California ISO
Shaping a Renewed Future

Renewables Integration Phase 2

Market Vision & Roadmap

Stakeholder Meeting
September 12, 2011

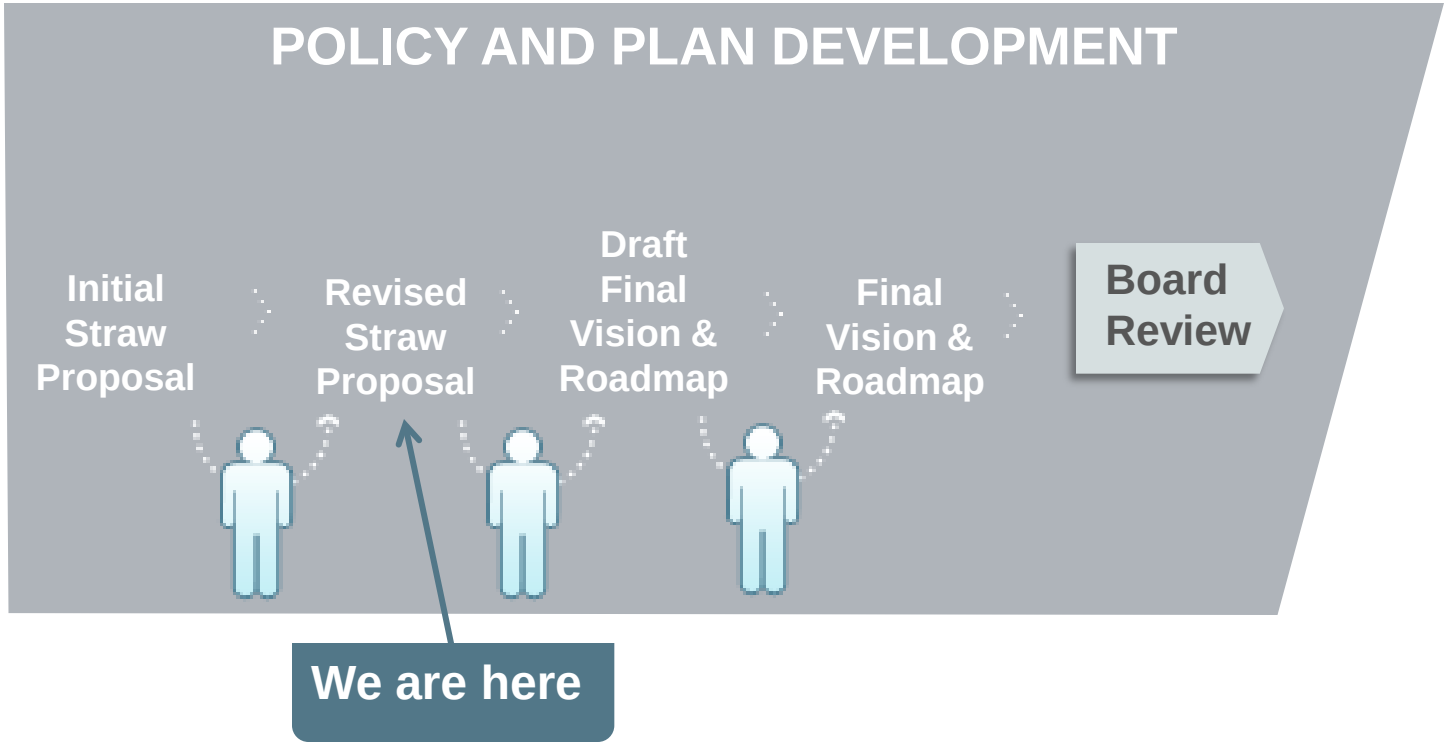
California ISO
250 Outcropping Way

Agenda

TIME	ITEM	PRESENTER
10:00-10:15	Introduction	Chris Kirsten
10:15-10:45	RI Phase 2 Expectations	Eric Little
10:45-11:15	Proposal Overview	John Goodin
11:15-12:00	Overview of Short-Term Initiatives	Khaled Abdul-Rahman
12:00-1:00	Lunch Break	
1:00-2:15	Discussion of Mid-Term Initiatives	Stephen Keehn
2:15-2:30	Break	
2:30-3:30	Discussion of Mid-Term Initiatives (cont)	Stephen Keehn
3:30-3:50	Overview of Long-Term Initiatives	Karl Meeusen
3:50-4:00	Wrap Up and Next Steps	John Goodin

