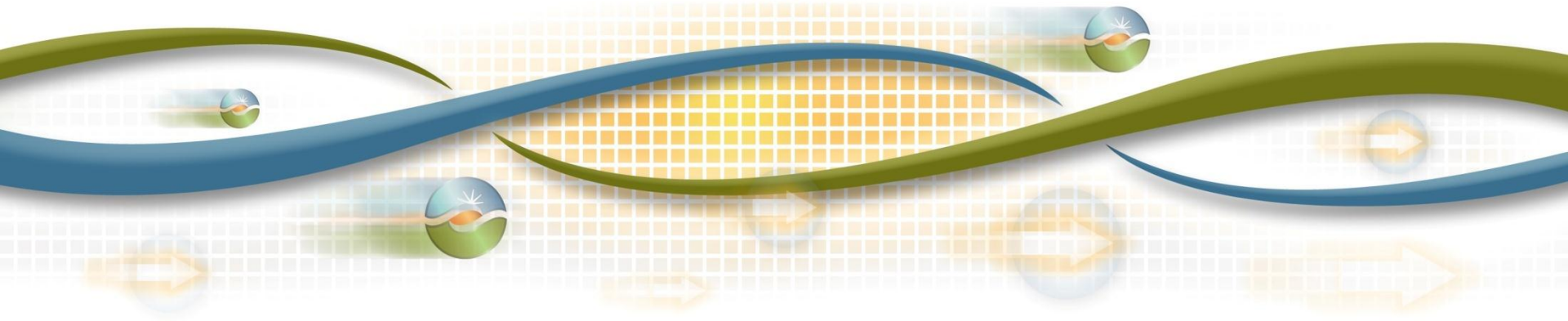


Reactive Power Requirements and Financial Compensation

Revised Straw Proposal Stakeholder Call

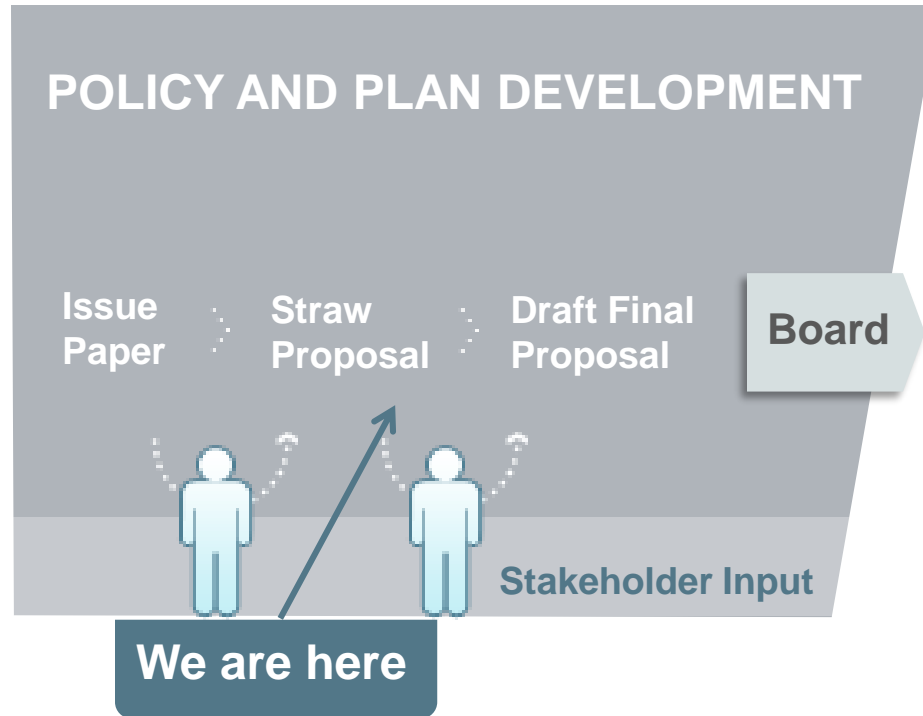
October 15, 2015



October 15, 2015 Stakeholder Meeting Agenda

Time	Topic	Presenter
9:00-9:05	Introduction	Kim Perez
9:05-9:20	Initiative schedule and stakeholder comments	Chris Devon
9:20-10:30	Technical requirements	Clyde Loutan
10:30-11:55	Financial compensation	Chris Devon
11:55-12:00	Next steps	Kim Perez

ISO policy initiative stakeholder process



Stakeholder process schedule

Milestone	Date
Revised Straw Proposal posted	Oct 8, 2015
Stakeholder call on Revised Straw Proposal	Oct 15, 2015
Revised Straw Proposal comments due	Oct 23, 2015
Draft Final Proposal posted	Nov 9, 2015
Stakeholder call on Draft Final Proposal	Nov 19, 2015
Draft Final Proposal comments due	Dec 3, 2015
Board of Governors meeting	Feb 3-4, 2016

