2011 CTPG Study Assumptions

November 1, 2011

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1 Introduction

The California Transmission Planning Group (CTPG) is a forum for conducting joint transmission planning studies consistent with Federal Energy Regulatory Commission (FERC) Order 890 principles and for coordinating CTPG members' transmission planning activities. The CTPG members include both transmission owners and operators who are subject to North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) transmission planning standards. The primary objective of CTPG has been to provide a foundation for a statewide transmission plan that identifies the transmission infrastructure needed to reliably meet California's 33% Renewable Portfolio Standard (RPS) goal by the year 2020.

An important qualification is that CTPG is not a transmission or generation project decision making body. The CTPG members that are planning entities for their Balancing Authority Areas (BAA) will make such decisions. The statewide plan is intended to be conceptual rather than prescriptive, in keeping with CTPG's purpose. As such, the CTPG regularly requests and consolidates information on renewable projects from its members and state agencies to develop a likely snapshot of California's generation portfolio at some future time. This snapshot is then studied to identify regional transmission issues and propose potential transmission infrastructure additions that address those issues.

In 2011, the CTPG continues the study of the state's 2020 transmission infrastructure needs by building upon the work completed in 2010. Phase 1 of the 2011 efforts consists of developing the basis for the assumptions used in the transmission planning studies. This document provides a summary of the information collected by CTPG in 2011 and the resulting assumptions to be used in the transmission planning studies.

2 2020 Renewable Energy Planning Target (Net Short)

The state of California Renewable Portfolio Standard (RPS) goal for the year 2020 is 33% of retail electricity sales. The amount of energy from renewable resources that will be needed to meet the state's goal after taking into account existing and under-construction renewable energy generation, and the expected incremental impact of programs to reduce retail load (energy efficiency, demand response, on-site generation) is called the renewable "net short".

The CTPG updated the amount of renewable energy resource additions, "net short", that will be required between 2011 and 2020 to meet the 33% RPS requirement for the state of California. Net short updates are being considered in the development of the CEC's 2011 Integrated Energy Policy Report with energy efficiency, CHP and distributed photovoltaic as key variables. The CEC staff's May 2011 forecast update includes a range of forecasts ("Updated Low", "Updated Mid" and "Updated High") and, correspondingly, a range of renewable net shorts. As detailed in Table 1, CTPG will utilize the "High" Net Short estimate.

Table 1: 2020 CTPG Net Short
(CEC "Updated High")

GWH	
305,256	**2020 CEC Energy Demand Forecast (May 2011)**
	Energy not subject to RPS
3,320	Central Valley Project Pump Load
1,507	Metropolitan Water District Pump Load
8,729	Department of Water Resources Pump Load
15,200	Energy Efficiency
2,336	Private Photovaltaic
-	Combined Heat and Power
274,164	**Retail sales subject to RPS**
90,474	**Renewable Generation Requirement (33%)**
43,500	Existing Renewables
46,974	**CEC Staff Renewable Net Short**
	CPUC Approved Solar PV Program
1,008	SCE
105	SDG&E
1,008	PG&E
44,852	**CTPG Renewable Net Short**

3 Existing Renewable Generation

The objective of this effort was to assure that the WECC seed cases used for the CTPG 2011 studies accurately modeled the types, amounts and locations of existing renewable energy resources located within California or directly interconnected with the California grid that were in-service as of December 31, 2010. A summary of such existing renewable generation in-service by resource type obtained from CEC draft QFER data as of early-April 2011 is provided in Table 2. With the assistance of the CTPG membership, the WECC seed cases were reviewed to identify which of the various units/plants were explicitly modeled in the seed cases and which were "load netted" and to determine if there were units/plants listed in the CEC data that needed to be added to the seed cases. The data obtained from this review was used to prepare change files to update the 2020 seed cases to include those units/plants that should be explicitly modeled.

The data in Table 2 indicates that, on an annual basis, the capacity factor for the existing wind generation would be approximately 18% which would be expected if the entire amount of wind capacity was not in-service for the entire year. Review of the CEC QFER data indicates that approximately 840 MW of wind generation (approximately 28% of the total amount in service at the end of 2010) was added during the year. If it was assumed that the full 3,019 MW of wind capacity had been in-service for all of 2010 and that the annual capacity factor of the installed

wind generation was 30%, the total wind generation during the year would have been approximately 7.9 GWH (an increase of about 3.1 GWH from the amount in Table 2). As a result, the total energy in Table 2 would increase to approximately 32 TWH.

