Generator Contingency and Remedial Action Scheme Modeling

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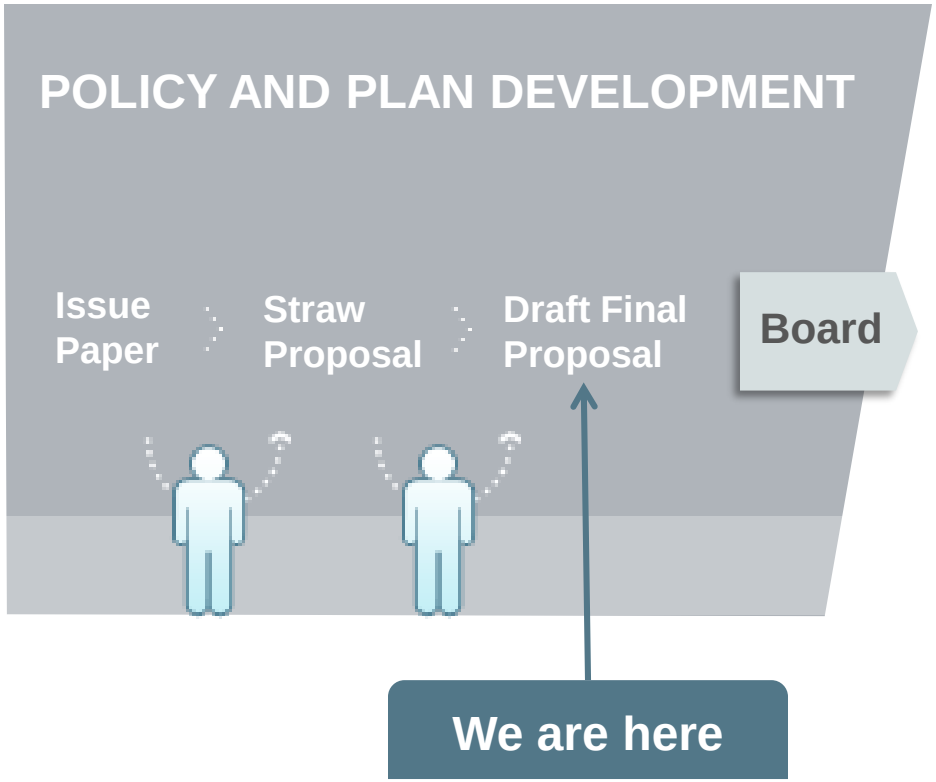
Draft Final Proposal
Stakeholder Conference Call
July 7, 2017

Agenda

Time	Topic	Presenter
9:00-9:05	Introduction	Jody Cross
9:05-9:30	Background & objectives	Perry Servedio
9:30-11:00	Stakeholder comments & changes to the proposal	Perry Servedio

ISO Policy Initiative Stakeholder Process



BACKGROUND & OBJECTIVES

Background

Generator Contingency & RAS Modeling

- Remedial action schemes can arm large portions of generation and load within the ISO and have the potential to drop large amounts of generation and load

- In certain outage conditions, potential generation loss can cause reliability issues on the system

- Transmission system security for these types of events is currently managed out-of-market
    - Potential for production cost savings
    - Potential to accurately reflect cost of supply in energy prices

Initiative Objectives

Generator Contingency & RAS Modeling

Initiative objectives:

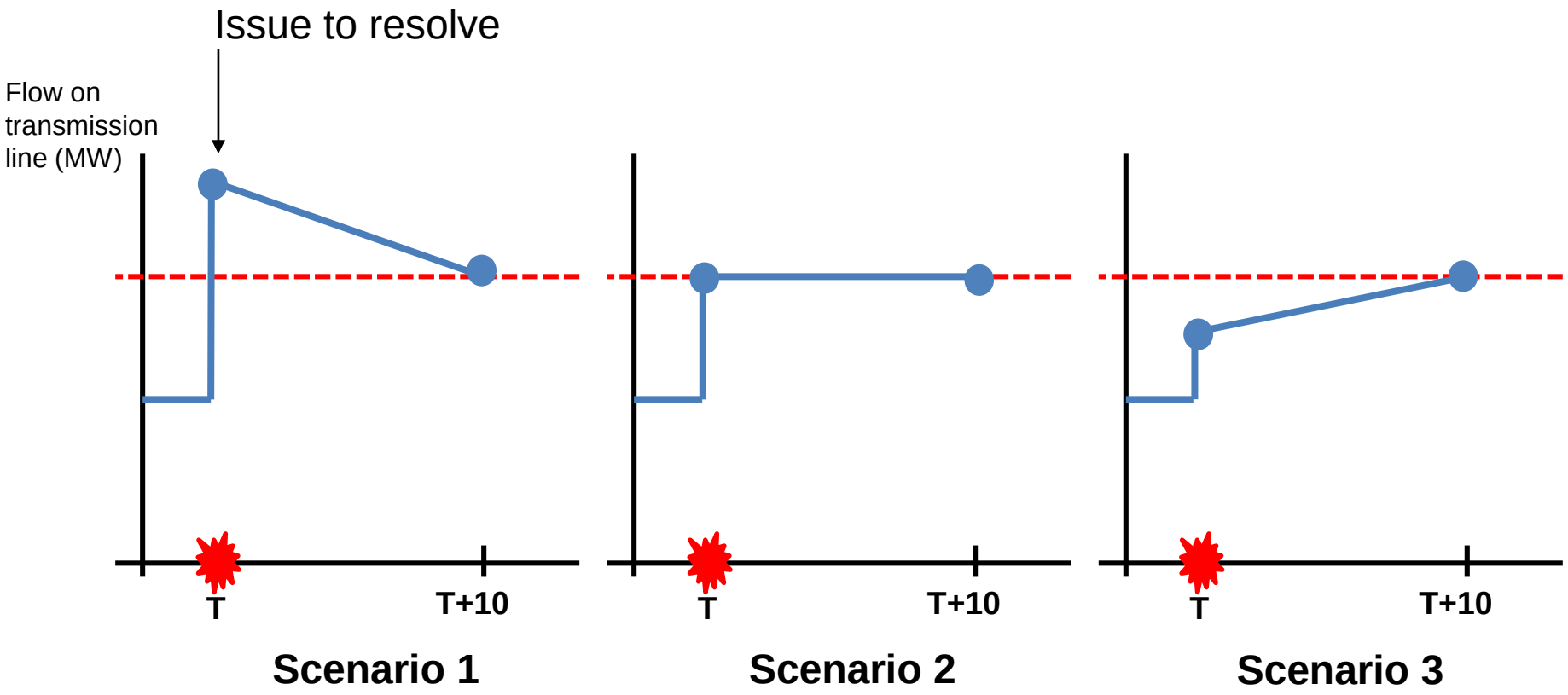
1. Allow for the benefits of increased transmission capability while protecting the transmission system for generator contingency and RAS events,

2. Appropriately pre-dispatch generation such that all transmission lines will be below emergency ratings if a generator contingency or RAS event were to occur,

3. Appropriately price the contribution to congestion for generators on RAS vs. generators not on RAS.

Issues

Ensure transmission line flows remain below emergency ratings



STAKEHOLDER COMMENTS & CHANGES TO THE PROPOSAL

Stakeholder comments

1. DC Energy, PG&E, Powerex, WPTF, and DMM **support**;
   - PG&E noted a concern about magnitude of the benefit
   - PG&E suggested extending the model to handle RAS load dropping and system reconfiguration
   - PG&E suggested that the ISO track RTCIO impact going forward
   - PG&E proposed an update to the CRRM GDF calculation
   - DMM concerned about CRR market modeling

2. Six Cities has no position
   - Supports modeling the CRR market consistent with the day-ahead market
   - Asks for clarity on why the modeling is optional for EIM entities

3. SCE does not **support**:
   - Unjustified revenue for RAS resources
     -ISO Response: energy prices are consistent with each resource's contribution to congestion
   - False incentives for network upgrades
     -ISO Response: no false incentives, the ISO determines the needed transmission upgrades
   - Distortions in the interconnection process
     -ISO Response: No distortion, interconnection decisions still based on reliability studies and fixed infrastructure costs

Overview of changes to the proposal

1. Extended proposal to use the methodology to also model remedial action schemes that drop load or reconfigure the transmission system.

