & 1 CATV	168	159	156	140
3-350 CU & 2/0 CU N & 3/0 TPX	FPL Only	257	230	220	200
	FPL With				
	1-100 pair	198	189	182	165
	1-600 pair	159	151	147	132
	1-CATV	196	187	181	164
	1-100 pair & 1 CATV	168	161	156	140
	1-600 pair & 1 CATV	141	133	130	116

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria

(2) Required clearance cannot be met with Pole length

C. *Storm Guying*

One method to overcome the overload on a pole due to transverse wind load is to add storm guys. Storm guys are installed in pairs(back to back) – one on each side of the pole perpendicular to the pole line. These guys should typically be installed 6 inches to 2 feet below the primary attachments.

Calculating the size of the guy wire is very much like calculating a deadend guy.

1. Calculate the transverse wind load on the pole, conductors and all attachments and equipment.
2. The load is then used to size the guy wire based on the load, the attachment height and lead length.
3. A final check should be made to verify that the strength of the pole above the guy attachment is adequate.

Using the example of Case I above for the 45'/2 pole, calculate the size of the storm guys and anchors required for extreme wind loading.

1. Transverse wind loads:

Pole	=	Wind load on pole
Primary	=	Wind Load per ft x span length x number of conductors
Neutral	=	Wind Load per ft x span length
CATV	=	Wind Load per ft x span length
Telephone	=	Wind Load per ft x span length
Transformer	=	Wind Load

Load on Pole	=						=	1713	pounds
Primary	=	3.816	x	170	x	3	=	1946	pounds
Neutral	=	2.094	x	170	x	1	=	356	pounds
CATV	=	4.171	x	170	x	1	=	709	pounds
Telephone	=	9.573	x	170	x	1	=	1627	pounds
Transformer	=	231.8	x	1			=	232	pounds
				Total Load			=	6583	pounds

2. Determine the guy wire size and anchor size required for this installation.

   To calculate the tension in the guy wire use the equation below

Equation 4.2.2-7 $$T_{DG} = \frac{T_{TWL}}{L} x \sqrt{H_G^{\;2} + L^2}$$

Where:

- T_{DG} = *Tension in down guy*
- T_{TWL} = *Transverse Wind Load*
- L = *The down guy Lead length*
- H_G = *The attachment Height of the down guy*

Use the total transverse wind load for the load to be guyed with the guy attached 6 inches below C phase primary (34.1') and a lead length of 20 feet.

$$T_{DG} = \frac{6583}{20}\sqrt{(34.1)^2 + (20)^2}$$

T_{DG} = 13,013 Pounds

For extreme wind loading, the required strength of the guy wire is equal to the rated breaking strength of the guy wire x 0.9.

Table 4.2.2-11 Storm Guy Strength

Guy Size	Rated Breaking Strength (RBS)	Allowable Guy Tension .9 X RBS
5/16	11200	10080
7/16	20800	18720
9/16	33700	30330

For this example, a 7/16" guy will be installed in each direction perpendicular to the pole line. Use the tension in the down guy to select the appropriate anchor from DCS D-4.0.2. In this case, a 10" screw anchor will do the job.

3. One final check is to be sure that the pole length above the storm guy attachment has sufficient strength to support the load above it. Basically, this is just like calculating the strength of the total pole but now the "ground line" is at the storm guy attachment height and all of the facilities above this point will create a moment here.

   With the top of the pole at 38' and the down guy at 34.1 feet, the length of pole exposed to the wind is now 38-34.1 = 3.9 ft.

   Use equation 4.2.2-3 to determine the strength of this section of pole.

From Table G (DERM 4.2.2) circumference at 3.9 feet down from the top of the pole = 26.5 inches

M_r = 0.000264 x (8,000) x $(26.5)^3$ x 0.75 = 29,478 ft.-lbs.

Use equation 4.2.2-4 to find the area of this section of pole

$$A = 3.9(\frac{25+26.5}{2})(\frac{1}{12}''\ ) = 2.66 sqft$$

Use equation 4.2.2-5 to find the center of the area of this section of pole

$$Height\ of\ center\ of\ area, H_{CA} = \frac{3.9(8.44+2(7.96))}{3(8.44+7.96)} = 1.93\ ft$$

Use equation 4.2.2-2 to find the wind load on this section of pole

Load in pounds = 0.00256 x (145)² x1.0 x0.97 x 1 x 1x 2.66= 139 pounds

Use equation 4.2.2-6 to determine the moment due to the wind load on this section of the pole at the guy attachment point

Moment = 1.93 x 139 = 269 ft lbs

Determine the moment created by the wind load on the conductors

Primary	=	3.816	x	170	x	1	x	4.9	=	3179	Ft-Lbs
	=	3.816	x	170	x	1	x	2.5	=	1622	Ft-Lbs
	=	3.816	x	170	x	1	x	0.5	=	324	Ft-Lbs
										5125	Ft-Lbs
Total Moment	=	269	+	5125	=	5393 Ft-Lbs					

This load is well under the strength calculated above and the design using storm guys will meet requirements.

4.2.3 Pole Framing

A. Slack Span Construction

Slack span construction is employed where it is impractical to follow conventional guying practices. The proper application is a pull-off from either a tangent pole or a properly guyed deadend pole to another properly guyed deadend pole. The intent is not to slack span to a stand alone (self-support) pole unless that pole has been properly sized for this application. Improper use of slack span construction can cause a pole to bow or lean which then can cause more slack in the conductors. More slack in the conductors can result in improper clearances and increased potential for conductors to make contact with each other.

DERM 4.4.5 page 1 shows the initial sag to be used when installing slack spans. The amount of sag shown, limits the per conductor tension to 50 pounds.

Slack Span design criteria:

1. Vertical construction is preferred for two and three phase installations (DCS E-5.7.1).
   Maintain 36” separation between phases at the poles.
2. Limit the span lengths to

Table 4.2.2-12 Slack Span Length & Sag

SLACK SPAN		
CONDUCTOR	MAXIMUM LENGTH	INITIAL SAG
568.3 ACAR	50'	3'-7"
3/0 AAAC	75'	2'-9"
1/0 AAAC	95'	2'-10"

3. Use class 2 poles minimum.
4. If crossarm construction is used, use the 9 foot heavy duty wood crossarms or the 8’6” steel crossarm for added horizontal spacing (DCS E-29.0.0 and E-29.1.0).

B. ***Targeted Poles***

There are many poles in the distribution system identified as Targeted Poles. These poles are deemed critical by virtue of the equipment mounted on them or their importance to maintaining the system. As stated in The Distribution Design Guide "The following list comprises what will be considered targeted poles. When installing and/or replacing an accessible targeted pole, use a III-H concrete pole or a spun concrete pole for spans greater than 300 feet. If the pole is inaccessible, use a Class 2 pole, or consider relocating the equipment to an accessible concrete pole."

Targeted Critical Pole List

"01" Feeder Switch Poles (first pole outside the substation)
Automated Feeder Switches
Interstate/Highway Crossings
Capacitor Banks
Multiple Primary Risers
3 Phase Reclosers (or three single phase Reclosers)
Aerial Auto Transformers
Multiple Circuits
3 phase Transformer Banks (3-100 kVA and larger)
Regulators
Primary Meter

The targeted pole also should meet the design criteria for wind loading as previously shown.

C. ***Distribution Design Guidelines***

The Storm Secure Organization has developed a set of guidelines for Distribution Designers to use when designing or maintaining distribution facilities. The designer can go online to see the most current version.

FPL

Distribution Design Guidelines

The following **guidelines** will be used to standardize the design of FPL's overhead distribution facilities **when practical, feasible, and cost effective**.

General

1. FPL has made a change to adopt Extreme Windloading (EWL) as the design criteria for: (1) new pole line construction, (2) pole line extensions, (3) pole line relocations, (4) feeder pole replacements on multi-circuit pole lines, and (5) feeder pole replacements on Top-CIF feeders. Reference the Pole Sizing section (pg 7) for the guidelines to determine the necessary pole class and type for all work. Refer to the Distribution Engineering Reference Manual Addendum for calculating pole sizes for specific framing under extreme wind loading conditions.

2. For maintenance, existing non-top-CIF pole lines may be evaluated using NESC combined ice and wind loading with Grade B construction. This represents the loading prior to the adoption of extreme wind loading. If the pole must be replaced, refer to the Pole Sizing section for the minimum class pole to be installed. Refer to the Distribution Engineering Reference Manual (DERM) Section 4 for calculating pole sizes for specific framing under the NESC combined ice and wind loading conditions.

3. Every attempt should be made to place new or replacement poles in private easements or as close to the front edge of property (right of way line) as practical.

4. Overhead pole lines should be placed in front lot lines or accessible locations where feasible.

5. When replacing poles, the new pole should be set as close as possible to the existing pole to avoid the creation of a new pole location.

6. Poles are not to be placed in medians.

7. Concrete poles are not to be placed in inaccessible locations or locations that could potentially become inaccessible.

8. Please reference the minimum setting depth charts located in DCS D-3.0.0 which shows the increased setting depths for concrete poles.

9. Every effort should be made not to install poles in sidewalks. If a pole must be placed in a sidewalk, a minimum unobstructed sidewalk width of 32" must be maintained to comply with the American Disabilities Act (ADA) requirements.

10. If concrete poles are required by the governing agency as a requirement of the permit, and if the work is being done solely for FPL purposes (feeder tie, etc.), then the concrete

poles are installed with no differential charges. If the concrete poles are required as a condition of the permit, and the work is being done at the request of a customer (and fall outside the Pole Sizing Guidelines) to provide service to the customer or relocation by request of the customer, then the customer is charged a differential cost for the concrete poles.

