Resource Shaping (pre rate period) – Flat annual to Flat Diurnal
&
Resource Support Services – Variable Diurnal to Flat Diurnal

Introduction

The objective of this paper is to design a Resource Support Service (RSS) (referred to as non-transmission integration services in the Regional Dialogue Policy) that meets BPA's goal of (1) assigning costs to those that cause them, (2) isolate Tier 1 resources from Tier 2 costs, and (3) support BPA's Tier 2 resources at a market price that makes them competitive.

This paper includes a brief summary of the Wind Integration Action Plan and how it relates to our proposed RSS.

This paper identifies both "source capacity" costs and "sink capacity" costs components of this support service. The source capacity is that capacity needed to insure firm flat diurnal delivery of power, the sink capacity is needed to absorb, store and return energy that is generated above flat diurnal power.

Two methods are outlined below that develop charges that recover these two types of costs. Although this paper focuses on wind and natural gas powered generation, the methodologies are designed to be consistent for all resource types.

RSS, as presented in this paper, is an energy neutral service. This paper also identifies three possible methods for accounting for energy when a resource either over or under performs.

Wind Integration Action Plan

The Wind Integration Action Plan (WIAP) primarily addresses within-hour costs and hour to hour ramping costs, not the cost of providing a service that flattens a resources variable output within the 24 diurnal periods of the year. We believe Power's cost to support wind and reshape it to the equivalent flat annual block product would be additive to those costs identified in the WIAP.

Below are the *preliminary* wind integration costs from the BPA study of wind generation at various levels of wind penetration ($/MWh of wind generation).

		Wind Penetration Level			
	Peak Area Load (MW)	5%	10%	20%	30%
BPA (Within-Hour Impacts Only)	9,090	$1.90	$2.40	$3.70	$4.60

There are two key conclusions found in the WIAP that help ground the RSS analysis: 1) The cost of wind integration starts low, particularly when integrating with a hydropower system that has substantial flexibility, and then rises as increased amounts of wind are added. Ultimately, costs plateau at the cost of integrating wind with natural gas power plants; 2) Wind energy is providing

value to Northwest electricity consumers, but the Northwest will still need other resources to meet peak loads.

Additional Information:
Idaho Power

Idaho Power recently released a study that evaluated the cost of integrating wind into their system. Idaho Power's study was a cost based study and has a cap on the amount of wind that could be integrated at the study's identified price. The results of the study indicate that Idaho Power sustains an increased cost by using the company's hydro system as the backup for the integration of wind generation. To offset a portion of these additional costs, the company proposes to pay wind developers roughly $7 per megawatt-hour (MWh) less than the current average market rate of approximately $64 per MWh (Idaho Power's avoided cost for these PURPA resources) for projects coming on line in 2008. The company cautioned that the integration process was dynamic and that integration analysis would be ongoing. As more wind is integrated, Idaho Power will update the study and file new relevant cost information. Idaho Power used their planning model to compare the operation and financial impacts of a benchmark flat resource to that of an equal sized variable wind resource. Unlike our analysis, which does not include within-hour costs, Idaho Power's integration rate includes within-hour operation and financial impacts.

Future Resource Smoothing Technologies

Other intermittent resource smoothing technologies could also be used to price RSS in the future. A R&D project being done for BPA, *Wide-Area Energy Storage and Management System to Balance Intermittent Resources in the Bonneville Power Administration and California ISO Control Areas,* identified several generic categories: flywheels; superconductive magnetic energy storage (SMES); pumped hydro-storage; compressed air energy storage (CAES); super capacitors, several electrochemical battery types, and demand-side control.

The R&D project selection process resulted in the selection of flywheels, pumped hydro-power (or conventional hydro power plant) and lead-acid (or nickel cadmium) batteries for detailed evaluation in the following stage of the study. Each of the latter technologies has been commercialized and has generated a record of operational experience that minimizes the risk of scaled–up application. As these technologies improve or become more competitive in the market, we will revaluate the cost of RSS.

