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April 14, 2020

VIA ELECTRONIC FILING

Adam J. Teitzman, Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0850

Re: *Review of 2020-2029 Storm Protection Plan Pursuant to Rule 25-6.030, F.A.C., Duke Energy Florida, LLC*; Docket No. 20200069-EI

Dear Mr. Teitzman:

Please find enclosed for electronic filing Duke Energy Florida, LLC's revised Direct Testimony of John W. Oliver with Exhibit No. __ (JWO-1), Exhibit No. __ (JWO-2), Exhibit No. __ (JWO-3), Exhibit No. __ (JWO-4), and Exhibit No. __ (JWO-5).

Thank you for your assistance in this matter. Please feel free to call me at (850) 521-1428 should you have any questions concerning this filing.

Sincerely,

/s/ Matthew R. Bernier

Matthew R. Bernier

MRB/cmk
Enclosure

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CERTIFICATE OF SERVICE
(Dkt. No. 20200069-EI)

I HEREBY CERTIFY that a true and correct copy of the foregoing has been furnished to the following by electronic mail this 14th day of April, 2020, to all parties of record as indicated below.

/s/ Matthew R. Bernier
Attorney

C. Murphy / R. Dziechciarz Office of General Counsel Florida Public Service Commission 2540 Shumard Oak Blvd. Tallahassee, FL 32399-0850 cmurphy@psc.state.fl.us rdziechc@psc.state.fl.us	J.R. Kelly / Charles J. Rehwinkel Office of Public Counsel c/o The Florida Legislature 111 West Madison St., Rm. 812 Tallahassee, FL 32399-1400 kelly.jr@leg.state.fl.us rehwinkel.charles@leg.state.fl.us

IN RE: PETITION FOR APPROVAL OF 2020-2029 STORM PROTECTION PLAN

BY DUKE ENERGY FLORIDA, LLC

FPSC DOCKET NO. 20200069-EI

DIRECT TESTIMONY OF JAY W. OLIVER

I. INTRODUCTION AND QUALIFICATIONS.

Q. Please state your name and business address.

A. My name is Jay W. Oliver. My current business address is 400 South Tryon Street, Charlotte, NC 28202.

Q. By whom are you employed and in what capacity?

A. I am employed by Duke Energy Business Services, LLC ("DEBS") as General Manager, Grid Strategy and Asset Management Governance. DEBS is a wholly-owned subsidiary of Duke Energy Corporation ("Duke Energy") that provides various administrative and other services to Duke Energy Florida, LLC ("DEF" or the "Company") and other affiliated companies of Duke Energy.

Q. What are your responsibilities as General Manager, Grid Strategy and Asset Management Governance?

A. My duties and responsibilities include planning for grid upgrades, system planning, and overall Distribution asset management strategy across Duke Energy.

Q. Please summarize your educational background and professional experience.

A. I have a Bachelor of Science degree in Electrical Engineering from the Georgia Institute of Technology and a Master's degree in Business Administration from the University of South Florida. I am a licensed Electrical Engineer and a registered Professional Engineer in Florida. From 30 years working in the electric utility business, I have experience in electric transmission, distribution, and information technology and telecommunications systems that support utility transmission and distribution networks. I began working at Duke Energy in 1996, joining one of its predecessor companies, Florida Progress. Over the past 10 years, I have held the positions of General Manager Grid Strategy and Asset Management Governance, General Manager Engineering and Technology, Director Distribution Services, Major Projects Manager, and Director, Grid Automation. I have been in my current role since January 2020.

II. PURPOSE AND SUMMARY OF TESTIMONY.

Q. What is the purpose of your direct testimony?

A. In 2019, the Florida Legislature enacted Section 366.96, Florida Statutes, which requires DEF to prepare and file a Storm Protection Plan ("SPP"). Specifically, "[e]ach plan must explain the systematic approach the utility will follow to achieve the objectives of reducing restoration costs and outage times associated with extreme weather events and enhancing reliability." Section 366.96(3), Fla. Stat. (the "SPP Statute"). As directed by the SPP Statute, the Florida Public Service Commission ("the Commission" or "FPSC") enacted Rule 25-6.030, F.A.C. (the "SPP Rule"), which specifies the elements that must be included in each utility's SPP. My testimony explains the process that the Company used to evaluate various programs and projects that would meet the criteria set out in the SPP statute and rule. The result of that analysis is presented in the Company's SPP, which is attached to my testimony in five exhibits.

Q. Do you have any exhibits to your testimony?

A. Yes, I am sponsoring the following exhibits to my testimony:

- Exhibit No. __ (JWO-1), DEF 2020 Project-Level Detail;
- Exhibit No. __ (JWO-2), DEF SPP Plan Program Summaries:
- Exhibit No. __ (JWO-3), DEF SPP 3-year Investment Summary;
- Exhibit No. __ (JWO-4), DEF SPP Support; and
- Exhibit No. __(JWO-5), DEF Service Area.

These exhibits were prepared by the Company under my direction, and they are true and correct to the best of my information and belief. Mr. Thomas G. Foster is co-sponsoring Revenue Requirements and Rate Impacts of Exhibit No. __ (JWO-2).

Q. Please summarize your testimony.

A. My testimony presents the Company's SPP for the planning period 2020-2029. DEF's SPP is designed to cost-effectively "strengthen the Company's infrastructure to withstand extreme weather conditions by promoting the overhead hardening of electrical transmission and distribution facilities, the undergrounding of certain electrical distribution lines, and vegetation management" in accordance with the legislature's directive. Since the destruction caused by the active

2004/2005 hurricane season, at the Commission's direction, DEF has made great strides in strengthening its system to withstand the impacts of extreme weather events. The programs included in DEF's SPP build upon that foundation and present a holistic approach to further strengthening the Company's infrastructure with the goal of reducing outage frequency and duration during extreme weather events and enhancing overall reliability.

III. CURRENT STORM HARDENING PLAN AND GRID IMPROVEMENT PROJECTS AND OVERVIEW OF SPP.

Q. Please explain what projects DEF is currently implementing related to storm hardening.

A. In 2007 the Commission enacted Rule 25-6.0432, which is "intended to ensure the provision of safe, adequate, and reliable electric transmission and distribution service for operational as well as emergency purposes; require the cost-effective strengthening of critical electric infrastructure to increase the ability of transmission and distribution facilities to withstand extreme weather conditions; and reduce restoration costs and outage times to end-use customers associated with extreme weather conditions." To meet these objectives, investor-owned utilities like DEF are required to file a storm hardening plan every three years. The Commission approves each utility's storm hardening plan depending on whether the plan meets the intended objectives. DEF filed its last Storm Hardening Plan, for years 2019-2021, in March 2019, and the Commission approved it by order in July 2019. DEF's 2019-2021 Storm Hardening Plan includes initiatives that meet the objective of the storm hardening rule. Given the similarities between the storm hardening rule and the SPP Rule, a majority of DEF's current storm hardening activities will meet the objectives of the new SPP Rule and will continue, though many of these activities will be combined into new SPP Programs such as the Feeder and Lateral Hardening Programs.

Q. How has DEF's current Storm Hardening Plan impacted the development of the SPP?

A. The current Storm Hardening Plan (and its previous iterations) provided the foundation upon which the SPP builds. Indeed, because Year 1 of the SPP is 2020, the activities included in the Storm Hardening Plan for 2020 are already planned and in flight, DEF was unable to pivot and change course on those projects for 2020. Accordingly, DEF has summarized the activities in the Storm Hardening Plan that will carry over as projects for year 1 of the SPP, as required by the SPP Rule. Starting in year 2021 (or year 2 of the SPP), DEF will begin a transition to a more holistic system vision for hardening against extreme weather events and enhancing reliability. Additionally, the Storm Hardening Plan activities selected for the SPP provided a baseline of knowledge on which to base this more holistic system vision for hardening against extreme weather events.

Q. Does DEF have any other projects in flight related to SPP?

A. Yes, in the 2017 Settlement approved by the Commission,[1] DEF received a base rate increase for certain grid improvement projects, such as Targeted

[1] Order No. PSC-2017-0451-AS-EU.

Undergrounding and Self-Optimizing Grid. Because these programs meet the criteria of SPP, in that they are expected to reduce extreme weather event cost and outage duration and improve overall reliability, DEF included those programs in the SPP.

Q. Please describe how the SPP is organized.

A. DEF's SPP is attached as five Exhibits. Exhibit No. __ (JWO-1) includes those activities in the Storm Hardening Plan or approved as part of the 2017 Settlement that will also be included in the SPP. Locations, unit counts, Capital and O&M costs by project are included, as well as the expected spend and unit counts for Years 1-3. This exhibit satisfies subsection (3)(e) of the SPP Rule. Exhibit No. __(JWO-2) provides summaries for all programs included in the SPP, associated justifications and benefits, unit counts, and projected spend for the first three years of the SPP. This exhibit satisfies subsection (3)(a), (3)(b), (3)(d), and (3)(f) of the SPP Rule. Exhibit No. __ (JWO-3) is DEF's 3-year Investment Summary across all SPP Programs. Exhibit No. __(JWO-4) includes a write-up of the program benefit and prioritization methodology. This exhibit provides information required by subsection (3)(d)5. of the SPP Rule. Exhibit No. _(JWO-5) includes a map of DEF's service area and an associated customer count as required by subsection (3)(c) of the SPP Rule. The remainder of my testimony will briefly summarize these sections, including the process by which DEF completed the analysis in each section. Mr. Foster's testimony will present the rate impact and revenue requirements as required by the SPP Rule.

Q. How did DEF approach the development of the SPP?

A. DEF recognized that the development of its first SPP pursuant to the SPP Statute and Rule would be an enormous, and important, undertaking. The work done in this first SPP will establish the framework for future SPP filings and analysis. As explained above, DEF was able to build off its existing Storm Hardening Plan and grid improvement projects, but it needed a robust method to gather data to drive the selection and prioritization of programs and evaluate benefits of each program. DEF thus initiated a Request for Proposals process to select a third-party contractor to provide modeling services and support for this analysis. As a result of this process, DEF selected Guidehouse[2] to provide modeling assistance. Guidehouse's team has a deep level of industry experience in the areas of Transmission and Distribution systems, climate resilience, risk mitigation, cost-benefit analyses, and predictive analytical techniques.

At the same time, DEF assembled a cross-functional team of Company experts from various business functions, including Distribution, Transmission, Vegetation Management, Geographic Information System ("GIS"), and associated systems to work collaboratively with Guidehouse to develop a plan of programs that will meet the requirements of the SPP Statute and Rule. Each element of the process is explained in greater detail below.

IV. OVERVIEW OF PROGRAMS EVALUATED IN THE SPP.

Q. How did DEF develop the list of programs for the SPP?

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[2] Guidehouse LLP completed its acquisition of Navigant Consulting, Inc, in October 2019. The two brands are now combined as Guidehouse.

A. As explained above, DEF first started with its existing Storm Hardening Plan activities. From there, DEF consulted with subject matter experts with knowledge of DEF's Transmission and Distribution system and assets to identify additional potential programs and projects that would meet the requirements of the SPP Statute and Rule. DEF also met with other utilities to identify and validate potential programs.

An example of a new SPP program is the Feeder Hardening Program. The Feeder Hardening Program upgrades overhead Distribution facilities on main line circuits to meet extreme wind loading requirements as defined in NESC Code 250C, grade C (extreme wind loading). This program results in stronger poles, among other things, and meets the criteria of SPP in that it is expected to reduce outage times and cost in extreme weather conditions and improve overall service reliability. A complete list of the program names and descriptions can be found in my Exhibit No. __ (JWO-2).

Q. Are there other potential programs that DEF may consider in the future for inclusion in the SPP?

A. Yes, DEF will continue to monitor emergent technologies that may warrant further review and consideration.

V. PROGRAM EVALUATION, PRIORITIZATION, AND SELECTION

Q. Once the Company had a list of the programs, what was the next step of the analysis?

A. With the program list, Guidehouse then requested detailed data from the Company to evaluate each program from a risk and benefit standpoint. Specifically, the Company provided GIS data regarding the specific types of locations of various types of assets across DEF's service territory (e.g., distribution feeder lines and poles, substations, transmission structures, etc.). DEF also provided information on items like prior storm damage, vegetation management outage data, and historical data on existing storm hardening programs.

Q. Please provide an example of how a particular program was analyzed within the Guidehouse model.

A. Using the Feeder Hardening program as an example, Guidehouse estimated a reduction in storm damage and duration, using CMI as a proxy for duration. That model further enables us to prioritize the work over the life of the program based on highest benefit work first. As discussed in more detail in Exhibit No. __ (JWO-2), the Guidehouse model prioritized work by looking at the probability of damage to particular assets (including consideration of information from various FEMA-produced models) and the consequences of that damage, including for example the number and/or type of customers served by particular assets. That information was then evaluated by subject matter experts in the Distribution and Transmission functions for further analysis and prioritization.

Q. Please discuss how DEF prioritized 2020 projects in the SPP.

A. As discussed above, the Commission approved DEF's last Storm Hardening Plan in 2019. Implementation of that plan has already been in flight for 2020, so the SPP did not make any changes to that work.

Q. Please discuss how DEF selected its 2021 programs in the SPP.

A. We continue the SHP and multi-year rate plan (as described above) and will begin the transition to the new SPP Programs: for Distribution the Feeder Hardening Program and for Transmission the Structure Hardening Program. These Programs were selected based on the analysis described herein and more specifically in Exhibit No. __ (JWO-2).

Q. How did DEF identify programs and projects for the other years of the SPP?

A. For year three of the SPP (2022) and beyond, DEF developed long-term plans for the work that is needed to harden and strengthen the Distribution and Transmission infrastructure against extreme weather events and improve overall reliability. These are more fully described in Exhibit No. __ (JWO-2). DEF will use the methodology outlined in Exhibit No. __ (JWO-2) to identify and prioritize the work within these specific programs it plans to implement in 2022. For years four through ten of the SPP, DEF generally assumed that it would continue similar programs as what it identified in year three. In terms of identifying the total amount of work planned for those years, DEF applied general assumptions given the work completed in years one through three and DEF's ability to feasibly complete work each year. However, DEF expects that when it files its next SPP, it will be able to provide additional details about the amount and scope of work planned for years four through ten.

Q. Does DEF believe there are any implementation alternatives that could mitigate the resulting rate impact for each of the first three years of the proposed Storm Protection Plan?

A. DEF does not believe there are any implementation alternatives that could mitigate the resulting rate impact for the first three years of the SPP without causing a parallel reduction in the benefits the SPP is designed to produce. To further mitigate the rate impact would require reducing or delaying commencement of work under the SPP (to the extent of the desired rate mitigation) which would also delay the realization of the benefits the SPP is designed to create.

VI. BENEFITS THAT DEF'S SPP WILL BRING TO DEF'S CUSTOMERS

Q. What is DEF proposing as its 2020-2029 SPP?

A. DEF proposes to implement activities included in Exhibit No. __ (JWO-1) and Exhibit No. __ (JWO-2). DEF is confident that the activities included in this ten-year plan will strengthen its infrastructure, reduce outage times associated with extreme weather events, reduce restoration costs, and improve overall service reliability.

Q. Can you provide any additional detail about each program DEF is proposing to include in its SPP?

A. Yes, for ease of reference, DEF has prepared specific information for each program. Each program summary includes a detailed narrative description of the program, the benefit analysis for that program, and a summary table of annual projected spend for that program for the first three years, as well as the estimated total 10-Year spend. Each program summary is included in Exhibit No. __ (JWO-2).

Q. Does this conclude your testimony?

A. Yes, it does.

DUKE ENERGY

Storm Protection Plan

Florida

Project-Level Detail

Contents

ACTIVITY DESCRIPTIONS & SCOPE

The following sections of this document describe each of the Duke Energy Florida activities that are in the current Storm Hardening Plan (SHP), have planned scope in 2020, and will have components of work incorporated into the Storm Protection Plan (SPP) moving forward. This exhibit includes the activity description, as well as project-level detail for Year 1 (2020) and scope and cost data for Year 2 (2021).

Note: Shifts of scope may occur between years to optimize benefits delivery to customers and execution efficiencies.

Distribution

Florida

Project-Level Detail

I. Targeted Underground (UG)

The Targeted Underground (UG) activity was developed to address difficult to access overhead lines with a history of vegetation-related outages. The locations were selected based on a 10-year outage history of both the fuse and downstream transformers, secondary, and services.

The primary purpose of this activity is to eliminate tree and debris-related outages in the area of exposure by converting heavily vegetated neighborhoods that are prone to power outages from overhead to underground construction. This will decrease outages, reduce momentary interruptions, improve major storm restoration time, improve customer satisfaction, and reduce costs.

Historical Reliability and Prioritization

The Targeted Underground activities use a ten-year historic reliability assessment of protective devices to generate a list of potential targets. These targets are then reviewed and prioritized based on the events/mile ratio, location of assets (for example rear lot distribution), and vegetation coverage.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Targeted Underground (TUG)*	2020	2021	2022
Totals	$ 42,458,678	$ 65,182,532	
Capital	$ 41,934,480	$ 64,398,532	
O&M	$ 524,198	$ 784,000	
Total Miles OH Replaced	45	72	

**Beginning in 2022, these activities will be incorporated into the Lateral Hardening Program*

2020 Planned Duke Energy Florida – Targeted Underground (TUG)

Location	Unit Count	Customer Count	Project Cost - Capital		Project Cost - O&M		Start Date	Finish Date
TROPIC TERRACE - A207	0.71	41	$	661,584	$	8,270	6/26/2020	8/14/2020
ZUBER - A203	0.43	10	$	396,205	$	4,953	5/19/2020	6/30/2020
REDDICK - A34	0.10	1	$	89,826	$	1,123	12/18/2019	1/15/2020
LAND O LAKES - C141	0.25	15	$	237,425	$	2,968	3/20/2020	4/13/2020
MAXIMO - X143	0.44	40	$	408,226	$	5,103	6/1/2020	7/13/2020
ZUBER - A204	0.08	1	$	70,445	$	881	8/3/2020	9/4/2020
ZUBER - A204	0.24	5	$	225,777	$	2,822	10/1/2020	11/11/2020
ZUBER - A205	0.14	8	$	127,006	$	1,588	10/1/2020	11/11/2020
TARPON SPRINGS - C305	0.81	78	$	755,324	$	9,442	7/13/2020	9/4/2020
HIGH SPRINGS - A15	0.31	3	$	290,165	$	3,627	7/1/2020	8/12/2020
PORT ST JOE - N52	0.63	57	$	587,692	$	7,346	7/1/2020	8/19/2020
PIEDMONT - M473	0.88	70	$	820,644	$	10,258	7/13/2020	9/4/2020
SANTOS - A230	0.14	2	$	132,596	$	1,658	5/5/2020	6/9/2020
DINNER LAKE - K1685	0.25	53	$	235,748	$	2,947	4/24/2020	5/29/2020
EUSTIS - M500	0.04	6	$	34,291	$	429	3/9/2020	4/3/2020
COUNTRY OAKS - K1443	0.10	2	$	90,385	$	1,130	7/1/2020	7/29/2020
CLERMONT - K601	0.23	9	$	211,987	$	2,650	7/1/2020	8/5/2020
LAKE PLACID - K1320	0.10	7	$	97,467	$	1,218	5/5/2020	6/2/2020
MAXIMO - X143	0.12	7	$	115,265	$	1,441	3/16/2020	4/20/2020
ZUBER - A204	0.28	8	$	261,745	$	3,272	8/3/2020	9/14/2020
COUNTRY OAKS - K1446	0.34	42	$	318,492	$	3,981	8/3/2020	9/21/2020
CLERMONT - K603	0.41	53	$	386,514	$	4,832	8/3/2020	10/5/2020
FORTIETH STREET - X84	0.05	9	$	44,261	$	553	2/24/2020	4/1/2020
HAINES CITY - K20	0.31	6	$	288,954	$	3,612	5/5/2020	6/9/2020
CARRABELLE - N42	0.51	25	$	471,961	$	5,900	8/3/2020	10/5/2020
WOLF LAKE - M564	0.03	1	$	30,936	$	387	5/5/2020	6/2/2020
PORT RICHEY WEST - C202	0.28	30	$	263,981	$	3,300	3/16/2020	4/27/2020
EASTPOINT - N231	0.03	4	$	29,259	$	366	7/1/2020	7/29/2020
JASPER SOUTH - N191	0.23	1	$	215,714	$	2,697	3/27/2020	5/1/2020
DENHAM - C153	0.26	5	$	244,041	$	3,051	1/27/2020	2/21/2020
PORT RICHEY WEST - C208	0.22	24	$	204,998	$	2,563	3/9/2020	4/13/2020
TRI CITY - J5036	0.40	15	$	373,376	$	4,667	5/12/2020	6/23/2020
DELTONA EAST - W0130	0.11	25	$	104,735	$	1,309	5/12/2020	6/16/2020
BAYVIEW - C652	0.07	26	$	64,574	$	807	6/3/2020	6/30/2020
DENHAM - C157	0.21	3	$	191,114	$	2,389	2/10/2020	3/13/2020
DENHAM - C155	0.12	2	$	111,817	$	1,398	6/3/2020	7/8/2020
PORT RICHEY WEST - C202	0.20	20	$	186,548	$	2,332	3/31/2020	5/5/2020
BAYVIEW - C657	0.39	20	$	361,449	$	4,518	2/24/2020	4/8/2020
VINELAND - K903	0.11	5	$	98,958	$	1,237	11/2/2020	12/11/2020
VINELAND - K903	0.06	4	$	55,909	$	699	3/23/2020	4/27/2020
SAFETY HARBOR - C3518	0.15	6	$	141,728	$	1,772	5/12/2020	6/16/2020
SAFETY HARBOR - C3527	0.29	16	$	265,845	$	3,323	3/9/2020	4/20/2020

PORT RICHEY WEST - C203	0.62	46	$	575,858	$	7,198	7/28/2020	9/22/2020
CASSELBERRY - W0027	0.07	15	$	65,133	$	814	2/6/2020	3/9/2020
CASSELBERRY - W0022	0.38	16	$	349,987	$	4,375	5/12/2020	6/23/2020
ZEPHYRHILLS - C855	0.15	27	$	144,058	$	1,801	3/16/2020	4/13/2020
WEST DAVENPORT - K1521	0.16	19	$	148,158	$	1,852	3/9/2020	4/13/2020
INTERCESSION CITY - K967	0.07	5	$	69,420	$	868	3/23/2020	4/20/2020
HOMOSASSA - A271	0.24	27	$	224,007	$	2,800	5/5/2020	6/9/2020
HOMOSASSA - A271	0.34	17	$	316,256	$	3,953	7/1/2020	8/12/2020
WINTER GARDEN - K204	0.16	16	$	145,549	$	1,819	5/5/2020	6/9/2020
LURAVILLE - A192	0.17	3	$	161,482	$	2,019	3/23/2020	4/27/2020
WINDERMERE - K302	0.21	11	$	195,773	$	2,447	5/5/2020	6/9/2020
WINDERMERE - K302	0.38	21	$	351,106	$	4,389	6/1/2020	7/13/2020
BAY HILL - K76	0.05	2	$	42,956	$	537	5/5/2020	6/2/2020
WINTER GARDEN - K204	0.26	35	$	241,618	$	3,020	5/15/2020	6/26/2020
REDDICK - A36	0.08	1	$	75,849	$	948	7/1/2020	7/29/2020
REDDICK - A36	0.17	1	$	157,755	$	1,972	12/19/2019	1/16/2020
REDDICK - A36	0.03	1	$	27,395	$	342	3/30/2020	4/27/2020
ZEPHYRHILLS - C853	0.25	25	$	234,070	$	2,926	4/6/2020	5/11/2020
LAKEWOOD - K1695	0.20	22	$	181,703	$	2,271	4/1/2020	5/6/2020
DINNER LAKE - K1690	0.50	15	$	465,905	$	5,824	5/5/2020	6/9/2020
LAKEWOOD - K1695	0.47	18	$	441,584	$	5,520	5/5/2020	6/16/2020
HEMPLE - K2246	0.15	12	$	141,821	$	1,773	6/1/2020	7/13/2020
HEMPLE - K2246	0.16	4	$	146,387	$	1,830	3/9/2020	4/13/2020
HEMPLE - K2253	0.46	25	$	425,744	$	5,322	6/1/2020	7/13/2020
SILVER SPRINGS - A154	0.17	5	$	158,967	$	1,987	5/19/2020	6/23/2020
SILVER SPRINGS - A154	0.08	2	$	72,867	$	911	12/17/2019	1/14/2020
SILVER SPRINGS - A154	0.11	2	$	105,667	$	1,321	5/1/2020	6/5/2020
CASSELBERRY - W0025	0.23	13	$	213,664	$	2,671	5/12/2020	6/16/2020
ALTAMONTE - M572	0.10	9	$	93,181	$	1,165	5/27/2020	6/23/2020
ALTAMONTE - M573	0.22	17	$	205,464	$	2,568	5/27/2020	6/30/2020
ALTAMONTE - M573	0.07	14	$	63,643	$	796	3/9/2020	4/3/2020
ZEPHYRHILLS - C851	0.08	13	$	77,433	$	968	12/9/2019	1/30/2020
ARCHER - A195	0.42	15	$	391,173	$	4,890	4/1/2020	5/13/2020
ZEPHYRHILLS NORTH - C340	0.17	6	$	158,408	$	1,980	2/10/2020	3/18/2020
ALDERMAN - C5010	0.13	23	$	122,440	$	1,531	1/13/2020	2/14/2020
HOMOSASSA - A272	0.20	4	$	186,362	$	2,330	5/13/2020	6/17/2020
ZEPHYRHILLS NORTH - C344	0.37	18	$	346,260	$	4,328	3/17/2020	4/21/2020
LURAVILLE - A192	0.19	10	$	175,739	$	2,197	5/5/2020	6/9/2020
WELCH ROAD - M552	0.40	11	$	375,799	$	4,698	4/16/2020	5/20/2020
WELCH ROAD - M552	0.22	6	$	203,787	$	2,547	3/30/2020	5/4/2020
CURLEW (HD) - C4988	0.47	3	$	438,230	$	5,478	4/1/2020	5/13/2020
NORTHEAST - X286	0.05	8	$	44,354	$	554	3/9/2020	4/13/2020

PERRY - N7	0.24	15	$	219,441	$	2,743	1/13/2020	1/28/2020
WILLISTON - A124	0.37	6	$	348,497	$	4,356	5/1/2020	6/12/2020
FORTIETH STREET - X82	0.11	21	$	101,008	$	1,263	5/5/2020	6/9/2020
ALTAMONTE - M578	0.21	16	$	199,593	$	2,495	8/3/2020	9/14/2020
ALTAMONTE - M576	0.78	59	$	727,463	$	9,094	7/1/2020	8/5/2020
LONGWOOD - M143	0.10	8	$	92,715	$	1,159	3/9/2020	4/13/2020
NORTH LONGWOOD - M1755	0.13	16	$	121,974	$	1,525	4/14/2020	5/11/2020
LONGWOOD - M144	0.07	10	$	68,861	$	861	5/12/2020	6/9/2020
ALTAMONTE - M578	0.15	7	$	137,069	$	1,713	3/9/2020	4/13/2020
APOPKA SOUTH - M727	0.09	2	$	79,483	$	994	1/21/2020	2/4/2020
APOPKA SOUTH - M727	0.10	3	$	91,876	$	1,148	5/1/2020	6/5/2020
APOPKA SOUTH - M727	0.04	2	$	37,645	$	471	2/3/2020	3/4/2020
PERRY - N9	0.13	6	$	124,862	$	1,561	2/18/2020	3/26/2020
PERRY NORTH - N14	0.15	14	$	140,051	$	1,751	5/5/2020	6/9/2020
LAKE WEIR - A64	0.29	11	$	274,790	$	3,435	7/1/2020	8/12/2020
DISSTON - X62	0.21	20	$	196,053	$	2,451	2/10/2020	4/7/2020
DISSTON - X65	0.31	30	$	288,861	$	3,611	4/1/2020	5/13/2020
LAKE WEIR - A64	0.11	5	$	104,922	$	1,312	2/10/2020	3/18/2020
MINNEOLA - K948	0.31	25	$	288,861	$	3,611	6/11/2020	7/16/2020
MINNEOLA - K948	0.23	17	$	218,882	$	2,736	10/1/2020	11/4/2020
LURAVILLE - A192	0.45	22	$	418,382	$	5,230	4/1/2020	5/13/2020
PERRY - N7	0.44	11	$	412,885	$	5,161	4/1/2020	5/13/2020
HOLDER - A48	0.07	1	$	68,674	$	858	2/10/2020	3/11/2020
WEKIVA - M103	0.08	4	$	76,781	$	960	5/27/2020	6/23/2020
WALSINGHAM - J553	0.11	55	$	100,635	$	1,258	3/16/2020	4/20/2020
BROOKSVILLE - A97	0.11	6	$	100,915	$	1,261	3/2/2020	3/27/2020
WALSINGHAM - J553	0.20	6	$	186,362	$	2,330	3/9/2020	4/13/2020
PINECASTLE - W0392	0.58	30	$	545,015	$	6,813	7/1/2020	8/19/2020
LAKE PLACID NORTH - K24	0.22	10	$	201,178	$	2,515	3/9/2020	4/13/2020
KENNETH CITY - X55	0.22	30	$	206,675	$	2,584	4/1/2020	5/6/2020
CLEARWATER - C16	0.37	44	$	343,651	$	4,296	4/1/2020	5/6/2020
WEKIVA - M103	0.12	3	$	113,681	$	1,421	1/27/2020	2/25/2020
PIEDMONT - M471	0.21	19	$	191,766	$	2,397	5/19/2020	6/23/2020
PERRY NORTH - N14	0.28	26	$	260,534	$	3,257	5/5/2020	6/16/2020
PERRY - N7	0.18	3	$	168,192	$	2,102	2/18/2020	3/26/2020
JASPER SOUTH - N191	0.15	5	$	138,001	$	1,725	5/5/2020	6/9/2020
COLEMAN - A105	0.11	8	$	99,890	$	1,249	6/1/2020	7/6/2020
WILDWOOD - A396	0.26	6	$	245,159	$	3,065	7/1/2020	8/12/2020
WILDWOOD - A396	0.12	2	$	110,513	$	1,381	6/1/2020	7/6/2020
EUSTIS - M503	0.07	3	$	62,711	$	784	7/1/2020	7/29/2020
EUSTIS - M499	0.27	14	$	249,166	$	3,115	5/5/2020	6/9/2020
FLORA MAR - C4008	0.78	62	$	725,227	$	9,066	7/1/2020	8/19/2020