11. When installing new OH secondary spans, multiplexed cable should be used instead of open wire secondary. When reconductoring or relocating existing pole lines containing open wire secondary, replace the open wire with multiplexed cable whenever possible. The system neutral should not be removed when replacing open wire secondary with multiplexed cable if primary wire is present. It is necessary to maintain a separate system neutral for operational continuity of the system.

12. When designing overhead facilities where secondary and service crossings exist across major roadways, the engineer should take into consideration placing these secondary street crossings underground. Operations Director Approval is required.

13. Whenever extending a feeder, reconductoring a feeder section, or attaching a device to a feeder, always reference the nearest existing disconnect switch number on the construction drawing and show the dimension to the switch. This will aid the Control Centers in updating their switching system and will aid AMG in updating AMS, as well as provide the Production Lead and Distribution Tech information needed for switching and RC Off requests.

14. When an overhead feeder crosses any obstacle to access (i.e. – water bodies such as rivers, canals, swamps; limited access R/W such as interstate highways, turnpikes, and expressways; etc.) disconnect switches should be placed on both sides of the obstacle in order to isolate the crossing in the event of a wiredown situation. See the example in the Crossing Multi-lane Limited Access Highways section (pg 5).

15. Projects that affect or extend feeder conductors should always be coordinated with Distribution Planning to ensure optimization of the distribution grid. Taking into account future feeder plans such as, feeder boundary changes, sectionalizing devices, integration of automation and remotely controlled protection.

As always, good engineering judgment, safety, reliability, and cost effectiveness should be considered. In addition to these guidelines, all distribution facilities shall be engineered to meet the minimum requirements set forth in all applicable standards and codes including but not limited to the National Electrical Safety Code (NESC), Utility Accommodation Guide, and FPL Distribution Construction Standards. Please contact a Distribution Construction Services (DCS) analyst with any questions.

FPL

New Construction

1. When installing a new feeder, lateral, or service pole, reference the Pole Sizing section for the guidelines to determine the necessary pole class and type to meet Extreme Wind Loading (EWL) for the wind zone region (105, 130, or 145 MPH).

2. Modified Vertical is the preferred framing for accessible locations. Post-top (single phase) or Cross Arm (multi phase) is the preferred framing for inaccessible locations.

3. During the design of new pole lines in developed areas, field visits should be conducted to ensure the design would cause minimum impact to the existing property owners.

4. Overhead pole lines should not be built on both sides of a roadway unless agreed to by the customer nor should multi-circuit pole lines be created. When designing main feeder routes all viable options must be reviewed (including alternative routes) and consideration should be given to constructing the line underground. If undergrounding is chosen and it is <u>not</u> the least cost option, approval is required from the Engineering & Technical Services Director and the Operations Director. In addition, prior to proceeding with any pole lines on both sides of a street or any multi-circuit feeder design recommendations, Operations Director approval is required.

5. When there is an existing pole line in the rear easement, every effort should be made not to build a second pole line along the right of way.

6. When installing a pole line within a transmission line, accessible distribution poles should be concrete. Distribution concrete poles should not be installed in inaccessible locations.

7. If concrete distribution poles are installed in a concrete transmission line there is no additional charge to the customer (the concrete poles are FPL's choice and not requested by the customer). Coordination between the transmission and distribution design is critical and consideration should be given to a design with all transmission poles versus distribution intermediate poles. This approach will reduce the overall number of poles.

8. When transmission is overbuilding (concrete structures), along an existing distribution corridor, if the distribution wood poles are in good condition, do not replace. If wood poles need to be changed out or relocated, replace with concrete poles to match the transmission pole type. Coordination between the transmission and distribution design is critical and consideration should be given to a design with all transmission poles versus distribution intermediate poles. This approach will reduce the overall number of poles.

Existing / Maintenance

1. When installing and/or replacing a feeder, lateral, or service pole on an existing pole line, reference the Pole Sizing section for the guidelines to determine the necessary pole class and type.

2. When installing or replacing a feeder pole on a feeder that serves a Top-CIF customer, ensure the new pole will meet extreme wind loading (versus just a minimum class 2 or IIIH pole) so that it will not have to be replaced when the feeder is hardened as a hardening project. Please reference the Storm Secure Hardening SharePoint Site: Distribution > Central Maintenance > Central Contractor Services > Hardening > Reports > Feeder Prioritization_xxxxxx Snapshot for the list of Top-CIF feeders within the Prioritization File.

3. When extending pole lines, the existing pole type should be used as a guide for the new pole type. If concrete poles are requested by the customer or are required as a condition of the permit and fall outside the Pole Sizing Guidelines, the customer will pay a differential charge for the concrete poles.

4. When replacing pole(s) and anchor(s) with larger self-supporting concrete poles, caution should be used, as the property owners in the vicinity of the pole will not necessarily perceive this concrete pole as a better choice.

5. When replacing poles on a multi-circuit feeder the replacement pole should be designed for Extreme Wind Loading using Pole Foreman to calculate the wind loading.

Relocations

1. When relocating a pole line, reference the Pole Sizing section for the guidelines to determine the necessary pole class and type to meet Extreme Wind Loading (EWL) for the wind zone region (105, 130, or 145 MPH).

2. When relocating either a concrete or wood pole line for a highway improvement project, the existing pole line ‘type’ should be used as a guide for the pole type replacements. There is no additional charge for concrete poles if the existing poles being relocated are concrete (like for like relocation). If the customer requests an “upgrade” to concrete poles, a differential is charged.

3. Reimbursable relocations will equal the cost to relocate the line built to Extreme Wind Loading (plus removal of old), including indirect cost.

4. Agency relocation projects should be coordinated with Distribution Planning to ensure optimization of the distribution grid and to take into account future feeder plans and potential feeder boundary changes.

Crossing Multi-lane Limited Access Highways

The following guidelines are to be used when an overhead feeder crosses any obstacle to access (i.e. –limited access R/W such as interstate highways, turnpikes, and expressways, etc.). Similar consideration can be given to water bodies such as rivers, canals, swamps.

1. Underground installation is the preferred design for all new crossings (1, 2, 3 phase) of multi-lane limited access highways & hardening of existing crossings; reference Fig 1. Limited Access Highway Crossing Schematic (Preferred). If underground construction is not feasible, reference Fig 2. Limited Access Highway Crossing Schematic (Alternate).

2. Underground crossing for 1 & 2 phases should be designed for potential three phase feeder size cable. Ensure riser poles meet or exceed extreme wind design for the designated region. For further information please contact the CMC Hardening Group.

3. For accessible overhead crossings, use concrete poles (III-H or greater square concrete pole) for the crossing poles and minimum Class 2 wood poles for the intermediate poles. For inaccessible overhead crossings, minimum Class 2 wood poles should be used for the crossing and intermediate poles. All poles installed should meet or exceed EWL for the designated region.

4. Every attempt should be made to install storm guys & back guys for the highway crossing poles. Storm guys are not required on the adjacent poles.

5. Frame the highway crossing pole double deadend (See LOC 2 & 3 Fig 2 below).

6. Install disconnect switches on adjacent poles on both sides of the crossing (or as required by field conditions) to isolate the feeder section for restoration. Switches are to be installed in **accessible** locations that can be reached with readily available aerial equipment. Switches should be installed at ~42 Above Grade (AG), with a maximum pole size of 50' wood or 55' concrete. If there is no load between the nearest existing switch and the crossing, an additional switch is not required.

7. Check for uplift on all poles. Refer to DERM Section 4.2.3 Page 4 of 16 & DCS E-4.0.2 and E-4.0.3. Back guys should be installed at the adjacent pole if required for uplift.

8. Ensure to maintain proper clearance above or under all highways as dictated by the owner of the R/W & DCS B-3.0.1.

9. Any conductors crossing the highway that have splices should be replaced with a continuous conductor (NESC 261H2a). See Fig 2 below for additional notes on the use of splices on adjacent spans. One additional set of deadend insulators at the highway crossing pole may be used if this eliminates the need for splices when installing a new pole.

10. Engineers must conduct a pre-design meeting with the Production Lead to ensure the feasibility of the proposed design.