Table 2: Existing In-State Renewable Generation as Of December 2010

Resource Type	Capacity (MW)	2010 Energy (TWH)	No. of Units/ Plants
Interconnected With California Grid			
Biomass	1,025	5.65	121
Geothermal	2,687	13.11	68
Small Hydro	1,169	4.18	210
Solar	429	0.91	21
Wind [1]	3,019	4.80	96
Total	8,329	28.65	516
Interconnected With Other Systems			
Biomass	20	0.04	1
Small Hydro	65	0.25	5
Total	85	0.29	6
Total Existing Renewables			
Biomass	1,045	5.69	122
Geothermal	2,687	13.11	68
Small Hydro	1,234	4.43	215
Solar	429	0.91	21
Wind	3,019	4.80	96
Total	8,414	28.94	522

In addition to the above existing in-state renewable generation, CEC reports indicate that in 2009 approximately 5.8 TWh of renewable generation utilized within California was located out-of-state. However, because no detail has been provided as to the location of these resources, the CTPG cannot, at this time, verify the existence of these facilities in the 2020 seed cases. Verifying that these facilities are modeled in the 2020 seed cases throughout the entire WECC would be a significant effort. The CTPG believes that, due to the accuracy of modeling of in-state resources, it is likely the out-of-state resources are also in the seed cases. Regardless, the CTPG 2011 Net Short accounted for these resources.

Also, in addition to the in-state and out-of-state renewable resources, the CEC identified approximately 4.6 TWh of renewable generation that is expected to be in-service by the end of 2011. The CTPG could not verify that all of these facilities were modeled in the base case. However, the CTPG believes that these facilities are also likely in the seed cases due to the

[1] CEC data did not include information as to the number of wind plants in service as of the end of 2010

accuracy of the modeled facilities prior to 2010. In the event the facilities expected to be completed this year are not currently modeled in the seed cases, it is expected these facilities will likely be inserted with the inclusion of the CPUC/POU discounted core since the core resources most accurately reflects the procurement plans of the state as of 2010.

Table 3 presents information regarding the capacity, annual energy, and number of units/plants by resource type which were identified as being explicitly modeled in the base cases (and interconnected with the California grid) or which were identified as being netted against the load at the pertinent high voltage busses.

Table 3 – Summary of Modeled and Load Netted Resources

Resource Type	Modeled Units			"Load Netted" Units		
	Capacity (MW)	2010 Energy (TWH)	No. of Units/ Plants	Capacity (MW)	2010 Energy (TWH)	No. of Units/ Plants
Biomass	846	4.73	50	179	0.92	71
Small Hydro	906	3.28	122	263	0.90	88
Solar	406	0.89	10	23	0.02	11
Total	2,158	8.90	182	465	1.84	170

As shown in Table 3, the total number of explicitly modeled biomass, small hydro, and solar units interconnected with the California grid is only slightly larger than the number of facilities that are load-netted. However, approximately 82% of the total capacity associated with the biomass, small hydro, and solar plants/units that are interconnected with the California grid is explicitly modeled in the base cases.

Table 4 presents information regarding the number and associated installed capacity of units/plants that were added to the three WECC seed cases as a result of the effort discussed above.

Table 4 – Summary of Units Added to Seed Cases

Resource Type	Summer Case		Spring & Fall Cases	
	Number of Units Added	Capacity Added MW)	Number of Units Added	Capacity Added MW)
Biomass	0	0	0	0
Geothermal	0	0	0	0
Small Hydro [2]	5	13	5	13
Solar [3]	1	5	1	5
Wind [4]	0	0	5	103
Total	6	18	11	121

[2] Units added to LADWP system in Owens Gorge area
[3] "Cal-Renew" unit added to PG&E system
[4] Hatchet Ridge project units added in spring case

When the small hydro and solar units were added to the data sets their status was set to "1" such that they were modeled as being on-line. However, the status of the wind units was set to "0" so as to match the "off-line" status of a majority of the existing wind units in the data sets.

Table 5 presents information comparing the capacity and number of units/plants by resource type interconnected to the California grid as presented in the CEC data to what was modeled in the seed cases after being modified to include the units shown in Table 4.

Table 5 – Comparison of CEC Data and "As Modeled" Data

Resource Type	Per CEC Data		In Data Sets	
	Capacity (MW)	No. of Units/ Plants	Capacity (MW)	No. of Units
"Modeled" Units				
Biomass	846	50	837	48
Geothermal	2,687	68	2,757	58
Small Hydro	906	122	952	105
Solar	406	10	390	10
Wind	3,019	96	3,024	96
Subtotal	7,864	346	7,960	317
"Load-Netted" Units				
Biomass	179	71		
Small Hydro	263	88		
Solar	23	11		
Subtotal	465	170		
Total	8,329	516		

As shown in Table 5 there are some differences between the number of units/plants contained in the CEC list to the number of units explicitly modeled in the seed cases. These differences are due to how various units/plants were "aggregated" in the CEC data compared to how they are modeled in the powerflow data. In addition, as shown in Table 5, the installed capacity of the "modeled" units in the powerflow data sets is about 95 MW (1.2%) higher than the capacity values from the CEC data. It is the CTPG's opinion that the modeling of the existing renewables (both with respect to the number of units and installed capacity) in the modified seed cases accurately reflects the information in the CEC data.