2. Expanded discussion on virtual bidding considerations to clarify the real-time settlement of day-ahead positions

3. Proposed to track the generator and remedial action scheme contingency impact on real-time congestion imbalance offset going forward after implementation.

4. Proposed to directly model the generator and remedial action scheme contingencies in the congestion revenue rights market.
   - Removed alternative approaches

5. Updated proposed methodology for calculating congestion revenue rights market generation distribution factors.
   - Analyzed accuracy and potential revenue imbalance impact

6. Clarified that the ISO will follow existing practices for enforcing contingencies in the congestion revenue rights market.

Modeling remedial action schemes that drop load or reconfigure the transmission system

EXTEND REMEDIAL ACTION SCHEME CONTINGENCY MODELING

Extend remedial action scheme contingency model

- If a remedial action scheme is programmed to drop load, this load drop will be modeled with the contingency.
  - Results in a different MW quantity spread to the system in the contingency
  - Loss of 1,000 MW of generation and 500 MW of load will result in modeling the pick-up effect of 500 MW of generation on the transmission system
  - Loss of 1,000 MW of load and 500 MW of generation will result in modeling the pick-up effect of 500 MW of load on the transmission system

- If a remedial action scheme is programmed to reconfigure the transmission system (switch lines in or out), this will be modeled with the contingency.
  - Results in different shift factors to use in the contingency case

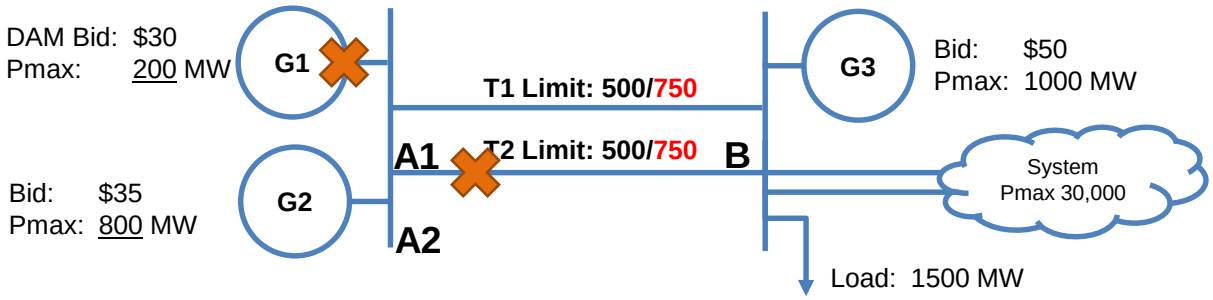
Virtual supply/demand impact on remedial action scheme constraints

IMPACT OF VIRTUAL SUPPLY/DEMAND

Impact of virtual supply/demand

- Virtual supply at generator contingency nodes will be treated the same as physical supply
- Enforce the contingency constraint regardless of amount of supply bid-in at the location
  - Zero MW of virtual/physical supply bids will simply lead to a zero MW pick-up by the rest of the system and no impact on constraints
- In the day-ahead market, generator contingency node is charged for the congestion it causes: applies to both virtual and physical

Virtual supply at RAS node in day-ahead



DAM

Virtual @A1 Bids $30
Physical @A1 no bid

Contingency:		Normal		Loss of T2 & G1			
Monitored:		AB Flow < 1000 MW		AB Flow < 750 MW (binds)			
AB Flow:		944.97 MW		750 MW			
Generator (i)	**λ^0**	**$SF^0_{i,AB}$**	**μ^0_{BA}**	**$GFF^{G1}_{i,AB}$**	**μ^{G1}_{AB}**	**LMP**	**Award**
Virtual @ A1	$50	1	$0	0.02515723	$15	$49.62	200
Physical @ A1	$50	1	$0	0.02515723	$15	$49.62	0
G2	$50	1	$0	1	$15	$35	744.97
G3	$50	0	$0	0	$15	$50	555.03

