FPL

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May 3, 2010

-VIA HAND DELIVERY -

Ms. Ann Cole
Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Blvd.
Tallahassee, FL 32399-0850

100266-EI

Re: Florida Power & Light Company's Electric Infrastructure Storm Hardening Plan, filed in compliance with Rule 25-6.0342, F.A.C.

Dear Ms. Cole:

I am enclosing for filing in the above docket the original and seven (7) copies of the Petition of Florida Power & Light Company for Approval of Storm Hardening Plan, together with a diskette containing the electronic version of same. The enclosed CD is HD density, the operating system is Windows XP, and the word processing software in which the document appears is Word 2003.

If there are any questions regarding this transmittal, please contact me at 561-304-5633.

Sincerely,

Scott A. Goorland

COM ____
APA ____
ECR 4 + CD
GCL 1
RAD 1
SSC 1
ADM ____
OPC ____
CLK ____

Enclosures

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: approval of Florida Power & Light Company's storm hardening plan pursuant to Rule 25-6.0342, F.A.C.	)))	Docket No. Filed: May 3, 2010

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

Florida Power & Light Company ("FPL") hereby petitions the Commission for approval of its Electric Infrastructure Storm Hardening Plan attached hereto as Exhibit 1 (the "FPL Plan"), which is submitted in compliance with Rule 25-6.0342, F.A.C. In support of this Petition, FPL states as follows:

1. FPL is a public utility subject to the regulatory jurisdiction of the Commission under Chapter 366, Florida Statutes. The Company's principal offices are located at 9250 West Flagler Street, Miami, Florida.

2. All notices, pleadings and other communications required to be served on the petitioner should be directed to:

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3. 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. Also, Order No. PSC-07-1023-FOF-EI, issued in Docket No. 070301-EI on December 28, 2007 ordered FPL

to file the updated plan by May 1, 2010. Since May 1, 2010 is a Saturday, the filing deadline becomes May 3, 2010 and the updated FPL Plan is timely filed.

4. 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 FPL Plan contains a detailed description of FPL's deployment plans for 2010, which is the only year for which FPL's planning and budgeting process has progressed to the point that such details are available. The Plan also includes a higher-level discussion of FPL's current expectations for deployment in 2011 and 2012. Details of FPL's plans for 2011 and 2012 will be subsequently provided consistent with the "Process to Engage Third-Party Attachers", which was stipulated by all parties in Docket No. 070301-EI.

5. As contemplated by subsection (6) of Rule 25-6.0342, FPL has sought input from joint users and third-party attachers. On March 12, 2010, FPL sent a detailed information package on its storm hardening plans 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 April 9, 2010. 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 April 26, 2010, eight attaching entities have contacted FPL regarding the FPL Plan. No attaching entity provided any cost or benefit information, expressed any concern with or suggested any changes to FPL's Plan.

6. The FPL Plan will continue to increase the storm resilience of FPL's transmission and distribution system. At the same time, the FPL Plan is carefully structured to achieve this

increased storm resilience in a cost-effective manner. Implementation of the FPL Plan is expected to benefit FPL customers during and after future storm events by reducing the extent of power outages, especially for critical functions such as hospitals and governmental services as well as businesses such as grocery stores, gas stations and pharmacies that meet essential community needs. Moreover, to the extent that FPL's hardened electric service facilities are better able to survive storm events undamaged, customers will also benefit due to a reduction in storm restoration costs. And because of the emphasis in the FPL Plan on cost-effective implementation, the cost of achieving these benefits will be minimized.

7. In order to deliver storm resilience benefits cost-effectively, the FPL Plan contemplates a continuation of its previously approved three-prong approach to storm hardening FPL's distribution system:

a. In the first prong, FPL intends to continue to apply the National Electrical Safety Code ("NESC") extreme wind loading ("EWL") design criteria to the electric facilities that serve critical infrastructure such as hospitals, 911 centers, special needs shelters, water treatment plants and fire stations (these critical services, and the electric facilities that serve them, are referred to as "CIFs") as well as specific poles that are important to overall restoration and relief efforts (these poles are referred to as "Targeted Critical Poles"). FPL believes that the expense of EWL design is warranted for these categories of electric facilities because the resulting storm resilience will be especially beneficial to FPL's customers. FPL notes that the application of EWL design criteria to electric facilities for all hospitals in FPL's service territory has been completed.

b. In the next prong, which is referred to as "Incremental Hardening," FPL increases the overall wind profile of certain main distribution lines (called "feeders") to a higher wind rating, up to and including EWL. Incremental hardening applies appropriate combinations of cost-effective engineering options (e.g., storm guying, relocation, adding intermediate poles, upgrading the pole) to eliminate weak links and take advantage of the existing storm resilience of a circuit. The focus of Incremental Hardening is on feeders serving businesses that meet essential community needs, such as grocery stores, gas stations and pharmacies.

c. The final prong in FPL's storm hardening approach is the continued application of previously approved design guidelines for poles that are set or replaced in conjunction with new construction, major planned work, relocation projects and daily work. The FPL Plan continues to include standardized pole size/type specifications to be used in those circumstances. The specifications reflect the utilization of stronger poles and shorter span lengths for the facilities that are subject to the new design guidelines. This results in stronger designs that are consistent with EWL and are intended to facilitate the evolution of FPL's overall distribution system to EWL criteria over time.

8. FPL's transmission system is already built to EWL standards and generally fared well in the 2004 and 2005 storm seasons. Nonetheless, based on experience with the performance of the system, including specific lessons learned from those storm seasons, FPL is continuing two initiatives system-wide to further improve the storm resilience of its transmission and substation system: replacement of all wood transmission structures (expanded from the originally approved initiative to replace single pole un-guyed wood transmission structures); and replacement of ceramic post insulators on all concrete transmission poles with polymer post insulators. These two initiatives were initially approved by the Commission as part of FPL's "Storm Preparedness Initiatives," in Order No. PSC-06-0781-PAA-EI, Docket No. 060198-EI, dated September 19, 2006 (the "Storm Initiatives Order"). FPL incorporates its Storm

Preparedness Initiatives and the Commission's Storm Initiatives Order herein by reference. FPL forecasts completion of these two transmission system hardening initiatives over the next 10 to 15 years for insulators and 25 to 30 years for wood pole replacement. FPL will prioritize the work based on factors including proximity to high wind areas, system importance, customer density, 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.

9. As contemplated by subsection (5) of Rule 25-6.0342, the FPL 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.

10. In 2010, FPL plans to spend approximately $45-$55 million on deploying its hardening plans for the distribution system. This includes plans to harden 44 feeders, including 39 feeders which provide service to CIF customers and five feeders serving special community needs. Additionally, FPL will harden critical poles at 16 highway crossings and 20 "01" switches. The Design Guidelines will be utilized system-wide for all new construction and daily work. In total, FPL's 2010 infrastructure hardening deployment plan for its distribution system will impact approximately 175 miles of overhead electric circuits. In addition, FPL expects to replace approximately 750 wood transmission structures and to replace ceramic insulators on about 72 concrete transmission poles in 2010.

11. As discussed in Paragraph 4 above, FPL's planning and budgeting process cannot provide equivalent detail at this time about deployment plans for 2011 and 2012. In general, FPL expects to annually harden approximately 40-55 feeders in 2011 and 2012 with costs

ranging from $44-$55 million for each of these years. For both years, most of the hardened feeders will serve CIF customers and community projects. Of course, FPL's 2011 and 2012 deployment plans may change based on FPL's experience with deployment in 2010 and other factors. For the transmission system, FPL expects to continue implementing the two initiatives described above at approximately the same rate in 2011 and 2012 as it is in 2010 .

12. FPL expects a reduction in storm restoration costs as well as non-storm (day to day) restoration costs ("Restoration Cost Savings") as a result of its planned hardening activities, especially when one considers the interaction among all of FPL's Storm Secure initiatives, including the FPL Plan, pole inspections, and increased vegetation management activities.[1] FPL has conducted an analysis of the average Restoration Cost Savings per mile of feeder for all planned hardening activities, and the estimated cost of those activities. The Restoration Cost Savings are expressed as a range at this time, 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. The second important uncertainty is how frequently FPL's service territory will be impacted by strong hurricanes. Based on a historical average, this will occur once every five years. However, as was experienced with the 2004-2005 hurricane seasons, strong hurricanes can periodically occur more frequently. The estimate of cumulative Restoration Cost Savings over time will be directly affected by how frequently storms hit FPL's

1 Of course, FPL's system is very diverse and geographically large. As a result, it will take many years of sustained effort to achieve these changes in the resiliency of FPL's system.

service territory. Takin g 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% to 70% 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, if FPL were to face major storms more frequently than that, as it did in the 2004-2005 hurricane seasons, then the net present value of Restoration Cost Savings likely would exceed the hardening costs. In addition to Restoration Cost Savings, it is also important to note that 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.

13. In summary, the FPL Plan is a cost-effective approach to increasing storm resilience in ways that will most benefit FPL's customers. Its deployment is structured to focus initially on providing the most critical and essential benefits to the greatest number of customers, with broader based implementation thereafter. This is the most efficient approach to achieving useful storm resilience as promptly as possible at a reasonable cost. The FPL Plan complies with all of the requirements of Rule 25-6.0343 and should be approved by the Commission expeditiously as a prudent commitment of resources to meeting the Commission's storm hardening goals.

WHEREFORE, FPL respectfully requests the Commission to approve FPL's storm hardening plan attached hereto as Exhibit 1.

Respectfully submitted,

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By: ______________________
Scott A. Goorland
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Florida Power & Light Company

Electric Infrastructure Storm Hardening Plan

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

May 3, 2010

Florida Power & Light Company
Electric Infrastructure Storm Hardening Plan

EXECUTIVE SUMMARY

The 2004 and 2005 hurricane seasons were the most extraordinary and challenging on record for Florida Power & Light Company (FPL) and its customers. Five direct landfalls and two indirect impacts in FPL's service territory resulted in significant customer outages and required extraordinary efforts to rebuild and restore the electric infrastructure. As a result, FPL concluded that fundamental and significant changes in the design, construction and operation of its system were required. Concurrently, the Florida Public Service Commission ("FPSC" or "Commission") was undertaking its own initiatives regarding storm preparedness and infrastructure hardening.

Ultimately, in 2006 and 2007, following various FPSC staff workshops, meetings, docketed proceedings, new rules, review and approval of various FPL plan submittals and the issuance of final orders, FPL now has in place:

- 8-year distribution and 6-year transmission pole inspection cycles;
- a 3-year average trim cycle for feeders, a plan to achieve a 6-year average tree trim cycle for lateral circuits and trimming of circuits serving top critical customers before the peak of each storm season; and
- a Governmental Adjustment Factor (GAF) tariff, which includes FPL investing 25% in applicable local government sponsored overhead to underground conversions.

Additionally, in compliance with the FPSC's newly adopted Rule 25-6.0342, Florida Administrative Code (F.A.C.), FPL filed and received approval for its detailed electric infrastructure hardening plan for the period 2007-2009.

Two key conclusions were drawn by FPL following the 2004 and 2005 storms seasons and FPL's forensic data analysis. These conclusions continue to form the basis for FPL's plan and are as follows:

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

Although no electrical system can be made fully resistant to hurricane impacts, FPL continues to believe that its proposed hardening plan will mitigate the impact of future storms. As a result, FPL's plan proposes a continuation of its previously approved three-prong approach for 2010 -2012. The three prongs, each of which serves a different purpose under the plan, are EWL, Incremental Hardening, and Design Guidelines. This approach continues to allow FPL to obtain hardening benefits across its entire service territory promptly and cost-effectively. Specifically, FPL will continue to:

- Apply EWL to existing and new feeders (main distribution lines) as well as any associated laterals directly serving Critical Infrastructure Facilities (CIF) (i.e., critical customers such as hospitals and 911 centers, and certain poles critical to operations and efficient restoration). Feeders are the backbone and therefore a critical component of FPL's overhead distribution system. Feeder performance can have a substantial impact on the overall service reliability to FPL's customers.
- Apply Incremental Hardening to certain existing feeders so that, with targeted cost-effective modifications, the entire feeder's wind profile can be increased, up to and including EWL. Incremental Hardening focuses on "Community Projects", meaning feeders serving essential community needs such as grocery stores, gas stations and pharmacies.
- Utilize system-wide FPL Design Guidelines containing criteria which will apply EWL to the design and construction of all new overhead facilities, major planned work, relocation projects, as well as daily work activities. These guidelines primarily are associated with changes in pole class, pole type and desired span lengths.

In 2010, FPL plans to harden 44 feeders, including 39 feeders which provide service to CIF customers and 5 feeders serving special community needs. Additionally, FPL will harden 16 highway crossings and 20 "01" switches. Costs associated with this work are estimated to range from $45-$55 million. FPL will also continue to implement hardening criteria for new construction, major relocations and other work. In 2011 and 2012, FPL expects to continue its strategy for hardening its infrastructure, including targeting 40-55 circuits annually. The projected annual costs for 2011 and 2012 are estimated to be $45-$55 million.

As noted earlier, FPL's transmission system is already built to EWL standards and performed well during the 2004 and 2005 storm seasons. However, to further improve its transmission and substation system, FPL has been replacing wood transmission structures and ceramic post insulators on concrete poles to meet more current and stringent design standards. These actions are consistent with FPL's approved plan for Storm Preparedness Initiative No. 4 in Docket No. 060198-EI.

As provided in Docket No. 070301-EI, in which the FPSC reviewed and approved FPL's 2007 – 2009 plan, as well as in this filing, FPL's storm hardening plan should result in less storm damage to the electrical infrastructure and therefore less restoration time and related costs. For example, in another Hurricane Wilma type event, FPL estimates that hardened feeder pole failure rates and associated restoration time, based on construction man-hours, 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. The costs and benefits of FPL's response to the Commission's requirement in Docket No. 060198-EI for 10-point storm implementation plans were discussed in FPL's "Storm Preparedness Initiatives" document, which was filed, reviewed and approved in that docket and is incorporated herein by reference. Additionally, day-to-day reliability benefits are being realized with hardened feeders. Finally, improved systems and processes, including improved storm forensics, will allow for more and better data to be collected, evaluated and analyzed. Of course, FPL's system is very diverse and geographically large so it will take many years of sustained effort to achieve the full benefits of storm hardening.

While there will be benefits from FPL's storm hardening and preparedness initiatives, it remains nearly impossible at this time to estimate the full extent of the benefits with any precision. The actions described above continue to represent industry leading changes in construction standards, maintenance practices and restoration processes. The analyses and forensic observations performed after Hurricanes Katrina and Wilma serve as the foundation for FPL's hardening efforts, but there is presently limited or no historical data available for purposes of conducting overall cost/benefit analyses on many of these new actions. As additional storm experience, more and better data, new improved processes, products and materials become available, better detailed cost /benefit analysis will be performed and more cost-effective hardening solutions implemented. In the meantime, FPL believes that continuing to implement its current hardening approach (targeting critical infrastructure for EWL, the application of Incremental Hardening for community projects, and the utilization of the Design Guidelines) remains in the best interest of its customers.