WALSINGHAM - J555	0.23	28	$	217,111	$	2,714	4/1/2020	5/6/2020
JENNINGS - N195	0.08	1	$	75,477	$	943	12/19/2019	1/14/2020
EAST CLEARWATER - C903	0.33	43	$	303,117	$	3,789	5/5/2020	6/9/2020
UMATILLA - M4407	0.08	7	$	76,129	$	952	7/1/2020	7/29/2020
UMATILLA - M4405	0.13	4	$	123,837	$	1,548	8/3/2020	9/4/2020
LISBON - M1519	0.06	2	$	53,579	$	670	7/1/2020	7/29/2020
LISBON - M1517	0.51	22	$	478,018	$	5,975	7/1/2020	8/19/2020
JASPER SOUTH - N191	0.18	8	$	167,726	$	2,097	3/30/2020	5/4/2020
JASPER SOUTH - N192	0.13	12	$	116,569	$	1,457	5/5/2020	6/9/2020
ZUBER - A202	0.27	2	$	255,968	$	3,200	7/1/2020	8/12/2020
HIGH SPRINGS - A15	0.08	3	$	70,724	$	884	12/18/2019	1/20/2020
LAKE OF THE HILLS - K1885	0.22	8	$	203,134	$	2,539	8/3/2020	9/4/2020
HIGH SPRINGS - A15	0.09	5	$	79,856	$	998	3/31/2020	4/28/2020
HIGH SPRINGS - A15	0.11	3	$	105,854	$	1,323	6/1/2020	7/6/2020
TRENTON - A90	0.12	1	$	113,215	$	1,415	2/10/2020	3/18/2020
TRENTON - A90	0.05	5	$	49,665	$	621	7/1/2020	7/29/2020
OVIEDO - W0175	0.06	2	$	53,579	$	670	9/1/2020	10/6/2020
OVIEDO - W0174	0.04	2	$	37,459	$	468	7/1/2020	7/29/2020
WINTER SPRINGS - W0192	0.18	6	$	170,987	$	2,137	6/1/2020	7/6/2020
ALAFAYA - W0298	0.18	6	$	168,937	$	2,112	7/1/2020	7/29/2020
CLERMONT - K603	0.42	59	$	389,962	$	4,875	10/1/2020	11/18/2020
TRENTON - A90	0.05	1	$	45,472	$	568	7/1/2020	7/29/2020
GEORGIA PACIFIC - A45	0.18	8	$	167,726	$	2,097	6/1/2020	7/6/2020
CONWAY - W0407	0.32	27	$	299,763	$	3,747	10/1/2020	11/18/2020
CONWAY - W0408	0.24	37	$	219,907	$	2,749	10/1/2020	11/4/2020
CONWAY - W0408	0.37	25	$	341,694	$	4,271	11/2/2020	12/4/2020
NORTH LONGWOOD - M1751	0.15	3	$	141,355	$	1,767	8/3/2020	9/14/2020
NORTH LONGWOOD - M1758	0.09	3	$	82,279	$	1,029	10/1/2020	11/4/2020
NORTH LONGWOOD - M1751	0.12	12	$	109,860	$	1,373	9/1/2020	10/13/2020
LAKE EMMA - M426	0.05	7	$	46,497	$	581	8/3/2020	9/4/2020
EASTPOINT - N231	0.15	38	$	135,951	$	1,699	7/1/2020	7/29/2020
TAVARES EAST - M581	0.05	7	$	46,404	$	580	8/3/2020	9/4/2020
SKY LAKE - W0363	0.11	15	$	101,101	$	1,264	9/1/2020	10/6/2020
MAXIMO - X150	1.08	119	$	1,006,913	$	12,587	7/13/2020	9/4/2020
PIEDMONT - M473	0.30	25	$	275,350	$	3,442	6/1/2020	7/6/2020
MAITLAND - W0087	0.16	12	$	151,885	$	1,899	11/2/2020	12/4/2020
ALTAMONTE - M579	0.04	5	$	36,713	$	459	11/2/2020	12/4/2020
ALTAMONTE - M579	0.03	3	$	25,252	$	316	11/2/2020	12/4/2020
MAITLAND - W0087	0.05	7	$	46,963	$	587	11/2/2020	12/4/2020
MAITLAND - W0079	0.05	4	$	43,515	$	544	10/2/2020	11/5/2020
PORT ST JOE - N52	0.38	39	$	355,392	$	4,443	7/1/2020	8/12/2020
BOGGY MARSH - K957	0.22	1	$	205,557	$	2,570	8/3/2020	9/14/2020

BAY RIDGE - M447	0.10	2	$	90,013	$	1,125	9/1/2020	10/6/2020
BAY RIDGE - M451	0.14	5	$	129,428	$	1,618	11/2/2020	12/4/2020
TAYLOR AVENUE - J2904	0.09	11	$	85,167	$	1,065	11/2/2020	12/4/2020
MAITLAND - M82	0.07	11	$	62,990	$	787	11/2/2020	12/4/2020
EATONVILLE - M1135	0.16	7	$	148,437	$	1,856	10/1/2020	11/11/2020
MYRTLE LAKE - M651	0.27	22	$	249,911	$	3,124	10/1/2020	11/18/2020
TROPIC TERRACE - A207	0.05	2	$	48,361	$	605	6/11/2020	7/9/2020
BEVERLY HILLS - A73	0.08	13	$	78,458	$	981	5/12/2020	6/9/2020
GE ALACHUA - A186	0.14	3	$	131,478	$	1,644	8/3/2020	9/14/2020
WALSINGHAM - J558	0.11	5	$	104,269	$	1,303	12/16/2019	2/10/2020
CLEARWATER - C5	0.09	18	$	83,863	$	1,048	3/31/2020	5/5/2020
LAKE WEIR - A61	0.18	9	$	165,117	$	2,064	3/9/2020	4/13/2020
GEORGIA PACIFIC - A45	0.07	5	$	61,499	$	769	3/9/2020	4/3/2020
DELAND - W0804	0.13	132	$	118,433	$	1,480	3/9/2020	4/13/2020
ST MARKS WEST - N336	0.11	9	$	103,524	$	1,294	3/31/2020	5/5/2020
BELLEAIR - C656	0.10	8	$	88,895	$	1,111	2/10/2020	3/13/2020
WAUKEENAH - N64	0.07	2	$	64,854	$	811	5/5/2020	6/2/2020
PERRY NORTH - N14	0.07	1	$	61,313	$	766	5/13/2020	6/10/2020
ST MARKS WEST - N336	0.08	1	$	77,620	$	970	7/1/2020	7/29/2020
SUN N' LAKE - K1296	0.12	4	$	108,835	$	1,360	2/24/2020	4/1/2020
LAKEWOOD - K1693	0.05	2	$	47,429	$	593	5/1/2020	5/29/2020
CLERMONT - K606	0.07	5	$	64,761	$	810	1/13/2020	2/4/2020
ANCLOTE - C4203	0.08	8	$	71,190	$	890	3/9/2020	4/3/2020
CLERMONT - K602	0.10	15	$	97,374	$	1,217	3/18/2020	4/22/2020
CLERMONT - K606	0.08	11	$	72,122	$	902	5/27/2020	6/23/2020
ZUBER - A203	0.22	8	$	200,339	$	2,504	3/9/2020	4/13/2020
LAKE WALES - K53	0.17	10	$	154,587	$	1,932	3/16/2020	4/13/2020
LAKE WALES - K58	0.34	35	$	321,101	$	4,014	5/5/2020	6/16/2020
REDDICK - A34	0.29	5	$	271,250	$	3,391	4/21/2020	6/2/2020
REDDICK - A34	0.08	2	$	74,545	$	932	3/16/2020	4/13/2020
SILVER SPRINGS SHORES - A131	0.28	20	$	261,279	$	3,266	5/5/2020	6/16/2020
ZUBER - A202	0.05	6	$	48,920	$	612	5/5/2020	6/9/2020
ZUBER - A202	0.11	2	$	103,058	$	1,288	2/24/2020	4/1/2020
SANTOS - A230	0.20	15	$	185,989	$	2,325	5/5/2020	6/9/2020
SANTOS - A230	0.11	2	$	101,101	$	1,264	1/13/2020	1/22/2020
DESOTO CITY - K3222	0.14	1	$	129,801	$	1,623	1/27/2020	3/17/2020
DESOTO CITY - K3222	0.06	1	$	59,729	$	747	3/2/2020	3/27/2020
DINNER LAKE - K1691	0.23	7	$	217,205	$	2,715	6/17/2020	7/22/2020
CYPRESSWOOD - K562	0.25	7	$	229,318	$	2,867	5/5/2020	6/9/2020
HAINES CITY - K21	0.13	2	$	124,024	$	1,550	5/13/2020	6/17/2020
HAINES CITY - K21	0.05	7	$	47,988	$	600	2/10/2020	3/13/2020
CYPRESSWOOD - K563	0.06	3	$	57,027	$	713	2/17/2020	3/20/2020
SKY LAKE - W0368	0.34	49	$	313,367	$	3,917	9/9/2020	10/20/2020
FERN PARK - M907	0.44	47	$	406,921	$	5,087	9/9/2020	10/13/2020
EATONVILLE - M1135	0.11	24	$	104,363	$	1,305	6/3/2020	6/30/2020
OBRIEN - A379	1.02	6	$	953,893	$	11,924	6/10/2020	7/22/2020

II. Deteriorated Conductor

The primary purpose of this activity is to replace over-dutied overhead conductor on the system that is prone to outages due to its brittle composition, small load capacity and reduced connection quality.

Historical Reliability and Prioritization

Deteriorated Conductor activities utilize a four-year historical reliability assessment of protective devices upstream of small copper overhead conductor, including a weighted scoring that included CMI performance (55%), count of devices involved in CEMI4 indicator (30%) and whether the feeder had been showing up on the 3% Worst Performing Feeder list (15%). The historical reliability assessment is then coupled with local operational knowledge from Operations and Engineering, as well as physical condition of the conductor (splices) to select the specific devices to address.

Once a target is selected, all of the copper conductor (typically #4 & #6) and smaller aluminum (typically #4) is brought up to the current aluminum equivalent (1/0); poles are replaced and brought up to the current specifications with increased spacing; transformers and other primary equipment are either replaced with newer units or retrofitted to new specifications; open wire secondary is replaced with insulated conductor; and vegetation is cleared to the standard. All of these efforts result in a lateral that is more resilient to weather and vegetation events.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Deteriorated Conductor*	2020	2021	2022
Totals	$ 14,597,739	$ 19,661,130	
Capital	$ 14,453,207	$ 19,427,994	
O&M	$ 144,532	$ 233,136	
Total Miles OH Replaced	58	76	

**Beginning in 2022, these activities will be incorporated into the Lateral Hardening Program.*

2020 Planned Duke Energy Florida – Deteriorated Conductor

Location	Unit Count	Customer Count	Project Cost - Capital		Project Cost - O&M		Start Date	Finish Date
APALACHACOLA' - N58 Total	15629	1000	$	743,784.11	$	7,437.84	07/06/20	11/27/20
APOPKA SOUTH' - M723 Total	8237	2209	$	391,998.83	$	3,919.99	11/04/19	04/10/20
ARCHER' - A196 Total	6178	492	$	294,011.02	$	2,940.11	06/29/20	10/09/20
BARBERVILLE' - W0902 Total	6864	1517	$	326,657.76	$	3,266.58	01/06/20	04/17/20
BOGGY MARSH' - K959 Total	3802	598	$	180,937.18	$	1,809.37	08/12/19	03/27/20
CLARCONA' - M342 Total	6125	1838	$	291,488.75	$	2,914.89	01/13/20	03/06/20
DELAND EAST' - W1110 Total	9293	1810	$	442,253.87	$	4,422.54	09/30/19	03/27/20
DUNDEE' - K3245 Total	3802	1812	$	180,937.18	$	1,809.37	01/06/20	01/31/20
DUNEDIN' - C104 Total	11349	2127	$	540,098.91	$	5,400.99	09/02/19	02/14/20
EAST ORANGE' - W0250 Total	4118	1886	$	195,975.62	$	1,959.76	09/23/19	02/28/20
LISBON' - M1517 Total	2745.6	2159	$	130,663.10	$	1,306.63	09/30/19	02/21/20
LISBON - M1518 Total	9768	1704	$	464,859.12	$	4,648.59	10/28/19	02/28/20
LOCKHART' - M402 Total	3115	619	$	148,242.85	$	1,482.43	09/23/19	02/14/20
MCINTOSH' - A51 Total	33474	1315	$	1,593,027.66	$	15,930.28	10/28/19	05/08/20
ORANGE CITY' - W0382 Total	12619	1563	$	600,538.21	$	6,005.38	01/13/20	08/07/20
PINECASTLE' - W0392 Total	3062	1538	$	145,720.58	$	1,457.21	05/01/19	02/14/20
SOPCHOPPY' - N327 Total	35271	1463	$	1,678,546.89	$	16,785.47	12/02/19	06/01/20
ST MARKS WEST' - N332 Total	16210	1105	$	771,433.90	$	7,714.34	04/01/20	10/30/20
TARPON SPRINGS' - C303 Total	17318	1985	$	824,163.62	$	8,241.64	09/09/19	04/24/20
WAUKEENAH' - N64 Total	19483	649	$	927,195.97	$	9,271.96	06/01/20	11/13/20
WEST LAKE WALES' - K866 Total	23707	1073	$	1,128,216.13	$	11,282.16	12/16/19	06/01/20
ZELLWOOD' - M33 Total	45672	1226	$	2,173,530.48	$	21,735.30	10/14/19	06/12/20
ZEPHYRHILLS' - C855 Total	5861	3133	$	278,924.99	$	2,789.25	10/12/20	11/27/20

III. Self-Optimizing Grid (SOG)

This program enables the automatic reconfiguration of the system to minimize the number of customers that experience sustained power outages. The Self-Optimizing Grid (SOG) Program transforms the radial distribution system into an automated distribution network that provides:

1. connectivity with automated switching,
2. capacity on the circuits to allow most circuits to be restored from alternate sources,
3. automated control with SCADA-enabled Automated Switching Devices (ASDs) to isolate faults and reconfigure the system,
4. segmentation such that the distribution circuits have much smaller line segments, thus reducing the number of customers that are affected by outages, and
5. feeders are segmented into blocks of approximately 400 customers.

Historical Reliability and Prioritization

The target selection and prioritization model for the Self-Optimizing Grid Program primarily include circuit customer count and 4 years of circuit backbone customer interruption (CI) data. Circuit backbone CI (breaker and electronic recloser) is included to ensure historically poor performing circuits are prioritized appropriately. Once a circuit is selected and prioritized, a "Team" (SOG Team) is developed around this circuit by reviewing available/ alternate circuit ties (requiring a review of grid topology). Annual work prioritization of the SOG Teams is generally based on customer count and circuit backbone CI; but it may also include such factors as total cost per SOG Team, load-growth considerations, and societal impacts (i.e., circuits with schools, hospitals, or airports).

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Self-Optimizing Grid (SOG)	**2020**	**2021**	**2022**
Totals	**$ 56,483,391**	**$ 81,269,879**	**$ 76,500,000**
Automation	$ 35,611,138	$ 56,911,355	$ 45,900,000
Capital	$ 34,860,275	$ 55,795,446	$ 45,000,000
O&M	$ 750,863	$ 1,115,909	$ 900,000
Total ASD's	580	851	686
Connectivity & Capacity	$ 20,872,253	$ 24,358,525	$ 30,600,000
Capital	$ 20,541,619	$ 23,880,906	$ 30,000,000
O&M	$ 330,634	$ 477,618	$ 600,000

2020 Planned Duke Energy Florida – Self-Optimizing Grid

Location	Unit Count	Customer Count	Project Cost - Capital		Project Cost - O&M		Start Date	Finish Date
WEST DAVENPORT - K1526 Total	1	3797	$	64,619	$	1,400	04/20/20	04/24/20
EAST ORANGE - W0252 Total	2	1571	$	129,238	$	2,800	02/13/20	04/03/20
EAST ORANGE - W0253 Total	1	1231	$	40,000	$	814	11/18/19	02/17/20
EAST ORANGE - W0274 Total	1	2399	$	64,619	$	1,400	10/15/19	04/09/20
SUNFLOWER - W0471 Total	2	1340	$	104,619	$	2,214	11/15/19	04/24/20
POINCIANA - K1236 Total	1	2461	$	64,619	$	1,400	11/14/19	03/11/20
POINCIANA - K1508 Total	1	2288	$	64,619	$	1,400	12/10/19	02/06/20
LONGWOOD - M142 Total	8	2406	$	516,952	$	11,200	01/20/20	02/28/20
LONGWOOD - M143 Total	3	852	$	193,857	$	4,200	01/21/20	01/29/20
CASSELBERRY - W0019 Total	3	1816	$	193,857	$	4,200	01/22/20	03/05/20
WINTER SPRINGS - W0187 Total	1	1302	$	64,619	$	1,400	05/06/20	05/06/20
WINTER SPRINGS - W0188 Total	3	2348	$	169,238	$	3,614	02/04/20	04/24/20
DELTONA EAST - W0121 Total	4	1492	$	258,476	$	5,600	04/30/20	05/21/20
DELTONA EAST - W0130 Total	5	1910	$	323,095	$	7,000	05/12/20	06/11/20
TURNER PLANT - W0762 Total	2	1414	$	129,238	$	2,800	05/26/20	05/28/20
TURNER PLANT - W0763 Total	3	1682	$	193,857	$	4,200	05/07/20	05/19/20
LAKE BRYAN - K231 Total	2	852	$	80,000	$	1,628	05/07/20	05/20/20
LAKE BRYAN - K238 Total	2	693	$	80,000	$	1,628	11/11/19	04/13/20
ISLESWORTH - K781 Total	2	3202	$	104,619	$	2,214	11/11/19	04/20/20
ISLESWORTH - K782 Total	4	870	$	160,000	$	3,256	11/04/19	05/28/20
VINELAND - K901 Total	1	406	$	64,619	$	1,400	04/14/20	04/20/20
VINELAND - K912 Total	2	2697	$	80,000	$	1,628	04/30/20	06/04/20
VINELAND - K915 Total	2	366	$	80,000	$	1,628	11/14/19	04/29/20
VINELAND - K917 Total	1	2755	$	40,000	$	814	04/20/20	04/24/20
OVIEDO - W0171 Total	3	1561	$	169,238	$	3,614	06/03/20	08/06/20
OVIEDO - W0172 Total	5	1398	$	273,857	$	5,828	03/12/20	08/13/20
OVIEDO - W0174 Total	6	1768	$	387,714	$	8,400	03/05/20	06/24/20
WINTER SPRINGS - W0193 Total	1	1610	$	64,619	$	1,400	05/06/20	05/06/20
WINTER SPRINGS - W0194 Total	5	1205	$	298,476	$	6,414	04/08/20	06/24/20
WINTER SPRINGS - W0195 Total	5	2686	$	249,238	$	5,242	05/06/20	09/03/20
LOCKWOOD - W0480 Total	5	1680	$	249,238	$	5,242	04/29/20	08/20/20
LOCKWOOD - W0481 Total	4	1430	$	258,476	$	5,600	03/17/20	05/27/20
LOCKWOOD - W0483 Total	1	1310	$	64,619	$	1,400	05/13/20	05/13/20
LAKE MARION - K1286 Total	2	2586	$	129,238	$	2,800	06/17/20	07/15/20
LAKE MARION - K1287 Total	6	2751	$	387,714	$	8,400	06/24/20	08/05/20
HEMPLE - K2255 Total	4	2076	$	160,000	$	3,256	11/19/19	04/30/20
WINTER GARDEN - K3285 Total	3	1124	$	120,000	$	2,442	11/11/19	04/28/20
LAKE MARION - K1288 Total	2	1585	$	129,238	$	2,800	03/23/20	04/15/20
DUNDEE - K3244 Total	3	2218	$	193,857	$	4,200	03/03/20	04/08/20

DELAND EAST - W1107 Total	1	331	$	64,619	$	1,400	12/30/19	01/06/20
RIO PINAR - W0972 Total	1	1732	$	64,619	$	1,400	07/22/20	07/22/20
NARCOOSSEE - W0214 Total	4	1525	$	258,476	$	5,600	07/08/20	08/19/20
NARCOOSSEE - W0217 Total	5	2533	$	323,095	$	7,000	07/29/20	09/09/20
NARCOOSSEE - W0220 Total	4	1537	$	258,476	$	5,600	07/22/20	08/19/20
RIO PINAR - W0972 Total	5	1732	$	323,095	$	7,000	05/27/20	06/17/20
RIO PINAR - W0973 Total	4	1532	$	258,476	$	5,600	06/24/20	09/16/20
RIO PINAR - W0975 Total	5	2306	$	323,095	$	7,000	06/17/20	08/24/20
BARNUM CITY - K1503 Total	2	2063	$	80,000	$	1,628	11/04/19	04/13/20
CHAMPIONS GATE - K1762 Total	1	2346	$	64,619	$	1,400	12/27/19	01/08/20
BARNUM CITY - K1763 Total	3	1677	$	120,000	$	2,442	11/11/19	04/24/20
BARNUM CITY - K3360 Total	1	2465	$	64,619	$	1,400	12/02/19	04/13/20
BARNUM CITY - K3362 Total	4	2338	$	160,000	$	3,256	04/13/20	05/15/20
INTERCESSION CITY - K967 Total	1	1398	$	64,619	$	1,400	12/30/19	04/09/20
ZELLWOOD - M33 Total	5	1226	$	323,095	$	7,000	06/09/20	06/23/20
KELLY PARK - M34 Total	3	1567	$	169,238	$	3,614	06/25/20	07/21/20
KELLY PARK - M821 Total	3	1338	$	144,619	$	3,028	06/30/20	07/14/20
LAKE PLACID - K1066 Total	5	1411	$	323,095	$	7,000	05/19/20	06/04/20
LAKE PLACID - K1320 Total	4	2243	$	258,476	$	5,600	05/05/20	07/16/20
FISHEATING CREEK - K1560 Total	8	2473	$	516,952	$	11,200	05/01/20	07/21/20
LAKE PLACID NORTH - K27 Total	4	563	$	258,476	$	5,600	04/30/20	07/02/20
LAKE PLACID - K757 Total	5	920	$	323,095	$	7,000	04/16/20	05/07/20
LAKE PLACID - K758 Total	3	1362	$	193,857	$	4,200	06/09/20	07/07/20
SUNFLOWER - W0470 Total	6	2096	$	264,619	$	5,470	10/01/20	11/04/20
SUNFLOWER - W0473 Total	5	1653	$	200,000	$	4,070	10/22/20	11/13/20
SUNFLOWER - W0474 Total	6	2126	$	264,619	$	5,470	10/06/20	12/02/20
BITHLO - W0953 Total	6	2354	$	338,476	$	7,228	10/08/20	12/09/20
BITHLO - W0954 Total	5	1805	$	224,619	$	4,656	10/22/20	12/18/20
ALAFAYA - W0298 Total	1	1667	$	64,619	$	1,400	10/08/20	10/14/20
EAST ORANGE - W0250 Total	1	1886	$	64,619	$	1,400	04/13/20	04/17/20
EAST ORANGE - W0255 Total	2	974	$	104,619	$	2,214	11/11/19	04/06/20
MEADOW WOODS SOUTH - K1775 Total	4	1325	$	258,476	$	5,600	07/02/20	07/21/20
MEADOW WOODS SOUTH - K1789 Total	1	336	$	40,000	$	814	07/23/20	07/29/20
HUNTERS CREEK - K42 Total	8	2131	$	467,714	$	10,028	06/11/20	09/02/20
HUNTERS CREEK - K45 Total	8	2501	$	320,000	$	6,512	07/09/20	10/15/20
HUNTERS CREEK - K51 Total	5	2035	$	224,619	$	4,656	07/06/20	10/01/20
SHINGLE CREEK - K861 Total	4	1383	$	233,857	$	5,014	06/25/20	08/06/20
WINDERMERE - K302 Total	1	1187	$	64,619	$	1,400	06/18/20	06/18/20
WINDERMERE - K303 Total	6	1938	$	387,714	$	8,400	06/23/20	07/30/20

BAY HILL - K68 Total	8	1826	$	516,952	$	11,200	06/02/20	07/23/20
OCOEE - M1090 Total	5	2276	$	323,095	$	7,000	05/26/20	08/11/20
WOODSMERE - M255 Total	4	1147	$	258,476	$	5,600	05/28/20	08/13/20
OKAHUMPKA - K285 Total	4	1686	$	258,476	$	5,600	03/25/20	05/13/20
OKAHUMPKA - K565 Total	2	1300	$	129,238	$	2,800	03/04/20	04/08/20
Frostproof - K101 Total	1	2647	$	64,619	$	1,400	09/16/20	09/16/20
FROSTPROOF - K102 Total	6	1966	$	387,714	$	8,400	08/05/20	09/09/20
FROSTPROOF - K104 Total	2	1440	$	129,238	$	2,800	07/22/20	07/29/20
TAUNTON ROAD - K1081 Total	2	1395	$	129,238	$	2,800	06/03/20	06/10/20
AVON PARK NORTH - K891 Total	4	1921	$	258,476	$	5,600	06/17/20	07/15/20
AVON PARK NORTH - K892 Total	1	356	$	64,619	$	1,400	06/24/20	06/24/20
ORANGEWOOD - K226 Total	5	1922	$	323,095	$	7,000	10/07/20	12/02/20
SHINGLE CREEK - K858 Total	5	1809	$	298,476	$	6,414	12/10/20	12/16/20
SOPCHOPPY - N327 Total	1	1463	$	64,619	$	1,400	07/07/20	07/07/20
CRYSTAL RIVER SOUTH - A158 Total	1	1401	$	64,619	$	1,400	01/01/20	01/16/20
TROPIC TERRACE - A207 Total	1	1414	$	64,619	$	1,400	04/14/20	04/14/20
HOMOSASSA - A272 Total	2	1545	$	129,238	$	2,800	01/16/20	01/22/20
CRAWFORDVILLE - N35 Total	6	1190	$	387,714	$	8,400	06/15/20	07/02/20
CRAWFORDVILLE - N36 Total	3	1182	$	193,857	$	4,200	06/17/20	06/22/20
REDDICK - A35 Total	4	569	$	258,476	$	5,600	04/09/20	05/12/20
REDDICK - A36 Total	3	1166	$	193,857	$	4,200	04/14/20	05/07/20
MCINTOSH - A50 Total	2	836	$	129,238	$	2,800	04/23/20	05/05/20
MCINTOSH - A51 Total	3	1315	$	193,857	$	4,200	04/28/20	05/14/20
PORT RICHEY WEST - C208 Total	6	2163	$	387,714	$	8,400	10/08/20	11/03/20
PORT RICHEY WEST - C210 Total	5	2355	$	323,095	$	7,000	08/20/20	12/08/20
FLORA MAR - C4001 Total	8	2268	$	516,952	$	11,200	08/18/20	12/17/20
FLORA MAR - C4002 Total	6	2310	$	387,714	$	8,400	09/08/20	11/12/20
FLORA MAR - C4003 Total	6	2380	$	387,714	$	8,400	09/01/20	10/01/20
FLORA MAR - C4006 Total	5	2932	$	323,095	$	7,000	08/13/20	09/10/20
ELFERS - C952 Total	2	2187	$	129,238	$	2,800	08/24/20	10/06/20
BAYBORO - X16 Total	6	2782	$	387,714	$	8,400	04/07/20	05/06/20
BAYBORO - X21 Total	8	2565	$	516,952	$	11,200	03/03/20	04/29/20
SIXTEENTH STREET - X43 Total	3	1253	$	193,857	$	4,200	02/20/20	04/07/20
SIXTEENTH STREET - X46 Total	3	2389	$	193,857	$	4,200	03/10/20	04/30/20
BAYBORO - X9 Total	5	2257	$	323,095	$	7,000	04/02/20	04/23/20
DUNEDIN - C103 Total	4	3052	$	258,476	$	5,600	01/30/20	06/11/20
DUNEDIN - C104 Total	5	2127	$	323,095	$	7,000	01/29/20	07/16/20
DUNEDIN - C108 Total	4	2279	$	258,476	$	5,600	01/22/20	06/09/20
CURLEW (HD) - C4988 Total	4	1708	$	258,476	$	5,600	01/29/20	06/16/20

PALM HARBOR - C753 Total	5	2129	$	323,095	$	7,000	06/04/20	06/30/20
PALM HARBOR - C755 Total	7	2597	$	452,333	$	9,800	06/09/20	07/14/20
EAST CLEARWATER - C907 Total	4	2824	$	258,476	$	5,600	06/04/20	07/09/20
HIGHLANDS - C2802 Total	3	2209	$	193,857	$	4,200	05/12/20	07/30/20
HIGHLANDS - C2803 Total	4	2595	$	258,476	$	5,600	06/04/20	07/23/20
HIGHLANDS - C2804 Total	4	2011	$	258,476	$	5,600	05/05/20	05/28/20
HIGHLANDS - C2805 Total	5	2835	$	323,095	$	7,000	06/09/20	07/28/20
HIGHLANDS - C2807 Total	4	1953	$	258,476	$	5,600	05/07/20	07/02/20
HIGHLANDS - C2808 Total	1	549	$	64,619	$	1,400	05/14/20	05/14/20
EAST CLEARWATER - C908 Total	6	2984	$	387,714	$	8,400	06/02/20	08/04/20
FLORA MAR - C4000 Total	5	2095	$	323,095	$	7,000	05/20/20	08/20/20
FLORA MAR - C4007 Total	3	1886	$	193,857	$	4,200	05/13/20	07/28/20
FLORA MAR - C4009 Total	4	1913	$	258,476	$	5,600	05/18/20	07/21/20
SEVEN SPRINGS - C4501 Total	5	2402	$	323,095	$	7,000	05/19/20	08/13/20
SEVEN SPRINGS - C4508 Total	5	3479	$	323,095	$	7,000	07/16/20	08/18/20
ELFERS - C950 Total	2	1961	$	129,238	$	2,800	05/15/20	05/21/20
PASADENA - X211 Total	9	3359	$	556,952	$	12,014	09/03/20	10/01/20
PASADENA - X213 Total	5	1926	$	298,476	$	6,414	07/09/20	10/08/20
Pasadena - X214 Total	8	2987	$	467,714	$	10,028	07/21/20	09/17/20
Pasadena - X217 Total	4	891	$	258,476	$	5,600	10/13/20	11/10/20
PASADENA - X219 Total	4	2104	$	258,476	$	5,600	07/16/20	09/01/20
Pasadena - X220 Total	2	2146	$	129,238	$	2,800	10/22/20	11/05/20
THIRTY SECOND STREET - X30 Total	1	3019	$	64,619	$	1,400	05/12/20	05/18/20
BELLVIEW - A12 Total	1	579	$	64,619	$	1,400	07/09/20	07/09/20
ORANGE BLOSSOM - A392 Total	1	1668	$	64,619	$	1,400	10/07/19	01/29/20
EAGLES NEST - A224 Total	4	1589	$	258,476	$	5,600	04/14/20	05/07/20
LADY LAKE - A244 Total	5	2466	$	323,095	$	7,000	04/21/20	05/21/20
CURRY FORD - W0596 Total	5	1605	$	298,476	$	6,414	10/08/20	12/15/20
RIO PINAR - W0974 Total	7	2504	$	378,476	$	8,042	10/13/20	12/08/20
ARBUCKLE CREEK - K1361 Total	2	1161	$	129,238	$	2,800	11/05/20	11/17/20
DESOTO CITY - K3220 Total	5	1370	$	323,095	$	7,000	10/01/20	11/19/20
DESOTO CITY - K3222 Total	1	482	$	64,619	$	1,400	10/06/20	10/06/20
SEBRING EAST - K541 Total	5	589	$	323,095	$	7,000	10/13/20	11/12/20
SEBRING EAST - K542 Total	3	104	$	193,857	$	4,200	10/20/20	11/12/20
BOGGY MARSH - K958 Total	6	2799	$	313,857	$	6,642	09/15/20	10/20/20
BOGGY MARSH - K961 Total	6	1994	$	313,857	$	6,642	09/22/20	10/22/20
UCF NORTH - W0994 Total	3	1368	$	193,857	$	4,200	10/15/20	11/04/20
ALAFAYA - W0289 Total	3	1898	$	144,619	$	3,028	10/22/20	10/08/20
ALAFAYA - W0298 Total	6	1667	$	255,488	$	6,449	11/05/20	12/02/20

IV. Submersible Underground

The Submersible Underground activity targets underground facilities that are prone to storm surge and use the current Duke Energy Florida storm surge standards. These standards include the use of specialized stainless-steel equipment and submersible connections.

