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April 4, 2005

Honorable Magalie R. Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Room 1-A209
Washington, D.C. 20426

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

Dear Secretary Salas:

For filing, please find the Notice of Intervention and Comments of the New York State Public Service Commission in the above-entitled proceedings. Should you have any questions, please feel free to contact me at (518) 474-6513.

Very truly yours,

Kimberly A. Harriman
Assistant Counsel

Attachment

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

NOTICE OF INTERVENTION AND COMMENTS OF THE PUBLIC SERVICE COMMISSION OF THE STATE OF NEW YORK

INTRODUCTION

On February 11, 2005, the Federal Energy Regulatory Commission (FERC or Commission) issued a Notice Establishing Comment Date for the FERC Staff Report entitled "Principles for Efficient and Reliable Reactive Power Supply and Consumption" (Staff Report).

The Staff Report examines the physical characteristics and costs of producing reactive power, reviews the history of reactive power pricing at the Commission, and develops pricing principles and examines market designs for reactive power. The Staff Report presents four high-level recommendations and asks questions designed to gather information on how best to implement the recommendations.

The New York State Public Service Commission (NYPSC) submits its Notice of Intervention and Comments pursuant to the February 11, 2005 Notice and Rule 214 of the Commission's Rules

of Practice and Procedure. Copies of all correspondence and pleadings should be addressed to:

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SUMMARY

Reactive power, measured in volt-amperes reactive or vars, helps maintain the reliability of the transmission system by controlling system voltages. When system voltages are optimal, more real power, measured in megawatts, can flow on the system. The Staff Report recommends that: (1) reactive power reliability needs be assessed locally, based on national standards; (2) reactive power needs should be procured in an efficient and reliable manner; (3) beneficiaries of reactive power should be charged accordingly; and (4) providers of reactive power should receive payment on a nondiscriminatory basis.

While the New York Independent System Operator's (NYISO) reactive power compensation sufficiently provides reactive power capability for the transmission system in New York, we agree, as a national matter, that FERC's inquiry into reactive power is reasonable.

We concur with the four recommendations and suggest the following modifications/clarifications:

(1) National standards should be developed through the existing processes within the North American Electric Reliability Council (NERC) and North American Electric Standards Board (NAESB) and should include the requirement that dynamic reactive power sources be capable of automatic voltage control (capability) and periodically tested.

(2) In order to ensure the efficient and reliable provision of reactive power, local studies should be performed to determine whether the simultaneous optimization of real and reactive power dispatch could be cost effective. If so, the use of Optimal Power Flows, considering contingencies, should be phased into dispatch operations as computer capabilities increase.

(3) Payment for reactive power capability should be for the capability range specified by Regional Transmission Organizations (RTOs), Independent System Operators (ISOs) and Transmission Owners (TOs) for maintaining reliability and effecting efficient transfer of real power; should cover the supplier's lost opportunity costs; and should be classified as ancillary to transmission service. The characteristics of reactive power do not appear to support a real-time or day-ahead market structure.

The following sections address the recommendations in light of New York's experience. Selected specific technical questions contained in the Staff Report are answered in the Appendix.

COMMENTS

1. Reactive Power Reliability Needs Should be Addressed and Supplied Locally, Based Upon Clear National Standards.

Reactive power reliability must be assessed locally and supplied locally. Reactive power losses increase significantly as the power is moved across the system. Therefore, reactive sources must be very close to the need. Where the system contains large amounts of generation and relatively short transmission lines, the transmission system tends to be less

vulnerable to voltage swings and resulting stability problems as reactive resources are plentiful to control voltage levels. In contrast, where the system has little generation and long transmission lines between generation resources, the system is more sensitive to changes in load and generation dispatch, thus requiring increased attention to the placement, amount and availability of reactive resources. In each of these cases, the overall system design has been (or needs to be) customized to ensure that sufficient reactive supplies are available locally.[1]

While local determination of reactive supply requirements is necessary, the need for national standards to maintain reliability is clear. A national requirement to maintain voltage levels safely above voltage collapse levels should ensure that uncontrolled, wide-spread system collapse will not occur. The specification of these and other standards are technical by nature and should be developed in the NERC and NAESB forums that were established to address issues such as those raised by FERC Staff.

