

## Variable Operations and Maintenance (VOM) Costs: Educational Document

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### Variable Operation & Maintenance Costs - Where we are today

Manual 15 does not specifically define Variable Operation & Maintenance (VOM) Costs, nor do any other PJM manuals. In a [Review of Generator Compensation and Cost Elements in the PJM Markets](#), PJM defined Variable Operating and Maintenance Adder as the adder covering “the cost of activities related to the variable operation and maintenance of the generator. These costs can occur over a significant number of years, and are generally divided by the hours of operation to derive a cost per hour of operation. Expenses in this category include items like:

- Air filter replacements
- Inspections and overhauls, including labor, parts, and rentals
- Water treatment expenses
- Catalyst replacements
- Major overhaul expenses

Such expenses are examined over a ten- or twenty-year cycle of operation, and then divided out among the hours of operation. While such expenses can be significant, the fact that they are spread out over such a long period means that they end up contributing a relatively small amount to the hourly cost.”<sup>1</sup>

Generators can include VOM in their cost based offers provided that they follow the guidelines in [Manual 15: Cost Development Guidelines](#). In 2009 the estimate of the average portion of real time LMP attributable to VOM was \$2.50 (6.4%)...<sup>2</sup> When unit type is considered, the most recent estimates for 2009 from the Independent Market Monitor are “Variable operation and maintenance (VOM) expenses were estimated to be \$7.09 per MWh for the CT plant, \$3.07 per MWh for the CC plant and \$2.97 per MWh for the CP plant....The VOM expenses for the CT and CC plants include accrual of anticipated, routine major overhaul expenses.”<sup>3</sup>

### References to PJM Documents

[Manual 15: Cost Development Guidelines](#) details the standards for determining cost components for markets where products or services are provided to PJM at cost-based rates, as referenced in Schedule 1, Section 6 of the PJM Operating Agreement. Generation Owners use Manual 15 to develop their cost based offers. Manual 15 provides detail instructions on how

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to calculate or use FERC accounts to determine VOM costs for various types of units when they are providing energy or ancillary services.

Combined Cycle and Combustion Turbine units can receive Long Term Service Contract Cost Recovery if they have a contract with a third party vendor to provide overhaul and maintenance work that have their long term maintenance costs included if they are consistent with Manual 15 and the dollar value of each component set in the contract.<sup>4</sup> Furthermore, Combustion Turbine and Combined Cycle Plant major inspection and overhaul expenses may be included in variable maintenance expenses if these costs are due to incremental degradation directly related to generation, starts or a combination of both. Also, long term maintenance expenses cannot be counted if they are included elsewhere in VOM.<sup>5</sup>

[Operating Agreement of PJM Interconnection \(OA\)](#) states that for generating units powered by machines, incremental maintenance cost and other incremental operating costs may be included in cost based offers<sup>6</sup> and the PJM [Open Access Transmission Tariff \(OATT\)](#) also allows for the above incremental cost components used by members on the interconnection to be defined in detail by the Board from time to time.<sup>7</sup>

The [OATT](#) and the [OA](#) also mention VOM in other ways:

1. "Black Start Unit O&M" must equal the annual variable O&M in M15.<sup>8</sup>
2. Cost Based Regulation offers can include a cost increase in variable operating and maintenance costs resulting from operating the unit at lower megawatt output.<sup>9</sup>
3. There is a specific VOM for providing Synchronized Reserve.<sup>10</sup>
4. Reliability Pricing Model Auction Clearing Requirements assumed variable operation and maintenance expenses for such resource of \$6.47 per MWh.<sup>11</sup>
5. Each Capacity Market Seller submitting a Sell Offer that is accepted in a Reliability Backstop Auction shall be paid the offer price in such Sell Offer ....net of the Variable Operations and Maintenance costs of such resource, as determined in accordance with the PJM Manuals.<sup>12</sup>
6. Development of Economic Transmission Enhancements and Expansions use variable O&M costs in the calculations to determine the economic benefits of accelerating or modifying planned reliability-based enhancements or expansions or of constructing additional economic based enhancements or expansions.<sup>13</sup>

