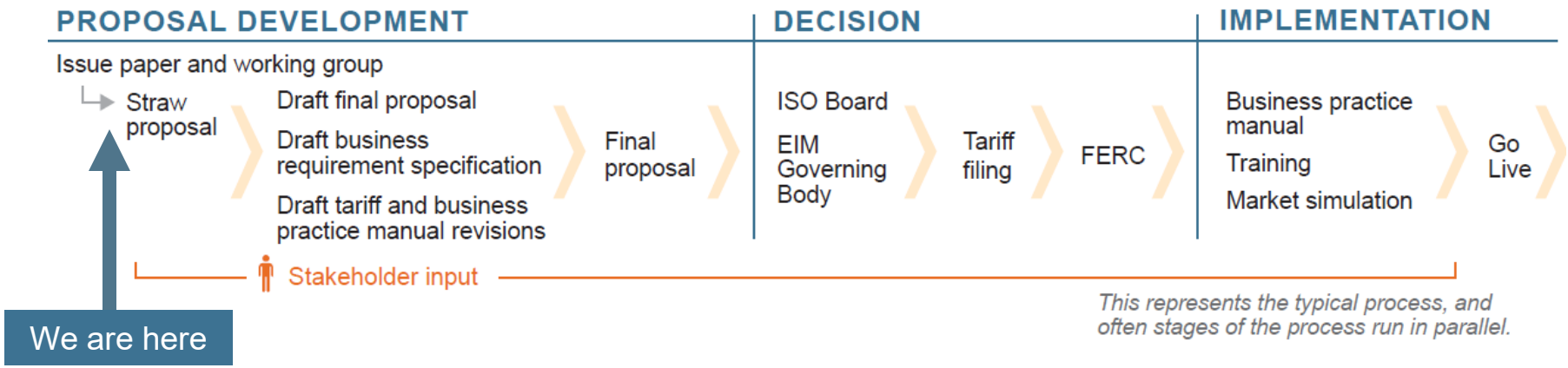
Adjustment to Inter-Tie Constraint Penalty Prices

Market Analysis and Forecasting
California ISO

November 19, 2021

Stakeholder Process



Agenda

- Introduction
- Background
- Explanation of the issue
- Proposed resolution

Acronyms

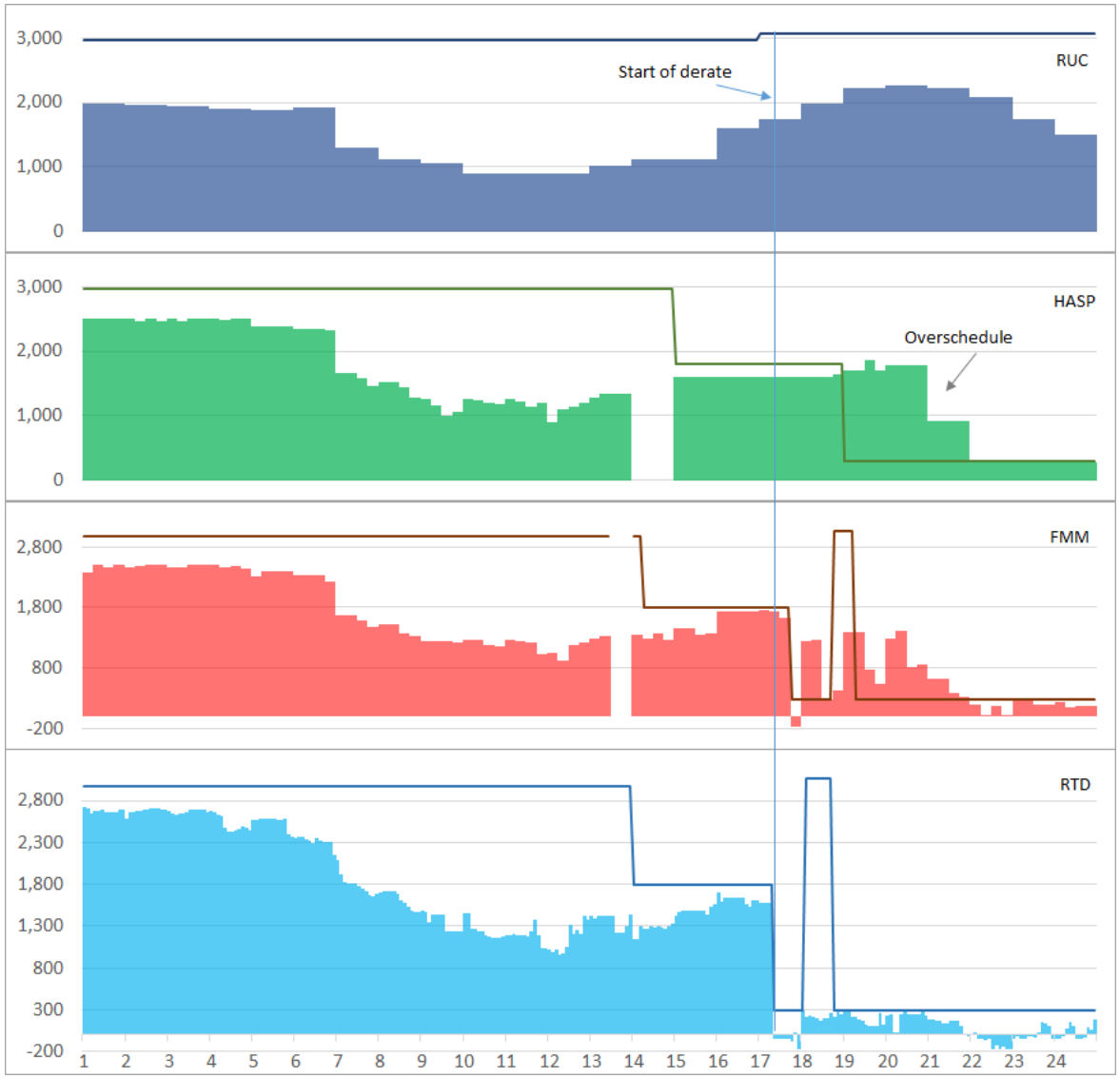
BPM	Business practice manual
FMM	Fifteen minute market
HASP	Hourly ahead scheduling process
IFM	Integrated forward market
ITC	Intertie constraint
LMP	Locational marginal price
MCC	Marginal congestion component
MLC	Marginal loss component
PBC	Power balance constraint
SMEC	System marginal energy price
RA	Resource adequacy
RT	Real time
RUC	Residual Unit commitment

