2021 WMP Update Workshop

Grid Design and System Hardening:
Inspections, Mitigation Choices and Emerging Technologies

February 23, 2021

Overall Distribution Risk by HFTD Tier

Overall risk can be considered a combination of the probability of a risk event and the impact of a potential ignition. Overhead exposure provides context for risk event frequency.

Probability of ignition:

	Risk Events		Ignitions		Ignition Rate	
Location	5-year Avg.	2020	5-year Avg.	2020	5-year Avg.	2020
Non-HFTD	630	607	9	6	1.46%	0.99%
Tier 2	213	217	7	7	3.37%	3.23%
Tier 3	197	188	5	10	2.74%	5.32%
System	**1041**	**1012**	**22**	**23**	**2.09%**	**2.27%**
HFTD (Tier 2 + Tier 3)	**411**	**405**	**13**	**17**	**3.07%**	**4.20%**

Impact of ignition:

Location	Consequence of Ignition by Tier*
Tier 3	61%
Tier 2	37%
Non-HFTD	2%

**The overall risk score that is being used in WMP and RAMP*

Exposure:

Location	Total OH (miles)	Harden (miles)	**Total OH Exposure** Unhardened (miles)
Tier 3	1648	531	1117
Tier 2	1818	346	1472
Non-HFTD	2984	71	2913
System	**6450**	**948**	**5502**
HFTD (Tier 2 + Tier 3)	**3466**	**877**	**2589**

Top 10 HFTD Distribution Risk Drivers

- Average ignitions represent the potential ignitions per year, per driver, based upon historical frequency of risk events and ignition rate
- Top 10 risk drivers make up 85% of ignition risk in the HFTD
- Greater understanding of HFTD ignition risk is utilized to prioritize wildfire mitigation programs

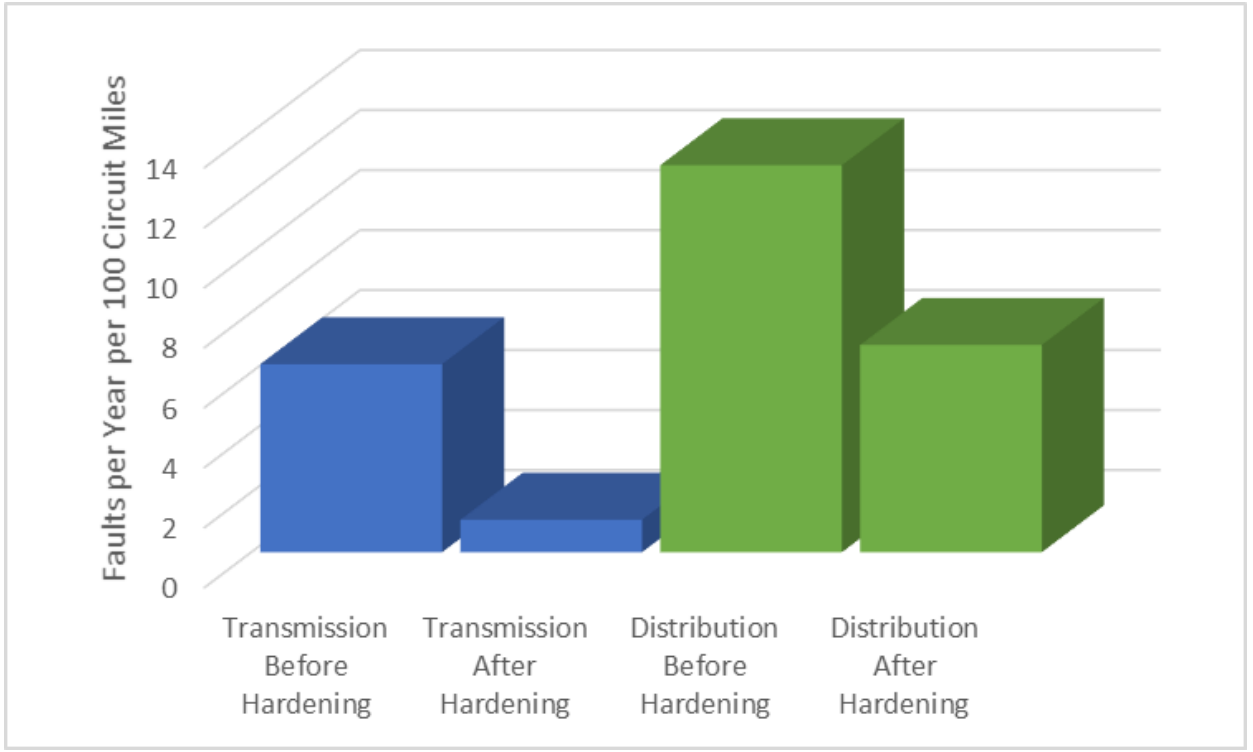
	Historical Risk Summary (2015-2020)			
Risk Driver	**Average Outages**	**Average Ignition rate**	**Average Ignitions**	**Risk Ranking**
Vehicle contact	38.2	6.55%	2.50	1
Veg. contact	12.2	13.70%	1.67	2
Lightning arrestor damage or failure	10.8	12.31%	1.33	3
Balloon contact	11.7	10.00%	1.17	4
Other	8.0	12.50%	1.00	5
Animal contact	44.7	1.87%	0.83	6
Connection device damage or failure	17.5	3.81%	0.67	7
Other contact from object	14.2	4.71%	0.67	7
Conductor damage or failure	19.0	3.51%	0.67	7
Transformer damage or failure	24.3	2.74%	0.67	7

