Generator Contingency & RAS Modeling Enhancements

Issue Paper

April 25, 2016

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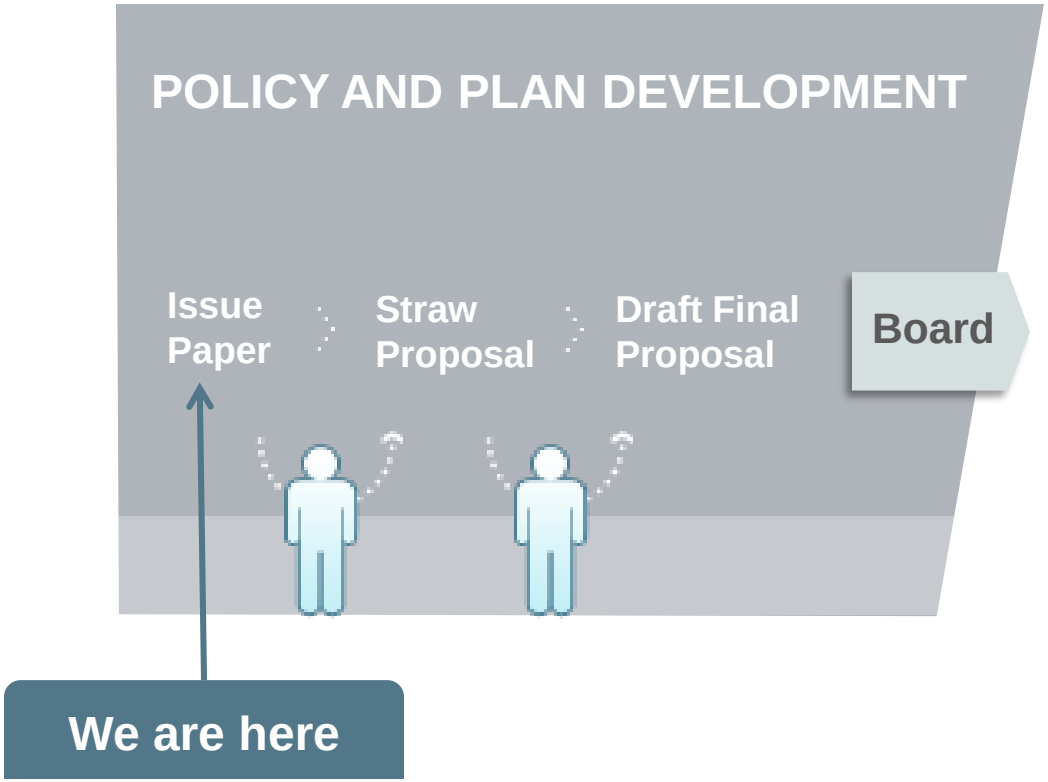
Senior Market Design and Regulatory Policy Developer

Agenda

Time	Topic	Presenter
3:00-3:05	Introduction	Tom Cuccia
3:05-3:30	Background	Perry Servedio
3:30-4:30	Issues	Perry Servedio

ISO Policy Initiative Stakeholder Process



Background

Background

N-1 security including loss of generation

A secure transmission system must be able to withstand credible transmission contingencies as well as credible generation contingencies.

1. **Transmission security for loss of transmission element**
   a. Transmission line or transformer loss

2. **Transmission security for loss of generation**
   a. Generator loss
   b. Generator loss due to RAS (includes loss of transmission element)

Background

Current contingency reserve procurement

- Contingency reserves currently procured regionally (and sub-regionally)
- Regions set up to model known transmission constraints
- Co-optimized with energy
- Do not consider more localized limitations to ensure sufficient deliverable contingency reserve procurement
- Deployed upon a generator contingency event

Background
Summary

System condition after deployment of contingency reserves

- Given a generator loss plus the deployment of contingency reserves, all transmission facilities must be below emergency ratings.

