PJM Manual 15:

Cost Development Guidelines

Revision:

Effective Date:

Prepared by

Cost Development Subcommittee

How to Use this Manual

To use this Manual, read sections one and two then go to the chapter for unit type for possible additional information.

Section 3: Nuclear Unit Cost Guidelines

Section 4: Fossil Steam Unit Cost Development

Section 5: Combined Cycle (CC) Cost Development

Section 6: Combustion Turbine (CT) and Diesel Engine Costs

Section 7: Hydro

Section 8: Demand Side Response (DSR)

Section 9: Wind Units

Attachment A: Applicable FERC System of Accounts

Section 7: Hydro

This section contains information for the development of Hydro or Hydro Pumped Storage cost offers.

Hydro Units – Generating unit in which the energy of flowing water drives the turbine generator to produce electricity. This classification includes pumped and run-of-river hydro.

Pumped Hydro Unit – Hydroelectric power generation that stores energy in the form of water by pumping from a lower elevation source to a higher elevation reservoir, then allowing the upper reservoir to drain turning the turbines to produce power.

7.1 Pumping Efficiency (Pumped Hydro Only)

Pumping Efficiency is the Pumped Hydro Unit's version of a heat rate. It measures the ratio of generation produced to the amount of generation used as fuel.

Pumping Efficiency (PE) is calculated by dividing the MWh of generation produced while operating in generation mode by the MWh required to pump the water needed to produce the generation MWh.

$$\text{Pumping Efficiency} = \frac{\text{MWh Generation Produced}}{\text{MWh Generation Pumped as Fuel}}$$

For example, it requires 1,000 ft^3 to produce one MWh of generation as water flows from the pond to the sink and it requires two MWh of pumping load to pump 1,000 ft^3 of water from the sink to the pond. The resultant efficiency is:

$$\text{Pumping Efficiency} = \frac{\text{MWh Generation Produced}}{\text{MWh Generation Pumped as Fuel}} = \frac{\text{3.5 MWh (Generated)}}{\text{5 MWh (Pumped)}} = 0.70$$

In order to account for environmental and physical factors associated with the characteristics of the pond and pumping operations that limit the accuracy of calculating short term pumping efficiency, a seven day rolling total of pumping and generation MWh are utilized for pumping efficiency calculations.

PE can be calculated by one of three methods. An owner must make the choice of method by December 31 prior to the year of operation and cannot change to another method for a period of one calendar year.

- Option 1: Twelve month calendar actual Pumping Efficiency.
  - The previous 12-month calendar year average Pumping Efficiency based on actual pumping operations.

- Option 2: Three month rolling Pumping Efficiency.
  - The previous three months rolling actual efficiency where the average monthly availability is 50% or greater. The calculation must be updated after each month.
- Option 3: The previous month actual Pumping Efficiency.
  - The previous month actual efficiency where the availability is 50% or greater. The calculation must be updated monthly.

7.2 Performance Factors

> **Note:** The information in Section 2.2 contains basic Performance Factor information relevant for all unit types. The following additional information only pertains to hydro units.

7.3 Fuel Cost

To be consistent with other PJM units within this manual the term fuel cost is used to account for the energy necessary to pump from the lower reservoir to the upper reservoir. The fuel costs for a Run-of-River Hydro Unit are equal to zero.

> **Note:** The information in Section 2.3 contains basic Fuel Cost information relevant for all unit types. The following additional information only pertains to pumped hydro units.

If, a Unit Owner wishes to change its method of calculation of pumped storage TFRC, the PJM Member shall notify the PJM MMU in writing by December 31 prior to the year of operation, to be evaluated pursuant to the Cost and Methodology Approval Process before the beginning of the cycle in which the new method is to become effective. The new cycle starts on February 1st and continues for a period of one year

Basic Pumped Storage Fuel Cost – Pumped storage fuel cost shall be calculated on a seven (7) day rolling basis by multiplying the real time bus LMP at the plant node by the actual power consumed when pumping divided by the pumping efficiency. The pumping efficiency is determined annually based on actual pumping operations or by Original Equipment Manufacturer (OEM) curves if annual data is not available due to the immaturity of the unit. The following equations govern pumping storage fuel cost:

$$\text{Pumping Power Cost } (\$/\text{MWh}) = \text{ Real Time LMP } (\$/\text{MWh}) * \text{ Pumping Power } (\text{MWh})$$

$$\text{Pumped Storage Fuel Cost } (\$/\text{MWh}) = \frac{\text{Pumping Power Cost } (\$/\text{MWh})}{\text{Pumping Efficiency}}$$

7.3.1 Total Energy Input Related Costs for Pumped Storage Hydro Plant Generation

Total energy input-related costs for all pumped storage hydro units shall be defined as follows:

$$\text{Pumped Storage Hydro Total Energy Input Related Cost} = \text{Basic Pumped Storage Energy Input Cost} + \text{Maintenance Cost}$$

7.4 Start Cost

See 7.7 Condensing Start Costs.