11. As always, use good engineering judgment to produce a quality, cost-effective design.

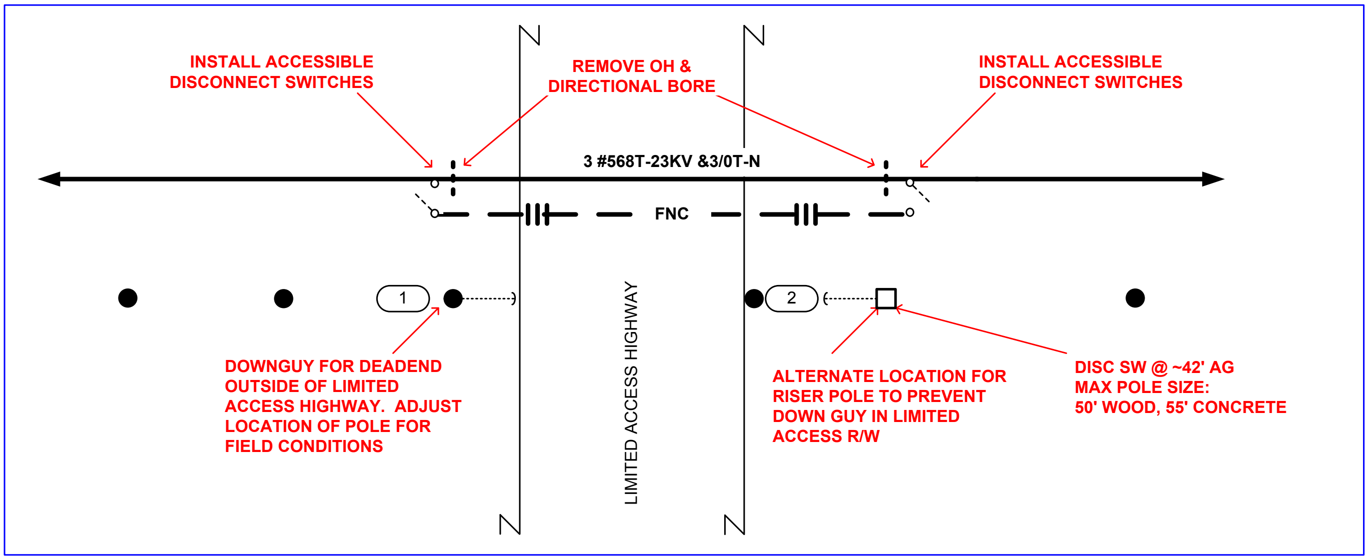


Fig 1. **Limited Access Highway Crossing Schematic (Preferred)**

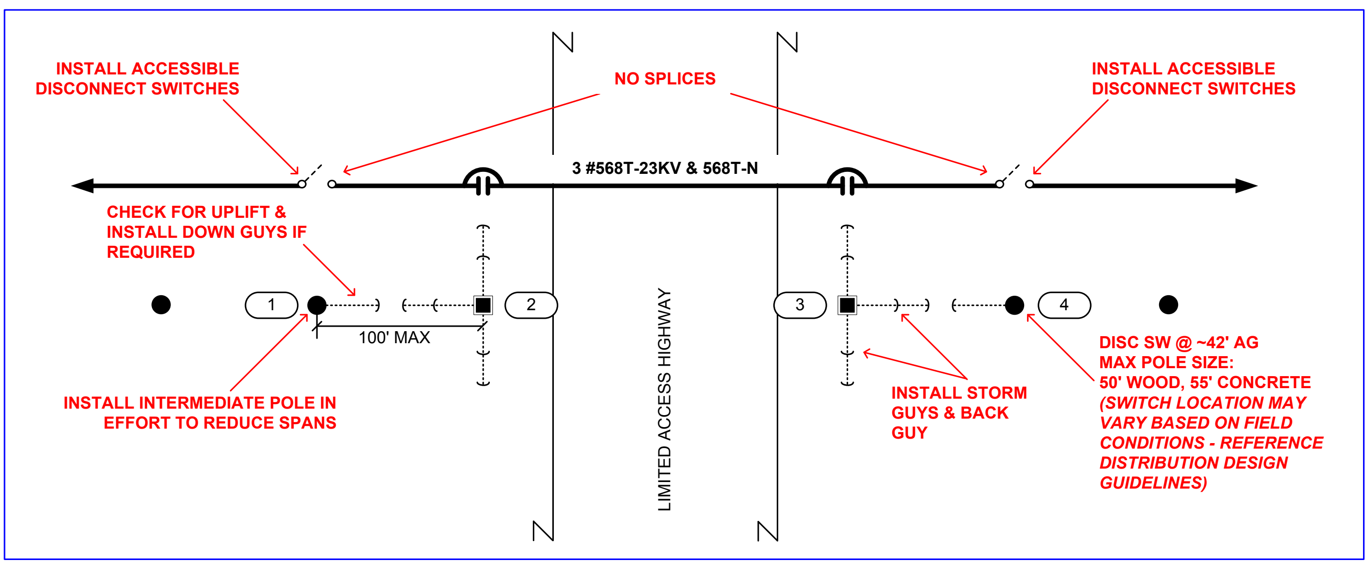


Fig 2. **Limited Access Highway Crossing Schematic (Alternate)**

FPL

Pole Sizing

1. FPL has made a change to adopt Extreme Windloading (EWL) as the design criteria for: (1) new pole line construction, (2) pole line extensions, (3) pole line relocations, (4) feeder pole replacements on multi-circuit pole lines, and (4) feeder pole replacements on Top-CIF feeders. Reference the Pole Sizing Guidelines (at the end of this section) to determine the necessary pole class and type.

2. When installing or replacing a feeder pole on a feeder that serves a Top-CIF customer, ensure the new pole will meet the extreme wind design (versus just a minimum class 2 or IIIH pole) so that it will not have to be replaced when the feeder is hardened as a hardening project. Please reference the Storm Secure SharePoint Site: Distribution > Central Maintenance > Central Contractor Services > Hardening > Reports > Feeder Prioritization_xxxxxx Snapshot for the list of Top-CIF feeders within the Prioritization File.

3. For maintenance, existing non-top-CIF pole lines may be evaluated using NESC combined ice and wind loading with Grade B construction. This represents the loading prior to the adoption of extreme wind loading. If the pole must be replaced, refer to the Pole Sizing Guidelines for the minimum class pole to be installed.

4. When performing work on an existing pole, and the pole requires change out (e.g., clearance height, location, condition, or the ability to support the planned activity), use the Pole Selection Guidelines. If the planned work can be done without changing out the pole and the pole meets minimum NESC grade B wind loading guidelines, use the existing pole(s).

5. Foreign pole owners are required to discuss design requirements with FPL prior to construction. FPL will assist with identifying the targeted poles.

6. Efforts should be made to ensure that span distances do not exceed 250 ft. for wood poles and 350 ft. for concrete poles even if longer spans would meet the Extreme Wind Loading requirements.

7. Concrete poles are preferred in the cases where replacement costs would be extremely high (i.e. duct system riser pole, corner poles with multiple circuits, critical poles, etc). No differential is charged for poles in this case.

FPL

Lateral Pole Policy

1. All existing poles must meet NESC grade “B” as an absolute minimum.
2. If a pole is modified in any way, it must meet NESC grade “B” at a minimum when completed.
3. If you become aware of a pole which does not meet NESC “B” or DCS standards, the pole must be immediately upgraded or modified to meet the NESC & DCS standards.
4. All replacement lateral poles must meet NESC “EWL” and be compliant with FPL Pole Policies.
5. Restoration of lateral poles should comply with the class 2/3 table.

For practical purposes this means…

1. Engineer all poles to the NESC EWL standards and to meet FPL policies.
2. Run Pole Foreman on all designed WR’s and poles suspected of being substandard.
3. If you are completing substantial work on a pole, such as installing additional cables, upgrading a TX, re-conductor or new framing: The pole must meet EWL and the revised class standards.
4. If you are completing minor like for like work such as replacing a fuse switch, insulator or other small equipment: The pole must meet NESC grade “B” and DCS standards at a minimum when the work is complete.
    a. Note: Most FPL poles currently exceed NESC grade “B”. This means there is some leeway for minor changes in wind loading and clearances while maintaining the NESC grade "B" minimum.
5. Temporary or time constrained poles may be installed to NESC grade “N” temporary construction. This is relatively complicated, requires sound engineering judgment and should be avoided. If grade NESC grade “N” is applied, a replacement pole engineered to NESC EWL must be designed and installed as soon as practical and not longer than 6 months after NESC grade “N” was installed.
6. Class 4 poles may only be installed for SVC, SEC, SL, OL’s. Once the available stock of class 4 is used up no more will be ordered and FPL will install class 3 poles for these applications.
7. In no case should class 4 poles be installed in laterals.

Contact Engineering Standards for situations that still are in question after careful consideration

Critical Pole Definitions & Sizing:

The following list comprises what will be considered critical poles. When installing and/or when doing work that otherwise requires the replacement of an accessible critical pole, use concrete. If the pole is inaccessible, use a minimum Class 2 wood pole, or consider relocating the equipment to an accessible concrete pole.

Critical Pole Identifier			
For new or when replaced use minimum III-H Square Concrete Pole[5] (minimum Class 2 if inaccessible)			
Critical Poles	**DCS Reference**	**Critical Poles**	**DCS Reference**
1st switch out of substation or duct system riser pole	UH-15.0.0 Fig 2 UH-15.3.1	**Automated Feeder Switches (AFS)[2]**	C-9.2.0
Interstate Crossings[1,3]	E-10.0.0 Fig 2	**Aerial Auto Transformers[2]**	I-9.0.0
Poles with multiple primary risers	UH-15.2.0	**3 phase transformer banks 3 – 100 kVA and larger[2]**	I-52.0.2
Multi-circuit poles[4]	Frame as existing	**Capacitor Banks[2]**	J-2.0.2 & J-2.0.3
Three-phase reclosers[2] (or Three single-phase reclosers)	C-8.0.0	**Regulators**	I-10.1.1
Primary Meter	K-28.0.0	**Intelliruptors**	C-9.5.0
All references are to the Distribution Construction Standards (DCS).			

For all critical poles run Pole Foreman to calculate the windloading for the specified pole and attachments combination. Additional information can be found in DERM Section 4 - Addendum for Extreme Wind Loading tables 4.2.2-8, 4.2.2-9, or 4.2.2-10.

1) *Every attempt should be made to install storm guys where feasible and practical.*
2) *Frame in-line per standard to equally distribute weight.*
3) *Refer to the Crossing Multi-lane Limited Access Highways section for details.*
4) *Contact CMC Hardening Group before designing new multi-circuit line.*
5) *To eliminate field drilling, inventory Special Drill Pole & create Pole Boring Detail for all III-H Poles on Hardening Jobs.*

FPL

Pole Sizing Guidelines:

The following tables should be used as guidelines to help determine pole class and type, when installing and/or replacing a feeder, lateral or service pole.

Feeder or Three Phase Lateral:

Pole Line Description	New Construction, Line Extension, & Pole Line Relocation	Existing Infrastructure[1]	Installing or Replacing a Critical Pole[2]
Wood	Use minimum Class 2 Wood Pole to meet EWL	Use Class 2 Wood Poles	Use III-H (Accessible) or Class 2 Wood (Inaccessible)
Concrete	Use minimum III-H Concrete Pole to meet EWL	Use III-H Concrete Poles	Use III-H Concrete Poles

When designing for EWL run Pole Foreman to calculate the windloading for the specified pole and attachments combination. Additional information can be found in DERM Section 4 - Addendum for Extreme Wind Loading tables 4.2.2-8, 4.2.2-9, or 4.2.2-10.

