

Thermal Overloads

| ID | Overloaded Facility | Contingency | Category | Category Description | Loading (%) | | | | Potential Mitigation Solutions |
|----|----------------------------|----------------------------------|----------|----------------------|----------------------|------------------------------|------------------------|------------------------|---|
| | | | | | 2017 Summer Peak Dry | 2017 Summer Partial Peak Dry | 2017 Spring Off-pk Wet | 2017 Winter-Off-pk Dry | |
| | WARNEVL-WILSON 230 | normal conditions | A | base case | <95% | 117.0% | 100.1% | <95% | upgrade the line |
| | CAYETANO - USWP-JRW 230 | normal conditions | A | base case | <95% | 99.9% | <95% | <95% | congestion management, reduce C. Cos generation |
| | LONETREE- USWP-JRW 230 | normal conditions | A | base case | <95% | 100.2% | <95% | <95% | |
| | LLAGAS - GILROY TAP 115 | normal conditions | A | base case | <95% | 101.3% | <95% | <95% | reduce Gilroy gen |
| | GATES-MIDWAY 500 kV | normal conditions | A | base case | <95% | <95% | <95% | 100.7% | congestion management |
| | WARNEVL-WILSON 230 | Gates 500/230 kV transformer | B | T-1 | <95% | 122.3% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | PDCI Bi-pole | B | PDCI | <95% | 118.2% | 101.1% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Tesla-Los Banos 500 kV | B | L-1 | <95% | 103.4% | 97.4% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | PDCI monopole | B | PDCI | <95% | 110.7% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Tracy-Los Banos 500 kV | B | L-1 | <95% | 103.3% | 95.2% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Los Banos-Gates 500 kV #1 | B | L-1 | <95% | 101.2% | 95.4% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | One Diablo unit | B | G-1 | <95% | 106.2% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | One San Onofre unit | B | G-1 | <95% | 105.6% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Los Banos-Midway 500 kV | B | L-1 | <95% | 100.7% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Moss Landing-Los Banos 500 kV | B | L-1 | <95% | 100.3% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Tesla-Metcalf 500 kV | B | L-1 | <95% | 103.2% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Los Banos-Gates 500 kV #3 | B | L-1 | <95% | 100.3% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Los Banos 500/230 kV transformer | B | L-1 | <95% | 103.3% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Vaca Dixon-Tesla 500 kV | B | L-1 | <95% | 100.9% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Olinda-Tracy 500 kV | B | L-1 | <95% | 101.2% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Table Mountain –Tesla 500 kV | B | L-1 | <95% | 100.4% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Tesla-Newark 230 kV | B | L-1 | <95% | 100.5% | <95% | <95% | upgrade the line |
| | CRAGVIEW - WEED JPS 115 #1 | Captain Jack -Olinda 500 kV | B | L-1 | 99.2% | 101.7% | <95% | <95% | adjust Weed phase shifter |
| | CRAGVIEW - WEED JPS 115 #1 | Malin-Round Mountain 500 kV #2 | B | L-1 | 96.6% | 100.5% | <95% | <95% | adjust Weed phase shifter |
| | CRAGVIEW - WEED JPS 115 #1 | Malin-Round Mountain 500 kV #1 | B | L-1 | 96.1% | 100.1% | <95% | <95% | adjust Weed phase shifter |
| | DELTA - CASCADE 115 #1 | Captain Jack -Olinda 500 kV | B | L-1 | 96.4% | 97.4% | <95% | <95% | adjust Weed phase shifter |
| | COTWDWAP-OLINDAW 230 #1&2 | Captain Jack -Olinda 500 kV | B | L-1 | 97.8% | <95% | <95% | <95% | WAPA project to upgrade |
| | CAYETANO - USWP-JRW 230 | C. Costa-La Positas 230 kV | B | L-1 | <95% | 103.5% | <95% | <95% | congestion management |
| | LONETREE- USWP-JRW 230 | C. Costa-La Positas 230 kV | B | L-1 | <95% | 103.8% | <95% | <95% | congestion management |

