Study Area: **PG&E Greater Fresno - Summer Peak**

California ISO
Shaping a Renewed Future

Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-T-1	Oro Loma #2 115/70kV	Base Case	A	N-0	125%	<90%	<90%	Mercy Springs 230kV substation mitigates - Action Plan.
Fres-SP-T-2	Oro Loma #2 115/70kV	Los Banos-Livingston Jct-Canal 70kV	B	L-1	136%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-3	Oro Loma #2 115/70kV	Los Banos-Livingston Jct-Canal 70kV and any single Helms PGP unit	B	L-1/G-1	128%	<90%	<90%	Mercy Springs 230kV substation mitigates - Action Plan.
Fres-SP-T-4	Borden-Gregg 230kV	Bus 2 Fault at Herndon 115kV	C1	Bus	105%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-5	Panoche-Oro Loma 115kV	Bus Fault at Los Banos 70kV	C1	Bus	150%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-6	Oro Loma #2 115/70kV	Bus Fault at Los Banos 70kV	C1	Bus	321%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-7	Oro Loma-Canal #1 70kV (Oro Loma-Dos Palos Section)	Bus Fault at Los Banos 70kV	C1	Bus	146%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-8	Los Banos-Canal-Oro Loma #1 70kV (Oro Loma-Mercy Springs Section)	Bus Fault at Los Banos 70kV	C1	Bus	120%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-9	Coalinga 1-Coalinga 2 70kV (Coalinga 1-Tornado Tap Section)	Bus Fault at Coalinga 2	C1	Bus	102%	102%	102%	Reconductor Coalinga 1-Coalinga 2 70kV. Recommend BAAH to eliminate C1 Bus contingencies at Coalinga 1 70kV bus.

Study Area: **PG&E Greater Fresno - Summer Peak**

California ISO
Shaping a Renewed Future

Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-T-10	Merced-Merced Falls 70kV	Bus Fault at Le Grand 115kV	C1	Bus	106%	104%	100%	Exchequer SPS mitigates
Fres-SP-T-11	Merced Falls-Exchequer 70kV	Bus Fault at Le Grand 115kV	C1	Bus	134%	132%	128%	Exchequer SPS mitigates
Fres-SP-T-12	Borden-Madera #2 70kV	Bus E Fault at Borden 70kV	C1	Bus	107%	114%	111%	Reconductor Borden-Madera #2 line. (Check impedances in model of parallel Borden-Madera #1 & #2 70kV lines.) Check if SPS is operational already.
Fres-SP-T-13	Herndon-Bullard #1 115kV (Pinedale Jct-Bullard Section)	Bus 1 Fault at Herndon 115kV	C1	Bus	116%	118%	129%	Short term: Cut-in Herndon-Bullard 115kV OL SPS. Recommend BAAH at Herndon 115kV.
Fres-SP-T-14	Herndon-Bullard #2 115kV (Herndon-Pinedale Section)	Bus 2 Fault at Herndon 115kV	C1	Bus	138%	146%	149%	Short term: Cut-in Herndon-Bullard 115kV OL SPS. Recommend BAAH at Herndon 115kV.
Fres-SP-T-15	Herndon-Barton 115kV	Bus 2 Fault at Herndon 115kV	C1	Bus	128%	135%	138%	Reconductor Herndon-Barton 115kV line. Recommend BAAH at Herndon 115kV
Fres-SP-T-16	Barton-Airways-Sanger 115kV (Airways-Sanger Section worst)	Bus 2 Fault at Herndon 115kV	C1	Bus	176%	183%	192%	Reconductor Barton-Airways-Sanger 115kV line. Recommend BAAH at Herndon 115kV
Fres-SP-T-17	Borden-Gregg #1 230kV	Bus 2 Fault at Herndon 115kV	C1	Bus	105%	<90%	<90%	Approved project to loop Wilson-Gregg 230kV through Borden mitigates later years.

Study Area: **PG&E Greater Fresno - Summer Peak**

California ISO
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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-T-18	Borden-Gregg #1 230kV	Herndon CB202 Failure	C2	Breaker	126%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan.
Fres-SP-T-19	Chowchilla-Kerckhoff #2 115kV	Herndon CB202 Failure	C2	Breaker	108%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-20	Barton-Airways-Sanger 115kV (Airways-Sanger Section)	Herndon CB202 Failure	C2	Breaker	111%	<90%	98%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-21	Manchester-Airways-Sanger 115kV	Herndon CB202 Failure	C2	Breaker	102%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-22	Kerckhoff-Clovis-Sanger #1 115kV (Kerckhoff-Woodward Jct Section)	Herndon CB202 Failure	C2	Breaker	102%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-23	Sanger-McCall #3 115kV	Herndon CB202 Failure	C2	Breaker	101%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-24	Herndon-Barton 115kV	McCall CB202 Failure	C2	Breaker	130%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-25	Herndon-Manchester 115kV	McCall CB202 Failure	C2	Breaker	131%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-26	GWF-Kingsburg 115kV	McCall CB202 Failure	C2	Breaker	103%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan

Study Area: **PG&E Greater Fresno - Summer Peak**

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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-T-27	Merced Falls-Exchequer 70kV	Wilson CB102 Failure	C2	Breaker	241%	<90%	<90%	North Merced 230/115kV Substation Project mitigates in later years - Action Plan
Fres-SP-T-28	Merced-Merced Falls 70kV	Wilson CB102 Failure	C2	Breaker	192%	<90%	<90%	North Merced 230/115kV Substation Project mitigates in later years - Action Plan
Fres-SP-T-29	Panoche-Oro Loma 115kV	Los Banos #3 & #4 230/70kV	C3	T-1-1	164%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-30	Oro Loma-Canal #1 70kV	Los Banos #3 & #4 230/70kV	C3	T-1-1	155%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-31	Los Banos-Canal-Oro Loma 70kV	Los Banos #3 & #4 230/70kV	C3	T-1-1	148%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-32	Los Banos-Livingston Jct-Canal 70kV	Oro Loma #2 115/70kV & Los Banos-Canal-Oro Loma 70kV	C3	L-1/T-1	135%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-33	Los Banos #3 230/70kV	Los Banos #4 230/70kV & Oro Loma #2 115/70kV	C3	T-1-1	124%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-34	Panoche-Oro Loma 115kV (Panoche-Hammonds Section)	Los Banos #3 & #4 230/70kV	C3	T-1-1	164%	<90%	<90%	Future approved project mitigates in later years - Action Plan
Fres-SP-T-35	Oro Loma #2 115/70kV	Los Banos #3 & Mercy Springs #1 230/70kV	C3	T-1-1	<90%	112%	119%	Recommend second 115/70kV at Oro Loma.