Review of the three seed cases (modified to add the resources summarized in Table 4) also indicated that a number of the existing renewable units/plants were modeled as "off-line". Table 6 summarizes these findings for the three cases. Review of the information in Table 6 indicates that in the "final" seed cases, the status of a number of units (particularly wind) will need to be changed so that these units are on-line in subsequent studies. The capacity modeled for these units (plus those already on-line) will also need to be adjusted, as appropriate, to be reflective of the seasonal/time-of-day conditions modeled in each of the various Scenarios discussed above.

Table 6 – Comparison of Total Units to "On-Line" Units

	Summer Case		Spring & Fall Cases	
	Total No. of Units	No. of On-line Units	Total No. of Units	No. of On-line Units
Biomass	48	44	48	43
Geothermal	58	56	58	54
Small Hydro	105	86	105	81
Solar	10	10	10	10
Wind	96	43	96	9
Total	317	239	317	197

4 Once-Through Cooling (OTC)

On May 4, 2010, the State Water Resources Control Board adopted a Statewide Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling (a.k.a. Once-Through Cooling or "OTC") under Resolution No. 2010-0020. The policy set specific compliance dates for fossil-fueled OTC plants and nuclear fueled power plants have compliance dates which coincide with the expiration of their respective Nuclear Regulatory Commission licenses which are beyond 2020.

California has sixteen coastal power plants, excluding Diablo Canyon and San Onofre nuclear power plants that use OTC technology. These plants have a combined capacity of 16,714 MW which includes six plants in northern California (total 5,499 MW), seven plants in southern California (total 8,516 MW), and three plants in the LADWP area (total 2,699 MW).

Plant owners/operators were required to submit implementation plans on April 1, 2011 to the Statewide Advisory Committee on Cooling Water Intake Structures. Where possible the CTPG will use information from the public implementation plans. Three of the 17 OTC plants have shut down or re-powered. The remaining 14 plants submitted implementation plans. Diablo Canyon and San Onofre will be modeled as base loaded.

Compliance options:

1. Retirement by compliance deadline.
2. Track 1 – Units are re-powered or retrofitted with closed cycle wet or dry cooling to decrease water inflow rate.
3. Track 2 – Comparable reduction in impingement mortality and entrainment using operational or structural measures. Must demonstrate Track 1 is not feasible.

Immediate and interim requirements must also be addressed with large organism exclusion devices and cease water intake on non-power generating units unless need is demonstrated.

The CTPG will review the need for generation within local areas in order to meet applicable local capacity requirements such as CAISO's "2013-2015 Local Capacity Technical Analysis, Report and Study Results" and similar studies made available by other Balancing Authorities. CTPG will assume OTC units are either repowered with efficient combined cycle technology, or with the newer generation of gas turbines, to meet local reliability requirements. No uncommitted transmission projects will be included. Adequate system support should be provided by following the local capacity requirements.

Based on the review of the implementation plans submitted by generator owners, the CTPG will be using the following guidelines for modeling the OTC units within the CTPG base cases.

If the implementation plan specifies:

1. Retirement by 2020, the unit will be retired.
2. Track 2 Compliance by 2020, the unit will remain unchanged.
3. Track 1 Compliance by 2020 and only changing cooling system, the unit will remain unchanged.
4. Track 1 Compliance by 2020 with new generator type and size, the unit will be modeled as stated.
5. Track 1 Compliance with an unstated generator type, but size or minimum MW known, the unit(s) will be modeled according to the following table:

Generic Power Flow Assumptions

GE LMS100	Simple Cycle	100 MW	
GE Frame 7	CC 2x1	500 MW	(140 MW, 140 MW, 220 MW)

*Start by assuming the largest generator and number of generators to reach target. If excess capacity is greater than 50 MW and less than 100 MW, remove one generic model and reduce the generation output pro-rata by the excess capacity amount. If excess capacity is less than 50 MW, increase the generation output pro-rata by the excess capacity amount.

Ex. 946 MW:	2 x 500 MW	1000	100 MW > 54 MW > 50 MW
	1 x 500 MW	500	
	4 x 100 MW	900	46 MW < 50 MW

6. Track 1 or Track 2 compliance, Track 1 assumptions will be used.
7. Track 1 or Retirement, Retirement will be assumed.
8. Two or more capacity options, the lower of the two will be used. Excess capacity will be reduced or increased on a pro-rata basis.