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| | | | | | 2017 Summer Peak Dry | 2017 Summer Partial Peak Dry | 2017 Spring Off-pk Wet | 2017 Winter-Off-pk Dry | |
| | GATES - MIDWAY 230.0 #1 | Gates 500/230 kV transformer | B | T-1 | <95% | <95% | <95% | 106.3% | use 30 min rating or trip both Helms pumps |
| | GATES - MIDWAY 230.0 #1 | Gates-Midway 500 kV | B | L-1 | <95% | <95% | <95% | 111.1% | use 30 min rating, trip both Helms pumps not sufficient |
| | ARCO-MIDWAY 230 | Gates-Midway 500 kV | B | L-1 | <95% | <95% | <95% | 99.2% | use 30 min rating or trip both Helms pumps |
| | WESTLEY -LOSBANOS 230.0 #1 | PDCI bi-pole | B | PDCI | <95% | <95% | 97.6% | <95% | upgrade or congestion management |
| | WESTLEY -LOSBANOS 230.0 #1 | Tesla-Los Banos 500 kV | B | L-1 | <95% | <95% | 101.1% | <95% | |
| | WESTLEY -LOSBANOS 230.0 #1 | Tracy-Los Banos 500 kV | B | L-1 | <95% | <95% | 97.2% | <95% | |
| | RIO OSO - BRIGHTON 230.0 #1 | Table Mtn 500/230 kV x-former | B | T-1 | <95% | <95% | 127.4% | <95% | trip Hyatt and Thermalito gen for flow from 230 to 500 on Tbl Mtn x-former, existing SPS |
| | ATLANC - GOLDHILL 230.0 #1 | Table Mtn 500/230 kV x-former | B | T-1 | <95% | <95% | 103.5% | <95% | |
| | PEASE - E.MRY J1 115.0 #1 | Table Mtn 500/230 kV x-former | B | T-1 | <95% | <95% | 134.0% | <95% | |
| | GLEAF TP -RIO OSO 115.0 #1 | Table Mtn 500/230 kV x-former | B | T-1 | <95% | <95% | 107.6% | <95% | |
| | E.NICOLS -RIO OSO 115.0 #1 | Table Mtn 500/230 kV x-former | B | T-1 | <95% | <95% | 134.1% | <95% | |
| | RIO OSO -OLIVH J1 115.0 #1 | Table Mtn 500/230 kV x-former | B | T-1 | <95% | <95% | 126.4% | <95% | |
| | E.MRY J1 - OLIVH J1 115.0 #1 | Table Mtn 500/230 kV x-former | B | T-1 | <95% | <95% | 134.4% | <95% | |
| | WARNEVL-WILSON 230 | 500 kV double outage north of Los Banos | C | L-2 | <95% | 114.0% | 110.7% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Gates-Gregg&Gates-Mc Call 230 kV | C | L-2 | <95% | 142.9% | 99.8% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | 500 kV double outage south of Los Banos | C | L-2 | <95% | 104.8% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Los Banos CB#832 | C | BRK | <95% | 104.8% | 102.3% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Haas-McCall and Balch-McCall 230 kV | C | L-2 | <95% | 111.1% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | 500 kV double outage north of Midway | C | L-2 | <95% | 101.2% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | 500 kV double outage south of Tracy | C | L-2 | <95% | 100.9% | 96.3% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Diablo-Midway 500 kV #1&2 | C | L-2 | <95% | 106.7% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Gates CB #652 | C | BRK | <95% | 101.1% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Vaca Dixon CB#732 | C | BRK | <95% | 100.8% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Tesla CB#612 | C | BRK | <95% | 100.4% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | Gates-Arco& Gates-Midway 230 kV | C | L-2 | <95% | 100.6% | <95% | <95% | upgrade the line |

