Contingency Modeling Enhancements

Straw Proposal Discussion

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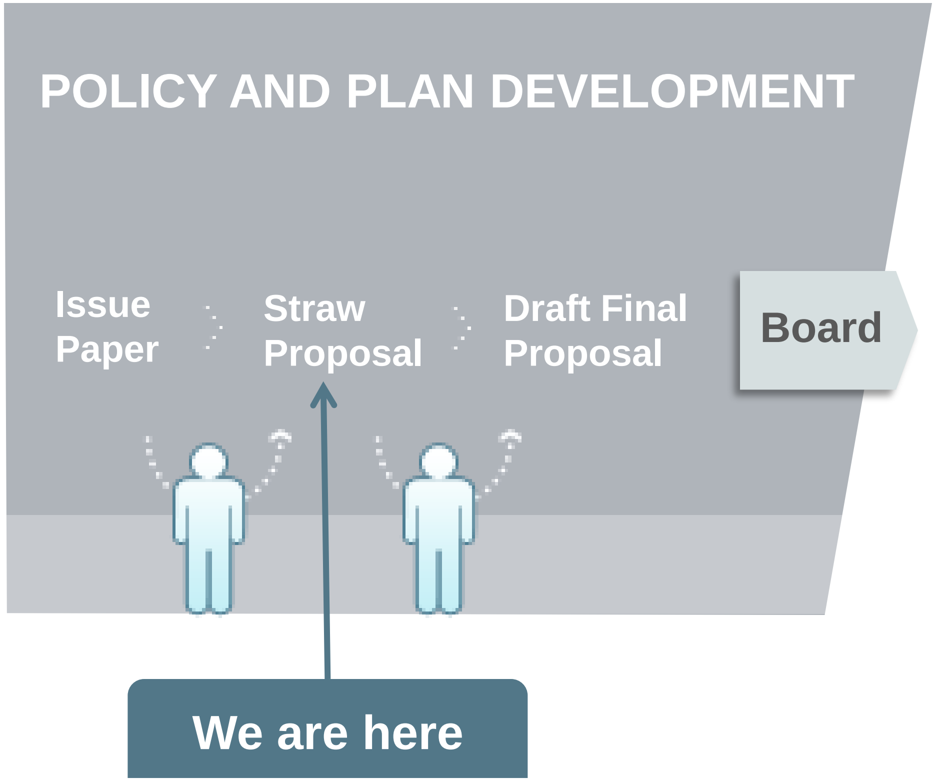
Agenda

Time	Topic	Presenter
10:00 – 10:05	Introduction	Chris Kirsten
10:05 – 12:00	Background and purpose	Delphine Hou
12:00 – 1:00	Lunch break	All
1:00 – 2:30	Examples of the preventive-corrective constraint	Lin Xu
2:30 – 2:45	Break	All
2:45 – 3:45	Examples of the preventive-corrective constraint	Lin Xu
3:45 – 4:00	Next Steps	Chris Kirsten

ISO Policy Initiative Stakeholder Process



Background and purpose

- 2012 Stakeholder Initiatives Catalog: *Additional Constraints, Processes, or Products to Address Exceptional Dispatch*
  - Highly ranked by stakeholders and ISO
  - Priority issue: 30 minute operating reserve
- NERC/WECC standard to transition the system back to a secure state within 30 minutes after a system disturbance
- This initiative seeks alternatives to the use of exceptional dispatch and MOC constraints to address NERC/WECC standard

Question: What is the need?

- Answer: WECC standard TOP-007-WECC-1 (WECC SOL standard)
- What is special about it?
  - Only applies to WECC entities
    - CAISO is the only market in WECC in the US
  - Only applies to major WECC paths
    - CAISO is responsible for 8
  - Stricter than NERC TOP-007 standard

the public interest.[14] According to NERC, TOP-007-WECC-1 is clear and unambiguous regarding what and who is required to comply. NERC states that TOP-007-WECC-1 has clear and objective measures for compliance and achieves a reliability goal (namely, that operating power flows along major paths are within not only interconnection reliability operating limits (IROLs) but also SOLs) effectively and efficiently. NERC also states that the requirements in TOP-007-WECC-1 are intended to be more stringent than and cover areas not covered by the corresponding continent-wide Reliability Standard TOP-007-0. NERC also notes that its public posting of the proposed regional Reliability Standard did not elicit any significant technical objection.[15]

