Memorandum

To: ISO Board of Governors

From: Keith Casey, Vice President, Market and Infrastructure Development

Date: August 24, 2016

Re: **Decision on reactive power requirements for non-synchronous generators**

This memorandum requires Board action.

EXECUTIVE SUMMARY

This memorandum presents Management's proposed tariff changes resulting from the reactive power requirements for non-synchronous generators and financial compensation policy initiative. The ISO proposes to apply a uniform requirement for non-synchronous generators to provide reactive power capability as a condition of interconnection. Management suspended this stakeholder initiative in November 2015 in light of a Federal Energy Regulatory Commission rulemaking on reactive power requirements for non-synchronous generators.[1] On June 16, 2016, FERC issued Order No. 827, requiring all newly interconnecting non-synchronous generators to provide reactive power capability. Order No. 827 also requires existing non-synchronous generators making upgrades to their facilities to provide reactive power if the ISO finds through an interconnection study that reactive power is necessary to ensure the safety and reliability of the electric grid. The ISO will submit a compliance filing in October 2016.

In addition, in previous orders FERC has requested that the ISO look into a market based mechanism for compensating resources for providing reactive power. As a result, this initiative addressed two issues: additional technical requirements for non-synchronous generators providing reactive power that were not included in FERC Order No. 827 and the ISO's rules for reactive power compensation. Specifically, Management seeks authority to require non-synchronous generators to install automatic voltage control, which is necessary for generators providing reactive power to maintain voltage schedules.

[1] The ISO has also referred to "asynchronous resources" in its policy initiative. FERC uses the term non-synchronous generators in Order No. 827. Both terms refer to resources connected to the bulk power system through power electronics, but that do not produce power at system frequency (60 Hz). These resources include solar photovoltaic, wind resources and battery storage.

Management has also determined that the ISO's current compensation method is consistent with the provisions of Order No. 827 and remains appropriate. Therefore, Management is not proposing any changes to the financial compensation for reactive power and voltage support at this time.

Management recommends the following motion:

> ***Moved, that the ISO Board of Governors approves the proposed revisions for reactive power requirements for non-synchronous generators, as described in the memorandum dated August 24 2016; and***
>
> ***Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed tariff change.***

DISCUSSION AND ANALYSIS

Technical Requirements

The ISO will comply with Order No. 827 through the adoption of uniform requirements for non-synchronous generators to provide reactive power capability and voltage regulation. In addition, Management proposes to request authority under Section 205 of the Federal Power Act to require non-synchronous generators providing reactive support to install automatic voltage control capability. Generators must be able to move within their required power factor range to maintain voltage schedules, which requires automatic voltage control regulator systems.

Financial Compensation

In response to FERC directives regarding compensation methods for reactive power, Management explored alternative methods of compensation, including mechanisms to compensate generators for both the capability and provision of reactive power. Management has concluded that the ISO's current tariff provisions for reactive power compensation are consistent with Order No. 827, which does not change FERC's existing policy on compensation for reactive power. This policy requires transmission providers to compensate an interconnecting generator for reactive power service when the transmission provider requests that the interconnecting generator operate outside of the specified reactive power range. This policy also provides that if the transmission provider compensates its own or affiliated generators for reactive power service within

the specified reactive power range, it must compensate all generators for this service, and at what rate such compensation should be provided.

The tariff provides for compensation for the provision of reactive power outside of a standard required range when the ISO asks generators to reduce their real power output. In these circumstances, which are extremely rare, the ISO compensates generators for their lost opportunity costs of providing energy. Because the current compensation methods are already compliant with Order No. 827, and the proposed requirements impose minimal incremental costs for market participation, Management has determined it is appropriate not to pursue any changes to the financial compensation for reactive power at this time.

The initiative also considered the appropriateness of developing an additional financial compensation structure for reactive power capability, essentially a capacity-type capability payment. After review, Management is not recommending any form of payment for reactive power capability, and believes that requiring reactive power capability from all generators is considered a good utility practice in the ISO's region. Reactive power capability and voltage support requirements are necessary for the reliable operation of the transmission system, and support the delivery of real power from generation to loads, which allows those generators to participate in the ISO market. Developers have the opportunity to capitalize the costs of installing this capability when they finance their projects.

Finally, in response to FERC's directive to explore a more market-based compensation mechanism for voltage support, Management has reconsidered the potential for market-based voltage support procurement and compensation, and has determined that market-based voltage support is infeasible given the localized nature of reactive power and voltage support and associated concerns about the potential exercise of market power.

POSITIONS OF THE PARTIES

The majority of stakeholders are generally supportive of the proposed technical requirements for non-synchronous generators providing reactive power. With respect to automatic voltage regulation requirements, some suppliers have stated that a generator cannot provide both voltage control and power factor control at the same time, and raised the question of why the ISO has listed both in its proposed requirements. Management is not proposing that a generator provide both voltage control and power factor control at the same time. The ISO stated that the generator must have the capability to operate in the voltage control mode or the power factor mode of operation, with the default being the voltage control mode. In other words, Management is requesting the generator maintain a voltage schedule while operating within the

specified power factor range. The voltage control mode would be the primary mode of operating, and ISO operators would not direct generators to operate in power factor mode other than in limited circumstances when temporary equipment malfunction occurred which limited the ability to utilize the voltage control mode.

Stakeholders have also requested clarification on how the ISO would deal with "hunting" issues, which occurs when two or more generators have the same point of interconnection and their efforts to control voltage schedules counteract each other causing the generators to boost and buck. One stakeholder suggested that the ISO take responsibility for any damage to equipment that might occur due to hunting. Management has proposed several options to deal with potential hunting issues, including allowing non-synchronous generators to control terminal voltage with proper compensation to the point of interconnection or any location between the generator terminal and the point of interconnection with compensation to the point of interconnection. Management has also proposed to allow developers the flexibility to develop a control scheme to utilize a voltage droop function with necessary supervisory controls to allow reactive power sharing among the non-synchronous generators, and generator owners have the option to consult with a technical expert in the reactive field to develop a mitigating scheme. Management will specify these mitigation options in its business practice manuals.

Management understands that stakeholders are largely split on certain aspects of the proposal with strong opinions in particular on the financial compensation issues. Most load serving entities believe that additional capacity payments may create over-recovery by existing generators that have already had the opportunity to capitalize their fixed costs when they installed reactive power equipment. Importantly, reactive power capability is an integral feature of synchronous generators and now part of standard inverter packages for non-synchronous generators. Suppliers have consistently argued that reactive power capital costs are not covered in contracts or market revenues and the ISO must pay capacity payments in addition to currently-approved provision payments. Management agrees with the load serving entities position and is not proposing additional compensation mechanisms at this time.

CONCLUSION

Management recommends that the Board approve the modifications to the reactive power requirements for non-synchronous generators described in this memorandum. The proposal will help to ensure that the ISO can maintain reliable grid operations as non-synchronous generators continue to make up a larger portion of the ISO's generation fleet.