- Given a transmission line loss, plus a generator loss due to RAS action, plus the deployment of contingency reserves, all transmission facilities must be below emergency ratings.

Issues

Issues
Summary

Market issues related to generator contingency and RAS modeling

1. Infeasible contingency reserve procurement
2. Insecure transmission given potential generator loss
3. Uneconomic dispatch given generation loss due to RAS

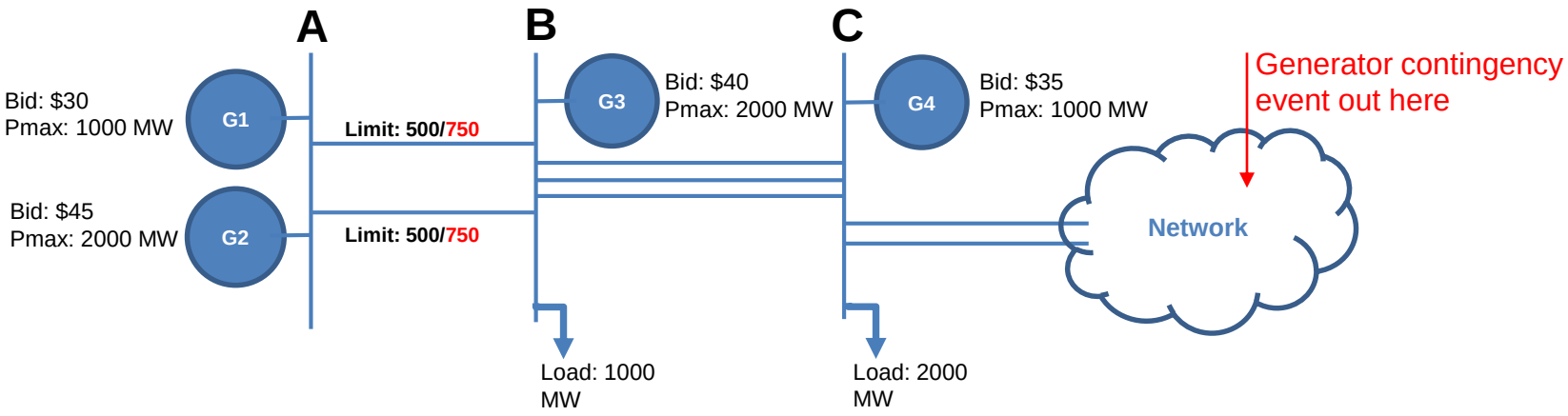
Issues

Infeasible contingency reserve procurement

- ISO holds contingency reserves for generator events
- Full quantity of reserves not guaranteed deliverable to system absent out-of-market actions

Issues

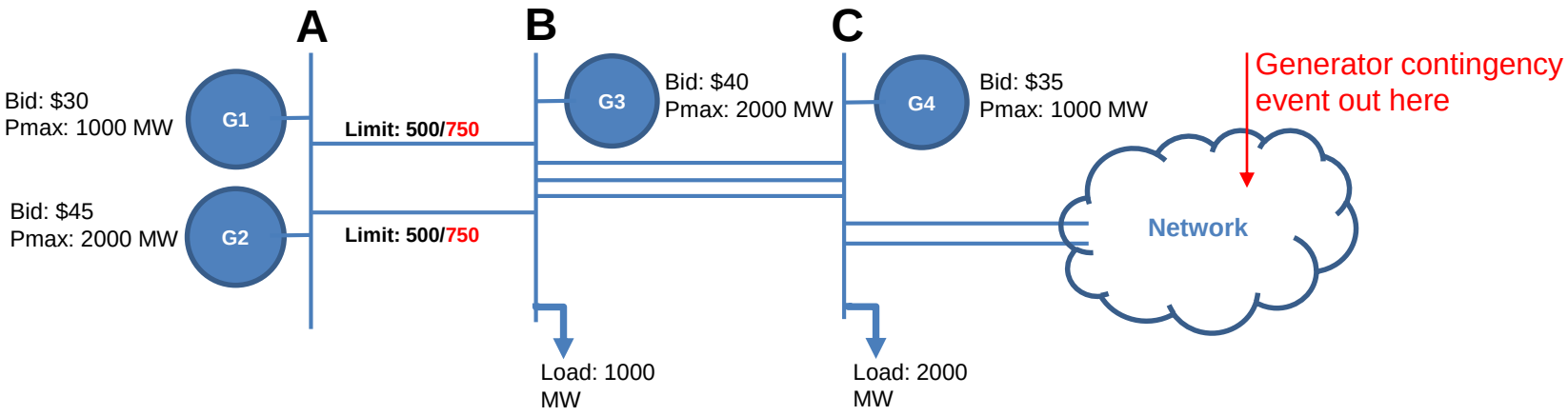
Infeasible contingency reserve procurement