Regional Dialogue Policy

BPA may make the policy decision to offer the same services used to integrate federal Tier 2 resources to customers who purchase under the Priority Firm rate schedule and need to integrate their non-federal resource dedicated to serve load above High Water Mark (HWM). BPA may choose to offer this service to existing resources as well. The rest of this paper identifies the costs involved with providing the service of shaping and integrating a non-flat resource into an

equivalent flat annual resource because BPA is leaning toward benchmarking all Tier 2 resources off a flat annual block.

Transmission Requirements

If this service is offered to resources located outside of BPA's control area, the utility purchasing the RSS will be responsible for securing transmission to BPA's service territory. RSS does not protect a customer from the loss of transmission to BPA's service territory. The problems of congestion management within BPA's service territory for Tier 2 resources have been identified but remain unsolved.

Eligibility

RSS is available to resources dedicated to serve preference loads consistent with the applicable 5(b)/9(c) policy. The resource must be metered and the data made available to BPA. Additional considerations will need to be made for resources that are located outside of BPA's control area (e.g. Transfer Customers). It is also possible that this service will only be offered to renewable resources and that BPA will require a scheduling service be purchased from BPA.

Capacity Credit

Unlike today, customers purchasing RSS will receive a capacity credit equal to the average forecast energy produced by the variable portion of the resource. The customer will pay the full RSS cost, but will not be required to pay a second time on the load side for that capacity purchased through the RSS.

Levels of Service

Under a tiered rate design, we have identified five levels of Tier 2 service.

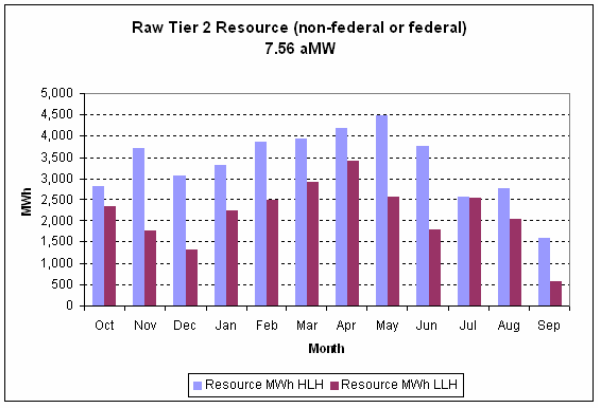
- **Level 1** – Customer needs service above HWM and decides to self-serve their Tier 2 and provides it in a flat annual block. PF power purchased is Tier 1. No resource charges will apply to this customer, but customer inherently accepts their own Shaping and Resource Support Services. UAI will apply to any variations from flat annual.

- **Level 2** – Customer needs service above HWM and decides to self-serve their Tier 2, but provides it in a shape that is flat within the diurnal periods but not flat across the month (consistent with the rules about allowable shapes). The customer guarantees this forecast shape. BPA will evaluate shape against market and PF posted rates prior to the beginning of the rate period and might assign a charge depending on Tier 1 rate design. Only PF power purchased is Tier 1. Customer will provide their own Resource Support Services. UAI will apply to any variations from their forecast resource shape.

BPA Rate Case

Forecast Ouput of Non-Federal Resource Revealed (Graph x2 to match 2-year Rate Period)

PF Prices Set and Published - Within-Year Shaping Charge Determined



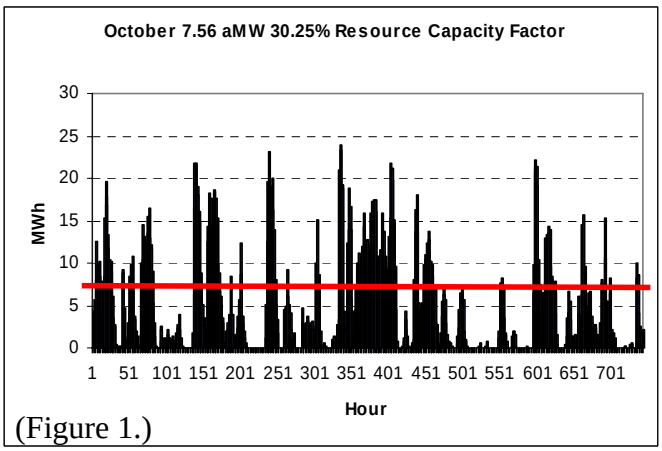
This charge will be zero under some Tier 1 rate designs.
Requirements: The resource shape is defined prior to publish of the PF Price and the resource shape must be consistent with shape restrictions.