In conclusion, without fundamental and significant changes in the way the electric infrastructure is constructed to harden and prevent outages, FPL believes the level of disruptions to its infrastructure from future storms would be much like that experienced in the 2004 and 2005 hurricanes season. It is important to note, however, that despite the implementation of these initiatives, when severe weather events impact the state – outages will occur. It is FPL's intention, however, to take the steps necessary to mitigate such impact. The tactical and strategic initiatives and plans FPL is pursuing, including the hardening plans included in this filing, not only address the resiliency of FPL's system to future severe weather events, but also provide for an increased level of day-to-day reliability for its customers. As new technologies become available and process enhancements and other improvement opportunities are identified, FPL will continue to make refinements to these plans.

INTRODUCTION

In compliance with Rule 25-6.0342, F.A.C., the following provides details on FPL's electric distribution and transmission infrastructure storm hardening plans.

DISTRIBUTION

1.0 HISTORY / BACKGROUND

Two extraordinary hurricane seasons in 2004 and 2005 made it clear that significant changes are 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. Standards that worked well and provided customers with reliable service in the past need to be enhanced going forward. For example, Florida generally, and South Florida in particular, is much more heavily and densely populated than it was at the time of Hurricane Andrew; customers' expectations have changed over time; there has been evidence presented that suggests Florida may be in a more active part of a multi-decade hurricane cycle and can expect more frequent storm events. Even if 2004 and 2005 were anomalies, as long-term statistics suggest, FPL must be prepared for further, significant storm activity in the years ahead.

Although no electrical system can be rendered fully resistant to hurricane impacts, FPL's storm hardening and preparedness initiatives, including its proposed hardening plan for 2010-2012, benefit its customers and communities. Continuing FPL's storm hardening approach to new construction, system upgrades and maintenance will provide significant improvements in FPL's system's resiliency to storms and its restoration time after a storm passes. Additionally, it will ensure that a critical mass of providers of basic services, essential to the health and safety of its communities, will have electric service as promptly as possible after a hurricane strike.

The foundation for FPL's detailed hardening plan is the extensive analyses that FPL conducted either directly, or with the aid of external resources, e.g., KEMA, Incorporated. 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" was the predominant root cause of distribution pole breakage as opposed to, for example, trees or other flying debris. This key data and the overall performance of FPL's transmission poles, which are already built to the NESC extreme wind criteria, forms the basis for FPL's proposal that certain parts of its distribution system be built to this highest criteria.

It is important to keep in mind that in order to achieve changes to the resiliency of FPL's system, it will take many years of sustained effort. FPL's system cannot be changed overnight. It is very large, geographically diverse and all parts of the system are susceptible to hurricane impact.

Additionally, it is important to not focus on any one aspect. 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 relatively small proportion of the total damage. For example, FPL and every other utility experience pole breakage during hurricane conditions. However, 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 fallen trees, etc.

Over time, substantial improvements to FPL's system will have cost implications for customers. To help control those costs and to get the most system improvement possible, as soon as possible, FPL has carefully developed its programs to focus early 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 2007-2009, FPL hardened 159 feeders to EWL, including 5 feeders critical to FPL power plant operations. These feeders primarily serve 154 CIF customers and total over 500 miles. An additional 112 CIF, served by these same feeders, also benefited from the EWL hardening improvements. CIF customers served by these hardened feeders include acute care facilities, hospitals, 911 centers, special needs shelters, and county emergency operation centers located throughout FPL's service territory. FPL also hardened to EWL 103 highway crossings and 192 "01" switches. During this same period, FPL also utilized its Incremental Hardening approach to address 65 feeders (approximately 150 miles) serving essential community needs such as grocery stores, gas stations and pharmacies and 3 feeders (approximately 30 miles) critical to FPL power plant operations. Finally, in 2007-2009 FPL also applied EWL to the design and construction of all new overhead facilities, major planned work, relocation projects as well as daily work activities.

The total costs for the 2007-2009 CIF and community project hardening efforts were $162M. The incremental costs associated with the hardening of newly installed overhead facilities, major planned work, relocation projects and daily work activities are not tracked.

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 2007. 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 is not intended to design facilities for the sorts of extreme wind speed that can be experienced during hurricanes.

2.1 Extreme Wind Loading Criteria (EWL)

EWL is calculated using the wind speeds shown in Figure 250-2(d) of the NESC for Florida. 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. The NESC requires the use of EWL for facilities that exceed 60 feet above ground or water level – normally transmission level structures.

2.2 FPL Compliance

Historically, FPL has in general utilized Grade B construction for all distribution lines, except as previously noted. There are also portions of FPL's where Grade C construction was utilized based on a probabilistic study of hurricanes at that time. 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. The DERM Addendum and DCS were last updated in March 2010 and December 2008, respectively.

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 proposes to continue 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, as well as, certain critical poles. 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, will target existing feeders, that with targeted modifications, the entire feeder's wind profile can be increased, up to and including EWL. The third prong will continue to use the system-wide implementation of FPL's Design Guidelines, which apply EWL criteria to the design and construction of all new overhead facilities, major planned work, relocation projects and daily work activities. 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 more cost-effective work methods are developed. 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, FPL proposes to continue implementing the application of EWL into three wind regions, corresponding to expected extreme winds of 105, 130 and 145 mph.

FPL reviewed its practices and procedures and determined that the most effective option for implementation of the extreme wind map would also be by county. Each of the counties that FPL serves was evaluated by applying the highest wind rating for that county. FPL decided on the three extreme wind regions of 105, 130 and 145 mph for the following reasons:

- A smaller number of wind regions generate advantages through efficiency of work methods, training, engineering and administrative aspects such as standards development and deployment.
- 105, 130 and 145 mph is a well balanced approach to meet the EWL criteria in the counties within each region.

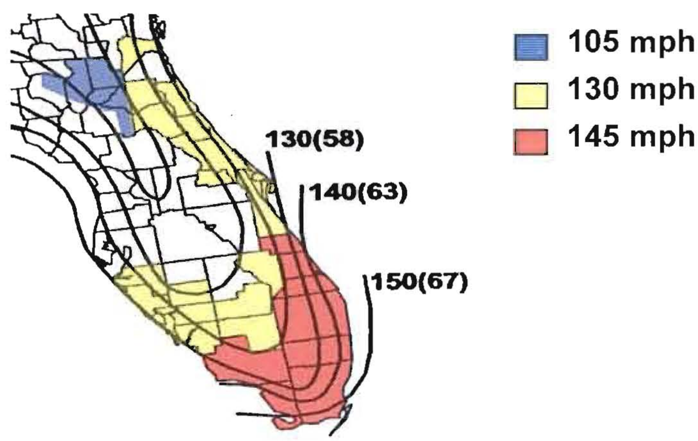


Figure 4-1 FPL Extreme Wind Regions (Meter/Sec)

Note: For the sparsely populated extreme southern tip of FPL's service territory, the design EWL wind speed will be 150 mph.

5.0 APPLICATION OF NEW DESIGN AND CONSTRUCTION STANDARDS

5.1 EWL

EWL will be applied to Top CIF feeders and any associated laterals directly serving critical customers. These facilities are critical and essential to the health, safety, welfare and security of the public. Examples of customers served by these facilities include hospitals, 911 Centers, Emergency Operations Centers (EOCs), water treatment plants, police and fire stations. To help identify these facilities, FPL has established a partnership with local EOCs, who assisted in providing input and selecting the most critical facilities. Based on this list, FPL's proposed plan is to harden these facilities to EWL where feasible, practical, and cost-effective.

EWL will also be applied to poles included in FPL's Targeted Critical Pole (TCP) Program. FPL's TCP Program focuses on poles that can impact restoration efforts. This program includes poles associated with overhead limited access highway crossings. If these poles fail, they can impede the flow of traffic and emergency vehicles. Priority will be given to potential evacuation routes or those highways used to provide relief efforts soon after the storm. TCP's also include the first distribution pole out of a substation, referred to in this report as "01" poles. If these poles fail, an entire feeder and associated laterals would lose service. All TCP's will be hardened to EWL where feasible, practical, and cost-effective.

5.2 Incremental Hardening

The objective of Incremental Hardening is to optimize the existing distribution infrastructure and increase the overall wind profile of a feeder to a higher wind rating, up to and including EWL. Incremental Hardening will apply appropriate combinations of cost-effective engineering options (e.g., storm guying, relocation, adding intermediate poles, upgrading the pole, etc.) to eliminate weaker links and take advantage of the existing storm resilience of a feeder. A minimum incremental wind rating is used for each of the established extreme wind regions as shown in Table 5-1. Incrementally hardening a feeder may not always achieve EWL, however, this approach will position FPL to do so in the future.

Extreme Wind Region	Incremental Hardening Minimum Wind Rating
145 MPH	125 MPH
130 MPH	115 MPH
105 MPH	105 MPH

Table 5-1 Incremental Hardening Minimum Wind Rating

Figures 5-1 and 5-2 illustrate an example of incremental hardening. In this example the wind rating of the two highlighted poles falls below the minimum wind rating for the region, which is 125 MPH in this example. All poles whose wind rating is below the minimum incremental rating will be upgraded.

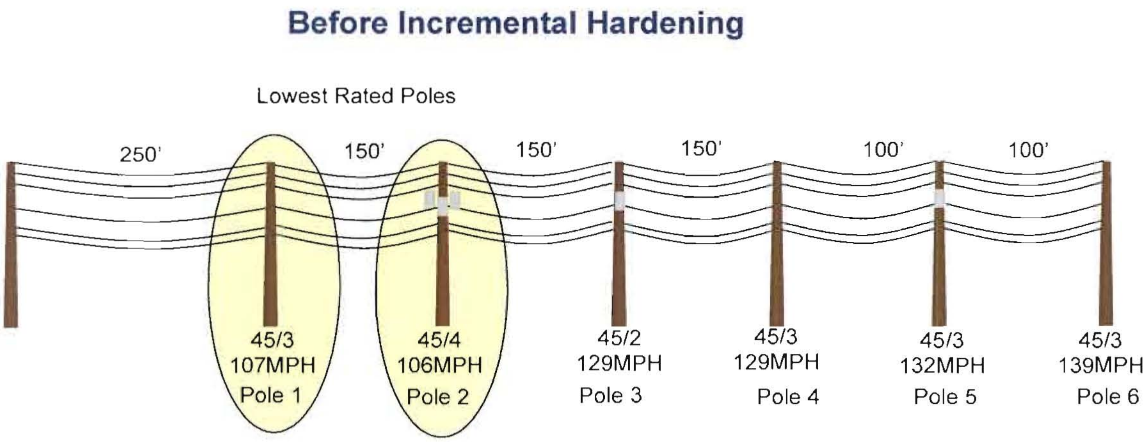


Figure 5-1: Feeder Wind Profile Before Incremental Hardening

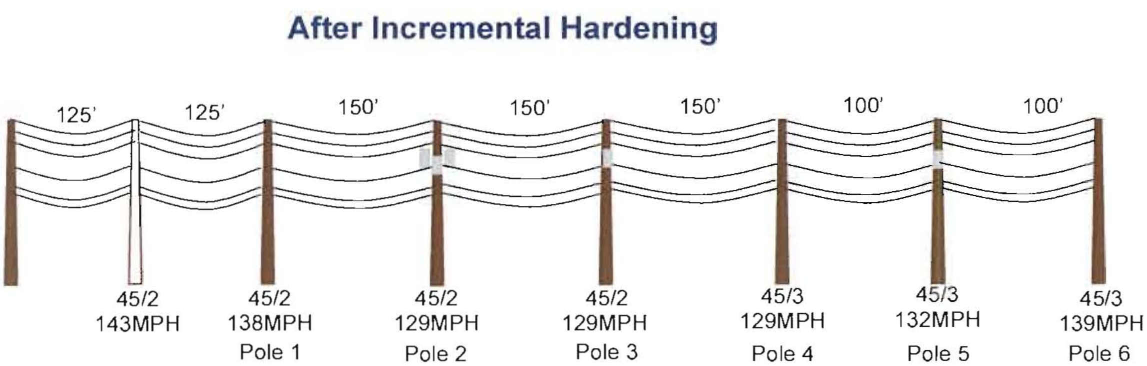


Figure 5-2: Feeder Wind Profile After Incremental Hardening

By targeting poles 1 and 2 for upgrading and installing an intermediate pole before pole 1, the feeder's overall wind profile has been raised to a higher wind rating in a cost-effective manner.

Incremental Hardening will target "community projects". Community Projects are associated with feeders that serve community needs such as grocery stores, gas stations and pharmacies. These types of services have also been identified as an essential need within the communities FPL serves. Typically these types of businesses are located near major thoroughfares and are easily accessible to the community.

FPL will also focus on the incremental hardening of poles that are critical during restoration events, but are not TCP's. These critical poles have additional electrical equipment or facilities attached such as automated feeder switches, capacitor banks and multiple circuits.

5.3 Design Guidelines for New Construction

FPL is utilizing its revised Design Guidelines and processes to apply EWL for new construction, major planned work, relocation projects and daily work activities. 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. Standardizing these processes ensures that this type of construction work aligns with FPL's hardening strategy.

FPL's pole sizing guidelines now provide for a minimum installation of Class 2 wood poles for all new feeder and three-phase lateral work in cases where previous designs might have called for a Class 3 wood pole. For two-phase and single-phase lateral work, a Class 3 wood pole is now required, where previous designs might have called for a Class 5 wood pole. For service and secondary work, a minimum of a Class 4 wood pole is to be used, where previously Class 5 or 6 wood poles could have been used. For critical poles, FPL is installing concrete poles at accessible locations. These guidelines position FPL for completely hardening existing circuits to EWL in the future.

Below, Table 5-2 illustrates a sample comparison of the Guidelines prior to 2007 vs. the Hardening Guidelines and the average percentage increase in wind rating. MPH calculations are dependent on various factors, including span length, equipment and attachments, framing, etc. Variations in any of these factors may yield different results.

Pole Type	Guidelines Prior to 2007	Hardening Guidelines	Average % Increase in Wind Rating
Critical Pole	Class 3 (wood)	Class III-H (concrete)	*47%
Feeder Pole	Class 3 (wood)	Class 2 (wood)	11%
Lateral Pole	Class 5 (wood)	Class 3 (wood)	22%
Service Pole	Class 5 (wood)	Class 4 (wood)	11%

*FPL working with manufacturer was able to increase the strength of new concrete poles.

