

California Independent System Operator Corporation

### Competitive Path Assessment for MRTU Preliminary Results for Spring and Summer Seasons

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California Independent System Operator Corporation

## **Meeting Agenda**

- Overview
- The Feasibility Index Approach
- The Simulation Model
- Candidate Path Selection
- Supporting Data
- Scenarios and Supplier Combinations
- Preliminary Results and Discussion.



## **Role of CPA in MRTU**

### Important Part of Local Market Power Mitigation (LMPM) Procedure in DAM and RTM.

- LMPM Procedure
  - Competitive Constraint Run (CCR) enforces only the Competitive Path constraints to meet forecast load.
  - All Constraint Run (ACR) enforces FNM.
  - Generator awards in ACR that are > CCR show instances where generator has local market power.
  - In these cases, unit's bid is mitigated from the CCR dispatch point to the maximum bid quantity.
- CPA determines which path constraints are enforced in the CCR (compared to ACR) and consequently where Local Market Power is identified and mitigated.





## **Overview of CPA**

- Use a three pivotal supplier framework to assess competitiveness.
  - Test whether transmission constraints are competitive when up to three potentially pivotal suppliers' capacity is removed from the market.

### Process for competitive path determination:

- Existing branch groups are 'grandfathered' competitive.
- Non-candidate, non 'grandfathered' paths are not competitive by default.
- Candidate paths tested for competitiveness using FI method.
- Test across range of seasons, load & hydro scenarios, potentially pivotal supplier combinations.
- Physical infeasibility (FI < 0 on candidate path) in any hour results in failure of competitive test for candidate path.



### Review of General Methodology The Feasibility Index Approach

- Feasibility Index (FI) tests physical supply of congestion relief on candidate paths when supplier's capacity is withheld.
  - Soft constraints on all non-grandfathered paths.
  - Run simulation to meet CAISO load with 1, 2, or 3 potentially pivotal suppliers' capacity removed.
  - Measure Feasibility Index of candidate paths: FI = (Path Limit – Path Flow) / Path Limit.
  - FI < 0 means congestion could not be relieved on that path when capacity was withheld => path is not competitive.



### **Review of General Methodology** *Simulation of Preliminary Results*

- Use MRTU FNM, Current internal resources, and various load and hydro production scenarios.
- Supplier portfolio composition determined by SC associated with internal resource.
- Simulation Features:
  - 24 hour Unit Commitment (Rounded Relaxation) and Economic Dispatch based on DC-OPF algorithm
  - Co-optimization of energy market and upward AS market
  - Load curtailment with a penalty price of \$1MM/MWh.
  - Transmission constraints violated with penalty price of \$50k/MW.
  - No transmission contingency or unit outages considered.
- Simulation Variations:
  - One day in Spring and one day in Summer
  - High, Medium, and Low load & hydro scenarios
  - 43 withdrawn supplier combinations considered



### **Candidate Path Selection**

- Set of candidate paths determined by the frequency of realtime mitigation of congestion on a constraint.
- If real-time congestion is mitigated in more that 500 hours in the prior 12 months, constraint is a "candidate" path.
- Count hours of congestion mitigation using real time outof-sequence dispatches and real time RMR dispatches.
- Data used in calculation reflect June 1, 2005, through May 31, 2006, period.
- These data, and the list of candidate paths, will be updated prior to the next release of results.