ISO Policy Initiative Stakeholder Process

Stakeholder Input Opportunities



Renewables Integration Phase 2

RI PHASE 2 EXPECTATIONS

ERIC LITTLE

Initiative Direction

- The ISO has changed its process to reach the overall objective
  - Recall our goal:
    - *Complete comprehensive vision and roadmap for end-state market design to meet 33% RPS*
  - And our original process:
    - 2011 – Perform studies and develop comprehensive market vision and roadmap
    - 2012 – 2013 – Design Market and file at FERC
    - 2014 – 2015 – Implementation

Initiative Direction (Cont'd)

- What the ISO heard about the schedule:
  - The proposed timeline does not provide sufficient time for stakeholder input
  - Consider phased implementation
  - A comprehensive roadmap is important but fix existing problems first

Initiative Direction (Cont'd)

- How is the ISO proposal changing to meet the objective and address the stakeholders' concerns?
  - Taking an incremental phased approach
    - Propose a comprehensive roadmap but at a less granular level than prior discussions
    - Identify short, medium, and long-term market enhancements to prioritize need, level of effort and focus discussion

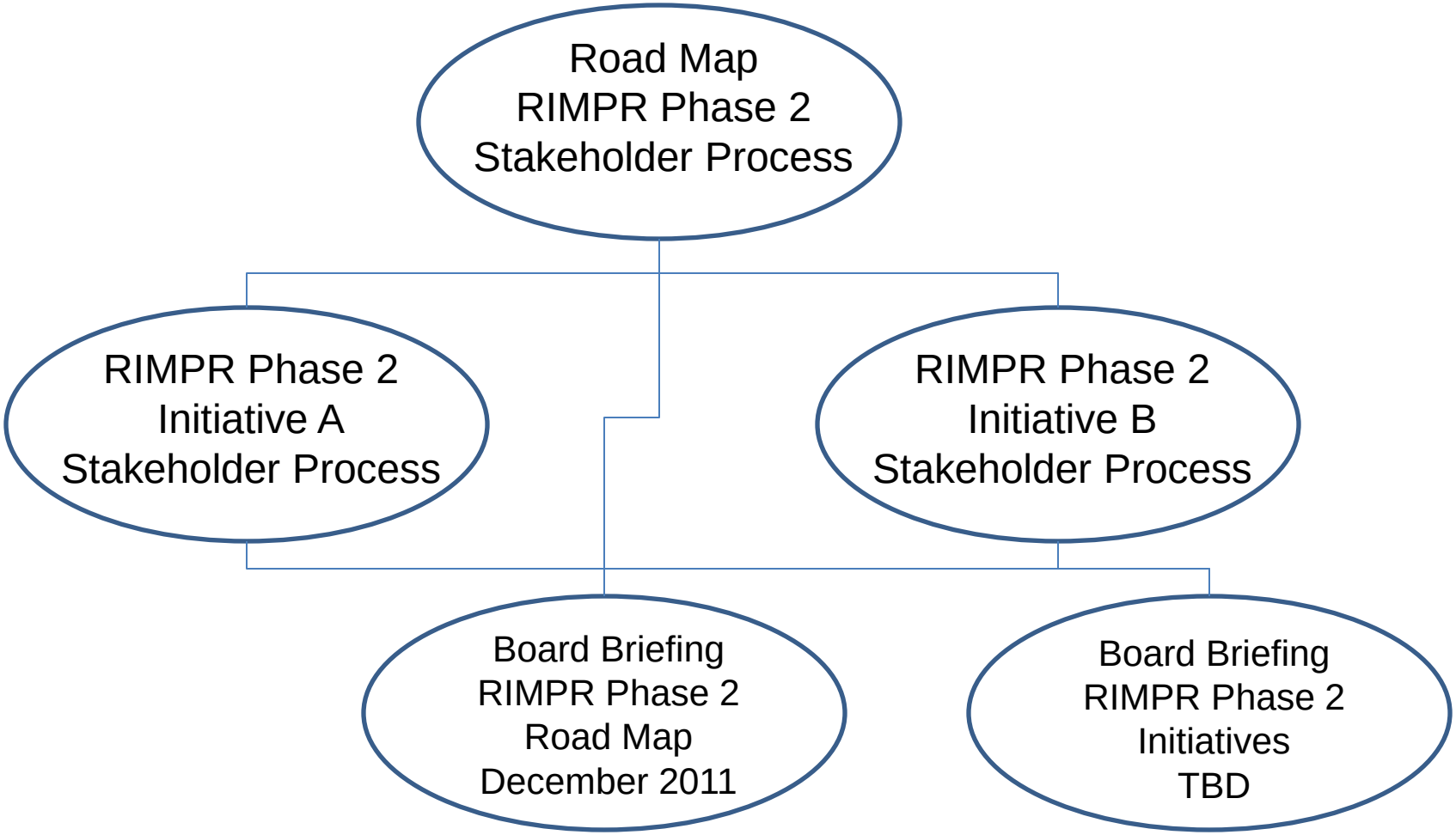
Initiative Objective

- Identify the immovable objects
  - Conflicts with other design elements
  - Conflicts with elements outside ISO control

- Identify difficult to tackle elements
  - Which elements will require the most consideration
  - Which elements will take the most time

- Acknowledge minor design issues will occur
  - These can be addressed during design rather than during the roadmap process

How & Where do We Address the Details?



Renewables Integration Phase 2

PROPOSAL OVERVIEW

JOHN GOODIN

Straw Proposal Revisions & Updates

- Incremental Design Approach
