

WECC's Variable Generation Subcommittee, Market Workgroup: White Paper on Electricity Markets and Variable Generation Integration

Version 1 dated 6/25/09 provided by Michael Mulligan, Jack Ellis, and Paul Arnold

How will regulation, load following, and balancing requirements change and how will they be supplied and delivered for variable generation integration?

“What in the current market structure, mechanisms, regulations, or oversight is a problem for Variable Generation Resources? And conversely, what problems do VG resources create for the market?” The tagging issue is an example of something that might fit under this umbrella; however, there is likely more to be explored here. Some of these issues may ultimately end up being more contractual, and hence the domain of WSPP

Introduction

Requirements:

- Maintain frequency stability (60 Hz)
- Manage intertie flows and transmission line loadings within thermal, voltage and security limits, CPS criteria, Interchange Scheduling rules, and related business practices for transmission reservations and scheduling.
- Minimize frequency, duration and amount by which conventional generation (thermal and hydro) must be moved away from its preferred operating point.
- Meets all Reliability and Critical Infrastructure Protection Standards
- Provide proper incentives for conventional and variable generators and for non-generation resources to operate in ways that minimize the impact of variable generation and load forecast uncertainty
- Provide means for non-generation resources to participate and help balance the grid (Order 719 requirement in California, generally a good policy objective)

- Minimize use of administrative remedies
- *Maximize economic efficiency (maximize social welfare in economist-speak)*
- What is at stake in terms of cost or avoided cost, e.g., adding combined cycle generator for ramping capability vs. methods to access system flexibility?
- Discussion on how markets can help integration of renewable generation, and added value to asset owners in terms of ability to market surplus capacity.
- Discussion of desirable market characteristics such as ability to reach more buyers
- Discussion of what type of markets could be easily implemented. Market participation not just limited to generators.
- Discussion of what types of new market products are useful such a fast ramping product.
- Discussion of differences between energy markets, ancillary service markets, and new market products for integration of renewable generation—what reactions can we expect?
- Discussion of general acceptance of markets and market mechanisms
- To the greatest extent possible, implement solutions that are simple, customer-friendly, don't require expensive infrastructure.

What is needed to integrate variable generation?

I suggest we define terms carefully (this is a rough start to the defs):

- Regulation (capacity service; seconds-minutes; energy integrates to zero)
- Load following (capacity service; for example providing longer-term ramping capability. Has an energy component that must be carefully separated from capacity component).
- Contingency reserve – reserve to cover big, fast events such as a unit trip or transmission outage. Other than transmission trip, VG output can't change this fast.
- Regulating reserve.
- Note that all of these are needed in systems without VG. Adding more VG will increase the need for these (and perhaps other) services
- Objective of the MWG is to explore market and other institutional frameworks (such as bi-lateral contracts, ADI, etc) to develop a deeper pool of accessible flexibility (i.e. more regulation, load following, etc) to help integration VG at low cost

- Point out that although WECC is concerned primarily with reliability, rules, if not instituted carefully, can block access to resources and therefore hinder reliability. The objective of the MWG is not to “price” services, but to help reduce or eliminate institutional barriers that prevent access to ancillary services that can help integrate VG.
- Ancillary services, primarily Regulating Reserves, to deal with short-term combined variability of load and generation. Contingency reserves may be adequate to the extent they are used only to deal with sudden contingencies such as the loss of a large generating plant. Increases in contingency reserve requirements may be justified if standards allow BA operators to use contingency reserves to deal with unexpected large changes in variable generation.
- Ramping/load following capability, to deal with large changes in variable generation over time lines that exceed the persistence requirements for existing ancillary services. A “ramping” service would likely cover time frames from five minutes to perhaps an hour.
- Sub-hourly scheduling time lines so that parties can make changes, particularly to inertia schedules, within an hour. This provides resource owners with the ability to self-manage changes in variable generation, conventional generation and load.
 - Requires investment in staffing and infrastructure
 - Will increasing amounts of renewable generation require corresponding faster scheduling intervals?
- Commercial and scheduling rules that provide resource owners with proper incentives to minimize their adverse impacts on the grid. These incentives must be accompanied by changes in scheduling and commercial practices that provide resource owners with the tools they need.
 - Requires changes to tariffs, business practices, staffing and infrastructure
- Dynamic schedules, so that Regulating Reserves can be shared across BA boundaries.
 - Provides access to system flexibility
 - Doesn’t reduce overall regulation requirements like consolidation, but provides options for how to manage variability and mitigate cost impacts
- Some means for sharing ACE responsibility (similar to ACE Diversity pilot) , so that the natural diversity in ACE across adjacent and/or interconnected BAs can be utilized to minimize movement of flexible resources while maintaining frequency stability and respecting inertia flow limits.

