2022 Wildfire Mitigation Plan

Grid Design & System Hardening

Christine Cowsert, Vice President
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March 10, 2022

Together, Building
a Better California

Overview

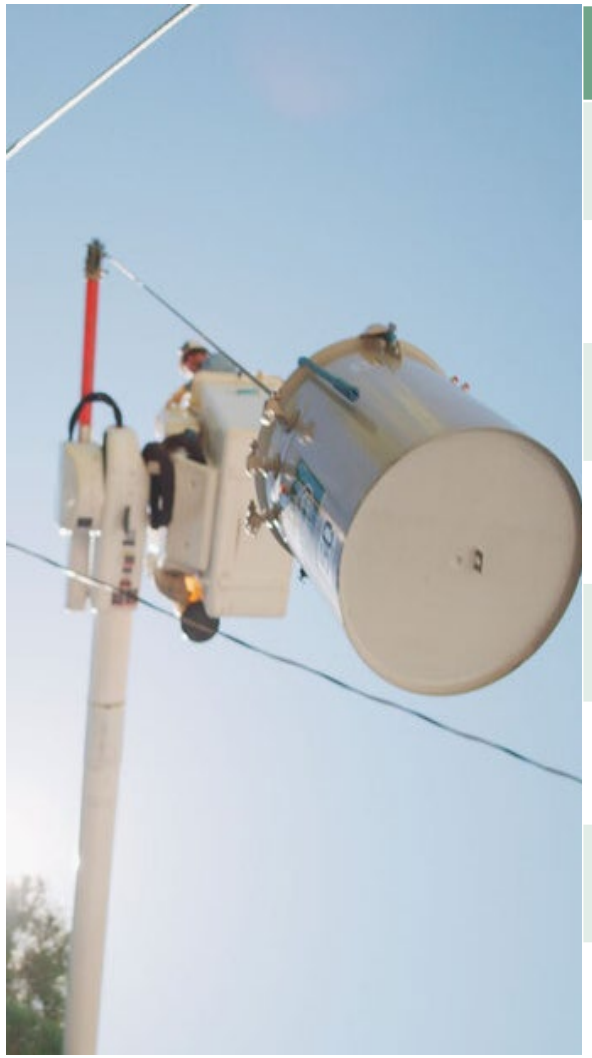
In 2021, we advanced our system hardening and grid design efforts by:

- **COMPLETING** 210 miles of distribution system hardening (which includes undergrounding, overhead hardening, line removal);
- **HARDENING** or removing 104 miles of transmission lines;
- **SYSTEMATICALLY REPLACING** equipment in HFTD areas that creates ignition risks, such as non-exempt fuses (more than 1,400) and surge arresters (more than 15,000); and,
- **LAUNCHING** our plan to underground 10,000 miles of overhead distribution lines in HFTD areas.

In 2022, we are rapidly expanding our system hardening efforts by:

- **COMPLETING** 470 circuit miles of system hardening work which includes overhead system hardening, undergrounding and removal of overhead lines in HFTD or buffer zone areas;
- **COMPLETING** at least 175 circuit miles of undergrounding work, including Butte County Rebuild efforts and other distribution system hardening work;
- **REPLACING** or removing 32 miles of transmission conductor to reduce ignition risk from those lines;
- **INSTALLING** additional automated devices which allow us to sectionalize our grid and reduce the impact of PSPS events; and,
- **REPLACING** equipment in HFTD areas that creates ignition risks, such as non-exempt fuses (3,000) and surge arresters (~4,500, all known, remaining in HFTD areas).

Initiative Targets



2022 Initiative Targets	Date
Replace the fuse with a circuit switcher on the Rincon Transformer Bank 1.	6/1/2022
Install and commission **100 new PSPS SCADA enabled Distribution Sectionalizing devices**.	9/1/2022
Install and SCADA commission **15 transmission line switches** on lines that traverse the HFTD areas.	9/1/2022
Replace 50 of the 104 remaining Motorized Switch Operators energizing HFTD or HFRA.	12/31/2022
Install 17 substation SCADA enabled reclosers on circuits serving line sections that feed into HFTD areas or HFRA, barring any exceptions due to connectivity issues	12/31/2022
Install 80 single phase recloser sets in HFTD areas or HFRA.	12/31/2022
Make operationally-ready **four additional Distribution Microgrid Pre-installed Interconnection Hubs** (PIHs).	12/31/2022
Remove 3,000 non-exempt fuses / cutouts identified on distribution poles in HFTD areas or HFRA.	12/31/2022