  - Market evolution vs. market transformation
- Added “Cost Causation” Principle
  - Market participants better manage their load and resource variability
  - More accurate forecasting and scheduling by market participants reduces operational uncertainty and costs

Straw Proposal Revisions & Updates (Cont'd)

- Pay for Performance Regulation
  - Support, but want guidance from FERC on direction
  - Likely implement in mid-term period if approved
- PIRP Cost Allocation
  - Updating proposal to include a summary of this issue

Objectives of Phased Approach

- Short-term: Today to 2013
  - Greater dispatchability from VERs and operational enhancements to increase market efficiency
- Mid-term: 2013 to 2015
  - Flexi-ramp product to increase transparency
  - Provide market incentives for flexibility
  - Address intertie pricing and settlement
  - Additional enhancements to facilitate VER dispatchability and scheduling

Objectives of Phased Approach (cont'd)

- Long-term: 2015 to 2020
  - Forward markets to provide cost transparency
  - Evaluate refinements from short and mid-term
  - Work with west to identify and coordinate market needs

Priority Mid-term Market Enhancements

Board Directed the ISO to Prioritize:

- Development of a flexi-ramp product
- Resolve Hourly Interties Settlements
  - Address RTIEO concerns
- Targeting Final Proposal by Spring 2012
  - Update Board in February 2012
  - Possible implementation in 2013

Milestones

- Revised Straw Proposal Published: August 29, 2011
- Draft Final Market Vision & Roadmap Published: October 11, 2011
- Launch flexi-ramp product and Intertie Settlement Initiatives: October 2011
- Final Market Vision & Roadmap Published: November 16, 2011
- MSC Opinion Adopted: November 17, 2011
- Board Review & Presentation: December 15, 2011