- **Level 3** – Customer purchases a variable output resource (consistent with the rules about allowable shapes) and wants BPA to guarantee that their resource is sufficient to meet the benchmark requirement (flat annual). In addition to the shaping charges in Level 2 (which addresses flat annual to flat diurnal), the customer would purchase Resource Support Services (RSS) from BPA such that their variable resource is comparable to a flat diurnal block. BPA can store energy (sink capacity) when the resource is producing more than its forecast annual average energy and deliver energy (source capacity) when the resource is producing less than its forecast annual average energy. The RSS will be posted under the PF rate schedule and updated with each rate case. In addition to PF Power purchased, customer will purchase RSS.

Two costs of providing this RSS have been identified.

Cost #1 is a source capacity charge and is defined as the forecast average annual output of this resource minus the forecast operational minimum (Figure 1 and Figure 2). BPA must reserve or build capacity equal to the average amount of energy produced by the resource and the resource's lowest hour of expected generation. BPA reserves capacity at the forecast average annual output of this resource minus the forecast operational minimum. This reserved capacity will be charged at a rate equivalent to the fixed capital costs of the marginal capacity resource (~$8.50/kW-month).

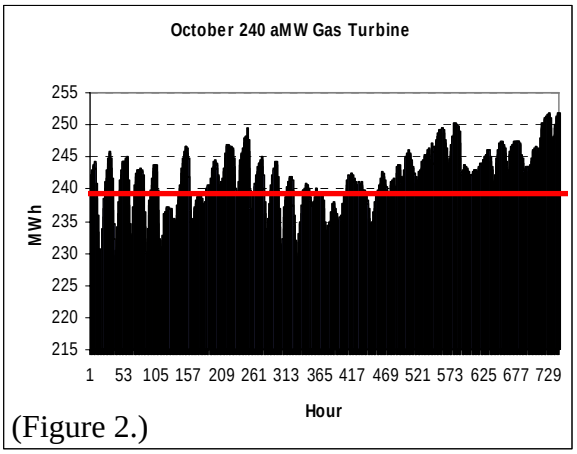
Historic October Resource



Cost #1

(Figure 1.)

Historic October Resource



Cost #1

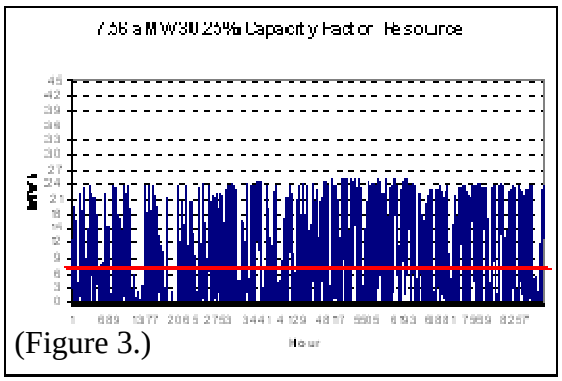
(Figure 2.)

Cost #2 is a Sink Charge. Two different capacity factor wind resources are shown in Figure 3 and Figure 4. Figure 3 shows a 7.56 aMW wind resource with a 30% capacity factor. Figure 4 shows a 7.56 aMW wind resource with a 21% capacity factor. BPA must also be able to absorb the highest hour of expected generation (Sink Capacity).

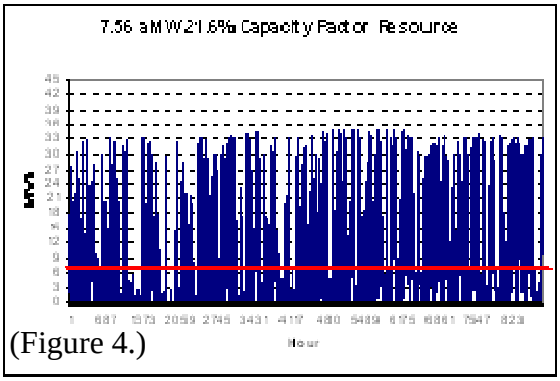
Reasons why this is a cost:

1. Absent these resources, operations would set a different optimum point for maximizing the benefits of the FBS. But with new resources that are less flexible than the hydro system, a new optimum point for operations of the FBS will generate fewer benefits than the original optimum point (e.g. more LLH generation, less HLH generation).
2. BPA runs the risk that existing resources cannot absorb the added energy (spill). This may be a small occurrence now, but with large amounts of wind generation, and low capacity factors, the probability of this occurring will increase. In addition, new fish operations could help or hinder this problem.
3. Absent some related sink charge, the two resources illustrated below (Figure 3 and 4) would pay the same support charge. If these two utilities paid the same support charge, BPA would effectively be saying it is indifferent between these two resources.
4. Not only will generation above the average annual output displace the generating utility's PF load, it can displace other PF load.

Cost #2



(Figure 3.)



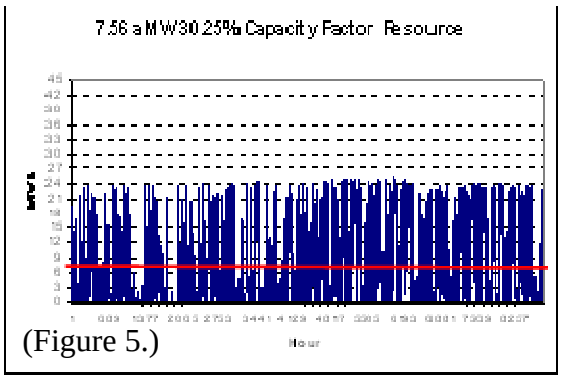
(Figure 4.)

Cost #2

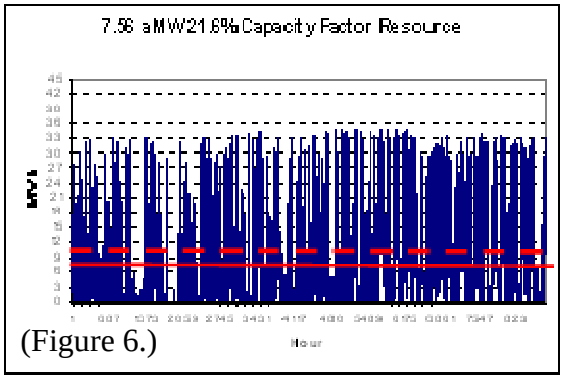
The following is an exploration of two possible methods BPA could use to capture both cost #1 and cost #2.

Method 1 for pricing RSS: ***Source Capacity at benchmark average Capacity Factor/ Sink Capacity at lost efficiency of pump storage***

This method would benchmark the source capacity costs off that of a "standard" similar technology plant, essentially using a portfolio approach for pricing resources. For this wind example, we used the 30% Capacity Factor resource would be the benchmark applied to all other wind farms. A different benchmark would be developed for each resource type.



(Figure 5.)

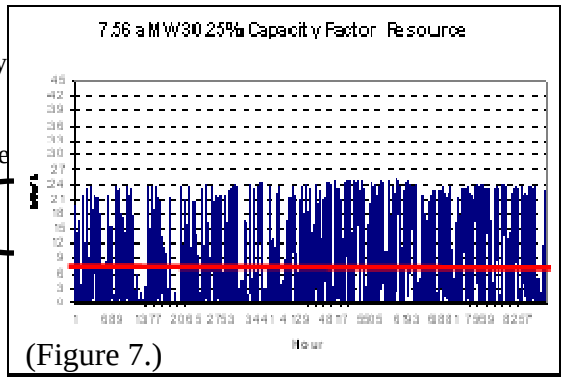


(Figure 6.)