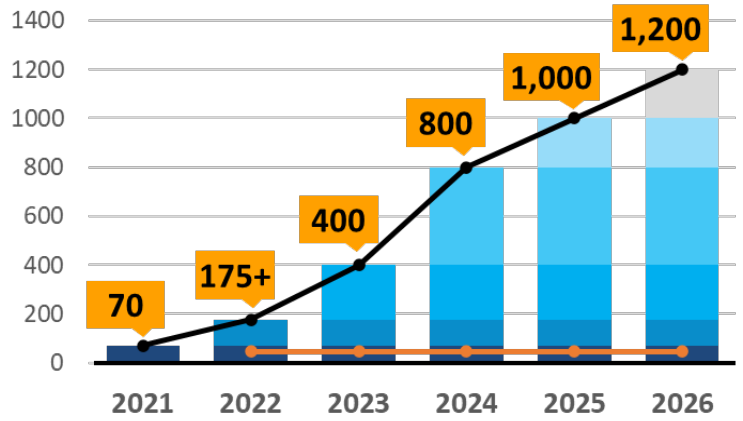
Initiative Targets *(continued)*

2022 Initiative Targets	Date
Equip 15 PG&E Service Centers or Materials Distribution Centers sites with **emergency back-up generation**	12/31/2022
Complete at least 175 circuit miles of undergrounding work.	12/31/2022
Complete at least 470 circuit miles of system hardening work which includes overhead system hardening, undergrounding and removal of overhead lines in HFTD or buffer zone areas with the exception of any mileage being undergrounded and tracked separately as part of our Butte County Rebuild efforts.	12/31/2022
Remove or replace 32 circuit miles of transmission conductor on lines traversing the HFTD areas or HFRA.	12/31/2022
Remove all the remaining non-exempt surge arrestors in HFTD areas (based on the known population of 4,590 surge arrestors as of January 1, 2022) through replacement with exempt equipment.	12/31/2022
Operate 2 new Remote Grid Standalone Power System (SPS) units	12/31/2022
Complete 55 circuit miles of undergrounding work as part of the **Butte County Rebuild** program.	12/31/2022

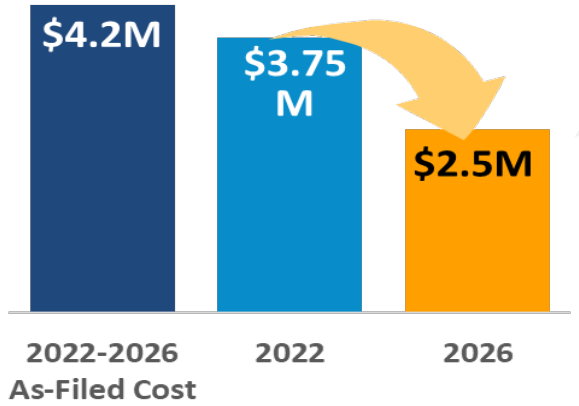
10k Undergrounding Program

PG&E is undertaking a major new initiative to underground approximately 10,000 miles of power lines in high fire risk areas.

Approximate Target Miles Per Year



Approximate Cost Per Mile



How?

- **Optimize** design and construction standards
- **Bundle** work strategically
- **Deploy** new technology and equipment

This commitment represents the largest effort in the U.S. to underground power lines as a wildfire risk mitigation.

Safe	Dependable	Sustainable
99% Risk Reduction & Long Term Resiliency	Reduces PSPS, EPSS and EVM Improves Reliability	Saves Trees

Questions & Feedback

Together, Building a Better California

SDGE™

& WILDFIRE SAFETY

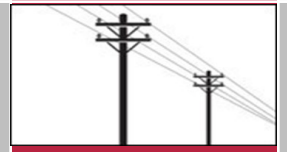
2022 WMP Energy Safety Workshop

March 10, 2022

Agenda

1. Grid Design & System Hardening
2. Risk Modeling & Assessment
3. Vegetation Management
4. Public Safety Power Shutoffs
5. Asset Management & Data Governance