These activities reduce outage frequencies for lines exposed to flooding or storm surge and includes conversion of existing underground lines to submersible lines to reduce susceptibility to flooding and storm surge.

The scope of work includes replacing any live-front equipment (e.g. switchgear, transformers) with dead-front equipment, including sealed connections on the secondary and services (no exposed bus bars). In some instances, the pad mounted equipment is placed on elevated structures – raising the equipment 2-4 feet above grade – to mitigate potential flood impacts.

Historical Reliability and Prioritization

This project was selected based on historical storm surge events, and the likelihood of future similar conditions.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Submersible Underground*	**2020**	**2021**	**2022**
Totals	$ 265,000	$ -	
Capital	$ 265,000	$ -	
O&M	$ -	$ -	
Total Units	24	0	

**Beginning in 2022, these activities will be incorporated into the Underground Flood Mitigation Program*

2020 Planned Duke Energy Florida – Submersible Underground

Location	Unit Count	Customer Count	Project Cost - Capital	Project Cost - O&M	Start Date	Finish Date
Tropic Terrace A207	24	183	$ 265,000	0	2/1/2020	3/31/2020

V. Pole Replacement and Inspection

In accordance with FPSC Order No. PSC-06-0144-PAA-EI, Duke Energy Florida's distribution department inspects company-owned wood poles on an average 8-year cycle. These inspections determine the extent of pole decay and any associated loss of strength.

The information gathered from these inspections is used to determine pole replacements and to effectuate the extension of pole life through treatment and reinforcement. Additionally, groundline reject information collected from the wood pole inspections is used to populate regulatory reporting requirements, provide data for loading analyses, identify other equipment maintenance issues, and track the results of the inspection activities over time.

If the pole is found to be sound (top and bottom) then it is treated at the ground level to discourage future rot. If it is deemed solid at the top but below acceptable limits at the ground level, then a steel brace is attached to the pole to provide structural stability.

If the pole fails both top and bottom criteria or beyond what a brace can support, then it is reported for replacement. The new poles meet or exceed the strength requirements of the NESC.

Historical Reliability and Prioritization

Pole inspections and replacement benefit the entire distribution system. The Wood Pole Inspection activities check the integrity of the wood poles in the distribution system, and the replacements are prioritized to ensure that the poles that do not pass the inspection are replaced.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Pole Replacement*	**2020**	**2021**	**2022**
Totals	$ 23,618,098	$ 22,608,270	
Capital	$ 22,072,989	$ 21,063,160	
O&M	$ 1,545,109	$ 1,545,110	
Total Units	2,668	2,650	

	DEF		
Pole Inspection*	**2020**	**2021**	**2022**
Totals	$ 4,000,000	$ 4,000,000	
Capital	$ -	$ -	
O&M	$ 4,000,000	$ 4,000,000	
Total Units	100,772	100,000	

**Beginning in 2022 these activities will be incorporated into the Feeder and Lateral Hardening Programs*

2020 Planned Duke Energy Florida – Pole Replacement

Location	Unit Count	Customer Count	Project Cost - Capital	Project Cost - O&M	Start Date	Finish Date
Apopka	5	105668	$40,677.95	$2,847.46	1/1/2020	5/31/2020
Deland	15	85601	$122,033.85	$8,542.37	1/1/2020	12/31/2020
Jamestown	14	138613	$113,898.26	$7,972.88	1/1/2020	12/31/2020
Longwood	25	92030	$203,389.75	$14,237.28	1/1/2020	12/31/2020
Inverness	85	79397	$691,525.15	$48,406.76	1/1/2020	12/31/2020
Monticello	7	58417	$56,949.13	$3,986.44	1/1/2020	7/31/2020
Ocala	40	80509	$325,423.60	$22,779.65	1/1/2020	12/31/2020
Clearwater	122	161275	$992,541.98	$69,477.94	1/1/2020	12/31/2020
Seven Springs	74	187524	$602,033.66	$42,142.36	1/1/2020	12/31/2020
St Pete	98	176058	$797,287.82	$55,810.15	1/1/2020	12/31/2020
Walsingham	86	156443	$699,660.74	$48,976.25	1/1/2020	12/31/2020
Zephyrhills	12	27764	$97,627.08	$6,833.90	1/1/2020	12/31/2020
Buena Vista	11	135224	$89,491.49	$6,264.40	1/1/2020	11/30/2020
Clermont	9	37129	$73,220.31	$5,125.42	1/1/2020	9/30/2020
Highlands	19	57450	$154,576.21	$10,820.33	1/1/2020	12/31/2020
Lake Wales	30	114912	$244,067.70	$17,084.74	1/1/2020	12/31/2020
SE Orlando	71	94574	$577,626.89	$40,433.88	1/1/2020	12/31/2020
Winter Garden	44	85734	$357,965.96	$25,057.62	1/1/2020	12/31/2020
Apopka	4	105668	$33,315.08	$2,332.06	1/1/2020	12/31/2020
Deland	219	85601	$1,824,000.63	$127,680.04	1/1/2020	12/31/2020
Jamestown	161	138613	$1,340,931.97	$93,865.24	1/1/2020	12/31/2020
Longwood	105	92030	$874,520.85	$61,216.46	1/1/2020	12/31/2020
Inverness	194	79397	$1,615,781.38	$113,104.70	1/1/2020	12/31/2020
Monticello	38	58417	$316,493.26	$22,154.53	1/1/2020	12/31/2020
Ocala	98	80509	$816,219.46	$57,135.36	1/1/2020	12/31/2020
Clearwater	104	161275	$866,192.08	$60,633.45	1/1/2020	12/31/2020
Seven Springs	87	187524	$724,602.99	$50,722.21	1/1/2020	12/31/2020
St Pete	384	176058	$3,198,247.68	$223,877.34	1/1/2020	12/31/2020
Walsingham	91	156443	$757,918.07	$53,054.26	1/1/2020	12/31/2020
Zephyrhills	0	27764	$0.00	$0.00	1/1/2020	12/31/2020
Buena Vista	33	135224	$274,849.41	$19,239.46	1/1/2020	12/31/2020
Clermont	11	37129	$91,616.47	$6,413.15	1/1/2020	12/31/2020
Highlands	60	57450	$499,726.20	$34,980.83	1/1/2020	12/31/2020
Lake Wales	124	114912	$1,032,767.48	$72,293.72	1/1/2020	12/31/2020
SE Orlando	141	94574	$1,174,356.57	$82,204.96	1/1/2020	12/31/2020
Winter Garden	47	85734	$391,452.19	$27,401.65	1/1/2020	12/31/2020

2020 Planned Duke Energy Florida –Pole Inspection

Location	Unit Count	Customer Count	Start Date	Finish Date
Jamestown	29,224	138,613	2/10/2020	12/31/2020
Longwood	13,100	92,030	2/10/2020	12/31/2020
Inverness	15,116	79,397	2/10/2020	12/31/2020
Ocala	504	80,509	2/10/2020	12/31/2020
Clearwater	8,062	161,275	2/10/2020	12/31/2020
Seven Springs	15,116	187,524	2/10/2020	12/31/2020
SE Orlando	19,650	94,574	2/10/2020	12/31/2020

**Note - The total inspection cost for 2020 is $4M O&M*

VI. Vegetation Management – Distribution

The Duke Energy Florida distribution Integrated Vegetation Management (IVM) Program ensures the safe and reliable operation of the distribution system by minimizing vegetation-related interruptions and ensuring adequate conductor-to-vegetation clearances, while maintaining compliance with regulatory, environmental, and safety requirements or standards.

The program activities focus on the removal and/or control of incompatible vegetation within and along the right of way to minimize the risk of vegetation-related outages. The IVM program consists of the following: routine maintenance "trimming", hazard tree removal, herbicide applications, vine removal, customer requested work, and right-of-way brush "mowing" where applicable. The IVM program incorporates a combination of both cycle-based maintenance and reliability-driven prioritization of work to reduce event possibilities during extreme weather events.

Duke Energy's distribution organization has proudly been recognized as a Tree Line USA utility for the past 14 years. There are no expected changes to the distribution vegetation program, and the program remains the same as previous storm hardening filings.

Duke Energy Florida Distribution will continue a fully IVM program focused on trimming feeders and laterals on an average 3- and 5-year cycles respectively. This corresponds to approximately 1,930 miles of feeder backbone and 2,455 miles of laterals to be trimmed annually. The circuit maintenance work performed in Florida is predominantly billed under a unit-based contract structure and not differentiated between Labor and Equipment. The estimated contractor ratio is 95%. The estimated utility personnel ratio is 5%.

2020 -2022 Labor / Equipment Breakout		
	Labor	Equipment
Utility Personnel Totals	$ 6,557,823	$ 202,819
Capital	$ 1,132,128	$ 35,014
O&M	$ 5,425,695	$ 167,805
Contract Personnel Totals	$ 97,703,126	$ 32,187,368
Capital	$ 3,092,319	$ 1,030,773
O&M	$ 94,610,807	$ 31,156,595

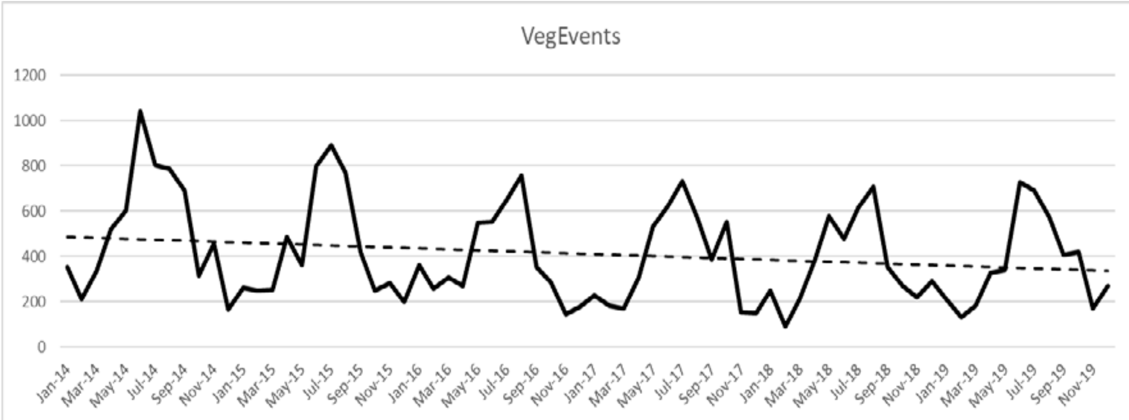
Historical Reliability and Prioritization

The chart below depicts the historical reliability activity for the vegetation management program. It demonstrates the value of consistent vegetation management in reducing outage events.

As part of the IVM program, Duke Energy uses a comprehensive circuit prioritization model to ensure that tree-caused outages are minimized by focusing on the feeders and or laterals that rate high in the model. Prioritization ranking factors are based on past feeder or lateral performance and probable future performance.

Criteria used to prioritize include tree-caused outages in prior years, outages per vegetated mile, and total tree customer minutes of interruption. Utilizing this prioritized process, Duke Energy Florida follows the ANSI 300 standard for pruning and the guide "Pruning Trees Near Electric Utility Lines" by Dr. Alex L. Shigo.

Vegetation Events 2014-2019



3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
VM - Distribution*	**2020**	**2021**	**2022**
Totals	$ 46,398,605	$ 44,477,139	$ 45,775,391
Capital	$ 1,499,298	$ 1,867,457	$ 1,923,480
O&M	$ 44,899,307	$ 42,609,682	$ 43,851,911
Approximate Miles	5,209	4,383	4,383

**Costs for 2021 and 2022 are based on an average of 1/3 of feeder mileage and 1/5 of lateral mileage being patrolled and remediated.*

Transmission

Florida

Project-Level Detail

VII. Pole Replacement

The Pole Replacement activities are based on field inspections of the poles on a regular schedule. The transmission department inspects company-owned wood poles on an average 4-year cycle and non-wood poles such as steel, towers, and concrete are visually inspected on an average 6-year cycle. In addition to the 4-year inspection, there is an average 8-year cycle of sound and bore inspection performed on the wood poles. These inspections determine the extent of pole decay and any associated loss of strength.

The information gathered from these inspections is used to determine pole replacements and to effectuate the extension of pole life through treatment. Additionally, information collected from the wood pole inspections is used to populate regulatory reporting requirements and identify other equipment maintenance issues.

Historical Reliability and Prioritization

These activities strengthen structures by eliminating damage from woodpeckers and wood rot. Wood pole failure has been the predominate structure damage to the transmission system during extreme weather. The new structures will be more resistant to damage from extreme weather events. Other related hardware upgrades will occur simultaneously, such as insulators, crossarms, switches, and guys. In 2020, Duke Energy Florida will continue to replace prioritized poles from inspections across its service territory. DEF Transmission prioritizes poles that need to be corrected based upon the inspection results and their status.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Pole Replacement*	**2020**	**2021**	**2022**
Totals	$ 34,285,154	$ 33,838,208	
Capital	$ 33,000,000	$ 33,000,000	
O&M	$ 1,285,154	$ 838,208	
Total Units	642	339	

**Beginning in 2021, the Structure Hardening Program will include a portion of the Pole Replacement activities. Beginning in 2022, these activities will be fully incorporated into the Structure Hardening Program.*

2020 Planned Duke Energy Florida – Pole Replacement

Location	Unit Count	Customer Count	Project Cost - Capital		Project Cost - O&M		Start Date	Finish Date
(AL-1) - Avon Park North - Frostproof	1	7189	$	29,419	$	556	4/29/2020	5/27/2020
(ASL-2) Douglas Ave. - Spring Lake	1	4618	$	136,786	$	2,377	1/28/2020	2/28/2020
(AUCF-1) - Alafaya - UCF	45	6033	$	2,212,210	$	113,566	5/4/2020	7/3/2020
(AW-1) - Archer - Williston	23	1473	$	733,092	$	16,091	2/8/2020	4/10/2020
(BBW-1) - Brookridge - Brooksville West CKT # 1	12	26226	$	389,707	$	19,686	2/10/2020	3/6/2020
(BCF-3) - Brooksville - Bushnell East	3	2356	$	197,392	$	10,424	5/11/2020	5/15/2020
(BF-1) Barcola - Ft Meade	4	70	$	111,948	$	2,226	10/5/2020	10/9/2020
(BHV-1)Bay Hill-Vineland	13	11268	$	621,159	$	31,235	6/1/2020	6/30/2020
(BWR-1) - Brooksville West - Hudson	19	0	$	654,092	$	30,985	3/2/2020	3/27/2020
(BZ-1) - Brooksville - Union Hall	15	0	$	749,449	$	38,952	4/6/2020	5/4/2020
(CEB-2) - Boggy Marsh - Lake Louisa (SEC)	60	10293	$	3,633,459	$	212,905	3/16/2020	7/31/2020
(CEB-3)Lake Louisa SEC - Clermont East	21	10293	$	726,386	$	50,112	2/3/2020	3/13/2020
(CP-2) Florida Gas Transmission - Perry	12	3562	$	389,004	$	9,969	1/27/2020	3/21/2020
(CPS-1) - Crawfordville - Port St Joe	7	2560	$	308,447	$	7,187	8/24/2020	9/18/2020
(DB-2) - Monticello - Boston (Ga Pwr)	1	0	$	140,814	$	3,848	6/15/2020	6/20/2020
(DLW-1) Disston - Starkey Road	3	13637	$	227,967	$	15,789	1/27/2020	1/30/2020
(DLW-3) Oakhurst-Walsingham	4	20746	$	189,532	$	9,510	5/18/2020	5/22/2020
(DLW-4) SeminoleOakhurst	7	16520	$	336,821	$	16,971	5/22/2020	6/5/2020
(DLW-6) - Ulmerton West - Walsingham	2	20746	$	159,707	$	7,886	2/17/2020	2/21/2020
(DWB-1) - Barberville - Deland West	9	3180	$	474,829	$	11,591	3/16/2020	4/4/2020
(FH-1) - Ft White - High Springs	19	2866	$	670,636	$	13,865	9/7/2020	10/22/2020
(FTO-3) De-energized Line	1	0	$	47,379	$	2,377	6/1/2020	6/30/2020
(GH-1) - High Springs - Hull Road	1	0	$	21,664	$	556	2/2/2020	2/3/2020
(HB-3) - Holder - Inverness	19	7302	$	559,241	$	10,573	6/15/2020	7/13/2020
(HBH-1) - Beverly Hills - Holder	9	6996	$	264,911	$	5,008	7/27/2020	8/20/2020
(HCL-1) Clearwater-Highlands	1	15408	$	25,808	$	1,068	1/28/2020	1/30/2020
(IS-1) - Chiefland - Inglis	20	1346	$	697,100	$	14,421	7/13/2020	8/6/2020
(JQ-2) - Bradfordville West - Drifton	24	10378	$	757,665	$	16,647	3/23/2020	5/9/2020
(JQ-4) - Drifton - Hanson	8	5409	$	346,795	$	7,743	5/18/2020	6/5/2020
(JW2) - Jasper -homerville (Ga Pwr)	2	0	$	172,494	$	4,404	5/11/2020	5/16/2020
(KZN) Kathleen-Zephyrhills North 230kV	5	11885	$	329,957	$	19,142	3/2/2020	3/13/2020
(LWC-1) - Lake Wales - Citrusville	1	4	$	140,814	$	3,848	8/3/2020	8/6/2020
(NT-1) - Newberry - Trenton	75	1328	$	3,539,155	$	181,596	4/1/2020	10/1/2020
(OCF-1) - Silver Springs - Silver Springs Shores	26	5399	$	702,328	$	15,025	1/22/2020	3/2/2020
(PF-1) Pasadena - 51st St	1	16213	$	99,095	$	5,669	9/7/2020	9/10/2020
(QX-1) - Atwater - Quincy	9	0	$	376,306	$	8,300	7/20/2020	8/13/2020
(SES-1) - Eustis South - Sorrento	26	8514	$	876,458	$	17,760	4/13/2020	6/5/2020
(SF-2) Suwannee River Pl - Ft White	9	5409	$	376,306	$	8,300	5/25/2020	6/13/2020
(WO-6) North Longwood-Winter Springs	2	14246	$	96,481	$	4,865	6/1/2020	6/30/2020
(WP-2) Apopka South-Woodsmere	5	11300	$	238,628	$	11,997	6/1/2020	6/30/2020
(WR-4) Conway-Pinecastle	1	5722	$	49,108	$	2,487	6/1/2020	6/30/2020
(JH-3) Liberty - Hosford (TEC) Radial	2	1203	$	170,211	$	4,404	7/6/2020	7/11/2020
(DWD-1) Davenport - West Davenport Radial	10	9677	$	294,297	$	5,565	6/15/2020	7/10/2020
(FSD-1) - Ft Green Springs - Duette (PREC) Radial	18	880	$	637,923	$	13,308	4/13/2020	5/22/2020
(FSM-1) - Ft Meade - Sand Mountain Radial	7	178	$	215,921	$	3,895	5/25/2020	6/12/2020
Arbuckle Creek Tap	5	1066	$	683,490	$	18,628	8/3/2020	8/21/2020
Crooked Lake Tap	11	1943	$	1,487,556	$	40,982	8/24/2020	10/2/2020
Desoto City Tap	17	2907	$	2,300,229	$	63,335	3/1/2020	4/3/2020
Leisure Lakes Tap	5	1955	$	683,490	$	18,628	7/13/2020	7/21/2020
Pembroke Tap	1	20	$	136,604	$	3,339	3/2/2020	3/5/2020
(HC-1) - Hanson - Cherry Lake (TREC) Radial	6	1591	$	176,584	$	11,638	6/22/2020	6/27/2020
Blair Tap (SVEC)	11	1502	$	1,598,936	$	44,273	4/13/2020	5/8/2020
Miccosukee Tap (TEC)	1	3684	$	248,042	$	7,017	10/4/2020	10/9/2020
Blichton Tap (SEC)	22	2586	$	1,556,170	$	82,621	8/3/2020	8/28/2020

VIII. Pole/Tower Inspections

The Pole/Tower Inspection activities are for transmission system poles and towers. The Tower and Pole Inspection activities in Duke Energy Florida's Storm Hardening Program included ground-line inspection and treatment activities. The wood and non-wood pole inspections are reported in our Annual Reliability Report as well as in the Storm Hardening Plan filing.

Historical Reliability and Prioritization

These inspections determine the extent of pole decay and any associated loss of strength. The information gathered from these inspections is used to determine pole replacements and extend pole life through treatment. In 2020, Duke Energy Florida will continue to inspect company-owned wood poles on an average 4-year cycle and non-wood poles on an average 6-year cycle.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Pole/Tower Inspections*	**2020**	**2021**	**2022**
Totals	$ 400,000	$ 400,000	
Capital	$ -	$ -	
O&M	$ 400,000	$ 400,000	
Total Units	10,959	12,000	

**Beginning in 2022, these activities will be incorporated into the Structure Hardening Program.*

2020 Planned Duke Energy Florida – Pole/Tower Inspections

Location	Unit Count	Customer Count	Start Date	Finish Date
Bell Tap (CFEC)	105	3034	3/16/2020	6/30/2020
New River Tap (WREC)	1	5041	3/16/2020	6/30/2020
(DLM-LMP-1-2) - Dundee - Lake Marion	1	7307	3/16/2020	6/30/2020
(BCF-3) - Brooksville - Bushnell East	1	136	3/16/2020	6/30/2020
Alachua Tap (CEC)	5	4135	3/16/2020	6/30/2020
Archer Tap (CEC)	4	3736	3/16/2020	6/30/2020
Brooksville Rock Tap	1	1	3/16/2020	6/30/2020
Camps Section Seven Tap	1	1	3/16/2020	6/30/2020
Croom Tap (WREC)	1	136	3/16/2020	6/30/2020
Foley Tap	1	2	3/16/2020	6/30/2020
Havana Tap (TEC)	1	2535	3/16/2020	6/30/2020
Lakewood Tap	29	6880	3/16/2020	6/30/2020
Leisure Lakes Tap	1	2503	3/16/2020	6/30/2020
Mcintosh Tap	45	2800	3/16/2020	6/30/2020
Otter Creek Tap (CFEC)	1	558	3/16/2020	6/30/2020
Point Milligan Tap (TEC)	7	2064	3/16/2020	6/30/2020
Webster Tap (SEC)	118	2621	3/16/2020	6/30/2020
Weeki Wachee Tap (WREC)	1	10184	3/16/2020	6/30/2020
White Springs Tap	1	1006	3/16/2020	6/30/2020
Winter Garden Citrus Tap	1	1	3/16/2020	6/30/2020
(BWR-HPNR-2) Hudson-New Port Richey	65	6226	3/16/2020	6/30/2020
(CFO-4) - Dallas - Silver Springs	63	3341	3/16/2020	6/30/2020
(FO-4) - Dearmin - Silver Springs	1	4413	3/16/2020	6/30/2020
(ICBL-1) - Intercession City Pl - Bonnet Creek	21	3230	3/16/2020	6/30/2020
(IS-3) - Ginnie - High Springs	41	2866	3/16/2020	6/30/2020
(RW-5) - Florida Gas Transmission East - Magnolia Ranch	43	6293	3/16/2020	6/30/2020
(AD-1) - Avon Park Pl - Desoto City	260	2202	3/16/2020	6/30/2020
(ALP-2) - Fisheating Creek - Lake Placid	80	6018	3/16/2020	6/30/2020
(AOGX-1) - Atwater - Oak Grove (TEC)	6	938	3/16/2020	6/30/2020
(APW-1) - Avon Park Pl - Wauchula	296	10,704	3/16/2020	6/30/2020
(BCF-2) - Central Fla - Coleman	107	2356	3/16/2020	6/30/2020
(BFE-1) - Bayboro - 16th St	54	14490	3/16/2020	6/30/2020
(BFR-1) - Brooksville - Florida Rock Radial	185	3	3/16/2020	6/30/2020
(BL-1) - Central Fla - Leesburg (BL)	87	4104	3/16/2020	6/30/2020
(BWKX-1) - Bradfordville West - Killearn (TEC) Radial	14	5844	3/16/2020	6/30/2020
(CET-1) - Avalon - Clermont East	112	33136	3/16/2020	6/30/2020
(CF-1) - Crystal River Pl - Bronson - Crew88	470	2678	3/16/2020	6/30/2020
(CFLE-1) - Central Fla - Leesburg (CFLE)	122	4104	3/16/2020	6/30/2020
(CLC-1) - Camp Lake - Clermont	135	10470	3/16/2020	6/30/2020
(CLC-2) - Clermont - Clermont East	59	10470	3/16/2020	6/30/2020
(CLL-2) - Leesburg - Okahumpka	103	4104	3/16/2020	6/30/2020

(CLL-3) - Howey SEC - Okahumpka	182	4104	3/16/2020	6/30/2020
(CRB-4) - Crystal River South - Twin County Ranch	32	4578	3/16/2020	6/30/2020
(CS-1) - Crawfordville - St Marks	159	1942	3/16/2020	6/30/2020
(DA-1) - Altamonte - Sanford	65	11644	3/16/2020	6/30/2020
(DA-2) - Debary Pl - Sanford (FPL)	39	1	3/16/2020	6/30/2020
(DB-3) - Monticello - Monticello (TREC) Radial	5	933	3/16/2020	6/30/2020
(DDW-2) - Deland West - Orange City	79	7746	3/16/2020	6/30/2020
(DLL-1) - Dallas - Orange Blossom	46	9300	3/16/2020	6/30/2020
(DLP-1) - Desoto City - Lake Placid North	166	1543	3/16/2020	6/30/2020
(DLW-1) - Disston - Starkey Road	74	13637	3/16/2020	6/30/2020
(DLW-4) - Oakhurst - Walsingham	50	16520	3/16/2020	6/30/2020
(DLW-6) - Umerton West - Walsingham	76	20746	3/16/2020	6/30/2020
(DR-1) - Dunnellon Town - Rainbow Lk Est (SEC) Radial	142	3555	3/16/2020	6/30/2020
(DWS-1) - Debary Pl - Lake Emma	117	6844	3/16/2020	6/30/2020
(ELCX-1) - Enola - Lake Cogen	1	1	3/16/2020	6/30/2020
(EU-1) - Eustis - Umatilla	104	4336	3/16/2020	6/30/2020
(FFG-1) - Ft Green Springs - Ft Meade	336	880	3/16/2020	6/30/2020
(FTR-2) - Bithlo - UCF	61	6033	3/16/2020	6/30/2020
(FTR-3) - Rio Pinar Pl - East Orange	111	13770	3/16/2020	6/30/2020
(FV-1) - Ft Meade - Vandolah	312	3559	3/16/2020	6/30/2020
(FWL-1) - Ft Meade - West Lake Wales	256	1063	3/16/2020	6/30/2020
(GBC-1) - Carrabelle - Gumbay	217	2394	3/16/2020	6/30/2020
(GH-1) - High Springs - Hull Road	315	5134	3/16/2020	6/30/2020
(HB-2) - Brooksville - Inverness - Crew74	97	7302	3/16/2020	6/30/2020
(HCR-HT-1) - Crystal River South - Homosassa Radial (Tropic Terrace No)	193	2767	3/16/2020	6/30/2020
(HDU-1) - Dunnellon Town - Holder	142	5372	3/16/2020	6/30/2020
(ICB-1) - Barnum City - Westridge	97	9347	3/16/2020	6/30/2020
(ICB-2) - Boggy Marsh - Westridge	64	9347	3/16/2020	6/30/2020
(ICLB-1) - Celebration - World Gateway	25	696	3/16/2020	6/30/2020
(ICLW-6) - Davenport - Haines City	197	12139	3/16/2020	6/30/2020
(IS-4) - Ginnie - Trenton	240	1328	3/16/2020	6/30/2020
(IT-CKT1) - Crystal River East - Inglis CKT #1	50	1346	3/16/2020	6/30/2020
(JW2) - Jasper -homerville (Ga Pwr)	96	1	3/16/2020	6/30/2020
(KWX-1) - Kathleen - West Sub (City Of Lakeland)	254	1	3/16/2020	6/30/2020
(LBV-1) - Lake Bryan - Disney World Lake Buena Vista	84	1	3/16/2020	6/30/2020
(LECW-3) - Clearwater - East Clearwater	81	19962	3/16/2020	6/30/2020
(LV-1) - Lake Bryan - Vineland	87	11268	3/16/2020	6/30/2020
(MSH-1) - Meadow Woods South - Hunters Creek	59	13410	3/16/2020	6/30/2020
(NR-2) - North Longwood - Winter Springs	7	14246	3/16/2020	6/30/2020
(OCC-1) - Clarcona - Ocoee	105	13138	3/16/2020	6/30/2020
(OD-1) - Deland East - Orange City	175	9628	3/16/2020	6/30/2020
(OLR-1) - Okahumpka - Lake County RR	35	1	3/16/2020	6/30/2020

(OSC-1) - Orangewood - Shingle Creek	55	8071	3/16/2020	6/30/2020
(PAX-1) - Parkway - Orlando Cogen Ltd	8	1	3/16/2020	6/30/2020
(PDL-1) - Dinner Lake - Phillips	162	11451	3/16/2020	6/30/2020
(PP-1) - Piedmont - Plymouth	185	3807	3/16/2020	6/30/2020
(PSJF-1) - Port St Joe - Fla Coast Paper Co Radial	39	0	3/16/2020	6/30/2020
(RW-4) - Rio Pinar Pl - Florida Gas Transmission East	138	1	3/16/2020	6/30/2020
(SLE-1) - Eatonville - Spring Lake	78	12607	3/16/2020	6/30/2020
(SLX-1) - Sky Lake - Southwood (OUC)	63	1	3/16/2020	6/30/2020
(SSC-1) - Occ Swift Creek #1 - Suwannee River	432	1	3/16/2020	6/30/2020
(TMS-2) - Meadwds South - Taft	105	1983	3/16/2020	6/30/2020
(TZ-2) - Odessa - Tarpon Springs	188	11861	3/16/2020	6/30/2020
(TZ-6) - Denham - Odessa	83	11861	3/16/2020	6/30/2020
(VFG-1) - Ft Green Springs - Vandolah CKT #1	113	1	3/16/2020	6/30/2020
(VHC-1) - Vandolah - Murphy Road (PREC) Radial	91	2679	3/16/2020	6/30/2020
(VW-1) - Vandolah - Wauchula	155	6940	3/16/2020	6/30/2020
(WCC-1) - Cross City - Wilcox	162	973	3/16/2020	6/30/2020
(WCE-1) - Montverde - Winter Garden	116	12825	3/16/2020	6/30/2020
(WCE-3) - Ocoee - Woodsmere	90	13138	3/16/2020	6/30/2020
(WEWC-1) - West Chapman Radial - Winter Park East	98	5801	3/16/2020	6/30/2020
(WF-1) - UCF - Winter Park East	167	6033	3/16/2020	6/30/2020
(WIW-1) - Windermere - Woodsmere	76	6854	3/16/2020	6/30/2020
(WLLW-1) - Lake Wales - West Lake Wales CKT #1	78	7851	3/16/2020	6/30/2020
(WP-1) - Apopka South - Plymouth	33	3807	3/16/2020	6/30/2020
(WP-2) - Apopka South - Woodsmere	155	11300	3/16/2020	6/30/2020
(LSP-UL-1) - Largo - Seminole	66	19045	3/16/2020	6/30/2020
(SSB-2) - Maricamp - Silver Springs	37	8556	3/16/2020	6/30/2020
(UL-1) - Largo - Ulmerton	28	5132	3/16/2020	6/30/2020
(CLT-1) - Brookridge - Lake Tarpon	150	93312	3/16/2020	6/30/2020
(CC-LTL-1) - Lake Tarpon - Palm Harbor	58	9629	3/16/2020	6/30/2020
(CC-NC-1) - Lake Tarpon - Ulmerton	67	5132	3/16/2020	6/30/2020

**Note – the total inspection cost for 2020 is $400K O&M.*

IX. Tower Replacements

This activity focuses on the replacement of towers identified through enhanced engineering inspections of similar towers in age and vicinity as the towers that failed during Hurricane Irma. Beginning in 2021, the Tower Replacements activities will replace lattice towers as identified by ground and drone inspections as well as data from the cathodic protection installations.

