

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Principles for Efficient and Reliable Reactive Power Supply and Consumption)) Docket No. AD05-1-000

**Oral Comments of John B. Howe on behalf of
American Superconductor Corporation
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Introduction

American Superconductor (“AMSC”) appreciates the opportunity to offer brief initial comments on the Commission Staff’s recent Report on reactive power issues (“Report”). AMSC furnishes a range of technology-based solutions to help grid operators manage reactive power challenges. We urge the Commission to consider, in any rule or pricing policy change, the important role that **distributed, mobile (and relocatable) dynamic VAR devices** can play – and are, today, playing – in assuring electric power system reliability and economic needs are met. Just as the Report emphasizes the need for rules that are **"technology neutral,"** conversely, new technologies are inherently **"policy neutral"** – that is, they can provide system performance benefits under a range of pricing or policy scenarios. Yet FERC’s rules and policies shape the extent to which users can see, quantify, and capture the economic benefits of using these new solutions. Thus we have a keen interest in rules related to the pricing of reactive power, and the recovery of investments and expenditures to meet this critical system need.

Today’s growing need for dynamic VAR support

The Report addresses a crucial need facing today’s electric power industry as it adjusts to conditions of competition and uncertainty. Power grid operators across the country face growing difficulties in assuring adequate dynamic VAR support that is appropriately distributed relative to loads. This fact arises from **several factors that are widely recognized, but very difficult to change.** These include: rising demand, especially in energy-dense metropolitan centers; mounting siting difficulties for new plants and lines; the actual, impending or threatened retirement of older, less-efficient generators in or near urban centers (driven by economics, competition and air regulations); the addition of new generators in areas of the grid that do not offer effective access to markets; and rapid changes in fuels markets. (Much of the recently-constructed gas-fired generation is now "out of market" due to current high gas prices.)

To explain the difficulty of planning under such conditions of unprecedented uncertainty, and the need for different tools that it creates, AMSC suggests an analogy. Imagine driving a car at night on a road that, while smooth-surfaced, is known to have random potholes – and encountering fog. The driver may know there are potholes ahead (i.e., random dynamic grid disturbances) yet will not know exactly where they are located. Under such conditions, the driver must slow down (i.e., incur congestion costs) or else court disaster (i.e., by hitting a pothole at high speed). Under such difficult conditions, the driver is not well served by adding more horsepower to the car’s engine (i.e., costly generation capacity). What is really most useful is having adequate shocks

and struts – a good suspension system to handle the unexpected anomalies on the road. The dynamic VAR technologies furnished by AMSC can be thought of, in short, as "**shock absorbers" for the grid.**

Applications of Dynamic VAR Technologies

The FERC Staff report contains detailed descriptions of AMSC's technologies, including: the D-VAR power electronics-based voltage boosters (p. 38); the Distributed SMES systems, which incorporate an electromagnet that stores real power to compensate for voltage drops (p. 39); and the new "SuperVAR" dynamic synchronous condenser, a prototype of which is undergoing testing on the Tennessee Valley Authority grid (p. 29). These technologies have been, or could be, used on a highly cost-effective basis in a wide range of applications including:

- facilitating imports into congested high-cost load pockets
- transfers across a system
- exports from supply "bubble" regions that have low-cost but locked-up generation that is limited by stability constraints
- flicker mitigation
- interconnection of wind generation
- improving transmission-level reliability
- improving local reliability and power quality
- preventing the need for "under-voltage load shedding," a technique that inconveniences some customers in order to preserve wider-area reliability and that needs to be maintained as a tool of last resort.

What Is the Most Appropriate Form of Pricing for Dynamic VARs?

Over the past five years, AMSC has gained extensive experience in studying grids and applying innovative solutions for these types of problems. We wish to offer some observations regarding possible alternatives for pricing reactive power that are based on this experience. In general, some – but only a portion – of the value of these distributed, dynamic VAR technologies is in their provision of steady-state VAR support. If this were the principal need on the system, other technologies could meet the need more cost-effectively. But the greatest value offered by these dynamic technologies is **in their ability to provide instantaneous, literally sub-cycle response to grid disturbances** (faster than is possible with generation), dampening them out quickly and, through well-distributed placement, close to the source.

The installation of seven Distributed SMES units completed by AMSC and GE Energy that was put in place in Northern Wisconsin in 2000 offers an illustration of the importance of the fast response capabilities of these technologies. These units were placed on an isolated loop of the grid that faces an urgent need for reinforcement to maintain reliability. These units have fired literally thousands of times over the past five years. The magnets in these devices have a reservoir of real power that could in theory be discharged for up to a second. Yet **never have the magnets discharged for longer than about 400 milliseconds (23 cycles)**. This actual experience illustrates the importance of brief bursts of voltage support, at strategic locations, in keeping the grid up and running.