Study Area: **PG&E Greater Fresno - Summer Peak**

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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-T-36	Los Banos-Livingston Jct-Canal 70kV (Chevron Pipeline-Santa Nella Section worst)	Oro Loma #2 115/70kV & Los Banos-Canal-Oro Loma 70kV	C3	L-1-1	135%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-37	Los Banos-Canal-Oro Loma #1 70kV (Oro Loma-Mercy Springs Section) (2015 Case) Oro Loma-Mercy Springs 70kV (2018 & Later)	Los Banos #3 & #4 230/70kV	C3	T-1-1	148%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-38	Oro Loma-Canal #1 70kV (Dos Palos-Santa Rita Section)	Los Banos-Canal-Oro Loma 70kV & Los Banos-Livingston Jct-Canal 70kV	C3	L-1-1	159%	<90%	<90%	Mercy Springs 230kV substation mitigates in later years - Action Plan
Fres-SP-T-39	Oro Loma-Canal #1 70kV (Santa Rita-Canal Section)	Oro Loma-Mendota 115kV & Mercy Spring-Mendota 115kV	C3	L-1-1	N/A	103%	103%	Reconductor Oro Loma-Canal #1 70kV
Fres-SP-T-40	Reedley-Orosi 70kV	Reedley-Dinuba 70kV & McCall-Reedley (McCall-Wahtoke Section) 115kV	C3	L-1-1	105%	<90%	<90%	Approved Reedley-Orosi 70kV reconductor mitigates later years. Action Plan
Fres-SP-T-41	Coalinga 1-Coalinga 2 70kV (Tornado Tap-Pennzier Tap Section worst)	Gates #5 230/70kV & Schindler #1 115/70	C3	T-1-1	138%	139%	142%	Recommend SPS for loss of Gates #5 230/70, Schindler #1 115/70kV, or Schindler-Huron-Gates 70kV
Fres-SP-T-42	Schindler-Coalinga #2 70kV (Schindler-Pleasant Valley Section)	Schindler-Huron-Gates 70kV & Gates #5 230/70kV	C3	L-1/T-1	<90%	99%	102%	Recommend SPS for loss of Gates #5 230/70, Schindler #1 115/70kV, or Schindler-Huron-Gates 70kV
Fres-SP-T-43	Biola-Glass-Madera 70kV	Borden-Madera #1 & #2 70kV	C3	L-1-1	93%	100%	101%	Reconductor Biola-Glass-Madera 70kV
Fres-SP-T-44	Borden-Glass 70kV	Borden-Madera #1 & #2 70kV	C3	L-1-1	109%	116%	117%	Reconductor Borden-Glass 70kV

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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-T-45	Remaining Borden-Madera 70kV	Borden-Madera #1 OR #2 & Borden-Glass 70kV	C3	L-1-1	109%	116%	116%	Reconductor Borden-Madera #1 & #2 70kV
Fres-SP-T-46	Borden #1 230/70kV	Borden #1 230/70kV & Coppermine-Friant 70kV	C3	L-1-1	104%	110%	99%	Wishon generation not on in 2015 & 2018. Dispatch Wishon.
Fres-SP-T-47	E2-Shepherd 115kV	Gregg-E1 #1 & #2 230kV	C3/C5	L-2	N/A	126%	122%	Modify Helms RAS
Fres-SP-T-48	Woodward-Shepherd 115kV	Gregg-E1 #1 & #2 230kV	C3/C5	L-2	N/A	124%	120%	Modify Helms RAS
Fres-SP-T-49	E2-Clovis-Sanger #1 OR #2 115kV (E2-Clovis 2 Jct Section worst)	Gregg-E1 #1 & #2 230kV	C3/C5	L-2	N/A	118%	118%	Modify Helms RAS
Fres-SP-T-50	E2 #1 OR #2 230/115kV	Gregg-E1 #1 & #2 230kV	C3/C5	L-2	N/A	141%	141%	Modify Helms RAS
Fres-SP-T-51	Chowchilla-Kerckhoff #2 115kV	Kerckhoff -E2 #1 & #2 115kV	C3/C5	L-2	N/A	148%	144%	Modify Kerckhoff 2 PH RAS
Fres-SP-T-52	Chowchilla-Kerckhoff #2 115kV (Sharon Tap-Oakhurst Jct Section worst)	Kerckhoff-Clovis-Sanger No. 1 & 2 115 kV	C3/C5	L-2	150%	N/A	N/A	Kerckhoff 2 PH RAS mitigates
Fres-SP-T-53	Remaining Kerckhoff-Clovis-Sanger 115kV	Kerckhoff-Clovis-Sanger #1 OR #2 & Chowchilla-Kerckhoff #2 115kV	C3/C5	L-1-1	113%	N/A	N/A	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-54	Chowchilla-Kerckhoff 2 115kV (Sharon Tap-Oakhurst Jct Section worst)	Kerckhoff-Clovis-Sanger #1 & #2 115kV	C3/C5	L-2	150%	N/A	N/A	Kerckhoff 2 PH RAS mitigates
Fres-SP-T-55	Chowchilla-Kerckhoff 2 115kV (Sharon Tap-Oakhurst Jct Section worst)	E2-Clovis-Sanger #1 & #2 115kV	C3/C5	L-2	N/A	148%	144%	Modify Kerckhoff 2 PH RAS
Fres-SP-T-56	Chowchilla-Kerckhoff #2 115kV	Kerckhoff-E2 #1 & #2 115kV	C3/C5	L-2	N/A	142%	138%	Modify Kerckhoff 2 PH RAS

Study Area: PG&E Greater Fresno - Summer Peak

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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-T-57	Wilson-Le Grand 115kV	Wilson #1 & #2 230/115kV	C3	L-1-1	134%	<90%	<90%	North Merced 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-58	Wilson-Le Grand 115kV	Kerckhoff-Clovis-Sanger #1 & #2 115kV	C3/C5	L-2	103%	N/A	N/A	Kerckhoff 2 PH RAS mitigates
Fres-SP-T-59	Wilson-Oro Loma 115kV	Wilson #1 & #2 230/115kV	C3	T-1-1	115%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Atwater SPS in short term
Fres-SP-T-60	Wilson-Merced #1 115kV	Wilson-Atwater #2 & El Capitan-Wilson 115kV	C3	L-1-1	104%	<90%	<90%	North Merced 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-61	Atwater-Livingston-Merced 115kV (Atwater-Atwater Jct)	Wilson-Atwater #2 & El Capitan-Wilson 115kV	C3	L-1-1	120%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Atwater SPS in short term
Fres-SP-T-62	Panoche-Oro Loma 115kV (Panoche-Hammonds Section)	Borden-Gregg & Wilson-Gregg 230kV	C3/C5	L-2	100%	<90%	<90%	Future project mitigates later years. Action Plan
Fres-SP-T-63	Panoche-Oro Loma 115kV (Panoche-Hammonds Section)	Panoche-Mendota & Dairyland-Le Grand 115kV	C3	L-1-1	<90%	107%	101%	Reconductor Panoche-Oro Loma 115kV
Fres-SP-T-64	Remaining McCall 230/115kV	Two McCall 230/115kV	C3	T-1-1	102%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-T-65	Kings River-Sanger-Reedley 115kV (Piedra 1 SW-Reedley Section worst)	Sanger-Reedley & McCall-Reedley (McCall-Wahtoke) 115kV	C3	L-1-1	146%	144%	155%	Reconductor Kings River-Sanger-Reedley 115kV or add second line
Fres-SP-T-66	Sanger-Reedley 115kV (Sanger Jct-Parlier Section)	Kings River-Sanger-Reedley & McCall-Reedley (McCall-Wahtoke Section) 115kV	C3	L-1-1	94%	95%	102%	Reconductor Sanger Reedley 115kV or add second line