### **Candidate Paths**

Candidate Path	Candidate Path
Bogue Area Import	Oakland 115kV
Colgate 60 kV	Palermo - Colgate
Humboldt Bank	Palermo 115kV
Humboldt Import	Pittsburg Transformers
Imperial Valley Bank	Pittsburg to San Mateo_E. Shore
Llagas to Gilroy	Ravenswood Cutplane
Metcalf to El Patio	Ravenswood to San Mateo
Metcalf to Morgan Hill	Sobrante - Grizzly - Claremont
Miguel Import	South of Lugo
Miguel Max Import	Table Mt - Rio Oso
MiraLoma Bank	Table Mt - Rio Oso & Palermo
Monta Vista - Jefferson	Tesla - Manteca
Moss Landing to Metcalf	Tesla Banks 6 & 4
North Geysers Import	Tesla to Delta Switchyard
North of Martin	Tesla to Pittsburg



# **Supporting Data**

- FNM
  - Used FNM model from CRR (Fall 2006 will update).
- Imports and Exports
  - Create single supplier across tie point in each direction with ten bid segments.
  - First segment: \$0 for aggregate HA schedule
  - Remaining 9 segments use quantity weighted average prices for remaining historical bid in imbalance quantity
  - Use bids from identified hydro scenario days.
- Gas Fired Resources
  - Existing resources and operation costs from MF w/ review.
  - Output bid at cost based on HR and gas price.
- Hydroelectric Resources
  - Two segment bids Historical HA schedule bid at \$0/MWh,
  - Remaining output based on weighted average bid price from historical imbalance bids from selected hydro scenario days.
- Other: QF, Cogen, Biomas, Nuclear
  - Constrained on at historical metered output and \$0 price (from identified load scenario days)



# **Supporting Data**

### Demand

- Zonal hourly energy demand from selected load scenario days (next slide).
- Load distribution factors from CRR FNM.
- System and SP26 Operating Reserve requirements are 7% of load.
- Regulation Up requirement is 400 MW.





### **Load Scenario Selection**

### Load Scenarios: high / medium / low

- Using 2006 as the base year
- For preliminary results Spring and Summer only.
- Create duration curve of daily peak load for a season (roughly 91 daily values).
- Choose representative load days based on cumulative percentage on duration curve:
  - 95% percentile day as high load day
  - 80% percentile day as medium load day
  - 65% percentile days as low load day
- Days within a season corresponding to these percentiles are the historical basis for the three load scenarios for that season.



## **Hydro Scenario Selection**

#### • Hydro Scenarios: high / medium / low

- Determine high/medium/low hydro years using annual hydro production data from 2002-2006
- Choose the 95<sup>th</sup> percentile day from seasonal hydro production duration curves for the identified high, medium, and low hydro years

Hydro Scenario	Winter	Spring	Summer	Fall		
High	3/23/2006	5/19/2006	7/3/2006	11/30/2006		
Medium	3/30/2005	5/25/2005	7/7/2005	12/26/2005		
Low	3/19/2004	4/15/2004	7/16/2004	12/13/2004		

Load Scenario	enario Winter		Summer	Fall	
High	1/9/2006	6/23/2006	7/26/2006	10/23/2006	
Medium	2/1/2006	6/4/2006	7/15/2006	10/19/2006	
Low	3/21/2006	5/11/2006	8/24/2006	10/20/2006	





## Withheld Supplier Combinations

#### Single Pivotal Suppler Withheld

- Identified top 7 SC's in terms of installed capacity in CAISO control area.
- Two and Three Pivotal Suppliers Withheld
  - Identify top 3 SC's in NP26 and top 3 SC's in SP26 in terms of installed capacity.
  - All combinations of any two or three of these 6 SC's were used in simulation.

### Number of Simulations Run

- Supplier combinations 43 (incl. no suppliers withheld).
- Load scenarios 3.
- Hydro scenarios 3.
- Seasons 2.
- Total number of simulations:  $43 \times 3 \times 3 \times 2 = 774$
- Total number of hours simulated:  $774 \times 24 = 18,576$



# **Supplier Portfolios by Zone**

- Top 3 Suppliers have 10,740 MW of capacity
- Top 3 Suppliers in NP26 have 7,829 MW of capacity
- Top 3 Suppliers in SP26 have 7,706 MW of capacity