Measured Efficacy of Wildfire Mitigations

In 2020, SDG&E performed several efficacy studies to measure the actual impacts of several wildfire mitigation programs:

- Transmission Hardening
- Distribution Hardening
- Expulsion Fuse Replacement
- Sensitive Relay Settings
- Inspection Program Repair Timelines
- Other Special Work Procedures / Infrastructure Protection Teams

The results of these studies provided a more granular understanding of the effectiveness of programs on specific risk event drivers and informed our RSE calculations



**Based on reliability fault data from 2000-2019 on 214 distribution hardening project line segments

Risk Spend Efficiency

- Risk Spend Efficiency (RSE) methodology in RAMP
- Benefit per dollar spent
- PSPS expected reductions were included in RSE calculations

Hardening Programs	3 Year RSE
Covered Conductor	71
OH Distribution Hardening - Bare	44
Strategic Undergrounding	58

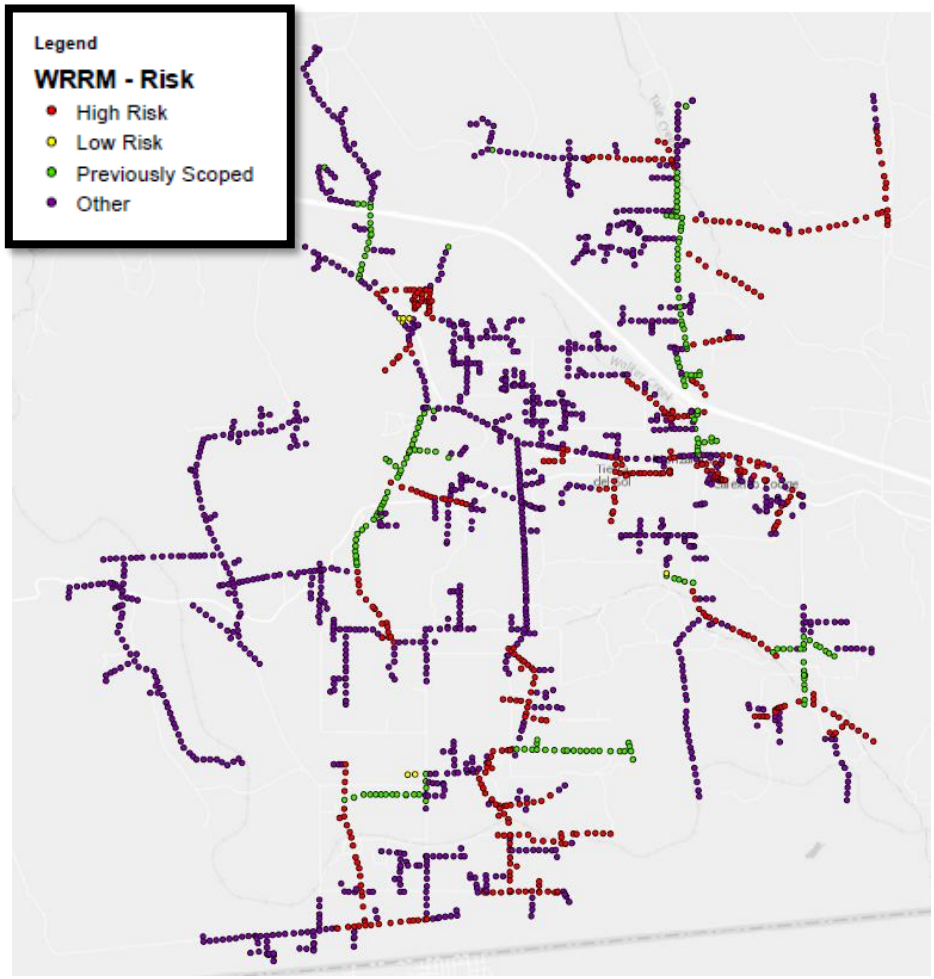
Programs with Top 10 RSE's	3 Year RSE
Recloser Protocols	458,336
Sensitive/Fast Protection Settings	79,025
PSPS Sectionalizing Enhancements	584
SCADA Capacitors	546
Expulsion Fuse Replacement	477
Resiliency Assistance Programs	373
Patrol Inspections of Distribution Electric Lines	369
Infrared Inspections of Distribution Electric Lines	366
Advanced Protection	281
Infrared Inspections of Transmission Electric Lines	245