2021 Wildfire Mitigation Plan Results

 **Undergrounding**	**25.9/25.0** Miles installed in 2021	**104%** Complete	**56** Miles Installed since 2020	 **Situational Awareness**	**17/17** Cameras Installed in 2021	**21** total since 2020	**46/25** Weather Stations Upgraded in 2021	**221** total since 2020
 **Covered Conductor Installation**	**20.6/20.0** Miles installed in 2021	**103%** Complete	**22.5** Miles Installed since 2020	 **Aerial Fire Suppression**	**793k** Gallons dropped YTD (2021)		**1.59M** Total gallons dropped since 2020	
 **Traditional Hardening**	**117/116** Miles installed in 2021	**101%** Complete	**321.5** Miles Installed since 2020	 **Enhanced Vegetation Management**	**12,578/17,000** Trees trimmed removed in 2021		**74%** Complete	**29,653** Trees removed / trimmed since 2020
 **Asset Install/Replacement**	**8,052/7,176** Asset installed/ Replaced in 2021	**112%** Complete	**13,322** Installed/Replaced since 2020	 **Distribution Inspections**	**168k/ 169k** Inspections since 2021		**99%** Complete	**350k** Inspections completed since 2020
 **Generators**	**3,404/3,013** Generators provided to eligible customers in 2021	**113%** Complete	**6,173** Generators provided since 2020	 **Transmission Inspections**	**17,711/19,638** Inspections completed in 2021		**90%** Complete	**43,247** Inspections completed since 2020

Grid Design & System Hardening

Shaun Gahagan

Manager, Wildfire Mitigation

Grid & Infrastructure Hardening

Transmission

- By the end of 2023, **100% of SDG&E's transmission system** in Tier 3 of the HFTD will be **hardened**
- **84%** risk event reduction
- Falling conductor protection will be implemented on transmission

Strategic Undergrounding

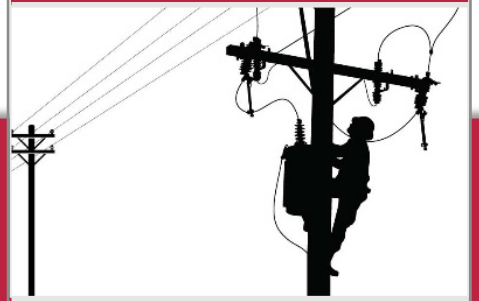
- SDG&E is **the first IOU** to apply wildfire mitigation undergrounding of overhead lines inclusive of secondaries & services in the HFTD
- **98%** risk event reduction
- 25+ miles completed in 2021
- **65 miles planned in 2022**

Covered Conductor

- **> 900 / 3,500 miles (25%)** of overhead distribution lines in the HFTD have been hardened with bare wire and begun transition to covered wire
- **65%** risk event reduction
- 20 miles completed in 2021
- **60 miles planned in 2022**
- Continued falling conductor protection

Asset Replacement Programs

Expulsion Fuse Replacement



3,976 / 3,970
Completed in 2021

100%
Complete

98%
HFTD Completion

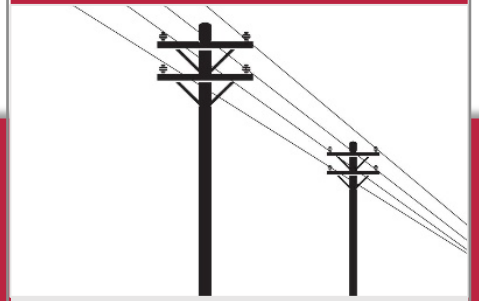
Capacitor Replacement

35 / 32
Completed in 2021

109%
Complete

41%
HFTD Completion

Hot Line Clamp Replacement

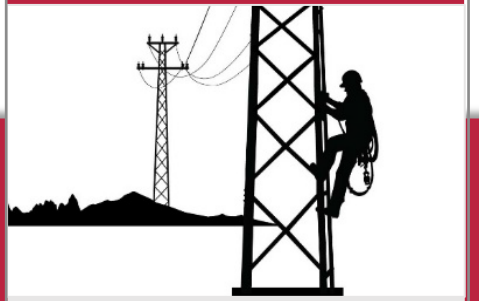


2,743 / 2,250
Completed in 2021

122%
Complete

67%
HFTD Completion

Lightning Arrester Replacement



1,789 / 1,400
Completed in 2021

128%
Complete

4%
HFTD Completion

Advanced Protection

Early Fault Detection

- Utilize sensors to detect faults prior to the asset failing
- 17 sensors installed on demonstration circuit