- Advanced ADI protocols yet to be developed
- What rules will be imposed on ADI, such as Interchange Scheduling?
- Additional transmission, to facilitate sharing of Regulating Reserves and ACE responsibility and to increase the [size of the pool of available] access to flexible resources available for supplying ancillary services and ramping/load following
- Achieving natural diversity of geographically and technologically dispersed variable resources to minimize overall variability through virtual or direct consolidation.
 - Ramping Need vs. Ramping Capability
 - Reduction in Regulation and Ramping Requirement
 - What solution does consolidation provide?
 - What consolidation configurations are best suited to provide solutions?
- Market-based mechanisms¹ for procuring and compensating integration services (which include regulating reserves and ramping/load following). Market-based mechanisms minimize the cost of these services, maximize economic efficiency and avoid administrative remedies. These mechanisms should operate on both hourly and sub-hourly settlement intervals.
 - Market based mechanisms exist for hourly energy and regulation but not for load following
 - Studies show a need for 'Fast' Energy Markets
 - Ramping vs. Incremental Energy
- Better forecasting tools, to minimize the amount of uncertainty associated with actual production by variable generators. Also need better visualization tools and put all these in the hands of the operators...we need to link this to the MWG objectives.
- Ability to buy and sell transmission on a more granular (at least hourly and possibly sub-hourly) basis to make better use of existing transmission capacity that may be fully utilized during the day but could deliver renewable energy during off-peak hours.
 - How does congestion management improve availability transmission capacity?
 - Can the market provide congestion management?

¹ Could be a formalized market, a voluntary bilateral market, a bulletin board, a contract, or other mechanism

- Minimum technical requirements on variable generators that address low voltage ride-through; temporary reductions in output (feathering, tilting arrays away from the sun, etc); and less abrupt changes in output due to high-speed cutouts or cloud cover.

Barriers

- Institutional inertia on the part of commercial parties and BA operators. Need to change the culture from “we can’t do that because...” to “we can do that for a price...” BA operators need to recognize that it’s no longer a matter of whether there will be a lot of variable generation. Instead, it’s figuring out how to take advantage of it.
- Reluctance to spend money for BA infrastructure upgrades and technology. Difficult because in some cases, BA operators spend money but other parties benefit. Need to discuss how BA operators can recover the cost of upgrades from those who benefit. Costs tend to be duplicative because of large number of BAs.
- Resistance from renewable developers to anything that increases their costs.
- ABC (anything but California) attitude regarding an “organized” market. Market-based mechanisms have to walk, talk and look like an RTO late without being called such.
- Out-dated scheduling and commercial arrangements that will be expensive and potentially time-consuming to modernize.
- Point out that many of these scheduling arrangements have high costs already, without significant VG. For example: hourly energy blocks impose significant ramping and regulation cost. This can be mitigated with faster schedules.
- Preference for Command and Control
 - Mandatory Compliance and potential risk of Sanctions fortifies this culture
- Stigma of Federal Regulation attached to Markets
- Certain solutions may already be written off as Impossible
 - Balancing Areas won’t consolidate
 - The number of Balancing Areas is increasing, not decreasing
 - Physical Transmission Rights will remain as dominant factor

- Contract Path methodology can result in under utilization of transmission
 - Need to look at flow based methods
- Formal, LMP Markets are not welcome in the West
- Scheduling and tagging rules are slow to change and favor transmission providers, not transmission users.
- RTO's have a bad reputation

Potential Solutions and Incremental Steps

- Somehow point out that a better understanding is generally needed about how to properly assess the need for additional reg and load following with wind – for example, some northwest entities have done a lot of analysis that assumes a constant level of load following reserve should be held for wind. That is expensive, wasteful, and not rational.
- Joint Initiative
 - Dynamic Scheduling System
 - Voluntary Flexible Business Practices for mid-hourly scheduling and use of hourly transmission
 - Bulletin Board type system for posting availability of system flexibility (load following and other services)
- Voluntary Balancing and Redispatch Markets
- Regional Transmission Tariff
- Voluntary, flexible, business practices
 - Conditional Firm Service and Dynamic Line Ratings are positive examples
 - Business Practices allowing mid-hour schedule changes
- Better use of available tools
 - West Wide System Model
 - Western Interchange Tools
 - WesTTrans OASIS

- Allowing Self Supply of Ancillary Services within a BA
- Allowing for Third Party Supply across BA boundaries
- Expansion of Virtual BA Techniques
- Creation of Wind Only BA and why this is happening on an ad-hoc basis
 - Provides access to reserve sharing groups
 - Allows imbalance energy to be provided under contract terms from more favorable suppliers
 - Treats imbalance as inadvertent energy
 - It's all about cost
 - Cost is driven by Policy
- Consolidation of logical Balancing Area Zones

What solutions are needed?

When are solutions needed?

What should WECC do? Are there global solutions that could be facilitated or implemented by WECC?

What should Industry (WECC Members) do?

What Market/Operating Mechanisms and strategies should be explored? Can we categorize and rank them in order of priority, ease of implementation, cost, and benefit?

Intra-hour scheduling changes to accommodate wind ramps

Dynamic Scheduling

ADI

Fast responding sub-hourly Markets (5-10 minute)

Advanced Virtual BA Concepts

Consolidated Wind Generation BA or

Aggregation of IPP resources with Wind

BA Consolidation

What Infrastructure is required to implement each Market and Operational strategies?

What Rules, Procedures, or Standards must be added, changed, or relaxed in order to implement Market and Operational Strategies?

What Regulatory and other Institutional Barriers must be overcome to implement each strategy?

Incorporate applicable literature

Administrative Stuff:

Target Date for completion of white paper?

Target Audience? VGS, JGC, WECC Board

Coordination Required with VGS OWG and WECC MIC