Wildfire Risk Reduction Model (WRRM)

Grid Hardening Using WRRM:

- Model outputs provide prioritized list of assets to target for mitigation through the FiRM program
- Analysis updates made to evaluate additional datasets for circuit-by-circuit grid hardening prioritization
- 2020 efficacy studies conducted showed 47% effectiveness of implemented grid hardening projects

WRRM Map Sample



Wildfire Risk Reduction Model

Asset Class Risk Summary

Project name	Risk Study
Date created	8/24/2017 14:20
Created by	DAS
Description	
Date exported	8/24/2017 14:28

Baseline Risk							Replacement Risk				
Asset Class	No. of Assets	Asset Type	Asset Age	Asset Subtype	Current Relative Failure Rate	Mean Expected Annual Impact	Replacement Asset	Replacement Relative Failure Rate	Mean Replacement Expected Impact	Mean 20 Year Risk Reduction	Total 20 Year Risk Reduction
PL1605Aa40T49WO1P00	1	Distribution Pole	40-49 years	Wood	0.531	PL1605Aa00T51SFOH00	0.255				
PL1605Aa40T49WO5C00	2	Distribution Pole	40-49 years	Wood	0.864	PL1605Aa00T51SFOH00	0.255			6	12
PL1605Aa40T49WO5P00	1	Distribution Pole	40-49 years	Wood	0.579	PL1605Aa00T51SFOH00	0.255				
PL1605Aa40T49WO7P00	1	Distribution Pole	40-49 years	Wood	0.603	PL1605Aa00T51SFOH00	0.255			1	1
PL1605Aa50T49WO3P00	2	Distribution Pole	50 years or older	Wood	0.616	PL1605Aa00T51SFOH00	0.255			2	3
PL1605Aa50T49WO1P00	4	Distribution Pole	50 years or older	Wood	0.59	PL1605Aa00T51SFOH00	0.255			1	6
PL1605Aa50T49WO5P00	4	Distribution Pole	50 years or older	Wood	0.643	PL1605Aa00T51SFOH00	0.255				2
L1605Aa50T49WO3O00	2	Distribution Pole	50 years or older	Wood	0.616	PL1605Aa00T51SFOH00	0.255			1	2
L1605Aa50T49WO2O00	2	Distribution Pole	50 years or older	Wood	0.603	PL1605Aa00T51SFOH00	0.255				1
L1605Aa50T49WO5O00	2	Distribution Pole	50 years or older	Wood	0.643	PL1605Aa00T51SFOH00	0.255				
PL1605AunkT50SFOO00	11	Distribution Pole	Unknown	Steel & Weath	0.3	PL1605Aa00T51SFOH00	0.255				
PL1605AunkT50SFOH00	5	Distribution Pole	Unknown	Steel & Weath	0.3	PL1605Aa00T51SFOH00	0.255				