		Installed	Percent of Zonal
Supplier	CAISO Zone	Capacity (MW)	Capacity
S1	NP26	4,182	21%
	SP26	751	3%
S2	SP26	3,976	16%
S3	SP26	2,582	11%
S4	NP26	2,347	12%
S5	NP26	1,300	7%
S6	NP26	595	3%
	SP26	1,101	5%
S7	SP26	1,148	5%





### **Results and Discussion**

### Competitive Path Designation Criteria

- For each simulation run, the FI is calculated for each candidate path for each simulated hour.
- If supply cannot meet load in an hour, the FIs for all candidate paths within the zone where load was curtailed are set to a negative value for that hour.
- If the FI for a candidate path is negative in an hour, that candidate path is non-competitive for that season.



## **Results – Spring Simulations**

	Minimum	Hours w/	Percent of	Test w/ 0%		Minimum	Hours w/	Percent of	Test w/ 0%
Candidate Path	FI	FI < 0	Hours w/ FI < 0	Fl < 0	Candidate Path	FI	Fl < 0	Hours w/ FI < 0	Fl < 0
NP26					NP26				
Bogue Area Import	-0.15	20	0.2%	Fail	Ravenswood Cutplane	*	3	0.0%	Fail
Colgate 60 kV	-1.38	669	7.2%	Fail	Ravenswood to San Mateo	-0.36	504	5.4%	Fail
Humboldt Bank	*	3	0.0%	Fail	Sobrante - Grizzly - Claremont	*	3	0.0%	Fail
Humboldt Import	*	3	0.0%	Fail	Table Mt - Rio Oso		3	0.0%	Fail
Llagas to Gilroy	*	3	0.0%	Fail	Table Mt - Rio Oso & Palermo		3	0.0%	Fail
Metcalf to El Patio	*	3	0.0%	Fail	Tesla - Manteca	*	3	0.0%	Fail
Metcalf to Morgan Hill	*	3	0.0%	Fail	Tesla Banks 6 & 4	*	3	0.0%	Fail
Monta Vista - Jefferson	*	3	0.0%	Fail	Tesla to Delta Switchyard	-0.24	138	1.5%	Fail
Moss Landing to Metcalf	-0.23	100	1.1%	Fail	Tesla to Pittsburg	-0.48	274	3.0%	Fail
North Geysers Import	*	3	0.0%	Fail					
North of Martin	*	3	0.0%	Fail	SP26				
Oakland 115kV	-0.04	69	0.7%	Fail	Imperial Valley Bank		0	0.0%	
Palermo - Colgate	*	3	0.0%	Fail	Miguel Import		0	0.0%	
Palermo 115kV	-0.36	112	1.2%	Fail	Miguel Max Import		0	0.0%	
Pittsburg to San Mateo_E. Shore	*	3	0.0%	Fail	MiraLoma Bank		0	0.0%	
Pittsburg Transformers	*	3	0.0%	Fail	South of Lugo		0	0.0%	

- 25 of 30 candidate paths failed the competitiveness test for Spring.
- Only one case with drop load in NP26: Low Hydro High Load with three prominent NP26 suppliers withheld.
- All NP26 candidate paths failed competitiveness test.
- All SP26 candidate paths passed the test.
- Applying the load curtailment rule resulted in 8 candidate paths in NP26 failing the test in Spring.