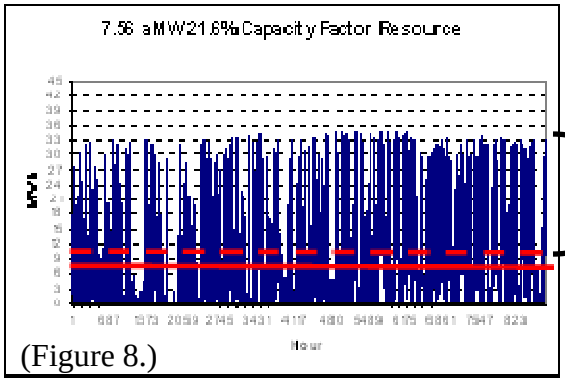
Capacity purchased to dashed line to equal 30% benchmark

Method one uses lost efficiency from pump storage to calculate the Sink Capacity cost on intermittent resources. We used a 25% loss of efficiency from pumping water and storing it for later generation. The total amount of energy above the capacity purchased was calculated and charged 25% of the average annual market price. The 30% wind farm has 3.63 aMW above the red line; the 21% wind farm has 2.76 aMW above the dotted red line.

25% efficiency lost for pump and storage applied to these MWh



(Figure 7.)



(Figure 8.)

25% efficiency lost for pump storage applied to these MWh

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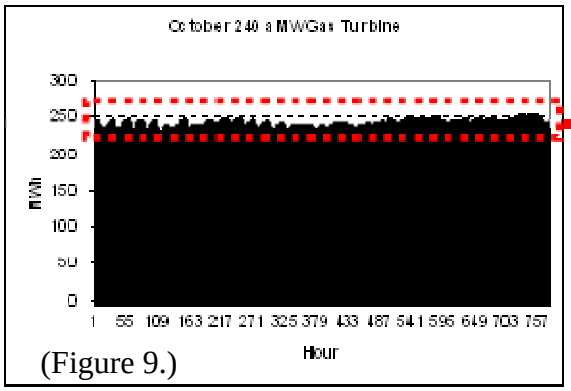
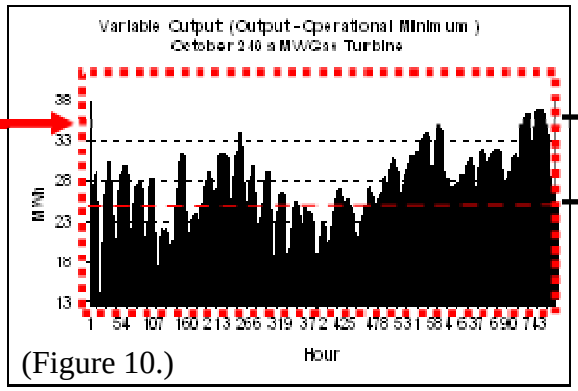
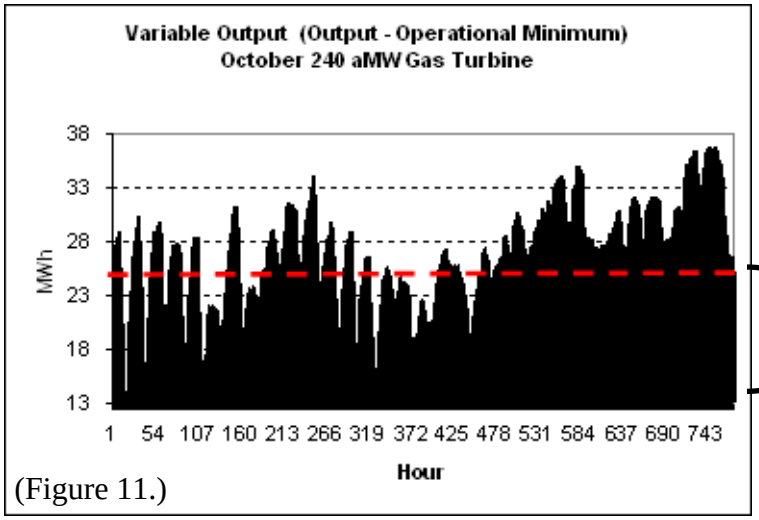


(Figure 9.)



(Figure 10.)

25% efficiency lost for pump storage applied to these MWh



(Figure 11.)