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| | BELLOTA-WARNEVL 230 | 500 kV double outage north of Los Banos | C | L-2 | <95% | <95% | 99.3% | <95% | upgrade or congestion management |
| | CRAVIEW - WEED JPS 115 #1 | Malin-Round Mntain 500 kV #1 &2 | C | L-2 | 107.4% | 109.1% | <95% | <95% | adjust Weed phase shifter |
| | CRAVIEW - WEED JPS 115 #1 | Round Mnt –Table Mnt 500 kV # 1 & 2 | C | L-2 | 95.1% | 99.5% | <95% | <95% | adjust Weed phase shifter |
| | DELTA - CASCADE 115 #1 | Malin-Round Mntain 500 kV #1 &2 | C | L-2 | 105.0% | 105.1% | <95% | <95% | adjust Weed phase shifter |
| | WESTLEY-LOS BANOS 230.0 #1 | 500 kV double outage north of Los Banos | C | L-2 | <95% | <95% | 134.4% | 115.5% | upgrade or congestion management, tripped 511 MW Id, 1940 MW gen |
| | WESTLEY-LOS BANOS 230.0 #1 | 500 kV double outage south of Tracy | C | L-2 | <95% | <95% | 100.3% | 98.9% | upgrade or congestion management |
| | WESTLEY-LOS BANOS 230.0 #1 | Los Banos CB#832 | C | BRK | <95% | <95% | 97.5% | <95% | |
| | BORDEN-GREGG 230 | 500 kV double outage north of Los Banos | C | L-2 | <95% | <95% | 97.4% | <95% | |
| | BORDEN-GREGG 230 | Gates-Gregg&Gates-Mc Call 230 kV | C | L-2 | <95% | <95% | 95.8% | <95% | |
| | PANOCH-GATES230 #1 & 2 | Gates-Gregg&Gates-Mc Call 230 kV | C | L-2 | <95% | <95% | <95% | 101.5% | |
| | ASHLAN - FGRDN T2 230.0 #1 | Gregg-Herndon 230 kV #1&2 | C | L-2 | 113.0% | <95% | <95% | <95% | trip 3rd Helms and load at Ashlan prior to upgrade |
| | GREGG - FGRDN T2 230.0 #1 | Gregg-Herndon 230 kV #1&2 | C | L-2 | 138.6% | 95.3% | <95% | <95% | trip 3rd Helms and load at Ashlan prior to upgrade |
| | GATES - MIDWAY 230.0 #1 | 500 kV double outage north of Midway | C | L-2 | <95% | <95% | <95% | 118.4% | drop renewables at Midway and all Helms pumps |
| | GATES - MIDWAY 230.0 #1 | Midway CB#812 | C | BRK | <95% | <95% | <95% | 108.6% | trip one Helms pump |
| | ARCO - MIDWAY 230.0 #1 | 500 kV double outage north of Midway | C | L-2 | <95% | <95% | <95% | 104.8% | drop renewables at Midway and all Helms pumps |
| | ARCO - MIDWAY 230.0 #1 | Midway CB#812 | C | BRK | <95% | <95% | <95% | 97.2% | trip one Helms pump |
| | TABLE MTN 500/230 kV # 1 | Double outage south of Table Mountain | C | L-2 | 102.6% | 96.6% | <95% | <95% | re-rate Table Mtn transformer |
| | GATES 500/230 kV | 500 kV double outage south of Los Banos | C | L-2 | <95% | <95% | <95% | 100.5% | upgrade or congestion amangement |
| | KEARNEY-HERNDON 230 | Gates-Gregg&Gates-Mc Call 230 kV | C | L-2 | <95% | 110.9% | <95% | <95% | |
| | CAYETANO-USWP JRW 230 | C. Costa-Brentwood & C. Costa-Delta 230 kV | C | L-2 | <95% | 105.9% | <95% | <95% | congestion management |
| | LONETREE - USWP JRW 230 | C. Costa-Brentwood & C. Costa-Delta 230 kV | C | L-2 | <95% | 106.2% | <95% | <95% | |