Study Area: **PG&E Greater Fresno - Summer Peak**

Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-T-67	McCall-Reedley 115kV (Wahtoke-Reedley Section	Kings River-Sanger-Reedley & Sanger-Reedley 115kV	C3	L-1-1	96%	96%	102%	Reconductor McCall-Reedley 115kV or add second line
Fres-SP-T-68	McCall-Kingsburg #2 115kV (Kingsburg Jct 1-Kingsburg Jct 2 Section worst)	GWF-Kingsburg & McCall-Kingsburg #2 115kV	C3	L-1-1	121%	119%	124%	Reconductor McCall-Kingsburg #1 & #2 115kV
Fres-SP-T-69	McCall-Cal Ave 115kV (McCall-Danish Creamery Section worst)	McCall-West Fresno & California Ave-Sanger 115kV	C3	L-1-1	98%	103%	115%	Reconductor McCall-Cal Ave 115kV
Fres-SP-T-70	Cal Ave-Sanger 115kV	McCall-West Fresno & McCall-California Ave 115kV	C3	L-1-1	96%	100%	108%	Reconductor Cal Ave-Sanger 115kV
Fres-SP-T-71	West Fresno-McCall 115kV	McCall-Cal Ave & Cal Ave-Sanger 115kV	C3	L-1-1	<90%	94%	104%	Reconductor West Fresno-McCall 115kV.
Fres-SP-T-72	Cal Ave-Sanger 115kV	McCall-Cal Ave & McCall-West Fresno 115kV	C3/C5	L-2	96%	100%	108%	Reconductor Cal Ave-Sanger 115kV
Fres-SP-T-73	Herndon-Ashlan 230kV (Herndon-Figarden Tap 1 Section)	Gregg-Herndon #1 & #2 230kV	C3/C5	L-2	102%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan. Helms RAS mitigates
Fres-SP-T-74	Gregg-Ashlan 230kV (Gregg-Figarden 2 Tap worst)	Gregg-Herndon #1 & #2 230kV	C3/C5	L-2	134%	<90%	<90%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan. Helms RAS mitigates

San Onofre Nuclear Generation Station was retired on June 7, 2013 and therefore was removed from the base cases used for the 2013/14 ISO transmission planning process.

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

California ISO
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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-T-1	Kearney-Herndon 230kV	Gates-Gregg 230kV	B	L-1	<90%	<90%	108%	INC Helms PGP
Fres-NP-T-2	Gates-Gregg 230kV (Gates-Henrietta Tap Section)	Panoche-Kearney 230kV	B	L-1	<90%	<90%	103%	INC Helms PGP
Fres-NP-T-3	Exchequer-Le Grand 115kV	Merced-Merced Falls 70kV	B	L-1	<90%	103%	<90%	Exchequer SPS mitigates
Fres-NP-T-4	Panoche-Oro Loma 115kV (Panoche-Hammonds Section)	Panoche-Mendota 115kV	B	L-1	<90%	<90%	114%	INC Helms PGP
Fres-NP-T-5	Wilson-Oro Loma 115kV (Oro Loma-El Nido Section)	Warnerville-Wilson 230kV	B	L-1	<90%	<90%	103%	INC Helms PGP
Fres-NP-T-6	Kearney-Kerman 70kV (Fresno WW-Kerman Section worst)	Helm-Kerman 70kV	B	L-1	<90%	229%	<90%	INC Fresno WW gen or drop Kerman 70kV load
Fres-NP-T-7	Merced-Merced Falls 70kV	Bus Fault at Le Grand 115kV	C1	Bus	171%	173%	<90%	Exchequer SPS mitigates
Fres-NP-T-8	Merced Falls-Exchequer 70kV	Bus Fault at Le Grand 115kV	C1	Bus	204%	206%	105%	Exchequer SPS mitigates
Fres-NP-T-9	Merced #2 115/70kV	Bus Fault at Le Grand 115kV	C1	Bus	130%	137%	<90%	Exchequer SPS mitigates
Fres-NP-T-10	Exchequer-Le Grand 115kV	Bus Fault at Merced Falls 70kV	C1	Bus	99%	103%	<90%	Exchequer SPS mitigates
Fres-NP-T-11	Kearney-Herndon 230kV	Bus 1E Fault at Gates 230kV	C1	Bus	97%	<90%	123%	INC Helms PGP
Fres-NP-T-12	Wilson-Oro Loma 115kV (Oro Loma-El Nido Section)	Bus 1E Fault at Gates 230kV	C1	Bus	<90%	<90%	101%	INC Helms PGP

Study Area: PG&E Greater Fresno - Summer Off-Peak & Summer Light Load

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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-T-13	Gates-Gregg 230kV	Bus 1 Fault at McCall 230kV	C1	Bus	<90%	<90%	107%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan (Should already be accounted for by 2017.)
Fres-NP-T-14	McCall #2 230/115kV	Bus 2 Fault at McCall 230kV	C1	Bus	<90%	<90%	105%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan (Should already be accounted for by 2017.)
Fres-NP-T-15	Panoche-Oro Loma 115kV (Panoche-Hammonds Section)	Bus 1 Fault at Panoche 115kV	C1	Bus	<90%	<90%	108%	INC Helms PGP
Fres-NP-T-16	Borden-Madera #2 70kV	Bus E Fault at Borden 70kV	C1	Bus	<90%	<90%	103%	Check impedances of same conductor parallel lines in base case
Fres-NP-T-17	Oro Loma #2 115/70kV	Bus Fault at Los Banos 70kV	C1	Bus	131%	<90%	<90%	Mercy Springs 230kV substation mitigates - Action Plan
Fres-NP-T-18	Coalinga #1-Coalinga #2 70kV (Tornado Jct-Coalinga 1 Section)	Bus Fault at Coalinga 2 70kV	C1	Bus	107%	109%	101%	Upgrade Coalinga 2 70kV to BAAH
Fres-NP-T-19	Herndon-Bullard #1 115kV (Bullard-Pinedale Section)	Bus 1 Fault at Herndon 115kV	C1	Bus	N/A	N/A	103%	Herndon-Bullard 115kV OL SPS
Fres-NP-T-20	Herndon-Bullard #2 115kV (Bullard-Pinedale Section)	Bus 2 Fault at Herndon 115kV	C1	Bus	N/A	N/A	134%	Herndon-Bullard 115kV OL SPS
Fres-NP-T-21	Herndon-Barton 115kV	Bus 2 Fault at Herndon 115kV	C1	Bus	N/A	N/A	125%	Recondcutor line with 477 SSAV rated 224 MVA SN/SE