Table 5-2 Design Guidelines Pole Recommendations

FPL's Distribution Design Guidelines are included in the Appendix, which is 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 must be performed. By capturing detailed information at each pole location such as pole type, class, span distance, attachments, wire size and framing, a comprehensive windloading 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 proposes to continue to utilize its "design toolkit" that focuses on evaluating and using cost-effective hardening options for each location. Examples of options in the toolkit include the following:

- Storm Guying – Install one guy in each direction perpendicular to the line of lead. This is a very cost-effective option; however, proper field conditions need to be present to allow for installation.
- Equipment Relocation – Equipment on a pole may be moved to a near-by stronger pole or one with a higher allowable wind rating.
- Intermediate Pole – Install a single pole when long span lengths are present. By reducing the span length, the wind rating of both adjacent poles is increased.
- Upgrading Pole Class – Replace the existing pole for a higher class pole to increase the pole's wind rating.
- Undergrounding Facilities – Utilize if there are significant barriers to build 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, can provide a cost-effective method to harden a circuit.

Design recommendations on any given project will take into account hardening (making facilities more resilient to storm force winds), mitigation (if circuit fails, how can damage be minimized), 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 pronged approach will help in reducing the amount of work required to restore power to a damaged circuit.

6.0 DEPLOYMENT PLANS

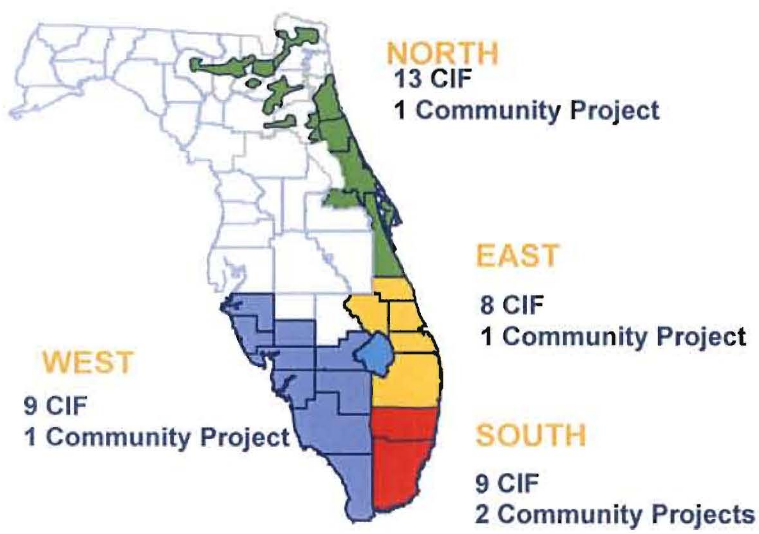
6.1 2010 Deployment Plan

In 2010, FPL proposes to utilize EWL to harden thirty nine (39) feeders and the associated laterals primarily serving thirty-nine (39) CIF customers. An additional 13 CIF customers served by these same feeders will also benefit from the EWL hardening improvements. The TCP Program will also focus on hardening to EWL approximately 16 overhead Highway Crossings mainly on Interstate 95 and 20 additional critical poles, each being the first feeder pole outside of a substation. These 36 poles have been targeted because of their criticality in expediting restoration efforts and have been prioritized so that circuits with the largest customer counts are completed first.

In addition to the facilities serving CIF customers, FPL plans to complete Incremental Hardening on feeders associated with five (5) community projects.

Lists of the CIF Customers and Community Projects' feeders planned for 2010 are included in the Appendix to this filing. The following map indicates, by region across the FPL service territory, where these projects are located.

Figure 6-1 – 2010 Feeder Hardening Map



Deployment plans and estimates utilizing the application of design guidelines were developed based upon historical new pole installations and replacements, expansion plans, as well as known relocation projects. The proposed 2010 deployment plan corresponds to approximately 160 overhead circuit miles and includes approximately 6,200 poles. It is estimated that over 40% of the 6,200 poles included in the 160 overhead circuit miles already meet EWL and will not require any additional hardening.

6.2 2011 and 2012 Deployment Plans

In 2011 and 2012, FPL will continue to address CIF hardening, critical poles, and community projects, and will continue to utilize the Design Guidelines. FPL estimates that during these two years it will annually harden approximately 40-55 feeders serving CIF customers and community projects. Consistent with the stipulation reached in late 2007 regarding the "Process to Engage Third Party Attachers", FPL will provide a preliminary list of projects in September 2010 and 2011 that it proposes to undertake in the following calendar year, pending internal budget approval. Then, when the budget is approved, FPL will provide the final list.

7.0 DESIGN AND CONSTRUCTION STANDARDS

7.1 Distribution Engineering Reference Manual (DERM)

FPL publishes its DERM to convey the standards of distribution design. The DERM provides FPL's designers with a reference for designing distribution facilities. This reference manual 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 2007 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 the designers and the construction crews with information needed to build the distribution facilities. Designers use the manual to convey instructions to the field. The field crews use the manual to construct the facilities. The DCS contains drawings and instructions on clearances, framing (how facilities will be arranged on the pole), grounding, guying, equipment, and the assembly of the various parts. All applicable pages associated with the 2007 NESC EWL criteria have been incorporated in the current version of the DCS (December 2008 Edition).

7.3 Design Guidelines

FPL's Design Guidelines and a 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. The intention of this document is to standardize designs for hardening as it relates to new construction, major planned work, relocations as well as daily work activities. These guidelines are primarily associated with changes in pole class, pole type and desired span lengths for overhead construction. In addition, FPL has adopted additional hardening guidelines for poles that are deemed critical for general operations or during restoration events. 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 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

In February 2010, consistent with the "Process to Engage Third Party Attachers", FPL provided its final list of 2010 hardening projects. On March 12, 2010, FPL mailed an informational package regarding its 2010-2012 hardening plans as well as the current draft of its "Attachment Standards and Procedures" to all attaching entities. In total, 93 packages were sent to these entities which included cable TV, telecommunication, and telephone companies as well as city and county agencies. FPL requested attaching entities to provide their input to FPL by April 9, 2010, including their costs and benefits associated with FPL's proposed hardening plans. As of April 26, 2010, FPL was contacted by 8 attaching entities. There were no suggested changes or issues with FPL's proposed 2010-2012 plans received from any attaching entity. Comments/input received included acknowledging receipt of FPL's package, seeking clarification or some additional information and stating that there were no issues with FPL's plans.

9.0 RESEARCH AND DEVELOPMENT

Design and construction to NESC EWL involves more than just engineering reference manuals and construction standards. Efforts are also underway to seek out and evaluate new products, work methods, and construction techniques that will enable FPL to cost-effectively build to this increased standard. Concurrent with this effort, FPL is also evaluating its existing construction practices to ensure they are adequate to meet EWL. Examples of these efforts include:

- FPL and KEMA evaluated the different pole technologies available from 13 vendors including steel, iron, several formulations of concrete, wood and composite materials. The evaluation confirmed that FPL has good economical source vendors for wood and concrete poles. The other pole technologies have very limited applications and higher cost.
- A comprehensive evaluation was completed on composite poles and their potential use from 15 manufacturers. This included the inspections of three manufacturing facilities and observation of certified strength testing to ANSI standards. A pilot installation of 79 composite poles was completed. These poles were installed throughout the FPL territory. Engineering calculations and testing involving deflection on these poles was completed. The results show that new, lighter weight concrete poles are more economical than composite poles due to the initial cost of a composite pole. Wind deflection is also a concern with composite poles versus concrete.
- FPL successfully evaluated the use of heavy-duty field equipment that will allow 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 crossarm braces for steel crossarms 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 the efforts to strengthen existing installations, specification and application guidelines were written to use the newly developed pole reinforcement method called the ET Truss. This enables a pole to be strengthened cost-effectively, avoiding a pole replacement.
- For underground facilities, FPL has piloted the use of the stainless steel Vista switchgear, below-grade and padmount 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 is now an FPL standard option provided to customers considering underground projects.
- FPL is engaged in collaborative research efforts with all Florida investor-owned utilities, Co-ops, Municipalities and led by 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 will 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 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 Beach, Fort Lauderdale and Sarasota.
- Secondary network systems and vaults with redundant throw-over, as in downtown Miami.

The current FPL system has approximately 67,000 total miles of distribution infrastructure. Underground power lines make up nearly 37% (25,000 miles) of this total with about 7% (1,700 miles) being in concrete encased duct bank. In the past five years, over 60% of all new distribution construction throughout the FPL service territory has been installed underground. In the tri-county area of Miami-Dade, Broward and Palm Beach Counties, where local ordinances for Underground Residential Distribution (URD) construction exist, approximately 90% of new construction is installed underground.

10.2 Equipment Technologies

The standard FPL URD equipment for all new underground residential distribution (pad-mounted transformers, switch cabinets, etc.) is dead-front made from stainless steel, or in combination with mild steel. Stainless steel equipment has the advantage of extended service life due to its resistance to weathering and corrosion, but has a considerably higher initial cost. Dead-front equipment (i.e., without energized parts exposed on the operating side of the equipment) is more reliable.

FPL does not presently use submersible equipment. Past installations which were in high-density downtown sidewalk vaults have experienced reliability issues, require large installation spaces and are costly to build and maintain. In an effort to make transformers more flood and surge resilient, FPL has purchased 6 single-phase 50 KVA pad mounted transformers which were jointly developed in cooperation with our current suppliers. FPL intends to install these units in a URD project as part of a pilot program during 2010. These transformers have higher resilience to storm surge and can be fully submerged without water infiltrating the tank.

FPL conducted a pilot project on Jupiter Island to test Vista Underground Distribution Switchgear and found it suitable for floodplains not expected to experience direct storm surge. The Vista switchgear is now an FPL standard option provided to customers considering underground projects.

10.3 Installation Practices

FPL complies with existing local ordinances when constructing underground systems. The Florida Building Code leaves the responsibility of determining adequate floodplains to each municipality which usually base their local ordinances on Federal Emergency Management Agency 100-year flood criteria.

10.4 Hardening and Storm Preparedness

Approximately 20% of FPL's underground distribution infrastructure is within the Category 1 - Category 3 floodplain as defined by the Florida Department of Community Affairs. However, FPL has not historically been as severely impacted by storm surge from hurricanes as it has been by wind. Recognizing that underground equipment is less impacted by predominantly wind events, FPL proposed the Governmental Adjustment Factor (GAF) tariff to promote conversion of electric facilities from overhead to underground. Through the GAF, which was approved as a pilot by the Commission in April 2007, FPL invests 25% of the total cost for qualified local government-sponsored conversion projects. On April 6, 2010, the Commission approved FPL's GAF tariff on a permanent basis.

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 outline the necessary steps to purge any sand and water that has invaded the equipment and to restore it to service.

11.0 PROJECTED COSTS AND BENEFITS

11.1 Costs

<u>FPL</u>

In 2010, FPL plans to harden 44 feeders, including 39 feeders which provide service to CIF customers and 5 feeders serving special community needs. Additionally, FPL will harden 16 highway crossings and 20 "01" switches. Costs associated with this work are estimated to range from $45 to $55 million. FPL will also continue to implement hardening criteria for new construction, major relocations and other work. The incremental costs of hardening associated with these activities are not specifically tracked.

In 2011 and 2012, FPL expects to continue its strategy for hardening its infrastructure, including targeting 40-55 circuits annually in 2011 and 2012. The projected annual costs for 2011 and 2012 are estimated to range from $45-$55 million. These estimates are based upon current work methods, products, and equipment and assume the necessary resources will be available to execute the plan.

Attaching Entities

As of April 26, 2010, no cost information has been received from attachers.

11.2 Benefits

FPL

FPL expects a reduction in storm restoration costs 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, because FPL does not feel that it has 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 at this time, 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 as follows:

- 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 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.

Second, 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 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. 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% to 70% 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.

FPL would also like to point out that, while the Commission's storm hardening rule calls for utilities to provide estimates of benefits and costs in connection to their storm hardening plans, 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.). A commonly-accepted definition of "cost-effective" is an activity that "produces optimum results for the expenditure." (Random House Unabridged Dictionary - 2006). This is a different measure than the benefit-cost ratio, and is typically used where, as FPL suggests is the case here, a particular outcome is desired without necessarily being able to quantify precisely the benefits of that outcome. In those circumstances, what becomes important from an economic perspective is to ensure that the desired outcome is achieved as efficiently as possible. FPL's storm hardening plan is highly cost-effective, at many levels. It focuses its hardening activities initially on critical infrastructure facilities and community projects, 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. And for community projects, the approach is even more targeted, specifically focusing on "weak link" poles, where hardening a few poles can significantly increase the strength of an entire pole line.

Attaching Entities

As of April 26, 2010, no benefits information has been received from attachers.

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's Storm Secure Plan identifies several initiatives specifically addressing the transmission infrastructure. In 2006, FPL increased its inspection cycle of transmission structures to a six year cycle, consistent with the FPSC order issued in April 2006.

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. ANSI C2 addresses EWL criteria (Rule 250C) and 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"
- No. 74: Guidelines for Electrical Transmission Line Structural Loading
- No. 91: Design of Guyed Electrical Transmission Structures

- ASCE/PCI, Guide for the Design of Prestressed Concrete Poles

Institute of Electrical and Electronics Engineers

- 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

Since FPL's transmission and substation system is already designed for EWL, FPL does not believe there is a general need for further hardening of the system. However, based on experience with the performance of the system, including specific lessons learned from the 2004-2005 storm seasons FPL has the following two transmission storm preparedness initiatives which have been 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, dated September 19, 2006 and reported on in FPL's March 1, 2010 compliance filing.