RTM

No physical bids @A1

Contingency:		Normal		Loss of T2 & G1			
Monitored:		AB Flow < 1000 MW		AB Flow < 750 MW (binds)			
AB Flow:		750 MW		750 MW			
Generator (i)	**λ^0**	**$SF^0_{i,AB}$**	**μ^0_{BA}**	**$GFF^{G1}_{i,AB}$**	**μ^{G1}_{AB}**	**LMP**	**Award**
Virtual @ A1	$50	1	$0	0.02515723	$15	$49.62	0
Physical @ A1	$50	1	$0	0.02515723	$15	$49.62	0
G2	$50	1	$0	1	$15	$35	750
G3	$50	0	$0	0	$15	$50	750

Congestion revenue rights market generator distribution factor calculation methodology

CRRM GDF METHODOLOGY

CRRM GDF methodology

- Generation distribution factor impacts where the system picks up the lost generation
- CRRM can only model one per time of use per month per resource per contingency
- DAM will have different GDFs per hour per resource per contingency
- Potential for revenue imbalance
  - CRRM GDFs should as accurate as possible
- Proposed to use monthly average GDF per resource per contingency

CRRM GDF methodology

$$GDF_{o_g,i} = \begin{cases} -1 & i = o_g \\ 0 & i \notin S_{FR} \wedge i \neq o_g \\ \left(\frac{1}{N}\right) \cdot \sum_{t \in H} \left(\frac{u_{i,t} \cdot G_{i,max,t}}{\sum_{i \in S_{FR}, i \neq o_g} (u_{i,t} \cdot G_{i,max,t})} \right) & i \in S_{FR} \wedge i \neq o_g \end{cases}$$

Where,

- *H is the set of hours in the season (or month) in the time period of interest (e.g. peak or off-peak),*
- *N is the number of hours in H*
- *t is the hour within H*
- *$u_{i,t}$ is the unit commitment status in hour t*

CRRM GDF methodology

Calculation accuracy

- Analyzed January 2016 through January 2017
- Calculated monthly CRR GDFs for 2016 based on 2015 data
- Calculated actual 2016 GDFs per hour in the day-ahead market
  - 94.7% of day-ahead market hours had GDFs within 0.005 of CRRM GDF
  - 97.3% of day-ahead market hours had GDFs within 0.01 of CRRM GDF
  - 99% of day-ahead market hours had GDFs within 0.02 of CRRM GDF

CRRM GDF methodology

Impact on revenue imbalance

- Analyzed January 2016 through January 2017
- Calculated monthly CRR GDFs for 2016 based on 2015 data
- Calculated actual 2016 GDFs per hour in the day-ahead market
- Used day-ahead market shift factors and GDFs to estimate potential revenue imbalance due to differences between CRRM and day-ahead market
  - $199,352 deficit over the year
  - 39% of observations positively impacted imbalance account
  - 45% of observations negatively impacted imbalance account
  - 16% of observations had no impact on the imbalance account

RECAP

Recap

1. Extended proposal to use the methodology to also model remedial action schemes that drop load or reconfigure the transmission system.

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3. Proposed to directly model the generator and remedial action scheme contingencies in the congestion revenue rights market.
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NEXT STEPS

Next steps

1. Stakeholder comments on draft final proposal due on Friday, July 14, 2017

2. EIM Governing Body meeting on September 6, 2017

    - Management seeking approval for the proposal to allow an EIM Entity to enforce generator or remedial action scheme contingencies within its EIM balancing authority area.

3. CAISO Board of Governors meeting on September 20-21, 2017

QUESTIONS