Study Area: PG&E Greater Fresno - Summer Off-Peak & Summer Light Load

California ISO
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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-T-22	Barton-Airways-Sanger 115kV	Bus 2 Fault at Herndon 115kV	C1	Bus	N/A	N/A	167%	Reconductor Barton-Airways-Sanger 115kV line. Recommend BAAH at Herndon 115kV
Fres-NP-T-23	Panoche-Gates #1 230kV	Gates 230kV CB312 Failure	C2	Breaker	107%	<90%	<90%	Use congestion management to mitigate
Fres-NP-T-24	Oro Loma #2 115/70kV	Panoche 230kV CB202 Failure	C2	Breaker	<90%	<90%	177%	INC Panoche 115kV generation
Fres-NP-T-25	Los Banos-Canal-Oro Loma #1 70kV (Oro Loma-Mercy Springs Section)	Panoche 230kV CB202 Failure	C2	Breaker	<90%	<90%	138%	INC Panoche 115kV generation
Fres-NP-T-26	Schinder-Huron-Gates 70kV (Calflax-Huron Jct Section)	Panoche 230kV CB202 Failure	C2	Breaker	103%	<90%	115%	INC Panoche 115kV generation
Fres-NP-T-27	Merced Falls-Exchequer 70kV (McSwain-Exchequer Section worst)	Wilson 115kV CB102 Failure	C2	Breaker	175%	<90%	<90%	North Merced 230/115kV Substation Project mitigates in later years - Action Plan
Fres-NP-T-28	Merced-Merced Falls 70kV	Wilson 115kV CB102 Failure	C2	Breaker	<90%	<90%	152%	INC Fresno Generation
Fres-NP-T-29	Oro Loma #2 115/70kV	Los Banos #3 & #4 230/70kV	C3	T-1-1	170%	<90%	<90%	INC Helms PGP
Fres-NP-T-30	Oro Loma #2 115/70kV	Panoche-Oro Loma 115kV & Panoche-Mendota 115kV	C3	T-1-1	<90%	<90%	122%	INC Helms PGP
Fres-NP-T-31	Borden-Glass 70kV	Borden-Madera #1 & #2 70kV	C3	L-1-1	<90%	<90%	104%	Reconductor Borden-Glass 70kV
Fres-NP-T-32	Kearney #2 230/70kV	Helm-Kerman 70kV & Kearney #4 230/70kV	C3	L-1/T-1	N/A	<90%	131%	Drop Kerman 70kV load.

Study Area: PG&E Greater Fresno - Summer Off-Peak & Summer Light Load

California ISO
Shaping a Renewed Future

Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-T-33	Coalinga 1-Coalinga 2 70kV (Tornado Tap-Pennzier Tap Section)	Schindler #1 115/70kV & Gates #5 230/70kV	C3	T-1-1	<90%	<90%	110%	Recommend SPS for loss of Gates #5 230/70, Schindler #1 115/70kV, or Schindler-Huron-Gates 70kV
Fres-NP-T-34	Los Banos-Canal-Oro Loma #1 70kV (Oro Loma-Mercy Springs Section) (2015 Case) Oro Loma-Mercy Springs 70kV (2018 & Later)	Panoche Oro-Loma 115kV & Panoche-Mendota 115kV	C3	L-1-1	<90%	<90%	111%	INC Helms PGP
Fres-NP-T-35	Panoche-Oro Loma 115kV (Panoche-Hammonds Section)	Warnerville-Wilson 230kV & Panoche-Mendota 115kV	C3	L-1-1	<90%	<90%	144%	INC Helms PGP
Fres-NP-T-36	Wilson-Oro Loma 115kV (Oro Loma-El Nido Section)	Warnerville-Wilson & Panoche-Kearney 230kV	C3	L-1-1	<90%	<90%	142%	INC Helms PGP
Fres-NP-T-37	Wilson-Le Grand 115kV	Kerckhoff-Clovis-Sanger #1 & #2 115kV	C3/C5	L-2	105%	N/A	N/A	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-NP-T-38	Henrietta #3 230/115kV	Gates-McCall & Helm-McCall 230kV	C3	L-1-1	<90%	<90%	123%	INC McCall 115kV generation
Fres-NP-T-39	Any McCall 230/115kV	Any two McCall 230/115kV	C3	T-1-1	<90%	<90%	143%	INC McCall 115kV generation
Fres-NP-T-40	GWF-Henrietta 115kV (Henrietta-Leprino Foods Jct Section)	Helm-McCall & Gates-McCall 230kV	C3/C5	L-2	<90%	<90%	119%	McCall UVLS may operate. INC generation.
Fres-NP-T-41	GWF-Kingsburg 115kV	Gates-McCall & Helm-McCall 230kV	C3/C5	L-2	<90%	<90%	102%	McCall UVLS may operate. INC generation.
Fres-NP-T-42	Kings River-Sanger-Reedley 115kV (Sanger-Rainbow Tap Section)	Sanger-Reedley and McCall-Reedley (McCall-Wahtoke) 115kV	C3	L-1-1	<90%	<90%	135%	Reconductor Sanger Reedley 115kV or add second line