Grid Hardening Risk-Informed Prioritization

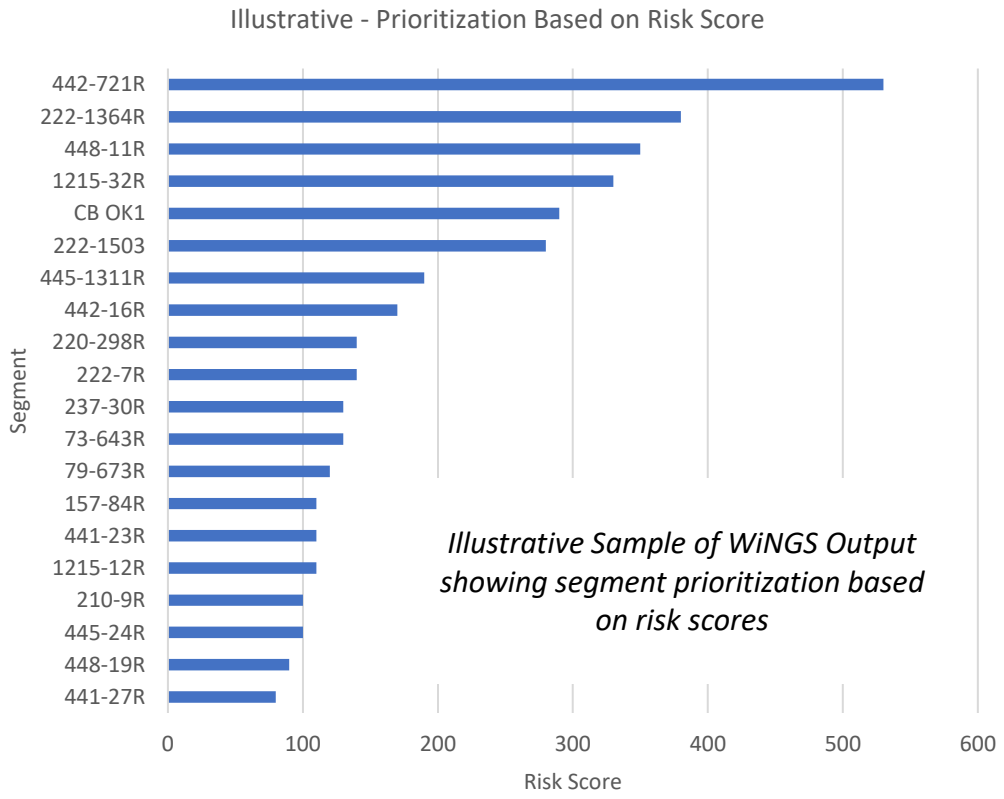
Segment Risk Assessment

Alternatives Analysis

Circuit Scoping

Circuit Design

Construction



Illustrative Sample of WiNGS Output showing segment prioritization based on risk scores

- Grid hardening priorities will be informed by WiNGS segment assessments
- WiNGS analysis includes evaluation of alternatives for each segment
- Although prioritization occurs at a segment level, each segment is evaluated in the context of other segments in the same circuit to ensure segment interdependencies and circuit topology are considered in design
- Priorities may shift as a result of constraints identified during the scoping phase

Traditional Hardening

- FiRM: Re-conductor small wire and wood to steel
- PRiME: Assess and remediate highest risk poles in HFTD
- CNF: Wood to steel and underground conversion in Cleveland National Forest
- Transmission: Wood to steel and increased loading/spacing

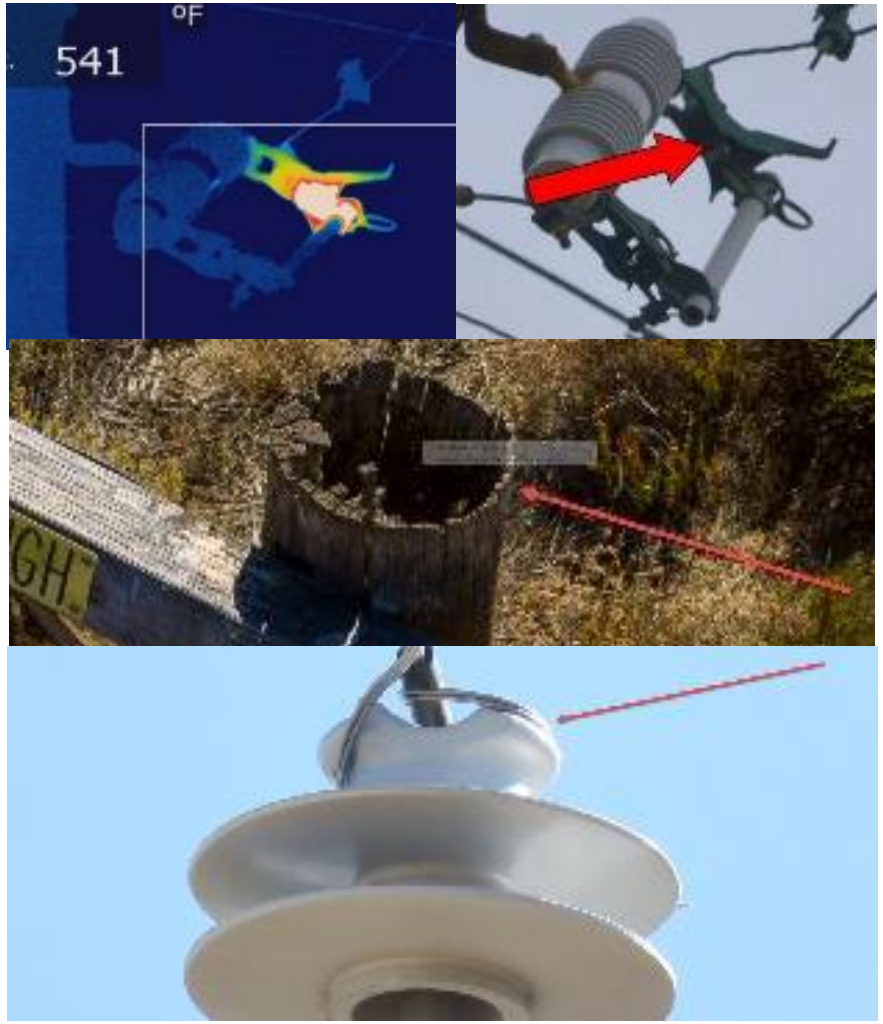
Traditional Hardening	Mileage	Capital $ (Direct)
2020	221	$227M
2021	116	$111M
2022	76	$29M