[1] A hallmark of efficient system design, as opposed to reliable design, is to have the reactive needs of the bulk electric system met at the bulk level and to have the reactive needs of the load met by resources on the lower voltage system. By having each portion of the system supply its own reactive needs, reactive requirements are minimized and more transmission capacity for real power flow is made available.

2. Reactive Power Does Not Appear to Possess the Characteristics Necessary for the Creation of a Competitive Market.

The last three Staff Report recommendations relate to business/market issues which, if implemented incorrectly, could have reliability impacts.[2] On the other hand, if implemented correctly, these could result in consumer savings.

We are skeptical that an effective real-time or day-ahead market could be established for reactive power. First, because reactive power cannot travel long distances on the system, there would have to be a series of very small, possibly overlapping markets. With such small markets, there is likely to be an insufficient number of suppliers to establish a truly competitive market. Second, the geographic definition of these "markets" would perpetually shift because reactive power needs alter as transmission lines and cables produce and absorb reactive power and loading levels and real power dispatches vary. Thus, as the geographic market for reactive power changes the value of the power changes and competitors continually shift in and out of the market as the boundaries of the market change.[3]

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[2] Specifically, the second, third and fourth recommendations pertain to reactive power procurement, payment by beneficiaries of reactive power and the level of compensation to providers of reactive power.

[3] Additionally, much of the reactive capability on the system is valuable as reserves. A real-time or day-ahead market based solely on hourly payments would fail to value reactive reserve capability.

To establish an efficient regulated approach, a control area study should be performed to determine the magnitude of savings achievable by optimizing simultaneous dispatch of real and reactive power. The study should determine the precise optimum voltage magnitude within a reliable operating range at each generator bus and at each substation bus where voltage can be controlled.[4] The study should compare actual production costs over the prior year with what would have been achieved had optimization been available.[5]

If the study determines significant savings can be achieved by optimizing both real and reactive power dispatches, control areas should be directed to move towards the introduction of OPF program use in real-time. Note that the use of an alternating current state estimator[6] is required to implement the OPF in real-time. State-of-the-art computers currently allow integration of OPF runs in the dispatch process every few hours.

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[4] A commonly used, available software program in the industry which computes the optimum voltage set points is the Optimum Power Flow (OPF) Program with contingency constraints.

[5] It may not be necessary to study 8760 hours throughout a historical year. For example, a study could examin peak and typical load periods to determine if savings could be produced if real and reactive power dispatches were optimized.

[6] A state estimator estimates the voltage profile and power flows on the system. A DC state estimator uses only real power flows to compute the estimate. An AC state estimator uses both real and reactive power flow to compute the estimate.

However, as computers and execution time improve, we believe that real and reactive/voltage dispatch can be established in five minute intervals.

While the implementation of optimizing real and reactive dispatch (if cost effective) holds the prospect for more efficient power transfers, any savings must be weighed against possible shortcomings in current system designs. A good system design should plan to supply bulk system reactive needs (voltage support) from bulk system facilities and plan for reactive power needs of the load to be supplied by non-bulk facilities. To the extent such design and implementation is carried out, this system configuration should facilitate increased savings when an OPF program is used to optimize reactive power use for daily operations.

3. All Bulk System Reactive Providers Should be Compensated for Providing Reactive Power.

As noted in Chapter 6 of the Staff Report, the goal of reactive resource investment is first for reliability purposes and then for economic purposes. Consequently, bulk system reactive providers should be compensated.

Generators should be compensated for installing the interconnection capability requirement at a flat fee.[7] If interconnection studies indicate that an increased reactive capability would increase system efficiency, the amount of added capability installed by a generator should be eligible for an additional cost-based capacity payment because suppliers have an obligation to make their reactive capacity available to the system operator on a real-time basis.[8] The payment for reactive capability should be contingent on periodic testing of the plant's reactive capacity and response rate. A lost opportunity cost payment is also warranted in the event real power generation must be curtailed to provide reactive support.

FERC Staff's third recommendation is that those who benefit from reactive power should be charged for it. The function of reactive power is to maintain appropriate voltage levels on the

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[7] The costs for reactive power should not be computed based upon the physical location of the reactive resource. To do otherwise may create a perverse incentive for generators to remotely locate from load. Under a locational based pricing method, a generator locating in a remote area of the system is likely to require a larger reactive power capability, and thus a larger payment for reactive power.