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

California ISO
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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-T-43	Remaining McCall-Kingsburg 115kV	McCall-Kingsburg #1 OR #2 115kV & Henrietta #3 230/115kV	C3	L-1/T-1	<90%	<90%	121%	Reconductor McCall-Kingsburg #1 & #2 115kV
Fres-NP-T-44	Wilson-Borden #1 230kV (Wilson-Storey 1 Section)	Gates-Gregg & Gates-McCall 230kV	C3	L-1-1	<90%	<90%	101%	HRAS Mitigates
Fres-NP-T-45	Panoche-Helm 230kV	Gates-Gregg & Gates-McCall 230kV	C3/C5	L-2	<90%	<90%	101%	INC Helms PGP
Fres-NP-T-46	Manchester-Airways-Sanger 115kV (Manchester-Airways Jct Section worst)	Barton-Airways-Sanger 115kV and Woodward-Shepherd 115kV	C3	L-1-1	109%	<90%	<90%	Trip another Helms PGP pump
Fres-NP-T-47	Barton-Airways-Sanger 115kV (Airways-Sanger Section worst)	Manchester-Airways-Sanger 115kV & Woodward-Shepherd 115kV	C3	L-1-1	109%	<90%	<90%	Trip another Helms PGP pump
Fres-NP-T-48	Borden #1 230/70kV	Borden #2 230/70kV & Coppermine-Friant 70kV	C3	L-1/T-1	<90%	<90%	104%	INC Wishon PH
Fres-NP-T-49	Remaining Borden-Madera 70kV	Borden-Madera #1 OR #2 & Borden-Glass 70kV	C3	L-1-1	<90%	<90%	104%	Reconductor Borden-Madera #1 & #2 70kV
Fres-NP-T-50	Chowchilla-Kerckhoff 2 115kV (Certainteed Jct-Sharon Tap Section)	Gates-Gregg & Gates-McCall 230kV	C3	L-1-1	<90%	<90%	123%	INC Helms PGP
Fres-NP-T-51	Exchequer-Le Grand 115kV	Wilson-Le Grand 115kV & Merced-Merced Falls 70kV	C3	L-1-1	<90%	100%	<90%	Exchequer SPS mitigates
Fres-NP-T-52	Gates-Gregg 230kV (Gates-Henrietta Tap Section)	Gates-McCall & Helm-McCall 230kV	C3/C5	L-2	<90%	<90%	127%	HRAS Mitigates
Fres-NP-T-53	Gates-McCall 230kV (Gates-Henrietta Tap 2 Section)	Gates-Gregg & Helm-McCall 230kV	C3	L-1-1	<90%	<90%	114%	INC Helms PGP
Fres-NP-T-54	Kearney-Herndon 230kV	Gates-Gregg & Gates-McCall 230kV	C5	L-2	109%	<90%	<90%	Trip another Helms PGP pump

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

California ISO
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Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-T-55	Wilson-Gregg 230kV (Wilson-Storey 1 Section)	Gates-Gregg & Gates-McCall 230kV	C3	L-1-1	<90%	<90%	107%	HRAS Mitigates
Fres-NP-T-56	Wilson-Gregg 230kV (Wilson-Storey 1 Section)	Gates-Gregg & Panoche-Kearney 230kV	C3	L-1-1	<90%	<90%	107%	HRAS Mitigates
Fres-NP-T-57	Herndon-Kearney 230kV	Gates-Gregg & Gates-McCall 230kV	C3	L-1-1	<90%	<90%	152%	HRAS Mitigates
Fres-NP-T-58	Panoche-Gates #1 OR #2 230kV	Gates-Gregg & Gates-McCall 230kV	C5	L-2	102%	<90%	<90%	Use congestion management to mitigate
Fres-NP-T-59	Gates-McCall 230kV (Gates-Henrietta Tap 2 Section)	Panoche-Kearney & Gates-Gregg 230kV	C5	L-2	<90%	<90%	108%	INC Helms PGP
Fres-NP-T-60	Panoche-Oro Loma 115kV (Panoche-Hammonds Section worst)	Panoche-Kearney & Gates-Gregg 230kV	C5	L-2	<90%	<90%	113%	INC Helms PGP
Fres-NP-T-61	Barton-Airways-Sanger 115kV	Panoche-Kearney & Gates-Gregg 230kV	C5	L-2	121%	<90%	<90%	Future project mitigates later years. Action Plan
Fres-NP-T-62	Manchester-Airways-Sanger 115kV	Panoche-Kearney & Gates-Gregg 230kV	C5	L-2	125%	<90%	<90%	Future project mitigates later years. Action Plan
Fres-NP-T-63	Wilson-Oro Loma 115kV (Le Grand Jct-El Nido Section worst)	Panoche-Kearney & Gates-Gregg 230kV	C5	L-2	<90%	<90%	137%	INC Helms PGP
Fres-NP-T-64	Wilson-Borden #1 230kV (Wilson-Storey 1 Section)	Panoche-Kearney & Gates-Gregg 230kV	C5	L-2	<90%	<90%	105%	INC Helms PGP
Fres-NP-T-65	Herndon-Barton 115kV	Panoche-Kearney & Gates-Gregg 230kV	C5	L-2	109%	<90%	<90%	Future project mitigates later years. Action Plan
Fres-NP-T-66	Manchester-Herndon 115kV	Panoche-Kearney & Gates-Gregg 230kV	C5	L-2	102%	<90%	<90%	Future project mitigates later years. Action Plan
Fres-NP-T-67	Gates-Gregg 230kV (Gates-Henrietta Tap Section)	Helm-McCall & Gates-McCall 230kV	C5	L-2	<90%	<90%	127%	INC Helms PGP

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

Thermal Overloads

ID	Overloaded Facility	Worst Contingency	Category	Category Description	Loading (%)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-T-68	Henrietta #3 230/115kV	Helm-McCall & Gates-McCall 230kV	C5	L-2	<90%	<90%	123%	INC Helms PGP
Fres-NP-T-69	Chowchilla-Kerckhoff #2 115kV	Kerckhoff-E2 #1 & #2 115 kV Lines	C5	L-2	<90%	101%	<90%	Kerckhoff 2 RAS mitigates

Study Area: **PG&E Greater Fresno - Summer Peak**

Voltage Deviations

ID	Substation	Worst Contingency	Category	Category Description	Post Cont. Voltage Deviation %			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-VD-1	Mendota 115kV Area (Mendota 115kV worst)	Panoche-Mendota 115kV	B	L-1	12.57%	<5%	<5%	Future project mitigates later years. Action Plan
Fres-SP-VD-2	Exchequer 70kV Area (Mariposa 70kV worst)	Exchequer-Le Grand 115kV	B	L-1	10.85%	10.43%	12.02%	Mariposa UVLS mitigates
Fres-SP-VD-3	Oro Loma 70kV Area (Firebaugh and Oro Loma 70kV worst)	Oro Loma #2 115/70kV	B	T-1	8.07%	N/A	N/A	Mercy Springs 230kV substation mitigates - Action Plan
Fres-SP-VD-4	Chowchilla 115kV Area (Chowchilla 115kV worst)	Le Grand-Chowchilla 115kV	B	L-1	6.92%	7.24%	7.23%	New project to loop Chowchilla CoGen into Chowchilla 115kV to eliminate tap line or loop Dairyland-Le Grand 115kV through Chowchilla 115kV
Fres-SP-VD-5	Corcoran 70kV Area (Angiola 70kV worst)	Kingsburg-Corcoran #2 115kV	B	L-1	5.36%	5.89%	5.92%	Add dynamic reactive support in Corcoran 115kV or 70kV area.
Fres-SP-VD-6	Dinuba 70kV	Reedley-Dinuba 70kV	B	L-1	7.79%	<5%	<5%	Future project mitigates later years. Action Plan
Fres-SP-VD-7	Borden 230kV	Borden-Gregg 230kV	B	L-1	5.29%	<5%	<5%	New project that loops Wilson-Gregg 230kV through Borden mitigates deviation.
Fres-SP-VD-8	Kerman 70kV	Helm-Kerman 70kV	B	L-1	<5%	<5%	12.38%	SPS to drop load for loss of Helm-Kerman 70kV or cut out load transfer for loss of Helm-Kerman 70kV
Fres-SP-VD-9	Exchequer 70kV Area (Yosemite 70kV worst)	Exchequer-Le Grand 115kV & McSwain Unit	B	L-1/G-1	15.09%	14.91%	16.68%	Add dynamic reactive support in Exchequer 70kV area
Fres-SP-VD-10	Los Banos 70kV Area (Ortiga 70kV Worst)	Bus Fault at Los Banos 70kV	C1	Bus	24.40%	<10%	<10%	Mercy Springs 230kV substation mitigates - Action Plan
Fres-SP-VD-11	Mendota 115kV	Bus 1 Fault at Panoche 115kV	C1	Bus	12.39%	<10%	<10%	Approved project to add new line, Oro Loma-Mendota 115kV, mitigates later years. Action Plan
Fres-SP-VD-12	Mariposa 2 70kV	Bus Fault at Exchequer 115kV	C1	Bus	<10%	<10%	10.96%	Mariposa UVLS mitigates
Fres-SP-VD-13	Herndon 115kV Area (Pinedale 115kV worst)	Bus 2 Fault at Herndon 115kV	C1	Bus	33.56%	35.45%	37.78%	Cut-in Herndon-Bullard OL SPS. This SPS should mitigate OL, LV, & Dev problems.