Single or Two Phase Lateral:

Pole Line Description	New Construction, Line Extension, Pole Line Relocation, Pole Replacement, & Intermediate Poles	Existing Infrastructure[1]	Installing or Replacing a Critical Pole[2]
Wood	105/135 mph: Use minimum Class 3 *MUST* meet EWL	105/135 mph: Use minimum Class 3	Use III-H (Accessible) or Class 2 Wood (Inaccessible)
	145 mph: Use minimum Class 2 *MUST* meet EWL	145 mph: Use minimum Class 2	
Concrete	Use minimum III-G[3] or III-H poles	Use III-G[3] or III-H poles to match existing line	Use III-H Concrete Poles

Notes: [1)] To be used when replacing equipment or installing new equipment on an existing pole.
[2)] Reference Critical Pole List on pg.8.
[3)] Use of III-G poles should be limited to existing concrete lateral pole lines whose wire size is less than or equal to 1/0A.
[4)] Use Pole Foreman to calculate wind loading on all poles.

FPL

Basic Span Lengths for selected poles for Extreme Wind Loading:

Facility	Phase(s)	Wire size	Pole size	Recommended Maximum Span Length[4] (FPL with 2 attachments – FPL ONLY)		
				105 MPH	130 MPH	145 MPH
Feeder		3#568 ACAR	Class 2	180' - 230'	125' - 200'	90' - 140'
		3#3/0 AAAC	Class 2	180' - 250'	170' - 250'	120' - 220'
Lateral	3 PH	3#1/0 AAAC	Class 2	180' - 250'	180' - 250'	155' - 250'
	2 PH	2#1/0 AAAC	Class 3	180' - 250'	180' - 250'	125' - 250'
	1 PH	1#1/0 AAAC	Class 3	180' - 250'	180' - 250'	150' - 250'

[4]The lower number equates to the maximum span for FPL primary and two 1" foreign attachments. The higher number equates to the recommended maximum span for FPL primary only. Reference the DERM Addendum for EWL tables 4.2.2-8, 4.2.2-9, 4.2.2-10 when adding additional attachment(s) or equipment. As always, good engineering judgment, safety, reliability, and cost effectiveness should be considered.

Service / Secondary / St. Light / Outdoor Light Poles:

When installing or replacing a service or street light poles, a minimum of Class 3 wood pole should be used. Specific calculations may require a higher class pole for large quadruplex wire.

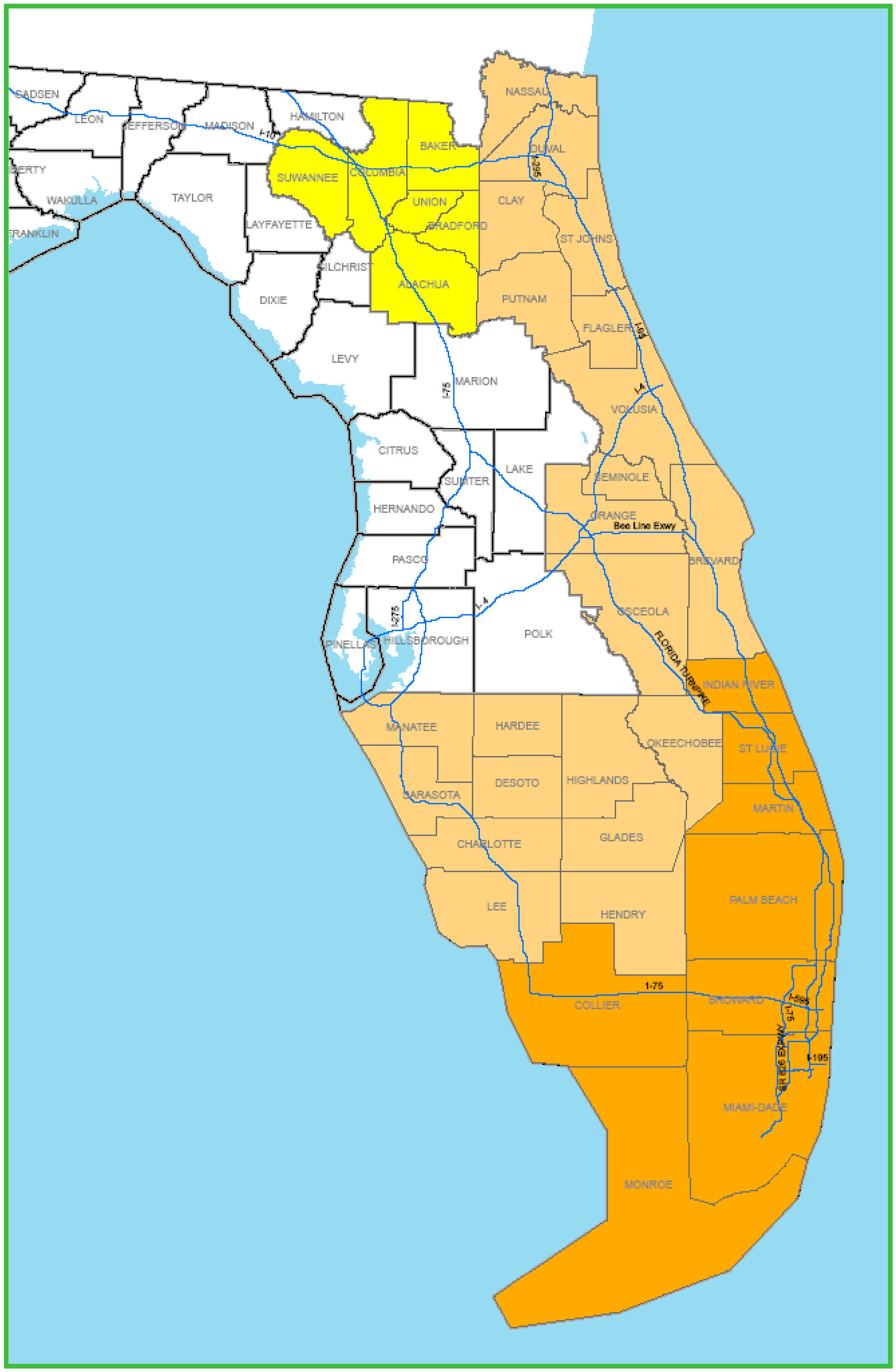
For any questions on pole sizing to meet EWL or running Pole Foreman to calculate windloading, please contact the CMC Hardening Group.

FPL

Extreme Wind Loading (EWL) 3 Zone Map

- 105 MPH
- 130 MPH
- 145 MPH

Wind Zone	County
130	Alachua
105	Baker
105	Bradford
130	Brevard
145	Broward
130	Charlotte
130	Clay
145	Collier
105	Columbia
145	Miami-Dade
130	De Soto
130	Duval
130	Flagler
130	Glades
130	Hardee
130	Hendry
130	Highlands
145	Indian River
130	Lee
130	Manatee
145	Martin
145	Monroe
130	Nassau
130	Okeechobee
130	Osceola
130	Orange
145	Palm Beach
130	Putnam
130	Sarasota
130	Seminole
130	St Johns
145	St Lucie
105	Suwannee
105	Union
130	Volusia



Notification of FPL Facilities

Form 360, Notification of FPL Facilities, is to be used for all construction projects. Please include a copy of this form in negotiations with builders and developers. This form can be found on the DCS Website under “Letters and Agreements”, or in WMS on the “Reports” menu item for the work request.

ADDENDUM

TO FPL'S PERMIT APPLICATION PROCESS MANUALS,
ATTACHMENT AGREEMENTS AND JOINT USE AGREEMENTS

FPL ATTACHMENT STANDARDS AND PROCEDURES

February 15, 2016

TABLE OF CONTENTS

I. SAFETY

SAFETY

It is the responsibility of the attacher to ensure that all persons involved with the application for attachment to FPL poles, and all persons involved with the field engineering, design, installation, construction and ongoing maintenance of these attachments, comply with all applicable federal, state and local safety laws and regulations including the Occupational Safety and Health Act, the National Electrical Safety Code (NESC), any requirements of FPL and any additional safety requirements requested by FPL.

It is also the responsibility of the attacher to warn its employees and contractors that electrical facilities are high voltage facilities and to inform these persons as to safety and precautionary measures which he or she must use when working on or near FPL poles and other facilities.

Proper guying of cables must be accomplished by the attacher.

To ensure that poles are always accessible for workers, particularly in locations inaccessible to bucket trucks, cable risers installed on FPL poles must not interfere with climbing space on the pole.

With the exception of pole-top antennas, second and third party attachments will be limited to the NESC designated communication space below the electrical supply space on all distribution poles with FPL attached. At no time may the communication/CATV worker encroach upon the electric supply space on the pole. Pole-top antenna work within or above the power supply space may only be made by FPL or FPL’s approved contractor with a work schedule approved by FPL. Governmental Entities requesting attachments to FPL street light facilities may have certain attachments (e.g. banners, holiday decorations, etc) to those facilities provided that the attachments are installed in accordance with the terms and conditions of their agreements for the use of such facilities.

For any device emitting radio frequency (RF) radiation, to ensure the health and safety of utility workers, attacher shall install electric service disconnects as part of attacher’s equipment to enable utility crews and personnel to disconnect power when working on the poles used for attacher’s devices. FPL crews will be instructed to disconnect power to attacher’s devices prior to working on the pole and to reconnect power to the devices when the work is complete. Furthermore, the attacher MUST label the device with language that advises the utility worker of the emission of RF radiation and advises the utility worker to disable the device.

FPL's poles routinely have attachments that emit RF radiation. Attachers are required to acknowledge that RF radiation on these poles exists, and that the owner of the device is responsible for the operation of those devices. Attachers are required to familiarize themselves, instruct and warn their employees, agents, contractors and subcontractors who are working around these devices, prior to performing any work or installation on or around any FPL pole.