Pro-Rata Reduction or Increase	Max	Pro-Rate	Modeled
	500	525.56	526
	100	105.11	105
	100	105.11	105
	100	105.11	105
	100	105.11	105
	900	946 MW	946 MW

GE machines will be used for generic power flow and dynamic response assumptions due to availability of models and information in the General Electric Positive Sequence Load Flow program (GE-PSLF). The capacity value assumptions were chosen for simplicity, consistency, and closeness to typical outputs of similar machines currently. Where specific machine information is made available, the CTPG will use that data instead of generic assumptions.

The following tables list the changes made to the OTC units by utility.

Table 7 - PG& E OTC Units

		2020 HS Case/ Plant Owners	Plant Owners		SWRB	CTPG Assumptions			
Generating Station	Units	Existing Capacity (MW)	Compliance Option	Implementation Timeline (Beyond Compliance Deadline)	Compliance Deadline	Area	Powerflow Model Changes	Modified Capacity (MW)	Units Modeled and Capacity
Contra Costa Generating Station	6-7	690	Retirement	2013	12/31/2017	PG&E	Retired	0	0
Humboldt Bay Power Plant	1-10	166	n/a	Complete		PG&E	n/a		No Change
Morro Bay Power Plant	1-4	650	Track 2	By Dec 31, 2015	12/31/2015	PG&E	Repower 164 MW	164	164
Moss Landing	1-2	1,020	Track 2	Compliance through 2032	12/31/2017	PG&E	No Change		No Change
Power Plant	6-7	1,509	Track 2	By Dec 31, 2017	12/31/2017	PG&E	Repower 100 MW	100	100
Pittsburg	5-6	660	Track 1	By Dec 31, 2017	12/31/2017	PG&E	No Change		No Change
Generating	7	740	Retirement	2016	12/31/2017	PG&E	Retired	0	0
Potrero Generating Station	3	0	Retired	February 28, 2011		PG&E	Retired	0	0

Table 8 - SDG&E OTC Units

		2020 HS Case/ Plant Owners	Plant Owners		SWRB	CTPG Assumptions			
Generating Station	Units	Existing Capacity (MW)	Compliance Option	Implementation Timeline (Beyond Compliance Deadline)	Compliance Deadline	Area	Powerflow Model Changes	Modified Capacity (MW)	Units Modeled and Capacity
	1	107				SDG&E			156
Encina Power	2	104	Track 1	2017	12/31/2017	SDG&E		558	156
Station	3	110				SDG&E	1 CC, 558 MW		246
	4-5	630	Track 2	2017	12/31/2017	SDG&E	No Change	628	No Change
South Bay Power Plant	1-4	0	Retired	-	12/31/2012	SDG&E	Retired	0	0

Table 9 - LADWP OTC Units

		2020 HS Case/ Plant Owners	Plant Owners		SWRB	CTPG Assumptions			
Generating Station	Units	Existing Capacity (MW)	Compliance Option	Implementation Timeline (Beyond Compliance Deadline)	Compliance Deadline	Area	Powerflow Model Changes	Modified Capacity (MW)	Units Modeled and Capacity
Harbor Generating Station	5	65	Track 1	2031	12/31/2015	LADWP	No Change; Transition Begins after 2020	65	No Change
Haynes Generating Station	5-6	535	Track 1	2013	12/31/2015	LADWP	No Change; 6 SC, 6x100 MW already modeled in 2020 HS case	600	No Change
	1-2	444	Track 1	2027	12/31/2015	LADWP	No Change; Transition Begins after 2020	444	No Change
	8	235	Track 1	2035	12/31/2015	LADWP	No Change; Transition Begins after 2020	250	No Change
Scattergood Generating Station	3	460	Track 1	2015	12/31/2020	LADWP	1 CC - 310 MW, 2 SC - 200 MW; Representation as specified by LADWP	510	510
	1-2	367	Track 1	2024	12/31/2020	LADWP	No Change; Transition Modeled in 2020 HS case	367	No Change