Study Area: **PG&E Greater Fresno - Summer Peak**

Voltage Deviations

ID	Substation	Worst Contingency	Category	Category Description	Post Cont. Voltage Deviation %			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-VD-14	Wilson 115kV area	Wilson CB102 Breaker Failure	C2	Breaker	0.00%	<10%	<10%	Wilson 115kV Area Reinforcement Project mitigates in later years - Action Plan
Fres-SP-VD-15	McCall 115kV and Reedley 70kV Areas	McCall CB202 Breaker Failure	C2	Breaker	11.20%	<10%	<10%	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-VD-16	Mendota 115kV	Panoche CB102 Breaker Failure	C2	Breaker	12.75%	<10%	N/A	Approved project to add new line, Oro Loma-Mendota 115kV, mitigates later years.
Fres-SP-VD-17	Pinedale 115kV	Herndon CB202 Breaker Failure	C2	Breaker	8.83%	<10%	10.11%	Cut-in Herndon-Bullard OL SPS. This SPS should mitigate OL, LV, & Dev problems.
Fres-SP-VD-18	Shepherd 115kV	Gregg-E1 #1 & #2 230kV lines	C3/C5	L-2	N/A	11.00%	<10%	Update Helms RAS.
Fres-SP-VD-19	Atwater 115kV Area (Atwater 115kV worst)	Wilson #1 & #2 230/115kV	C3	T-1-1	11.81%	N/A	N/A	Wilson 115kV Area Reinforcement Project mitigates in later years - Action Plan
Fres-SP-VD-20	Oro Loma 70kV Area (Los Banos 70kV worst)	Los Banos #3 & #4 230/70kV	C3	T-1-1	37.23%	N/A	N/A	Mercy Springs 230kV substation mitigates - Action Plan
Fres-SP-VD-21	Coalinga 70kV Area (Schindler 70kV worst)	Gates #5 230/70kV & Schindler #1 115/70kV	C3	T-1-1	23.15%	24.22%	26.03%	Add dynamic reactive support at Coalinga 2 70kV
Fres-SP-VD-22	Wilson 115kV Area (Gallo 115kV worst)	Wilson #1 & #2 230/115kV	C3	T-1-1	11.93%	N/A	N/A	Wilson 115kV Area Reinforcement Project mitigates in later years - Action Plan
Fres-SP-VD-23	Mendota 115kV	Panoche-Oro Loma & Panoche-Mendota 115kV	C3	L-1-1	12.73%	N/A	N/A	Future project mitigates later years. Action Plan
Fres-SP-VD-24	Newhall 115kV	Panoche-Mendota & Dairyland-Le Grand 115kV	C3	L-1-1	18.09%	N/A	N/A	Future project mitigates later years. Action Plan
Fres-SP-VD-25	Reedley 70kV Area (Dunlap 70kV worst)	Sanger-Reedley & McCall-Reedley (McCall-Wahtoke Section) 115kV	C3	L-1-1	12.44%	10.32%	12.17%	Add dynamic reactive support at Reedley 115kV
Fres-SP-VD-26	West Fresno 115kV Area (West Fresno 115kV Worst)	McCall-West Fresno & Cal Ave-Sanger 115kV	C3	L-1-1	13.94%	15.15%	17.82%	Add dynamic reactive support at West Fresno 115kV

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

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Voltage Deviations

ID	Substation	Worst Contingency	Category	Category Description	Post Cont. Voltage Deviation %			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-VD-1	Chowchilla 115kV Area (Chowchilla 115kV worst)	Le Grand-Chowchilla 115kV	B	L-1	<5%	<5%	6.82%	New project to loop Chowchilla CoGen into Chowchilla 115kV to eliminate tap line or loop Dairyland-Le Grand 115kV through Chowchilla 115kV
Fres-NP-VD-2	Exchequer 70kV Area (Yosemite 70kV worst)	Exchequer-Le Grand 115kV	B	L-1	<5%	<5%	8.43%	Modify Exchequer SPS to run back, instead of drop unit for loss of Exchequer-Le Grand 115kV
Fres-NP-VD-3	Mendota 115kV	Panoche-Mendota 115kV	B	L-1	6.59%	<5%	<5%	Future project mitigates later years. Action Plan
Fres-NP-VD-4	Henrietta 115kV	Henrietta #3 230/115kV	B	T-1	<5%	<5%	5.78%	INC GWF Henrietta generation
Fres-NP-VD-5	Exchequer 70kV Area (Yosemite 70kV worst)	Exchequer-Le Grand 115kV & McSwain Unit	B	L-1/G-1	<5%	<5%	12.78%	Mariposa UVLS mitigates
Fres-NP-VD-6	Coalinga 70kV Area (Avenal 70kV worst)	Gates #5 230kV & Coalinga Generator	B	L-1/G-1	<5%	<5%	10.78%	Add second Gates 230/70kV
Fres-NP-VD-7	Kerman 70kV	Helm-Kerman 70kV	B	L-1	<5%	<5%	11.35%	SPS to drop load for loss of Helm-Kerman 70kV or cut out load transfer for loss of Helm-Kerman 70kV
Fres-NP-VD-8	Herndon 115kV Area (Pinedale 115kV worst)	Bus 2 Fault at Herndon 115kV	C1	Bus	<10%	<10%	32.45%	Cut-in Herndon-Bullard OL SPS. This SPS should mitigate OL, LV, & Dev problems.
Fres-NP-VD-9	El Nido 70kV	Bus Fault at Le Grand 115kV	C1	Bus	13.22%	13.53%	<10%	Exchequer PH SPS mitigates
Fres-NP-VD-10	Wilson 115kV Area (Gallo 115kV worst)	Wilson CB102 Failure	C2	Breaker	48.64%	<10%	<10%	Wilson 115kV Area Reinforcement Project mitigates in later years - Action Plan
Fres-NP-VD-11	Cheney 115kV	Panoche CB102 Failure	C2	Breaker	<10%	<10%	11.96%	INC Wellhead Panoche
Fres-NP-VD-12	System Wide Low Voltage	Gates-Gregg & Gates-McCall 230kV	C3/C5	L-2	N/A	N/A	20.00%	Third Gates-Gregg 230kV will mitigate. INC Helms PGP.
Fres-NP-VD-13	Oro Loma 70kV Area (Los Banos 70kV & Pacheco PP worst)	Los Banos #3 & #4 230/70kV	C3	T-1-1	15.41%	N/A	N/A	Future project mitigates later years. Action Plan

