Utilization of Default Values for VOM/O&M

And How Much is Eligible for Recovery in the Energy Cost-Based Offer

Categorization and uniformity of accounting amongst suppliers of line item plant charges into VOM vs O&M for inclusion into the cost-based energy offer present significant challenges. The purpose of this proposal is to greatly simplify how much O&M/VOM is eligible to be recovered via the energy market.

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Disclaimer:

*The views and proposal presented herein are not representative of the AEP regulated operating companies of Appalachian Power Company, Indiana Michigan Power Company, Kentucky Power Company, or Wheeling Power Company***.**

Summary

This proposal eliminates the need to classify resource costs as short-run marginal, fixed O&M, variable O&M, etc., all of which have differing definitions by the accounting groups amongst and within companies and eliminates a potential desire or need for line item level cost auditing for the determination of unit-specific costs. This proposal has no impact on how a capacity supplier authors their capacity offer in RPM, nor does it ensure any type of actual cost recovery.

Costs not related to capital expenditures should be eligible for recovery from both the RPM auction and/or from inclusion within the cost-based energy offer. This proposal will allow the market participant to be eligible to recover costs typically associated with fixed and variable operations and maintenance as newly formed combined value in both potential markets; but will not permit double recovery. The end-result is to assign a fraction of the combined non-capital related costs (i.e. fixed and variable O&M), after taking into account potential revenues from the unit's capacity clearing price, that are eligible for inclusion in the cost-based energy offer. This new up-to value is called Energy Operations & Maintenance, or EOM. However, if RPM revenues are sufficient, a resource may not recover any fixed or variable operation and maintenance cost within its cost-based energy offer.

To the extent the computational result of the up-to value for EOM is higher than a resource's actual costs, there are significant competitive marketplace pressures for the resource to offer its true EOM cost in its cost-based energy offer, allowing it to compete with other resources - ensuring an opportunity to make energy and ancillary service market revenues and to capture revenues to pay for missing money not provided by RPM. This is true for merchant resources, resources that are part of rate-based constructs, and for partial capacity obligations and energy-only resources.

In order to minimize the possibility of a resource significantly increasing its EOM if it becomes mitigated, the EOM component in the cost-based offer may only be modified twice within a Delivery Year.

Details

1) Units may be eligible to include non-capital related expenses, such as fixed and variable operations and maintenance, in their cost-based energy offer if RPM revenues are insufficient, or otherwise nonexistent to cover these costs.
2) Each unit can utilize a newly created Default OM value, representing typical fixed and variable operations and maintenance costs for their type of asset[1] in a formula, with the RPM clearing price and their RPM awarded quantity, to determine an up-to value of fixed and variable operations and maintenance expense that is eligible for potential recovery in their cost-based offer energy offer. This resultant value is the **E**nergy **O**perations & **M**aintenance component of the cost-based energy offer or **EOM**.
3) If the unit is a capacity resource, receiving capacity revenues, and the RPM clearing price (for the BRA or IA in which the resource received a capacity assignment) is sufficient to cover the unit's Default OM value, no EOM component may be included in the cost-based energy offer.
4) It would be reasonable to embed an adder within the Default OM value to recognize that RPM revenues must also be utilized to fund expected Capacity Performance penalties and necessary capital project costs.
    i. Example - if the Default OM value was $100.00/MW-day and the RPM clearing price were $100.00/MW-day, conceptually all RPM revenue would simply be covering fixed and variable operations and maintenance, with no revenue remaining to offset the risk of CP penalties and fund necessary capital improvement projects.
        - Perhaps a 15% or 20% adder should be embedded within the Default OM values.
5) In the event a resource believes the Default OM value for its resource class is insufficient and for seeking approval to utilize a replacement Default OM value within the EOM formula, a resource may submit an alternative expected capacity factor and historical operations and maintenance costs, one example being FERC Form documentation, within their supporting documentation for PJM approval.

    Example –A unit owner may contemplate utilizing a 5-year historic capacity factor and associated operations and maintenance costs. Why might this be necessary?

    - A load following supercritical coal unit may have higher fixed and variable operations and maintenance costs vs a baseload or non-load following supercritical coal unit because of metal fatigue, creep, etc.
    - Units that cycle have higher operations and maintenance expenses than units that do not cycle.
    - Since capacity factor is based on the actual electrical energy output over a course of time divided by the maximum possible electrical output over the same course of time, the actual capacity factor of a unit may be different than an industry average, with the resultant EOM value may be slightly

[1] U.S. Energy Information Administration data embedded in "Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants" may be one example of an appropriate resource for classes and default cost values

higher or lower than the EOM associated with a unit accepting the Default OM values.