Table 10 - SCE OTC Units

		2020 HS Case/Plant Owners	Plant Owners		SWRB	CTPG Assumptions			
Generating Station	Units	Existing Capacity (MW)	Compliance Option	Implementation Timeline (Beyond Compliance Deadline)	Compliance Deadline	Area	Powerflow Model Changes	Modified Capacity (MW)	Units Modeled and Capacity
AES Alamitos Generating Station	1-6	2,010	Track 1	Some Units Beyond Dec 31, 2020	12/31/2020	SCE	2 CC (500), 4 SC (100)	1417	101 101 101 101 506 507
AES Huntington Beach Generating Station	1-4	900	Track 1	Some Units Beyond Dec 31, 2020	12/31/2020	SCE	1 CC (500), 3 SC (100)	800	500 100 100 100
AES Redondo Beach Generating Station	5-8	1,356	Track 1	Some Units Beyond Dec 31, 2020	12/31/2020	SCE	1 CC (500), 4 SC (100)	946	105 105 105 105 526
El Segundo Generating Station	1-2	0	Track 1	2013	12/31/2015	SCE	1 CC, 560 MW	560	157 157 246
	3	335	Retirement	2013	12/31/2015	SCE	RT - Retired	0	0
	4	335	Track 1	Retired by 2017 if unable to repower	12/31/2015	SCE	RT - Retired	0	0
Mandalay Generating Station	1-2	430	Track 2	Prior to Dec 31, 2020	12/31/2020	SCE	No Change	430	No Change
Ormond Beach Generating Station	1-2	1,520	Track 2	Prior to Dec 31, 2020	12/31/2020	SCE	No Change	1500	No Change

5 Study Process

The study process will involve three types of cases: seed cases, foundation cases, stress cases. A seed case, oftentimes referred to as a base case, is a projected snapshot of the WECC power grid for a particular season-year. WECC posts these cases, created jointly by its members, to facilitate transmission planning within WECC. A foundation case is a seed case that has been validated and updated with new information, recognizing that some time has lapsed since WECC approved and made available its study case. Finally, a stress case modifies a foundation case by redirecting path flows to test specific power system limitations.

The CTPG obtained from WECC's library cases to build several scenarios. These seed cases contain the most current detailed models of the entire WECC interconnected system. The following section provides the step-by-step verifications, updates and modifications of the WECC seed cases to create a scenario specific case for study. The creation of the seasonal foundation and stressed path cases is the result of the completion of Step 0. Step 1 will model the renewables (generation and associated transmission) as required for each scenario. The renewable generation will be modeled at zero output. Step 2 completes the scenarios by dispatching the renewables. At the end of each step, a contingency analysis will be performed to determine if reliability criteria has been met.

Step 0: Develop Foundation & Stress Path Cases

- Verify and update existing renewable generation
- Model implementation plans of Once-Through Cooling generation plants
- Verify and update all transmission projects which have Balancing Authority approvals
- Update to latest California Energy Commission 2020 load:
  - Summer peak
  - Spring
  - Fall
- Dispatch Paths:
  - Foundation - ensure all paths are within limits
  - Stress COI (n-s) & PDCI (n-s)
  - Stress WOR (e-w)
- Perform contingency analysis to confirm reliability criteria is met

Step 1: Add Renewable Projects

- Model renewable projects, generation and associated transmission such as gen-ties and collector systems, as required by scenario
- Renewable generation modeled at 0 MW output
- Perform contingency analysis to confirm reliability criteria is met

Step 2: Dispatch Renewables

- Dispatch renewable projects to anticipated output for each scenario
- Decrease fossil generation to balance renewable increase
- Perform contingency analysis to confirm reliability criteria is met
- Where reliability criteria violations are found, identify transmission infrastructure additions that mitigate the violations

All scenarios will include transmission projects that have been approved by their applicable Balancing Authority. A list of the significant transmission projects is provided in Table 11.