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

Voltage Deviations

ID	Substation	Worst Contingency	Category	Category Description	Post Cont. Voltage Deviation %			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-VD-14	Firebaugh 70kV	Los Banos-Canal-Oro Loma 70kV & Oro Loma #2 115/70kV	C3	L-1/T-1	10.61%	N/A	N/A	Future project mitigates later years. Action Plan
Fres-NP-VD-15	Coalinga 70kV Area (Schindler 70kV worst)	Gates #5 230kV & Schindler #1 115/70kV	C3	T-1-1	N/A	N/A	29.31%	Add second Gates 230/70kV
Fres-NP-VD-16	Mendota 115kV	Wilson-Le Grand & Panoche-Mendota 115kV	C3	L-1-1	11.86%	N/A	N/A	Future project mitigates. Action Plan
Fres-NP-VD-17	Dairyland 115kV	Le Grand-Dairyland & Panoche-Mendota 115kV	C3	L-1-1	<10%	<10%	11.72%	INC Helms PGP
Fres-NP-VD-18	West Fresno 115kV Area (West Fresno 115kV Worst)	McCall-West Fresno & Cal Ave-Sanger 115kV	C3	L-1-1	<10%	<10%	11.74%	Add dynamic reactive support at West Fresno 115kV
Fres-NP-VD-19	Kingsburg 115kV Area (Corcoran 115kV worst)	McCall-Kingsburg #1 & #2 115kV	C5	L-2	N/A	N/A	15.45%	INC GWF Henrietta generation

Study Area: **PG&E Greater Fresno - Summer Peak**

High/Low Voltage

ID	Substation	Worst Contingency	Category	Category Description	Voltage (PU)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-V-1	Firebaugh 70kV	Oro Loma #2 115/70kV	B	T-1	0.90	>0.90	>0.90	Mercy Springs 230kV substation mitigates - Action Plan
Fres-SP-V-2	Mendota 115kV Area (Mendota 115kV worst)	Panoche-Mendota 115kV (Paramount Farms new load interconnection)	B	L-1	0.89	>0.90	>0.90	Future project mitigates later years. Action Plan
Fres-SP-V-3	Exchequer 70kV Area (Mariposa 70kV worst)	Exchequer-Le Grand 115kV	B	L-1	0.89	0.90	0.88	Mariposa UVLS mitigates
Fres-SP-V-4	Mariposa 2 70kV	Bus Fault at Exchequer 115kV	C1	Bus	>0.90	>0.90	0.89	Mariposa UVLS mitigates
Fres-SP-V-5	Bullard 115kV	Bus 2 Fault at Herndon 115kV	C1	Bus	0.65	0.66	0.63	Herndon-Bullard OL SPS mitigates
Fres-SP-V-6	Reedley 70kV Area (Dunlap 70kV worst)	Bus 2 Fault at Herndon 115kV	C1	Bus	0.89	>0.90	>0.90	Reedley 70kV Area Reinforcement Project mitigates later years. Action Plan
Fres-SP-V-7	Los Banos 70kV Area (Ortiga 70kV Worst)	Bus Fault at Los Banos 70kV	C1	Bus	0.77	>0.90	>0.90	Mercy Springs 230kV substation mitigates - Action Plan
Fres-SP-V-8	Wilson 115kV area	Wilson CB102 Breaker Failure	C2	Breaker	0.00	>0.90	>0.90	Wilson 115kV Area Reinforcement Project mitigates in later years - Action Plan
Fres-SP-V-9	McCall 115kV and Reedley 70kV Areas	McCall CB202 Breaker Failure	C2	Breaker	0.86	>0.90	>0.90	North Fresno 115kV Reinforcement Project mitigates in later years - Action Plan
Fres-SP-V-10	Mendota 115kV	Panoche CB102 Breaker Failure	C2	Breaker	0.89	>0.90	>0.90	Approved project to add new line, Oro Loma-Mendota 115kV, mitigates later years. Action Plan
Fres-SP-V-11	Pinedale 115kV	Herndon CB202 Breaker Failure	C2	Breaker	0.89	>0.90	0.90	Cut-in Herndon-Bullard OL SPS. This SPS should mitigate OL, LV, & Dev problems.
Fres-SP-V-12	Shepherd 115kV	Gregg-E1 #1 & #2 230kV lines	C5	L-2	>0.90	0.89	>0.90	Update Helms RAS.
Fres-SP-V-13	Exchequer 70kV Area (Yosemite 70kV)	Exchequer-Le Grand 115kV & Exchequer-Mariposa 70kV	C3	L-1-1	0.84	0.84	0.82	Modify Exchequer SPS to run back, instead of drop unit for loss of Exchequer-Le Grand 115kV

Study Area: **PG&E Greater Fresno - Summer Peak**

High/Low Voltage

ID	Substation	Worst Contingency	Category	Category Description	Voltage (PU)			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-V-14	Borden 230kV	Borden-Gregg & Warnerville-Wilson 230kV	C3	L-1-1	0.90	>0.90	>0.90	Approved Pproject to loop Wilson-Gregg 230kV through Borden 230kV mitigates later years. Action Plan
Fres-SP-V-15	Atwater 115kV Area	Wilson#1 & #2 230/115kV	C3	T-1-1	0.89	>0.90	>0.90	Wilson 115kV Area Reinforcement Project mitigates in later years - Action Plan
Fres-SP-V-16	Oro Loma 70kV Area (Los Banos 70kV worst)	Los Banos #3 & #4 230/70kV	C3	T-1-1	0.68	>0.90	>0.90	Mercy Springs 230kV substation mitigates - Action Plan
Fres-SP-V-17	Mendota 115kV	Panoche-Mendota & Wilson-Le Grand 115kV	C3	L-1-1	0.79	>0.90	>0.90	Future project mitigates. Action Plan
Fres-SP-V-18	West Fresno 115kV Area (West Fresno 115kV Worst)	McCall-West Fresno & Cal Ave-Sanger 115kV	C3	L-1-1	0.84	0.83	0.79	Add dynamic reactive support at West Fresno 115kV
Fres-SP-V-19	Reedley 70kV Area (Dunlap 70kV worst)	Sanger-Reedley & McCall-Reedley (McCall-Wahtoke Section) 115kV	C3	L-1-1	0.89	>0.90	0.91	Reedley 70kV Area Reinforcement Project mitigates later years. Action Plan