Base case dispatch (absent out-of-market action)							
Generator (g)	P^0	AS	λ^0	SF_g^{AB}	μ^0_{AB}	μ^k_{AB}	LMP_g
G1	750	250	$40	1	$0	$10	$30
G2	0	750	$40	1	$0	$10	$30
G3	1250	0	$40	0	$0	$10	$40
G4	1000	0	$40	0	$0	$10	$40
Path Flows							
Pre-contingency					**After loss of G4 & AS Deployment**		
$Flow_{AB}$	750				$Flow_{AB}$	**1750 (Above emergency)**	

Issues

Infeasible contingency reserve procurement



Desirable base case dispatch							
Generator (g)	P^0	AS	λ^0	SF_g^{AB}	μ^0_{AB}	μ^k_{AB}	LMP_g
G1	750	250	$40	1	$0	$10	$30
G2	0	**500**	$40	1	$0	$10	$30
G3	1250	**250**	$40	0	$0	$10	$40
G4	1000	0	$40	0	$0	$10	$40
Path Flows							
Pre-contingency					**After loss of G4 & AS Deployment**		
$Flow_{AB}$	750				$Flow_{AB}$	**1500 (Below rating)**	

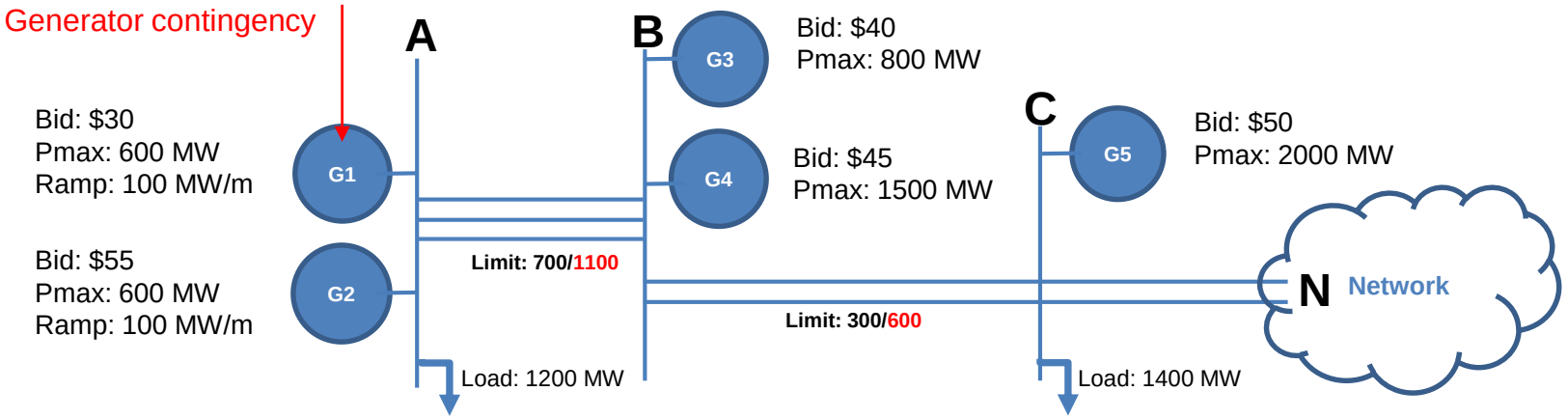
Issues

Insecure transmission given potential generator loss

- ISO requires N-1 security for loss of generation
- All transmission facilities must be below emergency ratings
- N-1 security for loss of generation not ensured absent out-of-market actions