Table 11: Balancing Authority Approved Transmission Projects

Project Name	Area:
Eldorado-Ivanpah Transmission Project (EITP)	SCE
Red Bluff Substation 500/230kV	
New Pisgah 500kV Sub, New Lugo-Pisgah 500kV T/L, Loop existing Eldorado-Lugo 500kV T/L	
Devers - Mirage 115 kV system Split	
Devers - Coachella valley 230 kV line loop	
San Joaquin Cross Loop	
Devers - Palo Verde 500 kV Transmission Line (DPV2)	
Rancho Vista 500/230 kV substation	
Mira Loma 500 kV shunt Capacitors	
Wildlife (formerly Jurupa) 230 kV substation	
Third A-Bank and rebuild of the 115 kV switch Rack at Victor Substation Phase 1	
Tehachapi Renewable Transmission Project	
Inland Empire Energy Center	
NRG El Segundo	
EME Walnut Creek	
Blythe Energy I Project	
T1058: San Benito Transmission Work (was San Justo Substation Interconnection)	PG&E
T1177: Natividad Substation Installation	
T970A: Crazy Horse Switching Station	
T1005: Sanger – Reedley 70 kV to 115 kV Conversion	
T854: Metcalf – Evergreen 115 kV	
T1173: Santa Cruz 115 kV Reinforcement	
T1003: Herndon 230/115 kV Transformer	
T1196: Morro Bay 230/115 kV Transformer Addition Project	
T1091: Tri-Valley Voltage Control	
T994: Lakeville – Ignacio #2 230 kV Line	
T258A: Gregg 230 kV Reactor	
T1120: Shepherd Substation Interconnection	
T759C: Atlantic – Lincoln Transmission	
T1042: Sanger – California Ave 70 kV to 115 kV Conversion	
T947: Hollister 115 kV Reconductoring	
T984: Pittsburg – Tesla 230 kV Reconductoring	
T1195: Ashlan-Gregg and Ashlan-Herndon 230 kV Line Reconductor	
T991: Contra Costa – Moraga 230 kV Line Reconductoring	
T1090: Midway – Renfro 115 kV Line Reconductor	
T1182: Mountain View/Whisman–Monta Vista 115 kV Reconductoring	
T982: Newark – Ravenswood 230 kV Line	
T197B: Ignacio – San Rafael and Ignacio – Las Gallinas 115 kV Reconductoring	
T986: Woodward 115 kV Reinforcement	
T444C: Missouri Flat – Gold Hill 115 kV Line	
T686A : Palermo – Rio Oso 115 kV Line Reconductoring	
T1040: Ravenswood – Cooley Landing 115 kV Reconductor	
T920A: South of San Mateo Capacity Increase	
T967: Tesla 115 kV Capacity Increase	
T249: Bay Meadows 115 kV Reconductoring	
T444D: Gold Hill - Horseshoe 115 kV Reinforcement	
T603B: Vaca Dixon-Lakeville 230 kV Reconductoring	
T1055: Stone Substation Capacity Increase	
T1127: Evergreen - Mabury 60 kV to 115 kV Conversion	
T1092: Occidental of Elk Hills 230 kV Interconnection	
T990: Moraga Transformer Capacity Increase	
T985B: Rio Oso 230/115 kV Transformer Upgrades	
T1214: Pit 3 - Pit 1 and Pit 3 - Round Mountain 230 kV Line Relays Replacement	
T1030: Table Mountain – Rio Oso 230 kV Reconductor and Tower Raises	

Project Name	Area:
COI 4800 Project	BPA
Little Goose Reinforcement Project	
West of McNary Reinforcement Project	
I-5 Corridor Reinforcement Project	
Imperial Valley-Dixieland 230 kV line	IID
Coachella Valley Substation to Mirage Substation (Path 42) double circuit 230 kV line reconductoring. (Path 42 Upgrade 1600 MW).	
El Centro Switching Station (ECSS) to Highline Station double circuit 230 kV transmission project.	
IV Sub to IID IV Sub and IID IV Sub to ECSS 230 kV transmission project.	
Path 42 upgrade to 800 MW	
Encina - Penasquitos 230 kV #2	SDG&E
Sunrise Powerlink	
HLSP1, HLSP2	LADWP
BCON18G	
SODMTGEN	
Barren Ridge - Haskell 230 kV (Barren Ridge Renewable Transmission Project Phase I)	
Barren Ridge - Rinaldi 230 kV upgrade (Barren Ridge Renewable Transmiission Project Phase II)	

The WECC seed cases will be updated to reflect current information regarding the status of fossil generation units. The following fossil plants will be added to the seed cases to reflect recently awarded power purchase agreements (PPAs).

PG&E Area:
Marsh Landing, 774 MW by 2013
Oakley, 672 MW by 2016
Mariposa, 200 MW by 2013
GWF Tracy Expansion, 150 MW addition by 2012
Los Esteros Expansion, 120 MW addition by 2013

SDG&E Area:
Pio Pico (304.8 MW) (LMS100)
Escondido Energy Center (repower an old gas turbine) (45 MW) (LM6000)
Quail Brush ("Cogentrix") (99.8 MW) (gas-fired Wartsilla reciprocating engines)

Tables 12 provide the target flows to stress particular paths for several scenarios. The left side of Table 12 lists the WECC path number, name and the megawatt (MW) ratings of the path. Several paths have two ratings, a north to south (n-s) and a south to north (s-n) rating. The WOR path is only rated in the east to west (e-w) direction. The right side of the table shows the path flow targets for the stress path cases. COI stressed will push Paths 66 and 65 to rated levels. WOR stressed will target a flow of 7,250 MW which was the maximum flow measured during 2010.

Representative megawatt levels of the major paths in California for the three foundation cases are listed in Table 13. These path flows are approximate values prior to the addition of renewable generation. Ultimately, load levels and the final generation dispatch pattern will dictate path flows. CTPG will not attempt to move paths to any particular value to form the foundation cases. Table 13 simply provides a gauge of the flows in the WECC seed cases.