Attachment of RF emitting devices is limited to one measured and FPL approved output device per pole. Attachers may not attach antennas or other RF emitting devices to a pole if it already has an antenna or RF emitting device installed by FPL or a third-party.

FPL inspects its poles on a routine basis. Poles requiring replacement are tagged by FPL for future replacement. Attachers are required to acknowledge that these tags and FPL's pole tagging convention exist, and that the form of the tags utilized by FPL may change from time to time. Attachers are to familiarize themselves, their employees, agents, contractors and subcontractors with FPL's pole tagging convention and any modifications to that convention, including the form of tag utilized, prior to performing any work or installation on or around any FPL pole.

II. STANDARDS

II. A. ATTACHMENT CRITERIA

No attachment or increase in bundle size of an existing attachment may be made to an FPL pole without prior approval by FPL's permit application vendor or an FPL engineer. (See the Procedures section.) Wireline and telecommunication antenna attachments may only be made to FPL distribution poles. Wireline attachments may be made to transmission poles ONLY if FPL distribution facilities are also attached to the pole and ONLY after receiving written approval from FPL's Transmission Department. Street Light Facilities - Governmental Entities requesting attachments to FPL street light facilities may make certain attachments (i.e. banners, holiday decorations, etc) to those facilities provided that the attachments are installed in accordance with the terms and conditions of their agreements for the use of such facilities. Electric service, if required, will be provided to an off-pole location. Power supplies are not allowed on the pole.

Attachment Criteria – Communication Space

NON JOINT USE POLE
(no telephone)

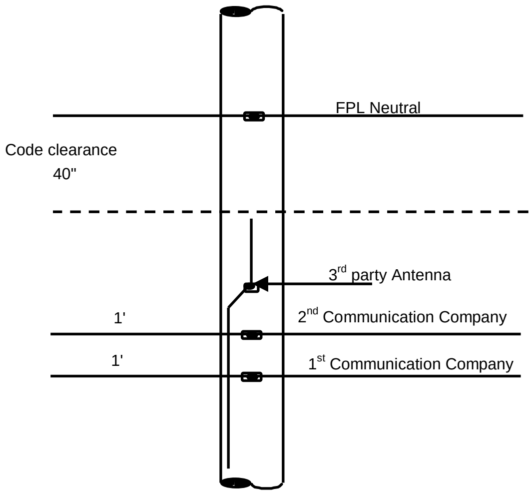


Fig. 1

JOINT USE POLE
(power & telephone)

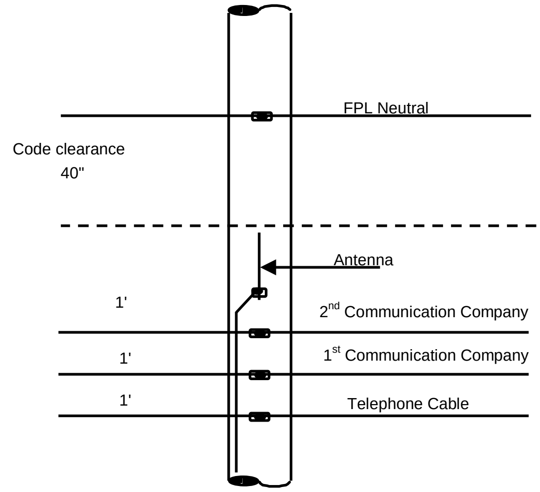


Fig. 2

1. The 1st cable attachment will be located at a height providing minimum clearance over roads, obstacles, etc.
2. All additional cable or antenna attachments will be located 1' above the highest existing communication cable, with antenna highest.
3. The antenna attachment will be a minimum of 1' above highest cable. Only one antenna attachment permitted per pole.

1. The 1st cable attachment will be located 1' above Telephone's highest cable Attachment
2. The 2nd cable attachment will be located 1' above the existing
3. The antenna attachment will be a minimum of 1' above highest communication cable. Only one antenna attachment permitted per pole.

NOTE: No cable or antenna attachment placed in the communication space will compromise the 40" NESC code clearance space.

NOTE: By signing this document, applicant acknowledges that FPL tags poles for replacement and that the form of the tags utilized by FPL may change from time to time and that Applicant, its employees, contractors, subcontractors and agents are familiar with FPL's pole tagging convention and any modifications to that convention, including the form of tag utilized, prior to performing any work or installation on or around any FPL pole.

NOTE: Applicant also acknowledges that FPL's poles routinely have attachments that emit RF radiation. Attachers are required to familiarize themselves, instruct and warn their employees, agents, contractors and subcontractors who are working around these devices, prior to performing any work or installation on or around any FPL pole.

Space Allocation

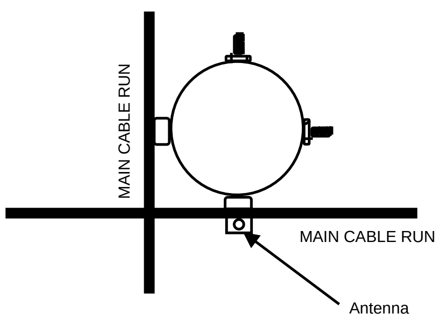


Fig. 3

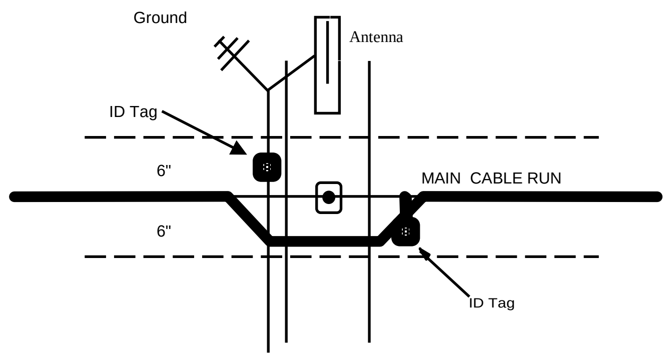


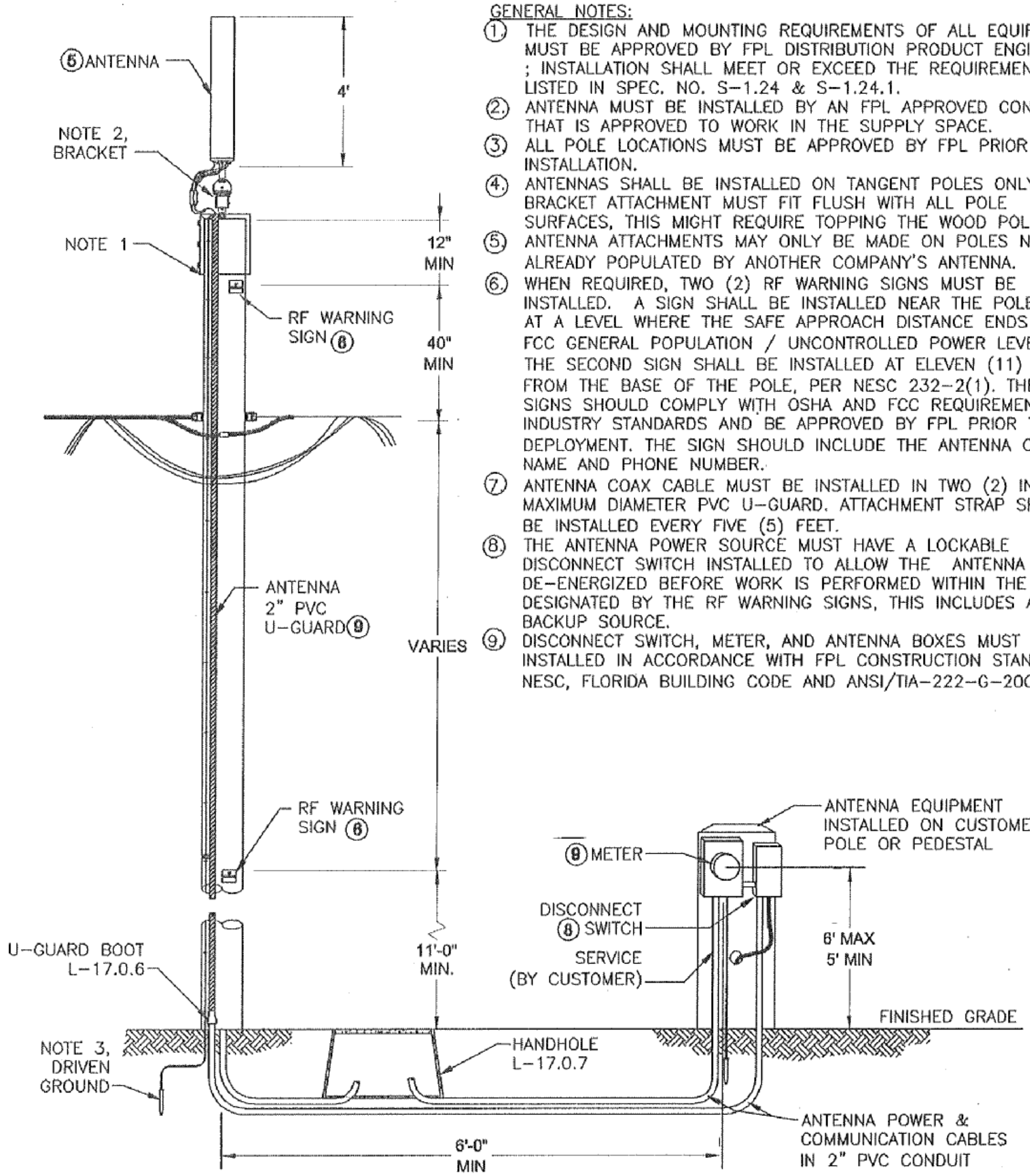
Fig. 4

POLE ATTACHMENT LOCATION
1. Attachment is limited to the communication space.
2. All main cable attachments shall be located either on the same side of the pole as FPL's neutral or on one common adjacent side.
3. No main line cable attachments shall be located on the side of the pole opposite FPL's neutral.
4. All electrical connections must be made off the pole.
5. No more than two risers will be allowed per pole. Keep in mind, FPL's electric service to attacher may be one of these risers.