Issues

Insecure transmission given potential generator loss

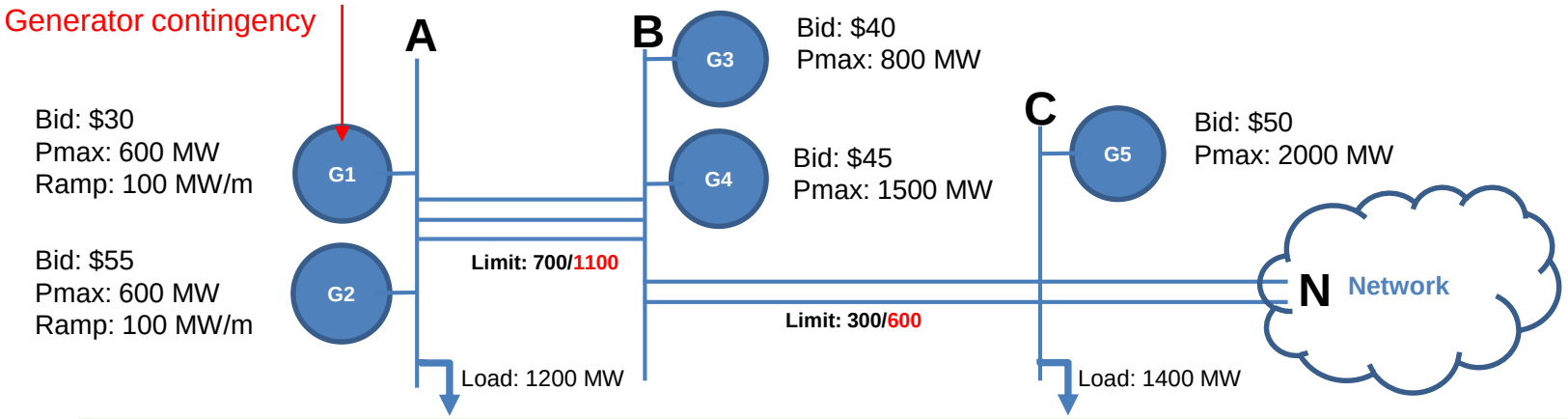


Base case dispatch (absent out-of-market action)										
Generator (g)	P^0	AS	λ^0	SF_g^{AB}	μ^0_{AB}	μ^k_{AB}	SF_g^{BC}	μ^0_{BC}	μ^k_{BC}	LMP_g
G1	600		$47.70	0.54	$0	N/A	0.54	$5	N/A	$45
G2	0		$47.70	0.54	$0	N/A	0.54	$5	N/A	$45
G3	800		$47.70	–0.46	$0	N/A	0.54	$5	N/A	$45
G4	100		$47.70	–0.46	$0	N/A	0.54	$5	N/A	$45
G5	1100		$47.70	–0.46	$0	N/A	–0.46	$5	N/A	$50
GN	0	600	$47.70	–0.46	$0	N/A	–1	$5	N/A	$50

Path Flows			
Pre-contingency		**After loss of G1**	
$Flow_{AB}$	–600	$Flow_{AB}$	**–1200 (Above emergency rating)**
$Flow_{BC}$	300	$Flow_{BC}$	–300
$Flow_{CN}$	0	$Flow_{CN}$	–600