Introduction

- Overscheduling is a condition in which intertie schedules exceed the intertie constraint limit
- On July 9, heavy derates on Malin, high volumes of self schedules on the intertie and tight supply created the conditions for this issue to materialize
- Based on current setup, the least cost solution was to relax the ITC limit rather than reducing import self schedules and relax further the power balance constraint
- Penalty prices for ITC constraints are defined in the Tariff at $1,250/MWh in RUC and $1,500/MWh in Real-time
- Proposed penalty prices for ITC constraints are $3,200/MWh in RUC and $2,900/MWh in Real-time

Overscheduling of Intertie constraints in HASP markets

- Right after Malin derate, market overscheduled imports, which required operators to actively cut imports in real-time, exacerbating the tightness of supply
- Overscheduling of interties poses a reliability concern



Implications of overscheduling on intertie constraints

- Reliability

Markets clear intertie schedules over the limit, which then requires operators to manually curtail after the fact

- Market efficiency

Market clearing process accounts for additional import supply that is not actually available

Import supply from overscheduling supports clearing of additional exports

Purpose of adjustment

- Proper scheduling priorities under all conditions
  - Power Balance constraint (PBC) is relaxed prior to Inter-Tie Constraint (ITC) relaxation
  - Net direction of the import schedules and export schedules do not violate either the physical limit for import or exports
- Proper inter-tie scheduling to help with reliability so that operators do not have to manually curtail schedules to maintain scheduling limits
  - Maintain proper scheduling priorities for reliability
  - Accurate assessment of feasible exports on non binding ITC constraints
  - Accurate measure of market infeasibility for situational awareness

Background on scheduling parameters

- **Market constraint relaxation parameter hierarchy:** Penalty factors within the optimization are to provide priority for scheduling for when constraints are relaxed

- **Locational Marginal Prices (LMP):** As stated in the CAISO Business Practice Manual for Market Operations Section 3.1, "The LMP is the marginal cost (expressed in $/MWh) of serving the next increment of Demand at that PNode." The LMP consists of three main parts including System Marginal Energy Component (SMEC), Marginal Loss component (MLC), and Marginal Congestion Component (MCC).

- **Power Balance Constraint (PBC) relaxation:** The PBC ensures that the sum of the demand and transmission losses is equal to the supply. The penalty price, as stated in the BPM, for real-time and HASP is $1,450 and in RUC is $1,600.

- **Inter-Tie Constraint (ITC) or Inter-Tie Scheduling Limit (ISL) relaxation:** An ITC is a scheduling constraint that is modeled in the market. An ISL is a group comprised of multiple ITCs. ITC's have a bi-directional limits for cleared intertie or system resource bids. An ITC constraint ensures intertie schedules, considering the net direction of the import schedules and export schedules, do not violate either the physical limit for import or exports. The penalty price, as stated in the BPM, for real-time and HASP is $1,500 and in RUC is $1,250. Id at Section 6.6.2.5.

Applicable HASP penalty prices from the BPM of Market Operations

Penalty Price Description	Scheduling Run Value Based on $1000 Cap	Pricing Run Value Based on $1000 Cap	Comment
Real-time price-taker self-schedule import with RUC schedule and import leg of high priority wheel through self-schedule with RUC schedule	-1200	-150	For hourly bids in HASP and fifteen- minute bids in FMM, a RUC scheduled import self-schedule Has a higher priority than over-generation energy slack
Real-time price-taker self-schedule import without RUC schedule and import leg of high priority wheel through self-schedule without RUC schedule	-1100	-150	For hourly bids in HASP and fifteen-minute bid in FMM, a real time submitted self-schedule with no RUC schedule has a higher priority than over-generation energy slack
Energy balance/Load curtailment, RUC cleared self-scheduled export using identified non-RA capacity. RUC cleared export leg of a wheel through self-schedule. Real-time export leg of a wheel through self-schedule. Real-time market self-scheduled export using identified non-RA capacity.	1450	1000	Scheduling run penalty price is set high to achieve high priority in serving forecast load and exports that utilize non-RA capacity. Energy bid cap as pricing run parameter reflects energy supply shortage.
Transmission constraints: Intertie scheduling	1500	1000	The highest among all constraints in scheduling run, penalty price reflects its priority over load serving. Energy bid cap as pricing run parameter reflects energy supply shortage.

Applicable RUC penalty prices from the BPM of Market Operations

Penalty Price Description	Scheduling Run Value	Pricing Run Value	Comment
Market energy balance -under procurement. IFM cleared self-scheduled exports using identified non-RA capacity. IFM cleared export leg of a wheel through self-schedule	1600	250	The RUC procurement may be less than the Demand forecast if the CAISO has committed all available generation and accepted intertie bids up to the intertie capacity.
Transmission constraints: branch, corridor, nomogram (base case and contingency analysis)	1250	250	These constraints affect the final dispatch in the Real-Time Market, when conditions may differ from Day-Ahead.
IFM cleared supply schedules	Min(energy bid price -$250, or $0)	0	These values preserve schedules established in IFM in both the RUC scheduling run and pricing run.
IFM cleared economical exports	IFM bid-in price +300	0	Export adder priority for IFM schedules