1. **Replacement of Wood Transmission Structures**
   FPL has implemented a comprehensive plan for replacing wood transmission structures with concrete per FPL's current design

2010 HARDENING PROJECTS

FPL
2010 Hardening Projects
CIF and Community Projects

Count	Region	County	Substation	Fdr	Driver	Hospital / 911 / Emergency Operation Center Address
1	Broward	Broward	PINEHURST	700337	Community Project	SW 15 Ave and SR84 & SW20St
2	Broward	Broward	FAIRMONT	700737	911	2601 W BROWARD BLVD # 1
3	Broward	Broward	ELY	702636	Emergency Operations Center	100 SW 3RD ST # PUB SAFETY
4	Broward	Broward	HOLLYBROOK	706161	911	12064 MIRAMAR PKWY # 911
5	Dade	Miami-Dade	RIVERSIDE	800532	Community Project	NW 47 Ave & Luis Sabines Way
6	Dade	Miami-Dade	FLORIDA CITY	803136	Emergency Operations Center	404 W PALM DR # CITY HALL
7	Dade	Miami-Dade	LAWRENCE	805138	911	1103 NW 7TH ST # STA 3
8	Dade	Miami-Dade	DADE	805431	Emergency Operations Center	7331 NW 74TH ST
9	Dade	Miami-Dade	SUNILAND	806534	911	12645 S DIXIE HWY # CITY HALL
10	Dade	Miami-Dade	COURT	809666	911	12450 SW 152ND ST # RADIO TOWER
11	Dade	Miami-Dade	INTERNATIONAL	810261	Emergency Operations Center	11695 SW 17TH ST
12	East	Martin	JENSEN	403435	Community Project	Causeway Blvd and A1A & Indian River Drive
13	East	Palm Beach	LINTON	401936	Emergency Operations Center	501 W ATLANTIC AVE #EOC/FIRE ADMIN
14	East	Palm Beach	LANTANA	402833	911	500 GREYNOLDS CIR #911,POLICE
15	East	Palm Beach	LANTANA	402835	911	1225 LANDS END RD #911MANALAPAN/SPALMBCH
16	East	Palm Beach	BOCA TEECA	404237	911	6500 Congress Ave
17	East	Palm Beach	BEELINE	405332	Hospital	5555 W BLUE HERON BLVD # KINDRED
18	East	Palm Beach	FOUNTAIN	405631	911	2995 JOG RD # 911,EOC,PD,FD
19	East	Palm Beach	HOMELAND	408664	Emergency Operations Center	14000 GREENBRIAR BLVD #EOC
20	East	Palm Beach	PLUMOSUS	Section of 408961	Emergency Operations Center	705 MILITARY TRL #JUP LBRY/ EOC
21	North	Brevard	COCOA	200432	911	1226 KING ST # POLICE / 911
22	North	Brevard	MELBOURNE	200535	911	701 S BABCOCK ST #911 DISPATCH OFFICE
23	North	Brevard	EAU GALLIE	201033	Community Project	Aurora Rd & Stewart Rd
24	North	Brevard	MINUTEMAN	201833	911	2 S ORLANDO AVE
25	North	Brevard	INDIAN HARBOR	202031	911	40 CHEYENNE CT
26	North	Brevard	INDIALANTIC	203234	911	216 5TH AVE # 911 CENTER
27	North	Brevard	MCDONNELL	203934	911	1100 JOHN GLENN BLVD # POLICE/911
28	North	Brevard	SATELLITE	204132	911	510 CINNAMON DR # POLICE
29	North	Brevard	BABCOCK	204262	911	130 MALABAR RD SE #POLICE DEPT
30	North	Columbia	NASH	306133	911	263 NW LAKE CITY AVE #911 CENTER
31	North	Putnam	HUDSON	101635	911	130 ORIE GRIFFIN BLVD # JAIL/911 CNTR
32	North	Seminole	COLLEGE	204634	911	144 BUSH LOOP #911 TRANSMITTER

FPL
2010 Hardening Projects
CIF and Community Projects

Count	Region	County	Substation	Fdr	Driver	Hospital / 911 / Emergency Operation Center Address
33	North	Seminole	CHULUOTA	207262	911	1301 TROPICAL AVE # 911 TOWER
34	North	Seminole	RINEHART	207934	911	4905 WAYSIDE DR # 1-911 TRANSMITTER
35	West	Charlotte	HARBOR	503761	911	22429 EDGEWATER DR # 911 REPEATER
36	West	Charlotte	CLEVELAND	504433	Emergency Operations Center	26571 AIRPORT RD # PUBLC SFTY & '7474 UTILITIES RD
37	West	Collier	RATTLESNAKE	507762	Emergency Operations Center	8075 LELY CULTURAL PKWY
38	West	De Soto	ARCADIA	501433	Emergency Operations Center	201 E OAK ST # COURT HSE/ADMIN
39	West	Lee	METRO	506166	Community Project	US41 btwn Beacon Manor and Brantley Rd.
40	West	Sarasota	SARASOTA	500134	911	1761 12TH ST #TOWER
41	West	Sarasota	COCOPLUM	503265	Emergency Operations Center	4980 CITY CENTER BLVD # FIRE STA/EOC
42	West	Sarasota	BENEVA	504133	Emergency Operations Center	3400 WILKINSON RD # 0291 / EOC
43	West	Sarasota	TUTTLE	504536	Emergency Operations Center	2050 RINGLING BLVD # POLICE / EOC
44	West	Sarasota	AUBURN	505767	911	721 CENTER RD # TOWER

FPL
2010 Hardening Projects
Critical Poles

2010 Critical Pole Deployment Plan ('01 Switches)		
Region	Substation	Feeder
BROWARD	PLAYLAND	701235
BROWARD	ROCK ISLAND	701831
BROWARD	HOLY CROSS	701933
BROWARD	PEMBROKE	702432
BROWARD	RAVENSWOOD	703133
DADE	GLADEVIEW	802232
DADE	ARCH CREEK	802833
EAST	LAKE PARK	403935
EAST	GERMANTOWN	404832
EAST	SANDALFOOT	405032
EAST	HUTCHINSON ISL	405131
NORTH	PORT ORANGE	100834
NORTH	TITUSVILLE	200332
NORTH	INDIAN HARBOR	202033
NORTH	INDIAN RIVER	202132
WEST	ENGLEWOOD	500764
WEST	FRUITVILLE	501064
WEST	LABELLE	502461
WEST	ONECO	502934
WEST	PINE RIDGE	504362

2010 Critical Pole Deployment Plan (Hwy X-ings)		
Region	Substation	Feeder
BROWARD	OAKLAND PARK	700437
BROWARD	CYPRESS CREEK	702137
BROWARD	PHOENIX	705461
BROWARD	GOOLSBY	707736
BROWARD	TWIN LAKES	707932
BROWARD	RAVENSWOOD	703134 / 703137
EAST	FOUNTAIN	405637
EAST	BUTTS	405934
EAST	BUTTS	405940
EAST	BUTTS	405940
EAST	SQUARE LAKE	407731
EAST	TARTAN	407861
EAST	QUANTUM	407931
EAST	DELMAR	406931 / 406936
WEST	POLO	507163
WEST	CASTLE	LAT 504662

Distribution Engineering Reference Manual (DERM)

Section 4 – Overhead Line Design

ADDENDNUM FOR EXTREME WIND LOADING

Distribution Engineering Reference Manual

FPL

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

$$\text{Strength} \times \text{Strength Factor} \geq \text{Load} \times \text{Load Factor}$$

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

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.

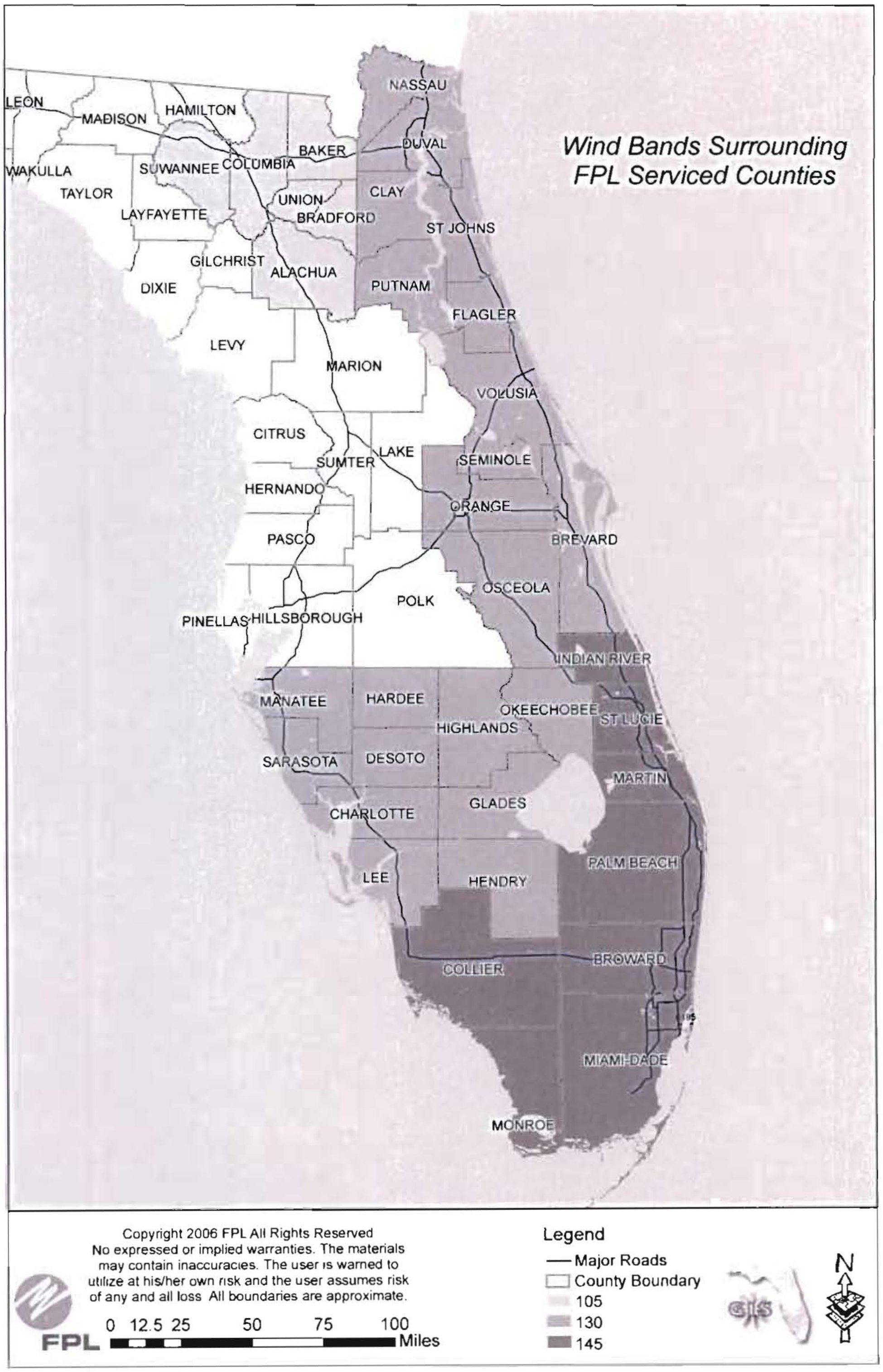
Table 4.2.2-2 Velocity pressure Exposure coefficient (k_z) and Gust Response Factors (G_{RF})

	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

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

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

Example Calculation for Wood Pole

Pole Length/Class = 45'/2
Setting depth = 7' (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 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 = $0.00256 \times (145)^2 \times 1 \times .93 \times 1 \times 1 \times .073$
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

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

Load in pounds = 0.00256 x $(145)^2$ x 1 x .97 x 1 x 1 x 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).

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 ≤33'
Transformers	Sq. Ft.	≤33'	>33' to 50'	>50' to 80'	
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

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

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**

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 (	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 (	161842
Transformer Moment =	6931
Available for Conductors =	154911
Conductor Moments per foot of span =	824
Maximum Span Distance =	**188 FT**

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	**FPL Only**	296	281	350	342	324	350
& 3/0 AAAC-N	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	**FPL Only**	206	195	273	256	224	283
& 3/0 AAAC-N	FPL With	(2)					
& 3/0 TPX	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	**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*	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	**FPL Only**	*250*	299	350	350	344	350
& 1/0 N	FPL With	(2)					
& 3/0 TPX	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

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

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

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

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

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 conductors	=	Wind Load per ft x span length x number of
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

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

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.

DISTRIBUTION DESIGN GUIDELINES

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 6) 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 your drawing and show the dimension to the switch. This will aid the dispatch centers in updating their switching system and will aid TRS in updating AMS, as well as provide the crew supervisor and admin 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 we are optimizing our distribution grid and to take into account future feeder plans and potential feeder boundary changes.

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. If you have any questions, please contact a Distribution Construction Services (DCS) analyst.

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 not 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, the transmission pole type should be used as a guideline for the distribution poles. 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, you need to ensure the new pole will meet the extreme wind design (and not just use the minimum class 2 or IIIH pole) so that it will not have to be replaced when the feeder is hardened as a Storm Secure project. Please reference **R: Drive/TOP CIF FEEDER LIST/ TOP CIF.xls** for the Top-CIF list.

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. Contact the Storm Secure Regional Planner for assistance in using the KEMA Toolkit to calculate the windloading.

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 we are optimizing our 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. – water bodies such as rivers, canals, swamps; limited access R/W such as interstate highways, turnpikes, and expressways; etc.).

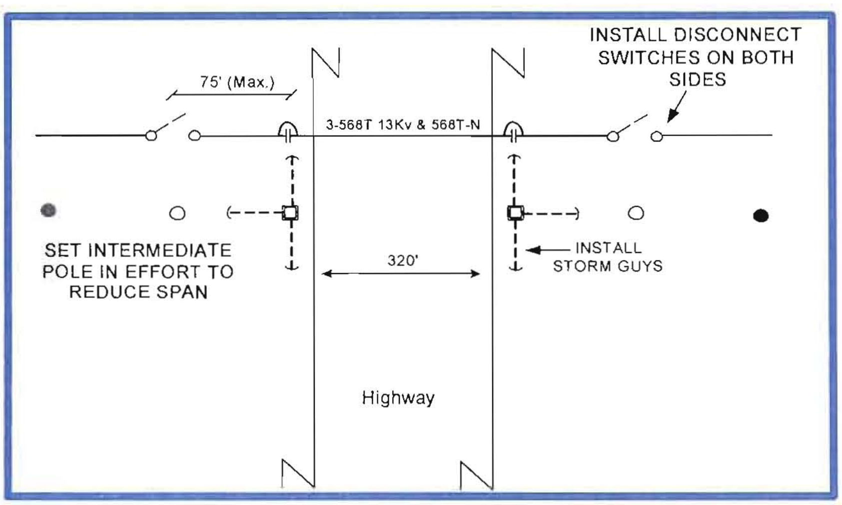
1. Underground installation is the preferred design for all new crossings (1, 2, 3 phase) of multi-lane limited access highways. If underground construction is not feasible or if working on an existing overhead crossing, reference the Overhead Highway Crossing schematic as shown below.

2. Underground crossing for 1 & 2 phases should be designed for potential three phase feeder size cable. Every effort should be made to ensure riser poles meet or exceed extreme wind design for the designated region. For further information please contact the Regional EPM Engineering Lead.

3. For accessible overhead crossings, use concrete poles (III-H or Spun) 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.

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

5. Install disconnect switches on adjacent poles on both sides of the crossing to isolate the feeder section for restoration. They are to be installed in accessible locations that can be reached with aerial equipment. If there is no load between the nearest existing switch and the crossing, an additional switch is not required.