Issues

Insecure transmission given potential generator loss



Desirable base case dispatch										
Generator (g)	P^0	AS	λ^0	SF_g^{AB}	μ^0_{AB}	μ^k_{AB}	SF_g^{BC}	μ^0_{BC}	μ^k_{BC}	LMP_g
G1	600		$52.30	0.54	$0	–$10	0.54	$5	$0	$55
G2	**100**		$52.30	0.54	$0	–$10	0.54	$5	$0	$55
G3	800		$52.30	–0.46	$0	–$10	0.54	$5	$0	$45
G4	**0**		$52.30	–0.46	$0	–$10	0.54	$5	$0	$45
G5	1100		$52.30	–0.46	$0	–$10	–0.46	$5	$0	$50
GN	0	600	$52.30	–0.46	$0	–$10	–1	$5	$0	$50

Path Flows			
Pre-contingency		**After loss of G1**	
$Flow_{AB}$	–500	$Flow_{AB}$	**–1100 (Below rating)**
$Flow_{BC}$	300	$Flow_{BC}$	–300
$Flow_{CN}$	0	$Flow_{CN}$	–600

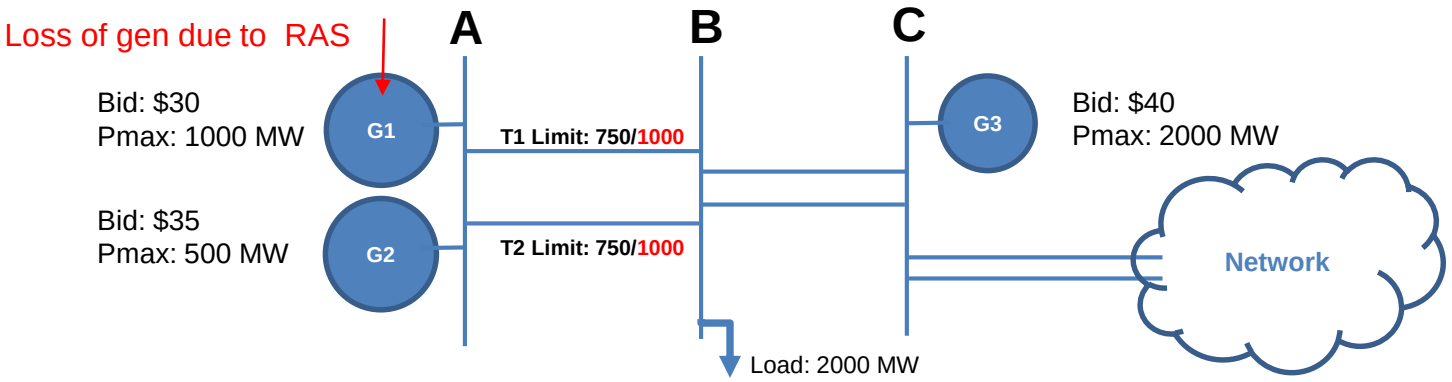
Issues

Uneconomic dispatch given generation loss due to RAS

- Lower production cost solution available when generation loss due to RAS action is modeled.
- All transmission facilities must be below emergency ratings
- Economic solution not ensured absent out-of-market actions