Falling Conductor Protection

- High speed relays de-energize broken conductors before contact with ground
- 10 circuits active in Tier 3

Sensitive Relay Settings

- Fast relay settings enabled during PSPS or Extreme FPI
- Reduce fault energy during highest risk conditions

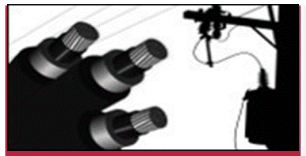
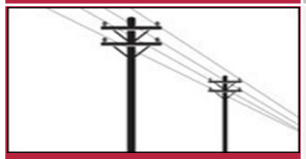
Distribution Communications Reliability Initiative

- Improve network availability, reliability & performance
- 25 Base Stations installed; 70 planned through 2024

PSPS Mitigations – Projections & Results

Reduced Number of Customers Impacted

3-Year Projected Total	2022 Projected Total	2021 Total	2020 Total
39,533	11,695	13,359	14,479

	2022 Projections	2021 Results	2020 Results
 PSPS Sectionalizing	10 Locations 4,607 Customers	11 Locations 9,719 Customers	23 Locations 12,870 Customers
 Strategic Undergrounding	65 Miles 2,533 Customers	26 Miles 242 Customers	15.5 Miles 276 Customers
 Microgrids	2 Locations 5 Customers	0 Locations 0 Customers	6 Locations 578 Customers

	2022 Projections	2021 Results	2020 Results
 Standby Power Programs	300 Customers	353 Customers	32 Customers
 Generator Grant Programs	3,000 Customers	2,310 Customers	1,300 Customers
 Generator Assistance Programs	1,250 Customers	735 Customers	

Microgrids & Temporary Generators

Continued investment in sustainable solutions that provide resiliency to customers impacted by a PSPS

2021 Accomplishments:

- Significant progress at Cameron Corners. Necessary adjacent undergrounding completed
- Construction completed at CAL FIRE's Ramona Air Attack Base
- Introduced mobile battery energy storage units to replace diesel temporary generators & provide mobile EV charging at Community Resource Centers

2022 Planning:

- Commissioning of Ramona Air Attack Base & Cameron Corners microgrids
- Complete land acquisition for Butterfield Ranch & Shelter Valley locations, with issuance of request for proposals for construction contracts
- Design & engineering of additional microgrid sites identified from WiNGS modeling
- Continue to explore mobile battery energy storage units in different applications & uses to verify robustness and flexibility