Renewables Integration Phase 2

OVERVIEW OF SHORT-TERM INITIATIVES

KHALED ABDUL-RAHMAN

Short-Term Market Enhancements

Day-Ahead Market Proposal	
Energy	
• **External Resources**	
– *Static schedules*	– No modifications proposed at this time
– *Dynamic transfers*	– Implement dynamic transfers policy as approved by FERC (implement 2013)
• **Internal Resources**	
– *Renewables*	– Implement Regulation Energy Management (implement 2012)
– *Conventional &* – *Non-intermittent*	– No modifications proposed at this time
• **Convergence Bidding**	– No convergence bidding at the ties
Ancillary Services	
• **Non-spin /Spin**	– No modifications proposed at this time
• **Regulation**	– No modifications proposed at this time – Procurement targets may increase – Regulation Energy Management implementation (implement spring ’12)
Integration Service	
	– Implement flexiramp constraint with opportunity cost compensation (implement Dec ’11)
RUC	
	– 72-hour RUC implementation (spring ’12) – More granular modeling of VERs and, therefore, more accurate RUC target

Short-Term Market Enhancements … *Continued*

Day-of Market Proposal	
Market Closing	
	– T-75-minutes
Energy	
• **External Resources**	
– *HASP*	– No modifications proposed at this time
– *Static schedules*	– No modifications proposed at this time
– *Dynamic transfers*	– Implement dynamic transfers policy as approved by FERC (implement 2013)
• **Internal Resources**	
– *Renewables*	– No modifications proposed at this time
– *Conventional &* – *Non-intermittent*	– Start-up and shutdown profiles – Multi-stage Generator enhancements – Non Generator Resource model (REM implementation)
• **PIRP**	– RIMPR Phase 1 changes (implement fall ’12)
• **Convergence Bidding**	– No convergence bidding at the ties
Ancillary Services	
• **Non-spin /Spin**	– No modifications to product
• **Contingent/non-contingent**	– Enhanced operating reserve management (spring ‘12)
• **Regulation**	– No modifications to product – Regulation Energy Management implementation (implement spring ’12)
• **Frequency Responsive Reserve**	– TBD. Going to NERC board May 2012
Integration Service	
	– Implement proposed flexiramp constraint (implement Dec ’11)

Renewables Integration Phase 2

REVIEW OF MID-TERM INITIATIVES

STEVE KEEHN

Mid-Term Issues

- Flexi-ramp Product
- Regulation Pay for Performance
- Intertie Scheduling and Settlement
- Variable Energy Resources More Granular Updating
- DEC Bids from PIRP Resources
- Frequency Response

Flexi-ramp Product

- Current Flexi-ramp Constraint
  - In RTPD reserve ramping capacity to be available in RTD
  - Compensation based on “opportunity costs” i.e. lost opportunities to receive revenue
    - From missed opportunities to earn revenue through an ancillary services award and/or non-binding energy dispatch RTPD
  - ISO selection made based on energy and AS bids
- Flexi-ramp Constraint is an interim solution designed for quick implementation
  - Only provides upward ramping capacity
  - Not procured in advance
  - Simple cost allocation to metered demand

Flexi-ramp Product (Cont'd)

- Replace the Flexi-ramp Constraint with a Product
  - Actually, 2 products:
    - Flexi-ramp Up
    - Flexi-ramp Down
  - Procure Day Ahead
    - Will interact with IFM and RUC, so look to integrate IFM and RUC procurement
  - Need to consider energy bids in optimization
  - Pay for Performance

Flexi-ramp Product (Cont'd)

- MW/min of ramping per period of time
  - What should the time frame be:
    - 5 minutes
    - 10 minutes
    - 15 minutes
- Units need to be certified to provide Flexi-ramp
- Units need to be capable of minimum ramp rate
- Bids must include Flexi-ramp Capacity component in addition to other elements

Flexi-ramp Product (Cont'd)