### **Results – Summer Simulations**

Minimum Hours w/ Percent of Test w/ 0%		Test w/ 0%		Minimum	Hours w/	Percent of	Test w/ 0%		
Candidate Path	FI	Fl < 0	Hours w/ Fl < 0	Fl < 0	Candidate Path	FI	Fl < 0	Hours w/ Fl < 0	Fl < 0
NP26					NP26				
Bogue Area Import	-0.14	80	0.9%	Fail	Ravenswood Cutplane	*	34	0.4%	Fail
Colgate 60 kV	-1.31	1,597	17.2%	Fail	Ravenswood to San Mateo	-0.45	939	10.1%	Fail
Humboldt Bank	*	34	0.4%	Fail	Sobrante - Grizzly - Claremont	*	34	0.4%	Fail
Humboldt Import	-0.01	115	1.2%	Fail	Table Mt - Rio Oso	-0.01	34	0.4%	Fail
Llagas to Gilroy	-0.08	55	0.6%	Fail	Table Mt - Rio Oso & Palermo	-0.01	34	0.4%	Fail
Metcalf to El Patio	*	34	0.4%	Fail	Tesla - Manteca	*	34	0.4%	Fail
Metcalf to Morgan Hill	-0.04	35	0.4%	Fail	Tesla Banks 6 & 4	*	34	0.4%	Fail
Monta Vista - Jefferson	-0.01	39	0.4%	Fail	Tesla to Delta Switchyard	-0.26	196	2.1%	Fail
Moss Landing to Metcalf	-0.32	217	2.3%	Fail	Tesla to Pittsburg	-0.54	558	6.0%	Fail
North Geysers Import	-0.03	110	1.2%	Fail					
North of Martin	*	34	0.4%	Fail	SP26				
Oakland 115kV	-0.10	319	3.4%	Fail	Imperial Valley Bank	*	7	0.1%	Fail
Palermo - Colgate	*	34	0.4%	Fail	Miguel Import	-0.18	128	1.4%	Fail
Palermo 115kV	-0.36	288	3.1%	Fail	Miguel Max Import	-0.12	52	0.6%	Fail
Pittsburg to San Mateo_E. Shore	*	34	0.4%	Fail	MiraLoma Bank	*	20	0.2%	Fail
Pittsburg Transformers	-0.01	45	0.5%	Fail	South of Lugo	-0.09	39	0.4%	Fail

- 30 of 30 candidate paths failed the competitiveness test for Summer.
- Load is curtailed in both NP26 and SP26 in high load scenarios across 16 different supplier withholding cases.
- The load curtailment rule resulted in 11 candidate paths failing the competitive test in Summer



## **Results – Negative FI Distribution**

Negative FI distributions by Hydro and Load Scenarios in Summer and Spring

# of hours w/ I	Lo				
In Summer Simulations		High	Medium	Low	Total
	High	1053	256	111	1420
Hydro	Medium	1007	221	114	1342
Scenarios	Low	1777	508	166	2451
Total		3837	985	391	5213

# of hours w/ I	negative FI	Lo			
In Spring Sim	ulations	High	Medium	Low	Total
	High	124	0	2	126
Hydro	Medium	118	0	4	122
Scenarios	Low	313	0	14	327
Tot	al	555	0	20	575



# **Penalty Price Sensitivity Analysis**

- Propose to use \$50,000/MW as soft constraint penalty price for CPA simulations:
  - Violation of soft constraints may be sensitive to penalty price.
  - If penalty price is too low, optimization may choose to violate line limits instead of committing higher-cost units.
  - If penalty price is too high, optimization may choose to curtail load (with \$1MM/MW VOLL) instead of violating line limits.
- For sensitivity, *reran* with \$5k/MW and \$200/MW.
- Observation: as penalty price increases...
  - Magnitude of negative FIs increases
  - Frequency of hours with negative FI decreases
  - The Competitive Path designations remain the same.
- Penalty price of \$50k/MW appears to be appropriate.