The **formula** representing the up-to value of operations and maintenance expense that may be included in the resources cost-based energy offer, to be known as **EOM** is as follows:

$$EOM = \frac{\left[(Default\ OM - RPM\ Clearing\ Price) \times \frac{UCAP\ Capacity\ Awarded}{Total\ UCAP\ Offered}\right] + \left[(Default\ OM)\, x \frac{Energy\ Only\ Quantity}{Unit\ ICAP\ or\ MFO}\right]}{24\ hr}$$

Where:

EOM=an up-to value representing Energy Operations and Maintenance costs that are eligible for inclusion as a component within the cost-based energy offer. Considered to be $0.00/MW-H if the result is negative. ($/MW-H)

Default OM=default values representing the combined variable and fixed operations and maintenance costs for resource classes including a default adder, or alternatively unit-specific and PJM-approved value representing actual historical operations and maintenances cost including a default adder. ($/MW-Day)

RPM Clearing Price = the RPM clearing price and associated revenues the unit will receive. ($/MW-Day)

UCAP Capacity Awarded = the quantity of UCAP from the unit that will be utilized as a capacity resource. (MW)

Energy Only Quantity = the UCAP quantity from the resource that is not being utilized as a capacity resource. In the event the resource is a windfarm, solar, or other highly variable intermittent resource, the Maximum Facility Output (MFO) minus any awarded capacity converted to ICAP may be utilized as an appropriate value. (MW)

Unit ICAP or MFO= For a portion of, or entire resource not in a capacity plan or receiving capacity revenues, one of the following methods may be utilized, depending on technology type: The Installed Capacity Value (ICAP) value of the resource, or for a windfarm, solar, or other highly variable intermittent resource, the Maximum Facility Output (MFO). (MW)

Examples

Example 1:

A 100MW sub-critical, cycling, load-following resource has a PJM computed Default OM/VOM value of $210/MW-Day. The resource owner has elected to utilize this default value.

If the unit clears in its entirety and RPM clears at $65/MW-day, the EOM formula is as follows:

$$EOM = \frac{\left[\left(\frac{\$210}{MW-Day} - \frac{\$65}{MW-Day}\right) \times \frac{100\ MW}{100\ MW}\right] + \left[\left(\frac{\$210}{MW-Day}\right) x \frac{0\ MW}{100\ MW}\right]}{24\ hr}$$

The includable cost-base portion of the energy offer representing the resource's EOM cannot be greater than $6.04/MW-H

Example 2:

A 100 MW sub-critical, cycling, load-following resource has a PJM computed Default OM/VOM value of $210/MW-Day. The resource owner has elected to utilize this default value (has not submitted a higher value for approval).

If the unit is not awarded capacity and RPM clears at $65/MW-day, the resource EOM formula is as follows:

$$EOM = \frac{\left[\left(\frac{\$210}{MW-Day} - \frac{\$65}{MW-Day}\right) \times \frac{0\ MW}{100\ MW}\right] + \left[\left(\frac{\$210}{MW-Day} x \frac{100 MW}{100\ MW}\right]\right.}{24\ hr}$$

The includable cost-base portion of the energy offer representing the resource's EOM cannot be greater than $8.75/MW-H

Example 3:

A 500 MW gas-fired combined cycle load-following resource has a PJM computed Default OM/VOM value of $122/MW-Day. The resource owner has elected to utilize this default value (has not submitted a higher value for approval).

If the unit clears 400 MW of its 500MW UCAP value and RPM clears at $65/MW-day, the resource EOM formula is as follows:

$$EOM = \frac{\left[\left(\frac{\$122}{MW-Day} - \frac{\$65}{MW-Day}\right) \times \frac{400\ MW}{500\ MW}\right] + \left[\left(\frac{\$122}{MW-Day}\right) x \frac{100\ MW}{500\ MW}\right]}{24\ hr}$$

The includable cost-base portion of the energy offer representing the resource's EOM cannot be greater than $2.92/MW-H

Example 4:

A 500 MW gas-fired combined cycle load-following resource has a PJM computed Default OM/VOM value of $122/MW-Day. The resource owner has elected to utilize this default value (has not submitted a higher value for approval).