Real Time Procurement

- Procured in Real-Time Preliminary Dispatch every 15 minutes
  - Same as other ancillary services
- Need to incorporate energy bids into optimization
  - Spin and Non-Spin only set the real-time price during contingencies
  - Flexi-ramp will likely be dispatched more often

Flexi-ramp Product (Cont'd)

Example:	Unit A	Unit B
Capacity (MW/5 min)	12	12
Cap. Bid($/MW/min	$6	$5
Energy Bid	$36	$240
Capacity Costs	$72	$60
Assume probability of dispatch is 50%		
Cost of Energy for 5 min.	$36	$240
Expected Total Cost	$90	$180

ISO invites suggestions on how appropriate optimization and pricing could be done

Flexi-ramp Product (Cont'd)

Day Ahead Procurement

- Need to be coordinated with IMF and RUC
  - Flexi-ramp and RUC capacity may provide the other
  - Target procurements depend not on bids, but on assessment of possible needs
- Energy bids in real-time must not exceed those in IFM
  - Necessary to avoid gaming

Flexi-ramp Product (Cont'd)

How are Procurement Targets Set?

- Time of year
- Time of day
- Trajectory of Load
- Historical/Forecast variability of renewables on line
  - If minimal renewables are on line, little need for Flexi-ramp Up
  - If renewables are at maximum, little need for Flexi-ramp Down
- Use 95% confidence level

Flexi-ramp Product (Cont'd)

How will the cost of Flexi-ramp be allocated?

- Allocate to load and supply deviations from integrated forward market schedules or instruction, and renewable resource deviations from their forecast-based schedules
- Allocate to all market participants based on their deviations from their scheduled or instructed energy (i.e., their uninstructed deviations)
  - Could use two-tiered system
  - The maximum amount allocated to tier 1 would be based on the megawatts of deviation, with any excess amount spread to metered demand

Flexi-ramp Product (Cont'd)

- How to ensure performance?
  - If a resource's responses are outside of a tolerance level they might:
    - Forfeit the capacity payment for providing flexi-ramp similar to no-pay;
    - Possibly have an additional penalty applied;
    - After several incidents of non-performance, the resource would no longer be certified to provide flexi-ramp
- How are Suppliers assured they will be made whole?
  - Bid Cost Recovery

Possible Alternative to Flexi-ramp Product

- Flexi-ramp Up is essentially spinning reserve
- Generators designate their spinning reserve bids as either:
  - Contingent: use only in an emergency
  - Non-Contingent: use it when you like
- If Non-Contingent Spinning Reserve is not actually needed for reserves in the hour, they could be dispatched to provide energy and/or ramping
- We can resolve the same issues by procuring more non-contingent spinning reserves

Possible Alternative to Flexi-ramp Product (Cont'd)

Potential Issues:

- Need minimum amount of Non-Contingent Spinning Reserves (or maximum allowed amount of Contingent)
  - Will require two prices: one for Non-Contingent and one for Contingent
- Only provides upward flexibility, does not address downward ramps
- How to ensure that this capacity is the last used
  - Bid Adder for Scheduling runs?

Regulation Pay for Performance

- Regulation accuracy will be increasingly important
- Flexi-ramp product will include pay for performance
- Therefore, the ISO would like to consider how to include Pay for Performance in Regulation
- Discussed in the initial scoping memo and meeting
- Current FERC NOPR
- ISO seeks comment on how to implement

Intertie Scheduling and Settlement

The Issue: Mismatch between Pricing at Interties and other nodes creates large amounts in the Real Time Energy Imbalance Offset

Currently:

- Many steps to remove reasons for price discrepancies
- Moving to remove virtual bidding at the interties

Potential Long Run Solution

- Single real-time settlement
  - 15 minute scheduling for ISO and WECC

Potential Interim Solutions

- The NYISO Approach
- Off-peak implementation of settling interties at real time prices

Intertie Scheduling and Settlement (Cont'd)

The NYISO Approach:

- Imports and Exports are scheduled in HASP
- If HASP shows no congestion on external interfaces, HASP will schedule imports and exports, but the price used for settlements will be the real-time price at the relevant proxy bus, computed as the time weighted average real-time price
  - Imports receive a bid production cost guarantee
    - If the real-time price is lower than their offer, they will be paid their offer price
  - Exports do not receive price assurance

Intertie Scheduling and Settlement (Cont'd)

The NYISO Approach:

- If HASP shows the intertie constrained:
  - Import Constraint – offer price of marginal import lower than internal ISO price
    - Imports paid HASP price, i.e. a price lower than the internal ISO price
  - Export Constraint – bid price of marginal export is higher than internal ISO price
    - Exports pay the higher HASP price
  - Thus, congestion does not give rise to shortfalls and uplifts

Intertie Scheduling and Settlement
Off-peak implementation of settling interties at real time prices

- Interties scheduled on hourly basis
- During off-peak periods intertie prices would be actual real-time prices from RTD
  - Means that hourly interchange schedules are price takers for the entire hour
  - There would be no bid cost recovery

Intertie Scheduling and Settlement
Off-peak implementation of settling interties at real time prices (Cont'd)

- Potential risks may limit imports to California until market participants gain experience with the settlement
  - Limit to off-peak to minimize risks to California from diminished imports
  - Since these periods are priced correctly, might be possible to allow convergence bidding at the interties in off peak periods
    - Provide hedging tool
- During off-peak hours much of the uplift charges in the Real Time Imbalance Energy Offset are generated

Variable Energy Resources More Granular Availability Updating

- Initial Straw Proposal discussed allowing intermittent resources to schedule (update their availability) on a more granular level than hourly
- In the Dynamic Transfer, intermittent resources outside the ISO and utilizing Dynamic Transfers have two methods to update their availability:
  - ISO will use persistence based on last telemetry
  - Resource can submit its own 5 minute forecast, which is returned as the operating point (adjusted down for congestion, if necessary) for the next interval and the basis for financial settlements of instructed and uninstructed energy
- Should a similar option exist for in-state intermittent or other resources?

Variable Energy Resources More Granular Availability Updating (Cont'd)

- Less radical option
  - Allow existing hour-ahead forecast provided 75 minutes before the hour to consist of 4 different 15-minute periods

- Easier to implement than 5 minute availability
- Would allow for solar ramping, for example
- Would allow ISO to adjust Flexi-ramp for the hour

- The ISO seeks stakeholder comment on how this proposal compares to allowing the 5-minute availability updates provided for dynamic transfers or whether some other timing for availability updates is preferred.

DEC Bids from PIRP Resources

- Allow PIRP resources to submit DEC bids in conjunction with hour-ahead schedule
  - If the bid is not dispatched, it does not effect normal PIRP monthly netting
  - If the bid is dispatched, then resource's deviation from hour-ahead self schedule would not be netted and would be settled at the real time interval prices
- If PIRP resources don't submit DEC bid, would still be subject to non-economic curtailment same as other self-schedules

DEC Bids from PIRP Resources (Cont'd)

- For any interval where the real-time market issues a DEC instruction to the PIRP resource, the deviation priced at the locational real-time price would be:
  - If a < t (the resource moved down from its telemetry value),

    MIN[MAX(0,s+i-2a),s]

  - If a ≥ t (the resource moved up from its telemetry value),

    MIN(s-a, i-a)

Where:

s = hour-ahead self-scheduled MWh

a = actual (metered) MWh

i = instructed MWh (dispatch instruction)

t = the telemetry registered output of the resource that is input to the scheduling run of the real-time market

DEC Bids from PIRP Resources (Cont'd)

- A resource that fails to follow the decremental instruction is at risk for the greater of its deviation from either 1) the hour-ahead schedule or 2) the instruction it received
- As long as the resource is moving in the correct direction, it won't be charged for positive deviation
- If it fails to reduce to where it was instructed, the resource loses some payment for not following the decremental instruction

DEC Bids from PIRP Resources (Cont'd)