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| | WARNEVL-WILSON 230 | Los Banos 500 kV Substation | D | Subst | <95% | 131.8% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | 2 Diablo units | D | G-2 | <95% | 114.0% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | 2 Palo Verde units | D | G-2 | <95% | 111.7% | <95% | <95% | upgrade the line |
| | WARNEVL-WILSON 230 | 2 San Onofre units | D | G-2 | <95% | 111.9% | <95% | <95% | upgrade the line |
| | WESTLEY-LOS BANOS 230.0 #1 | Tesla 500 kV Substation | D | Subst | <95% | <95% | 106.1% | 105.9% | upgrade or congestion management |
| | CAYETANO-USWP JRW 230 | Tesla 500 kV Substation | D | Subst | <95% | 100.6% | <95% | <95% | |
| | LONETREE - USWP JRW 230 | Tesla 500 kV Substation | D | Subst | <95% | 100.8% | <95% | <95% | |
| | GATES - MIDWAY 230.0 #1 | Midway 500 kV Substation | D | Subst | not solved | not solved | not solved | 203.8% | under review |
| | ARCO - MIDWAY 230.0 #1 | Midway 500 kV Substation | D | Subst | not solved | not solved | not solved | 175.8% | under review |
| | GATES - ARCO 230.0 #1 | Midway 500 kV Substation | D | Subst | not solved | not solved | not solved | 153.5% | under review |
| | SEMITRPC -WSCOPRSN 115 | Midway 230 kV Substation | D | Subst | 153.1% | <95% | not solved | not solved | under review |
| | WSCOPRSN -CHARKA 115.0 #1 | Midway 230 kV Substation | D | subst | 156.4% | <95% | not solved | not solved | under review |
| | CHARKA-FAMOSO 115.0 #1 | Midway 230 kV Substation | D | subst | 179.9% | <95% | not solved | not solved | under review |
| | FAMOSO -CAWELO C 115.0 #1 | Midway 230 kV Substation | D | subst | 189.8% | <95% | not solved | not solved | under review |
| | LERDO - OGLE JCT 115.0 #1 | Midway 230 kV Substation | D | subst | 117.0% | <95% | not solved | not solved | under review |
| | LERDO LRDO JCT 115.0 #1 | Midway 230 kV Substation | D | subst | 118.2% | <95% | not solved | not solved | under review |
| | OGLE JCT -CAWELO C 115.0 #1 | Midway 230 kV Substation | D | subst | 187.8% | <95% | not solved | not solved | under review |
| | LRDO JCT -KERN OIL 115.0 #1 | Midway 230 kV Substation | D | subst | 97.7% | <95% | not solved | not solved | under review |
| | WARNEVL-WILSON 230 | Midway 230 kV Substation | D | subst | <95% | 111.6% | not solved | not solved | under review |
| | Midway - Temblor 115 kV | Midway 230 kV Substation | D | subst | <95% | 137.0% | not solved | not solved | under review |
| | NOT SOLVED | NE SE SEPARATION | D | sys sep | not solved | not solved | not solved | not solved | system separation according the the scheme |
| | | Midway 500 kV Substation | D | subst | not solved | not solved | solved | solved | under review |
| | | Midway 230 kV Substation | D | subst | solved | solved | not solved | not solved | under review |
| | | Path 26 | D | corridor | solved | solved | solved | solved | under review |

2012/2013 ISO Reliability Assessment - Final Study Results

Study Area: **PG&E Bulk - Summer Light Load, Summer Off-Peak & Summer Partial Peak**



Voltage Deviations

| ID | Substation | Contingency | Category | Category Description | Post Cont. Voltage Deviation % | | | | Potential Mitigation Solutions |
|----|---|---------------------|----------|----------------------|--------------------------------|------------------------------|------------------------|------------------------|---|
| | | | | | 2017 Summer Peak Dry | 2017 Summer Partial Peak Dry | 2017 Spring Off-pk Wet | 2017 Winter-Off-pk Dry | |
| | Substations in Northwest , deviation up in partial peak, up to 6% | PDCI BI-pole outage | B | PDCI | <-5% | <-5% | <5% | <5% | trip capacitors at wind plants, consider exemption for deviation up for PDCI outage |

Transient Stability

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| | | | | 2017 Summer Peak Dry | 2017 Summer Partial Peak Dry | 2017 Spring Off-pk Wet | 2017 Winter-Off-pk Dry | |
| | Table Mtn 500/230 kV transformer w/SPS | B | T-1 | no issues | no issues | frequency violations in Table Mtn area | no issues | modify RAS |
| | 3-phase fault Newark-Ravenswood 230 kV | B | L-1 | no issues | no issues | 2 wind units at Birds Lndg tripped for undervoltage | no issues | the existing units (Shilo 1 & 2) don't have Low Voltage Ride Through capability |
| | 3-phase fault Midway-Kern # 1 (Stockdale1) 230 kV | B | L-1 | oscillations on Midway pumps, frq and vlt violations Windgap2 tripped | oscillations on Midway pumps, frq and vlt violations | oscillations on Midway pumps, frequency violations | oscillations on Midway pumps, frequency violations | trip Windgap2 pumps with a fault on Midway 230, consider exemption for slow frequency and voltage recovery or install dynamic device |
| | 3-phase fault Midway-Kern # 2 (Stockdale2) or # 3 230 kV | B | L-1 | oscillations on Midway pumps, frq and vlt violations | oscillations on Midway pumps, frq and vlt violations | oscillations on Midway pumps, frequency violations | oscillations on Midway pumps, frequency violations | |
| | 3-phase fault Midway-Gates 230 kV or any Cat B contingency with three-phase fault on Midway 230 kV | B | L-1 | oscillations on Midway pumps, frq and vlt violations Windgap2 tripped | oscillations on Midway pumps, frq and vlt violations | oscillations on Midway pumps, frequency violations, Windgap2 tripped | oscillations on Midway pumps, frq and vlt violations Windgap2 tripped | |
| | 3-phase fault Contra Costa-Las Positas 230 kV or any outage with three-phase fault on Contra Costa | B | L-1 | 4 wind units at Birds Landing tripped for undervoltage | 4 wind units at Birds Landing tripped for undervoltage | 3 wind units at Birds Landing tripped for undervoltage | 3 wind units at Birds Landing tripped for undervoltage | these are existing wind generators that don't have Low Voltage Ride Through capability |
| | 3-phase fault Tesla-Newark 230 kV | B | L-1 | no issues | no issues | 3 wind units at Birds Lndg tripped for undervoltage | no issues | the existing units don't have Low Voltage Ride Through capability |
| | 3-phase fault Newark-Ravenswood 230 kV | B | L-1 | no issues | slow frequency recovery at Newark 230 kV | no issues | no issues | no violations, not a load bus |
| | 3-phase fault Gates-Gregg 230 kV or any other outage with a three-phase fault on Gates 230 kV | B | L-1 | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | get detailed load model at Gates 115 kV. If detailed studies confirm the |