Issues

Uneconomic dispatch given generation loss due to RAS



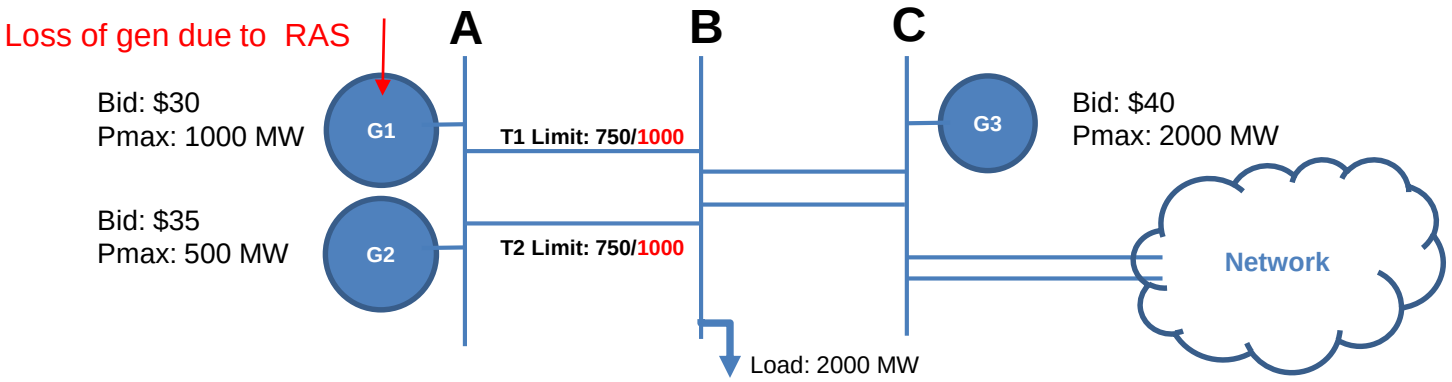
Base case dispatch (absent out-of-market action)							
Generator (g)	P^0	AS	λ^0	SF_g^{AB}	μ^0_{AB}	μ^k_{AB}	LMP_g
G1	1000		$40	1	$0	$5	$35
G2	0		$40	1	$0	$5	$35
G3	1000		$40	0	$0	$5	$40
GN	0	1000	$40	0	$0	$5	$40

Path Flows			
Pre-contingency		**After loss of T2 (and RAS G1)**	
$Flow_{AB}$	1000	$Flow_{AB}$	1000
$Flow_{BC}$	–1000	$Flow_{BC}$	–1000
$Flow_{CN}$	0	$Flow_{CN}$	0

Bid Cost = 1000(30) + 1000(40) = $70,000

Issues

Uneconomic dispatch given generation loss due to RAS



Desirable base case dispatch							
Generator (g)	P^0	AS	λ^0	SF_g^{AB}	μ^0_{AB}	μ^k_{AB}	LMP_g
G1	1000		$40	1	$5	$0	$35
G2	500		$40	1	$5	$0	$35
G3	500		$40	0	$5	$0	$40
GN	0	1000	$40	0	$5	$0	$40

Path Flows			
Pre-contingency		**After loss of T2 (and RAS G1)**	
$Flow_{AB}$	1500	$Flow_{AB}$	500
$Flow_{BC}$	–500	$Flow_{BC}$	–1500
$Flow_{CN}$	0	$Flow_{CN}$	–1000

Bid Cost = 1000(30) + 500(35) + 500(40) = $67,500

Issues
Summary

Market issues related to generator contingency and RAS modeling

1. Infeasible contingency reserve procurement
2. Insecure transmission given potential generator loss
3. Uneconomic dispatch given generation loss due to RAS

Next Steps

Next Steps

Date	Event
Wed 4/19/2016	Issue paper
Mon 4/25/2016	Stakeholder conference call
Fri 5/13/2016	Stakeholder comments due on issue paper
Thu 5/19/2016	Straw proposal posted
Thu 5/26/2016	Stakeholder conference call (straw proposal)
Thu 6/09/2016	Stakeholder comments due on straw proposal
Thu 6/23/2016	Revised straw proposal posted
Thu 6/30/2016	Stakeholder conference call (revised straw proposal)
Thu 7/14/2016	Stakeholder comments due (revised straw proposal)
Mon 8/8/2016	Draft final proposal posted
Mon 8/15/2016	Stakeholder meeting (draft final proposal)
Mon 8/29/2016	Stakeholder comments due (draft final proposal)
10/26-10/27	Board of Governors
Fall 2017	Implementation

Please submit comments to initiativecomments@caiso.com

Questions