Applicable RUC penalty prices for adder from IFM

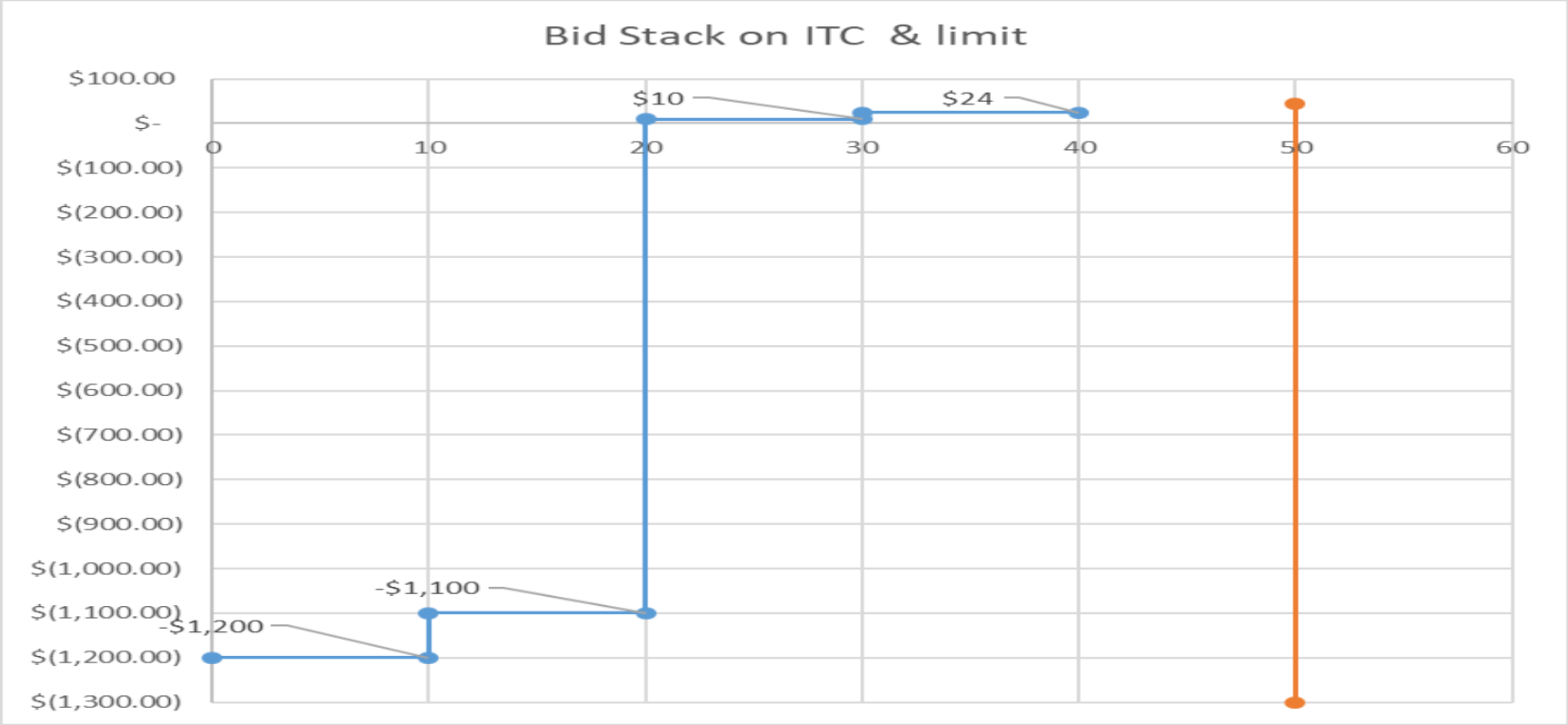
Penalty Price Description	Scheduling Run Value Based on $1000 Cap	Pricing Run Value Based on $1000 Cap	Comment
Import price-taker self-schedule. Import leg of a high priority wheel through self-schedule.	-1100	-150	Generic self-schedules for supply receive higher priority than Economic Bids at the bid floor.
Import leg of a low priority wheel through self-schedule	0	0	Import side of a low priority wheel self-schedule
Self-scheduled exports not using identified non-RA capacity, Exports leg of a low priority wheel through self-schedule	1050	1000	The scheduling parameter for self-scheduled exports not using identified non-RA capacity is set below the parameter for generic self-schedules for demand.

Illustration of the issue -Assumptions

- Imports only considered in examples for simplicity
  - When import limits are binding exports may clear due to pricing to provide counter flow
- Example assumptions
  - All LMP prices are based on the scheduling run
  - SMEC is $25/MWh
  - Loss component $0/MWh
  - Four types of import bids at the location
    - 10 MW offer at $24/MWh
    - 10 MW offer at $10/MWh
    - 10 MW real time self schedule (-$1,100 Penalty Price)
    - 10 MW RUC cleared self schedule (-$1,200 Penalty Price)