IDENTIFICATION TAG
1. Each separate attachment shall be identified in accordance with guidelines developed by the FUCC or FPL.
2. Each company shall register their unique ID tag with the FUCC's Joint Use Subcommittee or FPL.
3. Antenna ID tags shall be installed at every pole attachment.
4. Cable ID tags shall be installed at the first and last pole attachment as well as every fifth pole attachment and at every street intersection.

Typical Attachment Criteria for Pole Top Mounted Antennas

E-37.0.4	POLE TOP ANTENNA ON SERVICE POLE	E-37.0.4



GENERAL NOTES:

1. THE DESIGN AND MOUNTING REQUIREMENTS OF ALL EQUIPMENT MUST BE APPROVED BY FPL DISTRIBUTION PRODUCT ENGINEERING ; INSTALLATION SHALL MEET OR EXCEED THE REQUIREMENTS LISTED IN SPEC. NO. S-1.24 & S-1.24.1.
2. ANTENNA MUST BE INSTALLED BY AN FPL APPROVED CONTRACTOR THAT IS APPROVED TO WORK IN THE SUPPLY SPACE.
3. ALL POLE LOCATIONS MUST BE APPROVED BY FPL PRIOR TO INSTALLATION.
4. ANTENNAS SHALL BE INSTALLED ON TANGENT POLES ONLY. THE BRACKET ATTACHMENT MUST FIT FLUSH WITH ALL POLE SURFACES, THIS MIGHT REQUIRE TOPPING THE WOOD POLE.
5. ANTENNA ATTACHMENTS MAY ONLY BE MADE ON POLES NOT ALREADY POPULATED BY ANOTHER COMPANY'S ANTENNA.
6. WHEN REQUIRED, TWO (2) RF WARNING SIGNS MUST BE INSTALLED. A SIGN SHALL BE INSTALLED NEAR THE POLE TOP AT A LEVEL WHERE THE SAFE APPROACH DISTANCE ENDS FOR FCC GENERAL POPULATION / UNCONTROLLED POWER LEVELS. THE SECOND SIGN SHALL BE INSTALLED AT ELEVEN (11) FEET FROM THE BASE OF THE POLE, PER NESC 232-2(1). THESE SIGNS SHOULD COMPLY WITH OSHA AND FCC REQUIREMENTS, INDUSTRY STANDARDS AND BE APPROVED BY FPL PRIOR TO DEPLOYMENT. THE SIGN SHOULD INCLUDE THE ANTENNA OWNER'S NAME AND PHONE NUMBER.
7. ANTENNA COAX CABLE MUST BE INSTALLED IN TWO (2) INCH MAXIMUM DIAMETER PVC U-GUARD. ATTACHMENT STRAP SHOULD BE INSTALLED EVERY FIVE (5) FEET.
8. THE ANTENNA POWER SOURCE MUST HAVE A LOCKABLE DISCONNECT SWITCH INSTALLED TO ALLOW THE ANTENNA TO BE DE-ENERGIZED BEFORE WORK IS PERFORMED WITHIN THE AREA DESIGNATED BY THE RF WARNING SIGNS, THIS INCLUDES ANY BACKUP SOURCE.
9. DISCONNECT SWITCH, METER, AND ANTENNA BOXES MUST BE INSTALLED IN ACCORDANCE WITH FPL CONSTRUCTION STANDARDS, NESC, FLORIDA BUILDING CODE AND ANSI/TIA-222-G-2005.

CONSTRUCTION NOTES:

1. DOUBLE STAPLE TO SECURE POLE BOND.
2. DISCONNECT ANTENNA POWER WHEN WORKING WITHIN SAFE APPROACH DISTANCE DEFINED ON RF WARNING SIGNS.
3. DRIVEN GROUND REQUIRED AT EACH ANTENNA POLE.

FPL

OH & UG DISTRIBUTION SYSTEM STANDARDS

ORIGINATOR: A. RODRIGUZ　　DRAWN BY: E. SCHILLING

DATE: 1/9/12　　APPROVED: WILLIAM MONZON　　NO SCALE

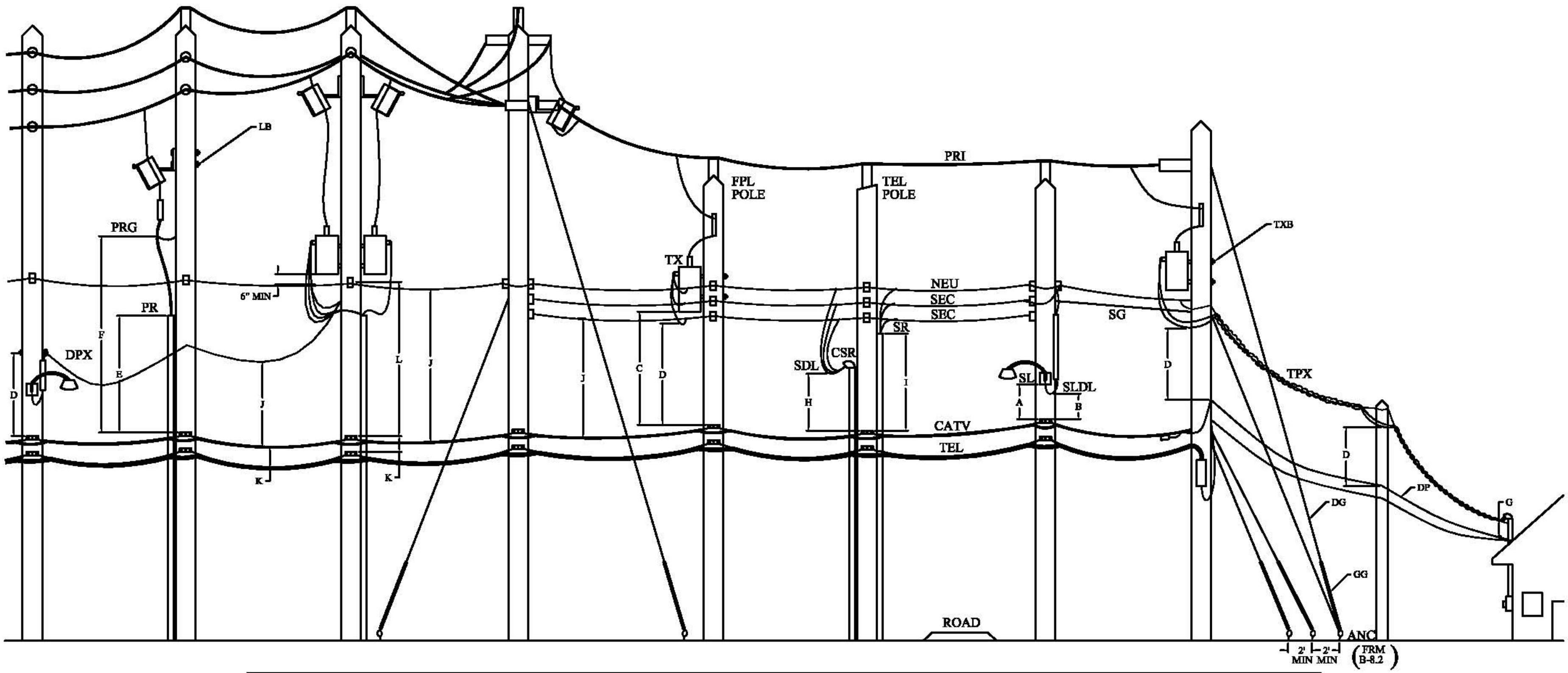
SUPERVISOR, OH/UG PRODUCT SUPPORT SERVICES

NO.	DATE	REVISION	ORIG.	DRAWN	APPR.

II.B. ATTACHMENT CLEARANCES

It is the responsibility of the attacher to ensure that attachments are designed and constructed in accordance with the National Electrical Safety Code, governmental agency and these guidelines, and to secure any necessary permit, consent or certification from state, county or municipal authorities or from the owners of the property to construct and maintain attachments to FPL poles. Wireless antenna clearance requirements are the same as the clearance requirements for CATV and telecommunications facilities.

CLEARANCES OF COMMUNICATION CABLES TO FPL & OTHER FOREIGN UTILITIES



CLEARANCES OF COMMUNICATION CABLES TO FPL & OTHER FOREIGN UTILITIES				
DIMENSION (LETTER)	SEPARATION FROM FOREIGN UTILITIES TO ..	* FPL MINIMUM REQUIREMENT	** NESC MINIMUM REQUIREMENT	NESC APPLICABLE REFERENCE SECTION
A	STREETLIGHT BRACKET	4 INCHES	4 INCHES	238 C. TABLE 238-2
B	STREETLIGHT DRIP LOOP	12 INCHES	12 INCHES	238 D
C	TRANSFORMER BOTTOM	30 INCHES	30 INCHES	238 B. TABLE 238-1
D	SVC DRP LP, SECONDARY	40 INCHES	40 INCHES	235, TABLE 235-5
E	PRIMARY RISER SHIELD	3 INCHES	NONE	239 G1, EXCEPTION 1
F	PRIMARY RISER GROUND	40 INCHES	40 INCHES	239 G1
G	SVC DROP AND DRIP LOOP	12 INCHES	12 INCHES	235 C1, EXCEPTION 3
H	CUSTOMER OWNED	40 INCHES	40 INCHES	TABLE 235-5
	SERVICE DRIP LOOP	16" IF COMMUNICATION CABLE AND RISER OPERATED BY SAME UTILITY		TABLE 235-5 EXCEPTION 3
I	SERVICE RISER	40 INCHES	40 INCHES	239 G7
J	MID SPAN	30 INCHES	30 INCHES	238-1
K	FOREIGN UTILITIES	12 INCHES	12 INCHES AT POLE; 4 INCHES ALONG SPAN	235 H
L	NEUTRAL	40 INCHES ***	30 INCHES	TABLE 235-5 EXCEPTION 6

* FOLLOW FPL MINIMUM ** NESC INFORMATION PROVIDED FOR REFERENCE ONLY *** WHERE NO SEC IS PLANNED BY FPL, 30" MIN CLEARANCE IS PERMISSABLE IF COMMUNICATION IS BONDED TO FPL'S GROUNDING SYSTEM

II.C. WINDLOADING CRITERIA AND CALCULATIONS

Before any additional load is added to an FPL owned pole, it is incumbent upon the attacher to verify that their addition meets FPL's Design Guidelines and Electric Infrastructure Storm Hardening Plan which are included as part of this filing. FPL or FPL's Permit Application Process Contractor will verify that the attacher's calculations conform to the Design Guidelines. Additionally if the load on a pole is increased, evidence that it meets those requirements, through engineering analysis, must be included with the Permit to attach or Notice of Intent to Overlash.

