Exhibit No. IMM-0008
Docket Nos. ER20-2186-003,
EL20-62-001

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

	)	
Fern Solar LLC	)	Docket Nos. ER20-2186-003,
	)	EL20-62-001
	)	

SUPPLEMENTAL TESTIMONY
RESPONDING TO BENCH QUESTIONS, SET #2

B-2-23

B-2-22

[Bethel]: Mr. Pasternack's explanation of his chosen reactive power allocator was terse. He stated first that the "size and cost of the generator/exciter and accessory electric equipment are proportional to the MVA rating of that equipment." He then presented the basic power triangle relationship, MVA2=MW2+MVAr2 . Then he concluded: "Therefore, the portion of the MVA-based cost related to MVAr production would be MVAr2 /MVA2" (See Ex. FER-0012 at 19-20 (Direct Testimony of Bernard M. Pasternak, Docket ER93-540-000, Ex. A-29)). Explain technically, with all necessary detail but in a way understandable to a layperson, why his three steps lead to an unavoidable conclusion that the portion of total equipment cost attributable to reactive capacity is the ratio of the squares of reactive power and apparent power. The conclusion is not obvious from his explanation.

B-2-23

[Bowring]: You assert that in determining the portion of total cost attributable to reactive capability, power factor is irrelevant. Focusing solely on Mr. Pasternack's three-step reasoning described in the immediately preceding question, explain where in that reasoning you think he errs.

Please see Attachment.

Attachment

There is no logical connection among Mr. Pasternack's three steps stated in his 1993 testimony. The first step is equivalent to a general statement that larger generators cost more. The first step uses MVA rating as a general, but approximate, metric for generator size. The exact nature of the proportional relationship is not specified. The second, and unrelated step, is a statement of the basic power triangle relationship among $(MVA)^2$, $(MW)^2$ and $(MVAR)^2$. The fact that the term MVA appears in both sentences does not create a logical link. The third statement is not logically related to either of the prior two steps. No support was provided for the fundamental assertion that the ratio of $(MVAR)^2$ to $(MVA)^2$ is related to the costs of providing real and reactive power. No support is provided for the specific functional form, e.g. the specific relevance of $(1 - PF^2)$ rather than $(1 – PF)$. No support was provided for Mr. Pasternack's inextricably related assertion that the ratio of $(MVAR)^2$ to $(MVA)^2$ is a function of the nameplate power factor rather than the power factor identified in the Interconnection Service Agreement (ISA) and actually required.

Mr. Pasternack's 1993 testimony made explicit that the allocator he proposed was based on subjective judgment. Mr. Pasternack stated that it was fair and equitable to reassign a significant part of the capital costs of generators to transmission customers, including internal and external transmission customers, that had previously been assigned to power customers. Mr. Pasternack stated that his goal was "a fair and equitable cost-based charge to transmission users." (Pasternack Direct Testimony at 9.) The Pasternack testimony was about reassigning costs that were already fully accounted for and not for any asserted costs to provide reactive power that were not recovered elsewhere and not for any asserted additional costs of providing reactive power. Mr. Pasternack stated that generator costs had not been allocated to transmission customers by AEP prior to the case in which he proposed the allocation. Mr. Pasternack recognized that AEP was "breaking new ground in developing such a VAr charge." (Pasternack Supplemental Rebuttal Testimony at 4.)

In his 1993 testimony, Mr. Pasternack was engaged in a cost allocation exercise designed to shift a significant level of generator costs from power customers to transmission customers. Mr. Pasternack proposed the use of an allocation approach using one minus the power factor squared $(1 - PF^2)$ where the PF was defined to be the nameplate power factor. The reason for the allocation approach was to maximize the allocation of reactive costs to transmission customers rather than power customers. The nameplate power factor is generally lower than the power factor required by the PJM Tariff. A lower power factor means that the PF^2 is also lower and therefore that the allocator $(1 - PF^2)$ is higher. The differences in the allocator based on different power factors can be extreme. For example, the allocation of costs to reactive using a nameplate power factor of 0.80 is 36 percent, while the allocation of costs to reactive using a power factor of 0.90 is 19 percent, and the allocation of costs to reactive using a power factor of 0.95 is 10 percent. If the choice is between allocating costs to reactive or power generation, it is not logical to use the largest reactive allocator rather than the largest generation allocator. No good reason, for example based on assertions about cost or function, was provided by Mr. Pasternak for using the largest reactive allocator.

In contrast to the Fern Solar case, Mr. Pasternack's cost allocation exercise was in a fully regulated cost of service environment where the regulated utility (AEP) had rates designed to allow recovery of 100 percent of all its costs. In that environment, cost of service exercises were primarily about rate design; what set of customers should pay more or less. In the Fern Solar case, the reactive allocation discussion cannot be separated from the capacity market design. The relationship between the capacity market and reactive is recognized in the PJM market rules. The capacity market explicitly accounts for reactive revenue in the energy and ancillary services offset in defining the capacity market demand curve (VRR curve). The capacity market includes all the costs of capacity. When capacity resources sell capacity, they attempt to maximize the amount of capacity in MW of installed capacity (ICAP) that they offer in the capacity market, net of the forced outage rate (UCAP). The ICAP amount is based on tests. Capacity resources are required to offer energy based on the full ICAP every day in the energy market. Holding aside the more fundamental issue with any positive cost of service payment for reactive, it is not logically consistent to include a reactive allocation factor based on a power factor that assumes power production at less than this full ICAP level which defines the obligation of the generator to provide real power in MW.