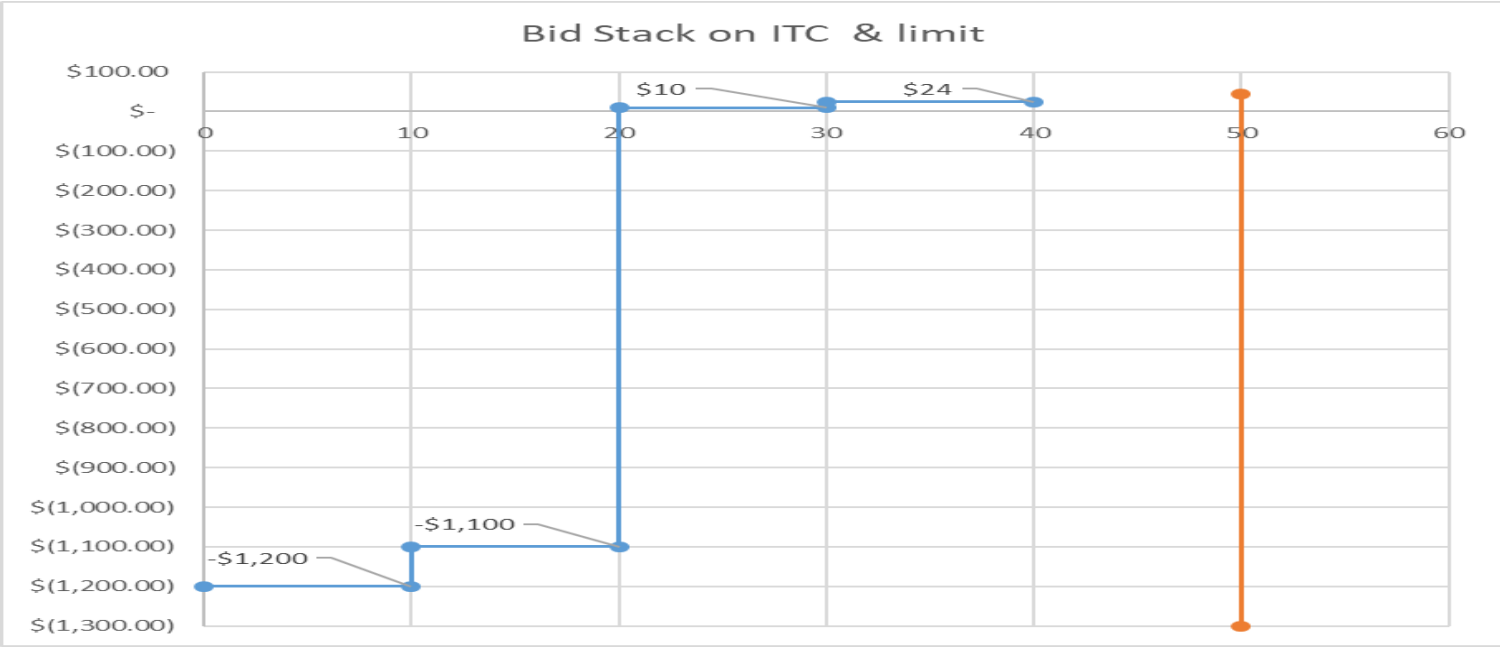
Illustration of the issue - Legend

- Blue line is the bid stack for each of the four bids
- Orange line is the ITC scheduling limit



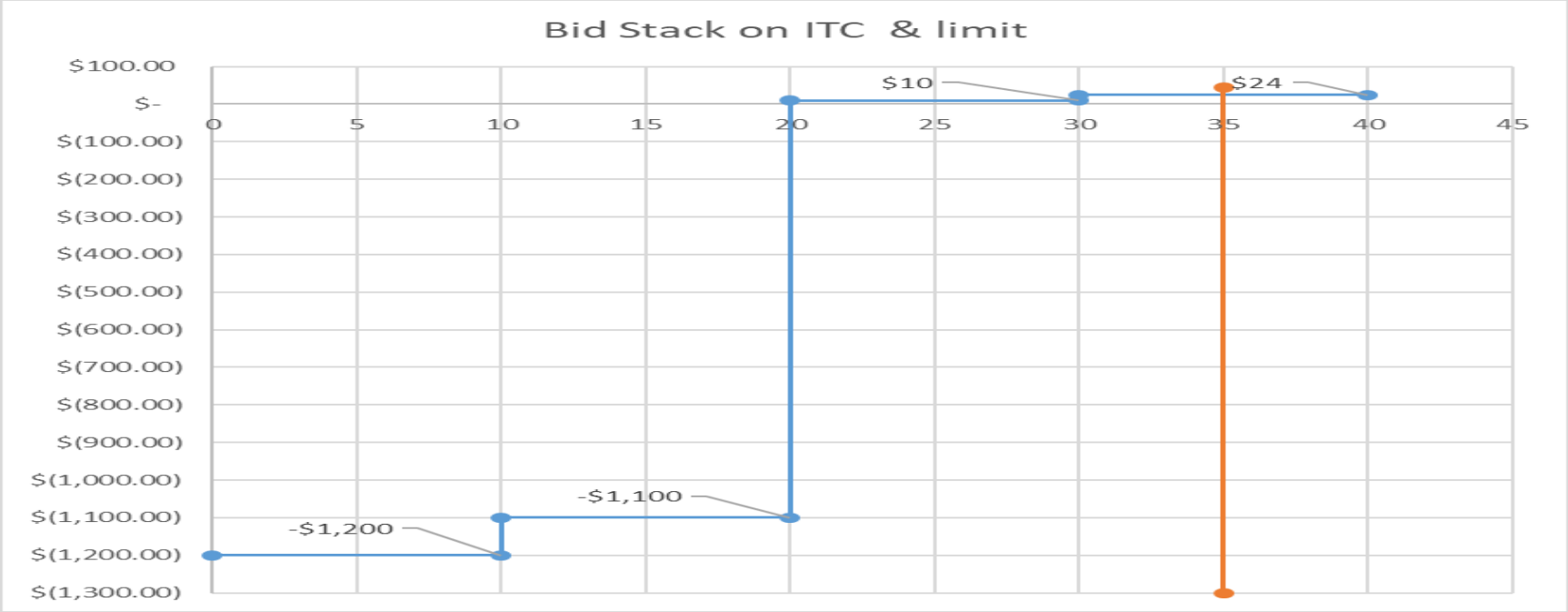
Example 1: Intertie limit is not binding

- 50 MW Import limit
- RUC Self Schedule clears 10 MW, RT Self Schedule clears 10 MW, economic bid @ $10 bid clears all 10 MW, and economic bid @ $24 bid clears all 10 MW
- Total schedules of 40 MW clears
- Clearing price is $25 (LMP) = $25 (SMEC) + $0 (MLC) + $0 (MCC)
- Intertie is not binding