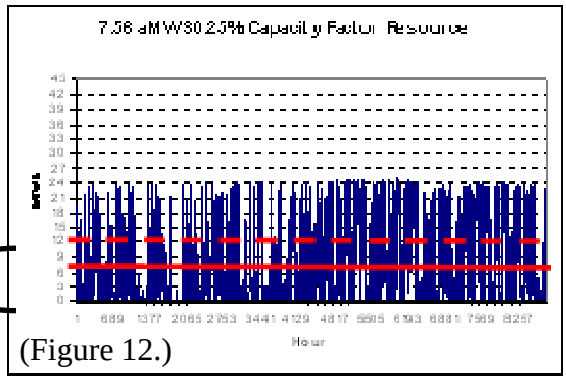
This method would also be applied to other resource types, such as a 240 aMW gas turbine with an operational capacity factor of 93%.

Because the utility has purchased RSS, the utility's demand billing determinant will be reduced by this firm capacity amount. In method one, both wind farms would see the 7.56 MW of capacity purchased through the RSS deducted from their demand billing determinant.

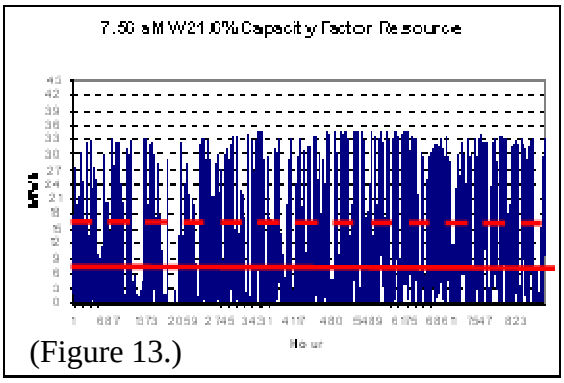
Method 2 for pricing RSS: ***Source Capacity at maximum generation minus minimum generation divided by two / Sink Capacity at lost efficiency of pump storage***

This method would benchmark the source capacity factor at one half of the difference between maximum and minimum operational capability. This benchmark would be the same for all generation types. This benchmark was picked because it made a good approximation for the average output of a gas turbine. This method implies a symmetrical resource that has a Sink Capacity equal to its Source Capacity.

Source Capacity Charge



(Figure 12.)

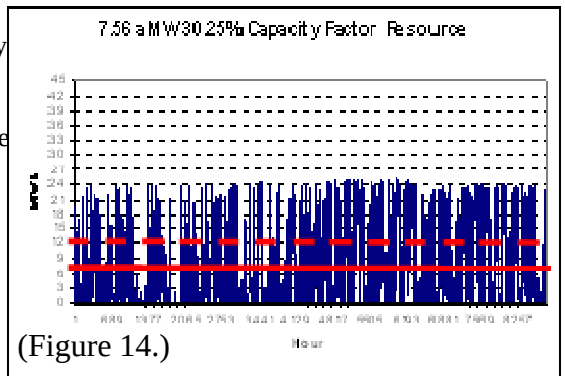


(Figure 13.)

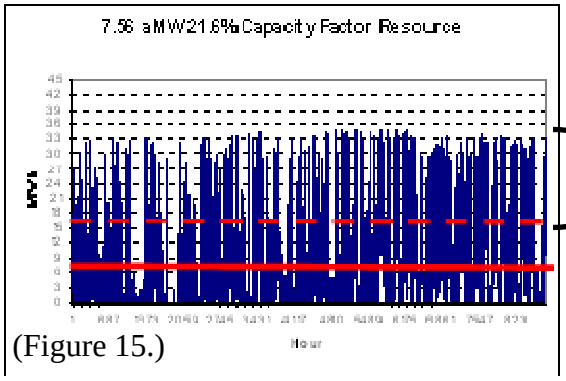
Source Capacity Charge

Similar to Method one, Method two uses lost efficiency from pump storage to calculate the Sink Capacity cost on intermittent resources. We used a 25% loss of efficiency from pumping water and storing it for later generation. The total amount of energy above the capacity purchased was calculated and charged 25% of the average annual market price. The 30% wind farm has 1.38 aMW above the dotted red line; the 21% wind farm has 1.96 aMW above the dotted red line. We applied this charge to the amount of MWhs above the purchased Source Capacity (Figures 14 & 15).

25% efficiency lost for pump and storage applied to these MWh



(Figure 14.)



(Figure 15.)