### Sensitivity Analysis to Penalty Price Summer – All Scenarios and Supplier Combos

	Penalty	Price: \$50	K/MW	Penalty Price: \$5K/MW			Penalty Price: \$200K/MW		
			Percent			Percent			Percent
			of			of			of
		Hours	Hours		Hours	Hours			Hours
Candidate Dath	Minimum	W/FI<	W/FI<	Minimum	W/FI<	W/FI<	Minimum		W/FI<
Reque Area Import	0.14	0	0.0%	0.24	145	1.6%	0.14	60	0.7%
Colorte 60 kV	-0.14	1507	17.09/	-0.24	140	1.070	-0.14	100	12 10/
Lumbaldt Bank	-1.51	1097	0.49/	-1.49	2209	24.3%	-1.30	1220	0.49/
Humboldt Ballk	0.01	J4 115	1.00/	0.01	120	1 20/	0.01	126	1.5%
Humbolat Import	-0.01	7	1.2%	-0.01	120	1.3%	-0.01	130	1.3%
Imperial Valley Bank	0.09	1	0.1%	0.00	4	0.0%	0.07	0	0.1%
Liagas to Gilroy	-0.08	20	0.6%	-0.08	102	1.1%	-0.07	41	0.4%
Metcalf to El Patio	0.04	34	0.4%	0.40	30	0.4%	0.00	38	0.4%
Metcali to Morgan Hill	-0.04	30	0.4%	-0.10	30	0.4%	-0.02	38	0.4%
Miguel Import	-0.18	128	1.4%	-0.18	1/0	1.8%	-0.18	83	0.9%
Miguel Max Import	-0.12	52	0.6%	-0.12	47	0.5%	-0.12	28	0.3%
MiraLoma Bank	-	20	0.2%		10	0.1%		24	0.3%
Monta Vista - Jefferson	-0.01	39	0.4%	-0.01	45	0.5%	-0.01	43	0.5%
Moss Landing to Metcalf	-0.32	21/	2.3%	-0.32	411	4.4%	-0.32	198	2.1%
North Geysers Import	-0.03	110	1.2%	-0.03	144	1.6%	-0.03	111	1.2%
North of Martin	*	34	0.4%	*	35	0.4%	*	38	0.4%
Oakland 115kV	-0.10	319	3.4%	-0.10	327	3.5%	-0.10	310	3.3%
Palermo - Colgate	*	34	0.4%	*	35	0.4%	*	38	0.4%
Palermo 115kV	-0.36	288	3.1%	-0.46	432	4.7%	-0.36	272	2.9%
Pittsburg Transformers	-0.01	45	0.5%	-0.02	42	0.5%	-0.01	51	0.5%
Pittsburg to San Mateo_E. Shore	*	34	0.4%	*	35	0.4%	*	38	0.4%
Ravenswood Cutplane	*	34	0.4%	*	35	0.4%	*	38	0.4%
Ravenswood to San Mateo	-0.45	939	10.1%	-0.45	932	10.0%	-0.45	947	10.2%
Sobrante - Grizzly - Claremont	*	34	0.4%	*	35	0.4%	*	38	0.4%
South of Lugo	-0.09	39	0.4%	-0.09	41	0.4%	-0.09	42	0.5%
Table Mt - Rio <u>Qso</u>	-0.01	34	0.4%	-0.09	42	0.5%	-0.01	38	0.4%
Table Mt - Rio <u>Qso</u> & Palermo	-0.01	34	0.4%	-0.09	42	0.5%	-0.01	38	0.4%
Tesla - Manteca	*	34	0.4%	*	35	0.4%	*	38	0.4%
Tesla Banks 6 & 4	*	34	0.4%	×	35	0.4%	*	38	0.4%
Tesla to Delta Switchyard	-0.26	196	2.1%	-0.26	152	1.6%	-0.25	201	2.2%
Tesla to Pittsburg	-0.54	558	6.0%	-0.54	566	6.1%	-0.53	550	5.9%



# **Next Steps and Discussion**

## Next Steps

- Update FNM.
- Update resource ownership / control ().
- Update candidate path list.
- Continue to work on incorporating security constraints.
- Expand to four seasons.
- Written Comments on Preliminary results: Send to Jeff McDonald (JMcDonald@caiso.com) by COB June 26.
- Future Releases:
  - Second round of preliminary results in late August.
  - Stakeholder meeting roughly two weeks later.
  - Final path designations in late October.

### Discussion