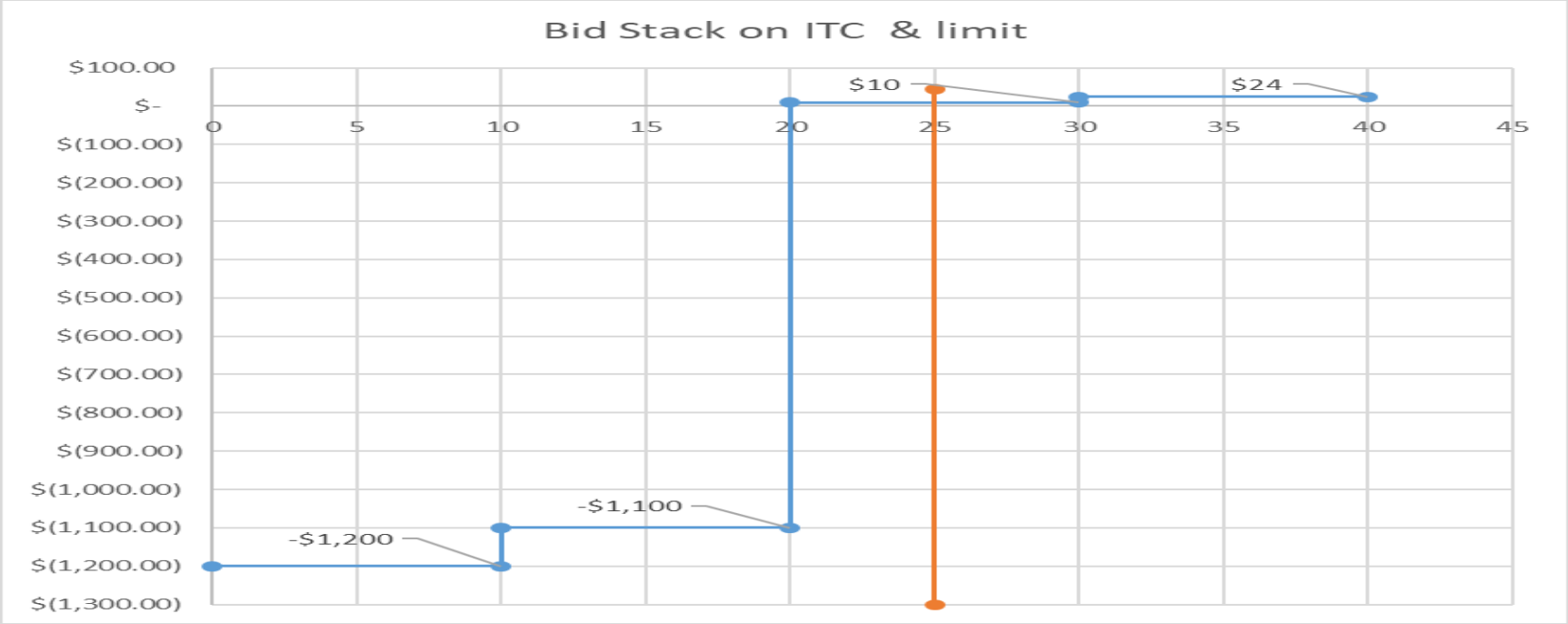
Example 2: Intertie limit is binding on economic bid

- 35 MW Import limit
- RUC cleared Self Schedule clears 10 MW, RT Self Schedule clears 10 MW, $10 bid clears 10 MW, and $24 bid clears only 5 MW
- 35 MW cleared
- $24 (LMP) = $25 (SMEC) + $0 (MLC) - $1 (MCC)
- Intertie is binding at $1



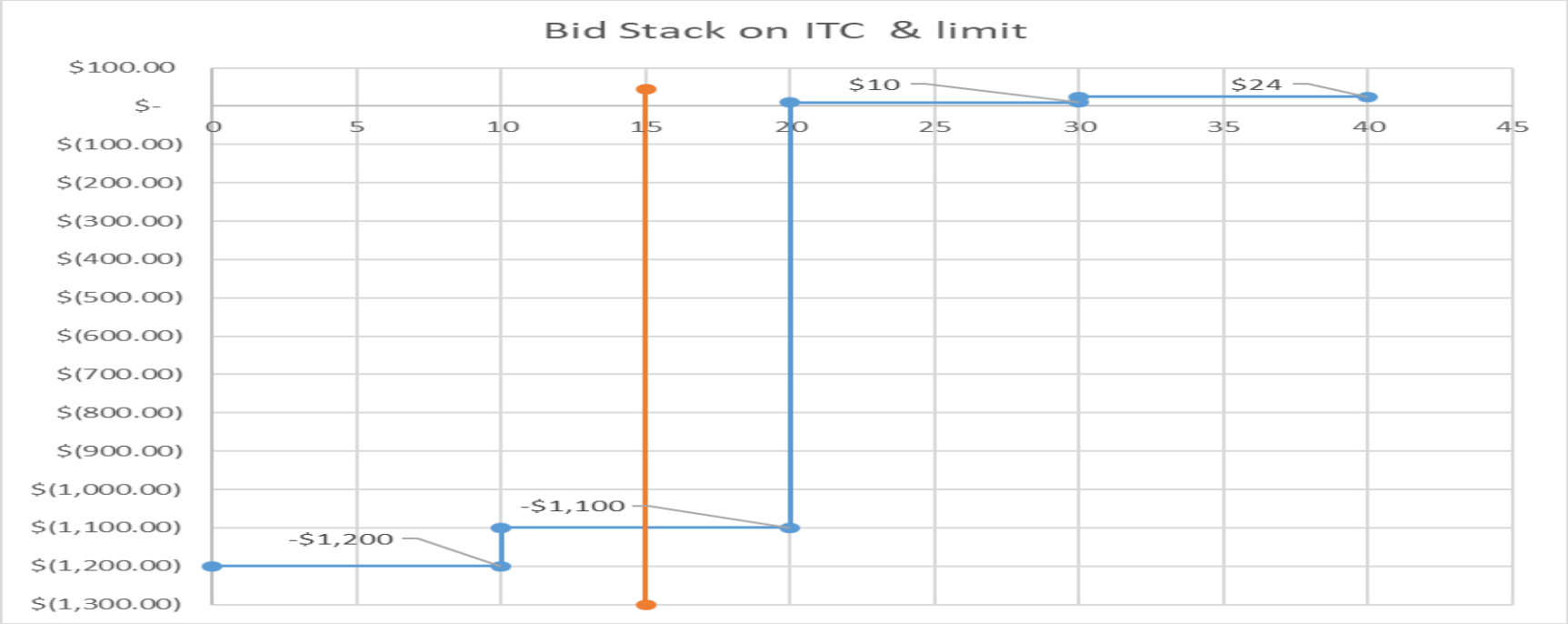
Example 3: Intertie limit is further de-rated

- 25 MW Import limit
- RUC cleared self schedule clears 10 MW, RT self schedule clears 10 MW, $10 bid clears only 5 MW, and $24 bid clears 0 MW
- 25 MW cleared
- $10 (LMP) = $25 (SMEC) + $0 (MLC) - $15 (MCC)
- Intertie is binding at $15