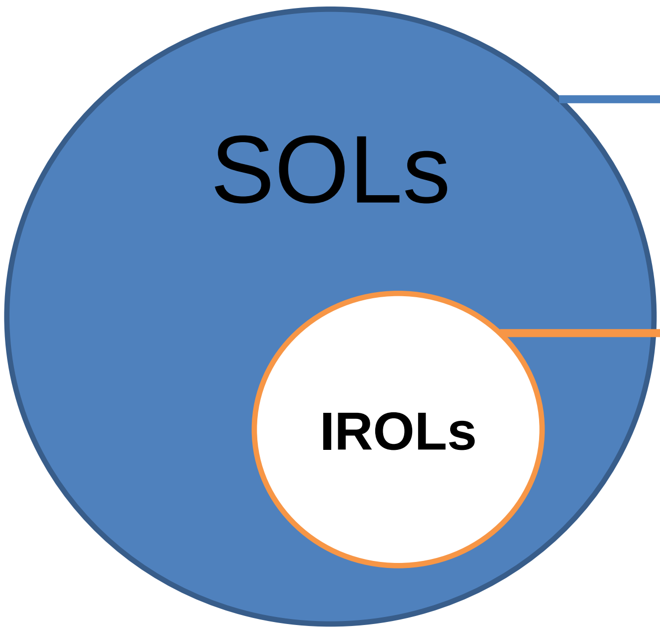
Source: 135 FERC ¶ 61,062

CAISO's major WECC paths

- Majority are internal to the ISO

Path name	Path number
South of Los Banos or Midway- Los Banos	15
PG&E – SPP	24
Northern – Southern California	26
SDGE – CFE	45
West of Colorado River (WOR)	46
Lugo – Victorville 500 kV	61
COI	66
SCIT	

SOLs versus IROLs



If there is a violation:

Types of limits	Definition	NERC standard	WECC standard
SOLs	Broad term for operating limit	Report violation	30 min for corrective action, no load shed
IROLs	Subset of SOLs that if violated, could expose a widespread area of the bulk electric system to instability, uncontrolled separation(s) or cascading outages	30 min for corrective action, can use load shed	Not applicable

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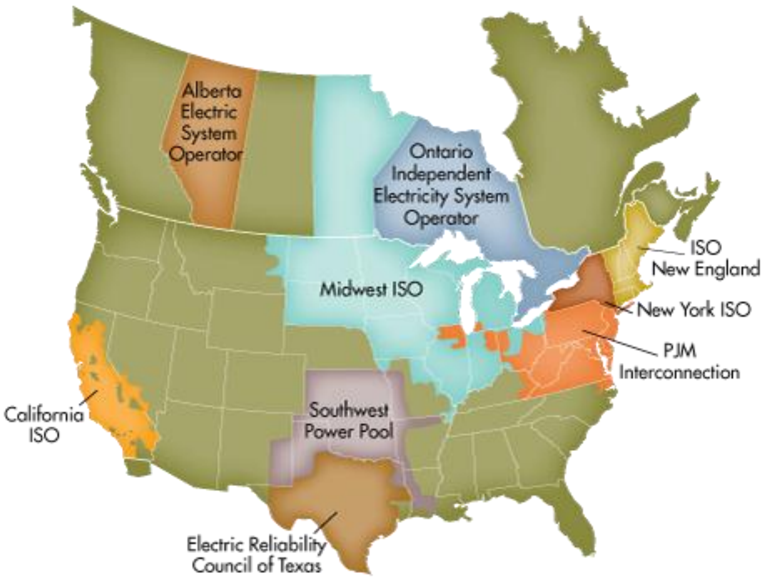
More on IROLs in the eastern interconnection



Source: ISO/RTO Council

- Some IROLs in the east are the interfaces between the interconnections (*i.e.*, NYISO)
- For these interfaces, IROLs can be managed in two additional ways:
  - Net interchange
    - Can be addressed by deliverable ancillary services procured on a system-wide basis
  - Market-to-market actions
    - Market-to-market redispatch
    - Reserve sharing

Question: Don't other ISOs/RTOs have 30 minute reserves to address 30 minute IROL corrective action?