[8] We favor a capacity payment rather than a marginal hourly charge in that the latter cost is near zero and is more complex to determine than a straight capacity charge. Additionally, there are cases where the reactive capacity of some suppliers may principally serve as reserves useful only under contingency conditions. Reactive reserves can be just as important as those that also provide active voltage regulation.

electric system. In contrast, real power is consumed at the customer level. As such the “purchase” of reactive power is appropriately classified and charged to customers as ancillary to transmission service.

Respectfully submitted,

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Dated: April 4, 2005
Albany, New York

Questions and Answers

General

Q. Should transmission providers report the value of real and reactive power on their systems? Would this help make better locational investment decisions?

A. Informing the market of locations where there is a reactive reliability need and where increased reactive capability would benefit market efficiency would help developers with their investment decisions. A reliability need should be identified through the normal system planning process. Incorporating a reactive study for efficiency is a good goal but is likely to be burdensome because planning processes today focus on system reliability needs, not on economics. An entire new genre of studies and criteria would need to be developed for economic reactive studies.

Q. By not properly pricing reactive power, are we missing opportunities to further increase reliability and efficiency?

A. Reliability is measured through system evaluations during normal and contingency conditions. But one could evaluate the economics of reactive power for more efficient operations through the use of OPF software in the dispatch process.

Q. Should reactive power reserves be differentiated by quality as are real power reserves? Should dynamic reactive power be differentiated from static reactive power?

A. The answer to both questions is yes. Response rates and capacity that are independent of the existing voltage are two qualities which differentiate dynamic from static reactive resources. Static resources should be treated as any other piece of transmission equipment while dynamic devices should be eligible for compensation on the same basis as generation.

Q. What are the relationships and differences among standard transmission assets, e.g., capacitors, FACTS devices and

generators in reactive power supplied? Where do FACTS fit in? What is the effect of different outage rates?

A. All of these assets have positive and negative aspects. Static devices lose capacity as voltage drops and, therefore, are valued less. They are also switched in or out in blocks making voltage control more difficult; but they are also less costly. FACTS devices, where necessary in the system, provide dynamic reactive capability and are an alternative to generators and synchronous condensers. Outage rates of static and dynamic devices should also have a bearing as to which device is chosen for installation.

Q. How, what and when are dispatch signals for reactive power sent to market participants?

A. In real time, signals could be sent by "desired voltage" signals similar to base-points. The signals could be sent at 5-minute intervals or slower, depending upon: (1) the capability of the Control Center; (2) the speed at which the OPF can be executed; and (3) the economic evaluation by the OPF program.

Q. Should the general approach to voltage scheduling be re-examined to improve reliability and efficiency?

A. As far as voltage is concerned, the general approach to reliability can be adequately addressed by the industry. The efficiency aspect has not been analyzed at all, and should be examined, particularly in view of the availability of the OPF with contingency constraints included. It could be used to schedule voltages at controllable buses through means such as generator voltages or setting taps. It could first be executed every few hours. As the computer speeds improve and the execution time of the OPF is reduced, it could be used to schedule real power and voltage at almost the same time, provided that an accurate AC state estimator is available.

Q. Should generators be required to supply an identified range of reactive power without compensation?

A. As a general matter, compensation should be provided. However, compensation should not be provided where reactive capability is installed beyond what the interconnection study indicated could be used for reliability or optimal dispatch.

System Planning

Q. Do we have enough reactive power capability in our generators to meet the reliability needs of our power system? If so, how do we know?

A. Required reactive capability (active, static and reserve levels) for a system is determined, and continuously verified, through planning studies, operations planning studies, and AC contingency evaluations. This ensures that there is sufficient capability available to the system from all resources, including but not limited to, generation.

Q. Should reactive power reserve requirements be locational and/or better defined like real power reserves?

A. Reactive resources are used to provide the reactive requirements of loads, but are also needed under contingency conditions. The latter may be classified as reserves. The reactive reserves required can be determined from system planning studies. As noted in Section 1 of our comments, reactive power needs to be produced locally, and likewise, reactive reserves need to be local. Every control area should be aware of its reactive power reserve requirements and ensure that the appropriate reserve level is available. However, this is generally accomplished in advance through planning studies and not through daily operating studies, as done for determining real power reserves.

Q. Should reactive power reserves be procured competitively?

A. No. See Section 2 of our comments.

Q. Are there optimal design characteristics with respect to reactive power for generators, transmission and load? If so, how are they derived? Or, do they depend on system characteristics? If so, how are they derived?