Overview of comments: August 20 straw proposal

- Stakeholder responses included comments on technical requirements, implementation timing and financial compensation
- Requested clarification on technical requirements
 - Point of control requirements (POI and inverter terminal flexibility)
 - Dynamic reactive power requirements
 - Additional reactive power needs studies
 - Consistency with NERC/WECC standards
- Comments on effective timing of requirements

Overview of comments (continued)

- Range of responses on financial compensation
 - Capability payments
 - Concerns of potential contractual interpretation
 - Provision payments
 - Compensation for clutches and other special cases
 - Incorporating lost PPA and PTC revenues into provision payments
 - Cost allocation

TECHNICAL REQUIREMENTS

Clyde Loutan

Proposed requirements for asynchronous generators

- a) An Asynchronous Generating Facility shall have an over-excited (lagging) reactive power producing capability to achieve a net power factor from 0.95 lagging up to unity power factor at POI, at Generating Facility's maximum real power capability.
- b) An Asynchronous Generating Facility shall have an under-excited (leading) reactive power absorbing capability to achieve a net power factor from 0.95 leading up to unity power factor at POI, at Generating Facility's maximum real power capability.
- c) Asynchronous Generating Facilities shall provide dynamic voltage response between 0.985 leading to 0.985 lagging at maximum real power capability at POI as specified in Figure 3.

Proposed requirements (continued)

- d) Asynchronous Generating Facilities may meet power factor range requirement at POI by using controllable external dynamic and static reactive support equipment.
- e) Within dynamic reactive capability range, Asynchronous Generating Facilities shall vary reactive power output between full sourcing and full absorption capabilities in a continuous manner.
- f) Outside dynamic range of 0.985 leading to 0.985 lagging, and within overall reactive capability range of 0.95 leading and 0.95 lagging, reactive power capability could be met at maximum real power capability with controllable external static or dynamic reactive support equipment.

Point of control for voltage regulation flexibility

- ISO will allow resources to choose POI or inverter terminal for point of control for voltage regulation
- Must be electrically compensated to meet standard requirements at POI (0.95 leading/lagging)
- Consistent with FERC Order 661A: system reliability requires that reactive support be provided at POI
- Stakeholders point to recently approved PJM standard (inverter terminal point of control requirement)
 - PJM interconnection agreements also require electrical compensation to meet specified voltage schedules at POI

Dynamic reactive power requirements

- Currently, dynamic reactive power is primarily provided by synchronous resources
- Needed to prevent voltage collapse during contingencies or abnormal operating conditions
- Need to replace dynamic reactive capability that was previously being provided by synchronous resources
- ISO has explored requiring 100% dynamic reactive support at inverter terminals, similar to other regions like PJM

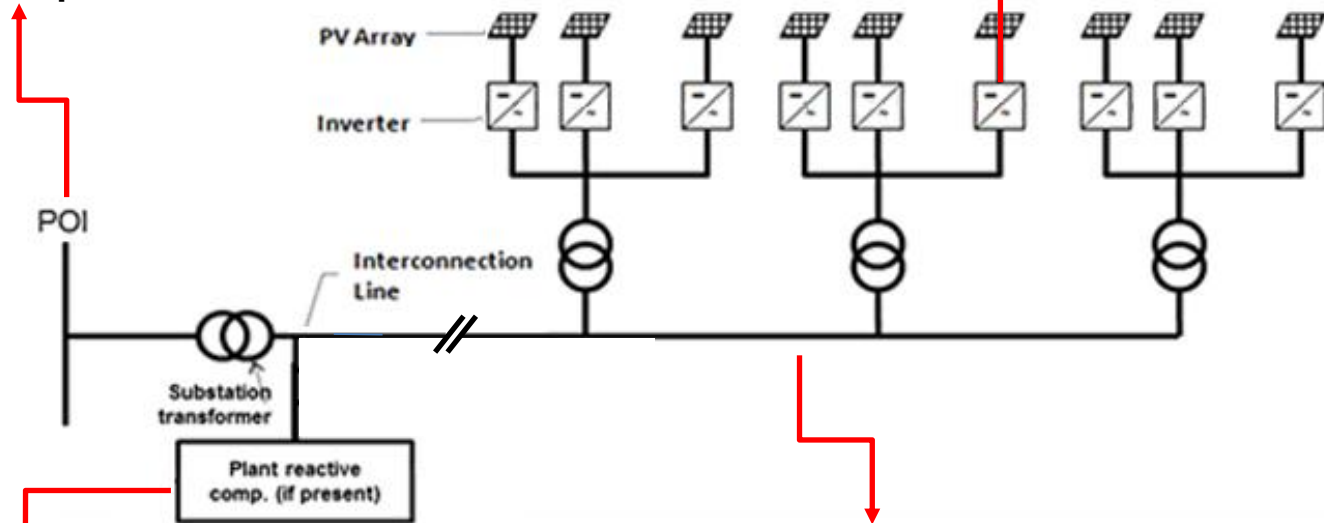
Dynamic reactive power requirements (continued)

- Asynchronous resources use inverters that have 100% full dynamic reactive power capabilities
- Assumption that resources could provide 50% dynamic electrically compensated to POI is conservative
- Allowing 50% static requirement and 50% dynamic gives lower cost option to meet requirements at POI
- Middle ground for flexibility in design options and lower cost to meet requirements
- Dynamic studies on case-by-case basis are not cost effective, time consuming, and very difficult to get accurate results for robust set of operating scenarios

Dynamic reactive power requirements - diagram

Proposing 50% overall dynamic requirement compensated to POI

100% dynamic capability is able to be provided by latest inverters



Static capability is provided closer to POI by capacitor banks, etc.