Advanced Inspections

- DIAR: Drone inspections in HFTD
  - 40 pictures per pole
  - Photos reviewed by QEW and prioritized

- Distribution Infrared Inspections
  - Pilot in Tier 3 and moving to Tier 2

DIAR Inspections	Inspections	Cost $ (Capital + O&M)
2020	37,310	$67.9M
2021	22,000	$49.0M
2022	22,000	$39.9M



Asset Specific Programs

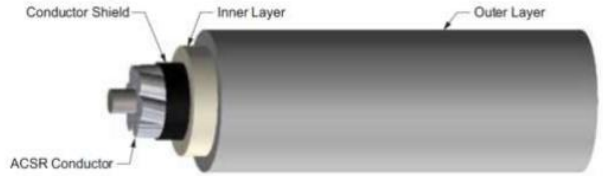
- Expulsion Fuse Replacements
  - Install new CAL FIRE approved fuses
- Hotline Clamp Replacements
  - Replace high risk hotline clamp connectors
- SCADA Capacitors
  - Modernize capacitors in the HFTD
- Lightning Arrestors
  - Install CAL FIRE approved lightning arrestors

Program	Year	Units	Capital $ (Direct)
Expulsion Fuses	2020	3,179	$6.5M
	2021	3,970	$10.2M
	2022	906	$3.1M
Hotline Clamps	2020	2,061	$3.3M*
	2021	2,250	$5.3M*
	2022	1,650	$4.3M*
SCADA Capacitors	2020	30	$992k
	2021	32	$1.6M
	2022	40	$1.8M
Lightning Arrestors	2020	0	$19k
	2021	924	$1.3M
	2022	1,848	$2.6M

*Hotline Clamp $ is O&M, not Capital

Covered Conductor

- Covered conductor helps reduce risk from animal contact, flying debris, balloon contacts, etc.
- In 2020, SDG&E completed 1.9 miles of covered conductor, and informed development of work methods and construction standards
- In 2021, $55M to install 20 miles of covered conductor
- Total: 81.9 miles 2020-2022



3-layer Covered Conductor

Covered Conductor	Mileage	Capital $ (Direct)
2020	1.9	$1.8M
2021	20.0	$55M
2022	60.0	$96M

Strategic Undergrounding

- Strategic undergrounding includes reducing wildfire and PSPS risk
- To keep critical facilities energized during PSPS events
- In 2021, scope will be in HFTD: Alpine, Boulevard, Cameron and Descanso
- Total: 135 miles 2020-2022

Strategic UG	Mileage	Capital $ (Direct)
2020	30	$76.8M
2021	25	$126.3M
2022	80	$197.2M