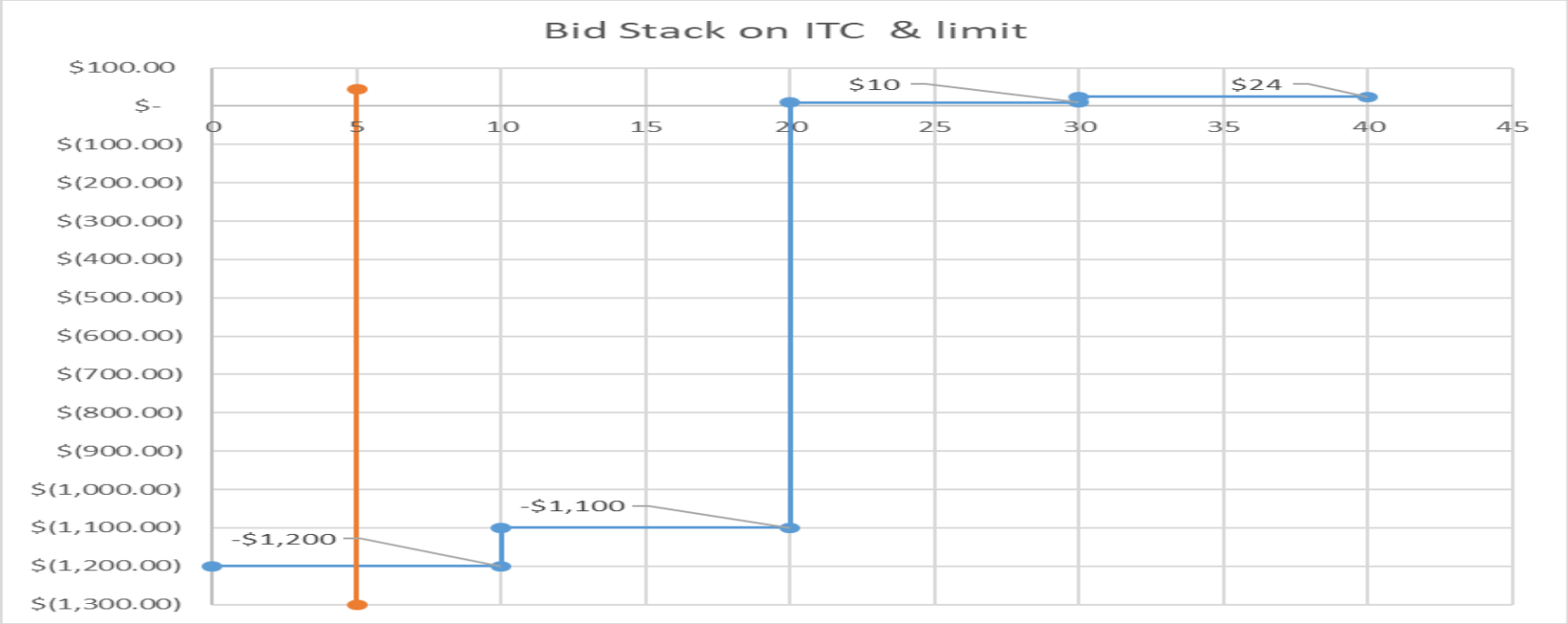
Example 4: Intertie limit de-rated impacting self-schedule

- 15 MW Import limit
- RUC cleared Self Schedule clears 10 MW, RT Self Schedule clears only 5 MW, $10 bid clears 0 MW, and $24 bid clears 0 MW
- 15 MW cleared
- -$1,100 (LMP) = $25 (SMEC) + $0 (MLC) - $1,125 (MCC)
- Intertie is binding at $1,125



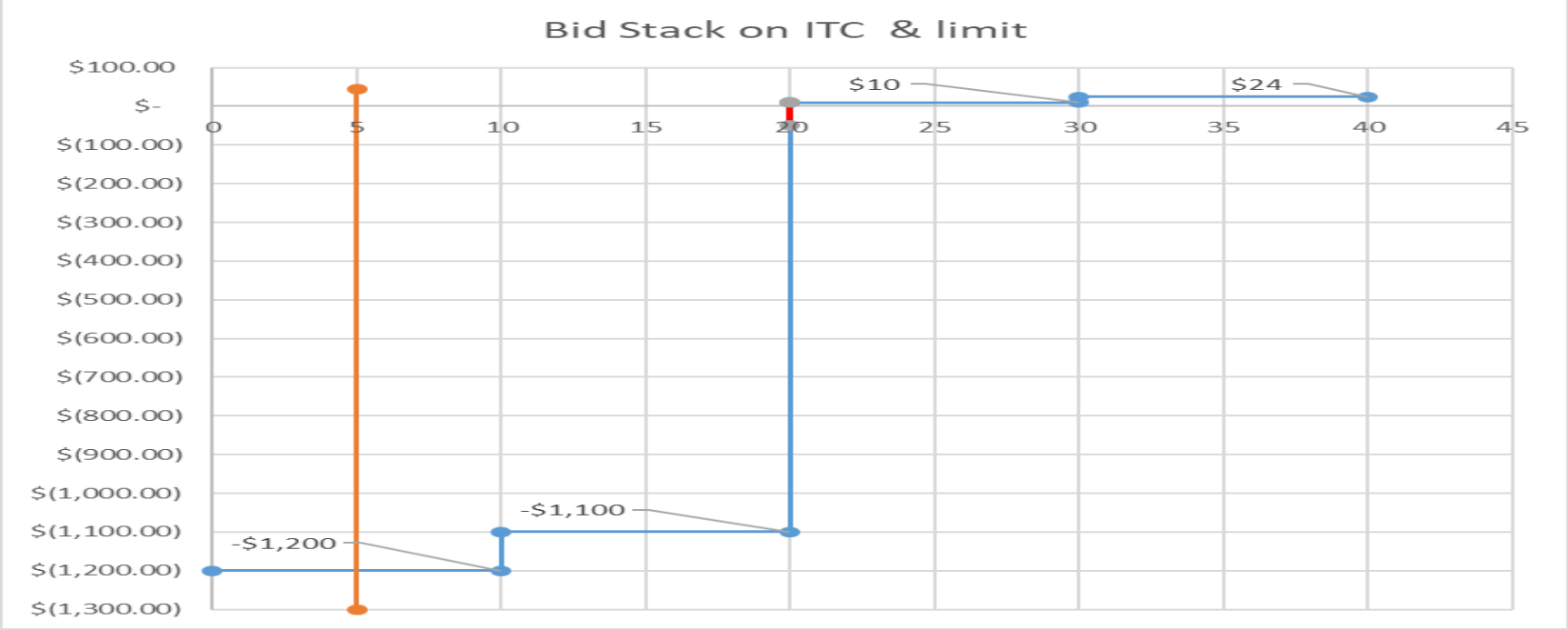
Example 4: Intertie limit de-rated into self schedule