- Answer: The 30 minute reserves are not directly procured to address the 30 minute IROL corrective action (but can help)
- Why?
  - 30 minute reserves replenish/supplement 10 minute reserves
  - IROLs can be managed via:
    - 10 minute reserves (primary)
    - 30 minute reserves (supplemental)
    - Manual intervention
    - Load shedding *(not available to ISO)*
    - Market-to-market actions *(largely not available to ISO)*

Question: Why is the WECC SOL standard challenging?

- Answer: Because it is based on flows and must be addressed within the 30 minute timeframe.
- Explanation
  - Unlike operating reserves, the standard is explicit about flow, but implicit about capacity requirement
  - There are multiple contingencies associated with each major WECC path
  - The flow on the system will change depending on which contingency occurs
  - The challenge is to be able to evaluate the post contingency flow, and figure out the explicit capacity requirements and their right locations

Take-aways thus far:

- The ISO, because of the WECC standard, is unique among US markets
- WECC standard is more stringent than NERC
- 30 minute reserves in other markets are not used to meet the similar NERC standard
- The WECC SOL standard is especially challenging because the solution is flow-based, has a 30 minute timeframe, and the ISO cannot rely on load shedding

Question: How is ISO currently addressing WECC SOL standard?

- Answer: Combination of 10 minute reserves, exceptional dispatches, and minimum online commitment (MOC) constraints

Question: Why are 10 minute reserves procured?

- Answer: To meet WECC standard BAL-STD-002-0 B.WR1
  - BAL-STD-002-0 B.WR1 is based on capacity
    - Must procure capacity equal to single largest contingency OR 5% of load served by hydro and 7% of load served by thermal
  - Different than WECC standard TOP-007-WECC-1
    - Must return system to secure state based on flow
  - Contingency reserves can help address TOP-007-WECC-1 but does not fully meet the standard

Question: How does exceptional dispatch help?

- Answer: Ensures the needed ramping capability exists within the 30 minute limit
- How?
  – Operators manually select units deemed effective (location, ramping capability, capacity, etc)
  – Units positioned through exceptional dispatches

Question: How do MOC constraints help?

- Answer: Commits effective capacity within the constraint
- How?
  - Engineering analysis defines the constraint (static geographic footprint).
  - Units within the constraint are committed in the day-ahead to Pmin but energy output above Pmin is optimized in the market

Correction: Straw proposal notes that MOC constraints involve manual actions. They do not. This will be corrected in the revised straw proposal.

Question: Why is the preventive-corrective constraint being proposed if ISO can use other mechanisms?

- Answer: Reliability and efficiency challenges remain
- Why?
  - For reliability, current mechanisms cannot precisely procure the corrective action in the right locations
  - For efficiency, procurement and dispatch are not optimized, bid costs may not be reflected, and fast response may not be reflected in the market
    - FERC order to reduce reliance on manual operations
- Bottom line = can use the market to efficiently ensure reliability

Reliability challenges

Mechanism	Addresses:	Amount of capacity procured determined by:	Locational definition:	Ensures accurate amt of capacity procured at right location?
10 min contingency reserves	NERC/WECC operating reserve requirements	WECC operating reserve requirements	System-wide	Partially – deliverability issues because not flow-based and granularity
Exceptional dispatch	As specified in ISO tariff	Operator judgment	Location specific based on operator judgment	Partially – potential deliverability issues and imprecise procurement
MOC constraint	WECC standard TOP-007-WECC-1 R1 and non-flow based constraints	Predefined static region and requirement	Predefined static region	Partially – predefined static regions and only commits units to Pmin
Preventive-corrective constraint	WECC standard TOP-007-WECC-1 R1	Optimized solution	Nodal	Fully

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Efficiency challenges

Mechanism	Optimized procurement?	Efficiently dispatched post-contingency?	Bid cost	Fast response valued in market?
10 min contingency reserves	Yes, for system-wide need co-optimized with energy	May have deliverability issues	Reflected in LMP	Yes
Exceptional dispatch	No, manual process	Very likely	Not reflected in LMP	No
MOC constraint	No, constraint is pre-defined and not dynamic	Likely	Not reflected in LMP	No, ramping speed not considered
Preventive-corrective constraint	Yes, at nodal level	Yes	Reflected in LMP and potential LMCP payment	Yes