Microgrids

Ramona Air Attack Base	Cameron Corners	Butterfield/Agua Caliente	Shelter Valley	South Campo	Sherilton Valley
CAL FIRE Air Support U.S. Forest Service Air Support Fire-retardant mixing stations	CAL FIRE Station, a school, and telecom switching center (east San Diego County)	Desert community (far east San Diego County)	Desert community San Diego Fire Station Community Center (far east San Diego County)	Feeding America distribution center, San Diego County Sheriff, Community Center, USPS (east San Diego County)	Vulnerable Community located in HFTD Tier 3 (east San Diego County)
Portable generator in place	Portable fossil fuel generator will serve customers this fire season	Portable fossil fuel generator will serve customers this fire season	Portable fossil fuel generator will serve customers this fire season	Portable fossil fuel generator will serve customers this fire season	Evaluating Solutions for 2021 Fire Season
Renewable source completion by July 2021	Renewable source completion by July 2021	Renewable source completion by December 2021	Renewable source completion by December 2021	Renewable source completion by Q1 2023	Renewable source completion by Q1 2023
Energy Storage	Solar + Energy Storage	Solar + Energy Storage	Solar + Energy Storage	Design in Progress	Design in Progress

Microgrids	Locations	Capital $ (Direct)
2020	4	$3.5M
2021	2*	$18.9M
2022	1*	$12.9M

*Additional Sites

Generators

Generator Grant Program (GGP) + AFN	Mobile Home Park Project (MHP)	Generator Assistance Program (GAP)	Fixed Backup Power (FBP)
Medical Baseline Customers 2,000 (Grants) + AFN Customers **2020: $5.1M** **2021: $7.6M** **2022: $7.6M**	MHPs located in HFTD (Stoneridge at Warner & Pine Valley Trailer Park + 2 TBD sites) **2020: N/A** **2021: $400K** **2022: $400K**	HFTD 2/3, low income Rebate program: 1,250 Rebates **2020: $761K** **2021: $1.8M** **2022: $1.8M**	Grid hardening alternative targeting most PSPS prone customers 413 Grants **2020: $1.7M** **2021: $10.4M** **2022: $10.4M**
Full Grant, no out of pocket for customer	Full Grant, no out of pocket for customer	$300 Standard rebate $450 CARE eligible rebate	Full Grant, no out of pocket for customer
Completion between Sept - Oct	Complete before end of 2021	Rebate Coupons Expire 12/31/2021	Construction complete by Q4 2021
Goal Zero Yeti 3000 + multiple re-charging sources	Generac PWRcell	Portable generators & batteries (available online and in store)	Generac 7173
			

Appendix

2020 Wildfire Mitigation Plan Progress

5.3.2 – Situational Awareness & Forecasting

- **5.3.2.1** Camera network and advanced weather station integration
- **5.3.2.3** Wireless fault indicators
- **5.3.2.4.1** Fire science and climate adaptation department

5.3.4 – Asset Management & Inspections

- **5.3.4.1** Detailed corrective maintenance program inspections
- **5.3.4.2** Transmission system inspections
- **5.3.4.4** Infrared inspections of distribution infrastructure
- **5.3.4.9.1** HFTD Tier 3 inspections
- **5.3.4.9.2** Drone assessments of distribution infrastructure
- **5.3.4.15** Substation system inspection

5.3.5 – Vegetation Management & Inspections

- **5.3.5.2** Detailed inspections of vegetation around distribution infrastructure – tree trimming
- **5.3.5.5** Fuels management
- **5.3.5.9** Other discretionary inspection of vegetation around distribution infrastructure – Enhanced inspections, patrols, and trims
- **5.3.5.20** Vegetation management to achieve clearances around electric infrastructure – Pole brushing

5.3.3 – Grid Design & System Hardening

- **5.3.3.1** SCADA Capacitors
- **5.3.3.2** Advanced protection
- **5.3.3.3** Distribution overhead system hardening
- **5.3.3.6** Pole replacement and reinforcement
- **5.3.3.7** Expulsion fuse replacement
- **5.3.3.8.1** PSPS sectionalizing enhancements
- **5.3.3.8.2** Microgrids
- **5.3.3.10** Hotline clamps
- **5.3.3.11.1** Customer resiliency programs
- **5.3.3.11.2** Expanded generator grant program
- **5.3.3.11.3** Whole house generator program
- **5.3.3.16** Strategic undergrounding
- **5.3.3.17.1** Overhead transmission fire hardening
- **5.3.3.17.2** Cleveland National Forest fire hardening
- **5.3.3.18.1** Distribution communications reliability improvements
- **5.3.3.18.2** Lightning arrestor removal and replacement

Complete | Ahead of Plan | On Track | Off Track