Table 12: Stress Path Target Flows (MW)

WECC Path						Stress Path Cases			
No.	Name	Rating				COI		WOR	
		MW	Dir.	MW	Dir.	MW	Dir.	MW	Dir.
66	California - Oregon Intertie (COI)	4,800	n-s	3,675	s-n	4,800	n-s	-	-
65	Pacific DC Intertie (PDCI)	3,100	n-s	3,100	s-n	3,100	n-s	-	-
46	West of Colorado River (WOR)	10,623	e-w	-	-	-	-	7,250	e-w

Table 13: Foundation Path Flows (MW) Pre-Renewables

WECC Path						Foundation Cases					
No.	Name	Rating				Fall		Summer		Spring	
		MW	Dir.	MW	Dir.	MW	Dir.	MW	Dir.	MW	Dir.
66	California - Oregon Intertie (COI)	4,800	n-s	3,675	s-n	1,750	s-n	3,700	n-s	3,750	n-s
15	Midway - Los Banos	3,265	n-s	5,400	s-n	3,650	s-n	1,800	s-n	1,800	n-s
26	Northern - Southern California	4,000	n-s	3,000	s-n	300	s-n	800	n-s	3,600	n-s
65	Pacific DC Intertie (PDCI)	3,100	n-s	3,100	s-n	1,850	s-n	2,600	n-s	2,600	n-s
27	Intermountain Power Project (IPP) DC Line	2,400	ne-sw	1,400	sw-ne	1,750	ne-sw	2,300	ne-sw	1,000	ne-sw
46	West of Colorado River (WOR)	10,623	e-w	-	-	5,100	e-w	3,000	e-w	5,500	e-w
49	East of Colorado River (EOR)	9,300	e-w	-	-	4,200	e-w	3,800	e-w	4,700	e-w
	Southern California Import Transmission (SCIT)	-	-	-	-	5,400		9,050		13,350	

6 Generation Re-Dispatch

When renewable resources are added to the pre-renewable power flow cases and dispatched at the output level corresponding to the applicable technology and the month/hour being simulated, an equal amount of fossil-fueled generation must be turned down (or decremented) in order to maintain a generation-load balance in the power flow program. Fossil generation was selected for reduction because of economics. With renewable generation mandated to occupy 33% of the electricity market in California, fossil generation must compete to remain in the market. It is anticipated that the least efficient units, in the absence of overriding reliability and/or operational requirements, will be the most likely to shut down by 2020. Fossil generation will be decreased in a merit-order fashion (least economic reduced first) across the WECC. This merit order is established through the use of heat rate data obtained from the WECC Transmission Expansion Planning & Policy Committee's (TEPPC's) 2017 economic database. Fossil units are decremented equally in blocks until all units in the block are turned off. Decrements below minimum output level are not allowed; i.e., the unit is turned off. Nuclear, qualifying facilities/cogeneration, and hydro units are not decremented in the summer peak cases.

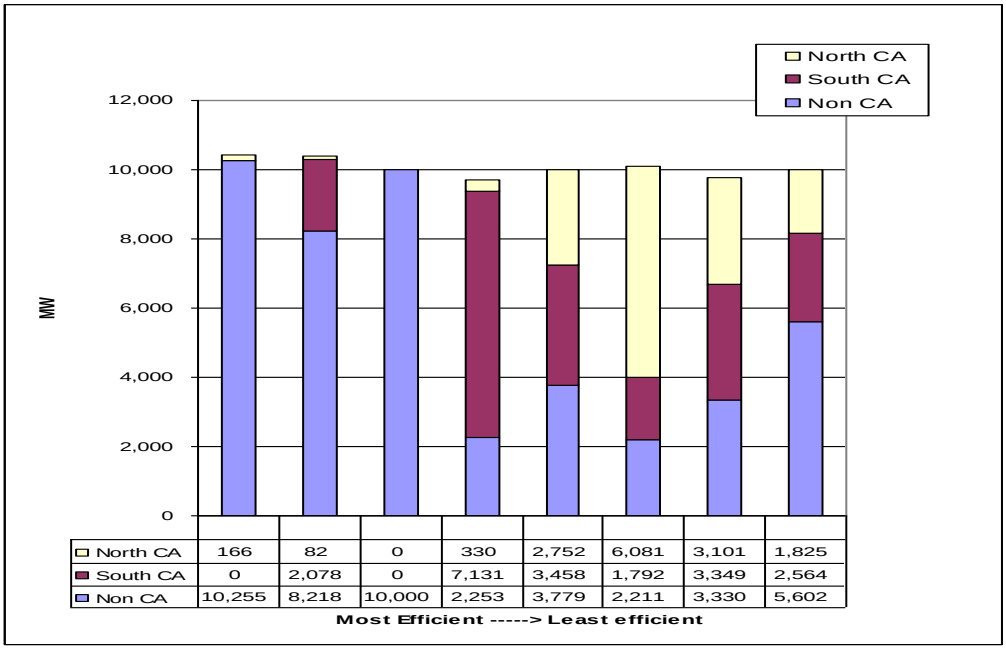
Because of their location, some fossil generation may be required to operate for local reliability reasons even though their variable operating costs are relatively high and application of a strict merit-order economic dispatch would suggest they should not run. CTPG will limit generation decrements to levels above known local capacity requirements as identified by the applicable balancing authority or as suggested by an examination of a WECC economic grid simulation

case conducted by the CAISO in connection with the CAISO's 2010/2011 transmission planning process.