Backup Generator & Battery Programs

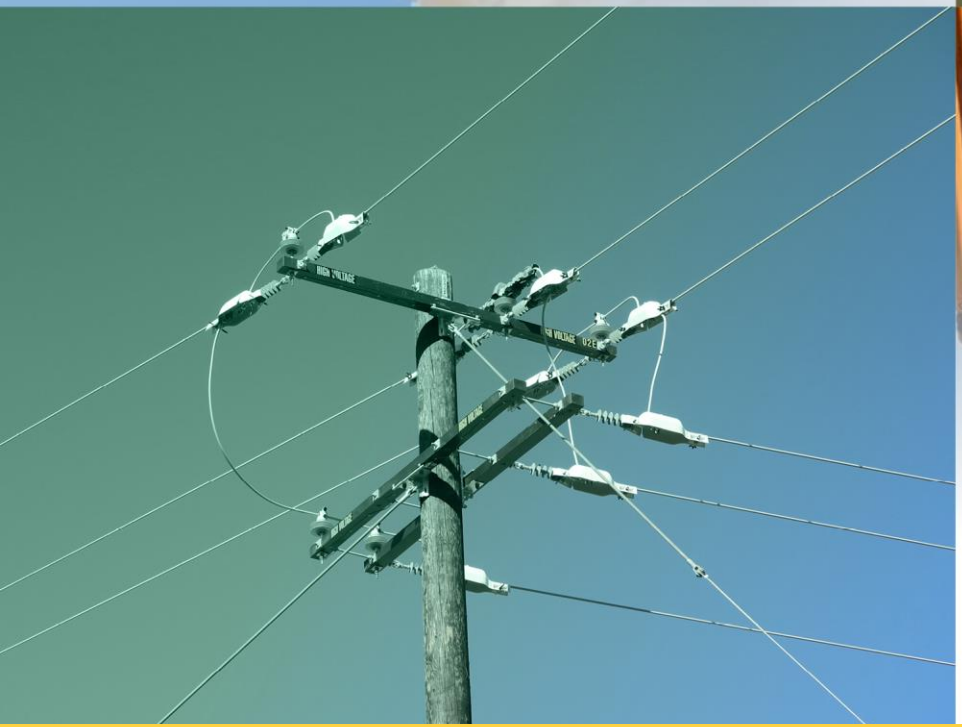
Program	Generator Grant Program	Generator Assistance Program	Fixed Backup Power
Summary	Portable backup battery provided to qualifying MBL or AFN customers in the HFTD at no charge 	Portable fuel generator & backup battery (portable power station) rebates for qualifying HFTD customers, additional rebate for CARE customers 	Provides a permanent generator to customers that have a high risk of experiencing a PSPS 
2021 Accomplishments	• Delivered 2,310 batteries (116% of 2,000 target); 3,795 total since 2019 • 47 backup batteries delivered to AFN customers • Streamlined process for Indian Health Council • 98% of customers are very satisfied, 94% are very prepared	• Issued 1,850 rebates (target = 1,250). 2,040 total since 2020 • 735 redeemed by customers • 88% of customers are somewhat to very satisfied with rebate process	• >465 generator install agreements signed; >350 operational by year's end • Began installation of Mobile Home Park resilience solution (solar + battery)
2022 Planning	• Target: 3,000 batteries • Continuing to evaluate competitive bids for program support • Develop online customer request form	• Target: 1,250 rebates • Update rebate process to allow purchase at additional retailers • Include more models with safety features to qualified product list	• Target: 470 generators • Integrate & test non-fossil fuel solutions • Expand to 2 mobile home parks, 2 schools, critical facilities & Community Resource Centers

SOUTHERN CALIFORNIA EDISON®

GRID DESIGN & SYSTEM HARDENING

2022 WMP Technical Workshop

March 10, 2022



2022 WILDFIRE MITIGATION PLAN UPDATE

Energy for What's Ahead®

Agenda

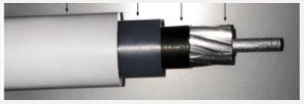
Presenter: Ray Fugere – Principal Manager, Wildfire Mitigation Strategy

Topics

1. 2021-22 Initiative Update and Long-Term Strategy
2. New Integrated Grid Hardening Strategy
3. New Technologies

2021-22 Initiative Update and Long-Term Strategy (1 of 2)

SCE maintains foundational system hardening activities while advancing key incremental focus areas each year based on risk assessment and prioritization

Activity	2021	Program to Date	2022 Target	Long-term Strategy
Covered Conductor 	**~1,500** circuit miles *(installed)*	**2,900+** circuit miles since 2018	**1,100** circuit miles	Install ~3,800 circuit miles in 2022-24 Scope may be adjusted with new Integrated Grid Hardening Strategy
Targeted Undergrounding	**~6** circuit miles *(installed)*	**~6** circuit miles since 2021	**11** circuit miles	Potential substantial scope increase with new Integrated Grid Hardening Strategy
Rapid Earth Fault Current Limiter (REFCL)	Studied three REFCL technologies to mitigate ground faults: Ground Fault Neutralizer (GFN), Resonant Grounded Substation (RGS) and Isolation Transformer (IT)		Develop plans for additional GFN locations and continue monitoring pilots	Plan to construct GFN at Acton and Phelan substations in 2023 Potential wider scale deployment
Branch Line Protection Strategy (Fuses) 	**350** fuses *(installed or replaced)*	**13,300+** fuses since 2018	**350** fuses	New installs target where only portions of the circuit extend into HFRA
Remote-Controlled Automatic Reclosers (RAR) and Remote-Controlled Switches (RCS)	**23** devices *(installed)*	**140+** devices since 2018	**15** devices	New installs target PSPS impacted circuits Thousands installed prior to the start of the wildfire mitigation program in 2018
Circuit Breaker Relay Hardware for Fast Curve	**95** relay units *(replaced or upgrade)*	**360** relay units since 2019	**104** relay units	Complete fast curve settings capability upgrades to identified circuit breakers in HFRA by 2024