Historical Reliability and Prioritization

These activities strengthen towers by eliminating damage from corrosion. The focus is on the replacement of towers identified through enhanced engineering inspections of similar towers in age and vicinity as the towers that failed during Hurricane Irma. The new towers will be more resistant to damage from extreme weather events. In 2020, Duke Energy Florida will continue to prioritize the replacement of towers of similar age and vicinity as the tower failure during Hurricane Irma.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Tower Replacements*	**2020**	**2021**	**2022**
Totals	**$ 806,721**	**$ 1,008,250**	
Capital	$ 802,221	$ 1,000,000	
O&M	$ 4,500	$ 8,250	
Total Units	2	3	

**Beginning in 2021, the Structure Hardening Program will include a portion of Tower Replacement activities. Beginning in 2022, these activities will be fully incorporated into the Structure Hardening Program.*

2020 Planned Duke Energy Florida – Tower Replacements

Location	Unit Count	Customer Count	Project Cost - Capital	Project Cost - O&M	Start Date	Finish Date
LINE HIGGINS PL - BROOKER CREEK115KV, HTE-2,LINE 115.0 KV	2	9,189	$ 802,221	$ 4,500	4/6/2020	5/1/2020

X. Overhead Ground Wires (OHGW)

The Overhead Ground Wires (OHGW) activities target lines to improve the lightning protection and address standards gaps.

The OHGW replacements are reported on our Annual Reliability Report.

Historical Reliability and Prioritization

Florida is known for a high concentration of lightning events, which continually stress the existing grid protection. Deteriorated OHGW reduces the protection of the conductor and exposes the line to repeated lightning damage and risk of failure impacting both the transmission system and associated distribution underbuilds. In 2020 and 2021, Duke Energy Florida will continue to prioritize by targeting the replacement of deteriorated OHGW on known lines with frequency and density of lightning events, outage history, structure design types, OHGW material, and inspection results of each line.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Overhead Ground Wires (OHGW)*	2020	2021	2022
Totals	$ 1,817,267	$ 1,534,884	
Capital	$ 1,817,267	$ 1,500,000	
O&M	$ -	$ 34,884	
Total Units	3	14	

Beginning in 2022, these activities will be incorporated into the Structure Hardening Program

2020 Planned Duke Energy Florida – Overhead Ground Wires (OHGW)

Location	Unit Count	Customer Count	Project Cost - Capital	Project Cost - O&M	Start Date	Finish Date
AL-165 to AL-188 (1.25Mi)	1.35	7851	$ 744,502	0	5/4/2020	5/29/2020
VHC-40-68 to 40-84 (1.7Mi)	1.7	2679	$ 213,560	0	7/6/2020	7/24/2020
VHC-83 to 88 (.25Mi)	0.25	2679	$ 859,205	0	7/27/2020	8/21/2020

XI. Substation Hardening

The Substation Hardening Program is a combination of the replacement of breakers and electro-mechanical relays. The breaker activity replaces oil circuit breakers with state-of-the-art gas and vacuum breakers. Existing vintage oil breakers are unreliable when isolating line faults and are contributing to increased customer outages.

The replacement of electro-mechanical relays with electronic relays is designed to support rapid restoration. Modern relay design with communications capabilities and microprocessor technology enables quicker recovery from events than the design of the existing electromechanical relays.

Historical Reliability and Prioritization

Oil circuit breakers are more unreliable than gas or vacuum breakers, especially in circumstances where they are operating numerous times over a short period, such as during extreme weather events. When oil circuit breakers are repeatedly called to operate, they generate arcing gasses within the oil tank that can accumulate and result in catastrophic failure. Existing vintage oil breakers are less reliable when isolating line faults and are contributing to increased and longer customer outages when there is a failure.

The Electronic Relay upgrades eliminate noncommunicating electromechanical and solid-state relays with digital relays. Upgrading to modern relay designs with communication capabilities and microprocessor technologies will enable quicker restoration from outage events. Another benefit is increased overall system intelligence, which will improve restoration planning. One digital relay replaces a variety of legacy single-function electromechanical relays. Two-way communications and event recording capabilities allow them to provide device performance information following a system event to support continuous system design and operational improvements.

In 2020 and 2021, Duke Energy Florida will prioritize substation hardening with the recommendations from SME analysis of breaker health, customer impacts, outage data and field expertise to set priorities for replacement of both oil Transmission and Distribution breakers. Relay upgrades will be matched with the breaker replacements when feasible. Recommendations for relay replacements will also include SME analysis of relay outages, customer impacts, operational impacts and field expertise.

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
Substation Hardening	**2020**	**2021**	**2022**
Totals	$ 5,004,000	$ 5,500,000	$ 7,500,000
Capital	$ 5,004,000	$ 5,500,000	$ 7,500,000
O&M	$ -	$ -	$ -
Total Units	26	29	39

2020 Planned Duke Energy Florida– Substation Hardening

Location	Unit Count	Customer Count	Project Cost - Capital	Project Cost - O&M	Start Date	Finish Date
Fortieth Street	2	8467	$ 468,000	$ -	7/5/2018	1/22/2020
Idylwild	10	12589	$ 1,980,000	$ -	3/1/2018	4/9/2020
UCF	4	6003	$ 936,000	$ -	9/11/2018	5/8/2020
Casselberry	8	19139	$ 1,512,000	$ -	9/4/2018	7/9/2020
Welch Road	2	10171	$ 108,000	$ -	7/27/2018	12/21/2020

XII. Vegetation Management – Transmission

Duke Energy Florida's transmission Integrated Vegetation Management (IVM) program is focused on safe and reliable operation of the transmission system by minimizing vegetation-related interruptions and ensuring adequate conductor-to-vegetation clearances, while maintaining compliance with regulatory, environmental, and safety requirements or standards. The program activities focus on the removal and/or control of incompatible vegetation within and along the right of way to minimize the risk of vegetation-related outages and ensure necessary access within all transmission line corridors. The IVM program consists of the following programs: planned threat and condition-based maintenance, including danger tree identification and mitigation; reactive work that includes hazard tree mitigation; and brush management (herbicide, mowing, and hand cutting operation).

Historical Reliability and Prioritization

Transmission utilizes LIDAR to generate a threat/condition-based Vegetation Management plan. NERC lines (200kV and above) are flown every year. A fourth of Non-NERC lines are currently flown each year. After 4 years all will be flown. Threat triggers target clearing for 6+ years of growth. The LIDAR program targets the entire Transmission system of approximately 5200 miles. The data is utilized to calculate and model risks which allows the focus of work performed to produce sustainable, reliable results for the transmission grid from vegetation. The estimated contractor ratio is 91.5%. The estimated utility personnel ratio is 8.5%.

2020 -2022 Labor / Equipment Breakout		
	Labor	Equipment
Utility Personnel Totals	$ 4,010,124	$ 167,089
Capital	$ 1,965,352	$ 66,835
O&M	$ 2,044,773	$ 100,253
Contract Personnel Totals	$ 30,545,624	$ 14,374,411
Capital	$ 15,159,336	$ 7,133,805
O&M	$ 15,386,288	$ 7,240,606

3-Year Scope

The chart below outlines the 3-Year Scope in Duke Energy Florida:

	DEF		
VM - Transmission	2020	2021	2022
Totals	$ 12,522,040	$ 17,228,315	$ 19,346,891
Capital	$ 4,469,073	$ 8,995,999	$ 10,860,255
O&M	$ 8,052,967	$ 8,232,316	$ 8,486,636
Approximate Miles	398	404	404

DUKE ENERGY

Storm Protection Plan

Florida

Program Descriptions

Contents

PROGRAM DESCRIPTIONS

The following sections of this document describe each of the Duke Energy Florida programs that are in the Storm Protection Plan (SPP). This exhibit includes the program vision, description, costs as well as estimated benefits from completion of the program.

Note: Shifts of scope may occur between years to optimize benefits delivery to customers and execution efficiencies.

At the Commission's direction and under its supervision, DEF has engaged in significant storm hardening activities since the 2006 adoption of the Storm Hardening Rule (Rule 25-6.0342, F.A.C., now proposed for repeal due to the adoption of § 366.96, Fla. Stat., and subsequent adoption of Rule 25-6.030, F.A.C.). After the 2016/2017 storm seasons, the Commission initiated its "Review of Florida's Electric Utility Hurricane Preparedness and Restoration Actions 2018"[1] to evaluate the efficacy of the approximately 12 years of hardening efforts. As a result of the analysis performed in that docket, the Commission determined that "Florida's aggressive storm hardening programs are working."[2] This conclusion was borne out by several observations: the length of outages the 2016/2017 storm outages was reduced markedly from the 2004-2005 storm season, hardened overhead distribution facilities performed better than non-hardened facilities, and underground facilities performed much better than overhead facilities.[3]

DEF agrees with the Commission's determination. In recognition of the efficacy of the storm hardening plans implemented since 2006, DEF's Storm Protection Plan ("SPP") carries on the storm hardening work included in the Company's recently approved 2019-2021 Storm Hardening Plan ("SHP); as such, the programs that are being carried over from the SHP into the SPP are the very programs the Commission has previously acknowledged "are grounded in substantive strengthening and protection of the utility's electric facilities. Programs include tree trimming, pole inspections, hardening of feeders and laterals, and undergrounding."[4] DEF's plan will continue these programs and build upon them, adding incremental investment over the life of the Plan. DEF will also continue researching and investigating additional technologies and programs.

That said, DEF also agrees with the Commission's recognition that "[n]o amount of preparation can eliminate outages in extreme weather events" so while DEF's Plan is designed with an eye toward strengthening the system and reducing outages and outage duration, it must be understood that there is no panacea and individual storms will produce unique challenges.

[1] Docket No. 20170215-EU.
[2] *Id.* at p. 1.
[3] *See id.* at pp. 2-3.
[4] *See id.* at p. 9.

DUKE ENERGY.

Distribution Programs

Florida

Program Summaries

Feeder Hardening Program Description

Vision

Feeder Hardening is a long-term program that will systematically upgrade the feeder backbone to meet the NESC 250C extreme wind load standard. The existing backbone is approximately 6,300 miles on 1,325 feeders.

Description

The Feeder Hardening program will enable the feeder backbone to better withstand extreme weather events. This includes strengthening structures, updating BIL (basic insulation level) to current standards, updating conductor to current standards, relocating difficult to access facilities, replacing oil filled equipment as appropriate, and will incorporate the company's pole inspection and replacement activities.

Structure Strengthening

Structure strengthening includes upgrading existing poles and other facilities as necessary to align with meeting the NESC 250C extreme wind load standard. For example, a stronger pole class reduces the extent of damage incurred on feeder lines during extreme wind events. Other related hardware upgrades will occur simultaneously, such as insulators, crossarms, support brackets, and guys.

BIL

While upgrading feeders to the extreme wind load standard, the company will also upgrade the BIL to further harden the system. Upgrading the BIL involves framing for more space between phases, more wood material between insulator mounting points, application of the larger standard insulator sizes, and moving arresters to the lowest level of the primary space.

Conductor Upgrades

As part of Feeder Hardening, DEF will replace any deteriorated or undersized conductor on the feeder backbone. This conductor is more susceptible to storm damage. It will be replaced with our current standard conductor.

Relocating Difficult to Access Facilities

Where practical, feeder sections that traverse hard to access areas, such as wetlands, will be relocated to truck-accessible routes. These line sections often suffer damage in extreme wind load events and, due to their location, are among the most expensive and longest to restore outages.

Replacing Oil-Filled Equipment

While working to upgrade each feeder, hydraulic (oil-filled) reclosers will be upgraded to electronic reclosers (vacuum interrupters) with communications and remote SCADA control capability, as available. Electronic reclosers enable remote visibility and control. Real-time operational information is remotely available, such as current per phase, voltage per phase, var flow per phase, health condition of the device, on-board battery health, fault information, and interrupter status by phase. This real-time data will help target restoration efforts helping to reduce outage durations. Additionally, these oil-filled devices can cause negative environmental impacts. Electronic reclosers are vacuum interruption devices and have no internal oil.

Figure 1: SCADA enabled Electronic Recloser

Pole Inspection and Replacement

PER FPSC Order, pole inspection is performed on an 8-year cycle. These inspections determine the extent of pole decay and any associated loss of strength. The information gathered from these inspections is used to determine pole replacements and to effectuate the extension of pole life through treatment and reinforcement.

Cost

It is expected that the 10-year cost will be approximately $1.5B Capital and $73M O&M. This would cover approximately 1,500 miles of feeder hardening and costs of the pole inspection and replacement activities.

	DEF		
Feeder Hardening	**2020**	**2021**	**2022**
Totals	$ -	$ 62,400,005	$ 111,365,448
Feeder Hardening	$ -	$ 62,400,005	$ 93,600,008
Capital	$ -	$ 60,000,000	$ 90,000,000
O&M	$ -	$ 2,400,005	$ 3,600,008
Total Units	0	63	95
Pole Inspection/Replacement*	$ -	$ -	$ 17,765,440
Capital	$ -	$ -	$ 15,629,040
O&M	$ -	$ -	$ 2,136,400
Total Units	0	0	1,680

**Pole Inspection and Replacement details for years 2020 and 2021 are included in Exhibit JWO-1. Beginning in 2022 these activities will be incorporated into the Feeder Hardening Program.*

Cost Benefit Comparison

The Feeder Hardening Program will begin in 2021 and is estimated to take 30 years to complete. Based on today's cost, the program will cost an estimated $6B in Capital and $239M in Project O&M. At completion, approximately 6,300 feeder miles will be hardened.

When the Feeder Hardening Program is complete, DEF estimates it will reduce the cost of extreme weather events on the Distribution system by approximately $22M to $28M annually based on today's costs. This represents a reduction of approximately 11% to 14% when compared to the average of 2016 to 2019 Distribution Major Event Day (MED) costs.

When the Feeder Hardening Program is complete, DEF estimates it will reduce Distribution MED Customer Minutes Interrupted (CMI) by approximately 153 million to 191 million minutes annually. CMI reduction is used as a proxy for reduction in extreme weather event duration for the average customer.

Prioritization Methodology

Work will be prioritized using the following process.

1. Probability of Damage: To prioritize the work in the Florida regions, the Transmission and Distribution systems were modeled, and weather simulations were run to provide probabilistic exposure frequency for all asset locations. The weather modeling uses the FEMA Hazus and Sea, Lake, and Overland Surges from Hurricanes (SLOSH) models, which contain the weather data for storms over the last 200 years. Using the geographical locations of the Florida assets and the historic storm paths embedded in the Hazus model, a spatial correlation of future storm exposure can be derived. To determine probability of damage given that exposure, six years of historical outage data was provided and correlated with the closest weather tower to determine the conditions during historic failures recorded in the outage data. Then, the expected quantities of asset failure for simulated future weather exposure conditions was derived by combining simulated weather patterns with historical asset failure through conditional probability methods.
2. Consequence of Damage: Once the output of probabilistic damage is assessed, the probable impact to customers is considered. This step considers number of customers served by a given asset (e.g., each pole, or segment of conductor on a feeder), observed outage durations, the mix of customers, and critical facilities. This step is performed both for the existing configuration of each feeder and the hardened configuration resulting from the

particular program. The difference between the existing condition and the hardened configuration is the program impact.

3. Distribution subject matter experts then use these outputs to determine the optimum deployment plan considering factors such as current projects in the area, critical customers, operational knowledge, and resource availability.

Lateral Hardening

Vision

Lateral Hardening is a long-term program that will systematically upgrade and harden branch line sections fed by the feeder backbone. There will be two main approaches, undergrounding and overhead hardening. The existing lateral system is approximately 11,800 miles on 1,325 feeders.

Description

The Lateral Hardening program will enable branch lines to better withstand extreme weather events. This will include undergrounding of the laterals most prone to damage during extreme weather events and overhead hardening of those laterals less prone to damage.

Lateral Undergrounding

Lateral segments that are most prone to damage resulting in outages during extreme weather events will be placed underground. Doing so will greatly reduce both damage costs and outage duration for DEF customers. Lateral Undergrounding focuses on branch lines that historically experience the most outage events, contain assets of greater vintage, are susceptible to damage from vegetation, and/or often have facilities that are inaccessible to trucks. These branch lines will be replaced with a modern, updated, and standard underground design of today.

Figure 1: An example of residential customers that would be candidates for Undergrounding due to section of line and service in heavily vegetated areas.

Figure 2: Section of lines that runs through backlot and heavily vegetated areas will be underground.

Lateral Hardening Overhead

The overhead hardening strategy will include structure strengthening, deteriorated conductor replacement, removing open secondary wires, replacing fuses with automated line devices, pole replacement (when needed), line relocation, and/or hazard tree removal.

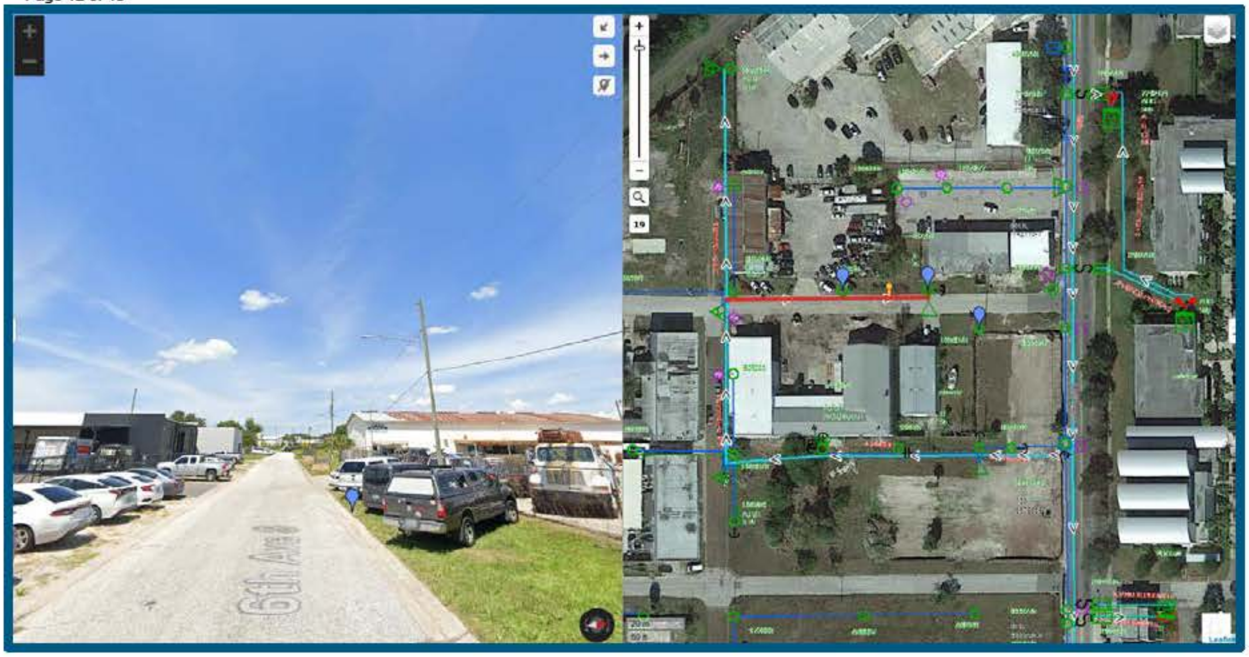


Figure 3: The teal tap line branches off the main road through an open lot to side streets where it splits again. It serves a few customers with minimal, to no vegetation. The street view is a view of the red line where there are no vegetation concerns.

Structure Strengthening

Structure Strengthening includes upgrading existing poles and other facilities as necessary to align with the NESC 250C extreme wind loading standard. For example, a stronger pole class reduces the extent of damage incurred on lateral lines during extreme wind events. Other related hardware upgrades will occur simultaneously, such as installation of insulators, crossarms, support brackets, and guys.

Conductor Upgrades

As part of Lateral Hardening Overhead, DEF will replace any deteriorated or undersized conductor on the lateral. This conductor is more susceptible to storm damage. It will be replaced with our current standard conductor.

Upgrade Open Wire Secondary

Removing the open secondary wire will mitigate outages during extreme weather conditions. This activity will eliminate an older design standard that is susceptible to wires contacting vegetation and debris. Modern triplex cable will be installed to replace the open wire secondary.

Figure 4: Three examples of open wire secondary that will be addressed

Fusing

DEF will replace current one-time use fuses with automated line devices (ALDs), which are small vacuum reclosers, to improve lateral performance in extreme weather events. ALDs use current fuse holders and do not generally require pole reframing. The reclosing capability inherent in the ALD will reduce outage events for downstream customers. ALDs will also serve as the temporary fault clearing device, thus reducing momentary interruptions for customers upstream on the feeder.

Figure 5: Installed ALD.

Line Relocation

Where practical, lateral line sections that traverse hard to access areas, such as wetlands, will be relocated to truck accessible routes. These line sections often suffer damage in extreme wind load events, and due to their location are among the most expensive to repair and take the longest to restore to service from an outage.

Hazard Tree

During the upgrade process DEF will identify hazard trees in the area surrounding the lateral requiring remediation. A hazard tree is a tree that is dead, structurally unsound, dying, diseased, leaning, or otherwise in a condition that is likely to result in striking electrical lines or other assets. Once identified, hazard trees are assigned to a contractor for remediation. When hazard trees are located in areas where DEF does not have the legal right to mitigate the danger, DEF or its contractor will work with the property owner to gain access and remediate.

Pole Inspection and Replacement

Per FPSC Order, pole inspection is performed on an 8-year cycle. These inspections determine the extent of pole decay and any associated loss of strength. The information gathered from these inspections is used to determine pole replacements and to effectuate the extension of pole life through treatment and reinforcement.

Cost

It is expected that the 10-year cost will be approximately $2.2B Capital and $66M O&M. This would cover approximately 1,500 miles of Lateral Hardening Underground, approximately 1,400 miles of Lateral Hardening Overhead, and costs of the pole inspection and replacement activities.

	DEF		
Lateral Hardening	**2020**	**2021**	**2022**
Totals	$ -	$ -	$ 187,320,107
Lateral Hardening	$ -	$ -	$ 141,637,547
Capital	$ -	$ -	$ 140,000,000
O&M	$ -	$ -	$ 1,637,547
Total Units	0	0	207
Pole Inspection/Replacement*	$ -	$ -	$ 45,682,560
Capital	$ -	$ -	$ 40,188,960
O&M	$ -	$ -	$ 5,493,600
Total Units	0	0	4,320

**Pole Inspection and Replacement details for years 2020 and 2021 are included in Exhibit JWO-1. Beginning in 2022 these activities will be incorporated into the Lateral Hardening Program.*

Cost Benefit Comparison

The Lateral Hardening Program will begin in 2022 and is estimated to take 30 years to complete. Based on today's cost, the program will cost an estimated $7.9B in Capital and $92M in Project O&M. At completion, approximately 11,800 lateral miles will be hardened.

When the Lateral Hardening Program is complete, DEF estimates it will reduce the cost of extreme weather events on the Distribution system by approximately $95M to $119M annually based on today's costs. This represents a reduction of approximately 46% to 58% when compared to the average of 2016 to 2019 Distribution MED costs.

When the Lateral Hardening Program is complete, DEF estimates it will reduce Distribution MED CMI by approximately by 406 million to 508 million minutes annually. CMI reduction is used as a proxy for reduction in extreme weather event duration for the average customer.

Prioritization Methodology

The following steps are used to prioritize the work:

1. Probability of Damage: To prioritize the work in the Florida regions, the Transmission and Distribution systems were modeled, and weather simulations were run to provide probabilistic exposure frequency for all asset locations. The weather modeling uses the FEMA Hazus and SLOSH models, which contain the weather data for storms over the last 200 years. Using the geographical locations of the Florida assets and the historic storm paths embedded in the Hazus model, a spatial correlation of future storm exposure can be derived. To determine probability of damage given that exposure, six years of historical outage data was provided and correlated with the closest weather tower to determine the conditions during historic failures recorded in the outage data. Then, the expected quantities of asset failure for simulated future weather exposure conditions was derived by combining simulated weather patterns with historical asset failure through conditional probability methods.
2. Consequence of Damage: Once the output of probabilistic damage is assessed, the probable impact to customers is considered. This step considers number of customers served by a given asset (e.g. each pole, or segment of conductor on a feeder), observed outage durations, the mix of customers, and critical facilities. This step is performed both for the existing configuration of each feeder, and the hardened configuration resulting from the particular program. The difference between the existing condition and the hardened configuration is the program impact.
3. Distribution subject matter experts then use these outputs to determine the optimum deployment plan considering factors such as current projects in the area, critical customers, operational knowledge, and resource availability.

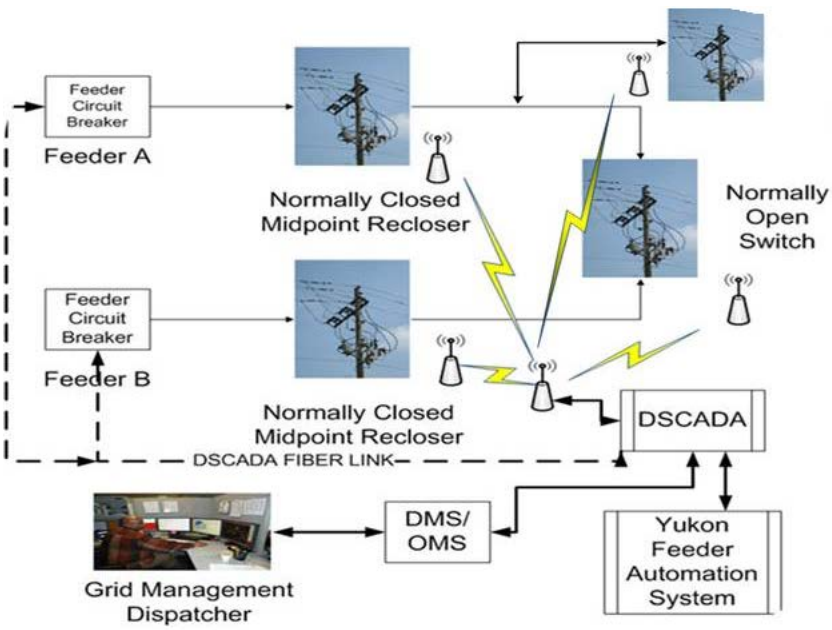
Self-Optimizing Grid – SOG

Vision

The SOG program started as part of DEF's Grid Investment Plan which was partially funded through the 2017 Revised and Restated Settlement Agreement. DEF plans to continue this program through the SPP and at completion in 2027, approximately 80% of the distribution feeders on the DEF system will have the ability to automatically reroute power around damaged line sections. 100% of the distribution feeders will have automated switching capability.

Description

The current grid has limited ability to reroute and rapidly restore power. The SOG program is established to address both of these issues.



The SOG program consists of three (3) major components: capacity, connectivity, and automation and intelligence. The SOG program redesigns key portions of the distribution system and transforms it into a dynamic smart-thinking, self-healing network. The grid will have the ability to automatically reroute power around trouble areas, like a tree on a power line, to quickly restore power to the maximum number of customers and rapidly dispatch line crews directly to the source of the outage. Self-healing technologies can reduce outage impacts by as much as 75 percent on affected feeders.

The **SOG Capacity projects** focus on expanding substation and distribution line capacity to allow for two-way power flow. **SOG Connectivity projects** create tie points between circuits. **SOG Automation projects** provide intelligence and control for the SOG operations; Automation projects enable the grid to dynamically reconfigure around trouble and restore customers not impacted by an outage.

Cost

The SOG program is planned to be complete in 2027. Below are the projected units and costs for 2020-2022:

	DEF		
Self-Optimizing Grid (SOG)	2020	2021	2022
Totals	$ 56,483,391	$ 81,269,879	$ 76,500,000
Automation	$ 35,611,138	$ 56,911,355	$ 45,900,000
Capital	$ 34,860,275	$ 55,795,446	$ 45,000,000
O&M	$ 750,863	$ 1,115,909	$ 900,000
Total ASD's	580	851	686
Connectivity & Capacity	$ 20,872,253	$ 24,358,525	$ 30,600,000
Capital	$ 20,541,619	$ 23,880,906	$ 30,000,000
O&M	$ 330,634	$ 477,618	$ 600,000

Cost Benefit Comparison

Costs from 2020 through 2027 are approximately $550M capital and $11M O&M.