Preventive-corrective constraint

- ISO currently has preventive modeling (weak preventive)

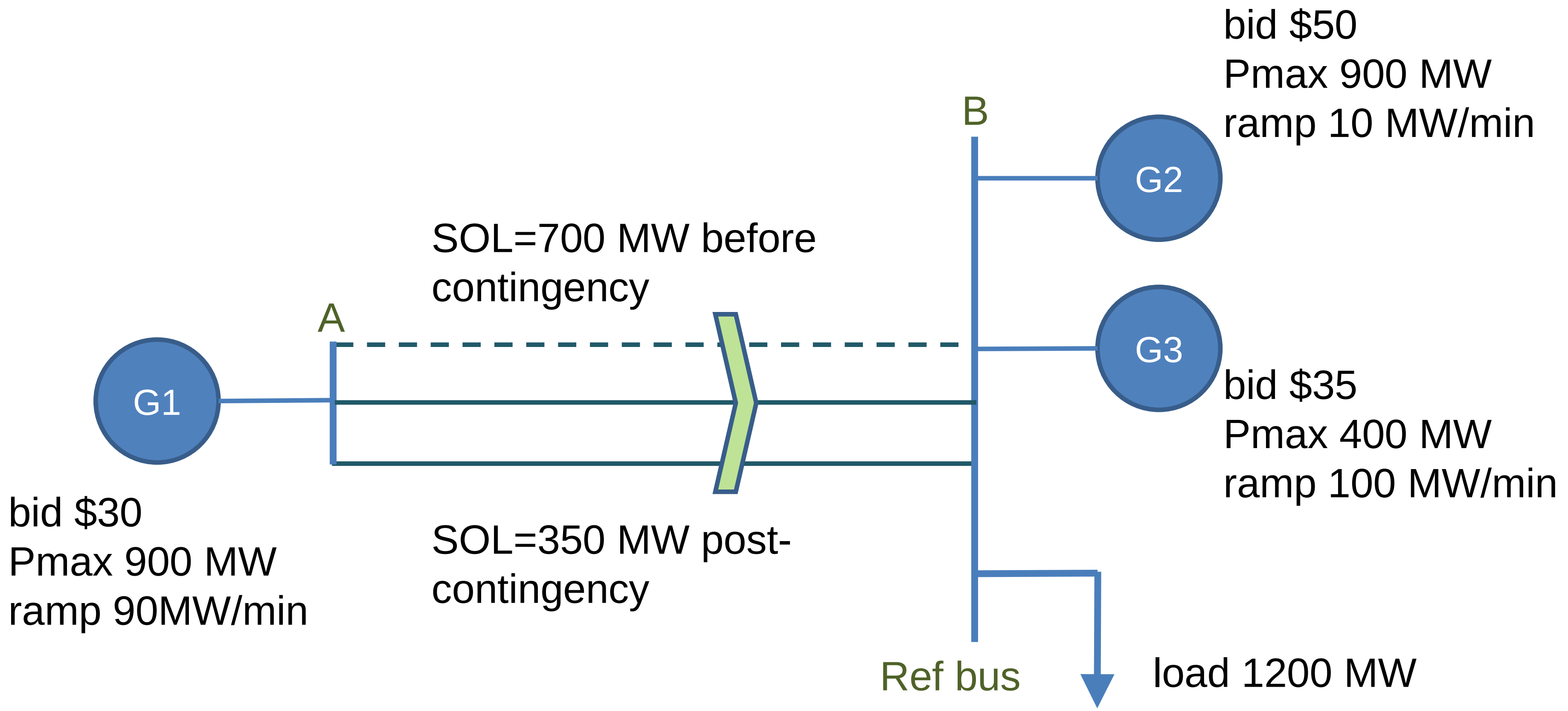
Model properties	Weak preventive	Preventive-corrective	Strong preventive
30-minute SOL compliance	Not modeled	Accurately modeled	Over modeled
Total bid cost	Lowest	Medium	Highest

- Preventive-corrective constraint will include:
  - currently procured 10 minute reserves
  - online generators
  - offline generators (if they can start within the given time frame)
  - demand response, and
  - pump storage

Locational marginal capacity price

- Main difference between weak preventive and preventive-corrective constraint is the inclusion of locational marginal capacity price (LMCP)
- If additional corrective capacity is needed, the LMCP will be paid to all units at a nodal level (LMCP can be $0)
- LMCP may reflect:
  - a resource's opportunity cost of being dispatched out of merit,
  - the marginal congestion cost saving, and/or
  - the marginal capacity value to null the incentive of uninstructed deviations in order to support the dispatch.