The entire 500 MW resource is committed as capacity and RPM clears at $125/MW-day, resource EOM formula is as follows:

$$EOM = \frac{\left[\left(\frac{\$122}{MW-Day} - \frac{\$125}{MW-Day}\right) \times \frac{500\ MW}{500\ MW}\right] + \left[\left(\frac{\$122}{MW-Day}\right) x \frac{0\ MW}{500\ MW}\right]}{24\ hr}$$

EOM is a negative value ($-.13/MW-H) and therefore should be considered $0.00/MWH, thus no EOM is eligible for inclusion into the cost-based energy offer.

Example 5:

A gas-fired combined cycle load-following resource has a PJM computed Default OM/VOM value of $122/MW-Day. The resource owner has received approval for utilizing a $150/MW-Day default value due that delivery year having a planned expected turbine overhaul or perhaps due to a larger expected capacity factor.

The entire 500 MW UCAP resource is committed as capacity at an RPM clearing price of $100/MW-day, resource EOM formula is as follows:

$$EOM = \frac{\left[\left(\frac{\$150}{MW-Day} - \frac{\$100}{MW-Day}\right) \times \frac{500\ MW}{500\ MW}\right] + \left[\left(\frac{\$150}{MW-Day}\right) x \frac{0\ MW}{500\ MW}\right]}{24\ hr}$$

The includable cost-base portion of the energy offer representing the resource's EOM cannot be greater than $2.08/MW-H

Example 6:

A 300 MW wind resource has a PJM computed Default OM/VOM value of $108.35/MW-Day. The resource owner has elected to utilize this default value (has not submitted a higher value for approval).

If the unit clears 45 MW UCAP of its 300 MW MFO value and RPM clears at $100/MW-day, the resource EOM formula is as follows:

$$EOM = \frac{\left[\left(\frac{\$108.35}{MW-Day} - \frac{\$100}{MW-Day}\right) \times \frac{45 MW}{45\ MW}\right] + \left[\left(\frac{\$108.35}{MW-Day}\right) x \frac{255\ MW}{300\ MW}\right]}{24\ hr}$$

The includable cost-base portion of the energy offer representing the resource's EOM cannot be greater than $4.19/MW-H. (this example utilizes a 0% EFORd)

From U.S. Energy Information Administration (EIA)

"Updated Capital Cost Estimates for Utility Scale Electricity for Utility Scale Electricity Generating Plants – April 2013"

(2013 data utilized in these examples because the available 2016 data no longer shows the cost of Advanced Pulverized Coal.)

TABLE 2-5 – TECHNOLOGY PERFORMANCE SPECIFICATIONS

Technology	Fuel	Nominal Capacity (kW) [1]	Nominal Heat Rate (Btu/kWh) [2]	Capital Cost ($/kW) [3]	Fixed O&M ($/kW-yr) [4]	Variable O&M ($/MWh) [5]	SO_2 (lb/MMBtu [6]	NO_X (lb/MMBtu)	CO_2 (lb/MMBtu)
Advanced Pulverized Coal	Coal	650,000	8,800	3,246	37.80	4.47	0.1 [7]	0.06	206 [7]
Advanced Pulverized Coal	Coal	1,300,000	8,800	2,934	31.18	4.47	0.1 [7]	0.06	206 [7]
Advanced Pulverized Coal with CCS	Coal	650,000	12,000	5,227	80.53	9.51	0.02 [10]	0.06	20.6 [9]
Advanced Pulverized Coal with CCS	Coal	1,300,000	12,000	4,724	66.43	9.51	0.02 [10]	0.06	20.6 [9]
NGCC	Gas	620,000	7,050	917	13.17	3.60	0.001	0.0075 [12]	117
AG-NGCC	Gas	400,000	6,430	1,023	15.37	3.27	0.001	0.0075 [12]	117
Advanced NGCC with CCS	Gas	340,000	7,525	2,095	31.79	6.78	0.001	0.0075 [12]	12 [9]
Conventional CT	Gas	85,000	10,850	973	7.34	15.45	0.001	0.03 [11]	117
Advanced CT	Gas	210,000	9,750	676	7.04	10.37	0.001	0.03 [11]	117
IGCC	Coal	600,000	8,700	4,400	62.25	7.22	0.025 [10]	0.0075 [12]	206 [7]
IGCC	Coal	1,200,000	8,700	3,784	51.39	7.22	0.025 [10]	0.0075 [12]	206 [7]
IGCC with CCS	Coal	520,000	10,700	6,599	72.83	8.45	0.015 [10][8]	0.0075 [12]	20.6 [9]
Advanced Nuclear	Uranium	2,234,000	N/A	5,530	93.28	2.14	0	0	0
Biomass Combined Cycle	Biomass	20,000	12,350	8,180	356.07	17.49	0	0.0075[12]	195
Biomass BFB	Biomass	50,000	13,500	4,114	105.63	5.26	0	0.08	195
Fuel Cells	Gas	10,000	9,500	7,108	0	43.00	0.00013	0.013	130
Geothermal – Dual Flash	Geothermal	50,000	N/A	6,243	132.00	0	0.2 [13]	0	120 [13]
Geothermal – Binary	Geothermal	50,000	N/A	4,362	100.00	0	0.2 [13]	0	120 [13]
MSW	MSW	50,000	18,000	8,312	392.82	8.75	0.07 [14]	0.27 [15]	200
Hydroelectric	Hydro	500,000	N/A	2,936	14.13	0	0	0	0
Pumped Storage	Hydro	250,000	N/A	5,288	18.00	0	0	0	0
Onshore Wind	Wind	100,000	N/A	2,213	39.55	0	0	0	0
Offshore Wind	Wind	400,000	N/A	6,230	74.00	0	0	0	0
Solar Thermal	Solar	100,000	N/A	5,067	67.26	0	0	0	0
Photovoltaic	Solar	20,000	N/A	4,183	27.75	0	0	0	0
Photovoltaic – Tracking	Solar	150,000	N/A	3,873	24.69	0	0	0	0
Photovoltaic – Tracking with 10% storage	Solar	150,000	N/A	4,054					
Photovoltaic – Tracking with 20% storage	Solar	150,000	N/A	4,236					