III. PROCEDURES

III.A. PROCEDURES FOR JOINT USERS

FPL and Incumbent Local Exchange Carriers (ILEC) explore the benefits of joint use and share the cost of pole ownership.

New Construction

1. New facilities are designed and built in accordance with FPL's Design Guidelines and Electric Infrastructure Storm Hardening Plan filed with the FPSC and the existing joint use agreement.
2. The joint use agreement for each company dictates which company sets the new pole(s) and how costs are distributed.
3. If FPL is building the new pole line, CIAC will be collected for the increased size and strength required to accommodate the attachments of third parties requesting to attach.

There are times when the ILEC determines they would like to attach to a pole they were not previously attached to or they wish to modify their facilities, which would in turn increase the loading on a pole

Existing Poles

1. If the ILEC is increasing load on the pole, it is imperative for the ILEC engineer to review the engineering calculations at each pole, so that engineering requirements of each pole complies with FPL's Design Guidelines and Electric Infrastructure Storm Hardening Plan filed with the FPSC. This is true if the pole is owned by FPL or the ILEC. FPL encourages the ILEC to discuss with the FPL engineer when determining the design criteria of the pole.
2. If the new attachment would compromise the loading standard, the ILEC engineer may request make-ready from the FPL engineer to accommodate their attachments. A contribution will be charged in accordance with the joint use agreement or supplemental (addendum) agreements that followed it.

III. B. PROCEDURE FOR THIRD PARTIES (CATV AND TELECOMMUNICATIONS CARRIERS (non-ILECs))

1) **APPLY** for permit or submit Notification of Intent to Overlash.

- Create appropriate application package(s) and retain copies for your company:

- Non-make ready – no FPL construction is needed

  - Make ready - requires design, cost approval, invoice, payment, and construction of FPL work order prior to FPL permit approval (includes cases where make ready is necessitated by overlash and where adjustments to FPL facilities on a foreign pole are needed)

- Notification of Intent to Overlash - When overlashing to existing attachments where resulting bundle is heavier than the existing attachment or has an increased diameter over that of the existing attachment and there is no need for make ready

- Remember that permits are not granted for attachments to poles that are exclusively part of an FPL street lighting system.

- The attachment permit is for cables, wires and supporting hardware only, not for power supplies, amplifiers, antennas or similar equipment.

- Review permit application package for accuracy and completeness to avoid rejection.

- Submit complete permit package (Permit number must include submittal year).

2) **RECEIVE** approved Exhibit “A”

3) **CONSTRUCT/QC** attachments.

- You must have an approved Exhibit “A”

- **A copy of the approved Exhibit “A”, highlighted CATV and FPL maps must be available for inspection on the job site during construction of the attachments.**

- You must complete construction within 60 days of approval or permit will automatically expire, and you will need to re-apply.

- Build facilities as designed in approved permit package.

- **Conform to FPL requirements (clearances, tagging, bonding, down guys,**

anchors, guy guards, proper brackets for attachments per reverse side of the Exhibit "A", no stand off or extension arms, etc.) and NESC standards.

- Upon completion of construction, perform quality control review of facilities for compliance and make adjustments if necessary.

4) NOTIFY of construction completion. (Exhibit "B")

- **Send notice monthly (provided there have been attachments/removals during that month). Remember to include all routine attachments to drop or lift poles.**

- Notice (Exhibit "B") must be sent to permit process contractor (Alpine).

- Notice (Exhibit "B") must be sent within 30 days after construction of the attachments is complete.

Additional Steps for Antenna Attachers

Prior to applying for a permit to attach as described above, the attacher must:

1) OBTAIN Equipment Evaluation Approval from FPL

   - Required once for every new piece of equipment to be installed on or above FPL property

   - A copy of the approved Equipment Evaluation Form must be included with each complete permit application package submitted to the permit application vendor.

2) OBTAIN Pole Top Evaluation Approval from FPL, if required

   - A Pole Top Evaluation Package is only required if the antenna will be installed above primary conductor or in-line with a primary conductor pole line.

   - Where required, a unique Pole Top Evaluation is required for each installation, regardless of the pole owner, if FPL has facilities on the pole.

   - A copy of the approved Pole Top Evaluation Package, if required, must be included with each complete permit application package submitted to the permit application vendor of the pole owner.

   - If FPL make-ready is required on a foreign utility pole, a make-ready permit is required from FPL and an attachment permit is required from the foreign utility pole owner.

III.C. PROCEDURES FOR GOVERNMENTAL ATTACHMENTS

Attachment Permits are required for:
- New attachments to FPL poles
- Overlashings of existing attachments to FPL poles where the resulting bundle is heavier than the existing attachment or has an increased diameter over that of the existing attachment
- Major rebuilds or upgrades
- Attachments to non-FPL poles that require FPL make-ready

The attachment permit is for licensee cables, wires and supporting hardware only, not for power supplies, amplifiers or similar equipment.

Wireline attachments are not allowed to be attached to poles exclusively a part of an FPL street lighting system.

Permits requiring FPL make-ready will not be approved until FPL design, payment by the applicant and construction is completed by FPL.

PERMIT APPLICATION PROCESS

1. Field Survey - Identify ownership and pole size and existing attachments, conductor sizes, and span lengths.

2. Complete the Pole & Midspan Measurement Form

3. Ensure that all minimum clearances will be maintained.

4. Calculate windloading.

5. Complete the "Attachment and Application and Permit Exhibit A".

6. Assemble permit package (which may or may not include request for make ready.

7. Review completed package for accuracy

8. Submit package to FPL for approval

9. Once approved make attachments

10. When complete return Exhibit B to FPL

SECTION IV.

PERMIT APPLICATION PROCESS FOR FPL TRANSMISSION POLES (AND TRANSMISSION GUY STUBS)

REVISED 2/1/2016

[NOTE: PERMIT APPROVAL IS BY FPL – TRANSMISSION PROJECTS DEPARTMENT ONLY AND REQUIRES ADDITIONAL TIME TO GAIN APPROVAL]

Application Requirements
Applications will be considered only for transmission poles already having distribution underbuilt facilities.

All applications for attachment to transmission poles require complete structural calculations. Applicant shall demonstrate that the poles can withstand the additional proposed mechanical and environmental loads. Calculations shall be provided with input and GT-STRUDL output forms, with non-linear analysis results and structural summary, signed and sealed by a Professional Engineer – Structural, licensed in the State of Florida.

Application Costs
The cost associated with reviewing the application calculations will be the responsibility of the applicant. Review of calculations for approval is performed by FPL Transmission at a cost of $175 per manhour (regardless of final approval or disapproval of the request). A deposit of $5,000 dollars, payable to FPL, is required for quantities of up to 25 poles.

Application Process
Submit completed application to FPL Representative (same as for distribution attachments). Your representative will review the application for completeness. Completed applications will be forwarded to FPL's Transmission Projects Group for review.

1.0 DESIGN CRITERIA

When more than one code applies, the more stringent criteria shall govern.

1.1 CLEARANCES

Any overhead cable installation shall comply with FPL 2012 NESC Basic Clearances for Overhead Transmission Lines (or later published standard), the National Electric Safety Code (NESC)-2012 (or latest version adopted by the Florida Public Service Commission) or other governmental agency codes.

1.2 DESIGN LOADS

1.2.1 POLE DESIGN
Design loads shall meet the specifications defined in the National Electric Safety Code (NESC)-2012, the American Society of Civil Engineer (ASCE) ASCE/ANSI 7-05 "Minimum Design Loads for Buildings and Other Structures" and ASCE Manual 74, "Guidelines for Electrical Transmission Line Structural Loading" (2009). For structures with cellular antennas, design shall meet, in addition to the others listed, the specifications defined in ANSI/TIA/EIA 222, "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures".

STEEL TRANSMISSION STRUCTURES
Designs shall meet the specifications defined in the ASCE Standard 48-11, "Design of Steel Transmission Pole Structures",

and ASCE Standard 10-15, "Design of Latticed Steel Transmission Structures".

CONCRETE TRANSMISSION POLES
Designs shall meet the specification defined in the ASCE Manual 123 "Prestressed Concrete Transmission Pole Structures: Recommended Practice for Design and Installation" (2012).

WOOD TRANSMISSION POLES
Designs shall meet the specification defined in the IEEE Standard 751 "Trial-Use Design Guide for Wood Transmission Structures" and ANSI O5.1, "Specifications and Dimensions for Wood Poles" (2015).