The CTPG has issued a survey to transmission planning entities throughout WECC to identify dispatchable generators, obtain minimum output of dispatchable units and descriptions of constraints requiring specific dispatchable units to be on line for specific system conditions. While not all WECC entities responded to the survey, the majority did and those responses have been incorporated into the economic merit-order list of WECC generators that may be decremented in the power flow program. The responses however did not provide significant information regarding minimum generation requirements and the conditions in which reliability considerations will supersede economic merit-order. The economic merit-order list of dispatchable gas-fired generators is provided on a spreadsheet that is available on the CTPG web site.

Figure 1 provides a summary of the fossil units in WECC ranked by efficiency in the horizontal axis. Each column represents approximately 10,000 MW with the most efficient on the left and the least efficient on the right. The figure reflects both the CTPG assumptions regarding OTC units and the WECC survey results for dispatchable generation. The colors distinguish resources located in Northern California, Southern California and outside California.

Figure 1: WECC Install Capacity
Dispatchable Gas-Fired Generation



North CA	166	82	0	330	2,752	6,081	3,101	1,825
South CA	0	2,078	0	7,131	3,458	1,792	3,349	2,564
Non CA	10,255	8,218	10,000	2,253	3,779	2,211	3,330	5,602

While the economic merit-order list of dispatchable gas-fired generators excludes any generators that WECC entities identified as must-run, it does not indicate the minimum amount of generation that must be on-line in specific load pockets for the system conditions that will be

evaluated in CTPG's studies. Other documents will be used to determine these minimum amounts. [5]

The CAISO has published a December 30, 2010 document entitled *2013-2015 Local Capacity Technical Analysis, Report and Study Results* which sets forth the minimum amount of dependable generating capacity that must be available in the following load pockets within the CAISO BAA: Humboldt, North Coast/North Bay (northeast of San Francisco), Sierra, Stockton, Greater Bay (east of San Francisco), Greater Fresno, Kern, Los Angeles Basin, Big Creek/Ventura and San Diego. This document is available at http://www.caiso.com/287c/287ca3cc28a80.pdf.

Minimum generation requirements in the San Diego area are governed by San Diego Area Unit Commitment Requirements for Voltage Stability and by the Local San Diego Area 25% Minimum Generation Requirement. These minimum generation requirements are described in the document named "*San Diego Area Generation Constraints*" which is available on the CTPG web site. The Los Angeles basin area served by SCE is subject to a similar minimum generation requirement.

Within the SMUD BAA, there are two minimum generation requirements. One ties the minimum amount of generation that must be committed within a defined SMUD load area to load levels within the SMUD load area. The other ties the minimum amount of generation which must be committed from among a specific set of generators to load levels within a defined Sacramento load area. A document setting forth these requirements will be posted on the CTPG website.

MID has minimum on-line generation requirements tied to the MID distribution service area's daily peak loads. A document setting forth these requirements will be posted on the CTPG website.

TID has minimum on-line generation requirements tied to the TID distribution service area's daily peak loads. A document setting forth these requirements will be posted on the CTPG website.

Associated with Path 15 is a remedial action scheme (RAS) which drops specific generators south of Midway substation as well as load north of Los Banos Substation. If this generation is decremented, the RAS become less effective and Path 15 must be de-rated in the south to north direction. To prevent this de-rate in the study, the decision was made to not decrement the associated generators.

Given the robust information regarding minimum generation levels in California versus the limited information received from the WECC survey, CTPG will bypass economic merit-order dispatch in areas outside of California for the following reasons:

[5] The WECC survey provided some information on minimum generation requirements, particularly for certain areas of California. The WECC survey yielded limited information on minimum generation requirements in areas outside of California; it is not known whether this is because there are few limits or because the WECC entities have simply not provided it. CTPG anticipates an ongoing effort to collect and refine information regarding minimum generation requirements throughout the WECC.

1) When decrementing specific units or blocks of units in an area produce local reliability issues.

2) Unable to achieve stress path flow targets as specified in a CTPG scenario. Bypassing economic merit-order dispatch shifts the analysis to a more traditional transmission planning approach by examining the impact of a single specific transmission assumption; high import path flows into California and the resulting impact.

Deviations from economic merit-order dispatch will be document in the study report.