At completion, with more customers automatically restored through automated switching, cost reductions can be achieved through better targeting of restoration efforts and personnel. SOG enables the grid to rapidly reroute power around damaged line sections. Accordingly, the benefit from the completion of this program is a reduction in customers affected by long duration outages as a result of extreme weather events and enhancement of overall reliability via anticipated decrease in CMI.

When the SOG Program is complete, DEF estimates it will reduce Distribution MED CMI by approximately by 227 million to 284 million minutes annually. CMI reduction is used as a proxy for reduction in extreme weather event duration for the average customer.

Prioritization Methodology

The following steps are used to prioritize the work:

1. Probability of Damage: While SOG does not directly reduce damage but rather is intended to reduce the duration of outages, SOG impacts are conservatively assessed after other hardening projects. Since other hardening projects reduce equipment failures and outages, the simulated SOG impacts are evaluated against this new hardened baseline. To prioritize the work in the Florida regions, the Transmission and Distribution systems were modeled, and weather simulations were run to provide probabilistic exposure frequency for all asset locations. The weather modeling uses the FEMA Hazus and SLOSH models, which contain the weather data for storms over the last 200 years. Using the geographical locations of the Florida assets and the historic storm paths embedded in the Hazus model, a spatial correlation of future storm exposure can be derived. To determine probability of damage given that exposure, six years of historical outage data was provided and correlated with the closest weather tower to determine the conditions during historic failures recorded in the outage data. Then, the expected quantities of asset failure for simulated future weather exposure conditions was derived by combining simulated weather patterns with historical asset failure through conditional probability methods.

2. Consequence of Damage: Once the output of probabilistic damage is assessed, the probable impact to customers is considered. This step considers number of customers served by a given asset (e.g., each pole, or segment of conductor on a feeder), observed outage durations, the mix of customers, and critical facilities. For SOG, this step is performed based on the hardened configuration of the feeder after completion of the Feeder Hardening program (see above for a description of the Feeder Hardening program).
3. Consequence of Automation: Because the program benefits are tied to reduction in outage length and customers affected during outages, these values were calculated as a part of the simulation described in steps 1 and 2, with the addition of SOG automation. The outage time reduction varied feeder by feeder, based on number of customers served, historic observed outage durations by asset class on each feeder, the reduction impact of feeder hardening on the feeder, and current level of automation.
4. Distribution subject matter experts then use these outputs to determine the optimum deployment plan considering factors such as current projects in the area, critical customers, operational knowledge, and resource availability.

Underground Flood Mitigation

Vision

The Underground Flood Mitigation program is a targeted program to harden existing underground distribution facilities in locations that are prone to storm surge during extreme weather events. This program will address the areas identified as being at high risk for significant flooding by installing submersible equipment within 20 years.

Description

Underground Flood Mitigation will harden existing underground line and equipment to withstand a storm surge through the use of DEF's current storm surge standards. This involves the installation of specialized stainless-steel equipment and submersible connections. The primary purpose of this hardening activity is to minimize the damage caused by a storm surge to the equipment and thus reduce customer outages and/or expedite restoration after the storm surge has receded.

For selected locations, DEF would raise any pad mount transformer currently in an area that is prone to storm surge onto an elevated pad and change all the connections to waterproof (submersible) connections. Conventional switchgear would be replaced with submersible switchgears that are able to withstand the storm surge.

Cost

It is expected that the 10-year cost will be approximately $11M.

	DEF		
UG Flood Mitigation*	2020	2021	2022
Totals	$ -	$ -	$ 500,000
Capital	$ -	$ -	$ 500,000
O&M	$ -	$ -	$ -

Cost Benefit Comparison

The Underground Flood Mitigation Program is scheduled to start in 2022 and estimated to take 20 years to complete. Based on today's cost, the program will cost an estimated $26M in Capital.

When the Underground Flood Mitigation Program is complete, DEF estimates it will reduce the cost of extreme weather events on the Distribution system by approximately $1M to $1.4M annually based on today's costs. This represents a reduction of approximately 1% when compared to the average of 2016 to 2019 Distribution MED costs.

When the Underground Flood Mitigation Program is complete, DEF estimates it will reduce Distribution MED CMI by approximately 500,000 to 650,000 minutes annually. CMI reduction is used as a proxy for reduction in extreme weather event duration for the average customer.

Prioritization Methodology

Work will be prioritized using the following process.

1. Probability of Damage: To prioritize the work in the Florida regions, the Transmission and Distribution systems were modeled, and weather simulations were run to provide probabilistic exposure frequency for all asset locations. The weather modeling uses the FEMA Hazus and SLOSH models, which contain the weather data for storms over the last 200 years. Using the geographical locations of the Florida assets and the historic storm paths embedded in the Hazus model, a spatial correlation of future storm exposure can be derived. To determine probability of damage given that exposure, six years of historical outage data was provided and correlated with the closest weather tower to determine the conditions during historic failures recorded in the outage data. Then, the expected quantities of asset failure for simulated future weather exposure conditions was derived by combining simulated weather patterns with historical asset failure through conditional probability methods.
2. Consequence of Damage: Once the output of probabilistic damage is assessed, the probable impact to customers is considered. This step considers number of customers served by a given asset (e.g., each pole, or segment of conductor on a feeder), observed outage durations, the mix of customers, and critical facilities. This step is performed both for the existing configuration of each feeder, and the hardened configuration resulting from completion of the program. The difference between the existing condition and the hardened configuration is the program impact.
3. Distribution subject matter experts then use these outputs to determine the optimum deployment plan considering factors such as current projects in the area, critical customers, operational knowledge, and resource availability.

Distribution Vegetation Management

Vision

DEF will continue to utilize a fully Integrated Vegetation Management (IVM) to minimize the impact of vegetation on the distribution assets.

Description

DEF Distribution will continue a fully IVM program focused on trimming feeders and laterals on an average 3 and 5-year cycles respectively. This corresponds to trimming approximately 1,930 miles of feeder backbone and 2,455 miles of laterals annually. The IVM program consists of the following: routine maintenance “trimming”, hazard tree removal, herbicide applications, vine removal, customer requested work, and right-of-way brush “mowing” where applicable. The IVM program incorporates a combination of both cycle-based maintenance and reliability-driven prioritization of work to reduce event possibilities during extreme weather events and enhance overall reliability.

Additionally, a hazard tree patrol is conducted every year on all three-phase circuits. Hazard trees are defined as trees that are dead, dying, structurally unsound, diseased, leaning or otherwise defective. The trees that are located within the right of way are removed prior to hurricane season each year, hazard trees that are located outside the right of way require landowner permission prior to removal. The contact with the landowner is initiated, permission for removal and the removal is also targeted for completion prior to hurricane season. If a feeder circuit is relocated or circuit height changes, an additional hazard tree assessment will be conducted in the line segments that will be impacted.

DEF will optimize the IVM program costs against reliability and storm performance objectives to harden the system for extreme weather events. There are four key objectives for optimization:

- Customer and employee safety;
- Tree-caused outage minimization, with the objective to reduce the number of tree-caused outages, particularly in the “preventable” category;
- Effective cost management; and
- Customer satisfaction.

Cost

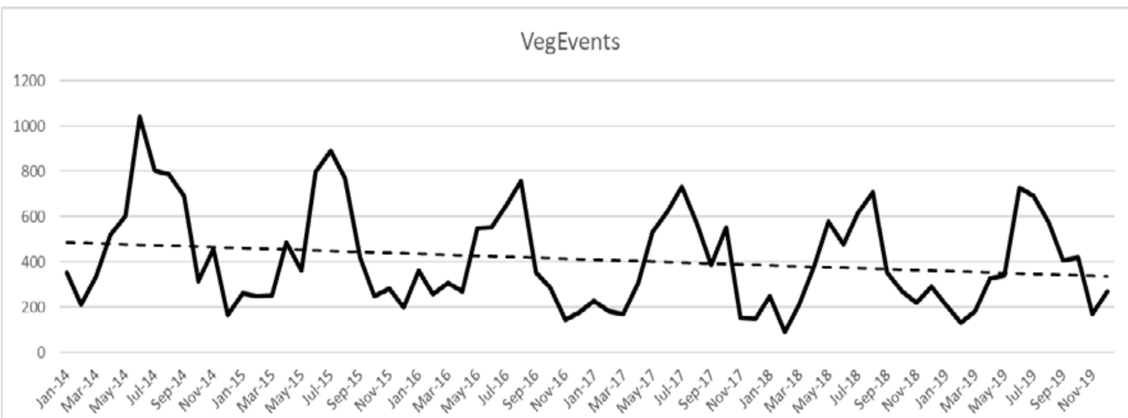
It is expected that the 10-year cost will be approximately $20M Capital and $477M O&M. This would cover the inspection and vegetation remediation activities. The circuit maintenance work performed is predominantly billed under a unit-based contract structure and not differentiated between labor and equipment. The estimated contractor ratio is 95%. The estimated utility personal ratio is 5%.

2020 -2022 Labor / Equipment Breakout		
	Labor	Equipment
Utility Personnel Totals	$ 6,557,823	$ 202,819
Capital	$ 1,132,128	$ 35,014
O&M	$ 5,425,695	$ 167,805
Contract Personnel Totals	$ 97,703,126	$ 32,187,368
Capital	$ 3,092,319	$ 1,030,773
O&M	$ 94,610,807	$ 31,156,595

	DEF		
VM - Distribution*	2020	2021	2022
Totals	$ 46,398,605	$ 44,477,139	$ 45,775,391
Capital	$ 1,499,298	$ 1,867,457	$ 1,923,480
O&M	$ 44,899,307	$ 42,609,682	$ 43,851,911
Approximate Miles	5,209	4,383	4,383

**Costs for 2021 and 2022 are based on an average of 1/3 of feeder mileage and 1/5 of lateral mileage being patrolled and remediated.*

Cost Benefit Comparison



DEF's Distribution IVM program is focused on ensuring the safe and reliable operation of the distribution system by minimizing vegetation-related interruptions and ensuring adequate conductor-to-vegetation clearances, while maintaining compliance with regulatory, environmental and safety requirements/standards. The chart above shows a reduction in vegetation related outage events over the past 5 years and demonstrates the effectiveness of the IVM program. Activities focus on the removal and/or control of incompatible vegetation within and along the right of way to minimize the risk of vegetation-related outages.

Prioritization Methodology

As part of the IVM program, DEF uses a comprehensive circuit prioritization model to minimize tree-caused outages by focusing on the feeders and or laterals that rate high in the model. Prioritization ranking factors are based on past feeder or lateral performance and probable future performance. Examples of the criteria used in prioritization include tree-caused outages in prior years, outages per vegetated mile, and total tree customer minutes of interruption. Utilizing this prioritized process, DEF follows the ANSI 300 standard for pruning and the guide "Pruning Trees Near Electric Utility Lines" by Dr. Alex L. Shigo.

DUKE ENERGY.

Transmission Programs

Florida

Program Summaries

Structure Hardening

Vision

The Structure Hardening program focuses on DEF's transmission structures throughout the state. As part of the program, all wood poles on the Florida transmission system will be replaced with non-wood structures within 15 years. In addition, Structure Hardening will upgrade lattice tower structure types that have failed during extreme weather and/or fail inspection.

Description

The Transmission Structure Hardening program addresses existing vulnerabilities on the system. This will enable the transmission system to better withstand extreme weather events. This program includes wood to non-wood upgrades, tower upgrades, adding cathodic protection, automating gang operated air break switches, Overhead Groundwire upgrades, and structure inspections.

Figure 1: Wood Pole to Non-Wood Upgrade candidate

Wood to Non-Wood Upgrade

This activity will upgrade wood poles to non-wood material such as steel or concrete. Wood pole failure has been the predominate structure damage to the transmission system during extreme weather. This strengthens structures by eliminating damage from woodpeckers and wood rot. The new structures will be more resistant to damage from extreme weather events. Other related hardware upgrades will occur simultaneously, such as insulators, crossarms, switches, and guys. This will upgrade an identified 20,520 wood poles.

Tower Upgrade

Tower Upgrade will prioritize towers based on inspection data and enhanced weather modeling. The upgrade activities will replace tower types that have previously failed during extreme weather events. Over 700 towers have been identified as having this design type.

In addition, the tower upgrade activities will upgrade lattice towers identified by visual ground inspections, aerial drone inspections and data gathered during cathodic protection installations (discussed below). This will improve the ability of the transmission grid to sustain operations during extreme weather events by reducing outages and improving restoration times. Other related hardware upgrades will occur simultaneously such as insulators, cathodic protection, and guys.

Figure 2: Double Circuit Tower

Cathodic Protection

The purpose of the Cathodic Protection (CP) activities will be to mitigate active groundline corrosion on the lattice tower system. This will be done by installing passive CP systems comprised of anodes on each leg of lattice towers. The anodes serve as sacrificial assets that corrode in place of structural steel, preventing loss of structure strength to corrosion. Each CP project will address all towers on a line from beginning point to end point.

The following tangible benefits will be gained related to hardening the lattice system:

- Site Classification - Subsurface investigation and cathodic protection installation on all lattice structures, prioritizing lines based on system criticality, age, and potential storm impact. Galvanization and member thickness measurements will be taken on all legs and diagonals, and structural steel will be classified by corrosion severity. Concrete piers will be classified on concrete health, cracking, and rebar corrosion. This system evaluation will identify any potential weak spots resulting from ground line corrosion on DEF's lattice system.

- Corrosion Mitigation – Each lattice-structure tower leg will have cathodic protection installed on it in order to arrest the corrosion process.

- Corrosion Database – Soil conditions recorded at each tower site will include resistivity, soil pH, redox, and half-cell potentials. These values will be saved into a database which will be used to help classify areas of DEF's system prone to corrosion. This information will be used to aid in condition-based maintenance of system infrastructure.

Gang Operated Air Break (GOAB)

The GOAB line switch automation project is a 20-year initiative that will upgrade 305 switch locations with modern switches enabled with SCADA communication and remote-control capabilities. Automation will add resiliency to the transmission system. Later years will include adding new switch locations to add further resiliency to the transmission system. Transmission line switches are currently manually operated and cannot be remotely monitored or controlled. Switching, a grid operation often used to section off portions of the transmission system in order to perform equipment maintenance or isolate trouble spots to minimize impacts to customers, has historically required a technician to go to the site and manually operate one or more-line switches. The GOAB upgrade increases the number of remote-controlled switches to support faster isolation of trouble spots on the transmission system and more rapid restoration following line faults.

Figure 3: DEF Manually Operated Switch

Overhead Ground Wire (OHGW)

Florida is known for a high concentration of lightning events, which continually stress the existing grid protection. Deteriorated overhead ground wire reduces the protection of the conductor and exposes the line to repeated lightning damage and risk of failure impacting the system. This initiative will also reduce the safety risk due to the required removal of OHGW prior to any restoration work on the system. By targeting deteriorated OHGW on lines with high lightning events, the benefit of this activity will be maximized. An added benefit is upgrading to fiber optic OHGW, facilitating high-speed relaying and enhanced communication and control between stations and centralized control centers.

Structure Inspections and Drone Inspections

The transmission system's inspection activities include all types of structures, line hardware, guying, and anchoring systems. Inspections include:

- Aerial helicopter Transmission Line Inspections
- Wood Pole Line Patrols
- Wood Pole Sound and Bore Line Patrol – 8-year cycle
- Non-wood Structure Line Patrols – 6-year cycle

Further, in 2021 DEF will conduct drone inspections on targeted lattice tower lines. The intent of this additional inspection is to identify otherwise difficult to see structure, hardware, or insulation vulnerabilities through high resolution imagery. DEF is incorporating drone patrols into the inspections because drones have the unique ability to provide a close vantage point with multiple angles on structures that is unattainable through aerial or ground patrols with binoculars.

Cost

DEF estimates the 10-year cost will be approximately $1.3B Capital and $41M O&M, and will entail approximately:

- 12,000 wood to non-wood poles;
- 400 tower replacements;
- CP protection for all towers;
- 100 GOABs;
- 500 miles of OHGW; and
- system inspection cycles, ground and aerial.

	DEF		
Structure Hardening*	**2020**	**2021**	**2022**
Totals	$ -	$ 41,395,564	$ 136,259,137
Capital	$ -	$ 40,000,000	$ 132,250,000
O&M	$ -	$ 1,395,564	$ 4,009,137
Total Units	0	521	1,482

**Pole and tower Inspection and Replacement details for years 2020 and 2021 are included in Exhibit JWO-1. Beginning in 2022 these activities will be incorporated into the Structure Hardening Program.*

Cost Benefit Comparison

The Structure Hardening Program will begin in 2021 and is estimated to take 30 years to complete. Based on today's cost, the program is estimated to cost $2.6B in Capital and $71M in Project O&M. At completion, approximately:

- 20,520 wood to non-wood poles;
- 720 tower replacements;
- CP protection for all towers;
- 305 GOABs;
- 4,300 miles of OHGW; and
- System inspections.

When the Structure Hardening Program is complete, DEF estimates it will reduce the cost of extreme weather events on the Transmission system by approximately $19M to $24M annually based on today's costs. This represents a reduction of approximately 38% to 48% when compared to the average of 2016 to 2019 Transmission MED costs.

When the Structure Hardening Program is complete, DEF estimates it will reduce Transmission MED CMI by approximately 13 million to 16 million minutes annually. CMI reduction is used as a proxy for reduction in extreme weather event duration for the average customer.

Transmission system damage can result in severe consequences in both cost and outage duration. The estimation of benefits represents an annual average expected value based on historical data and does not represent what could happen in individual events or scenarios in which severe damage occurs on critical parts of the Transmission system.

Prioritization Methodology

Work will be prioritized using the following processes:

1. Probability of Damage: To prioritize the work in the Florida regions, the Transmission and Distribution systems were modeled, and weather simulations were run to provide probabilistic exposure frequency for all asset locations. The weather modeling uses the FEMA Hazus and SLOSH models, which contain the weather data for storms over the last 200 years. Using the geographical locations of the Florida assets and the historic storm paths embedded in the Hazus model, a spatial correlation of future storm exposure can be derived. To determine probability of damage given that exposure, six years of historical outage data was provided and correlated with the closest weather tower to determine the conditions during historic failures recorded in the outage data. Then, the expected quantities of asset failure for simulated future weather exposure conditions was derived by combining simulated weather patterns with historical asset failure through conditional probability methods.
2. Consequence of Damage: Once the output of probabilistic damage is assessed, the probable impact to customers is considered. This step considers number of customers served by a given asset (e.g. each pole, or segment of conductor on a line), observed outage durations, the mix of customers, and critical facilities. This step is performed both for the existing configuration of each asset, and the hardened configuration resulting from completion of the Program. The difference between the existing condition and the hardened configuration is the program impact.
3. Transmission subject matter experts then use these outputs to determine the optimum deployment plan considering factors such as current projects in the area, critical customers, operational knowledge, and resource availability.

Substation Flood Mitigation

Vision

Substation Flood Mitigation is a targeted program upgrading 20 sites identified as being at risk for significant flooding during extreme weather events.

Description

The Substation Flood Mitigation program builds in protection for substations most vulnerable to flood damage using flood plain and storm surge data. It includes a systematic review and prioritization of substations at risk of flooding to determine the proper mitigation solution, which may include elevating or modifying equipment, or relocating substations altogether.

Flood mitigation will be a targeted application of mitigation measures for substations. New assets could include control houses, relays, or total station rebuilds to increase elevation, etc.

Cost

It is expected that the 10-year cost will be approximately $27M Capital. This would cover approximately 14 substations on the DEF system.

Cost Benefit Comparison

The Substation Flood Mitigation Program is scheduled to start in 2023 and estimated to take 15 years to complete. Based on today's cost, the program will cost an estimated $38M in Capital. At the completion of the program 20 targeted substations will be hardened with flood mitigation strategies.

When the Substation Flood Mitigation Program is complete, DEF estimates it will reduce the cost of extreme weather events on the Transmission system by approximately $400,000 to $500,000 annually based on today's costs. This represents a reduction of approximately 1% when compared to the average of 2016 to 2019 Transmission MED costs.

When the Substation Flood Mitigation Program is complete, DEF estimates it will reduce Transmission MED CMI by approximately 9 million to 11 million annually. CMI reduction is used as a proxy for reduction in extreme weather event duration for the average customer.

Transmission system damage can result in severe consequences in both cost and outage duration. The estimation of benefits represents an annual average expected value based on historical data and do not represent what could happen in individual events or scenarios in which severe damage occurs on critical parts of the Transmission system.

Prioritization Methodology

Work will be prioritized using the following processes:

1. Probability of Damage: To prioritize the work in the Florida regions, the Transmission and Distribution systems were modeled, and weather simulations were run to provide probabilistic exposure frequency for all asset locations. The weather modeling uses the FEMA Hazus and SLOSH models, which contain the weather data for storms over the last 200 years. Using the geographical locations of the Florida assets and the historic storm paths embedded in the Hazus model, a spatial correlation of future storm exposure can be

derived. To determine probability of damage given that exposure, six years of historical outage data was provided and correlated with the closest weather tower to determine the conditions during historic failures recorded in the outage data. Then, the expected quantities of asset failure for simulated future weather exposure conditions was derived by combining simulated weather patterns with historical asset failure through conditional probability methods.

2. Consequence of Damage: Once the output of probabilistic damage is assessed, the probable impact to customers is considered. This step considers number of customers served by a given asset (e.g. each pole, or segment of conductor on a line), observed outage durations, the mix of customers, and critical facilities. This step is performed both for the existing configuration of each asset, and the hardened configuration resulting from completion of the program. The difference between the existing condition and the hardened configuration is the program impact.
3. Transmission subject matter experts then use these outputs to determine the optimum deployment plan considering factors such as current projects in the area, critical customers, operational knowledge, and resource availability.

Loop Radially-Fed Substations

Vision

The Loop Radially-Fed Substation program will convert radially-fed substations to networked substations. The targeted program will address approximately 20 sites over 20 years.

Description

The Loop Radially-Fed Substations program builds a more resilient and networked transmission system by creating a secondary feed into substations that are more likely to experience long outage durations during extreme weather events. As part of the construction of the additional feed, other assets could include equipment such as breakers, switches, bus work, structures, insulators, potential transformers, lightning arresters, relays, control houses.

Cost

The estimated 10-year cost will be approximately $52M. This would cover approximately 5 substations on the system.

Cost Benefit Comparison

The Loop Radially-Fed Substations Program is scheduled to start in 2025 and estimated to take 20 years to complete. Based on today's cost, the program will cost an estimated $206M in Capital. At the completion of the program 20 targeted substations will be addressed.

When the Loop Radially-Fed Substations Program is complete, it will provide an alternate source of power to limit interruptions experienced by customers.

When the Loop Radially-Fed Substations Program is complete, DEF estimates it will reduce Transmission MED CMI by approximately 450,000 to 600,000 minutes annually. CMI reduction is used as a proxy for reduction in extreme weather event duration for the average customer.

Transmission system damage can result in severe consequences in both cost and outage duration. The estimation of benefits represents an annual average expected value based on historical data and do not represent what could happen in individual events or scenarios in which severe damage occurs on critical parts of the Transmission system.

Prioritization Methodology

Work will be prioritized using the following processes:

1. Probability of Damage: To prioritize the work in the Florida regions, the Transmission and Distribution systems were modeled, and weather simulations were run to provide probabilistic exposure frequency for all asset locations. The weather modeling uses the FEMA Hazus and SLOSH models, which contain the weather data for storms over the last 200 years. Using the geographical locations of the Florida assets and the historic storm paths embedded in the Hazus model, a spatial correlation of future storm exposure can be derived. To determine probability of damage given that exposure, six years of historical outage data was provided and correlated with the closest weather tower to determine the conditions during historic failures recorded in the outage data. Then, the expected quantities of asset failure for simulated future weather exposure conditions was derived by combining

simulated weather patterns with historical asset failure through conditional probability methods.

2. Consequence of Damage: Once the output of probabilistic damage is assessed, the probable impact to customers is considered. This step considers number of customers served by a given asset (e.g. each pole, or segment of conductor on a line), observed outage durations, the mix of customers, and critical facilities. This step is performed both for the existing configuration of each asset, and the hardened configuration resulting from program completion. The difference between the existing condition and the hardened configuration is the program impact.
3. Transmission subject matter experts then use these outputs to determine the optimum deployment plan considering factors such as current projects in the area, critical customers, operational knowledge, and resource availability.

Substation Hardening

Vision

The Substation Hardening Program started as part of DEF's Grid Investment Plan which was partially funded through the 2017 Revised and Restated Settlement Agreement. DEF plans to continue this program through the SPP. The Substation Hardening program will focus on upgrading oil breakers and electromechanical relays. The program will eliminate 443 oil breakers within 10 years. This program will also upgrade approximately 1,237 electromechanical relay groups to electronic relays to properly isolate line faults and reduce storm restoration duration by automating fault identification within 20 years.

Description

Substation Hardening will address two major components.:1) Upgrading oil breakers to state-of-the-art gas or vacuum breakers to mitigate the risk of catastrophic failure and extended outages during extreme weather events; and 2) Upgrading electromechanical relays to digital relays will provide communications and enable DEF to respond and restore service more quickly from extreme weather events.

Breaker Upgrades

Replacing oil circuit breakers with state-of-the-art breakers will result in the transmission system being able to more effectively and consistently isolate faults, reclose after momentary interruptions, and improve the customer experience through fewer interruptions. Oil circuit breakers are more unreliable than gas or vacuum breakers, especially in circumstances where they are operating numerous times over a short period, such as during extreme weather events. When oil circuit breakers are repeatedly called to operate, they can generate arcing gasses within the oil tank that can accumulate and result in catastrophic failure. Existing vintage oil breakers are less reliable when isolating line faults and can contribute to increased and longer customer outages when there is a failure.

Electronic Relays

The Electronic Relay upgrades eliminate noncommunicating electromechanical and solid-state relays with digital relays. Upgrading to modern relay designs with communication capabilities and microprocessor technologies will enable quicker restoration from outage events. Another benefit is increased overall system intelligence, which will improve restoration planning. One digital relay replaces a variety of legacy single-function electromechanical relays. Two-way communications and event recording capabilities allow them to provide device performance information following a system event to support continuous system design and operational improvements.

Grid automation will be implemented to reduce duration and impacts from system issues. Digital relays will be installed to add remote monitoring and operations to key assets, which allows for rapid service response and better protection and monitoring of equipment during extreme weather events. Restoration times will be reduced due to remote monitoring and control which will allow quicker pinpointing and resolution of issues.

Cost

The estimated 10-year cost for Substation Hardening Program is expected be approximately $109M Capital.

This would upgrade all oil filled breakers and approximately 600 relay groups on the DEF system.

	DEF		
Substation Hardening	**2020**	**2021**	**2022**
Totals	$ 5,004,000	$ 5,500,000	$ 7,500,000
Capital	$ 5,004,000	$ 5,500,000	$ 7,500,000
O&M	$ -	$ -	$ -
Total Units	26	29	39

Cost Benefit Comparison

The Substation Hardening Program is estimated to take 20 years to complete. Based on today's cost, the program will cost an estimated $199M in Capital.

When the Substation Hardening Program is complete, DEF estimates it will reduce the cost of extreme weather events on the Distribution system by approximately $70,000 to $90,000 annually based on today's costs.

When the Substation Hardening Program is complete, DEF estimates it will reduce Distribution MED CMI by approximately 15 million to 19 million minutes annually. CMI reduction is used as a proxy for reduction in extreme weather event duration for the average customer.

Transmission system damage can result in severe consequences in both cost and outage duration. The estimation of benefits represents an annual average expected value based on historical data and do not represent what could happen in individual events or scenarios in which severe damage occurs on critical parts of the Transmission system.

Prioritization Methodology

Work will be prioritized using the following processes:

1. Probability of Damage: To prioritize the work in the Florida regions, the Transmission and Distribution systems were modeled, and weather simulations were run to provide probabilistic exposure frequency for all asset locations. The weather modeling uses the FEMA Hazus and SLOSH models, which contain the weather data for storms over the last 200 years. Using the geographical locations of the Florida assets and the historic storm paths embedded in the Hazus model, a spatial correlation of future storm exposure can be derived. To determine probability of damage given that exposure, six years of historical outage data was provided and correlated with the closest weather tower to determine the conditions during historic failures recorded in the outage data. Then, the expected quantities of asset failure for simulated future weather exposure conditions was derived by combining simulated weather patterns with historical asset failure through conditional probability methods.
2. Consequence of Damage: Once the output of probabilistic damage is assessed, the probable impact to customers is considered. This step considers number of customers served by a given asset (e.g. each pole, or segment of conductor on a line), observed outage durations, the mix of customers, and critical facilities. This step is performed both for the existing configuration of each asset, and the hardened configuration at project completion. The difference between the existing condition and the hardened configuration is the program impact.

3. Transmission subject matter experts then use these outputs to determine the optimum deployment plan considering factors such as current projects in the area, critical customers, operational knowledge, and resource availability.

Transmission Vegetation Management

Vision

DEF will continue to utilize Integrated Vegetation Management (IVM) to minimize the impact of vegetation on the transmission assets.

Description

DEF's Transmission IVM program is focused on ensuring the safe and reliable operation of the transmission system by minimizing vegetation-related interruptions and adequate conductor-to-vegetation clearances, while maintaining compliance with regulatory, environmental, and safety requirements or standards. The program activities focus on the removal and/or control of incompatible vegetation within and along the right of way to minimize the risk of vegetation-related outages and ensure necessary access within all transmission line corridors. The IVM program includes the following activities: planned threat and condition-based maintenance, reactive work that includes hazard tree mitigation, and brush management (herbicide, mowing, and hand cutting operation).

Transmission utilizes LIDAR to generate a threat/condition-based Vegetation Management plan. NERC lines (200kV and above) are flown every year. A fourth of non-NERC lines are currently flown each year. After 4 years all lines will have been flown. Threat triggers target clearing for 6+ years of growth. The LIDAR program targets the entire Transmission system of approximately 5,200 miles.

Cost

The estimated contractor ratio is 91.5%. The estimated utility personnel ratio is 8.5%.

2020 -2022 Labor / Equipment Breakout		
	Labor	Equipment
Utility Personnel Totals	$ 4,010,124	$ 167,089
Capital	$ 1,965,352	$ 66,835
O&M	$ 2,044,773	$ 100,253
Contract Personnel Totals	$ 30,545,624	$ 14,374,411
Capital	$ 15,159,336	$ 7,133,805
O&M	$ 15,386,288	$ 7,240,606

	DEF		
VM - Transmission	2020	2021	2022
Totals	$ 12,522,040	$ 17,228,315	$ 19,346,891
Capital	$ 4,469,073	$ 8,995,999	$ 10,860,255
O&M	$ 8,052,967	$ 8,232,316	$ 8,486,636
Approximate Miles	398	404	404

Cost Benefit Comparison

It is expected that the 10-year cost will be approximately $108M Capital and $90M O&M. This would cover the inspection and vegetation remediation activities.