2021-22 Initiative Update and Long-Term Strategy (2 of 2)

Activity	2021	Program to Date	2022 Target	Long-term Strategy
Tree Attachment Remediation 	**538** tree attachments *(remediated)*	**1,040+** tree attachments since 2019	**500** tree attachments	Expect to complete program by 2025
C-Hooks (transmission) 	**50** C-Hooks *(replaced)*	**50** C-Hooks since 2021	**10** C-Hooks	Replace all inventoried C-Hooks with hardware in SCE's current construction standard by 2022
Long Span Initiative (e.g., line spacers) 	**361** locations *(remediated)*	**361** locations since 2021	**1,400** locations	Evaluate timing of remediations; target higher risk spans not planned for covered conductor work by 2023
Vertical Switches 	**16** switches *(installed)*	**16** switches since 2021	**15** switches	Expect to complete in-scope by 2023
Microgrids	Negotiated contract with microgrid equipment vendor; attempted to obtain land needed for microgrid pilot		Seek approval for land easement	Pursue other opportunities if approval is not received 6/30/22. (Note: separate from microgrid control system pilots at schools)
Vibration Damper Retrofit 	**New activity for 2022:** Mitigate risk of wind-driven Aeolian vibration that may lead to conductor abrasion or fatigue over time (can reduce covered conductor's useful life from 45 years to an average of 25 years)		Retrofit vibration dampers on 100 structures	Expect to retrofit ~2,700 structures in total by 2026

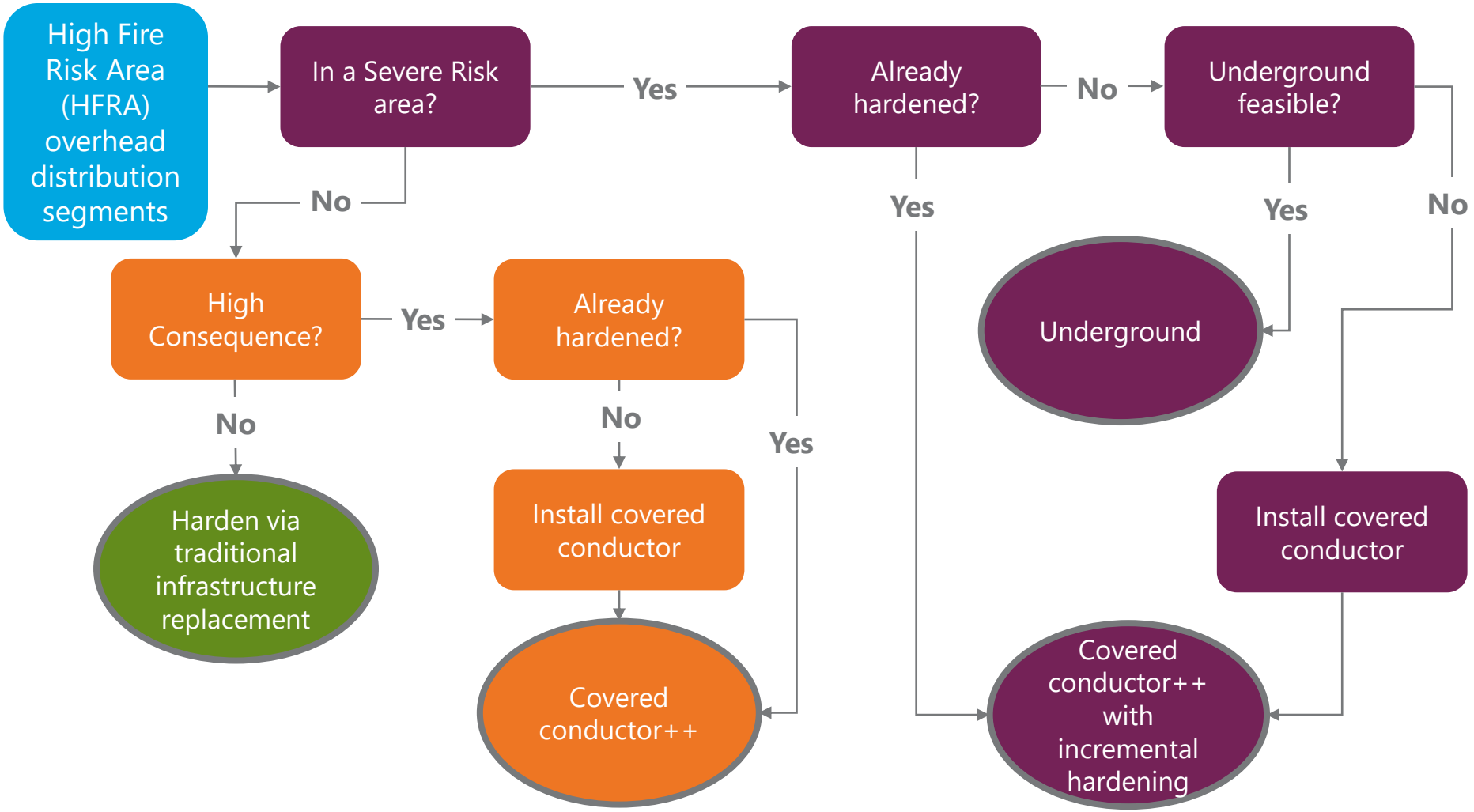
Other ongoing system hardening initiatives include: PSPS-driven hardening work, transmission open phase detection and legacy facilities