1.2.2 WEATHER RELATED LOADS

Transmission poles are required to resist the weather-related loads (Extreme Wind and Ice/Wind). The applied wind load cases that need to be considered for transmission structures from ALL angles are defined as follows:

District Loads (NESC Section 250 B)

FPL service territory is classified as the "Light Loading District".

Extreme Wind Loads (NESC Section 250 C)

ASCE 7-05 "Minimum Design Loads for buildings and Other Structures" and ASCE Manual 74, "Guidelines for Electrical Transmission Line Structural Loading" (2009) are the basis of this control criteria. The Importance Factor is 1.15 for this load case.

Extreme Ice with Concurrent Wind loads (NESC Section 250 D)

ASCE 7-05 "Minimum Design Loads for buildings and Other Structures" and ASCE Manual 74, "Guidelines for Electrical Transmission Line Structural Loading" (2009) are the basis of this control criteria. The Importance Factor is 1.15 for this load case.

Serviceability Requirements

45–mph, 3-second gust wind load is considered as the minimum wind load applied for the zero-tension condition, which is only applied to prestressed concrete poles. This load case is also used for deflection criteria for all structure types. The calculation of the wind pressure also follows the requirements of ASCE 7-05 "Minimum Design Loads for Buildings and Other Structures" and ASCE Manual 74, "Guidelines for Electrical Transmission Line Structural Loading" (2009). The Importance Factor is 1.0 for this load case.

1.2.3 OSHA REQUIREMENTS

This project shall be designed to meet all Occupations Safety and Health Administration (OSHA) rules and regulations.

2.0 PERMIT PACKAGE

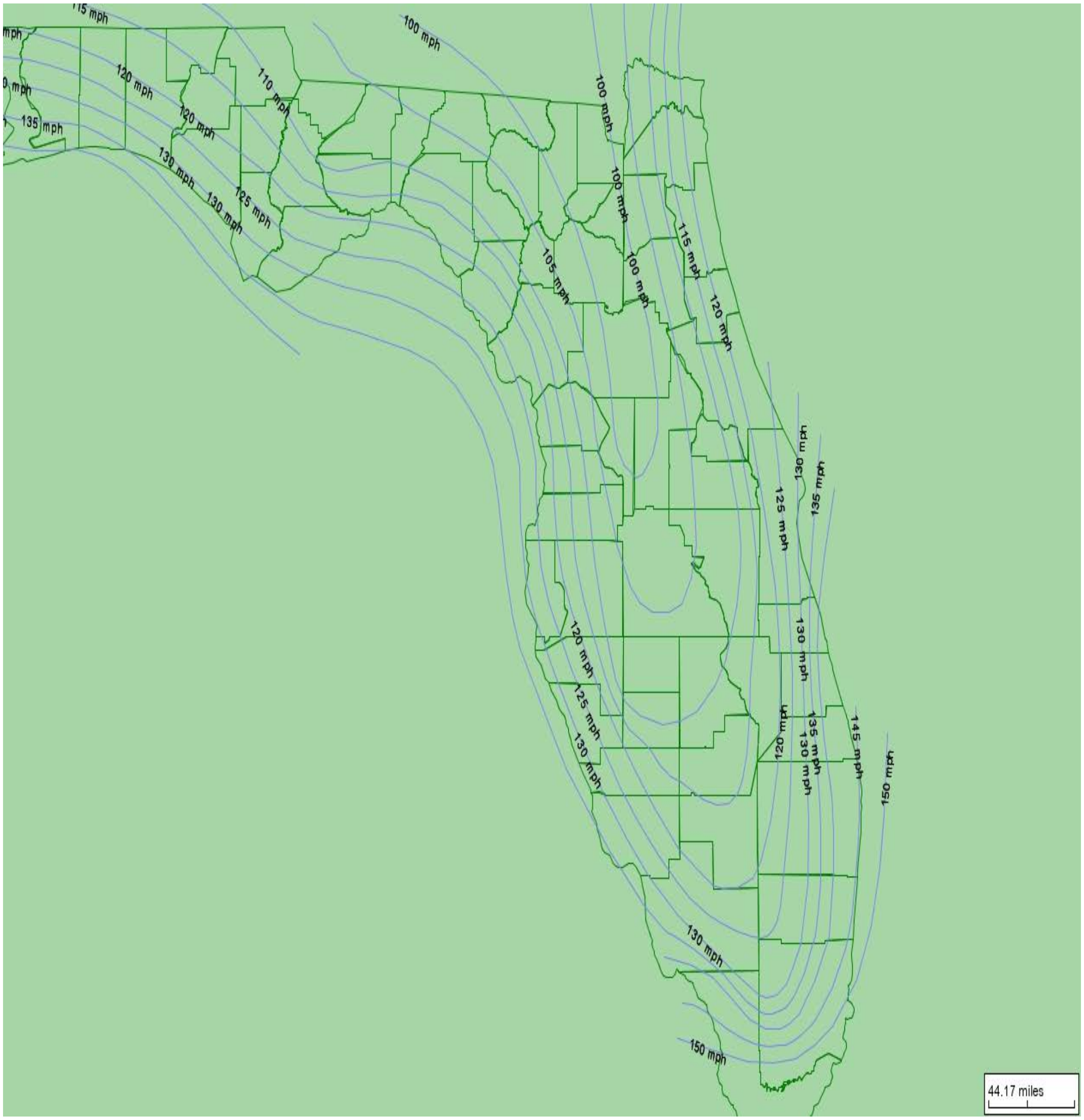
A permit application shall consist of two (2) complete packages in the following order:

1) Payment for Permit (payable to FPL)
2) Original, signed Exhibit "A" (front and back)
3) Calculations (signed and sealed)
4) Field Notes
5) Pictures of all affected poles, with corresponding pole identification numbers (photographs or jpeg files)
6) Licensee maps (plan/profile) showing route, spans, pole heights, and the Licensee facilities proposed for installation
7) Copy of the FPL Primary Map, with the affected area highlighted

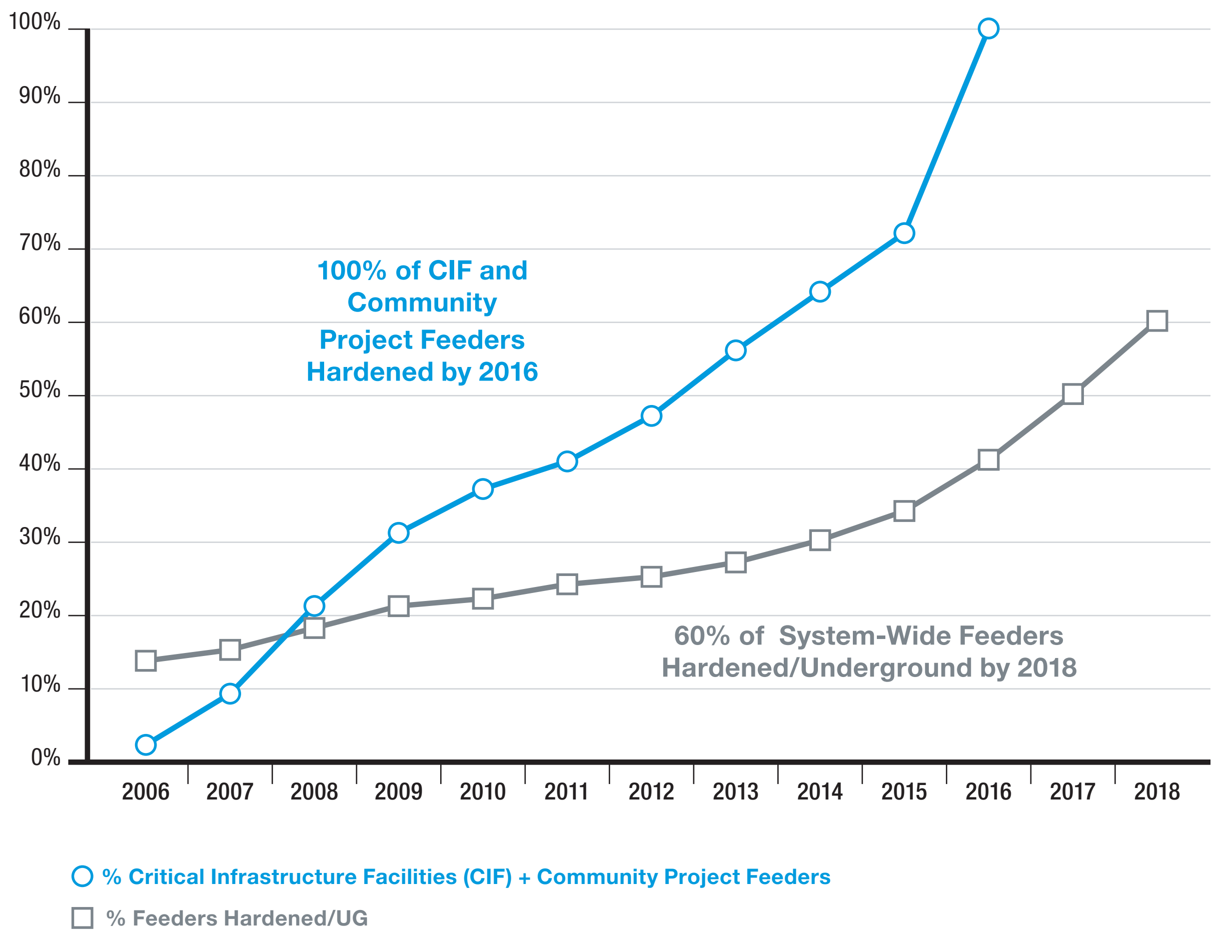
3.0 APPROVAL / DISAPPROVAL

Upon review of the permit application, a response stating approval or disapproval will be communicated by the FPL – Transmission Projects Department.

FLORIDA WIND ZONES-2002



Percentage of FPL Feeders Hardened/Underground



While much of FPL's T&D infrastructure has been hardened – additional work remains