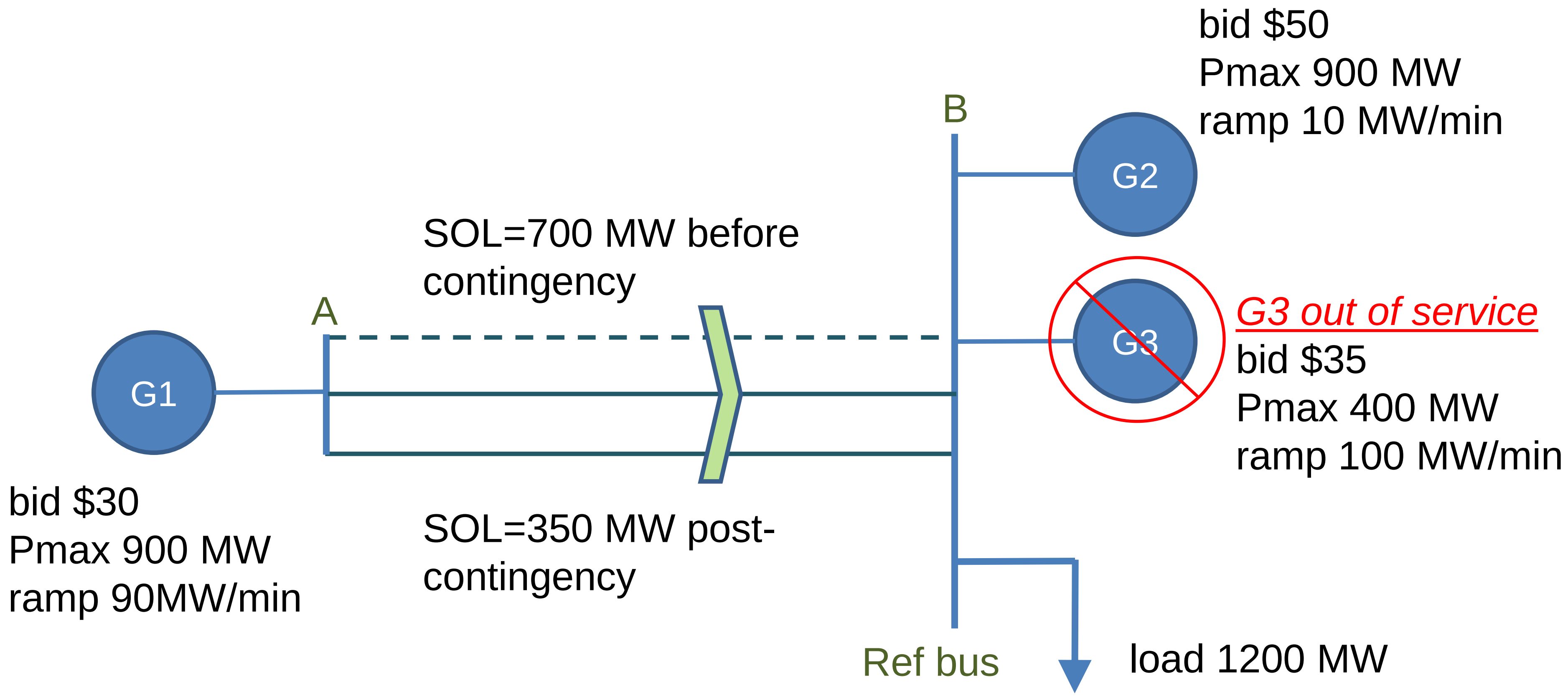
Example 1: Out-of-merit dispatch with LMCP reflecting opportunity cost