The IVM program's planned threat and condition-based maintenance include danger tree identification and mitigation, reactive work that includes hazard tree mitigation, and brush management (herbicide, mowing, and hand cutting operation) to reduce event possibilities during extreme weather events and enhance overall system reliability.

Prioritization Methodology

Planned work for DEF is scheduled and prioritized through a manual process using the date of previous work activities as well as threats and conditions identified through patrols, inspections and assessments. As systems and technologies can be developed and implemented, DEF intends to leverage those technologies/systems and analytics to evaluate numerous variables coupled with local knowledge to optimize the risk-based planning and scheduling of work.

Revenue Requirements and Rate Impacts

Rule 25-6.030(3)(g): An estimate of the annual jurisdictional revenue requirements for each year of the Storm Protection Plan.

Estimated Annual Jurisdictional Revenue Requirements for Each Year of the Storm Protection Plan										
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
($ Millions)	$ -	$ 8.8	$105.6	$169.3	$241.1	$320.4	$404.9	$486.2	$560.9	$632.2

Rule 25-6.030(3)(h): An estimate of rate impacts for each of the first three years of the Storm Protection Plan for the utility's typical residential, commercial, and industrial customers.

Estimated SPP Rate Impacts Residential $/1,000 kWh	2020	2021	2022
(1) Total SPP Estimated Rate	$0.00	$0.27	$3.28
(2) Less: Amounts Historically Recovered in Base Rates	$0.00	$0.00	$2.06
(3) SPP Rate Impact Less Base Reduction	$0.00	$0.27	$1.22
(4) Typical Commercial % Increase from 2020 Bill	0.0%	0.2%	2.0%-2.3%
(5) Typical Industrial % Increase from 2020 Bill	0.0%	0.2%-0.3%	1.6%-4.2%

Notes:

(1) DEF's 2017 Settlement Agreement ends at the end of 2021. In 2022 line (1) shows the total estimated SPP rate. It assumes all spend that has traditionally been recovered in base rates for Storm Hardening activities (vegetation management for example) is now recovered through the SPPCRC. Line (2) shows the offsetting reduction estimated in base rates. Line (3) is the net SPP impact.

(2) Commercial & Industrial % Increase does not consider base rate reduction due to shift of existing spend in base rates to the SPPCRC in 2022.

Distribution Capital Summary	2020	2021	2022	Notes
Pole Replacement	$ 22,072,989	$ 21,063,160	$ -	Beginning in 2022 all Pole Replacement and Inspection work will be absorbed in to Feeder Hardening and Lateral Hardening.
Pole Inspection	$ -	$ -	$ -	
Feeder Hardening	$ -	$ 60,000,000	$ 105,629,040	
Targeted Underground	$ 41,934,480	$ 64,398,532	$ -	The Target Underground and Deteriorated Conductor programs sunset in 2021. They are replaced by the Lateral Hardening program in 2022.
Deteriorated Conductor	$ 14,453,207	$ 19,427,994	$ -	
Lateral Hardening	$ -	$ -	$ 180,188,960	
Self Optimizing Grid	$ 55,401,894	$ 79,676,352	$ 75,000,000	SOG program continues as is
Submersible UG	$ 265,000	$ -	$ -	The Submersibe UG progam sunsets in 2020. It is replaced by the UG Floof Mitigation program in 2022.
UG Flood Mitigation	$ -	$ -	$ 500,000	
Distribution Vegetation Management	$ 1,499,298	$ 1,867,457	$ 1,923,480	
Totals	**$ 135,626,868**	**$ 246,433,495**	**$ 363,241,480**	

Distribution O&M Summary	2020	2021	2022	Notes
Pole Replacement	$ 1,545,109	$ 1,545,110	$ -	Beginning in 2022 all Pole Replacement and Inspection work will be absorbed in to Feeder Hardening and Lateral Hardening.
Pole Inspection	$ 4,000,000	$ 4,000,000	$ -	
Feeder Hardening	$ -	$ 2,400,005	$ 5,736,408	
Targeted Underground	$ 524,198	$ 784,000	$ -	The Target Underground and Deteriorated Conductor programs sunset in 2021. They are replaced by the Lateral Hardening program in 2022.
Deteriorated Conductor	$ 144,532	$ 233,136	$ -	
Lateral Hardening	$ -	$ -	$ 7,131,147	
Self Optimizing Grid	$ 1,081,497	$ 1,593,527	$ 1,500,000	SOG program continues as is
Submersible UG	$ -	$ -	$ -	The Submersibe UG progam sunsets in 2020. It is replaced by the UG Floof Mitigation program in 2022.
UG Flood Mitigation	$ -	$ -	$ -	
Distribution Vegetation Management	$ 44,899,307	$ 42,609,682	$ 43,851,911	
Totals	**$ 52,194,643**	**$ 53,165,460**	**$ 58,219,466**	

Transmission Capital Summary	2020	2021	2022	Notes
Pole Replacement	$ 33,000,000	$ 33,000,000	$ -	Beginning in 2022 all Pole/Tower Replacement and Inspection and OH Ground Wire Replacement work will be absorbed in to Structure Hardening.
Pole/Tower Inspections	$ -	$ -	$ -	
Tower Replacements	$ 802,221	$ 1,000,000	$ -	
OH Ground Wire Replacement	$ 1,817,267	$ 1,500,000	$ -	
Structure Hardening	$ -	$ 40,000,000	$ 132,250,000	
Substation Hardening	$ 5,004,000	$ 5,500,000	$ 7,500,000	Substation Hardening program continues as is
Substation Flood Mitigation	$ -	$ -	$ -	Program scope begins after 2022
Loop Radially Fed Substations	$ -	$ -	$ -	Program scope begins after 2022
Transmission Vegetation Management	$ 4,469,073	$ 8,995,999	$ 10,860,255	
Totals	**$ 45,092,561**	**$ 89,995,999**	**$ 150,610,255**	

Transmission O&M Summary	2020	2021	2022	Notes
Pole Replacement	$ 1,285,154	$ 838,208	$ -	Beginning in 2022 all Pole/Tower Replacement and Inspection and OH Ground Wire Replacement work will be absorbed in to Structure Hardening.
Pole/Tower Inspections	$ 400,000	$ 400,000	$ -	
Tower Replacements	$ 4,500	$ 8,250	$ -	
OH Ground Wire Replacement	$ -	$ 34,884		
Structure Hardening	$ -	$ 1,395,564	$ 4,009,137	
Substation Hardening	$ -	$ -	$ -	Substation Hardening program continues as is
Substation Flood Mitigation	$ -	$ -	$ -	Program scope begins after 2022
Loop Radially Fed Substations	$ -	$ -	$ -	Program scope begins after 2022
Transmission Vegetation Management	$ 8,052,967	$ 8,232,316	$ 8,486,636	
Totals	**$ 9,742,621**	**$ 10,909,222**	**$ 12,495,773**	

Storm Protection Plan Project for Duke Energy Florida

Final Report

Prepared for:

DUKE ENERGY FLORIDA

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April 2020

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Executive Summary

Duke Energy Florida (DEF) engaged Guidehouse Inc. (Guidehouse or the project team)[1] to help develop the DEF Storm Protection Plan (SPP). The SPP seeks to strengthen DEF's electric grid infrastructure to withstand extreme weather conditions and enhance overall reliability.

Guidehouse assisted DEF with developing and refining its analytical methods of project selection and prioritization to help target the most cost-effective grid strengthening solutions. This document provides Guidehouse's recommendations for a strategic 10-year investment plan and corresponding detailed 3-year capital investment plan for DEF's SPP. Program assumptions related to impacted assets, costs, and expected benefits are provided to support the recommendations. The project team used a wide range of data sources—both from DEF and from publicly available studies and sources—to complete the analysis and to develop a detailed bottom-up simulation of program impacts. Guidehouse used these data sources and others to model the locational impacts of extreme weather conditions and the anticipated reduction in restoration costs and outage times used to develop SPP program and investment recommendations.

The recommended plan focuses on core programs deployed on the distribution grid, within substations, on the transmission grid, and for vegetation management. These programs and associated projects will cost-effectively prevent or reduce the impacts of extreme weather events to DEF customers while enhancing the overall reliability of the electric system across DEF's service area.

SPP Full Deployment

In 2020, DEF will file its SPP for strengthening the electric grid infrastructure to withstand extreme weather conditions and enhance reliability within its service area. Full deployment of many SPP programs will span beyond the 10-year timeline defined in DEF's SPP regulatory filing. Some of the individual programs—e.g., distribution lateral hardening—may require 20 to 30 years to complete. For this assessment, the Guidehouse project team regarded completion of 3-year and 10-year plans as milestones towards achieving the greater benefits of a longer-range, fully hardened state of the DEF electric system.

When fully deployed, the extreme weather protection and reliability improvements offered by the SPP will produce significant ongoing benefits to DEF customers. The annual average benefits expected from the SPP investments include expected avoided restoration costs and projected reduced customer minutes of interruption (CMI).

[1] Guidehouse LLP completed its acquisition of Navigant Consulting, Inc, in October 2019. The two brands are now combined as Guidehouse.

Table-ES 1 and Table-ES 2 highlight the average annual avoided restoration costs and CMI reductions, respectively, given the average expected storm frequency and the potential for elevated storm frequency.

Table-ES 1. Estimated Annual Avoided Restoration Costs for Fully Deployed SPP

	Average Storm Frequency		Elevated Storm Frequency	
Program Category	**Estimated Annual Avoided Restoration Costs**		Estimated Annual Avoided Restoration Cost	
	(2020 Dollars)	(% Reduction)	(2020 Dollars)	(% Reduction)
Distribution	$118.4 million	58%	$148.0 million	72%
Transmission	$19.3 million	39%	$24.1 million	49%
Vegetation Management	N/A	N/A	N/A	N/A

Notes: % Reduction represents modeled restoration cost savings relative to average storm restoration costs from 2016 through 2019. Storm frequency assumptions are provided in Appendix B.

Source: Guidehouse, Inc.

Table-ES 2. Estimated Annual CMI Reduction with Fully Deployed SPP

	Average Storm Frequency	Elevated Storm Frequency
Program Category	**CMI Reduction Minutes**	CMI Reduction Minutes
Distribution	786.5 million	983.1 million
Transmission	37.6 million	47.0 million
Vegetation Management	NA	NA

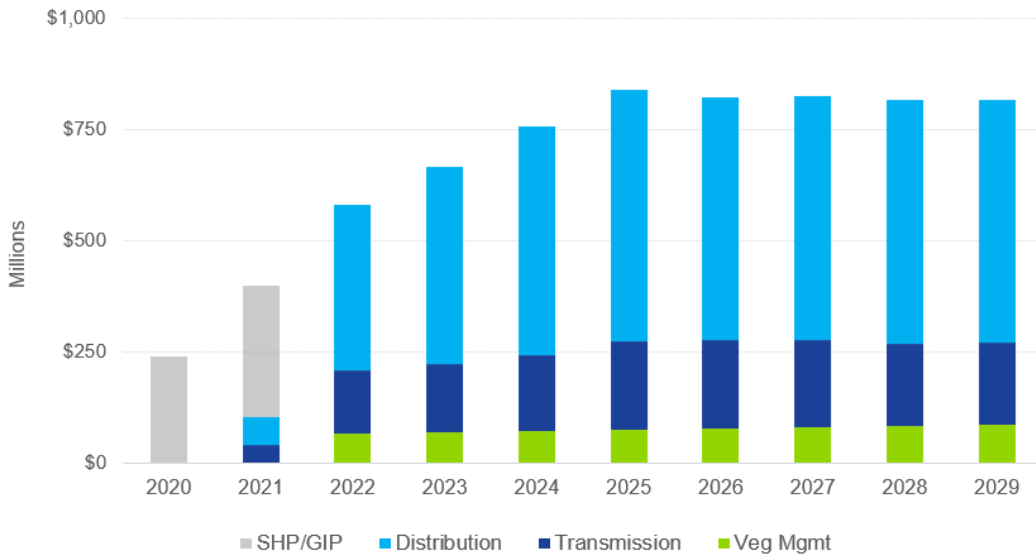
Notes: Storm frequency assumptions are provided in Appendix B.

Source: Guidehouse, Inc.

10-Year SPP Roadmap

DEF estimates a total investment of $6.4 billion in capital and associated O&M to deploy its proposed 10-year SPP. In this initial 10-year plan, SPP investments begin to ramp up in year 2 (2021) with additional investment in 2022 through 2029, as Figure-ES 1 depicts.

Figure-ES 1. SPP 10-Year Investment by Major Category



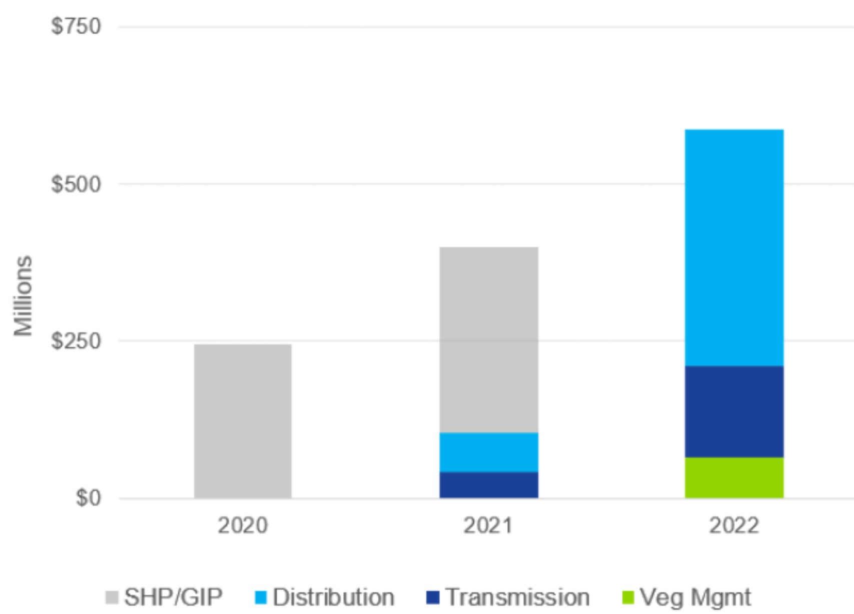
Source: Guidehouse, Inc.

In 2020 and 2021, DEF will invest approximately $540 million in capital and O&M for program investments as part of its previously approved Storm Hardening Plan (SHP) and for elements of its Grid Investment Plan (GIP). Hardening programs from these plans will become part of DEF's ongoing SPP. Beginning in 2021, DEF will add an incremental investment of approximately $100 million in capital and O&M as part of SPP implementation, with the full transition to the SPP investment program in 2022.

3-Year SPP Details

Over the first 3 years of the SPP, exclusive of investment associated with SHP/GIP in 2020 and 2021, DEF estimates a total SPP investment of approximately $690 million in capital and associated O&M, as depicted in Figure-ES 2.

Figure-ES 2. SPP 3-Year Investment by Major Category



Source: Guidehouse, Inc.

Within the SPP, DEF includes 10 programs. Table-ES 3 lists these programs by major investment category.

Table-ES 3. List of SPP Programs

Category	SPP Program
Distribution	D1: Feeder Hardening
	D2: Lateral Hardening
	D3: Self-Optimizing Grid
	D4: Underground Flood Mitigation
Transmission	T1: Structure Hardening
	T2: Substation Flood Mitigation
	T3: Loop Radially Fed Substations
	T4: Substation Hardening
Vegetation Management	VM1: Distribution Vegetation Management
	VM2: Transmission Vegetation Management

Source: Guidehouse Inc.

The body of this report details the estimated investment and expected activities associated with each of these SPP programs.

1. Introduction

Duke Energy Florida (DEF) engaged Guidehouse Inc. (Guidehouse or the project team)[2] to help develop the DEF Storm Protection Plan (SPP). The SPP seeks to strengthen DEF's electric grid infrastructure to withstand extreme weather conditions and enhance overall reliability. Guidehouse assisted DEF with developing and refining its analytical methods of project selection and prioritization to help target the most cost-effective grid strengthening solutions.

This document provides Guidehouse's recommendations for:

- Strategic 10-year investment plan for the DEF SPP (Section 2)
- Detailed 3-year capital investment plan for the DEF SPP (Section 3)

The recommended 10-year plan focuses on core programs deployed on the transmission grid, within substations, on the distribution grid, and for vegetation management. These programs and projects will cost-effectively prevent or reduce the impacts of extreme weather events to DEF customers while enhancing the overall reliability of the electric system across DEF's service area.

Program assumptions related to impacted assets, costs, and expected benefits are provided to support the recommendations. Guidehouse also assessed historical DEF, industry, and national weather data to model the locational impacts of various extreme weather conditions; the analysis estimates the anticipated reduction in restoration costs and outage times associated with the project team's SPP recommendations.

Guidehouse references the following data sources in the modeling and analysis of DEF's SPP programs.

- GIS data (DEF-specific)
- Asset management data (DEF-specific)
- Outage management system data (DEF-specific)
- Fragility analysis data[3]
- Inspection data (DEF-specific)
- Historic storm reports (DEF-specific)
- Vegetation coverage data (DEF-specific)

[2] Guidehouse LLP completed its acquisition of Navigant Consulting, Inc, in October 2019. The two brands are now combined as one Guidehouse.

[3] Panteli, Mathaios, et al. "Power system resilience to extreme weather: fragility modeling, probabilistic impact assessment, and adaptation measures." *IEEE Transactions on Power Systems* 32.5 (2016): 3747-3757.; Guikema, Seth, and Roshanak Nateghi. "Modeling power outage risk from natural hazards." *Oxford Research Encyclopedia of Natural Hazard Science*. 2018.

- Historic hourly National Oceanic and Atmospheric Administration (NOAA)[4] weather data from 199 weather stations
- Predictive windspeed frequency models
- Predictive flood frequency models
- Customer, load, and apparent power at risk data at (DEF-specific)
- Customer value of unserved energy
- Financial and other miscellaneous data[5]

Section 3 provides program-specific modeling assumptions included in Guidehouse's recommended investment plan. DEF engineering and planning personnel, regional staff, and other subject matter experts will be able to use the results of this analysis to inform the detailed planning and design-level analysis efforts needed to implement the SPP and realize its benefits.

The modeling methodology is discussed in Appendix A.

1.1 Full SPP Deployment Benefits

Full deployment of many SPP programs will span beyond the 10-year timeline defined in DEF's SPP regulatory filing. Some of the individual programs—e.g., distribution lateral hardening—may require 20 to 30 years to complete. For this assessment, the Guidehouse project team regarded completion of 3-year and 10-year plans as milestones towards achieving the greater benefits of a longer-range, fully hardened state of the DEF electric system. When fully deployed, the extreme weather protection and reliability improvements offered by the SPP will produce significant ongoing benefits to DEF customers. Table 1 and Table 2 highlight the estimated annual avoided restoration costs and reduced customer minutes of interruption (CMI), respectively, given the average expected storm frequency and the potential for elevated storm frequency.[6]

[4] NOAA is an agency within the US Department of Commerce that focuses on understanding, predicting, and information sharing on the conditions of the oceans, atmosphere, and related ecosystems.

[5] This includes inflation rates, DEF's weighted average cost of capital (WACC), valuation horizons, and more.

[6] Note that the given percentages are relative to a baseline of the 4-year average value for each benefit—that is, the 4-year average restoration cost and the 4-year average CMI. As such, it is possible for a percent reduction to be greater than 100%. For example, a 200% transmission-driven reduction in CMI indicates that the transmission programs proposed will reduce CMI by two times the average amount of CMI that has been experienced on the transmission system. This is possible given that the transmission system has not experienced large direct storm impacts over the past 4 years.

Table 1. Estimated Annual Avoided Restoration Costs for Fully Deployed SPP

Program Category	Average Storm Frequency: Estimated Annual Avoided Restoration Costs (2020 Dollars)	Average Storm Frequency: Estimated Annual Avoided Restoration Costs (% Reduction)	Elevated Storm Frequency: Estimated Annual Avoided Restoration Cost (2020 Dollars)	Elevated Storm Frequency: Estimated Annual Avoided Restoration Cost (% Reduction)
Distribution	$118.4 million	58%	$148.0 million	72%
Transmission	$19.3 million	39%	$24.1 million	49%
Vegetation Management	N/A	N/A	N/A	N/A

Notes: % Reduction represents modeled restoration cost savings relative to average storm restoration costs from 2016 through 2019. Storm frequency assumptions are provided in Appendix B.
Source: Guidehouse, Inc.

Table 2. Estimated Annual CMI Reduction with Fully Deployed SPP

Program Category	Average Storm Frequency: CMI Reduction Minutes	Elevated Storm Frequency: CMI Reduction Minutes
Distribution	786.5 million	983.1 million
Transmission	37.6 million	47.0 million
Vegetation Management	NA	NA

Notes: Storm frequency assumptions are provided in Appendix B.
Source: Guidehouse, Inc.

Upon SPP full deployment, DEF can expect to avoid an estimated $138 million in storm restoration costs annually and an estimated annual reduction of about 824 million CMI.

Guidehouse used data from storm damage experienced since 2015 as well as customer outage data collected over this same period to support this analysis. The average storm frequency referenced in the tables above considers the weather conditions most likely to be experienced across the DEF service territory each year based on weather data from the past 200 years.[7] Should storm activity intensify or become more frequent, the SPP would deliver even more value in avoided restoration costs and CMI reduction.

Details on the 10-year and 3-year portions of Guidehouse's SPP recommendation are provided in the sections below.

[7] Storm frequencies were derived from HAZUS MH model runs. See www.fema.gov/hazus, msc.fema.gov/portal/home, and Schneider, Philip J., and Barbara A. Schauer. "HAZUS—its development and its future." Natural Hazards Review 7.2 (2006): 40-44.

1.2 Program Categorization

Guidehouse evaluated dozens of program elements and hundreds of assets as part of the SPP analysis and modeling. The project team categorized SPP programs into three program types: standards-based, targeted, and enabling, as defined in Table 3. The team used these program types in the analysis and modeling activities to drive how individual projects within each program are prioritized into the 10-year and 3-year investment plans.

Table 3. SPP Program Types

Program Type	Description
Standards-based	Programs that leverage standards to specify the hardening approach and to determine the conditions (including locational specifics, system characteristics, and vulnerabilities) that are eligible for deployment.
Targeted	Programs that seek to harden specific areas of the system that have specific characteristics (e.g., flood-prone areas) and merit deployment at those locations.
Enabling	Programs that are necessary to maintain the resilience of the system and that require continuous application to be effective.

Source: Guidehouse, Inc.

1.3 Program List

Table 4 lists the programs considered in the SPP analysis, the categories to which they belong, and their associated program types.

Table 4. DEF SPP Programs

Category	SPP Program	Program Type
Distribution	D1: Feeder Hardening	Standards-based
	D2: Lateral Hardening	Standards-based
	D3: Self-Optimizing Grid	Standards-based
	D4: Underground Flood Mitigation	Targeted
Transmission	T1: Structure Hardening	Standards-based
	T2: Substation Flood Mitigation	Targeted
	T3: Loop Radially Fed Substations	Targeted
	T4: Substation Hardening	Standards-based
Vegetation Management	VM1: Distribution Vegetation Management	Enabling
	VM2: Transmission Vegetation Management	Enabling

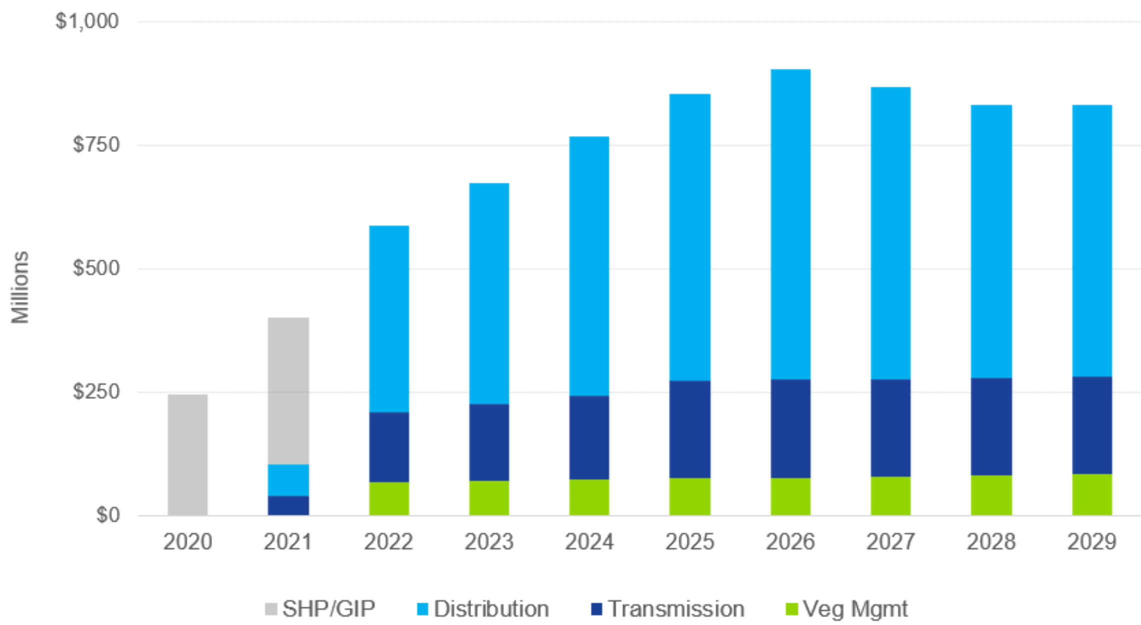
Source: Guidehouse, Inc.

Appendix C describes each program and how they were considered in the analysis process. Section 2 and Section 3 detail on Guidehouse's recommended 10-year and 3-year investment plan. Section 3 also offers additional details for each individual program and their associated extreme weather benefits.

2. Storm Protection Plan 10-Year Investment Plan

The recommended SPP, which spans 2020 through 2029, calls for a total investment of $6.4 billion in capital and associated O&M, with SPP-specific investment starting in year 2 (2021). Figure 1 shows this investment by year and investment category.

Figure 1. SPP Investment by Category Over 10 Years



Source: Guidehouse, Inc.

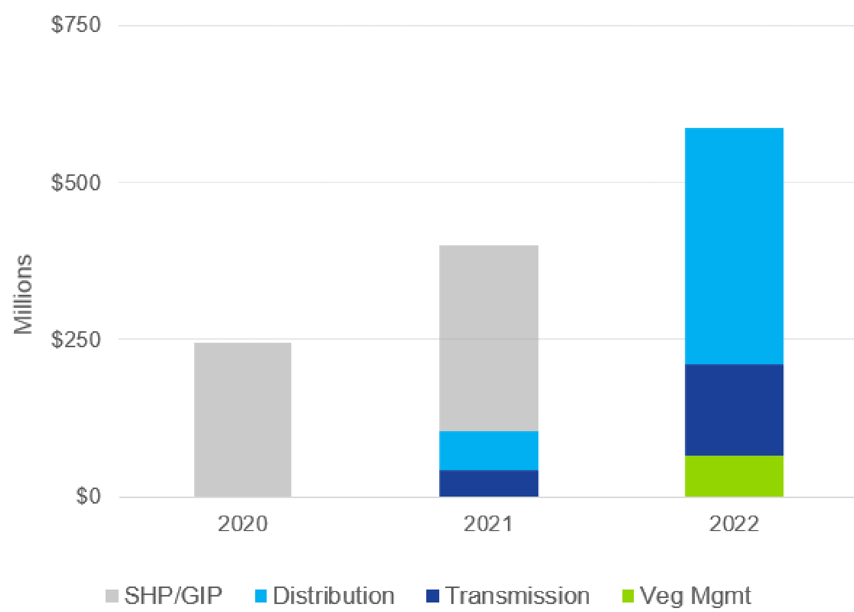
For 2020 and 2021, DEF has planned approximately $540 million in capital and O&M for storm hardening investments as part of its previously approved Storm Hardening Plan (SHP) and Grid Investment Plan (GIP) from the 2017 Settlement[8]. The amounts shown in Figure 1 include portions of the SHP and GIP programs that will become part of DEF's ongoing SPP. SPP will add approximately $100 million in incremental capital and O&M investment to these prior programs in 2021; in 2022, the first full year of SPP implementation, all investment shown is associated with SPP programs.

[8] Order No. PSC-2017-0451-AS-EU, issued November 20, 2017, in Docket No. 20170009-EI, In re: Application for limited proceeding to approve 2017 second revised and restated settlement agreement, including certain rate adjustments, by Duke Energy Florida, LLC.

3. Storm Protection Plan 3-Year Capital Plan

The following subsections provide a detailed program-level view of the first 3 years of the DEF SPP. A total of approximately $690 million in capital and O&M for SPP investments is estimated over the 3-year period, 2020 through 2022, as shown in Figure 2. This does not include the previously identified investment in 2020 and 2021 associated with the SHP/GIP.

Figure 2. SPP 3-Year Investment by Major Category



Source: Guidehouse, Inc.

Guidehouse used program definition details provided by DEF subject matter experts to define the program within its modeling and analysis approach. These details allowed the analysts to assess program costs, estimate benefits, and develop recommended program prioritization. A brief overview of program definitions is provided to facilitate understanding of the Guidehouse assessment teams' results.[9]

3.1 Distribution Programs

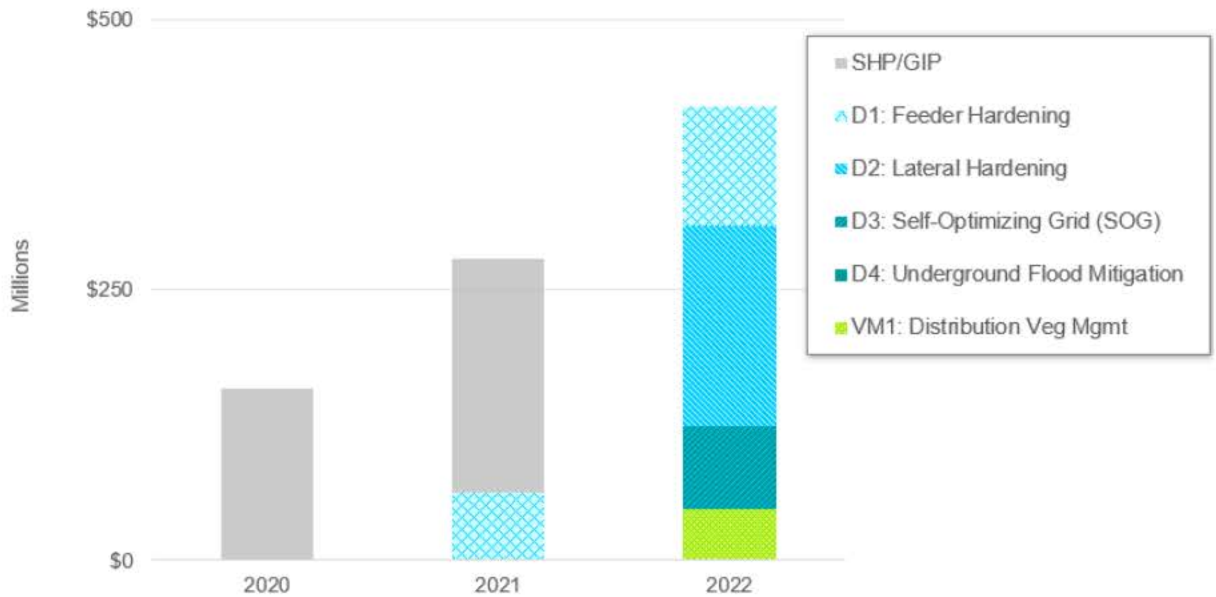
Distribution programs are proactive actions designed to upgrade the capabilities and resilience of distribution assets to reduce system and customer outages and susceptibility to extreme weather events. These actions can be generally categorized as one or more of the following:

- Accelerated replacement of prioritized infrastructure assets to lower the risk of in-service failures during extreme weather conditions.