Overhead Highway Crossing schematic

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, you need to ensure the new pole will meet the extreme wind design (and not just use the minimum class 2 or IIIH pole) so that it will not have to be replaced when the feeder is hardened as a Storm Secure project. Please reference **R: Drive/TOP CIF FEEDER LIST/ TOP CIF.xls** for the Top-CIF list.

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, 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.

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 (minimum Class 2 if inaccessible)			
Critical Poles	**DCS Reference[5]**	**Critical Poles**	**DCS Reference[5]**
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 3	**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		
[5]All references are to the Distribution Construction Standards (DCS).			

If the critical pole is for new construction, line extensions, relocations, or is on a Top-CIF feeder use the DERM Addendum for Extreme Wind Loading tables 4.2.2-8, 4.2.2-9, or 4.2.2-10 determine if you need a stronger pole than the minimum class 2 or IIIH pole. For situations that are not in these tables, run the KEMA Toolkit to calculate the windloading for the specified pole and attachments combination.

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 the Regional EPM Engineering Lead before designing new multi-circuit line.

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 (or stronger as needed) to meet EWL	Use Class 2 Wood Poles	Use III-H (Accessible) or Use Class 2 Wood (Inaccessible)
Concrete	Use minimum III-H Concrete Pole (or stronger) as needed to meet EWL	Use III-H Concrete Poles	Use III-H Concrete Poles

When designing for EWL refer to the DERM Section 4 - Addendum for Extreme Wind Loading tables 4.2.2-8, 4.2.2-9, or 4.2.2-10 to determine if you need a stronger pole than the minimum class 2 or IIIH pole. For situations that are not in these tables, run the KEMA Toolkit to calculate the windloading for the specified pole and attachments combination.

Single or Two Phase Lateral:

Pole Line Description	New Construction, Line Extension, & Pole Line Relocation	Existing Infrastructure[1]	Installing or Replacing a Critical Pole[2]
Wood	Use Class 3 Wood Pole	Use Class 3 Wood Poles	Use III-H (Accessible) or Use Class 2 Wood (Inaccessible)
Concrete	Use 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 a pole or installing an intermediate pole within an existing pole line. If it is a Top-CIF feeder pole or a multi-circuit pole then it also needs to meet EWL.
2) Reference Critical Pole List on pg.7.
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.

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:

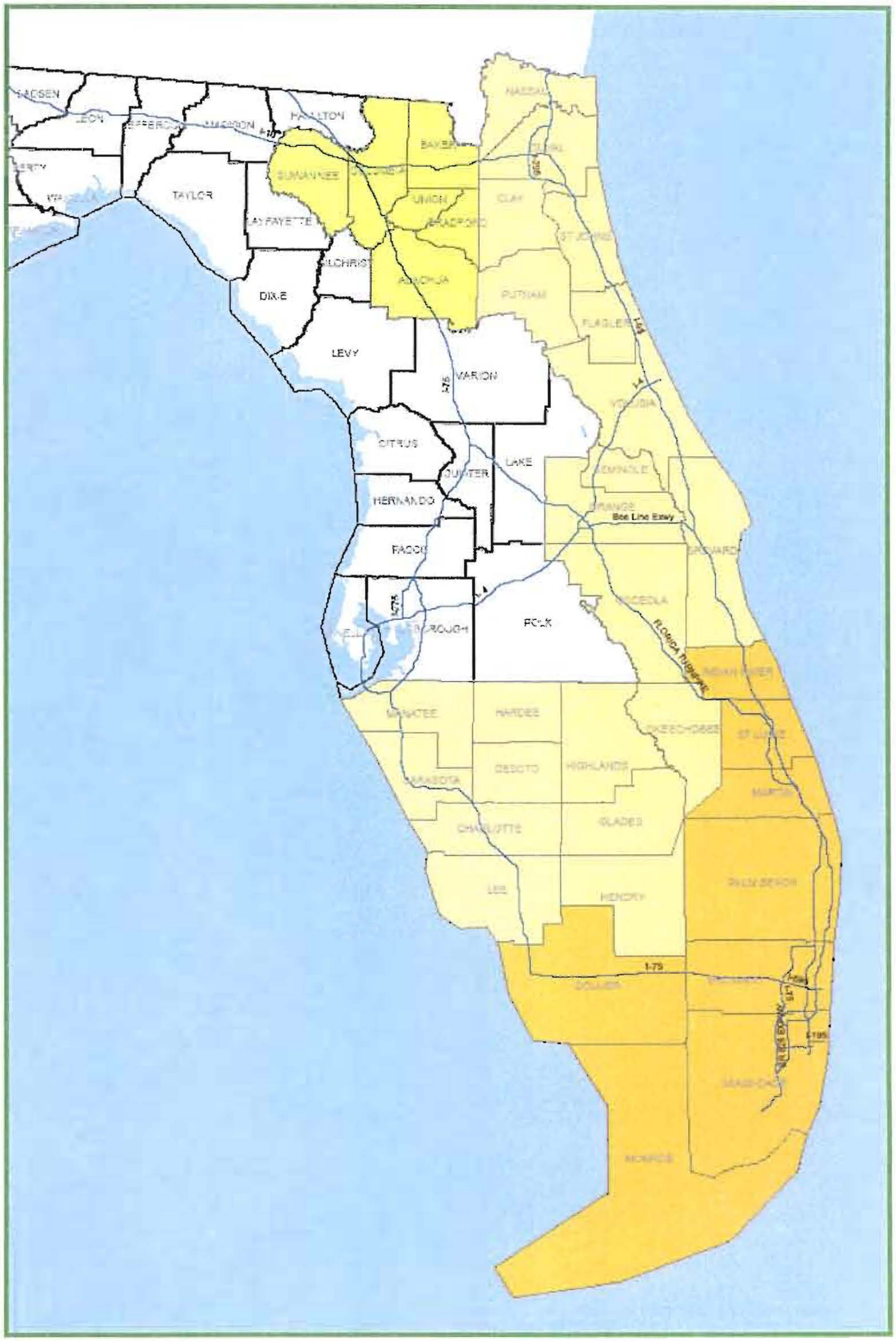
When installing or replacing a service or street light poles, a minimum of Class 4 wood pole should be used. Specific calculations may require a higher class pole for large quadruplex wire.

If you have any questions on pole sizing to meet EWL or running the KEMA Toolkit to calculate windloading, please contact the Regional EPM Engineering Lead.

Extreme Wind Loading (EWL) 3 Zone Map

105 MPH
130 MPH
145 MPH

Wind Zone	County
105	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 your 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 your work request.

NOTIFICATION OF FPL FACILITIES

Customer/Agency ___________
Developer/Contractor Name ______
Location of Project _______
FPL Representative ______
Developer/Contractor Representative _____

Date of Meeting/Contact: __________
Project Number/Name: __________
City: ____________
Phone: __________
FPL Work Request #/Work Order #: ___________

FPL calls your attention to the fact that there may be energized, high voltage electric lines, both overhead and underground, located in the area of this project. It is imperative that you visually survey the area and that you also take the necessary steps to identify all overhead and underground facilities prior to commencing construction to determine whether the construction of any proposed improvements will bring any person, tool, machinery, equipment or object closer to FPL's power lines than the OSHA-prescribed limits. If it will, you must either re-design your project to allow it to be built safely given the pre-existing power line location, or make arrangements with FPL to either deenergize or ground our facilities, or relocate them at your expense. **You must do this before allowing any construction near the power lines**. It is impossible for FPL to know or predict whether or not the contractors or subcontractors, and their employees, will operate or use cranes, digging apparatus or other mobile equipment, or handle materials or tools, in dangerous proximity to such power lines during the course of construction, and, if so, when and where. Therefore, if it becomes necessary for any contractor or subcontractor, or their employees, to operate or handle cranes, digging apparatus, draglines, mobile equipment, or any other equipment, tools or materials in such a manner that they might come closer to underground or overhead power lines than is permitted by local, state or federal regulations, you and any such contractor or subcontractor must notify FPL in writing of such planned operation prior to the commencement thereof and make all necessary arrangements with FPL in order to carry out the work in a safe manner. **Any work in the vicinity of the electric lines should be suspended until these arrangements are finalized and implemented.**

The National Electrical Safety Code ("NESC") prescribes minimum clearances that must be maintained. If you build your structure so that those clearances cannot be maintained, you will be required to compensate FPL for the relocation of our facilities to comply with those clearances. As such, you should contact FPL prior to commencing construction near pre-existing underground or overhead power lines to make sure that your proposed improvement does not impinge upon the NESC clearances.

It is your responsibility and the responsibility of your contractors and subcontractors on this project to diligently fulfill the following obligations:

1. Make absolutely certain that all persons responsible for operating or handling cranes, digging apparatus, draglines, mobile equipment or any equipment, tool, or material capable of contacting a power line, have a copy of and are familiar with all applicable state and federal regulations, including but not limited to U.S. Department of Labor OSHA Regulations, before commencing their work.

2. Make sure that all cranes, digging apparatus, draglines, mobile equipment, and all other equipment or materials capable of contacting a power line have attached to them any warning signs required by U.S. Department of Labor OSHA Regulations.

3. Post and maintain proper warning signs and advise all employees, new and old alike, of their obligation to keep themselves, their tools, materials and equipment away from power lines per the following OSHA minimum approach distance table:

Power Line Voltages	OSHA Minimum Approach Distance	
0 - 69,000 volts	10 Feet	
115,000-138,000 volts	11 Feet	
230,000 volts	13 Feet	*When uncertain of the voltage, stay 18 feet away
500,000 volts	18 Feet	or call FPL or your local utility.

4. All excavators are required to contact the Sunshine State One Call of Florida, phone number 1-800-432-4770 or 811 a minimum of two working days (excluding weekends) in advance of commencement of excavation to ensure facilities are located accurately.

5. Conduct all locations and excavations in accordance with the Florida State Statute 556 of the Underground Facilities Damage Prevention & Safety Act and all local city and county ordinances that may apply.

6. When an excavation is to take place within a tolerance zone, an excavator shall use increased caution to protect underground facilities. The protection requires hand digging, pot holing, soft digging, vacuum methods, or similar procedures to identify underground facilities.

A copy of this notification must be provided by you to each contractor and subcontractor on this project, to be shared with their supervision and employees prior to commencing work on this project.

____
Means by which this notification was provided to customer and/or contractor

____
Address

____
FPL Representative Signature

____
Date

____
Customer/Developer/Contractor Representative Signature

____
Date

Form 360 Rev. 5/16/08

HARDENING DESIGN GUIDELINES
QUICK REFERENCE GUIDE

Hardening Design Guidelines
Quick Reference Guide

Feeder or Three Phase Lateral:

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

Single or Two Phase Lateral:

Pole Line Description	New Construction[1]	Existing Infrastructure[2]	Installing or Replacing a Critical Pole
Existing Wood	Use Class 3 Wood Pole to meet EWL	Use Class 3 Wood Poles	Use III-H (Accessible) or Use Class 2 Wood (Inaccessible)
Existing Concrete	Use III-G or III-H poles to meet EWL	Use III-G or III-H poles to match existing line	Use III-H Concrete Poles

Facility	Phases(s)	Wire size	Pole size	Recommended Span Length[3] (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'

[1]To be used when extending or relocating a pole line. For span length details, use the table above.
[2]To be used when replacing a pole or installing an intermediate pole within an existing pole line.
[3]The lower number equates to the maximum span for FPL primary and 2 foreign attachments. The higher number equates to the maximum span for FPL primary only. Reference the addendum DERM tables when adding additional attachment(s) or equipment. Remember to always contact the Regional EPM Engineering Lead when working on a Top CIF feeder. As always, good engineering judgment, safety, reliability, and cost effectiveness should be considered.

Critical Pole Identifier

Replace with III-H Square Concrete Pole (Class 2 if inaccessible)

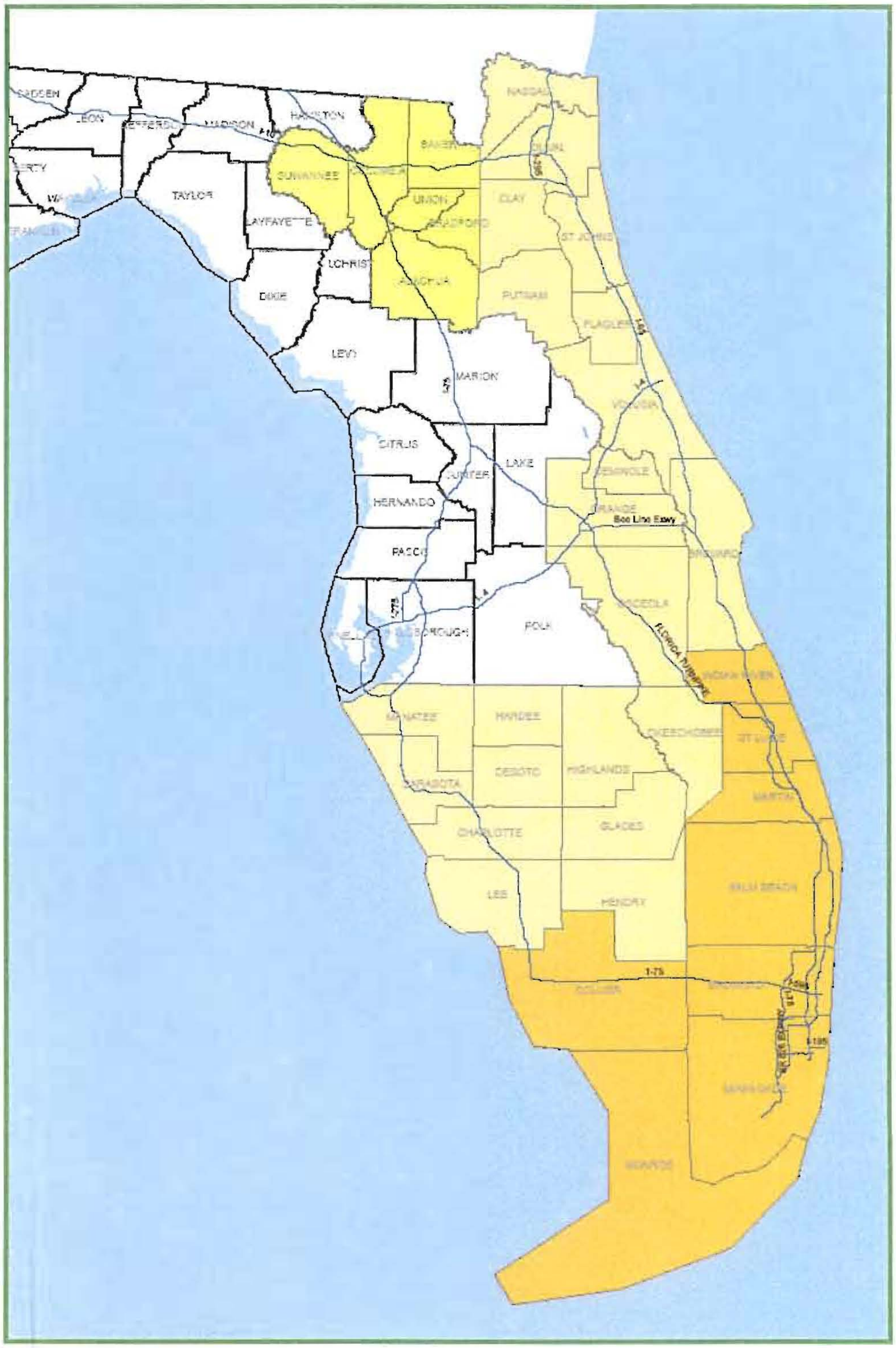
Critical Poles	DCS Reference[4]	Critical Poles	DCS Reference[4]
1st switch out of substation	UH-15.0.0 Fig 2 UH-15.3.1	**Automated Feeder Switches (AFS)**	C-9.2.0
Interstate Crossings	E-10.0.0 Fig 3	**Aerial Auto Transformers**	I-9.0.0
Poles with two 3 phase risers	UH-15.2.0	**3 phase transformer banks 3 – 100 kVA and larger**	I-52.0.2
Multi-circuit poles	Frame as existing	**Capacitor Banks**	J-2.0.2 & J-2.0.3
Three-phase reclosers (or Three single-phase reclosers)	C-8.0.0	**Regulators**	I-10.1.1
Primary Meter	K-28.0.0		

[4]All references are to the Distribution Construction Standards (DCS).

