



# **SCE's Wildfire & Contact with Energized Equipment Risk Assessments (SED RAMP Review Appendix C)**



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## **Main Sections**

- **ANALYSIS OF SCE'S WILDFIRE RISK ASSESSMENT**
- **ANALYSIS OF CONTACT WITH ENERGIZED EQUIPMENT (CEE) RISK ASSESSMENT**





## **ANALYSIS OF SCE'S WILDFIRE RISK ASSESSMENT**

- **POLE DRIVER & RELATED MITIGATION PROGRAMS**
- **CIRCUIT BY CIRCUIT RISK ANALYSIS FOR WCCP**
  - **USING INDEX SCORE FOR RSEs**  
(RSEs = RISK SPEND EFFICIENCIES)
- **TREE TRIMMER SAFETY RISK ANALYSIS**
  - **WITH INCREASED VEGETATION MANAGEMENT**
- **WILDFIRE RELEVANT CONSEQUENCES**





## **POLE DRIVER & RELATED MITIGATION PROGRAMS**

- **Pole Loading & Deterioration Pole Replacement Programs**
  - NOT part of SCE's Wildfire Risk Assessment
  - Disagree that Completely Compliance Programs
- **Pole Drivers NOT Included as Wildfire Triggering Event**
- **Risk Analysis on Pole Failure Ignition Events Needed**
- **Pole Top Deterioration Causes Wire-Down**
  - PL & Deterioration Assessments Programs do **NOT** detect
  - Can These **High Cost** Programs Mitigate this Pole Driver?
- **Would Pole Top Inspections Be More Beneficial?**
- **Lack of Root Cause Analysis (1/31/2017 SED Report)**
- **Pole by Pole Risk Analysis - RSE calculations**





## CKT BY CKT RISK ANALYSIS FOR WCCP USING INDEX SCORE FOR RSEs

- **W. Kent Muhlbauer** - Pipeline Risk Management Authority
- **Index Score** Combined with **Average Cost of CC per Mile**
  - Estimated Cost per Ckt Improve RSE Calculations (Future?)
  - **HFTA Circuits with Highest Risk Reduction per Cost**
- **Compare Ckt Index Scores** For ALL Mitigation Measures
  - Refined Project Cost Estimates Per Ckt Improve RSEs

CC = Covered Conductor

WCCP = Wildfire Covered Conductor Program





## Top 9 Ranked OH Circuits for Fire Threat Characteristics

Fire Threat (Frequency) Characteristics												
Rank	OH Circuit Name	Total Circuit Length (OH Primary) (Ckt Mi.)	Total HFRA Length - OH Primary (Ckt Mi.)	Length (Ckt Mi.) Within Tier 3 - OH Primary	Length (Ckt Mi.) Within Tier 2 - OH Primary	High Wind in HFRA Length (Ckt Miles) - OH Primary	Historical Wiredown Count (May 2014 - 2017)	Small Conductor (Ckt Miles)	Mitigated HFRA Fault / Total Ckt Length	HFRA Vegetation Fault Count	Index Score	Potentially Mitigated HFRA Faults (2015-2017)
1	THACHER	83.55	83.56	83.53	0.03	67.77	2	36.58	0.12	8	39.51	10
2	METTLER	130.09	130.09	129.45	0.64	111.59	2	45.80	0.12	0	36.93	16
3	CUDDEBACK	89.07	89.42	87.77	1.65	60.59	2	29.46	0.09	5	34.09	8
4	JORDAN	164.04	164.04	0.00	164.04	63.33	2	151.23	0.04	3	32.47	6
5	HUGHES LAKE	102.19	89.59	67.84	21.51	80.37	2	56.25	0.06	2	28.76	6
6	CHAWA	98.99	98.99	97.56	1.43	87.01	1	44.91	0.02	0	27.91	2
7	GALAHAD	57.33	57.36	57.05	0.31	57.36	5	32.92	0.09	3	27.50	5
8	TITAN	118.74	103.15	46.45	27.17	102.83	3	81.72	0.03	1	26.86	4
9	TENNECO	100.36	100.36	47.08	51.09	57.74	1	55.00	0.11	3	26.53	11