### Other RTO practices regarding VOM

[Electric Reliability Council of Texas \(ERCOT\) Verifiable Cost Manual M14](#) states that "For purposes of calculating Mitigated Offer Caps, Variable O&M costs are limited to the incremental

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O&M costs a Resource incurs while operating above LSL (Low sustained Limit Output)... Emission costs may be included as an additional component of the Variable O&M cost.” It also states “Operating costs are the non-fuel costs incurred while a Resource is operated, whether incurred during startup or at different output levels. These costs may include, for example, labor costs, the cost of consumables and non-durable goods, costs related to emissions, water costs, etc.” Appendix 4 lists permissible operating & maintenance cost categories by unit type...<sup>14</sup>

[Independent Electricity System Operator \(IESO\) Presentation on Day Ahead Guaranteed Costs](#) provides a definition and examples of Variable Operations & Maintenance Costs. However, IESO does not provide a specific list of categories to include. Variable O&M is defined as “A variable charge which is applied to recover the incremental maintenance and operation costs associated with running a generating unit. It excludes O&M costs which are independent of unit operation.” These costs can include incremental maintenance and operations costs associated with startup or ongoing production, costs not covered by fuel or maintenance cost, and other variable costs not captured above. It also states “Avoidable or incremental charges allowed do not include amounts associated with sunk costs for existing plant or equipment, even if incurred on an incremental basis, or incremental charges related to profit.”<sup>15</sup>

[California Energy Commission Report on Comparative Costs of California Central Station Electricity Generation](#) provides a summary of the fixed and variable costs components included in Levelized Costs in generalized lists. Fixed Costs should include Capital & Financing of construction, Insurance, Property Taxes, Fixed O&M (Staffing and other costs that are independent of operating hours), and Corporate Taxes. Variable Cost include cost of Fuel and Operations & Maintenance costs that are a function of operating hours, such as scheduled outage maintenance (including annual maintenance and overhauls), forced outage maintenance, consumables (non-fuel products), water supply, and environmental equipment maintenance.<sup>16</sup>

### Other Areas where VOM is Included

Start Cost for generating units can also include incremental costs such as labor and maintenance. “Start Cost - The dollars per start as determined from start fuel, total fuel-related cost, performance factor, electrical costs, start maintenance adder, and additional labor cost, if required above normal station manning levels.”<sup>17</sup>

Synchronous Reserve cost can include variable operating & maintenance costs. “Companies that request and receive reimbursement from PJM for the costs associated with operating a



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generating unit in the condensing mode or for altering the output of a generator at the request of PJM in order to provide Synchronized Reserves must maintain records to document how those costs were calculated.” These records shall be made available to PJM upon request.<sup>18</sup>

Unit(s) providing regulation service can include variable operating & maintenance components in their cost calculations with the following limitations:

“The cost increase (in \$/MWh of Regulation) of variable operations and maintenance (VOM) cost resulting from operating the unit at lower MW output incurred from the provision of Regulation. VOM costs shall be calculated by the following methods and shall not exceed those levels below: For non-hydro units that have been providing Regulation service for less than 10 years, or all hydro units regardless of the historical years of Regulation service, the following variable operation and maintenance (VOM) costs can be applied by unit type up to the following:

Super-critical Steam:	\$10.00 per MWh of Regulation
Sub-critical Steam:	\$3.50 per MWh of Regulation
Combined Cycle:	\$2.50 per MWh of Regulation
Combustion Turbine:	\$2.00 per MWh of Regulation
Hydro:	\$1.00 per MWh of Regulation...” <sup>19</sup>

### VOM & ACR: effects in RPM

Avoidable expenses are incremental expenses directly required to operate a Generation Capacity Resource that a Generation Owner would not incur if such generating unit did not operate in the Delivery Year or meet Availability criteria during Peak-Hour Periods during the Delivery Year. For the purpose of determining an Avoidable Cost Rate, avoidable expenses shall exclude variable costs recoverable under cost-based offers to sell energy from operating capacity on the PJM Interchange Energy Market under the Operating Agreement.<sup>20</sup>