Hardening Design Guidelines
Quick Reference Guide

105 MPH
130 MPH
145 MPH

Wind Zone	County
105	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



ATTACHMENT GUIDELINES
&
PROCEDURES

ADDENDUM

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

FPL ATTACHMENT STANDARDS AND PROCEDURES

March 10, 2010

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.

In all cases, 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. Governmental Entities requesting attachments to FPL street light facilities may have 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.

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.

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

NON JOINT USE POLE
(no telephone)

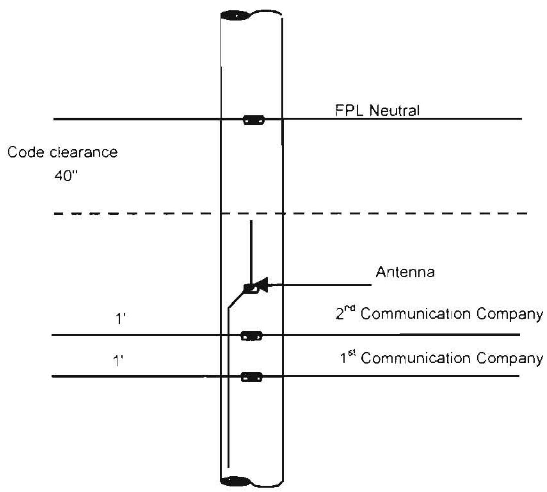


Fig 1

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

JOINT USE POLE
(power & telephone)

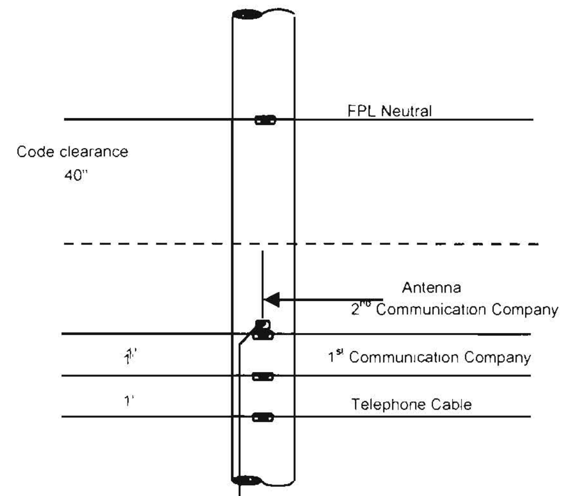


Fig. 2

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 communication cable
3. The antenna attachment will be a minimum of 1' above highest communication cable

NOTE: No communication cable or antenna attachment will intrude on the 40" NESC code clearance space.

Space Allocation

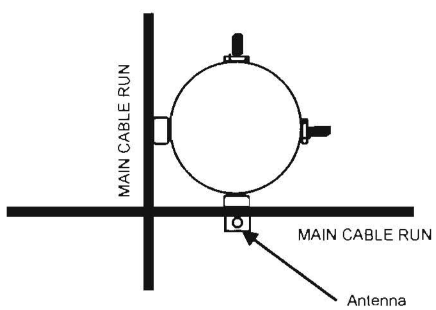


Fig. 3

POLE ATTACHMENT LOCATION

1. Attachment is limited to the communication space or lower.
2. All main cable attachments shall be located either on the same side of the pole as FPL's neutral or on one adjacent side.
3. No main line cable attachments shall be located on the side of the pole opposite FPL's neutral.
4. Only 2 sides of the pole, FPL's neutral and one adjacent side, shall be occupied on any given pole
5. All electrical connections must be made off the pole
6. No more than two risers will be allowed per pole FPL's service to Licensee may be one of these risers.

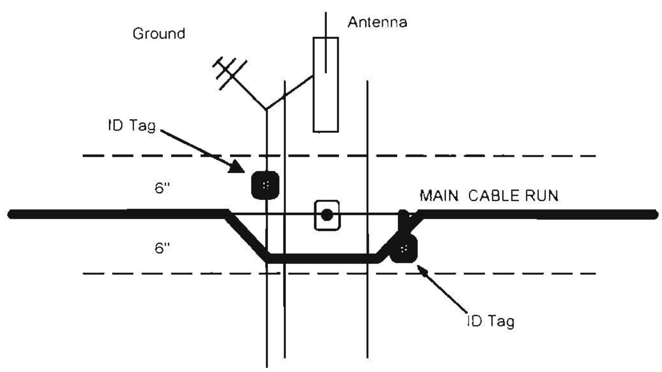


Fig 4

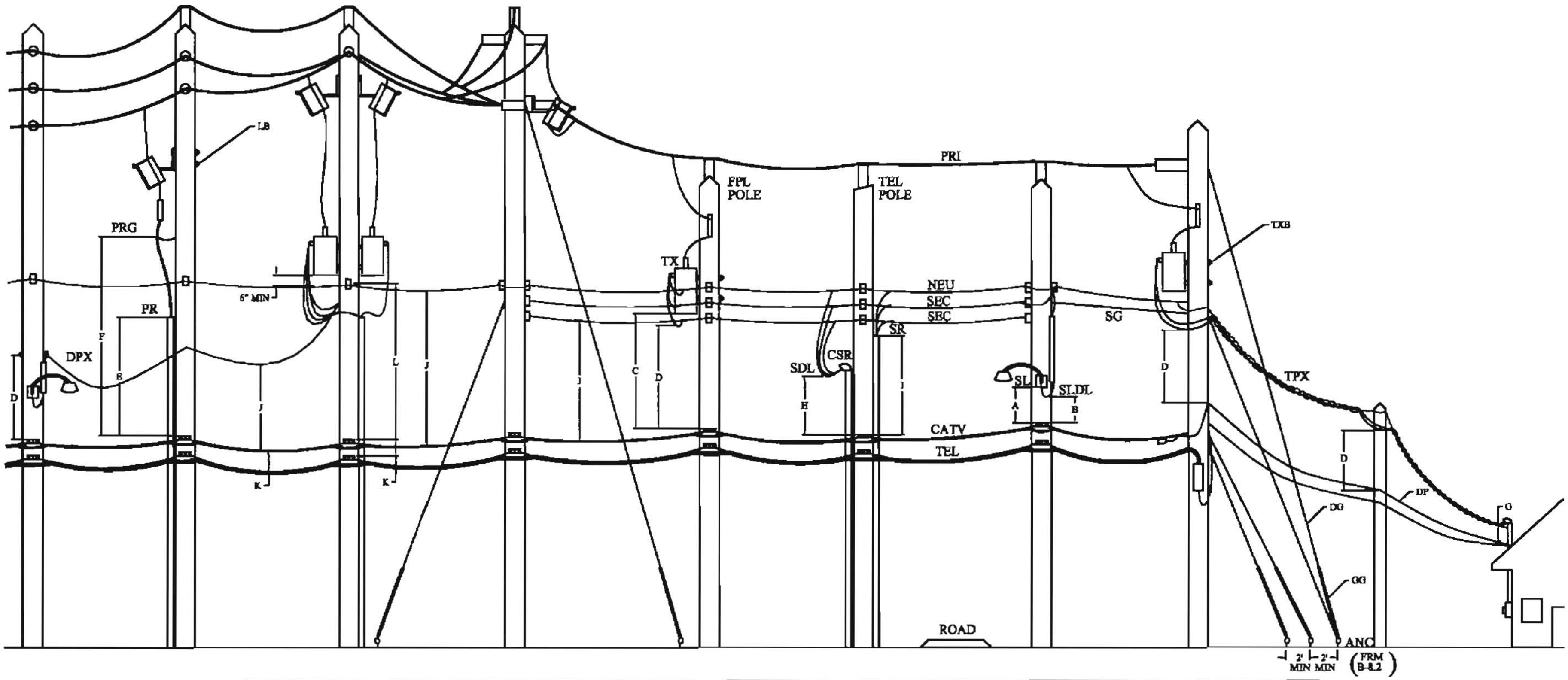
IDENTIFICATION TAG

1. Each separate attachment shall be identified in accordance with FUCC's Foreign Attachment Guidelines specifications or FPL.
2. Each company shall register their unique ID tag with the FUCC's Joint Use Subcommittee or FPL.
3. An ID Tag will be installed at every pole attachment.

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 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 SERVICE DRIP LOOP	40 INCHES	40 INCHES	TABLE 235-5
		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

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 17) 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.
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. 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.
9. 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.

10. 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.

11. 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.

12. Whenever extending a feeder, reconductoring a feeder section, or attaching a device to a feeder, always reference the nearest existing disconnect switch number on your drawing and show the dimension to the switch. This will aid the dispatch centers in updating their switching system and will aid TRS in updating AMS, as well as provide the crew supervisor and admin tech information needed for switching and RC Off requests.

13. 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 14).

14. Projects that affect or extend feeder conductors should always be coordinated with Distribution Planning to ensure we are optimizing our distribution grid and to take into account future feeder plans and potential feeder boundary changes.

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 standards.

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 not 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, the transmission pole type should be used as a guideline for the distribution poles. 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, you need to ensure the new pole will meet the extreme wind design (and not just use the minimum class 2 or IIIH pole) so that it will not have to be replaced when the feeder is hardened as a Storm Secure project.

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.

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 we are optimizing our 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. – water bodies such as rivers, canals, swamps; limited access R/W such as interstate highways, turnpikes, and expressways; etc.).

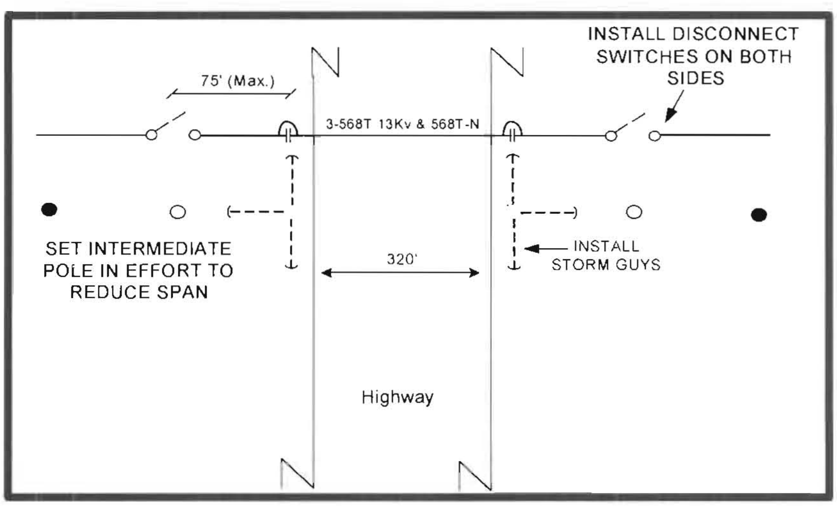
1. Underground installation is the preferred design for all new crossings (1, 2, 3 phase) of multi-lane limited access highways. If underground construction is not feasible or if working on an existing overhead crossing, reference the Overhead Highway Crossing schematic as shown below.

2. Underground crossing for 1 & 2 phases should be designed for potential three phase feeder size cable. Every effort should be made to ensure riser poles meet or exceed extreme wind design for the designated region. For further information please contact the Regional EPM Engineering Lead.

3. For accessible overhead crossings, use concrete poles (III-H or Spun) 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.

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

5. Install disconnect switches on adjacent poles on both sides of the crossing to isolate the feeder section for restoration. They are to be installed in accessible locations that can be reached with aerial equipment. If there is no load between the nearest existing switch and the crossing, an additional switch is not required.



Overhead Highway Crossing schematic

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, you need to ensure the new pole will meet the extreme wind design (and not just use the minimum class 2 or IIIH pole) so that it will not have to be replaced when the feeder is hardened as a Storm Secure project. Contact the FPL Engineer to determine the design requirements.

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, 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.

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 (minimum Class 2 if inaccessible)			
Critical Poles		**Critical Poles**	
1st switch out of substation or duct system riser pole		**Automated Feeder Switches (AFS)[2]**	
Interstate Crossings[1,3]		**Aerial Auto Transformers[2]**	
Poles with multiple primary risers		**3 phase transformer banks 3 – 100 kVA and larger[2]**	
Multi-circuit poles[3]		**Capacitor Banks[2]**	
Three-phase reclosers[2] (or Three single-phase reclosers)		**Regulators**	
Primary Meter			

[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.*

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 (or stronger as needed) to meet EWL	Use Class 2 Wood Poles	Use III-H (Accessible) or Use Class 2 Wood (Inaccessible)
Concrete	Use minimum III-H Concrete Pole (or stronger) as needed to meet EWL	Use III-H Concrete Poles	Use III-H Concrete Poles

Single or Two Phase Lateral:

Pole Line Description	New Construction, Line Extension, & Pole Line Relocation	Existing Infrastructure[1]	Installing or Replacing a Critical Pole[2]
Wood	Use Class 3 Wood Pole	Use Class 3 Wood Poles	Use III-H (Accessible) or Use Class 2 Wood (Inaccessible)
Concrete	Use 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 a pole or installing an intermediate pole within an existing pole line. If it is a Top-CIF feeder pole or a multi-circuit pole then it also needs to meet EWL.