Cost allocation studies require the creation of allocation factors. Once the judgment has been made to allocate costs, cost allocation studies require that there is some way, regardless of its rationale, to assign costs to customer classes. That is not true in markets. Mr. Bethel, in his uncritical acceptance of Mr. Pasternack's allocation approach, would ignore the underlying reality of the cost of service reactive allocation factors applied in a market environment. The actual impact is that, in PJM markets, the larger the reactive allocation, the larger the guaranteed, non market revenues received and the less the generator has to rely on markets. The effective function of the proposed reactive allocation approach is to assign risk to customers and away from investors. This is exactly contrary to market principles. In a market, the generation owner is not guaranteed any level of cost recovery. In a market, the concept of cost recovery is not relevant. Investors invest with the expectation of earning a target rate of return from markets, with the associated uncertainty. When PJM introduced markets to replace cost of service regulation, all of the capital costs of generation were included in the PJM markets and no longer subject to cost of service regulation. Mr. Pasternack's approach, which was incorrect even at the time he proposed it, does not apply in markets like the PJM markets.

Reactive power is an ancillary service. It is ancillary to the provision of energy and capacity. It is not intended to supplant or exceed the role of the capacity market. Yet that is exactly the implication of the approach supported by Mr. Bethel. The results of the application of the proposed allocation method, including the proposed use of the nameplate power factor, also demonstrate the unreasonable nature of the approach. The nameplate power factor is the power factor at the generator terminals and not the power factor actually provided to the transmission system and not the power factor required by PJM. Mr. Bethel proposes that PJM customers pay more for reactive power from the Fern Solar facility than the capacity market clearing price in PJM markets. This absurd result demonstrates the practical effect of applying the illogical and unsupported reactive allocation approach to the Fern Solar facility. The results are particularly disproportionate for inverter based resources like Fern Solar.

The basic math referenced repeatedly in the discussions of reactive allocators is straightforward. The basic math is presented in equation format and all in one place for purposes of clarification:

(1) $MVA^2 = MW^2 + MVAR^2$

(2) $1 = \frac{MW^2}{MVA^2} + \frac{MVAR^2}{MVA^2}$

(3) $\left(1 - \frac{MW^2}{MVA^2}\right) = \frac{MVAR^2}{MVA^2}$

(4) $PF = \frac{MW}{MVA}$

(5) $(1 - PF) = \frac{MVAR}{MVA}$

(6) $PF^2 = \frac{MW^2}{MVA^2}$

(7) $(1 - PF^2) = \frac{MVAR^2}{MVA^2}$

Defined terms:

MVA: Apparent power in megavolt amperes

MW: Real power in megawatts

MVAR: Reactive power in megavolt amperes reactive

PF: Power factor

Equation (1) is the referred to as the power triangle relationship. Equation (2) is equation (1) after both sides are divided by MVA^2. Equation (3) subtracts the term (MW^2/MVA^2) from both sides of equation (2). Equation (4) is the definition of the power factor (PF), MW divided by MVA. Equation (5) is (1 – PF), MVAR divided by MVA. Equation (6) is the PF squared, from equation (4). Equation (7) combines equation (3) and equation (6), showing that (1 – PF^2) equals $MVAR^2$ divided by MVA^2. Equation (7), using a nameplate PF value, is the allocation approach used by Mr. Pasternack and Mr. Bethel to assign generation costs to reactive.

In summary, the equations are based on the definition of the power triangle and the definition of the power factor. The rest is just rearranging terms following the rules of algebra. There is no relationship between the power triangle equation or the definition of the PF, and the costs of providing reactive power. These equations do not create or support such a relationship.

This set of equations is the basis for the reactive allocation approach used by Mr. Pasternack. The equations provide a bit more clarity to the relationships identified by Mr. Pasternack but do nothing to change the fact that there is no logical relationship among the three steps listed by Mr. Pasternack as the rationale for his use of (1 – PF^2) as the basis for allocating a significant share of the costs of generating units to reactive power. There is also no basis in these equations for the use of a nameplate PF which significantly increases the claimed allocation of costs to reactive.

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DECLARATION

JOSEPH E. BOWRING states that I prepared the testimony to which this declaration is attached with the assistance of the staff of Monitoring Analytics, LLC, and that the statements contained therein are true and correct to the best of my knowledge and belief. Monitoring Analytics, LLC, is acting in its capacity as the Independent Market Monitor for PJM.

Pursuant to Rule 2005(b)(3) (18 CFR § 385.2005(b)(3), citing 28 U.S.C. § 1746), I further state under penalty of perjury that the foregoing is true and correct.

Executed on November 29, 2022.

Joseph E. Bowring