- 5 MW Import limit
- RUC cleared Self Schedule clears at 5 MW, RT Self Schedule clears at 0 MW, $10 bid clears 0 MW, and $24 bid clears 0 MW
- 5 MW cleared
- -$1,200 (LMP) = $25 (SMEC) + $0 (MLC) - $1,225 (MCC)
- Intertie is binding at $1,225

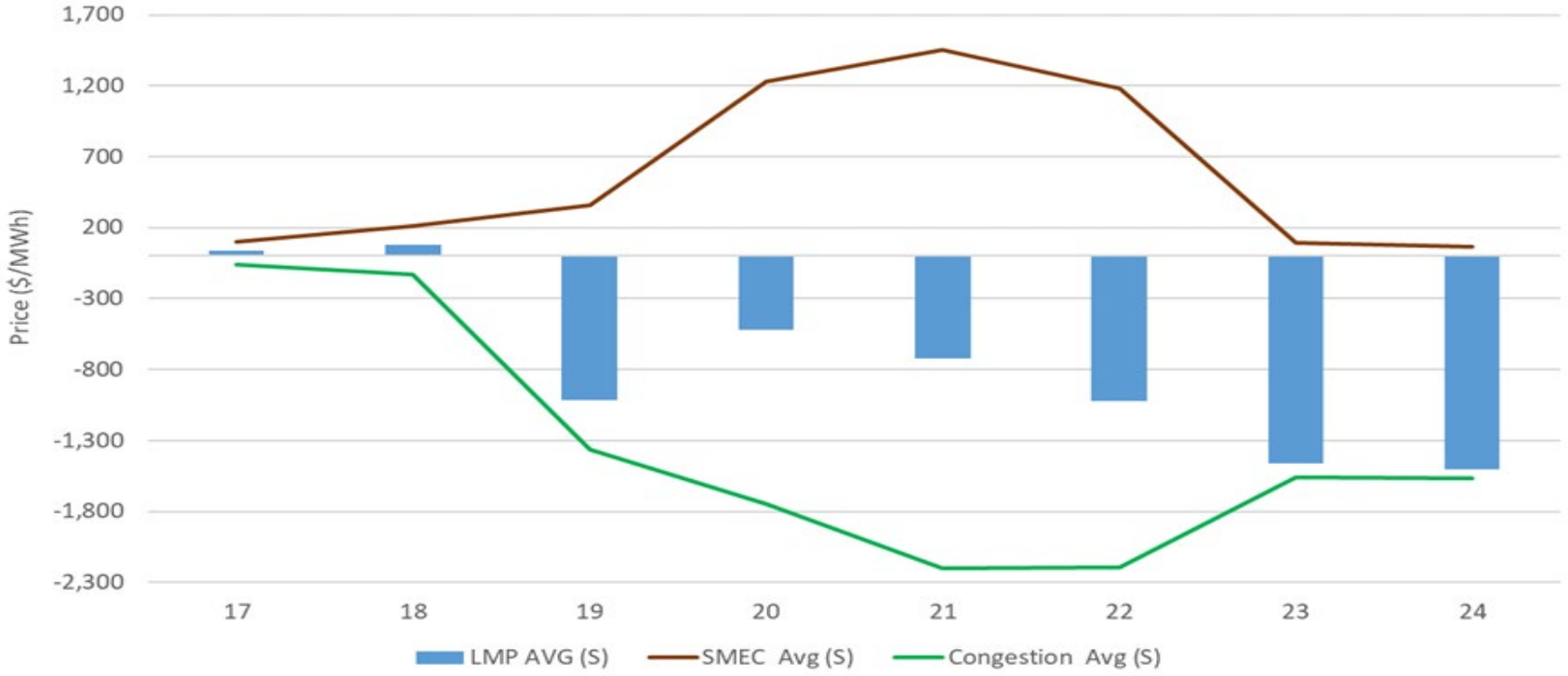


Explanation of the issue - HASP

- Relaxation of penalty prices caps components
- PBC relaxation penalty price $1,450 MWh will set SMEC
- ITC relaxation penalty price -$1,500 MWh
- (LMP) = (SMEC) + (Loss) - (MCC)
    - -$50 (LMP) = $1,450 (SMEC) + $0 (MLC) - $1,500 (MCC)
- Price when PBC relaxation occurred is not low enough to cut SS