## TREE TRIMMER SAFETY RISK ANALYSIS WITH INCREASED VEGETATION MANAGEMENT

- **Increased Veg Mgt to Reduce WF Risks Due to WMP**
  - Could Increase Tree Trimmer Worker Risk for CEE (Arc Flash)
- **SED CEE Scenario with Potential Larger 3<sup>rd</sup> Party CEE Risks**
  - Probability of Outcome 3, Intact Energized Wire Contact
  - If Tree Trimmers Inexperienced and/or Lack Sufficient Training
- **SED has Concerns with CEE Historical Data Utilized**
  - Recommend Risk Analysis with Recent & Projected Data
- CEE Section for Further Analysis





## WILDFIRE RELEVANT CONSEQUENCES

- **SCE's Risk Assessment Modeling Consequences (25% each)**
  - **Serious Injuries (SI), Fatalities, Reliability, and Financial**
- **CalFIRE Consequences to Improve Risk Analysis**
  - **Acres Burned; Structures Destroyed; & Structures Damaged**
  - Beyond Financial Consequences similar to Fatalities & SI
- **U.S. EPA Air Quality Index (AQI)**
  - Unsafe AQI for Weeks due to Tragic Nov'18 Camp Fire
    - Very Unhealthy (AQI = 201 to 300)
    - Hazardous (AQI greater than 300)
  - Consequence for Incremental AQI After Wildfire
    - Area of Unsafe Air Quality & # People Impacted
    - Use AQI for each Day/Hour/15-minute Increment?







## **ANALYSIS OF CEE RISK ASSESSMENT**

- **SCE DATA: WIRE-DOWN & 3RD-PARTY CONTACT EVENTS**
- **POLE DRIVER**
- **METALLIC BALLOONS (INCLUDING FOIL OR FOIL-LINED)**
- **WIRE-DOWN TRIGGERING EVENT FREQUENCIES**
- **COMPLIANCE PROGRAM - CM1**
- **CONTROL 1 – OH CONDUCTOR PROGRAM**
- **CEE COMBINED RISK ANALYSIS & ARC FLASH RISKS**
- **RISK ANALYSIS OF DESIGN, CONSTRUCTION & OPERATION INCLUDING GROUNDING METHODOLOGIES**
- **CIRCUIT/LINE SECTION/LINE SEGMENT RISK ANALYSIS**
- **THIRD PARTY (TREE TRIMMERS) SAFETY RISK ANALYSIS**





## SCE DATA: WIRE-DOWN & 3RD-PARTY CONTACTS

- **Two Triggering Events** in SCE's CEE Bowtie Risk Analysis
  1. Wire Down: Ave **1,154/Yr** Events from **2015-2017**
  2. Contact With Intact OH Conductor: **5/Yr** from **2008-2016**
- **Five Primary Wire-Down Drivers (D1 to D5)**
  - Two Main Wire-Down Drivers: D1 & D2
- **One Primary CEE (Intact) Driver (D6 – 3<sup>rd</sup> Party Contact)**

<b>2018 Projected CEE Driver Frequency</b>	
Name	Frequency
D1 - Equipment Caused	206
D2 - Equipment / Facility Contact	773
D3 - SCE Work / Operation	7
D4 - Unknown	168
D5 - Downstream Equipment	0
D6 - Third Party Contact	5

- **Why Different Historical Years Ranges for RSEs?**
  - Redo CEE RSE calculations for 2015-2018 Data





## POLE DRIVER

- Annual Frequency of 11 Wire-Down Triggering Events
- 5% of all Equipment Cause drivers
- **Only Tiny Fraction (i.e. 1%) ALL CEE Events**
  - Pole Failure due to Vehicle Collision NOT included Here
  - **Separate Sub-Driver D2E – Vehicle for Collisions**

CEE D1 Equipment Cause Frequencies				
Driver	Name	Annual Frequency	Percentage (Category)	Percentage (All Triggering Events)
D1a	Connector / Splice / Wire	130	63%	11%
D1b	Other	65	32%	6%
D1c	Pole	11	5%	1%
D1	Equipment Cause	206	100%	18%

- **Lack of Root Cause Data related to Pole Failures**





## METALLIC BALLOONS (INCLUDING FOIL OR FOIL-LINED)

- Metallic Balloon Contacts with OH Lines
  - Can Create a Short Circuit
  - Can Trigger Ckt Damage, Overheating, Fire, or an Explosion
- Cal. Penal Code § 653.1 (Foil Balloon Law)
  - Requires All Helium-Filled Balloons to Be Weighted