Example 1:

- Suppose t = 120, s = 100, i = 80, and a = 80
- a < t, so the first formula applies
- the deviation = MIN[MAX(0, 20), 100] = 20
- In this case the resource is paid (charged the negative price) for exactly following the decremental dispatch, based on the MWh amount by which its actual or instructed output is below its hour-ahead schedule

Example 2:

- Suppose t = 120, s = 100, i = 80, and a = 85. Same as example 1, except that in this case the resource only partially followed the decremental dispatch
- a < t, so the first formula applies
- the deviation = MIN[MAX(0, 10), 100] = 10
- In this case the resource is paid (charged the negative price) for partially following the decremental dispatch, but its payment is reduced to reflect the fact that it continued to deviate above the instructed level

DEC Bids from PIRP Resources (Cont'd)

Example 3:

- Suppose t = 120, s = 100, i = 80, and a = 125
- a > t, so the second formula applies
- the deviation = MIN(-25, -45) = -45
- In this case the resource is charged (paid the negative price) for ignoring the decremental dispatch and actually increasing its output

Example 4:

- Suppose t = 120, s = 100, i = 80, and a = 0 Same as example 1, except that in this case the resource reduces its output all the way to zero, beyond the level instructed
- a < t, so the first formula applies
- the deviation = MIN[MAX(0, 180), 100] = 100
- In this case the resource is paid (charged the negative price) for its entire output reduction below its hour-ahead self-schedule

DEC Bids from PIRP Resources (Cont'd)

- The ISO seeks stakeholder comments on both the general concept and the specific proposed formulas

Frequency Response

- During a frequency deviation,
  - Inertia: how large is the initial change
  - Governor Response: how much response comes from the governors of units – this is generally up to 15-20 seconds
  - AGC response: How much response once AGC begins to address the issue

Frequency Response (Cont'd)

- Guidelines as to how much of these we should have
  - Based on load level
- Renewables (Wind, PV) may not provide inertia or governor response
- Fully loaded resources may not have much room for governor response

- ISO will consider in more detail after the Inertia Study is released, scheduled for later this month

Renewables Integration Phase 2

LONG-TERM INITIATIVES

KARL MEEUSEN

Ensuring Adequate Long-term Flexibility *Challenges*

- ISO's 20% RPS Study and preliminary 33% RPS Study indicate future operating challenges
- As shown in the 20% RPS Study, thermal resources:
  - Will run less and receive up to 39% less revenue
  - Will experience up to 35% more starts
- Inadequate revenue could lead to early resource retirement
- OTC retirements reduce fleet flexibility

Ensuring Adequate Long-term Flexibility *Consequences*

- More start-ups of thermal resources translates into an increased need for these resources
- Insufficient revenue will cause flexible, thermal resources to retire, impacting grid reliability
- Forward procurement to ensure sufficient ramping capacity is available long-term

Ensuring Adequate Long-term Flexibility *Solution*

- Forward procurement of long-term fleet flexibility need not replace the CPUC's resource adequacy program
- The focus is ensuring adequate flexible capacity
  - RA requirements ensure adequate planning reserve margin
  - Flexible capacity addresses operating needs for integrating intermittent resources
- The ISO and CPUC must work together to ensure sufficient resource "flexibility" is procured in advance
- To implement a solution by 2015-2020 a design solution must be vetted and finalized by 2012/2013

Renewables Integration Phase 2

WRAP-UP AND NEXT STEPS

JOHN GOODIN

Schedule

- **Comments due on Revised Straw Proposal: September 22, 2011 – phase2ri@caiso.com**
- **Draft Final Market Vision & Roadmap Published: October 11, 2011**
- **Stakeholder Meeting to Review Draft Final Vision & Roadmap: October 18, 2011**
- **Comments due on Draft Final Market Vision & Roadmap: November 2, 2011**
- **Final Market Vision & Roadmap Published: November 16, 2011**
- **Board Review & Presentation: December 15, 2011**