7.5 No Load

Hydro Units have do not have No Load costs.

7.6 Maintenance

> **Note:** The information in Section 2.6 contains basic Maintenance Cost information relevant for all unit types. The following additional information only pertains to hydro units.

This account shall include the cost of labor, materials used and expenses incurred in the maintenance of plant, includible in Account 332, Reservoirs, Dams, and Waterways. (See operating expense instruction 2.) However, the cost of labor materials used and expenses incurred in the maintenance of fish and wildlife, and recreation facilities, the book cost of which is includible in Account 332, Reservoirs, Dams, and Waterways, shall be charged to Account 545, Maintenance of Miscellaneous Hydraulic Plant.

7.7 Synchronized Reserve: Hydro Unit Costs to Condense

> **Note:** The information in Section 2.7 contains basic Synchronized Reserve Cost information relevant for all unit types. The following additional information only pertains to hydro units if applicable.

Some Hydro units have the ability to purge the turbines of water and run backwards effectively creating a capacitor. This method of operation of the machine is referred to as operating the Hydro unit in synchronous condensing mode.

Total synchronous condensing costs for Hydro units shall include the following components:

$$\text{Hydro Costs to Condense } (\$/\text{MWh}) =$$
$$\text{Condensing Start Costs} + \left(\frac{\text{VOM}}{\text{Synchronized Reserve MW}}\right) + \text{Margin}$$

Condensing Start costs if applicable, start costs shall be applied when a unit moves from cold to condensing operations and when a unit moves from condensing operations to energy generation, but shall not be applied when a unit moves from energy generation to condensing operations.

In addition (+) identified **variable Operating and Maintenance** cost in $/Hr. divided by the Synchronized MW provided. These costs shall be totaled over the Maintenance Period and divided by total MWh generated over the maintenance period. These variable Operating and Maintenance costs shall include:

- Maintenance of Electric Plant as derived from FERC Account 544
- Maintenance of Reservoirs as derived from FERC Account 543

In addition (+) **margin** up to $7.50 per MW of Synchronized Reserve service provided.

Total hydro condensing offers must be expressed in dollars per hour per MW of Synchronized Reserve ($/MWh) and must specify the total MW of Synchronized Reserve offered.

7.8 Regulation Cost

Note: The information in Section 2.8 contains basic Regulation Cost information relevant for all unit types.

Section 9: Wind Units

-This section contains information for the development of Wind unit cost offers.

Wind Units – Generating unit in which the energy of blowing wind drives the turbine generator to produce electricity.

9.1 Heat Rates

Wind units do not burn fuel so heat rates are not applicable.

9.2 Performance Factors

> **Note:** The information in Section 2.2 contains basic Performance Factor information relevant for all unit types. The following additional information only pertains to Wind units.

Wind units do not burn fuel so Performance Factors are equal to 1.0.

9.3 Fuel Cost

> **Note:** The information in Section 2.3 contains basic Fuel Cost information relevant for all unit types. The following additional information only pertains to wind units.

Wind units fuel costs are equal to zero.

9.4 Start Cost

> **Note:** The information in Section 2.3 contains basic Start Cost information relevant for all unit types. The following additional information only pertains to wind units.

Wind units Start Fuel and Total Fuel related Costs are equal to zero.

9.5 No Load

Wind Units do not have No Load costs.

9.6 Maintenance

> **Note:** The information in Section 2.6 contains basic Maintenance Cost information relevant for all unit types. The following additional information only pertains to wind units.

9.7 Synchronized Reserve: Wind Unit Costs to Condense

Note: The information in Section 2.7 contains basic Synchronized Reserve Cost information relevant for all unit types. The following additional information only pertains to wind units if applicable.

Some Wind units have the ability to disconnect the generator from the rotor via a clutch and run in synchronous condensing mode.

Total synchronous condensing costs for Wind units shall include the following components:

$$\text{Wind Costs to Condense (\$/MWh)} =$$
$$\text{Condensing Start Costs} + \left(\frac{\text{VOM}}{\text{Synchronized Reserve MW}}\right) + \text{Margin}$$

Condensing Start costs if applicable, start costs shall be applied when a unit moves from cold to condensing operations and when a unit moves from condensing operations to energy generation, but shall not be applied when a unit moves from energy generation to condensing operations.

In addition (+) identified **variable Operating and Maintenance** cost in $/Hr. divided by the Synchronized MW provided. These costs shall be totaled over the Maintenance Period and divided by total MWh generated over the maintenance period.

In addition (+) **margin** up to $7.50 per MW of Synchronized Reserve service provided.

Total wind condensing offers must be expressed in dollars per hour per MW of Synchronized Reserve ($/MWh) and must specify the total MW of Synchronized Reserve offered.

9.8 Regulation Cost

Note: The information in Section 2.8 contains basic Regulation Cost information relevant for all unit types.