AMSC's experience is important and relevant in light of the debate, reflected in the Report, over how to price the provision of reactive power. Should VARs be valued on a "capacity" basis or "as-delivered?" In AMSC's view, and to employ another analogy, it may be best to think of dynamic reactive support not as a "commodity" subject to market forces, but rather as a **critical service that must be available on a continuous, 24/7 basis** if it is to offer value.

VAR Support Compared to Public Safety Services

In many ways, this service is similar to police and fire protection of local communities, which are furnished as government services, rather than competitively procured. **Policemen, for example, are not paid on the basis of how many bullets they fire to thwart crime** – that would establish some pretty perverse incentives! Instead, police are salaried, and staffing levels set on the basis of the force level required to get the job done. In fact, much of the value that police forces provide is in crime deterrence by virtue of their constant presence in the community, in addition to the services provided in emergency situations. This presence creates a sense of safety that enables citizens to use their time and resources to more productive "highest and best uses" rather than self-defense and constant vigilance. Likewise, fire protection is a government function. While many smaller and rural communities have volunteer fire departments, this is no longer the norm in cities. Our complex urbanized society cannot depend on volunteers who quit their day jobs to fight fires – and it certainly would be infeasible to compensate them at the "opportunity cost" of forgoing their daily employment. Instead, we use a variety of tools – including fire codes, building codes, sprinklers, and professional firefighters – to prevent or reduce the occurrence of fires in the first place. Like policemen, firemen actually spend most of their time not actively fighting fires but doing inspections, training, and engaging in other activities that reduce fire risk.

Pricing Implications for Dynamic VAR Technologies

As these analogies suggest, the value of reactive power support from dedicated, dynamic reactive power resources **cannot be reasonably calculated on the basis of how long, and how often, they are actually fired**. Such an approach would require that a nearly infinite rate be applied for their use. This would make rational financial analysis to justify dynamic voltage support installations very difficult or even impossible. A more reasonable gauge of the value of these technologies can be found **in the value of the increase in power flows that they enable, on a steady-state basis**.

By way of example, AMSC and GE Energy supplied, in 2003, a reliability and power transfer solution for the grid in Southwestern Connecticut consisting of three D-VAR units with related equipment. The presence of these units enables the import, on a reliable basis, of approximately 100 MW of additional power, procured at lower cost from central New England, into the southwestern part of the state – a region that is subject to extremely high locational prices under the region's newly-implemented pricing system. This differential in locational power costs provides a stream of savings in total system costs that rapidly repays the investment in dynamic VAR equipment.

Conclusion

While FERC has expressed interest in whether there are "market" solutions for provision of reactive power, leading electricity industry experts remain far from agreement that such a structure is possible or even desirable, since reactive power demand is "derived" rather than "direct." Staff acknowledges that putting such a framework in place could require 5-10 years, yet our nation's power system faces immediate needs and reliability challenges. **Rather than letting pursuit of the perfect become the enemy of the good**, AMSC suggests that FERC pursue a range of more modest, incremental but doable steps. These could include, for example:

- the creation of clear reliability and reactive power support standards, uniform in nature but applied in a way that is suited to local conditions
- greater regulatory encouragement of investment in dynamic reactive support
- greater efforts, in collaboration with the states, to overcome disincentives to grid investment (especially low-impact grid upgrades) contained in state regulation. Many utilities operate under long-term rate freezes that bar recovery of incremental investments between rate cases. These might be modified to promote investment (by utilities and/or RTOs) in distributed, mobile and relocatable dynamic voltage support required for regional reliability needs.

AMSC's experience convinces us that **distributed, dynamic VAR support can offer a much more cost-effective solution than traditional approaches** such as adding new generation – which is costly and, in any case, problematic to finance since many regional generation markets are saturated. These dedicated VAR technologies offer other advantages: the avoidance of siting controversy; zero local air quality impacts; lower investment risk, since individual units are mobile and relocatable; and fuller use of existing generation and transmission assets. In sum, **promotion of distributed, dynamic VAR technologies offers the potential for a win/win/win by consumers**, who would enjoy a lower total cost of service; **by grid owner/operators**, who would benefit from a broader and more flexible solution set for their reliability and power delivery challenges; **and by generation asset owners**, who would find that existing assets can be used more fully and efficiently, and costly new assets deferred. As the Commission contemplates changes in its rules and regulations regarding reactive power, AMSC urges that it give careful consideration to ensure that its new rules encourage, and do not deter, adoption of innovative, lower-cost strategies that are made possible by the use of these new technology tools.

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