HASP scheduling prices at Malin on July 9, 2021



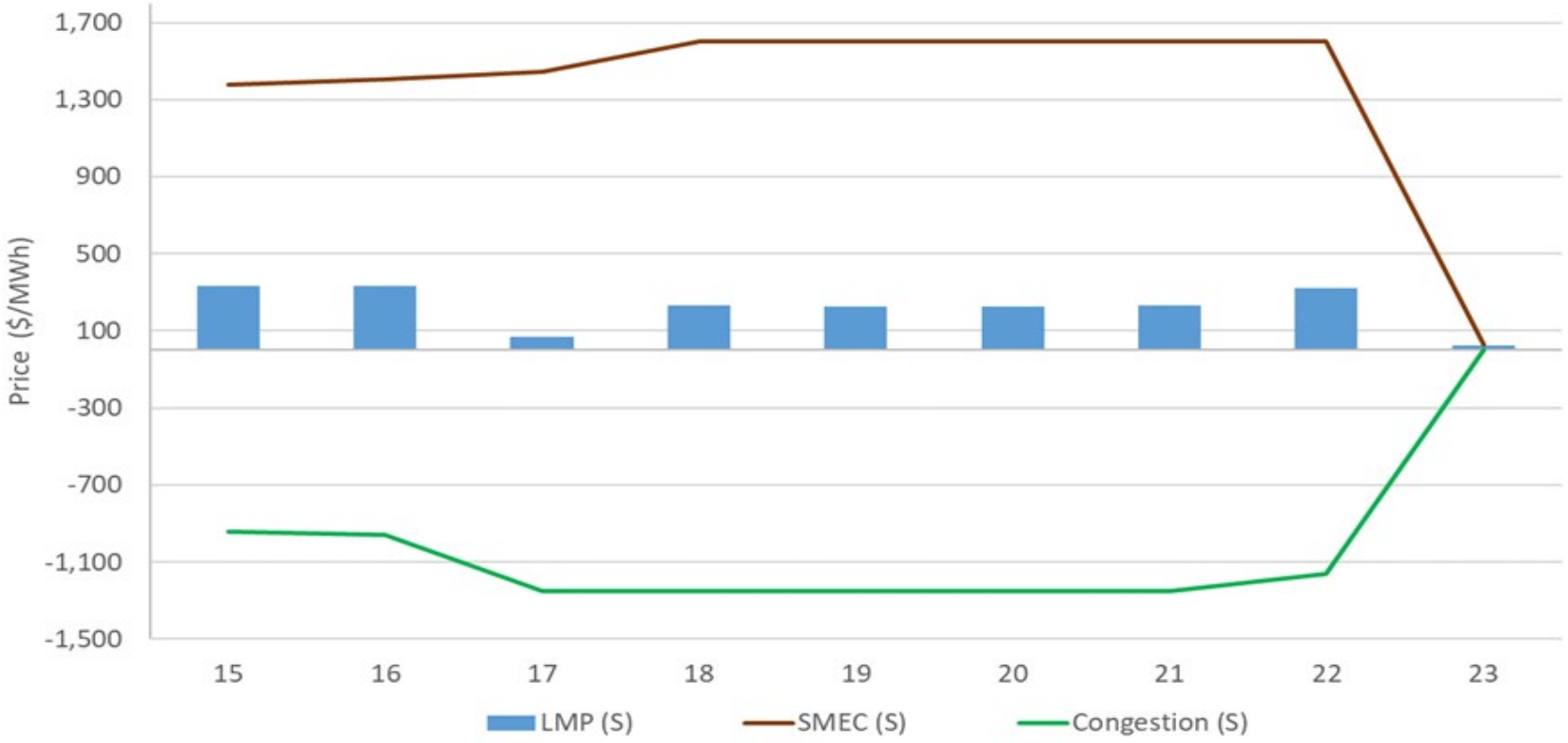
Explanation of the issue - RUC

- Relaxation of penalty prices caps LMP components
- PBC relaxation penalty price $1,600 MWh will set SMEC
- ITC relaxation penalty price -$1,250 MWh
- Self schedules in RUC based upon IFM cleared price with adder
  - IFM cleared import SS -$1,100 MWh with adder -$250 MWh results in RUC import self schedule of -$1,350 MWh
- (LMP) = (SMEC) + (MLC) - (MCC)
  - $350 (LMP) = $1,600 (SMEC) + $0 (MLC) - $1,250 (MCC)
- Price when PBC relaxation occurred is not low enough to cut SS

Explanation of the issue - RUC

- Relaxation of penalty prices caps LMP components
- PBC relaxation penalty price $1,600 will set SMEC
- ITC relaxation penalty price -$1,250
- (LMP) = (SMEC) + (Loss) - (MCC)
    - $350 (LMP) = $1,600 (SMEC) + $0 (Loss) - $1,250 (MCC)
- Price when PBC relaxation occurred is not low enough to cut SS

RUC scheduling prices at Malin on August 19, 2020



Proposed resolution - HASP

- Proposed relaxation parameter has to be large enough to cover self schedules, losses, and a tolerance
  - Tolerance is a pad to create a band between possible price occurrences and other penalty prices $100 MWh is used
  - Loss assumption is due to observations for high loss penalty factors with high SMEC prices - $150 MWh is used
- (LMP) = (SMEC) + (Loss) + (MCC)
  - -$ 1,200(LMP) < $1,450 (SMEC) + $150 (MLC) + $X (MCC) + Tolerance
  - Or -$1,200 - $1,450 - $150 - $100 (Tolerance) = -$2,900
- Proposed HASP price is **$2900**

Proposed resolution - RUC

- Proposed relaxation has to be large enough to cover SS and loss and Tolerance
  - Tolerance is a band to create a band between possible price occurrences and other penalty prices
  - Loss assumption is due to observations for high band
- (LMP) = (SMEC) + (Loss) + (MCC)
  - -$ 1,350(LMP) < $1,600 (SMEC) + $150 (MLC) + $X (MCC) + Tolerance
  - Or -$1,350 - $1,600 - $150 - $100 (Tolerance) = -$3,200
- Proposed RUC price is **$3,200**

Additional Adjustments due to change - HASP

Penalty Price Description	Scheduling Run Value Based on $1000 Cap	Pricing Run Value Based on $1000 Cap	Proposed - Scheduling Run Value Based on $1000 Cap	Proposed - Pricing Run Value Based on $1000 Cap	Comment
Exceptional Dispatch for Tie Generators	1,600	1,000	3,200	1,000	Priority to exceptional dispatches made by operators for Tie generators
EIM Base scheduled exports	1,550	1,000	3,100	1,000	EIM base scheduling priority for export when tagged schedules do not exist
Tagged Quantity for exports	1,550	1,000	3,100	1,000	After clearing in the real time market, Inter-tie tagged priority for exports. Higher priority than load in real time.
EIM Base scheduled imports	-1,250	-150	-3,100	-150	EIM base scheduling priority for import when tagged schedules do not exist
Tagged Quantity for imports	-1,250	-150	-3,100	-150	After clearing in the real time market, Inter-tie tagged priority for imports. Higher priority than over-generation energy slack
EIM Transfer Constraint	1,500	1,000	2,900	1,000	Penalty price and pricing parameter consistent with the transmission constraint;

Additional Adjustments due to change - RUC

No other penalty prices have been identified for additional penalty price adjustments

Questions?

Next Steps

- All related information for the this initiative is available here: http://www.caiso.com/informed/Pages/MeetingsEvents/MiscellaneousStakeholderMeetings/Default.aspx
- Please submit stakeholder written comments on today's discussion to ISOStakeholderAffairs@caiso.com by December 3, 2021