2) Reference Critical Pole List on pg.16.

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.

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. As always, good engineering judgment, safety, reliability, and cost effectiveness should be considered.

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

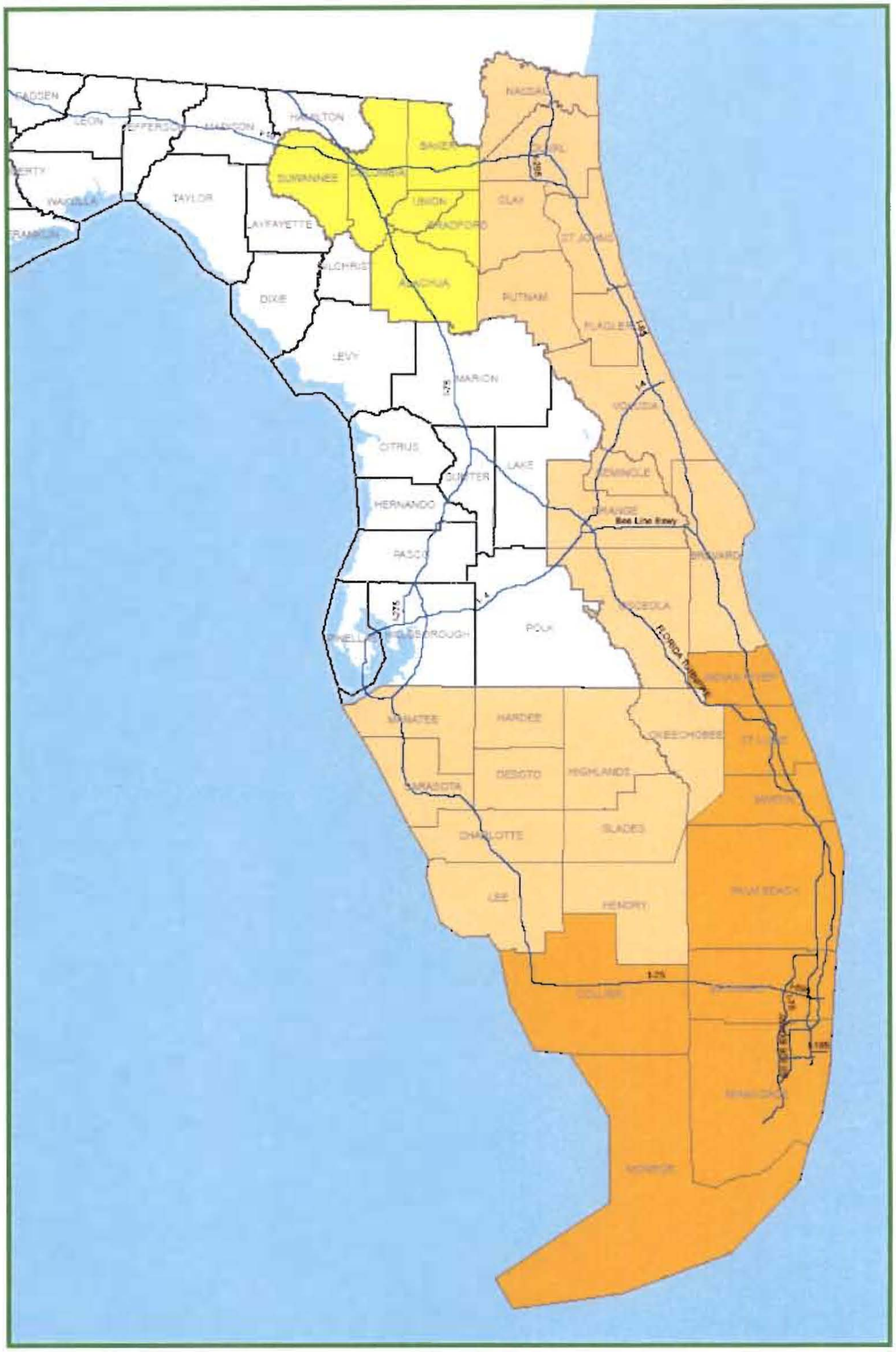
When installing or replacing a service or street light poles, a minimum of Class 4 wood pole should be used. Specific calculations may require a higher class pole for large quadruplex wire.

If you have any questions on pole sizing to meet EWL contact the local FPL Engineer.

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



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

$$\textit{Strength} \times \textit{Strength Factor} \geq \textit{Load} \times \textit{Load Factor}$$

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

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.

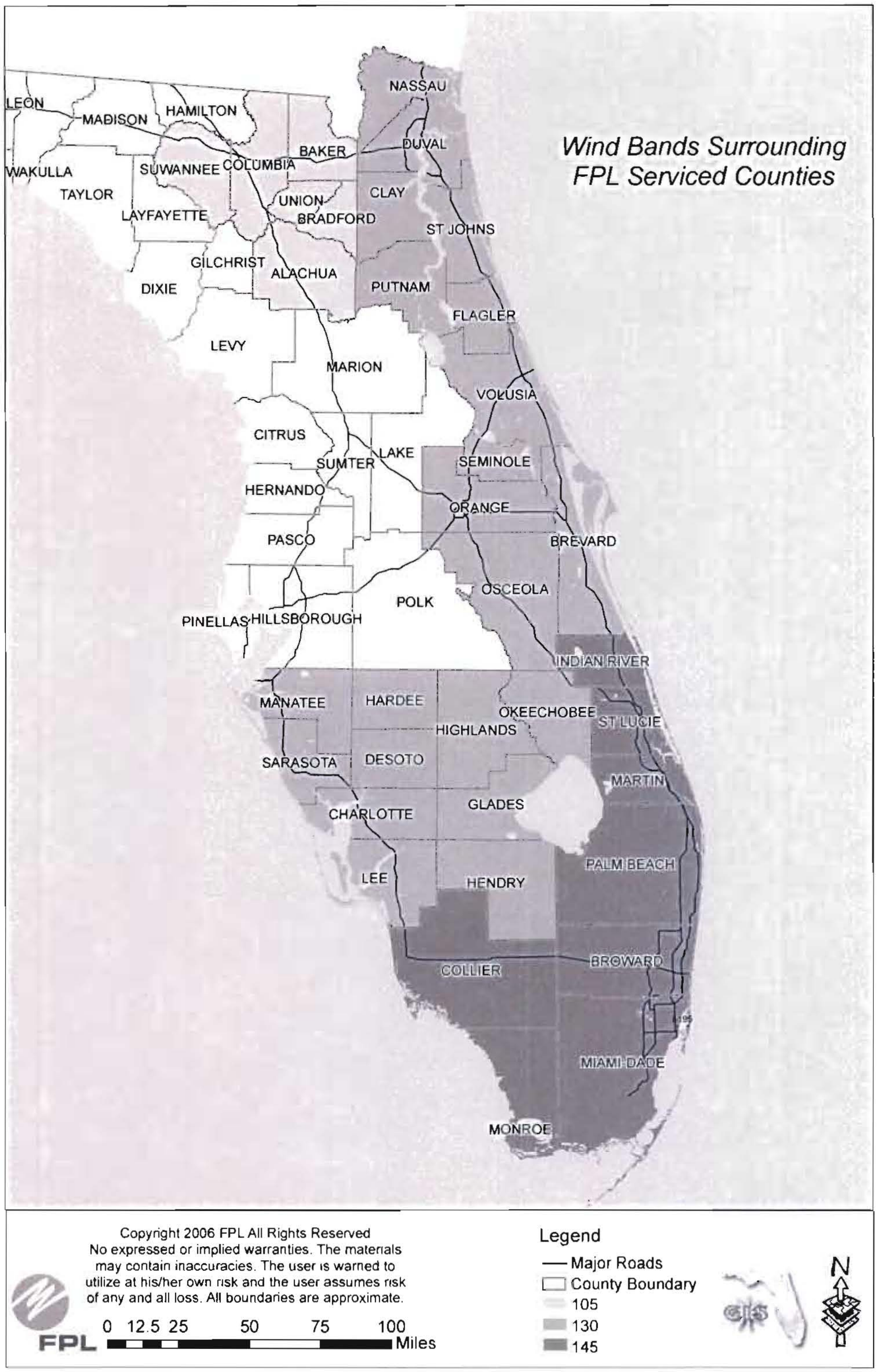
Table 4.2.2-2 Velocity pressure Exposure coefficient (k_z) and Gust Response Factors (G_{RF})

	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 (in this example circumference = 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

$$M_r = 4.7 \text{ KIPS} \times (50 - 11 - 2) = 173{,}900 \text{ ft-lbs}$$

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:

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'
Wind Region = 145 mph

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

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'
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"

$$A = \frac{38.5}{12}x\left[\frac{15.75+9.00}{2}\right] = 39.70\,sq.ft.$$

$$Height\ of\ center\ of\ area,\ H_{CA} = \frac{H_1(b+2a)}{3(b+a)} = \frac{38.5(15.75+18.00)}{3(15.75+9.00)}$$

$$H_{CA} = Moment\ Arm = 17.5\ ft.$$

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'
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

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 x $(Vmph)^2$ x k_z x G_{RF} x I x C_f x $A(ft^2)$

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

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

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

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 ≤33'
Transformers	Sq. Ft.	≤33'	>33' to 50'	>50' to 80'	
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

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

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 shown in the examples below. The calculations are 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: Modified Vertical and 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 table 4.2.2-4.

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

Table 4.2.2-4 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.

Table 4.2.2-4 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.

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.

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**

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 ;	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 ;	161842
Transformer Moment =	6931
Available for Conductors =	154911
Conductor Moments per foot of span =	824
Maximum Span Distance =	**188 FT**

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.

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. 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.

The 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

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

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.

The initial sag when installing slack spans limits the per conductor tension to 50 pounds.

Slack Span design criteria:

1. Vertical construction is preferred for two and three phase installations. 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.

B. ***Targeted Critical Poles***

There are many poles in the distribution system identified as Targeted Critical 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 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.

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. Before facilities are designed and put into place, the FPL engineer and the ILEC engineer discuss the needs of both companies and the requirements for design by either the detail plans filed with the FPSC or the existing joint use agreement.
2. The joint use agreement for each company dictates which company sets the new pole(s)
3. If FPL is building the pole line, a notice of build is sent by FPL to all CATV companies and telecommunication carriers with attachments adjacent to the new pole line.
4. If FPL is building the new pole line CIAC will be collected for the increased size and strength required to accommodate the facilities of all third parties requesting attachments.

There are times when the ILEC determines they would like to attach to a pole they previously were not 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 learn if the pole has been hardened or if the pole now has stronger windloading requirements due to detail plans filed with the FPSC. This is true if the pole is owned by FPL or the ILEC. Discussion with the FPL engineer will help determine 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 our agreement.

III.B. PROCEDURES FOR THIRD PARTIES (CATV AND TELECOMMUNICATION CARRIERS (non-ILECs))

1) **APPLY** for permit.

- When making new attachments or overlashing to existing attachments where the resulting bundle is heavier than the existing attachment or has an increased diameter over that of the existing attachment, apply for permit or notice of intent to overlash for attachments to FPL poles. Apply for a permit for Non-FPL poles that require FPL 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 CATV cables, wires and supporting hardware only, not for power supplies, amplifiers or similar equipment.

- Create appropriate permit application package(s):

    - Non-make ready

    - Make ready (requires design, cost approval, invoice, payment, and construction of FPL work order prior to FPL permit approval)

    - Major rebuild or upgrade

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

- Submit complete permit package.

2) **RECEIVE** approved permit. (Exhibit “A”)

3) **CONSTRUCT** attachments.

- You must have an approved permit. (Exhibit “A”)

- You must complete construction within 60 days of permit approval (180 days if Major rebuild permit), 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, etc.) and NESC standards.
- Field review facilities for compliance upon completion of construction.

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.

III.C. PROCEDURES FOR GOVERNMENTAL ATTACHMENTS

Attachment Perrnits 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 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

III.D. PROCEDURES FOR ATTACHMENTS TO TRANSMISSION POLES

Application Requirements
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 GT-STRUDL output forms, with non-linear analysis results, 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 $96 per manhour (regardless of final approval or disapproval of the request). A deposit of $2,000 dollars, payable to FPL, is required for quantities of up to 50 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 2007 NESC Basic Clearances for Overhead Transmission Lines, the National Electric Safety Code (NESC)-2007 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)-2007, the American Society of Civil Engineer (ASCE) latest edition "Minimum Design Loads for Buildings and Other Structures" and ASCE Manuals #74, "Guidelines for Electrical Transmission Line Structural Loading".

STEEL TRANSMISION STRUCTURES

Designs shall meet the specifications defined in the ASCE/SEI 48-05 "Design of Steel Transmission Pole Structures" latest edition, and ASCE Standard latest edition, "Design of Latticed Steel Transmission Structures".

CONCRETE TRANSMISSION POLES

Designs shall meet the specification defined in the ASCE-PCI "Guide for the Design of Prestressed Concrete Pole".

WOOD TRANSMISSION POLES

Designs shall meet the specification defined in the IEEE Standard 751 "Trial-Use Design Guide for Wood Transmission Structures".

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:

Under Combined Ice/Wind loads (NESC Section 250 B)

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

Under Extreme Wind Loads (NESC Section 250 C)

ASCE latest edition "Minimum Design Loads for buildings and Other Structures" and ASCE Manuals #74, "Guidelines for Electrical Transmission Line Structural Loading" are the basis of this control criteria.

Under Serviceability Requirements (FPL Policy for Concrete Pole)

45 mph wind load is considered as the minimum wind load applied for this zero-tension condition, which is only applied to prestressed concrete poles. The calculation of the wind pressure also follows the requirements of ASCE latest edition "Minimum Design Loads for Buildings and Other Structures" and ASCE latest edition Manuals #74, "Guidelines for Electrical Transmission Line Structural Loading".

Basic Wind Speeds (ANS/ASCE latest edition). Refer to enclosed drawings showing Basic Wind Speeds within FPL Service Territory. Map file name: wind_cont_FL-1.g12 created 10-22-02 attached.