A. There are no optimal reactive power designs for generators. Generally, the larger the amount of reactive capacity designed for by the generator the larger the cost of the unit. For reliability reasons, the design is dictated by system characteristics manifested in the interconnection study. Optimal generation design for economic purposes is an area that has not been well explored. However, in order

to maximize the use of the bulk system for real power flows it is well known that economically efficient system design for transmission and load provides for minimum reactive flow between the bulk system and the lower level system.

For Generators

Q. What is "good utility practice" for reactive power supply and reserves from generators?

A. “Good utility practice” is to have generator reactive capability to at least 0.95 lagging (0.90 preferred) and 0.95 leading. However, interconnection studies may establish that additional capability may be necessary.

Q. Should the power factor requirement for generators be measured at the high or the low side of the step-up transformer?

A. The reactive capability requirement should be determined by system planning studies, and it does not matter where it is measured. If the power factor is measured at the high side of the step up transformer, more reactive capacity has to be built into the generator to account for the losses incurred in going through the transformer. Manufacturers of generating equipment, however, should be informed about where it will be measured so they can design their units accordingly.

Q. Should there be reactive power requirements for non-synchronous generators (wind, solar etc)? If so, what?

A. Yes. Active reactive capability should be available at all generator interconnection points. Modern wind machines are capable of reactive support. Active reactive devices can be paired with other non-synchronous generators.

Q. What is the role of distributed generation in providing reactive power?

A. Distributed generation interconnected to the transmission system should perform the same role as any other generation.

Q. What are the options for reactive power output as a function of investment in generator design?

A. The minimum reactive power requirements should be determined from interconnection studies and clearly stated for manufacturers.

Q. Does it make economic sense to oversize the generator or the turbine?

A. There may be cases where it makes sense to oversize the generator, turbine, or both. This should be a developer decision based on energy/capacity market signals, planning study information and interconnection results. Thus, if the interconnection study demonstrates that the system could benefit from more reactive power capability, the generator should be compensated for that capability.

Q. Should the required reactive power capability differ based on location on the system? For instance, should we allow generators distant from load to have less capability?

A. The reactive capability should be based upon the location of the generator on the system. Although distance from load is a factor in determining reactive requirements, local system design and density of generation are more relevant drivers. Again, interconnection studies should determine the amount of reactive capacity that should be designed into the generator. It is possible that reactive capability could be more important for generators distant from loads, to control transmission voltages, than for generators closer to the loads.

For Transmission

Q. Should there be interconnection standards with respect to merchant transmission?

A. There should be interconnection standards for merchant transmission. Those standards should require that when the line is heavily loaded, bus voltages should remain within acceptable limits rather than sag below the lower limit of the acceptable voltage range. This could mean that merchant transmission may have to supply additional reactive resources for those periods. During low load periods, merchant transmission may have to provide shunt inductive reactive resources to keep the bus voltages from rising above the acceptable higher voltage limit. The alternative would be that the system would have to provide the reactive resources required during high load periods,

and to absorb the reactive power of the transmission line during low load periods or to switch out the transmission line during low load periods.

Q. Can thermal transmission constraints be relieved by supplying or consuming reactive power? If so, how, and to what extent?

A. Yes, thermal transmission constraints can be relieved by maintaining higher, but acceptable, voltages on a transmission line. This is best done by minimizing the reactive flow on transmission lines, providing reactive support for voltages, and providing the reactive requirements of loads below the bulk level.

Q. Can non-thermal transmission constraints be relieved by supplying or consuming reactive power?

A. The non-thermal transmission constraints are primarily voltage and stability. The voltage constraints can be totally relieved through reactive resources. The stability limits can be relieved to a more limited extent as there are other system factors and facilities that impact stability limits besides reactive support.

Systems Operators

Q. How are voltage schedules determined? Who decides? What are the criteria? Are they optimized? Are generators required to operate at a given power factor, or are they required to maintain a specified voltage? Are generation costs incorporated into voltage schedule decisions?