CEE D2 Equipment / Facility Contact Frequencies				
Driver	Name	Annual Frequency	Percentage (Category)	Percentage (All Triggering Events)
D2a	Animal	53	7%	5%
D2b	Metallic Balloons	111	14%	10%
D2c	Other	39	5%	3%
D2d	Vegetation	171	22%	15%
D2e	Vehicle	206	27%	18%
D2f	Weather	193	25%	17%
CEE D2	Equipment / Facility Contact	773	100%	68%

- ***No-Cost Solution = Ban Metallic Balloons in CA***
  - ***New Law Could Eliminate/Significantly Reduce This Driver***





## WIRE-DOWN TRIGGERING EVENT FREQUENCIES

- SED Combined into One Table for Better Perspective
  - Annotations included based on SCE’s RAMP info
- Addressed further for OH Conductor Program Control Measure

Wire-Down Triggering Event Frequencies		
Name	Annual	%
Connector / Splice / Wire	130	11%
Other Equipment Cause	65	6%
Pole (normally top degradation)	11	1%
Animal (e.g. squirrel, bird etc.)	53	5%
Metallic Balloons	111	10%
Other (e.g. Gunshot damage, Drones, etc.)	39	3%
Vegetation	171	15%
Vehicle Accidents (usually into pole)	206	18%
Weather	193	17%
Unknown	168	15%
<b>TOTAL Annual Triggering Events:</b>	<b>1147</b>	<b>100%</b>

- SCE Should Work to Have Less Unknown Events (15%)





## COMPLIANCE PROGRAM - CM1

- SCE Did NOT Model Compliance Activities in Risk Analysis

**Table III-1 – Inventory of Compliance and Controls<sup>23,24</sup>**

ID	Name	Driver(s) Impacted	Outcome(s) Impacted	Consequence(s) Impacted	2017 Recorded Cost (\$M)	
					Capital	O&M
CM1	Distribution Deteriorated Pole Remediation Program and Pole Loading Program (PLP) Replacements	Not Modeled	Not Modeled	Not Modeled	\$ 270.9	\$ 30.9
CM2	Vegetation Management	Not Modeled	Not Modeled	Not Modeled	\$ 5	\$ 84.3
CM3	Overhead Detailed Inspection, Apparatus Inspections, and Preventive Maintenance	Not Modeled	Not Modeled	Not Modeled	\$ 5	\$ 36.0
CM4	Intrusive Pole Inspections and Pole Loading Assessments	Not Modeled	Not Modeled	Not Modeled	\$ 5	\$ 6.0
C1	Overhead Conductor Program (OCP)	D1a1b, D2a1d,f	I	II	\$ 198.7	\$ 1
C1a	Overhead Conductor Program (OCP) Utilizing Targeted Covered Conductor	D1a1b, D2a1d,f	O1	SDI, SDP	\$ 5	\$ 1
C2	Public Outreach	I	O1, O5	SDI, SDP	\$ 5	\$ 5.1

- SED Does NOT believe CM1 (High Cost) is a Compliance Program
  - At Minimum, Portions of the PLP Replacements are NOT
    - Some of SCE's Internal Standards Are More Stringent than GOs
      - High Fire Areas (HFAs)
      - Wind Loading
- CM1 Risk Reduction Analysis with RSEs to Determine Effectiveness
  - What Triggering Events & Drivers does CM1 Mitigate?





## CONTROL 1 – OH CONDUCTOR PROGRAM (OCP)

- Model of C1 – 100% Bare OH Conductor in 2018-2020
- SCE Plans Future Use of Covered Conductor (CC) in Non-HFRAs
  - Only 90% OCP for Years 2021-2023
  - 10% OCP Costs Allocated to C1a OCP & Targeted CC for 2021-2023
- **Detailed Circuit/Line Segment RSEs Could Be Utilized**

Wire-Down Triggering Event Frequencies					
Name	Annual	%	20% Less	New %	New/Old
Equipment Cause	206	21%	91	12%	44%
Equipment / Facility Contact	773	79%	654	88%	85%
	979	100%	745	100%	

- OCP Impacts D1 (Equipment Cause) & D2 (Equip/Facility Contact)
  - Reduce D1 Wire-Downs with 10.9% Mitigation Effectiveness in 2018
    - Growing Significantly Each Year to 55.9% Effectiveness in 2023
    - Reduces the Frequency of Faults
  - Reduce D2 Wire-Downs with 3.0% Mitigation Effectiveness in 2018
    - Growing to 15.5% in 2023 since Reduce Faults Causing Wire-Downs