25% efficiency lost for pump and storage applied to these MWh

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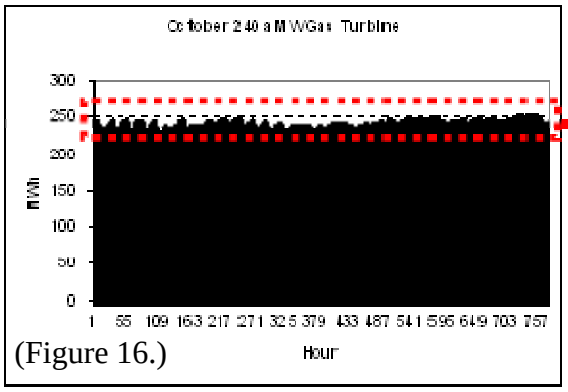
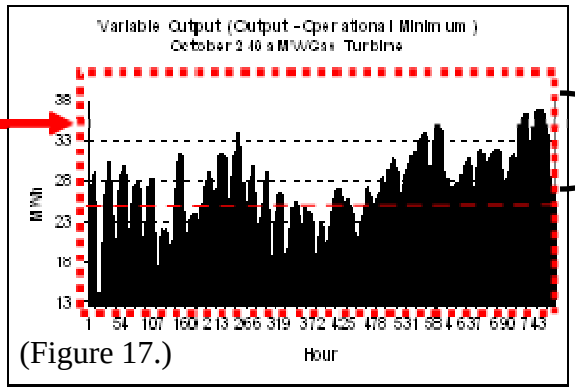
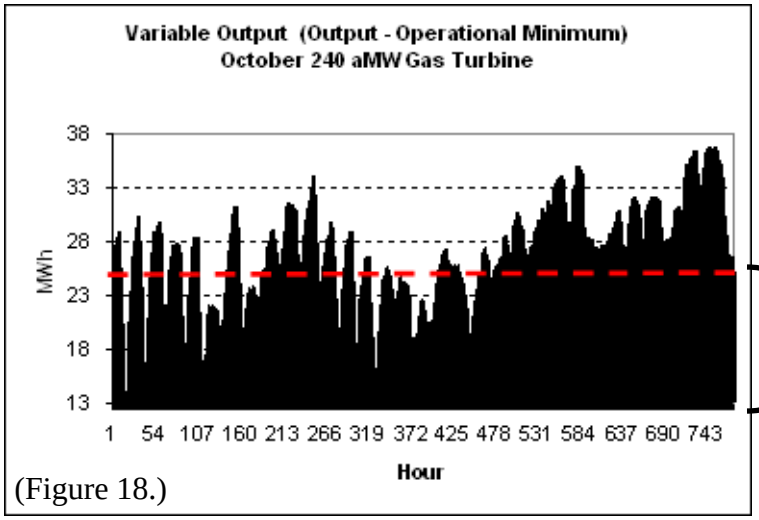


(Figure 16.)



(Figure 17.)

25% efficiency lost for pump and storage applied to these MWh



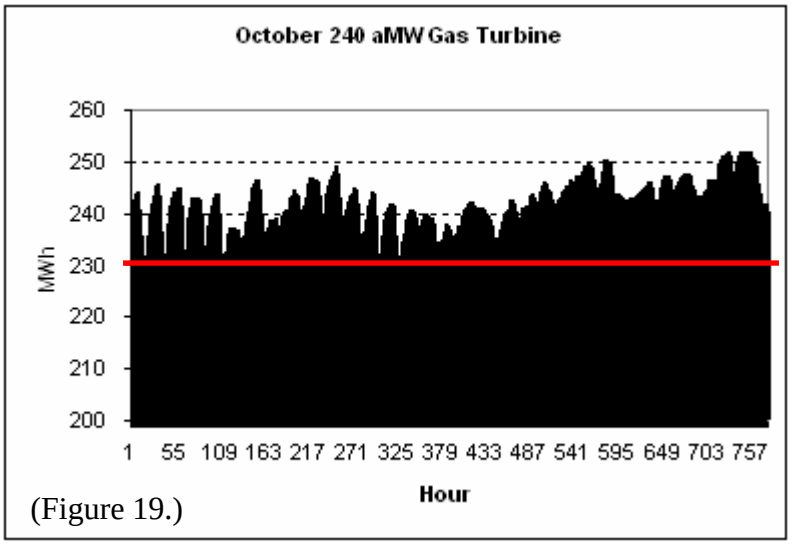
Source Capacity Charge

(Figure 18.)