### VOM and FERC Code of Accounts

The *FERC System of Accounts* was created when a predominant amount of the nation’s electrical generating resources were part of a vertically integrated regulated utility. Although many of those resources are now owned by merchant generators or Independent Power Producers the descriptions of the accounts are still useful in understanding the initial concepts

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that were being enacted at the time. These accounts include the cost of labor, materials used, and expenses incurred in the maintenance of steam plant, electric plant, reactor plant, reservoirs, dams and waterways. Essentially, FERC account 512, 513, 553, 530, 545 and 531 do not shed light on the components of maintenance, they simply state “This account shall include the cost of labor, materials used and expenses incurred in the maintenance...”.

### FERC Cost of Service Manual

Fixed costs are costs that do not vary with the level of output of a generation unit. “Fixed costs are costs which remain constant regardless of the volume of throughput...”<sup>21</sup>

Variable costs are those which are correlated with the level of output. “Variable costs are costs which vary with the volume of throughput.”<sup>22</sup>

### Summary

In general, additional guidance in Manual M15 should be provided to clearly define what incremental operations and maintenance cost for each type of unit should be included in the calculation of VOM.

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<sup>1</sup> PJM A Review of Generation Compensation and Cost Elements in the PJM Markets

<sup>2</sup> SOM 2009 Energy Market Part 2 Table 2-64 page 74.

<sup>3</sup> SOM 2009 page 148

<sup>4</sup> Cite Manual 15 section and page

<sup>5</sup> Manual 15 Cite section, page

<sup>6</sup> “Each Market Participant obligated to sell energy on the PJM Interchange Energy Market at cost-based rates may include the following components or their equivalent in the determination of costs for energy supplied to or from the PJM Region:

For generating units powered by boilers

Firing-up cost

Peak-prepared-for maintenance cost

For generating units powered by machines

Starting cost from cold to synchronized operation

For all generating units

Incremental fuel cost

Incremental maintenance cost

No-load cost during period of operation

Incremental labor cost

Other incremental operating costs”

<sup>7</sup> “The PJM Board, upon consideration of the advice and recommendations of the Members Committee, shall from time to time define in detail the method of determining the costs entering into the said

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components, and the Members shall adhere to such definitions in the preparation of incremental costs used on the Interconnection.”<sup>7</sup>

<sup>8</sup> OATT Schedule 6A P511

<sup>9</sup> OATT P847

<sup>10</sup> OATT P847

<sup>11</sup> OATT P1534

<sup>12</sup> OATT P1592

<sup>13</sup> OA P420

<sup>14</sup> [http://www.ercot.com/content/wcm/attachments/training\\_courses/71/COMS\\_Verifiable\\_Cost\\_Manual\\_v0.14.doc](http://www.ercot.com/content/wcm/attachments/training_courses/71/COMS_Verifiable_Cost_Manual_v0.14.doc)

<sup>15</sup> [http://www.ieso.ca/imoweb/pubs/consult/se16/se16\\_DACP-OWG-20060222-DACP-costs.pdf](http://www.ieso.ca/imoweb/pubs/consult/se16/se16_DACP-OWG-20060222-DACP-costs.pdf)

<sup>16</sup> <http://www.energy.ca.gov/2009publications/CEC-200-2009-017/CEC-200-2009-017-SD.PDF>

<sup>17</sup> M15 P32 section 6.1.2

<sup>18</sup> M15 P37 Section 7.1.2

<sup>19</sup> M15 P55 section 9.2

<sup>20</sup> OATT P1571

<sup>21</sup> <http://www.ferc.gov/industries/gas/gen-info/cost-of-service-manual.doc>

<sup>22</sup> <http://www.ferc.gov/industries/gas/gen-info/cost-of-service-manual.doc>