A. Acceptable voltage schedules are largely determined by the equipment such as generators and transformers, which are connected to the system, and by system stability considerations. A satisfactory voltage range to maintain reliable operation is usually provided by RTOs, ISOs, or TOs to generators and held automatically at controllable buses. Some operators of the bulk system may tend to operate near the upper limit of the voltage range in order to minimize losses. Optimization of voltage within the acceptable limit is not now conducted. Optimization of voltage/reactive power flow can be accomplished through the OPF, but whether that produces significant cost benefits will have to be studied. To carry out the optimization of reactive power in real time requires an AC state estimator.

Q. Should the approach to voltage management and scheduling be re-examined? How does voltage scheduling affect economic operations? Should there be incentives for voltage management?

A. Economically efficient voltage scheduling should be studied to determine if it is cost-effective. If studies indicate that economic voltage management would significantly lower production costs, and if implementation is not overly expensive, implementation of the use of an OPF (considering constraints) should be required, where possible, and not just encouraged through incentives. Current FERC requirements already call for re-dispatch if it will enable a transmission request. Where cost effective, implementation of voltage management could be considered an extension of a transmission request for re-dispatch, and thus an incentive would not be required.

Q. Under what circumstances might a generator be required to reduce real power output due to a shortage of reactive power?

A. When voltage sags below reliable levels and a reduction in real power output would allow increased reactive power output as dictated by the generator’s capability curve (D-curve).

Costs

Q. What are the cost differences among reactive power from capacitors, FACTS and generators?

A. We are uncertain of the cost differences since each of the above equipment has different characteristics, such as voltage, response time, and variability of reactive capacity and controllability; thus it is difficult to identify the cost differences.

Q. What is the incremental investment cost for generator reactive power capability?

A. Costs will depend upon the equipment used to provide the generator with reactive power capability. Additionally, the incremental cost may not be linear with increased reactive capacity.

Order No. 888 Rate Design

Q. Are independent power suppliers being compensated comparably to the generation supplied that is owned by transmission owners?

A. This question is not applicable to New York. Generation in New York is not owned by vertically integrated utilities.

Q. Can the capital costs of reactive power capability be effectively unbundled? Should reactive power pricing be unbundled? If so, how?

A. In New York, reactive power is compensated through reactive capacity payments, and therefore, is already unbundled.

RTO Markets

Q. What software advances are needed for efficient and reliable reactive power markets?

A. For efficient use of reactive power, the OPF is already available, although it might operate too slowly for use in a real time-market. It could be operated every few hours, until either the computers speed up, or the program itself is made to operate more rapidly, or both. It still has to be established whether it would be cost effective, in a particular control area, to use the OPF (in combination with an AC state estimator) to optimize reactive and real power dispatch.

Q. Should reactive power capability requirements be locational and procured in capacity markets?

A. Reactive power capability requirements are best provided locally; we are skeptical regarding their procurement, which should not be through markets, as discussed in Sections 1 and 2 of our comments.

Q. How should merchant generators and transmission be compensated for the capability to provide reactive power?

A. See Section 3 of our comments.

Q. How should distributed energy resources be compensated for supplying dynamic reactive power?

A. In the same way as all other dynamic reactive resources are compensated.

Q. Should reactive power be paid opportunity cost compensation based on the real power price?

A. Yes, for lost opportunities.

Q. Should a separate reactive power capacity market be developed? If so, what should the capacity supply obligation time frame be? Daily? Monthly? Annually?

A. See Section 2 of our comments.

Q. Should there be different types of payments or markets for reactive power from different sources (generators, capacitors, SVC, Statcom, synchronous condensers, etc)?

A. Yes. There should be specific payments for active devices that produce reactive power. On the other hand, payments for static devices should be considered and treated just as another piece of transmission equipment.

Q. What are the computational impediments to including reactive power in the day-ahead and real-time markets?

A. See Section 2 of our comments related to the use of OPF and the continuously shifting definition of what is a market due to transmission line production/absorption of reactive power.

Q. What are the non-computational impediments to including reactive power in the day-ahead and real-time markets?

A. A real-time and day-ahead reactive power market would not properly reflect the value of reactive reserves.

Q. What kind of market power mitigation would be needed?

A. If a generator were needed for reactive power and alternative sources were not available, energy market mitigation could be needed, even in the absence of a reactive power market.

Q. What is the magnitude of reactive power value (price) relative to real prices?

A. Reactive power production costs are a small percentage of real power production costs.

Q. What is the volatility of reactive value (price) relative to real prices?

A. If the principal price is for capacity, there would be little volatility.