This method would also be applied to other resource types, such as a 240 aMW gas turbine with an operational capacity factor of 93%.

Because the utility has purchased RSS, the utility's demand billing determinant will be reduced by this firm capacity amount. In method two, both wind farms would see the 7.56 MW of capacity purchased through the RSS deducted from their demand billing determinant.

- **Level 4** – Forced Outage Reserves (FOR) will be available for all levels and will provide limited insurance for unplanned (planned is determined in rate case) outages. FOR is generally applied to the capacity of the resource and is a reservation product. When Forced Outage Reserve Energy (FORE) is delivered it replaces the expected resource performance. FOR capacity and FORE are posted rates under the PF rate schedule. In addition to PF Power purchased, customer will purchase FOR and will pay a market price for energy when delivered. Intermittent resources that have a minimum output that equals zero and are purchasing RSS from BPA do not need to purchase FOR due to the nature of the RSS for the resource. Additional charges may apply when use restrictions defined in the FOR contract are exceeded.



Forced Outage Reserves are purchased for this energy (flat energy generation below RSS). In the event that FOR are not purchased for this energy or the usage rules under FOR are exhausted, a penalty charge will apply to both the undelivered energy and capacity.

(Figure 19.)

- **Level 5** – Customer needs service above HWM and decides to have BPA provide their Tier 2 energy. The price of this service will be evaluated through Level 4 and Level 5 but all resource variations and unexpected events will be BPA's responsibility. PF Power purchased is both Tier 1 and Tier 2. Tier 2 price will include cost of RSS equal to posted rates for non-federal resources.

BPA served Tier 2

BPA will enter into Power Purchase Agreements (PPA) to purchase output from specific resources for provision of Tier 2 requirements power. The costs of each PPA are unique and may reflect imbedded escalation as part of the PPA compensation; therefore Tier 2 rates may vary by rate period or possibly by year. Based on customer election and proper notification to BPA, Power will have a forecast of total Tier 2 power need for each category of Tier 2 rate requested. These Tier 2 rate pool costs will include the cost of Resource Shaping Services (RSS) specific to each set of resources underlying the PPAs, plus the actual purchase price committed to by BPA.

Energy Accounting

RSS is designed to be an energy neutral service, but because RSS will be purchased for resources that produce variable output, BPA must decide how to account for the inevitable over and under performance of resources. While the RSS recovers costs for variable energy generation, it does not guarantee that BPA or the Utility responsible for the resource recovers the cost/benefit when the amount of energy is less or greater than the forecast amount. For this reason, an adjustment must be made to hold both sides whole. Three possible methods are identified below.

Option 1: Load Variance True-up
Treat resources the same as load. When a resource produces less energy than its forecast, the utility responsible for that resource will be charged at rate period forecast market prices (Load Variance). When the resource over performs the forecast, the customer will be credited at rate period forecast market prices (Load variance). The true-up would be billed real-time based on forecast market rates.

Option 2: Periodic True-up
The under/over performance of resources will be addressed through periodic true-ups. When a Tier 2 resource pool (vintage, load growth, etc.) produced more energy (and RECs) than forecast a credit will be computed for the sales of those MWhs and that credit will be assigned to customers that purchased that pools output. When the resource pool under performs a debit will be computed for MWhs that BPA provided under the RSS service. The costs will be assigned to customers that purchased the output of those resources. The granularity (seasonally, monthly, yearly) of the true-up will also need to be decided. The true-up would use real-time prices but be billed rate period to rate period.

Option 3: Forecast Guarantee
BPA would build in its RSS the cost of guaranteeing the rate period output of a resource. Each rate period BPA will revisit the actual performance of resources in each pool to refine and update the forecast of available energy in each pool. If resources are underperforming for any reason the quantity available may be reduced or additional like resources may be added to the pool to provide sufficient energy to meet specific Vintage Tier 2 obligations. If resources are performing better than forecast the quantity available may be increased or otherwise used or disposed of as BPA sees fit.