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| | 3-phase fault Gates-Gregg, Gates-Mc Call or any other single or double outage with a 3-phase fault on Gates 230 kV | C | L-2 | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | issue, install SVC at Gates 115 kV or move load to 70 kV |
| | 3-phase fault Contra Costa-Las Positas & C Cos-Lone Tree 230 kV or any contingency with a three-phase fault at Contra Costa 230 kV | C | L-2 | 4 wind units at Birds Landing tripped for undervoltage | 4 wind units at Birds Landing tripped for undervoltage | 3 wind units at Birds Landing tripped for undervoltage | 3 wind units at Birds Landing tripped for undervoltage | these are existing wind generators that don't have Low Voltage Ride Through capability |
| | 3-phase fault Contra Costa-Brentwood and C Costa-Delta 230 kV or any contingency with a three-phase fault at Contra Costa 230 kV | C | L-2 | 4 wind units at Birds Landing tripped for undervoltage | 4 wind units at Birds Landing tripped for undervoltage | 3 wind units at Birds Landing tripped for undervoltage | 3 wind units at Birds Landing tripped for undervoltage | these are existing wind generators that don't have Low Voltage Ride Through capability |
| | 3-phase fault Gates-Arco and Gates-Midway 230 kV or any contingency with a three-phase fault at Gates 230 kV | C | L-2 | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | underfreq Id trip and freq violations at Gates 115 kV | get detailed load model at Gates 115 kV. If detailed studies confirm the issue, install SVC at Gates 115 kV or move load to 70 kV |
| | 3-phase fault Midway-Kern #3 and 4 230 kV or any Cat C contingency with a three-phase fault at Midway230 kV | C | L-2 | delayed voltage recovery on Wind gap pumps | no issues | oscillations on Windgap pumps, Windgap 2 tripped | oscillations on Windgap pumps, Windgap 2 tripped | trip Windgap2 pumps with a fault on Midway 230, or install dynamic device |
| | 3-phase fault Northeast-Southeast separation | D | corridor | system separation, under and over-voltage and frequency load shedding and generation tripping | system separation, under and over-voltage and frequency load shedding and generation tripping | system separation, under and over-voltage and frequency load shedding and generation tripping | system separation, under and over-voltage and frequency load shedding and generation tripping | no cascading outages |
| | Path 26 outage with 3-phase fault | D | corridor | Stable with RAS, local oscillations in New Mexico | stable w/RAS, no issues | no issues, acceptable for Cat D | Helms pumps tripped for underfrq, large vlt and freq dips | acceptable for Cat D |
| | Outage of Midway 500 kV substation with 3-phase fault | D | substation | large Vlt and Frq dips, load and gen tripping, stable | no issues, acceptable for Cat D | no issues, acceptable for Cat D | unstable | under review |

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| | Outage of Midway 230 kV substation with 3-phase fault | D | substation | Large vlt and frq dips, acceptable for Cat D | Large vlt and frq dips, acceptable for Cat D | over frq gen tripping around Midway, large vlt and frq dips | load and gen tripping around Midway, oscillations | under review |