Example 1: Preventive-corrective solution and LMCP compensation

	Energy in base case						
Gen	P^0	LMP	λ^0	μ_{AB}^0	Bid cost	Revenue	Profit
G1	700	$30	$50	$–5	$21,000	$21,000	$0
G2	250	$50	$50	$–5	$12,500	$12,500	$0
G3	250	$50	$50	$–5	$8,750	$12,500	$3,750
	Corrective Capacity in contingency *kc*=1						
Gen	ΔP^1	LMCP^1	λ^1	μ_{AB}^1	Bid cost	Revenue	Profit
G1	–350	$0	$15	$–15	$0	$0	$0
G2	200	$15	$15	$–15	$0	$3,000	$3,000
G3	150	$15	$15	$–15	$0	$2,250	$2,250

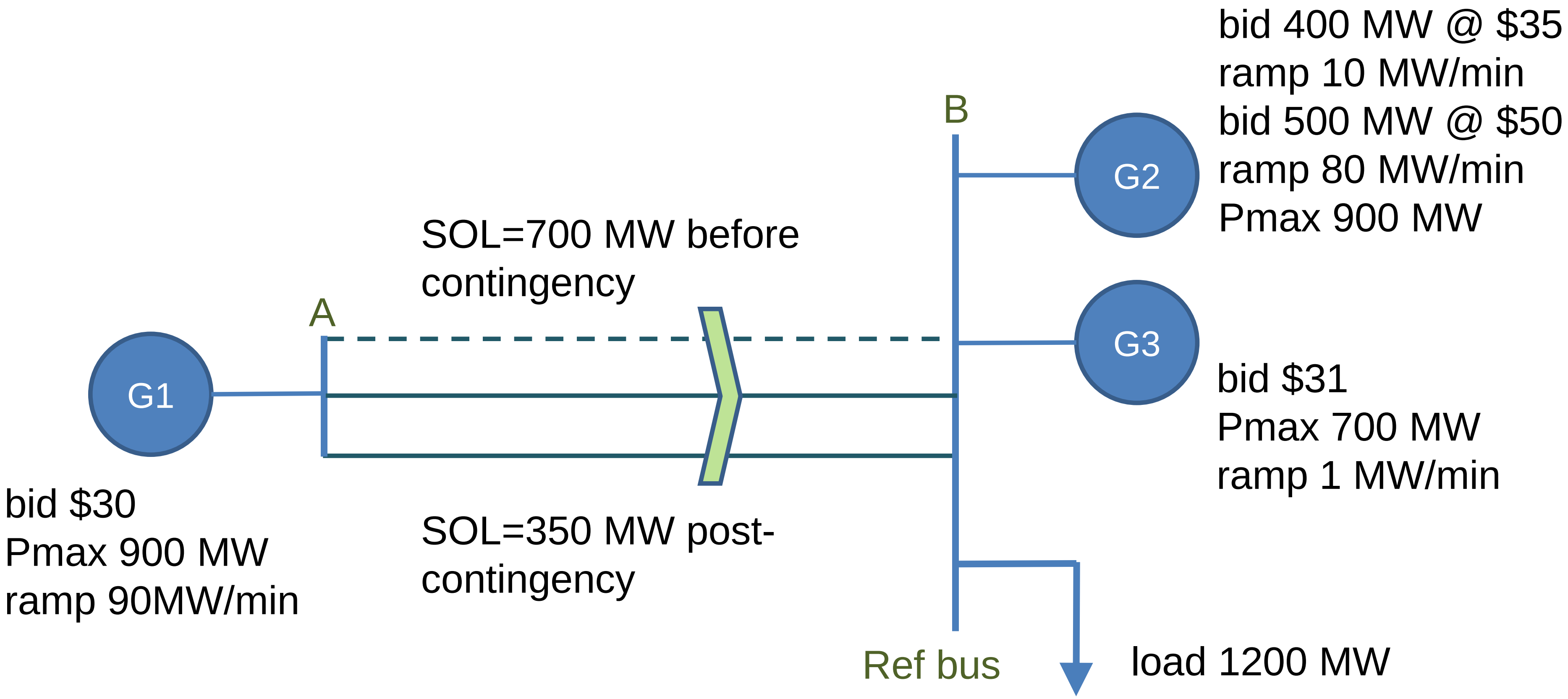
Example 2: Reducing pre-contingency flow with LMCP reflecting congestion cost saving