[9] DEF will provide more complete definitions of each program in its filing materials; however, Appendix C defines the program characteristics that were captured specifically to facilitate the modeling and analysis activities presented in this report.

- Structure hardening to decrease susceptibility to extreme weather and wind damage to infrastructure through replacing and upgrading to current engineering standards, and relocation to more accessible locations for repair crews and undergrounding to avoid tree-related outages.
- Installation of automation technologies to improve system measurement, monitoring, and control and installation of alternate distribution line sources to provide system redundancy to reduce outages and improve operational efficiency.
- Proactive preventive and corrective maintenance programs to evaluate and mitigate asset deterioration to avoid in-service failures.

Figure 3. Distribution Programs Summary Spend by Year and Program



Source: Guidehouse, Inc.

Table 5. Distribution SPP Programs Investment for Years 1 to 3

Distribution SPP Programs	2020	2021	2022
D1: Feeder Hardening	-	$62.4 million	$111.4 million
D2: Lateral Hardening	-	-	$187.1 million
D3: Self-Optimizing Grid	-	-	$76.6 million
D4: Underground Flood Mitigation	-	-	$0.5 million
VM1: Distribution Vegetation Management	-	-	$45.8 million
SHP/GIP	$187.8 million	$237.2 million	-

Notes: *Amounts shown for each program reflect the capital investment and associated O&M spend required. Guidehouse's use of bottom-up modeling methodology may result in slight variations from reported budgeted spend amounts. Please see Appendix A for a description of Guidehouse's modeling methodology.*

Source: Guidehouse, Inc.

DEF anticipates a total of approximately $485 million in capital and O&M for SPP distribution investments (including distribution vegetation management) over the 3-year period, 2020 through 2022.

3.1.1 D1: Feeder Hardening

The Feeder Hardening program is a standards-based program that systematically upgrades the feeder backbone. This upgrade enables the feeder backbone to better withstand extreme weather events.

Work includes strengthening structures, updating basic insulation level to current standards, updating the conductor to current standards, relocating difficult-to-access facilities, and replacing oil-filled equipment. As part of this program, the poles supporting the feeder backbone line undergo strength testing, inspection. Poles showing signs of decay will be treated or replaced.

Table 6. Distribution Feeder Hardening Program (3-Year Plan)

D1: Feeder Hardening	2020	2021	2022
SPP Program Investment	**-**	**$62.4 million**	**$111.4 million**
Approx. No. of SPP Projects	**-**	**28**	**26**
Approx. No. of Line Miles	-	*63.3*	*89.5*
SHP/GIP Program Investment	$7.7 million	$7.5 million	-

Notes: *SHP/GIP Program Investments* reflect capital and O&M required for storm hardening investments that have been previously approved as part of DEF's Storm Hardening Plan (SHP) and/or Grid Investment Plan (GIP). The number of projects and number of units shown reflect SPP activity only. Guidehouse's prioritization methodology may result in variations from other reported estimated line miles and unit counts for future years. Please see Appendix A for a description of Guidehouse's modeling methodology.

Source: Guidehouse, Inc.

3.1.2 D2: Lateral Hardening

The Lateral Hardening standards-based program identifies lateral segments to be placed underground that are most prone to outages during extreme weather events. Relocating lateral segments underground greatly reduces both damage costs and outage durations for DEF customers.

The Lateral Undergrounding strategy focuses on branch lines that historically experience the most outage events, contain significantly aged assets, are susceptible to damage from vegetation, and often have facilities that are inaccessible to trucks. These branch lines will be replaced with a modern, updated, and standard underground design of today.

The Overhead Hardening strategy will include structure strengthening, deteriorated conductor replacement, removing open secondary wires, replacing fuses with automated line devices, pole replacement (when needed), line relocation, and hazard tree removal.

Lateral branch line poles also receive inspection and preventive maintenance to identify wood poles that are showing signs of decay or that fall below the minimum strength requirements.

Decayed poles with reduced structural integrity are identified for replacement or treated for pole life extension.

Table 7. Distribution Lateral Hardening Program (3-Year Plan)

D2: Lateral Hardening	2020	2021	2022
SPP Program Investment	**-**	**-**	**$187.3 million**
Approx. No. of SPP Projects	**-**	**-**	**143**
Approx. Underground Line Miles	-	-	*89.2*
Approx. Overhead of Line Miles	-	-	*91.9*
SHP/GIP Program Investment	$76.9 million	$104.0 million	-

Notes: *SHP/GIP Program Investments reflect capital and O&M required for storm hardening investments that have been previously approved as part of DEF's Storm Hardening Plan (SHP) and/or Grid Investment Plan (GIP). The number of projects and number of units shown reflect SPP activity only. Guidehouse's prioritization methodology may result in variations from other reported estimated line miles and unit counts for future years. Please see Appendix A for a description of Guidehouse's modeling methodology.*

Source: Guidehouse, Inc.

3.1.3 D3: Self-Optimizing Grid

The Self-Optimizing Grid (SOG) program consists of three major components: capacity, connectivity, and automation and intelligence. SOG is a standards-based program that redesigns portions of the distribution system into a dynamic smart-thinking, self-healing network. SOG equips the grid with an ability to automatically reroute power around trouble areas, such as contact between a fallen tree and a power line, to quickly restore power to the maximum number of customers and rapidly dispatch line crews directly to the source of the outage. Completion of the SOG program will result in an overall reduction of the duration of outages stemming from extreme weather events.

Table 8. Self-Optimizing Grid Program (3-Year Plan)

D3: Self-Optimizing Grid	2020	2021	2022
SPP Program Investment	**-**	**-**	**$76.6 million**
Approx. No. of SPP Projects	**-**	**-**	**346**
SHP/GIP Program Investment	$56.5 million	$81.3 million	-

Notes: *SHP/GIP Program Investments reflect capital and O&M required for storm hardening investments that have been previously approved as part of DEF's Storm Hardening Plan (SHP) and/or Grid Investment Plan (GIP). The number of projects and number of units shown reflect SPP activity only. Guidehouse's prioritization methodology may result in variations from other reported estimated line miles and unit counts for future years. Please see Appendix A for a description of Guidehouse's modeling methodology. The number of projects shown above represents the number of circuits impacted, not the number of automated devices.*

Source: Guidehouse, Inc.

3.1.4 D4: Underground Flood Mitigation

Underground Flood Mitigation is a targeted program which will harden existing underground lines and equipment to withstand a storm surge in flood prone areas. This involves the installation of specialized stainless-steel equipment and submersible connections. The primary purpose of this hardening activity is to minimize the damage caused by a storm surge to the equipment and thus expedite the restoration after the storm surge has receded.

Table 9. Underground Flood Mitigation (3-Year Plan)

D3: Underground Flood Mitigation	2020	2021	2022
SPP Program Investment	**-**	**-**	**$0.5 million**
Approx. No. of SPP Projects	**-**	**-**	**1**
SHP/GIP Program Investment	$0.3 million	-	-

Notes: *SHP/GIP Program Investments reflect capital and O&M required for storm hardening investments that have been previously approved as part of DEF's Storm Hardening Plan (SHP) and/or Grid Investment Plan (GIP). The number of projects and number of units shown reflect SPP activity only. Guidehouse's prioritization methodology may result in variations from other reported estimated line miles and unit counts for future years. Please see Appendix A for a description of Guidehouse's modeling methodology. The number of projects shown above represents the number of circuits impacted, not the number of units.*

Source: Guidehouse, Inc.

3.2 Transmission Programs

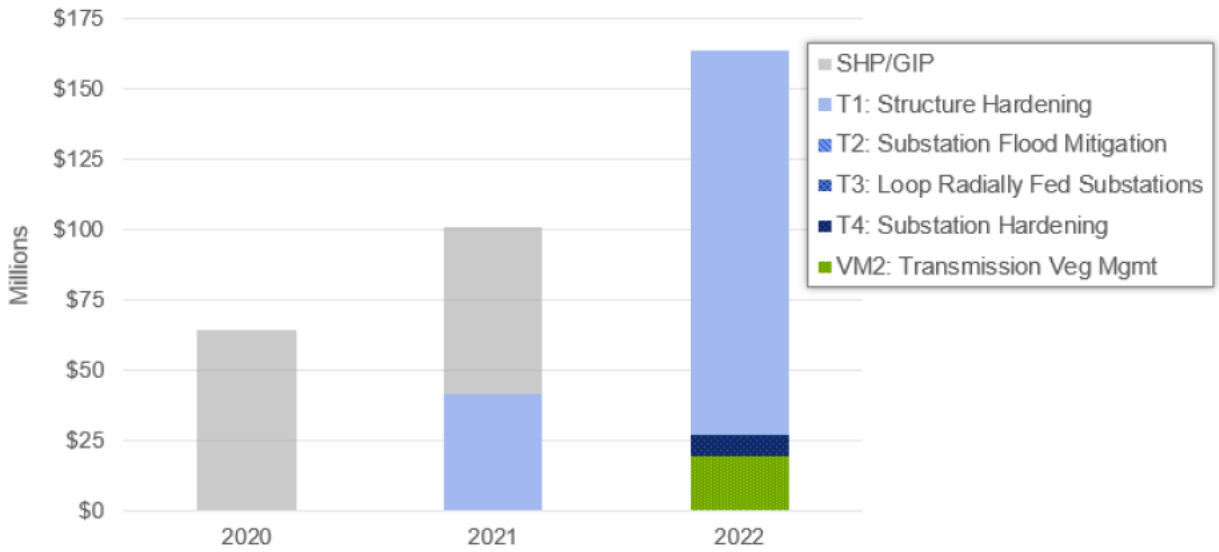
Transmission programs are designed to upgrade the capabilities and resilience of transmission assets to reduce system and customer outages and susceptibility to extreme weather events. These actions can be generally categorized as one or more of the following:

- Accelerated replacement of prioritized infrastructure assets to lower the risk of in-service failures during extreme weather conditions.
- Structure hardening to decrease susceptibility to extreme weather and wind damage to infrastructure through replacement and upgrading to current engineering standards.
- Installation of automation technologies to improve system measurement, monitoring, and control and installation of alternate transmission line sources to provide system redundancy to reduce outages and improve operational efficiency.
- Programmatic preventive and corrective maintenance programs to evaluate and mitigate asset deterioration to avoid in-service failures and capture detailed asset condition data. These comprehensive programs evaluate structures, foundations, insulators, conductor, and other hardware components. In cases where structures are difficult to access and/or more detailed inspection is required, fixed wing quadrotor drones are used.

Figure 4 shows a breakout of investment for the individual transmission programs.

Table 10 contains the specific investment dollars by year.

Figure 4. Transmission Programs Summary Spend by Year and Program



Source: Guidehouse, Inc.

Table 10. Transmission SPP Programs Investment for Years 1 to 3

Transmission SPP Programs	2020	2021	2022
T1: Structure Hardening	-	$41.4 million	$136.3 million
T2: Substation Flood Mitigation	-	-	-
T3: Loop Radially Fed Substations	-	-	-
T4: Substation Hardening	-	-	$7.5 million
VM2: Transmission Vegetation Management	-	-	$19.3 million
SHP/GHP	$54.8 million	$59.5 million	-

Notes: *Amounts shown for each program reflect the capital investment and associated O&M spend required. Guidehouse's use of bottom-up modeling methodology may result in slight variations from reported budgeted spend amounts. Please see Appendix A for a description of Guidehouse's modeling methodology.*

Source: Guidehouse, Inc.

DEF anticipates a total of approximately $205 million in SPP transmission investments (including transmission vegetation management) over the 3-year period, 2020 through 2022.

3.2.1 T1: Structure Hardening

Structure Hardening is a standards-based program that upgrades transmission wood pole H-frame structures with steel poles or other materials on overhead transmission lines. Where applicable, manual transmission gang-operated air-break (GOAB) switches are upgraded to supervisory control and data acquisition (SCADA) enabled GOAB switches.

Prioritized transmission towers are upgraded to the current design standard. Cathodic protection (CP) measures are applied as an effective method to control ongoing corrosion in the reinforced concrete structures supporting transmission towers.

On both types of structures, overhead transmission ground wires susceptible to damage or failure are upgraded to optical ground wire. Optical ground wires provide improved grounding and lightning protection as well as high-speed data transmission for system protection and control and communications.

Structure Hardening also includes several comprehensive programmatic structure inspections which capture condition data. Transmission system towers insulators, guying, anchoring, and foundations are ground inspected, and corrective maintenance activities are completed to correct deficiencies. Drone inspections are used to capture inspections data for structures in difficult to access areas and/ or instances where closer inspection is required to evaluate structure hardware condition.

Programmatic ground inspections identify transmission wood poles that are showing signs of decay or that fall below the minimum evaluation pole strength requirements. Insulators, conductors, guying, and other hardware is also inspected. Decayed poles with reduced structural integrity are identified for replacement or treated for pole life extension. If required, other corrective maintenance is completed, and decayed poles are identified for replacement.

Table 11 outlines the investments and scale of the Transmission Structure Hardening Program included in the SPP.

Table 11. Transmission Structure Hardening Program (3-Year Plan)

T1: Structure Hardening	2020	2021	2022
SPP Program Investment	**-**	**$41.4 million**	**$136.7 million**
Approx. No. of SPP Projects	**-**	**39**	**140**
Approx. No. of Poles Replaced	-	*645*	*1366*
Approx. No. of Towers Replaced	-	*19*	*9*
Miles of Overhead Ground Wire	-	-	*40.6*
SHP/GIP Program Investment	$37.3 million	$36.7 million	-

Notes: *SHP/GIP Program Investments reflect capital and O&M required for storm hardening investments that have been previously approved as part of DEF's Storm Hardening Plan (SHP) and/or Grid Investment Plan (GIP). The number of projects and number of units shown reflect SPP activity only. Guidehouse's prioritization methodology may result in variations from other reported estimated line miles and unit counts for future years. Please see Appendix A for a description of Guidehouse's modeling methodology. The number of projects shown above represents the number of lines impacted.*

Source: Guidehouse, Inc.

3.2.2 T2: Substation Flood Mitigation

Transmission Substation Flood Mitigation is a targeted program that evaluates flood mitigation measures for substations. New assets may include containment curbing, pumps, pits, walls, and total station rebuilds to increase elevation or other measures.

Guidehouse's SPP recommendation did not include any Substation Flood Mitigation projects during the initial three-year period of the plan. While this program provides adverse weather hardening benefits, this targeted program scope begins after year 3.

3.2.3 T3: Loop Radially Fed Substations

The Loop Radially Fed Substations targeted program evaluates radially fed substations fed from a single transmission line source. When the radial transmission line assets are damaged during extreme weather events, customers may experience long outages during repair activities because an alternate feed is not present. Enabling transmission system redundancy and the ability to serve customers from an alternate power source can eliminate or shorten long outage durations. Assets required within a substation may include breakers, switches, buss work, structures, insulators, potential transformers, relays, and control houses. A transmission tie line may also be required.

Guidehouse's SPP recommendation did not include any Loop Radially Fed substation projects during the initial three-year period of the plan. While this program provides adverse weather hardening benefits, this targeted program scope begins after year 3.

3.2.4 T4: Substation Hardening

Substation Hardening is a standards-based program that will address two major components. 1) Upgrading oil breakers to state-of-the-art gas or vacuum breakers to mitigate the risk of catastrophic failure and extended outages during extreme weather events. 2) Upgrading electromechanical relays to digital relays with advanced system protection functions and communications to enable Duke Energy Florida to respond and restore service more quickly from extreme weather events.

Table 12. Transmission Substation Hardening Program (3-Year Plan)

T4: Substation Hardening	2020	2021	2022
SPP Program Investment	**-**	**-**	**$7.5 million**
Approx. No. of SPP Projects	**-**	**-**	**17**
SHP/GIP Program Investment	$5.0 million	$5.5 million	-

Notes: *SHP/GIP Program Investments reflect capital and O&M required for storm hardening investments that have been previously approved as part of DEF's Storm Hardening Plan (SHP) and/or Grid Investment Plan (GIP). The number of projects and number of units shown reflect SPP activity only. Guidehouse's prioritization methodology may result in variations from other reported estimated line miles and unit counts for future years. Please see Appendix A for a description of Guidehouse's modeling methodology. The number of projects shown above represents the number of substations impacted.*

Source: Guidehouse, Inc.

3.3 Vegetation Management Programs

Vegetation Management is an essential, widely accepted baseline practice for storm hardening electric transmission and distribution systems against severe weather events. Vegetation management (that is, tree pruning, cutting, danger tree removal, mowing, and chemical control of undesirable vegetation) is combined with other severe weather event hardening measures as part of DEF's overall SPP for electric transmission and distribution line systems.

Severe weather events, including high winds, heavy rain, and coastal surges, can cause trees to uproot and branches to break; this debris falls or flies into power lines, causing damage. For transmission systems, the primary cause of tree-related damage is weakened trees outside the utility easement falling into conductors and creating damage. For distribution systems, which often cross heavily vegetated areas, the primary cause of power outages and asset damage is trees within or outside the utility easement. Fallen trees and branches also impede service restoration and emergency service response due to blocked roadways and streets.

3.3.1 VM1: Distribution Vegetation Management Program

The Distribution Vegetation Management enabling program includes tree trimming, tree removals within easement, and associated activities on the distribution system. Also included are danger and hazard tree removals on the distribution system outside of easement requiring landowner permission.

Table 13. Distribution Vegetation Management Program (3-Yr Plan)

VM1: Distribution Vegetation Management	2020	2021	2022
SPP Program Investment	-	-	$45.8 million
SHP/GIP Program Investment	$46.4 million	$44.5 million	-

Source: Guidehouse, Inc.

3.3.2 VM2: Transmission Vegetation Management

The Transmission Vegetation Management-enabling program applies tree trimming, tree removals within easements, and associated activities on the transmission system. The program also includes right-of-way danger and hazard tree removals outside of easements on the transmission system.

Table 14. Transmission Vegetation Management Program (3-Yr Plan)

VM2: Transmission Vegetation Management	2020	2021	2022
SPP Program Investment	-	-	$19.3 million
SHP/GIP Program Investment	$12.5 million	$17.2 million	-

Source: Guidehouse, Inc.

Appendix A. Storm Protection Plan Methodology

This appendix provides the key approaches, methods, and assumptions Guidehouse used to develop its analysis for the Duke Energy Florida (DEF) Storm Protection Plan (SPP) investment plan.

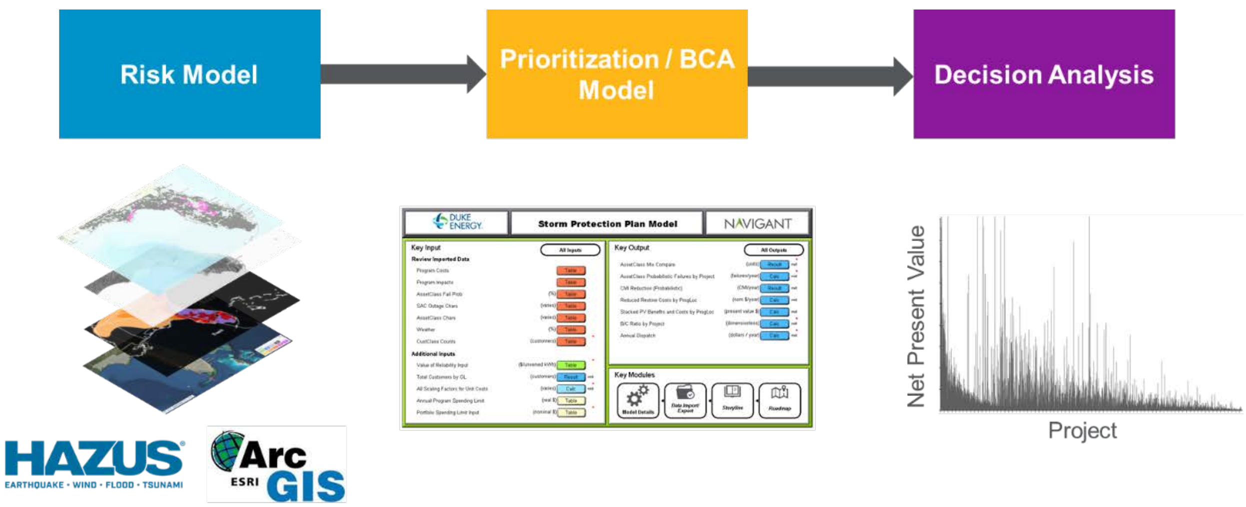
A.1 Overview of SPP Model

Guidehouse developed and employed a three-tiered modeling and analysis approach (referred to as the SPP model) to assess the effectiveness of proposed storm hardening programs and to inform the implementation prioritization process. The approach allowed the project team to simulate the deployment of these programs at every applicable location and under a range of weather conditions within the DEF service area. The following subsections describe the modeling approach and each of the three tiers of analysis (risk model, benefit-cost analysis, and decision analysis) incorporated into the SPP model to support the evaluation and prioritization of individual DEF SPP programs.

A.1.1 High Level Modeling Approach

Figure A-1 illustrates the data flow of program information through the three tiers of modeling and analysis.

Figure A-1. High Level Overview of DEF SPP Modeling Solution



Source: Guidehouse, Inc.

The first stage, the risk model, imports layers of data from the DEF GIS related to asset (e.g., asset type, age, condition), the latitudinal and longitudinal position of assets, and their relational configuration—that is, the way in which the assets interconnect. The risk modeling stage also imports probabilistic weather models to assess the risk exposure to grid assets in varying extreme weather conditions (storm surge, flooding, high winds). Each simulated location in the territory reflected DEF's asset mix at that location and the probability of experiencing a range of weather conditions. The output of the risk model stage characterizes the degree and associated cost of damage that would occur under a defined weather scenario.

The benefit-cost analysis (BCA) model analyzes the benefits and costs of each relevant combination of program and location. The model uses outputs from the risk model and other information to simulate the expected present value of costs and benefits associated with each program.

The decision analysis is a high-level prioritization of projects according to the BCA model's outputs. This high-level prioritization does not account for real-world constraints such as the availability of work crews, site-specific engineering considerations, and other prioritization factors.

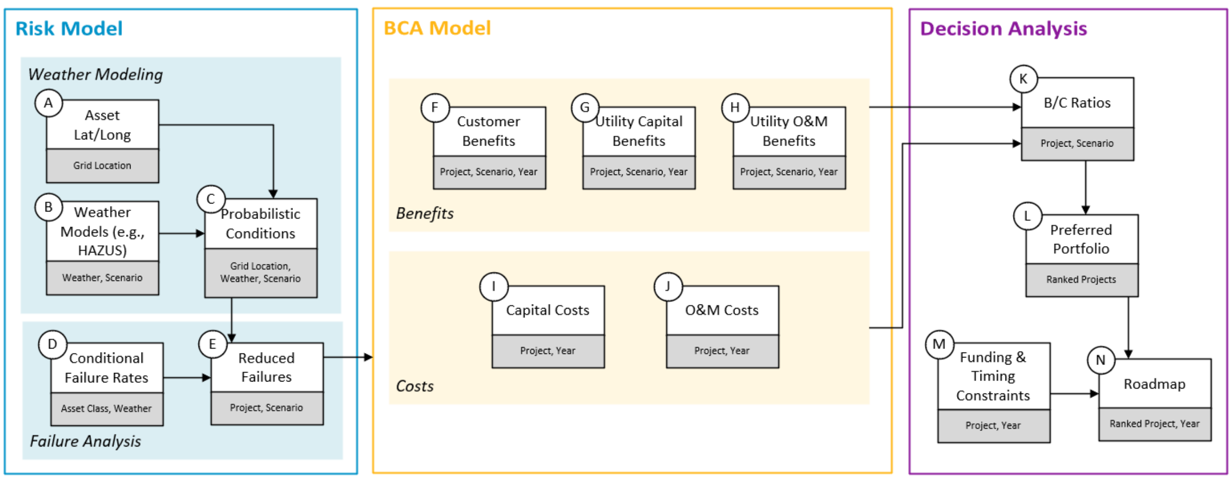
A.1.2 Detailed Modeling Approach

The SPP model characterizes individual transmission and distribution assets and storm hardening measures into broader categories, referred to as asset classes. Each program can then be defined based on the asset classes in place before and after the program is implemented. Programs are deployed at a locational level. Locations are defined as distribution circuits, transmission substations, and transmission lines. A project is one program deployed at a single location. The scope of the project depends on the number of assets present at the location.

Binning individual assets into asset classes is a practical method for estimating the value of each project without having to carry each individual asset (e.g., an individual utility pole) through the risk, BCA, and decision analysis modules. This method maintains the locational quantities of asset classes, the locational probability of weather conditions, and the relationship between customers and assets in the GIS.

The approach leverages a synthetic modeling technique to develop the portfolio of projects that are best suited to increase grid hardening and resiliency and to develop a high-level prioritized investment plan for project implementation. This solution is illustrated in Figure A-2, split by modules for risk, BCA, and decision analysis.

Figure A-2. Detailed Modeling Approach Flow Diagram



Source: Guidehouse, Inc.

The following sections summarize the concepts, logic, inputs, and outputs associated with each element of the flowchart in Figure A-2.

Risk Model

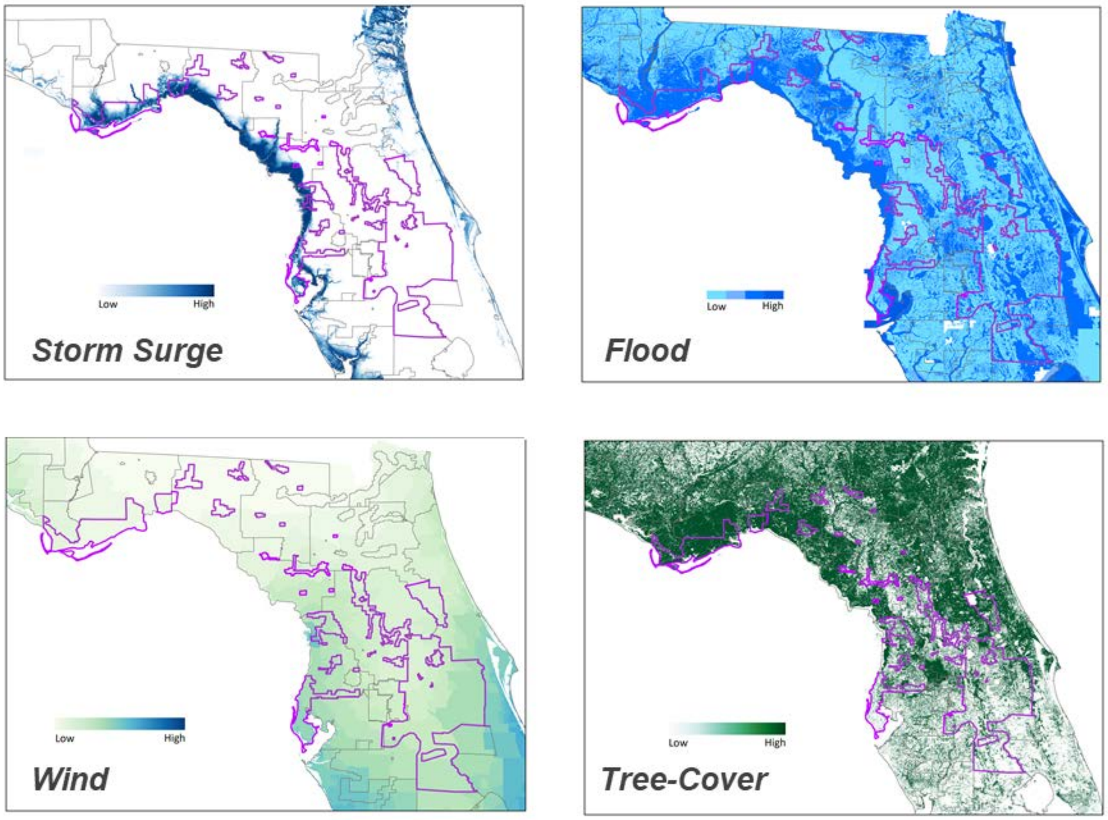
The primary purpose of the risk model is to estimate the expected frequency of asset failures under various weather conditions before and after the programs are implemented. The risk model is a bottom-up simulation of asset performance, calibrated to observed customer impacts and restoration costs in DEF territory. Components A through E from the risk model section in Figure A-2 are summarized as follows.

A	**Asset Lat/Long**	• Latitude and longitude of the asset (points), or latitude and longitude of vertices (line)
B	**Weather Models**	• Federal Emergency Management Agency (FEMA) and National Oceanic and Atmospheric Administration (NOAA) historic data and probability simulations of weather conditions (flood, storm surge, and wind speed) • FEMA HAZUS[10] model used for wind speed • FEMA SLOSH[11] model used for storm surge • NOAA and FEMA flood risk layers
C	**Probabilistic Conditions**	• Annual probability of occurrence for a given weather condition and location combination • Conditions are specific to each location
D	**Conditional Failure Rates**	• Probability of asset class failure when exposed to a given weather condition • Conditional failure rates applied to each location, thus picking up the location-specific probabilistic conditions in C
E	**Reduced Failures**	• Reduction in probability of asset class failure when a measure/program is applied • Dependent on the probabilistic conditions (weather) in C • Reduced outage time as well as equipment failure counts allow the value to reducing either or both to be incorporated into the BCA

Guidehouse simulated the weather conditions in the model through detailed environmental GIS data streams (Figure A-3).