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:

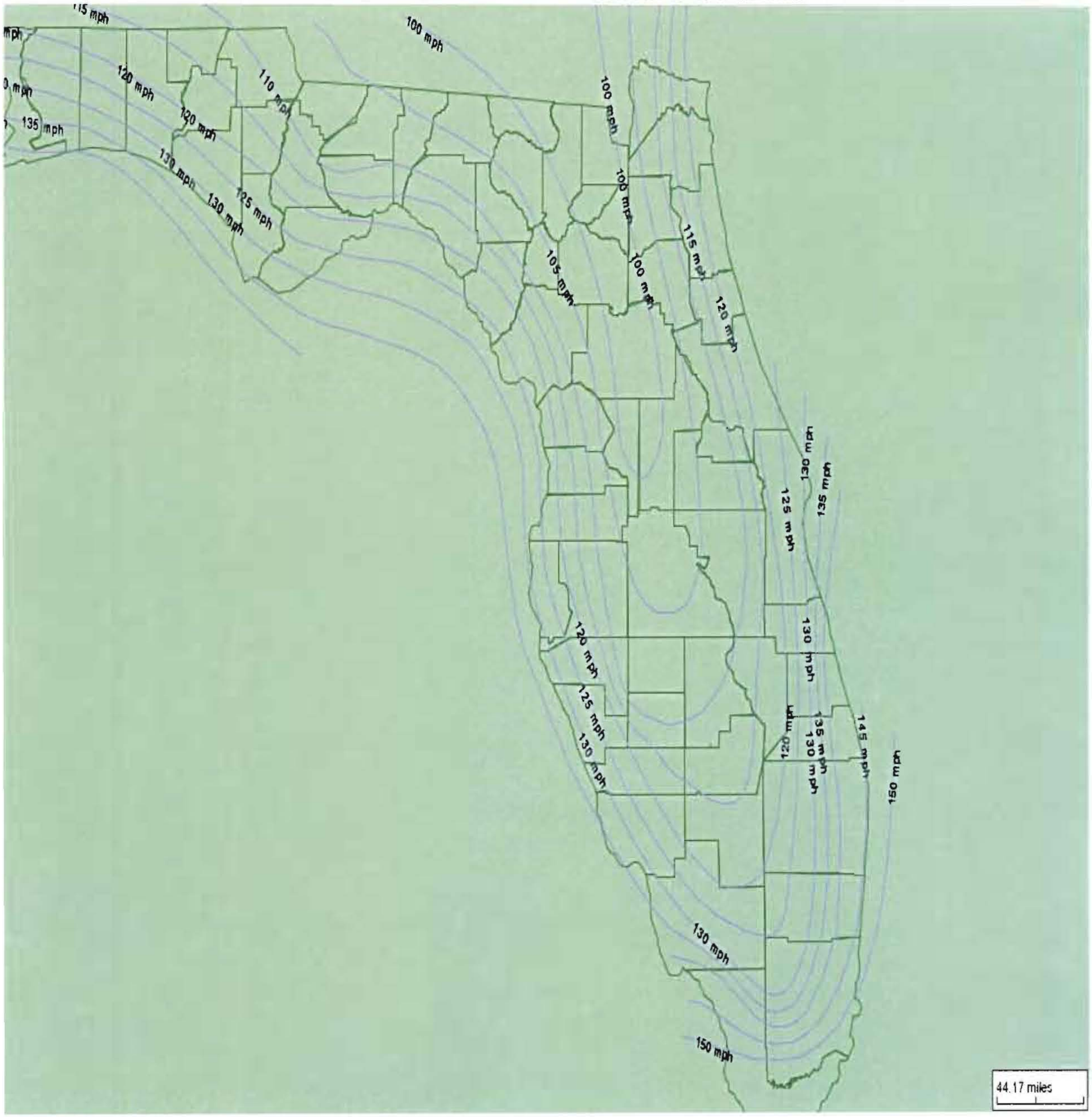
1) Payment for Permit (payable to FPL)
2) Original, signed Exhibit "A" (front and back)
3) Calculations (signed and sealed)
4) Field Notes
5) Pictures of all affected poles, with corresponding pole identification numbers (photographs or jpeg files)
6) Licensee maps (plan/profile) showing route, spans,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

To Be Used For Transmission Attachment Permits



2010 ATTACHERS LIST

2010 ATTACHERS LIST

AT&T
Neil Jennings
State Manager – Joint Use / Right of Way
AT&T - Florida, Inc.
3400 Martin Luther King Drive
Pensacola, FL 32503

Verizon
Steve R. Lindsay
Section Manager – Centralized Joint Use
Mail Code FLTP0937
P.O. Box 110
Tampa, FL 33601

CenturyLink - Florida
Henry Bowlin
Manager Network Support - Joint Use
952 First Street, Altamonte Springs, Florida
Mailstop: FLALTH 0101-115 32701

Windstream Communications
Gary Cary
Windstream Florida, Inc
206 White Ave,
Live Oak, FL 326064
Attn: Engineering

Northeast Florida Telephone Company
Jered Bearden
130 North 4th Street
P.O. BOX 485
Macclenny, Fl 32063-0485

Indiantown Telephone Systems
Attn: Mike Brown
15925 S.W. Warfield Blvd.
Indiantown, F1 33456

DeltaCom, Inc.
John McGuffey, Field Engineer II
1809 Hillyer Robinson Ind Pkwy
Anniston, AL 36207

ATC Outdoor DAS, LLC
Attn: Director of DAS Solutions and Acquisitions
400 Regency Forest Drive
Suite 300
Cary, NC 27518

Dedicated Fiber Systems, Inc.
Attn: Charles T. Nichols
4651 Salisbury Rd
Suite 4004
Jacksonville, FL 32256

ePath Communications, Inc.
Attn: Joseph A. Tortoretti, CEO
5110 Eisenhower Blvd.
Suite 310
Tampa, FL 33634

ExteNet Systems, Inc.
Attn: Mr. Terry Ray, Vice President and CFO
1901 S. Meyers Rd
Suite 190
Oakbrook Terrace, IL 60181

Fiberlight
Attn: Chad Pifer
3655 Brookside Parkway
Suite 550
Alpharetta, GA 30022

FPL Fibernet LLC
Attn: Sheldon S Jordan
9250 West Flagler Street
Miami, FL 33174

Hotwire Communications, LLC
Kristin Johnson, President
300 E. Lancaster Avenue, Suite 208
Wynnewood, PA 19083

Level 3 Communications (SE Florida)
Attn: Jonathon Hager
1025 Eldorado Blvd
Broomfield, CO 80021

Lightstream Tech
Attn: Michael Hughes
3550 West Waters Avenue
Tampa, FL 33614

MCI
Attn: Virgil Springer
6929 N. Lakewood Ave.
Tulsa, OK 74117

NewPath Networks, LLC
Attn: Michael J. Kavanaugh, CEO
1300 North Northlake Way
Seattle, WA 98103

Nextel South, Corp.
Attn: Tim Thompson, Regional Vice President
Field Engineering and Operations
6575 The Corners Parkway
Norcross, GA 30092

NextG Networks, Inc.
Attn: Contracts Administrator
2216 O'Toole Avenue
San Jose, CA 95131

NUVOX Communications
Attn: John Hunt
2301 Lucien Way Suite 200
Maitland, FL 32751

PT Wireless
Attn: Joe Faber
444 High Street Suite 400
Palo Alto, CA 94301
Qwest Communications Corporation
Attn: Gary Hunt
700 West Mineral Avenue
UT H27.19
Littleton, Colorado 80120

SETEL
Attn: Ken Kirkland
1165 South 6 Street
Macclenny, FL 32063

Sunesys, LLC
Attn: Paul T. Bradshaw
202 Titus Av
Warrington, PA 18976

S.F.M. & T., INC
Attn: Tom Terwilliger
15398 SW 153 St
Miami, FL 33187

T-Mobile South, LLC
Attn: Harlan Kickhoefer
8100 SW 10th Street
Building 3, Suite 1000
Plantation, FL 33324

TAPCO
Attn: Thomas J. Farrell
23170 Harborview Road
Charlotte Harbor, FL 33980

TCG South Florida
Attn: V.P. of Operations
1001 West Cypress Creek Rd.
Suite #209
Fort Lauderdale, FL 33309

Tier 3 Communications
Attn: Loren Rosenthal
2235 First Street
Suite 217
Fort Myers, Florida 33901

Time Warner Telecom
Attn: Carla Hicks
6230 Shiloh Rd.
Suite 210
Alpharetta, GA 30005

U.S. Metropolitan Telecom, LLC
Attn: Carlie Ancor
24017 Production Circle
Bonita Springs, FL 34135

XO Communications
Attn: Leslie Strickland - Corporate Accounting
11111 Sunset Hills Road
Reston, VA 20190

City of Cocoa Beach
Jeff Thiel, I.T. Director
2 South Orlando Avenue
Cocoa Beach, FL 32931

City of Hollywood
Attn: John Barletta
2600 Hollywood Blv
Hollywood, FL 33020

City of Stuart
Public Works Director
121 SW Flagler Avenue
Stuart, FL 34994

City of Miami Beach
Trish Walker, Chief Financial Officer
1700 Convention Center Drive
Miami Beach, FL 33139

Palm Beach County
Attn: Chuck Spalding
Palm Beach County Government Center
301 North Olive Avenue
8th Floor
West Palm Beach, FL 33401

Town of Juno Beach
Town Manager
340 Ocean Drive
Juno Beach, FL 33408

Village of Wellington
Tom Amberguy
14000 Greenbriar Blvd
Wellington, FL 33414

WLRN
Attn: Chief Engineer
172 NE 15 Street
Miami, FL 33132

City of Bradenton Beach
Attn: Nora Idso
107 Gulf Drive North
Bradenton Beach Fl 34217

City of Palm Bay
C/O Deputy City Manager Sue Hahn, P.E., ICMA-CM
120 Malabar Rd
Palm Bay, Fl. 32907

City of South Daytona
1672 S. Ridgewood Ave
South Daytona, FL 32119

Collier County
Collier County Government Complex
Attn: Traffic Operations Supervisor
3301 E. Tamiami Trail
Naples, FL 34112

Myakka River State Park
13207 S.R. 72
Sarasota, Florida 34241

Sarasota County
Transportation Department – Engineering Division
Sarasota County Operations Center
1001 Sarasota Center Blvd.
Sarasota, FL 34240

City of Palm Beach Gardens
Patricia Snider, City Clerk
10500 North Military Trail
Palm Beach Gardens, FL 33410

Town Of Juno Beach
Attn: Joseph LoBello
340 Ocean Drive
Juno Beach, FL 33408

Seminole County
Attn: Traffic Engineering
140 Bush Loop
Sanford, FL 32773

City of Hollywood
Attn: Town Clerk
2600 Hollywood Boulevard
Hollywood, Florida 33020-4807

Vero Beach
1053 20th Place
Vero Beach FL 32960

Volusia County
Department of Engineering
123 W. Indiana Ave
DeLand FL, 32720

Broward County
Traffic Engineering Division
2300 West Commercial Boulevard
Fort Lauderdale, Florida 33309

West Palm Beach
ENGINEERING SERVICES
401 Clematis Street
West Palm Beach, FL 33401

City of Boca Raton
Attn: Town Clerk
201 W. Palmetto Park Rd.
Boca Raton, FL 33432

Brevard County
Attn: Traffic Engineering
2725 Judge Fran Jamieson Way
Suite A-204
Viera, Fl 32940

City of Cape Canaveral
105 Polk Avenue
Cape Canaveral, Florida 32920

Charlotte County
18500 Murdock Circle
Port Charlotte, FL 33948

Indian River County
Attn: Traffic Engineering
1028 20th Place
Vero Beach FL 32960

Manatee County
Manatee County Board of Commissioners
P. O. Box 1000, Bradenton, FL 34206-1000
1112 Manatee Avenue West, Bradenton, FL 34205

Martin County
County Administrative Center
2401 SE Monterey Road
Stuart, FL 34996-3322

City of Melbourne
City Hall
900 E. Strawbridge Ave.
Melbourne, FL 32901

Palm Beach County
Palm Beach County Governmental Center
301 N. Olive Avenue
West Palm Beach, FL 33401

City Of Port St. Lucie
City Clerk's Office
121 SW Port St. Lucie Blvd.
1st Floor, Building "A", Room 187
Port St. Lucie, FL 34984-5099

City of Rockledge
City Hall
1600 Huntington Lane
Rockledge, Florida
32955-2660

St. Lucie County
Board of County Commissioners
2300 Virginia Avenue
Fort Pierce, Florida 34982

State of Florida, Department of Transportation
Ruth Yanks
FDOT Utility Section
3400 W Commercial Blvd
Fort Lauderdale, FL 33309

Town of Lake Park
Attn: Mike Wells or Terry Leary
535 Park Avenue
Lake Park, FL 33403

Hendry County
Hendry County Commission
25 E. Hickpoochee Ave
LaBelle, Florida 33935

City of Deltona
Municipal Complex
2345 Providence Boulevard
Deltona, Florida 32725

City of Fort Myers
City Clerks Office
2200 Second Street
Fort Myers, Florida 33902

City of Lauderdale Lakes
Roy Denson, Assistant Director of Public Works
4300 N.W. 36th Street
Lauderdale Lakes, Florida 33319

City of Coral Springs
City Attorney
9551 W. Sample Road
Coral Springs, Florida 33065

City of Boynton Beach
City Clerk's Office
100 E. Boynton Beach Blvd
Boynton Beach, Florida 33435-3838

City of Delray Beach
Assistant City Manager
100 NW 1st Av
Delray Beach, Florida 33444

City of Cape Canaveral
City Clerk
105 Polk Ave.
Cape Canaveral, FL 32920

City Of Palm Bay
City Clerk
120 Malabar Rd SE
Palm Bay, FL 32907

City Of West Melbourne
City Attorney
2285 Minton Road.
West Melbourne, Florida 32904-4928

Town of Indialantic by the Sea
City Clerk
216 5th Avenue
Indialantic FL 32903

City Of Fort Lauderdale
City Clerk
100 N. Andrews Avenue
Fort Lauderdale, FL 33301

Columbia County
Public Works
607 NW Quinten St
Lake City, Fl 32055

City Of Miami
City Clerk
3500 Pan American Drive
Miami, Florida 33133

City Of Labelle
City Clerk
PO Box 580
LaBelle, FL 33975

City Of Riviera Beach
City Clerk
600 West Blue Heron Blvd.
Riviera Beach, Florida 33404

City Of Pompano Beach
City Clerk
100 West Atlantic Boulevard
Pompano Beach, Florida 33060

Comcast
Christopher McDonald
Director State Government Affairs-Florida
300 West Pensacola St.
Tallahassee, Florida 32301

Advanced Cable Communications
Jeff Glaser
12409 NW 35 St.
Coral Springs, Florida 33065

Atlantic Broadband
Dave Floberg
1681 Kennedy Causeway
North Bay Village, Florida 33141

Communication Services
Darrell Larid
17774 NW US HWY 441
High Springs, Florida 32643

Florida Cable
Gary English
23505 SR 40
Astor, Florida 32102

Brighthouse Network
Dennis Black
700 Carillon Parkway, Suite 6
St. Petersburg, Florida 33716

City of Pahokee
City Clerk
171 N Lake Ave
Pahokee, Florida 33476