Example 2: Preventive-corrective solution and LMCP compensation with G3 out of service

	Energy in base case			
Gen	P^0	LMP	λ^0	μ^0_{AB}
G1	550	$30	$50	$0
G2	650	$50	$50	$0
G3	0	$50	$50	$0
	Corrective Capacity in contingency *kc*=1			
Gen	ΔP^1	$LMCP^1$	λ^1	μ^1_{AB}
G1	–200	$0	$20	–$20
G2	200	$20	$20	–$20
G3	0	$20	$20	–$20

Example 3: Dynamic ramp rate with LMCP zeroing out uninstructed deviation incentive



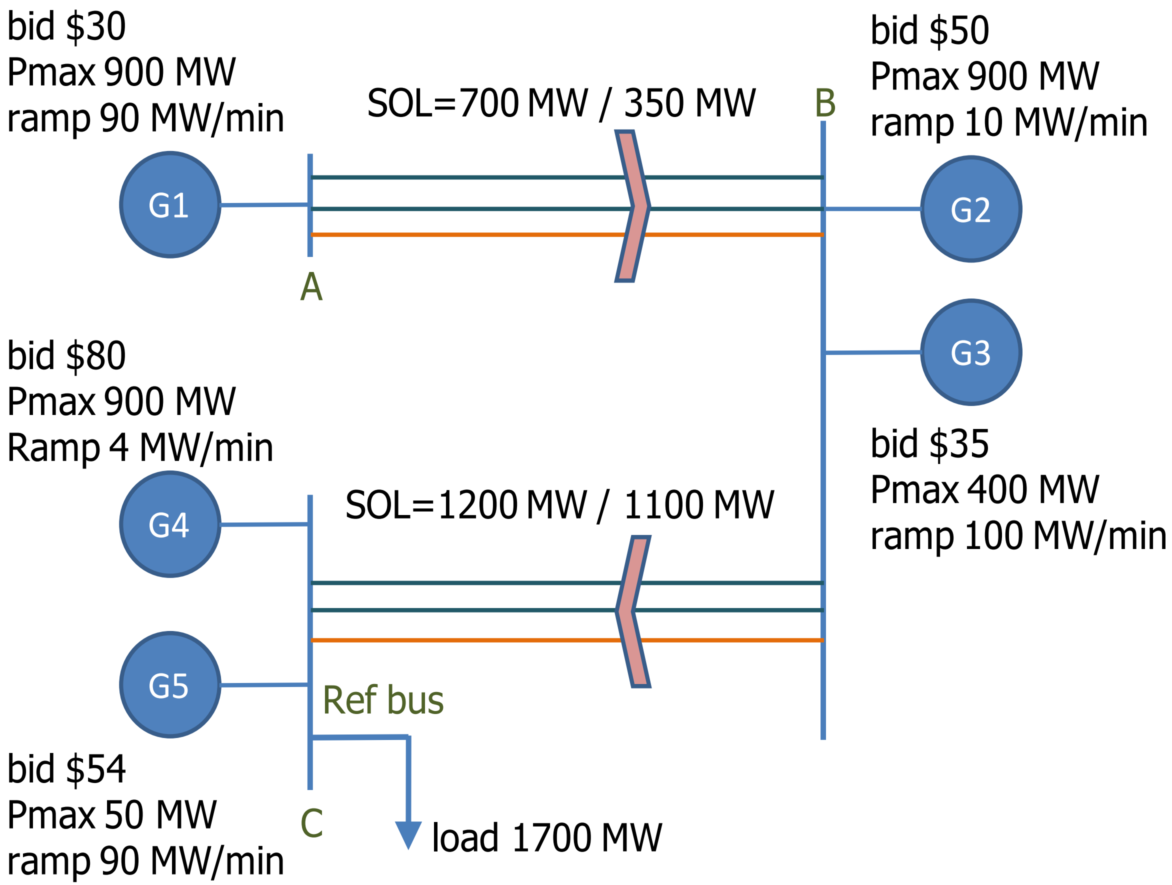
Example 3: Preventive-corrective solution and LMCP compensation with G2 having dynamic ramp rate