[10] FEMA's Hazards US – Multi-Hazard (HAZUS) Model; https://msc.fema.gov/portal/resources/download
[11] FEMA's The Sea, Lake and Overland Surges from Hurricanes (SLOSH) Model; https://slosh.nws.noaa.gov/slosh/

Figure A-3. Environmental GIS Layers

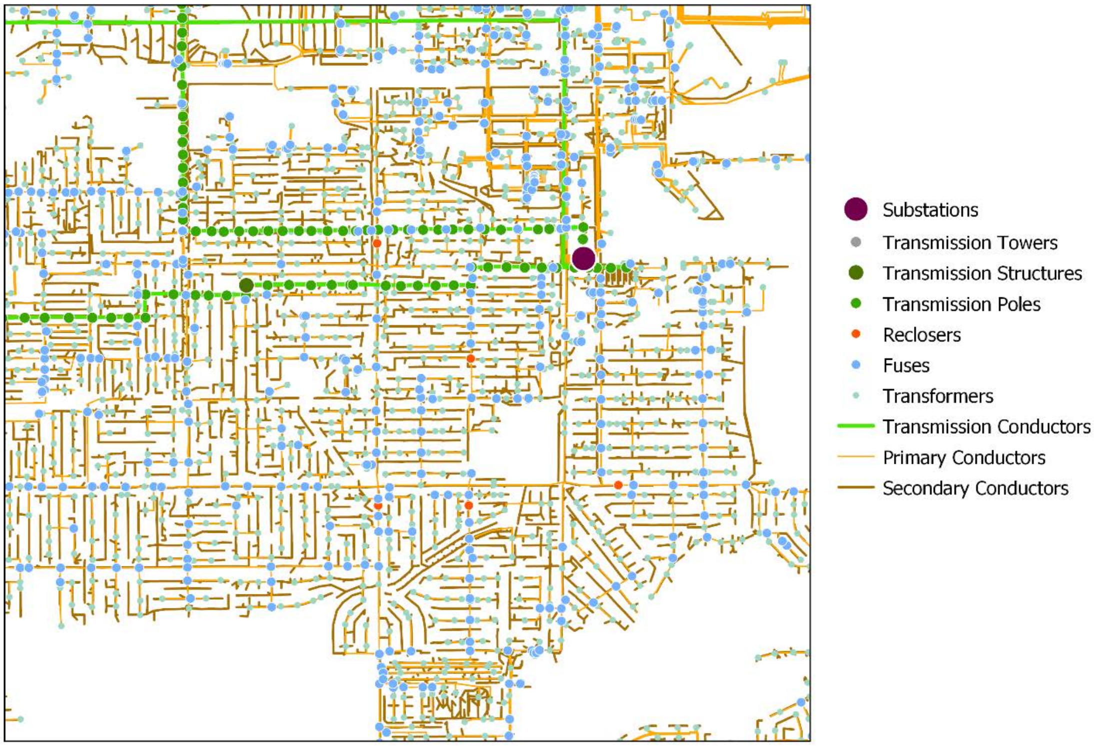


Source: HAZUS-MH, SLOSH, USGS, NOAA, Ventyx Energy Velocity

Guidehouse synthesized various data streams from the US Geological Survey (USGS), FEMA, and NOAA, including HAZUS simulations on storm surge and wind speeds, tree cover, and flood plains (Figure A-3), into a GIS. When formatted and regularized, the project team used these layers to generate probabilistic future conditions in DEF territory. Each combination of an asset location and weather scenario has an expected annual frequency of flooding, storm surge, and high wind conditions.

The impact of a program can then be estimated given the location-specific weather condition modeling and the mix of assets deployed. The asset mix is determined from DEF GIS and asset management system data (Figure A-4).

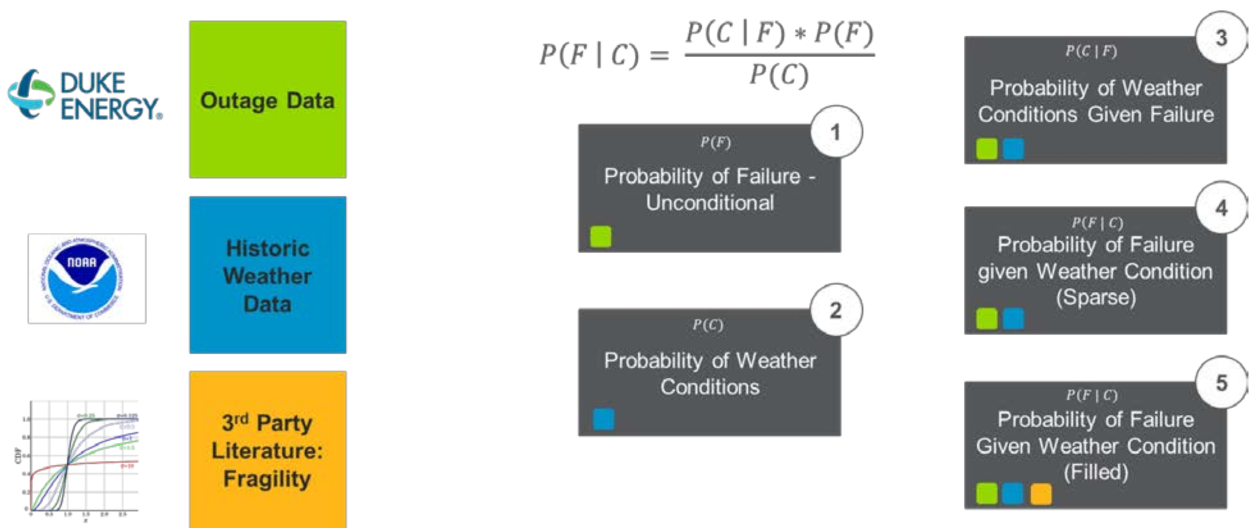
Figure A-4. Partial Illustration of GIS Asset Data



Source: Guidehouse, Inc., Duke Energy Florida

Guidehouse performed conditional failure analysis using historic DEF outage data, DEF asset data, and NOAA weather data. Each outage event was matched to historic data from the nearest weather station to the outage and the time of the outage. Figure A-5 illustrates the process for developing the probability of failure given weather conditions.

Figure A-5. Conditional Failure Analysis Approach



Source: Guidehouse, Inc.

The project team used five steps to derive conditional failure rates by asset class:

1. Count the total number of outages for each asset class divided by the total number of assets in each class, adjusted for the average event time, as described in Appendix B.
2. Count the frequency of each weather condition as recorded at each location.
3. Using data from local weather stations, match the conditions observed at each location to each outage.
4. Using conditional probability statistics, calculate the probability of failure (step 1) given the weather condition (step 2), and the condition probability (step 3).
5. Fill in any gaps (conditions not observed for a location and asset class combination) using fragility analysis literature.[12]

BCA Model

The BCA model is a tool used to calculate annual cash flows of each value stream relevant to the BCA. The model aggregates information and data from multiple sources and calculates results under different weather scenarios. Guidehouse assessed costs and benefits over a 30-year period for distribution programs and a 40-year period for transmission programs.

One of the core benefits assessed in the BCA model is customer outage benefits. This benefit is calculated based on the customer value of electricity (in terms of $/unserved kWh). The customer value of electricity varies based on the length of the outage and customer class.[13] The other benefits include utility capital and operations and maintenance (O&M) benefits associated with a hardened grid that experiences less asset failures relative to the conditions before the program implementation. The project team estimated the costs of program implementation on a location level based on the number of units deployed. The unit costs were developed by DEF and account for labor, material, indirect costs, staging and logistics, and contingency.

Referring back to Figure A-2, components F through J from the BCA model section are summarized below.

F	**Customer Benefits**	• Quantify reduction in outage time and associated downstream load by customer class. • Value of avoided outages is based on the value of an unserved kWh, which depends on the type of customer and the length of the outage. • The ICE calculator typically applies to outage times less than or equal to 16 hours. For outage times greater than 16 hours, Guidehouse applied the 16-hour outage values as a simplifying assumption.

[12] Panteli, Mathaios, et al. "Power system resilience to extreme weather: fragility modeling, probabilistic impact assessment, and adaptation measures." *IEEE Transactions on Power Systems* 32.5 (2016): 3747-3757.; Guikema, Seth, and Roshanak Nateghi. "Modeling power outage risk from natural hazards." *Oxford Research Encyclopedia of Natural Hazard Science*. 2018.

[13] The Interruption Cost Estimate (ICE) Calculator is an electric reliability planning tool developed by Lawrence Berkeley National Laboratory and Nexant, Inc. Available at https://icecalculator.com/home.

G	**Utility Capital Benefits**	• Calculated based on the reduced asset failures and the capital cost to replace those assets. • Value of deferring future capital replacement of existing assets by replacing them before the end of their expected useful lifetime with hardened equipment.
H	**Utility O&M Benefits**	• Calculated based on the reduction in O&M restoration costs associated with the reduction in asset failures.
I	**Capital Costs**	• The capital costs required to deploy the programs.
J	**O&M Costs**	• The O&M costs required to deploy the programs.

Decision Analysis

In the decision analysis portion of the model, the project-level BCA results were used to determine the prioritization and deployment plan for the programs. Thus, any prioritization shown in this report is driven only by the project BCA results; they do not include many crucial factors for project implementation. Guidehouse's analysis in this report does not consider other important factors that should be considered in program implementation that were outside the scope of this study, such as technology and regulatory risk, broader community benefits, customer inconvenience, viewshed, customer engagement, and local engineering expertise. This may mean that the actual implementation may differ from the BCA-based prioritization presented in this report.

Components K through N from the decision analysis section of Figure A-2 are summarized below.

K	**B/C Ratio**	• The costs and benefits of each project and scenario over the analysis period are converted into present values using discount rates for each cost test. Net present values and benefit-cost (B/C) ratios are then calculated for each project and scenario. • The B/C ratios are based on a theoretical deployment of the solution starting in the first year of the analysis period.
L	**Preferred Portfolio**	• Using the B/C ratios, the project team ranked each project from most preferred to least preferred. • Interactive effects were accounted for by counting the benefits of a program after other interacting programs' impact (e.g., self-optimizing grid impacts were estimated after feeder hardening). This ensured that program benefits were not double counted.
M	**Funding & Timing Constraints**	• Guidehouse applied program- and portfolio-level funding constraints, which DEF provided. These represent practical limits on program implementation.
N	**Roadmap**	• Projects were deployed algorithmically according to the ranking in step L and the constraints in step M. Annual program deployment analysis was guided by practical limitations on achievable implementation provided by the DEF project team and subject matter experts.

Appendix B. Weather Scenario Modeling

Guidehouse's model uses a detailed GIS representation of the Duke Energy Florida (DEF) service area to increase the accuracy and precision of the risk model and the benefit-cost analysis (BCA). This service area-specific GIS representation allows for simulated weather conditions and exposure probabilities to vary significantly depending on the latitude and longitude of each specific asset. The project team developed three weather scenarios (Average, Above Average, Increased Storm Frequency), with each weather scenario designed as discrete, consistent, representative outlooks on storm frequency and intensity applied at each asset location across the DEF service area throughout the planning horizon.

To illustrate the team's methodology surrounding weather scenario development, Guidehouse built the tables below from total probabilities of storm events (tropical storm, Category 1 hurricane, Category 2 hurricane, etc.) across Florida, as informed by the Hurricane Research Division of the National Oceanic and Atmospheric Administration (NOAA) Atlantic basin hurricane database. While the tables illustrate the methodology applied across the entire state, in the GIS model, weather conditions were simulated at a detailed location level (latitude/longitude) before being applied to the BCA.

Saffir-Simpson Scale	
Category	**Wind Speed (mph)**
Blue Sky	0 – 40
Tropical Storm	40 – 74
Category 1	74 – 96
Category 2	96 – 111
Category 3	111 - 130
Category 4	130 - 157
Category 5	157+

B.1 Scenario 1 – Average Storm Frequency

The average storm frequency scenario is defined by average conditions experienced in DEF territory: the frequency is the total number of events over all years, divided by the number of years. This is the annual average likelihood of each storm category to strike West Central Florida based on 1851-2018 NOAA data. The severity classes of events are based on the Saffir-Simpson scale (see above table) with the probability representing the likelihood that a windspeed event of at least that magnitude will occur in any given year. It is common to refer to a hurricane by the highest point on the Saffir-Simpson scale that it achieves, although the actual windspeeds at any given location affected by the hurricane will tend to be lower. As hurricanes achieve landfall and move inland, windspeeds typically decrease. These factors are accounted for in the detailed locational probabilities in the Guidehouse model.

To compute these numbers, Guidehouse first estimated the average duration of a storm event as approximately 22 hours using the historical NOAA data. The team then calculated the number of hours experienced historically in each range of wind speeds for all of DEF's territory, being careful to account for multiple station measurements in the same period. The probabilities below are relative to observed wind speed. The maximum windspeed present during a given 22-hour window was then used to assign those 22 hours to a severity class.

By summing the hours in each severity class and annualizing, the project team can obtain the probabilities $P_{S,22}$ of any given 22-hour event over the year belonging to severity class S. The team can then apply the following survival equation to compute the probability that no storm of that severity class occurs for the entire year:

$$P_{no\ S,year} = (1 - P_{S,22})^{\left(\frac{8760}{22}\right)}$$

The probability that a storm of severity S does occur during any given year is $1 - P_{no\ S,year}$, producing the table below. Note that this is different than the expected frequency of events per year, which is a function of $P_{S,22}$.

Scenario 1

Blue Sky	Tropical Storm	Category 1	Category 2	Category 3	Category 4	Category 5
100.00%	98.92%	76.09%	40.77%	21.46%	6.62%	0.36%

Source: Guidehouse, Inc.

B.2 Scenario 2 – Above Average Storm Frequency

Above average storm frequency is defined by increasing the annual likelihood of storm strike by 10%. That is to say, the overall likelihood of storms increases by a factor of 0.1. Note that $P_{Blue\ Sky,22}$ is also reduced slightly, but the effect is negligible on the likelihood of getting a blue sky day in the year.

Scenario 2

Blue Sky	Tropical Storm	Category 1	Category 2	Category 3	Category 4	Category 5
100.00%	99.32%	79.28%	43.79%	23.33%	7.25%	0.39%

Source: Guidehouse, Inc.

B.3 Scenario 3 – Increased Storm Frequency

The increased storm frequency scenario is defined by increasing the annual likelihood of a storm event by 25% relative to the base scenario. Again, the effect on blue sky is negligible—there is still a nearly 100% chance (out to more than eight decimal places) to experience a 22-hour blue sky event.

Scenario 3

Blue Sky	Tropical Storm	Category 1	Category 2	Category 3	Category 4	Category 5
100.00%	99.65%	83.29%	48.04%	26.06%	8.20%	0.45%

Source: Guidehouse, Inc.

Appendix C. SPP Programs Descriptions for Modeling

This section describes the transmission, distribution and vegetation management programs evaluated in the Storm Protection Plan (SPP) model. Each description includes the following elements:

- **Program description:** Programs descriptions provide a general overview of the severe weather hardening actions and associated assets considered for model evaluation.
- **Extreme weather benefits:** Extreme weather benefits provide an overview of how each program provides benefits for outage prevention, system hardening, and outage reduction.
- **Program elements:** Program elements are the specific modeled assets added to or upgraded within each program that will provide severe weather storm hardening benefits.

Guidehouse developed these descriptions to facilitate the modeling and analysis activities. More complete program descriptions are provided by DEF.

C.1 D1: Feeder Hardening Program

C.1.1 Feeder Hardening (Overhead)

Description	The Feeder Hardening program is a standards-based program that systematically upgrades the feeder backbone. This upgrade enables the feeder backbone to better withstand extreme weather events. Work includes strengthening structures, updating basic insulation level to current standards, updating the conductor to current standards, relocating difficult-to-access facilities, and replacing oil-filled equipment. Feeder backbone line poles also receive preventive maintenance and undergo inspection to identify wood poles showing signs of decay or identify those falling below minimum strength requirements.
Extreme Weather Benefit	**Outage prevention**. Upgrading assets lowers the risk of in-service failure during extreme weather conditions. **System hardening.** Replacing or upgrading infrastructure to make it less susceptible to extreme weather and wind damage.
Elements	Rebuilds existing primary backbone non-hardened circuit assets with new upgraded construction. This project type includes upgrading assets: poles - Class 2 or greater, overhead conductor -- larger than 1/0, reclosers – self-healing, and overhead transformers – conventional.

C.1.2 Feeder Wood Pole Replacement and Treatment

Description	The Feeder Wood Pole Inspection and Treatment enabling activities are an inspection and preventive maintenance activity to determine if wood poles are showing signs of decay or if they fall below the minimum strength requirements. Poles with decay determined to be State 5 (Priority 1 - Replace immediately) or State 4 (Priority 2 - Replace as soon as practicable) are scheduled for replacement. Poles with minor deterioration (State 3) or deemed still serviceable (States 3, 2) may receive treatment to extend life of the pole.
Extreme Weather Benefit	**Outage prevention.** Identifying decayed poles more vulnerable to storm or severe weather damage and targeting them for strengthening measures, replacement, or treatment. Extreme weather benefits are not modeled for enabling activities.
Elements	Identifies decayed poles to be replaced or poles to be treated to extend the life of the pole.

C.2 D2: Lateral Hardening Program

C.2.1 Lateral Hardening (Underground)

Description	Lateral Hardening Undergrounding standards-based activity focuses on branch lines that historically experience the most outage events, contain significantly aged assets, are susceptible to damage from vegetation, and often have facilities that are inaccessible to trucks. These branch lines will be replaced with a modern, updated, and standard underground design of today.
Extreme Weather Benefit	**Outage prevention.** Reducing likelihood of outages caused by vegetation impacts during extreme weather **System hardening.** Replacing or upgrading infrastructure to make it less susceptible to extreme weather and wind damage.
Elements	Replaces existing primary overhead branch line segments with new relocated underground line segments. All overhead assets are removed and replaced with underground distribution transformers, underground primary and secondary conductors, and a new overhead distribution fused riser pole is installed.

C.2.2 Lateral Hardening (Overhead)

Description	The Lateral Hardening Overhead standards-based activity identifies lateral segments to be placed underground that are most prone to outages during extreme weather events. Doing so will greatly reduce both damage costs and outage durations for DEF customers.
Extreme Weather Benefit	**Outage prevention.** Reducing outage frequency by moving the line to the front of the premise from the back, thus avoiding exposure to vegetation in high winds. This activity reduces outage duration by making the line more accessible to crews. **System hardening.** Replacing or upgrading infrastructure to make it less susceptible to extreme weather and wind damage.
Elements	Upgrades existing non-hardened primary branch lateral distribution overhead primary circuits with extreme wind load standard construction and other associated asset upgrades. This includes upgrading assets: poles - Class 2 or greater, overhead primary conductor – 1/0 or greater, overhead service – triplex, reclosers – self-healing, fuses – trip savers, and overhead transformers – conventional.

C.2.3 Lateral Wood Pole Inspection and Treatment

Description	The Lateral Wood Pole Inspection and Treatment enabling activity is an inspection and preventive maintenance activity to determine if wood poles are showing signs of decay or fall below the minimum strength requirements. Poles with reduced strength determined to be State 5 (Priority 1 - Replace immediately) or State 4 (Priority 2 - Replace as soon as practicable) are identified for replacement. Poles with minor deterioration (State 3) or deemed still serviceable (States 3, 2) may receive treatment to extend life of the pole.
Extreme Weather Benefit	**Outage prevention.** Identifying poles more vulnerable to storm or severe weather damage and targets them for strengthening/uplift measures, replacement, or treatment. Extreme weather benefits are not modeled for enabling activities.
Elements	Identifies decayed poles to be replaced or poles to be treated to extend the life of the pole.

C.3 D3: Self-Optimizing Grid Program

Description	The SOG program consists of three major components: capacity, connectivity, and automation and intelligence. The self-optimizing grid standards-based program redesigns portions of the distribution system into a dynamic smart-thinking, self-healing network. The grid will have the ability to automatically reroute power around trouble areas, like a tree on a power line, to quickly restore power to the maximum number of customers and rapidly dispatch line crews directly to the source of the outage. The benefit from completing this program is fewer customers affected by long duration outages as a result of extreme weather events.
Extreme Weather Benefit	**Outage reduction.** Adding the ability to reroute power during severe weather events reduces outage duration, frequency, and number of customers affected.
Elements	Adds one overhead self-healing recloser per approximately every 400 customers on primary overhead backbone circuits.

C.4 D4: Underground Flood Mitigation Program

Description	Within flood prone areas, Underground Flood Mitigation is a targeted program which will harden existing underground lines and equipment to withstand a storm surge through the use of the current Duke Energy Florida storm surge standards. This involves the installation of specialized stainless-steel equipment and submersible connections. The primary purpose of this hardening activity is to minimize the damage caused by a storm surge to the equipment and thus expedite the restoration after the storm surge has receded.
Extreme Weather Benefit	**Outage prevention.** Limiting equipment failures due to flood intrusion. **System hardening.** Replacing or upgrading infrastructure to make it less susceptible to extreme weather and wind damage.
Elements	Upgrades existing non-submersible underground distribution assets with new submersible underground assets and applies other flood proofing measures such as sealing ducts and equipment enclosures.

C.5 T1: Structure Hardening Program

C.5.1 Wood Pole Replacement

Description	The Wood Pole standards-based activity prioritizes replacing transmission wood pole H-frame structures with steel poles or other materials on transmission lines. Where applicable, the program targets replacing manual transmission gang-operated air-break (GOAB) switches with supervisory control and data acquisition (SCADA)-enabled GOAB switches.
Extreme Weather Benefit	**Outage prevention.** Providing for the acceleration of the replacement of wood poles, which lowers the risk of pole failure-related outages. **System hardening.** Replacing or upgrading infrastructure to make it less susceptible to extreme weather and wind damage. **Outage reduction.** Sensing voltage and current and enabling SCADA operators or master system software to perform remote switching. This capability eliminates the need to operate the devices locally from the control cabinet, as well as automatic sectionalizing operations. Compared to manual switching, remote switching can significantly reduce outage durations times.
Elements	• On transmission lines, replaces existing prioritized transmission wood pole H-frame structures with new steel poles or other materials • Upgrades existing manual GOAB switches with SCADA-enabled GOAB switches.

C.5.2 Structure Inspections

Description	Structure Inspections are an enabling activity providing programmatic inspection and corrective maintenance activities on overhead transmission steel towers and transmission wood poles. Through inspections, defective towers and poles are identified. Transmission system tower insulators, guying, anchoring, and foundations are ground inspected and corrective maintenance activities are completed to correct deficiencies. Programmatic ground inspections are performed to identify transmission wood poles that are showing signs of decay or fall below the minimum pole strength requirements. Conductors, insulators, and guying are also evaluated. If required, corrective maintenance is completed, and decayed defective poles are identified for replacement.
Extreme Weather Benefit	**Outage prevention.** Proactively evaluating tower and pole for deterioration, which lowers the risk of in-service failure during extreme weather conditions. Extreme weather benefits are not modeled for enabling programs.
Elements	Inspects towers, guying, and foundations; completes corrective maintenance; and identifies defective towers and poles for replacement.

C.5.3 Tower Replacements

Description	The Tower Replacements standards-based activity upgrades prioritized transmission towers to the current severe weather design. Cathodic protection (CP) measures are applied as an effective method to control ongoing corrosion in the reinforced concrete structures supporting transmission towers.
Extreme Weather Benefit	**Outage prevention.** Replacing prioritized steel, wood/steel towers with a new CP steel tower lowers the risk of in-service failure during extreme weather conditions. **System hardening.** Replacing or upgrading infrastructure to make it less susceptible to extreme weather and wind damage.
Elements	• Replacement of existing prioritized transmission towers with a new steel transmission tower • Installation of CP on upgraded transmission tower footers for ongoing corrosion control.

C.5.4 Tower Drone Inspections

Description	The Tower Drone enabling activity uses drones to capture inspections data for structures in difficult to access areas and/ or instances where closer inspection is required to evaluate structure hardware condition.
Extreme Weather Benefit	**Outage prevention.** Proactively evaluating towers for deterioration lowers the risk of in-service failure during extreme weather conditions. Extreme weather benefits are not modeled for enabling programs.
Elements	Provides detailed inspection and data collection of towers and associated hardware.

C.5.5 Overhead Ground Wires

Description	The Overhead Ground Wires standards-based activity targets replacement of transmission overhead ground wire susceptible to damage or failure with optical ground wire (OPGW). OPGW improves grounding and lightning protection and provides high speed transmission of data for system protection and control and communications.
Extreme Weather Benefit	**Outage prevention.** Lowering the risk of overhead ground wire in-service failure during extreme weather conditions due to lightning damage or mechanical failure. **System hardening.** Providing redundant sources of fiber optic communications for system protection and control.
Elements	Upgrades existing overhead ground wire with overhead OPGW.

C.6 T2: Substation Flood Mitigation Program

Description	The Substation Flood Mitigation targeted program evaluates substations for the application of flood mitigation measures. New assets may include containment curbing, pumps, pits, walls, and total station rebuilds to increase elevation or other measures.
Extreme Weather Benefit	**Outage prevention.** Reducing risk of prolonged outages caused by flooding. **System hardening.** Replacing or upgrading infrastructure to make it less susceptible to water intrusion and extreme weather conditions.
Elements	Removes existing non-flood mitigated substations and upgrades with flood mitigation substations (flood mitigation applied to existing non-flood mitigated substations).

C.7 T3: Loop Radially Fed Substations Program

Description	The Loop Radially Fed Substations targeted program evaluates radially fed substations that are fed from a single transmission line source. When the radial transmission line assets are damaged during extreme weather events, long customer outages may be experienced during repair activities because an alternate transmission feed is not present. Enabling transmission system redundancy and the ability to serve customers from an alternate power source can eliminate or shorten long outage durations. Assets required within a substation may include breakers, switches, buss work, structures, insulators, potential transformers, relays, and control houses. A transmission tie line may also be required.
Extreme Weather Benefit	**Outage reduction**. Enabling substation and customer load to be fed from an alternate source while repairs to damaged line segments are completed.
Elements	Adds new circuit segment (line tie) and required substation modifications/equipment and controls to an existing radially fed substation.

C.8 T4: Substation Hardening Program

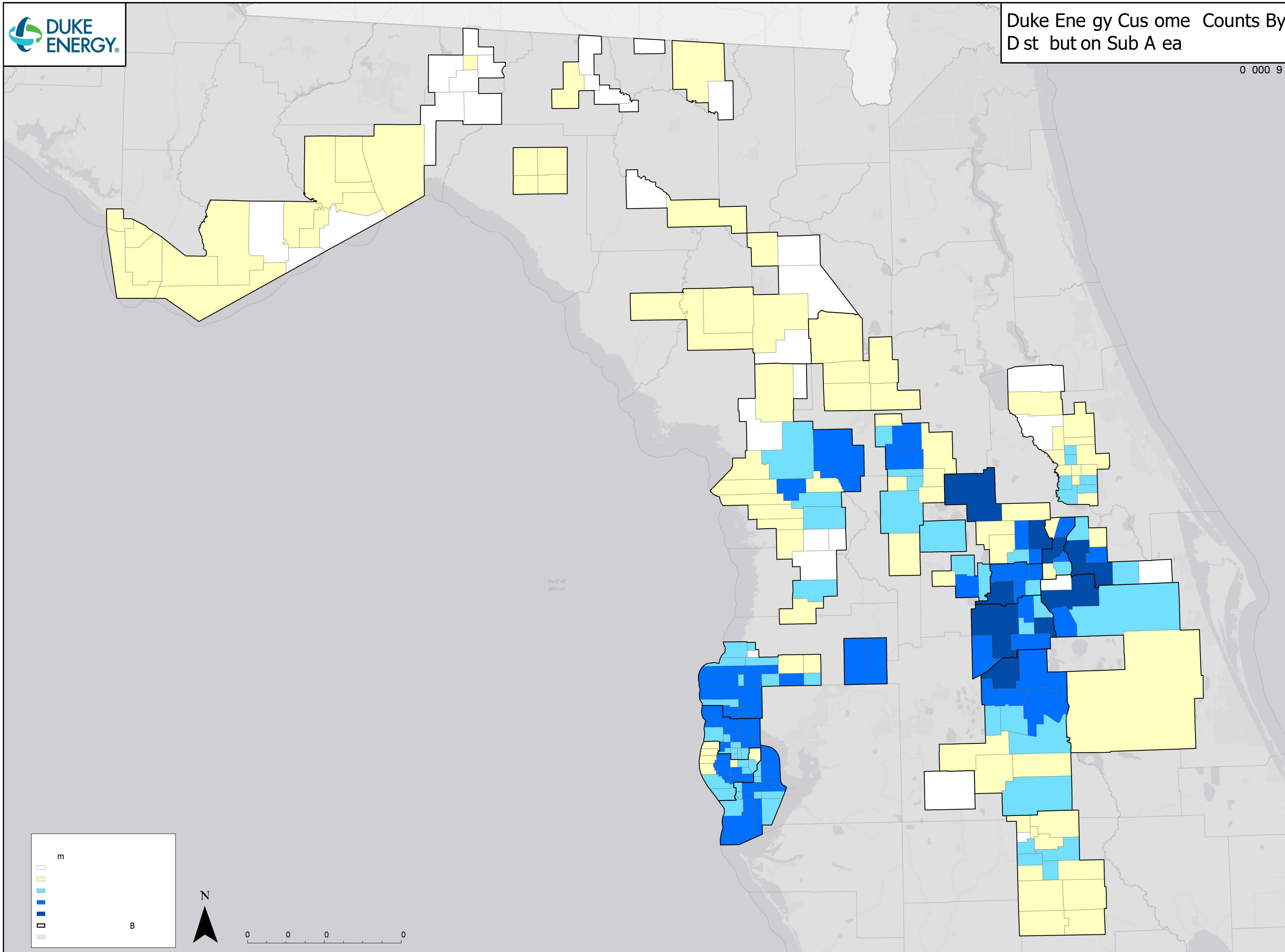
Description	Substation Hardening is a standards-based program that will address two major components. 1) Upgrading oil breakers to state-of-the-art gas or vacuum breakers to mitigate the risk of catastrophic failure and extended outages during extreme weather events. 2) Upgrading electromechanical relays to digital relays with advanced system protection functions and communications to enable Duke Energy Florida to respond and restore service more quickly from extreme weather events.
Extreme Weather Benefit	**Outage reduction.** Reducing risk of in-service failures of breakers and relays during extreme weather conditions. Enabling more rapid identification and location of faults on transmission lines. **Outage prevention.** Supporting prompt and accurate diagnosis of grid events and operations to prevent recurrence.
Elements	Removes existing electromechanical relays and oil-filled substation breakers and upgrades with programmable electronic relays and gas-filled substation breakers.

C.9 VM1: Distribution VM Program

Description	The Distribution Vegetation Management enabling program includes tree trimming, tree removals within easement, and associated activities on the distribution system. Also included are danger and hazard tree removals on the distribution system outside of easement requiring landowner permission.
Extreme Weather Benefit	**Outage prevention.** Removal of vegetation likely to interfere with system operation during extreme weather reduces the likelihood of outages.
Elements	Application of cycle trimming, removal, demand trimming, herbicide, and hazard tree removal.

C.10 VM2: Transmission VM Program

Description	The Transmission Vegetation Management enabling program includes tree trimming, tree removals within easement, associated activities on the transmission line as well as right-of-way danger and hazard tree removals outside of easement on the transmission system.
Extreme Weather Benefit	**Outage prevention.** Removal of vegetation likely to interfere with system operation during extreme weather reduces the likelihood of outages.
Elements	Application of cycle trimming, removal, row mowing, herbicide, and hazard tree removal.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