California ISO Frequency Response Initiative
Comments of Jack Ellis

These comments reflect my personal views and my professional opinions based on more than 40 years of power industry experience. I have prepared these comments on my own initiative, on my own time and at my own expense. Although I will be following its progress from time to time, I will be unable to participate in the ISO's stakeholder process other than on an ad-hoc basis. My comments will focus on primary response.

Responses to ISO Questions

1) *How should the ISO ensure there is sufficient frequency response capability on the system in all hours to satisfy the new requirement?*

The ISO needs to establish a simple but stringent set of performance obligations for primary frequency response providers. These should include at least a) the amount of committed response (capacity); b) the expected duration of the response, which should be in the range of 5-15 minutes; c) maximum allowable response latency, which starts when frequency drops below the threshold value that should trigger primary frequency response and ends when a frequency response provider begins responding; d) rise time, which is the maximum amount of time a resource has to ramp from zero to its committed frequency response level. All of these parameters should be obtainable from telemetry data. Because this service is critical to ensuring frequency recovery after a system disturbance, providers of primary frequency response that fail to perform in accordance with their obligations should be subject to significant financial penalties whether or not a failure to perform during a specific event results in an ISO violation of the standard.

At least some primary frequency response will be provided by synchronous motors, but the amount of primary frequency response available from this potential resource at any point in time is currently unknown and may be difficult to estimate with any degree of certainty. Primary frequency response can also be provided by certain interruptible loads like water heating (of which there is very little in California), but these amounts will be equally difficult to predict. The same holds true for inverter-based response from wind, solar and other kinds of supply resources that are not predictable or controllable. Consequently providers of demand-side and intermittent resource-based primary frequency response should be required to demonstrate that they can meet their obligations with a very high degree of certainty during those periods of the day for which they wish to provide the service.

2) *Should the ISO develop a market product to procure frequency response?*

Yes. Primary frequency response is a distinct service with unique performance requirements. A well-designed market product is the best way to elicit interest from providers, and to ensure that the ISO's obligations are met with a high level of certainty at the lowest possible cost. The alternative to a market

product is a blanket obligation on existing synchronous and non-synchronous resources that is unlikely to be cost effective or satisfy competing environmental and reliability objectives.

3) *If the ISO cannot develop a product in time for the fall 2016 release, what interim solutions would be appropriate? For example, using existing or modifying spinning reserve procurement.*

The only reasonable alternative is to procure primary frequency response from neighboring Balancing Authorities that have an excess, and only to the extent that ISO resources capable of providing primary frequency response that would otherwise be committed and dispatched are inadequate. Spinning reserve is a source of secondary frequency response and existing ISO procurement should be adequate under foreseeable conditions to meet any secondary frequency response requirement. However primary frequency response will likely require providers to ramp much faster over a much shorter time frame than resources that provide spinning reserve. If, for example, the ISO's primary frequency response requirement is 800 MW and if that entire amount is provided solely by combined cycle plants that can ramp 50 MW in a minute or less (surely a heroically optimistic assumption), then 16 of them would be required to be running all the time at a level that provides enough headroom to increase their output by 50 MW. The adverse environmental and economic consequences and the practical problems associated with relying solely on spinning reserve from fossil-fired resources as a source of primary frequency response are obvious. Hydro and pumped storage resources are far better candidates, but their suitability will depend on the performance criteria for primary frequency response providers established by the ISO, which based on my reading of the BAL-003-1 standard can set them as it sees fit so long as measured performance during a disturbance is satisfactory.

It is worth pointing out that if the ISO feels it lacks enough time to develop a market product, the situation is of the ISO's own making. BAL-003-1 has been under development for several years and the ISO has known about the likely implementation date for at least 18 months.

4) *WECC standards apply only to synchronous generators. Should the ISO explore a requirement that non-synchronous generators have a primary response capability?*

If the ISO is asking whether the ISO should consider amending its tariff so that non-synchronous generators must be capable of providing primary frequency response, the answer is no. Imposing such an obligation is unnecessary and unfair. Non-synchronous generators typically operate under fixed-price purchased power agreements (PPA). Unless the buyers are willing to amend those contracts to cover the incremental cost of any upgrades that would be needed to provide primary frequency response, a tariff-based obligation is arguably a burdensome, unilaterally imposed amendment to the PPA with no compensation. If a market product for primary frequency response is developed, non-synchronous generators can make the choice to add primary frequency response capability or not depending on the cost of any required modifications and the potential revenues they think they could earn. Moreover, while it might be feasible to equip most or all non-synchronous generators so they could provide primary frequency response, it is not clear that doing so is the most cost-effective way to meet the standard.

Other Comments

The ISO should make a further distinction that separates non-synchronous generators with a fully controllable and predictable energy supply, and non-synchronous generators with a variable, partially controllable energy supply. Batteries and other storage technologies that use inverters fall into the first category, and their ability to provide primary frequency response is a simple matter of knowing the state of charge. Wind and solar resources fall into the second category, and their ability to provide primary frequency response is less predictable and more uncertain. Owners of assets in the first category should be able to provide primary frequency response on a one-for-one basis, meaning one kW of sufficiently fast acting storage should be able to provide one kW of primary frequency response. Owners of assets in the second category seeking to provide frequency response should expect to dedicate at least several kW of geographically diverse resource capacity for each kW of primary frequency response compensation they expect to receive in order to account for the variability and uncertainty of the underlying energy supply.

Excess solar production may well be capable of providing more primary frequency response than the ISO needs when the sun shines, but whether this is the most cost-effective way to procure and provide primary frequency response can only be determined by establishing a primary frequency response market product along the lines outlined in response to ISO question 1 and then allowing potential providers to compete for the business. The cost of equipping all renewable resources with more advanced inverters that operate no more than 25% of the time for solar and perhaps as much as 35% for wind could well be higher than relying on a combination of other resources.

The financial penalties a primary frequency response provider should face if it fails to perform should be onerous enough to preclude the need for certification or periodic testing, both of which may demonstrate an ability to perform during the testing or certification process but offer no guarantee that a provider will perform the way it should following a disturbance. Clawbacks of reservation payments, which the ISO employs for certain types of ancillary services, will not be adequate. Instead, providers should face penalties that always make meeting the ISOs performance standards the less expensive alternative. In addition, any penalties imposed on the ISO for its failure to meet its share of the primary frequency response standard should be allocated first to any providers that failto perform during any disturbance during the NERC compliance period in proportion to the amount by which their performance fell short.

Please direct any questions regarding these comments to:

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