	Energy in base case			
Gen	P^0	LMP	λ^0	μ_{AB}^0
G1	700	$30	$31	–$0.43
G2	218.57	$31	$31	–$0.43
G3	281.43	$31	$31	–$0.43
	Corrective Capacity in contingency *kc*=1			
Gen	ΔP^1	$LMCP^1$	λ^1	μ_{AB}^1
G1	–350	$0	$0.57	–$0.57
G2	330	$0.57	$0.57	–$0.57
G3	20	$0.57	$0.57	–$0.57

Example 3: Preventive-corrective solution and LMCP compensation with G2 having dynamic ramp rate

- Question: How should we interpret LMCP of $0.57?
- Answer: The value of LMCP is to support the dispatch by eliminating the incentive of uninstructed deviations.
- Explanation
  - Assume G2 wants to generate 1 MW less than the ISO's dispatch 218.57 MW, so it could avoid losing $4
  - By doing so, the corrective capacity it can provide reduces to 323 MW:
    - from 217.57 MW to 400 MW, ramp 182.43 MW in 182.43/10 = 18.24 minutes,
    - from 400 to 540.56, ramp 140.56 MW in 140.56/80=1.76 minutes
  - G2 would lose corrective capacity payment for 7 MW, a total of 0.57*7=$4

Example 4: Multiple contingencies with LMCPs reflecting location opportunity costs



Example 4: Preventive-corrective solution and LMCP compensation with two SOLs

	Energy in base case				
Gen	P^0	LMP	λ^0	μ^0_{AB}	μ^0_{BC}
G1	700	$30	$80	–$5	–$19
G2	150	$50	$80	–$5	–$19
G3	350	$50	$80	–$5	–$19
G4	470	$80	$80	–$5	–$19
G5	30	$80	$80	–$5	–$19
	Corrective Capacity in contingency *kc*=1				
Gen	ΔP^{kc}	LMCP	λ^1	μ^1_{AB}	μ^1_{BC}
G1	–350	$0	$15	–$15	$0
G2	200	$15	$15	–$15	$0
G3	50	$15	$15	–$15	$0
G4	80	$15	$15	–$15	$0
G5	20	$15	$15	–$15	$0
	Corrective Capacity in contingency *kc*=2				
Gen	ΔP^{kc}	LMCP	λ^2	μ^2_{AB}	μ^2_{BC}
G1	0	$0	$11	$0	–$11
G2	–150	$0	$11	$0	–$11
G3	50	$0	$11	$0	–$11
G4	80	$11	$11	$0	–$11
G5	20	$11	$11	$0	–$11

Take-aways

- The preventive-corrective model prepares the system to comply with the WECC SOL standard
- The optimization can position the resources, and/or manage the pre-contingency flows in the most economic way
- The LMCPs reflect the correct marginal values of corrective capacity in terms of
  - Opportunity cost,
  - Congestion cost saving, and/or
  - Instruction penalty (incentive to deviate from ISO instruction)
- The LMCPs reflect correct marginal values when there are multiple contingencies

Feedback sought from stakeholders

1. We welcome any questions, comments, or suggestions on this straw proposal
2. We welcome alternative proposals and would like to see how the alternative is superior to the preventive-corrective constraint
3. Pros and cons for allowing capacity bids
4. Pros and cons for removing bid-in ramp rate functionality
5. Local market power and manipulation concerns
6. Cost allocation

Next Steps – revised schedule

Item	Date
Post issue paper	3/11/2013
MSC presentation*	3/19/2013
Stakeholder conference call	3/26/2013
Stakeholder comments due	4/9/2013
Post straw proposal	5/15/2013
Stakeholder meeting	5/22/2013
Stakeholder comments due	~~6/4/2013~~ 5/28/2013
Post revised straw proposal	6/18/2013
Stakeholder call	6/25/2013
Stakeholder comments due	7/1/2013
Post draft final proposal	~~7/1/2013~~ 7/25/2013
Stakeholder call	~~7/9/2013~~ 8/1/2013
Stakeholder comments due	~~7/24/2013~~ 8/8/2013
Board meeting	9/12-13/2013

Please submit comments to ContingencyModeling@caiso.com

*Will bring this issue to another MSC meeting closer to the draft final proposal