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

High/Low Voltage

ID	Substation	Worst Contingency	Category	Category Description	Voltage (PU)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-V-1	System wide (Oro Loma 70kV worst)	None	A	N-0	<1.05	1.08	<1.05	INC Fresno Area generation
Fres-NP-V-2	Exchequer 70kV Area (Yosemite 70kV worst)	Exchequer-Le Grand 115kV & McSwain Unit	B	L-1/G-1	>0.90	>0.90	0.88	Mariposa UVLS mitigates
Fres-NP-V-3	Coalinga 70kV Area (Avenal 70kV worst)	Gates #5 230kV & Coalinga Generator	B	L-1/G-1	>0.90	>0.90	0.87	Add second Gates 230/70kV
Fres-NP-V-4	Los Banos 70kV Area (Los Banos 70kV worst)	Los Banos #4 230/70kV	B	T-1	<1.10	1.10%	<1.10	Adjust taps in area to lower precontingency voltage to meet CAISO planning standards for voltage
Fres-NP-V-5	Herndon 115kV Area (Pinedale 115kV worst)	Bus 2 Fault at Herndon 115kV	C1	Bus	>0.90	>0.90	0.68	Cut-in Herndon-Bullard OL SPS. This SPS should mitigate OL, LV, & Dev problems.
Fres-NP-V-6	Kearney 70kV Area (Fresno WW 70kV worst)	Bus 1 Fault at Herndon 230kV	C1	Bus	<1.10	1.12	<1.10	Adjust taps in area to lower precontingency voltage to meet CAISO planning standards for voltage
Fres-NP-V-7	Henrietta 230kV	Bus 1E Fault at Gates 230kV	C1	Bus	>0.90	>0.90	0.89	INC Helms PGP, INC GWF Henrietta generation
Fres-NP-V-8	El Nido 70kV	Bus Fault at Le Grand 115kV	C1	Bus	0.88	>0.90	>0.90	Exchequer PH SPS mitigates
Fres-NP-V-9	Kingsburg 70kV Area (Angiola 70kV worst)	McCall CB202 Breaker Failure	C2	Breaker	>0.90	>0.90	0.68	System wide low voltage
Fres-NP-V-10	Wilson 115kV Area (Gallo 115kV worst)	Wilson CB102 Failure	C2	Breaker	0.53	>0.90	>0.90	Wilson 115kV Area Reinforcement Project mitigates in later years - Action Plan
Fres-NP-V-11	System Wide Low Voltage	Gates-Gregg & Gates-McCall 230kV	C3/C5	L-2	>0.90	>0.90	0.80	INC Helms PGP
Fres-NP-V-12	Oro Loma 70kV Area (Pacheco PP 70kV worst)	Los Banos #3 & #4 230/70kV	C3	T-1-1	0.89	>0.90	>0.90	Future project mitigates. Action Plan
Fres-NP-V-13	Coalinga 70kV Area (Avenal 70kV worst)	Gates #5 230kV & Schindler #1 115/70kV	C3	T-1-1	>0.90	>0.90	0.68	Add second Gates 230/70kV

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

High/Low Voltage

ID	Substation	Worst Contingency	Category	Category Description	Voltage (PU)			Potential Mitigation Solutions
					2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fres-NP-V-14	Dairyland 115kV	Le Grand-Dairyland & Panoche-Mendota 115kV	C3	L-1-1	>0.90	>0.90	0.88	INC Helms PGP
Fres-NP-V-15	West Fresno 115kV Area (West Fresno 115kV Worst)	McCall-West Fresno & Cal Ave-Sanger 115kV	C3	L-1-1	>0.90	>0.90	0.85	Add dynamic reactive support at West Fresno 115kV
Fres-NP-V-16	Kingsburg 115kV Area (Corcoran 115kV worst)	McCall-Kingsburg #1 & #2 115kV	C5	L-2	>0.90	>0.90	0.82	INC GWF Henrietta generation

Study Area: **PG&E Greater Fresno - Summer Peak**

Post-Transient Voltage Deviations

ID	Substation	Worst Contingency	Category	Category Description	Post Cont. Voltage Deviation %			Potential Mitigation Solutions
					2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fres-SP-PTVD-1	Herndon 115kV Area	Herndon CB202 failure	C9	SLG Bus Section Fault with delayed clearing	NOT SOLVED	N/A	N/A	North Fresno 115kV Area Reinforcement Project mitigates. Action Plan.
Fres-SP-PTVD-2	Reedley, Sanger, & McCall 115kV Areas	McCall CB202 failure	C9	SLG Bus Section Fault with delayed clearing	NOT SOLVED	N/A	N/A	North Fresno 115kV Area Reinforcement Project mitigates. Action Plan.

Study Area: **PG&E Greater Fresno - Summer Peak**

Single Contingency Load Drop

ID	Worst Contingency	Category	Category Description	Amount of Load Drop (MW)			Potential Mitigation Solutions
				2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	

No single contingency resulted in total load drop of more than 250 MW.

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

Single Contingency Load Drop

ID	Worst Contingency	Category	Category Description	Amount of Load Drop (MW)			Potential Mitigation Solutions
				2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	

No single contingency resulted in total load drop of more than 250 MW.

Study Area: **PG&E Greater Fresno - Summer Peak**

Single Source Substation with more than 100 MW Load

ID	Substation	Load Served (MW)			Potential Mitigation Solutions
		2015 Summer Peak	2018 Summer Peak	2023 Summer Peak	
Fresno-SP-SS-1	Henrietta 230kV	153	157	167	Momentary load drop for loss of Gates-Gregg 230kV before transfer to Gatest-McCall 230kV. Recommend BAAH at Henrietta 230kV to mitigate. This contingency will activate the Henrietta RAS before switching to alternate 230kV source.

Study Area: **PG&E Greater Fresno - Summer Off-Peak & Summer Light Load**

Single Source Substation with more than 100 MW Load

ID	Substation	Load Served (MW)			Potential Mitigation Solutions
		2015 Summer Off-Peak	2018 Summer Light Load	2018 Summer Partial Peak	
Fresno-NP-SS-1	Henrietta 230kV	75	65	143	Momentary load drop for loss of Gates-Gregg 230kV before transfer to Gatest-McCall 230kV. Recommend BAAH at Henrietta 230kV to mitigate. This contingency will activate the Henrietta RAS before switching to alternate 230kV source.