New Integrated Grid Hardening Strategy (1 of 2)

- SCE developed a new integrated grid hardening strategy and analysis that can be applied at each circuit segment and considers wildfire risk drivers and PSPS risk, and which mitigation or combination of mitigations cost effectively addresses those risk drivers
- Refined approach focuses on:
  - Portions of HFRA where ignition consequences are most significant (Severe Risk Areas, High Consequence Segments)
  - Deploying mitigations to address as many significant risk drivers in high-risk locations as reasonably possible (includes undergrounding, covered conductor and/or REFCL plus other mitigations)
- Impacts future scoping initiatives going forward

Total High Fire Risk Area (HFRA) Overhead Distribution Segments (Total of ~9,700 circuit miles, of which 30% is already hardened)	**Severe Risk Areas** (~1,900 circuit miles)	Areas that meet criteria including fire risk egress constrained locations, extreme high wind areas, extreme consequence areas, etc.
	High Consequence Segments (~5,000 circuit miles)	Segment that meets 300-acre consequence threshold or at risk of Public Safety Power Shutoff (PSPS)
	Other HFRA Segments (~2,700 circuit miles)	Segment that is not in a severe risk area and does not meet high consequence criteria

New Integrated Grid Hardening Strategy (2 of 2)



Covered conductor++: Installing covered conductor combined with fire-resistant poles installation, asset inspections, fast-curve settings for circuit breaker relays, along with vegetation management activities (as necessary) including hazard tree management, pole brushing and line clearing

New Technologies

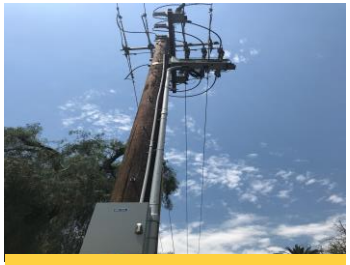
SCE continues to explore and pilot the following new technologies to improve system resiliency:

Incipient Fault Detection

Early Fault Detection (EFD) detects high frequency radio emissions which can occur from incipient failure, such as severed strands on a conductor, vegetation contact, or tracking on insulators

Fault Detection

Distribution Open Phase Detection (DOPD) detects one or more open phase (broken conductor) conditions to reduce risks associated with down-wire incidents



High Impedance Detection

High Impedance (Hi-Z) relays use protective elements to reduce the propagation of low-magnitude fault conditions (Hi-Z conditions) that can lead to ignition risk, such as downed conductor or arcing events

Asset Defect Detection Using AI/ML

Applies image recognition algorithms to speed up identification of potential asset defects. Detection algorithm will continue to improve over time with **artificial intelligence** and **machine learning**.

Fire Detection

Uses **satellite technology** and SCE's HD wildfire cameras to detect and map wildfire ignitions. Results in a more comprehensive view of fires that improves intelligence for more rapid and effective fire response.

Thank You