Interconnection feeder length may be a significant distance if units are located far from POI

Dynamic capability provided by the unit's inverters would not be as effective at the POI (increases costs)

Requests for additional reactive power technical studies

- Stakeholders requested further study on reactive power needs to avoid unnecessary costs on suppliers
- ISO will not conduct additional assessments prior to establishing uniform requirements
- ISO reiterates case-by-case study is inefficient and insufficient to identify all reactive power needs
- Reasonable to forego these studies to reduce interconnection study cost and timeframes
- Will not impose unnecessary costs, and incremental costs to new resources are minimal

Consistency with NERC/WECC standards

- ISO is proposing uniform requirements because system is experiencing significant influx of asynchronous resources
- Replace current system impact study process that is insufficient to determine if asynchronous resources need to provide reactive power under all operating scenarios
- ISO will consider modifying tariff to align with any future requirements adopted by NERC or WECC

Timing for effectiveness of proposal

- ISO proposes applying this new policy for asynchronous resources beginning with interconnection customers in Cluster 9 (planned for April 2016)
- Only Cluster 9 resources and beyond will be subject to proposed requirement
- Any resources already in ISO interconnection process will be exempt from these new requirements (if need for reactive power is not identified through current studies done during interconnection process)

FINANCIAL COMPENSATION

Chris Devon

Capability compensation

- ISO previously considered developing financial compensation for reactive power capability
- ISO believes that capability for reactive power support by all resources is good utility practice
- Therefore ISO is not proposing any form of payment for reactive power capability
- According to manufacturer information, placing uniform requirements on all new asynchronous resources will not present a significant incremental cost

Capability compensation (continued)

- Voltage support requirements are necessary for reliable operation of transmission system
- Supports delivery of real power from generation to loads which allows those resources to participate in ISO markets
- Generating Unit must be capable of operating at capacity registered in the CAISO Controlled Grid interconnection data, and shall follow the voltage schedules issued by the CAISO from time to time (Tariff Section 4.6.5.1)

Capability compensation (cont.)

- Under Order 2003 FERC adopted standard power factor requirements for generators “because it is a common practice in some NERC regions”
- FERC has addressed various rules relative to payment for reactive power capability, but FERC has not adopted a requirement that ISO/RTOs adopt a payment for capability to provide reactive support

Provision payment proposal

- ISO explored potential enhancements to payment compensation mechanisms for reactive power provision
- ISO investigated potential for more market based procurement and compensation for voltage support
- Considered payments for reactive power provision within required lead/lag range to compensate resources that were more frequently utilized in standard range
- Determined this concept would be impractical
- ISO is not proposing any changes to existing provision payment methodology

Resources with non-typical reactive power capabilities

- ISO explored additional provision payments and other compensation for resources providing reactive power with specialized equipment and during certain low/no real power output situations
- Resources with clutches; other resources with capability to operate in synchronous condenser mode; solar resources at night; wind turbines below max output
- These resources are “out of the money” in energy market optimization but are still providing a service without being eligible for current opportunity cost payments

New reactive power exceptional dispatch category

- ISO has identified need to create a new exceptional dispatch (ED) category for these purposes
- Proposing to call this new ED category “Reactive Power Exceptional Dispatch”
- Compensation mechanism to address lack of any opportunity cost based provision payment available under current provision payment structure

New reactive power ED category (continued)

- Purpose of new category and payment methodology is to utilize and compensate resources to provide reactive power support while they are not producing real power
- Intended to make resources whole for any costs so they are financially indifferent to responding to provide reactive power support

New reactive power ED category (continued)

- ISO will calculate payments for new ED category using LMP and unit cost data that is already included in Master File
- Proposing to include following costs in payment calculations
 - Costs of real power consumed for purposes of station power, or otherwise needed to provide voltage support/reactive power paid at nodal LMP value
 - Minimum load costs including fuel, variable O&M, or other opportunity costs
 - Start-up costs (if resource started under ED instruction)

ISO seeking feedback on reactive power ED category

- ISO seeks feedback from stakeholders regarding any costs that ISO should consider including in cost calculation for new ED category
- Any other costs that ISO has not specifically identified?

Cost allocation

- Appropriate to keep current cost allocation for current provision payments consistent
- Propose to allocate any compensation payments that are granted under new reactive power exceptional dispatch category consistent with current provision payment cost allocation methodology
- New ED category cost allocation would be same as current method for voltage support which has been previously approved by FERC

Next steps

- Stakeholders are welcome to submit written comments by **October 23, 2015** to InitiativeComments@caiso.com
- Draft Final Proposal will be posted on November 9, 2015