## CONTROL 1 – OH CONDUCTOR PROGRAM (OCP)

- Driver Analysis basis is 1,965 OH Ckt Miles Reconductored 2018-23
- Based on 85% of Wire-Down Events due to **168 Unknown Drivers**
- 5.5% Deployment of Total 36,040 Distribution Ckt Miles
- **Two OH Conductor Failure Modes: Arcing & Melting**
  - Reconductoring 50% and 90% Effective for Arc & Melt Failures, respectfully
  - Branch Line Fusing 0% and 90% Effective for Arc & Melt Failures, respectfully
- Mitigation Effectiveness by Driver:
  - 90% for Connector/Splice/Wire
  - 80% for Other Equipment Causes (0% for Pole Drivers)
  - 55% for Animal Contact
  - 46% for Other Contact (e.g. Gunshot Damage & Drones)
  - **32% for Mylar Balloons** & 28% for Weather & 24% Vegetation
  - 0% for Vehicle (e.g. Hitting Pole/Equipment)
- Why 20% Baseline Wire-Down Risk Reduction for 5.5% Deployment?







## CEE COMBINED RISK ANALYSIS & ARC FLASH RISKS

- SCE Defines CEE Risks As OH Public Safety Risks ONLY
- SCE Does NOT Include Risks to:
  - Employees; 3<sup>rd</sup> Party Contractors; or Alleged Vandals/Thieves
- Risk Analysis for All OH CEE for Distribution Lines
  - Some Drivers May be Different
  - Combined Evaluation May Highlight Certain Risk Drivers More
- Does CEE Risks Include Arc Flash Risks?
  - 3<sup>rd</sup> Party Arc Flash Risks
  - Arc Flash Well Studied in Past Decade





## RISK ANALYSIS OF DESIGN, CONSTRUCTION & OPERATION INCLUDING GROUNDING METHODOLOGIES

- Protection Equipment Can Stop Flow Of Electricity
  - If Fault Temporary, Can Reclose In Secs/Mins
  - If Fault Permanent, Electricity Can Remain Interrupted (Lockout)
- **SCE Estimates Almost 1/3 Wire-Down Events Are Energized**
- Analysis of System Design to Improve Fault Detection
  - Can Fault Related Risks Be Further Reduced?
  - Can Grounding Methodologies Be Improved to Reduce Risks?
    - **Wye vs Delta 3 Phase Systems Relative to Grounding?**
    - **Multi-Grounded System?**
- Comparative Statistics to U.S. Distribution Systems?





## CIRCUIT/LINE SECTION/LINE SEGMENT RISK ANALYSIS

- **Risk Analysis with RSEs for Circuits is Feasible (Index Scores)**
- IEEE Standard Dictionary of Electrical and Electronics Terms (1992)
  - **Circuit (NESC):** A conductor or system of conductors through which an electric current is intended to flow. (C2-1984)
  - **Line Section:** A portion of OH line/cable bounded by 2 terminations, a termination and a tap point, or 2 tap points. (859-1987)
  - **Line Segment:** A portion of a line section that has a particular type of construction *or is exposed to a particular type of failure*, and therefore which may be regarded as a single entity *for the purpose of reporting and analyzing failure and exposure data*.
    - Note: A line segment is a subcomponent of a line section. (859-1987)
- **Data Available for Line Section/Segment Risk Analysis?**
  - Line Sections with Discrete Termination Points for RSEs
  - Further Line Segments Risk Analysis, If Feasible





## THIRD PARTY (TREE TRIMMERS) SAFETY RISK ANALYSIS

### Three Risk Model Outcomes

2018 CEE Outcome Likelihood			
Outcome	Name	# of Triggering Events (2018)	%
CEE O1	Energized Wire-Down	362.80	31.30%
CEE O2	De-Energized Wire-Down	791.67	68.30%
CEE O3	Intact Energized Wire Contact	4.64	0.40%
		1159.11	100.00%

- Primary Safety Impact is 3<sup>rd</sup> Party Contacts (SCE)
  - Even Though Only 0.4% of All CEE (Public) Outcomes
  - **Inputs for O3 is Significantly Higher Than O1**
    - **183 (SI) and 159 (Fatalities)**
- Data Sources From Different Timeframes – Effective?
  - **Risk analysis for Similar Years (i.e. 2015-2018)**
  - Additional analysis focused on F & SI outcomes





For questions, please feel free to contact me.

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