Footnotes are listed on the next page.

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Example computation for a **N**atural **G**as **C**ombined **C**ycle **C**alculation of Default O&M/VOM:

Fixed O&M=$13.17/kW-yr=$13.17/kW-yr x 1000kW/MW x yr/365 days = ~ $36/MW-day

Variable O&M=$3.60/MW-h=$3.60/MW-h x 24H/day=$86.40/MW-day

Default OM = $36/MW-day+$86.40/MW-day=~$122/MW-day[2]

[2] For these examples, the Default OM does not include an embedded adder.

Answers to Common Questions and Comments:

1. Isn't RPM supposed to cover fixed O&M?
    a. The goal of the capacity market was to provide "the missing money." For many assets even after receiving capacity revenues the money remains missing. The design and inclusion of wide varieties of suppliers eligible to offer into the capacity market have ensured a clearing price that is too low to recover fixed and variable O&M for many resources. For a supplier or load, RPM is about obtaining a revenue stream to help offset any cost –obtaining $40.00 is better than obtaining no dollars. This proposal takes into account the impact of RPM. <u>If RPM revenues are sufficient, no fixed or variable O&M may be included in the resource's cost-based energy offer.</u>
2. I disagree – RPM is the method to capture your fixed O&M and you should have included those costs in your offer.
    a. Unfortunately RPM clearing prices have shown otherwise, especially for the majority of the RTO. RPM is a good mechanism to attract gas resources, or to send a retirement signal to a resource already near the end of its life. It is not a mechanism to support the operational costs of other types or categories of assets.
        i. A coal resource is not competing for a capacity award against another coal resource; it is competing with gas, imports, speculative offers, and demand response – all of which have much lower, or no O&M costs.
        ii. A nuclear unit cannot compete against the O&M costs associated with gas, imports, speculative offers, and demand response without lowering its capacity offer.
        iii. The impact of a neighboring area (LDA) becoming constrained is not something that can hedged and greatly impacts the ability to recover fixed O&M via RPM. Unconstrained LDAs often have RPM prices that cannot even support the fixed O&M maintenance costs of the most economical assets.
3. Is an energy only resource (or resource that received no capacity award) allowed to recover fixed O&M?
    a. No. <u>You cannot currently recover fixed O&M if you are not a capacity resource</u>, further exasperating the desire of an entity to receive any amount of money from RPM to help offset costs. <u>This proposal resolves this current problem.</u>

4. If RPM is not high enough to recover costs, isn't that a signal to retire or mothball?
    a. In reality RPM only provides accelerated signals to retire if the resource is already within the last years of its expected operational life. The next misperception is related to mothballing an asset. It is only academically possible to lay off personnel and put a resource into mothball for a year in hopes of ample capacity revenues the following year. In the real world, people have families and costs - experienced staff will simply find jobs elsewhere.
    b. When the rest of market cleared at approx. $16/MW-day, all resources should have retired under this type of argument. Thankfully, this argument is not feasible.
5. Won't this raise energy prices?
    a. Not necessarily. Under this proposal we should <u>expect to see a decrease in the cost-based energy offer where RPM clearing prices are already sufficient to cover costs.</u> This proposal does not allow the opportunity to recover variable and fixed operations and maintenance costs within the energy offer for resources that receive sufficient RPM payments. In addition, it is logical that a resource not receiving sufficient RPM revenues are already attempting to recover these costs within their price-based energy offer. Since the amount of mitigation of resources is very small when compared to the entire marketplace, the impact of this change will likely be insignificant.
6. What about the other areas where the RPM clearing price is lower?
    a. It is true that in areas with low RPM clearing prices the component of maintenance costs within the cost-based energy offer will be eligible to rise to a rate that allows for a potential recovery of some costs. This is reasonable since the RPM market is not able to cover the costs of the asset and an asset should not be obligated to operate below its cost.
    b. It is also just and reasonable for units to be able to recover these types of costs if they have only received a partial, or no RPM award/revenues – something that cannot be accomplished today.
7. Defaults are a terrible idea – a generator will simply offer the default value in the energy market and costs will go up.
    a. The default value is utilized in the computation; for a capacity resource it does not represent the cost that can be included in the cost-based energy offer. Furthermore, PJM is a highly competitive marketplace, with a wide variety of resources competing to supply

energy. It is not an economically sound strategy to utilize a higher value than necessary since doing so will likely result in not receiving energy and ancillary service revenue, and not recovering any recoverable fixed and variable maintenance cost. Most generators are not mitigated to their cost-based energy offer, to which this proposal applies, so if they were going to simply increase costs, they already have the means of doing so in their price-based energy offers.

   b. This proposal provides no guarantee of cost recovery.

8. Have any other RTOs/ISOs utilized this method?
   a. We are not aware of this method being utilized in another market.
9. What about units that are frequently mitigated or fail the three pivotal supplier test, what is stopping them from simply offering the highest computed value in the cost-based offer?
   a. A resource will not be allowed to modify the operation & maintenance component of its cost-based energy offer more than twice a year. This should provide sufficient protection against this type of behavior, while still allowing a resource to modify its value IF they are being operated at an unanticipated capacity factor or have experienced unanticipated outages or increased maintenance.
      i. For a Frequently Mitigated Unit, PJM can request sufficient O&M and VOM information from the unit owner to ensure the cost-based energy offer utilizing this computation is reasonable.
10. Aren't we losing granularity by combining fixed and variable O&M?
   a. No. We are actually making the costs of operating assets easier to compare. By combining fixed and variable O&M, we ensure resources are not shifting costs from one category to another and we rid ourselves of accounting interpretations amongst companies, and sometimes within various levels of the same company. Anything that is not a capital expense is now accounted for within this new combined category.
11. Didn't FERC say that the energy costs should only have short-run marginal costs included?
   a. They may have. Unfortunately the FERC are not aware of all the complexities, and highly company specific determinations of what should or should not be included in the short-run determination of cost. It is reasonable to believe that if FERC receives a proposal that is just and reasonable, it would approve the proposal.
12. The default values for O&M and VOM from the EIA data are for new assets and an assumed capacity factor. My resource is mature and has a different capacity factor. How would this impact me?

a. As a resource owner, you may utilize the Default OM value as an input for the computation of an up-to value for the maintenance component (EOM) that could be included in the energy cost-based offer. If this value is too high, and to remain competitive you would utilize a lower actual value in your cost-based energy offer if it better reflects your current operations and maintenance costs. To the extent the Default OM values are not sufficient to reflect your combined O&M/VOM cost, you may submit additional cost detail to PJM for approval to utilize a replacement Default OM value within the EOM calculation.

13. How can we be assured that a traditional utility with resources participating in PJM that already receive cost recovery is not double-charging customers?
    a. This proposal creates no incremental opportunity for this to occur. <u>It will continue to be the responsibility of the utility and their state(s) to ensure rate-based consumers are not paying twice for costs.</u>
    b. It is reasonable for a utility to include EOM costs in their cost-based offer, especially when they may not receive RPM revenues and they have excess energy (beyond their customers' current utilization) for sale to PJM.