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# BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

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| **IN THE MATTER OF IDAHO POWER COMPANY'S PETITION TO MODIFY THE METHODOLOGY FOR DETERMINING FUEL COSTS USED TO ESTABLISH PUBLISHED RATES FOR PURPA QUALIFYING FACILITIES** | ) | **CASE NO. IPC-E-07-15**<br><br>**REPLY COMMENTS OF THE COMMISSION STAFF** |

**COMES NOW** the Staff of the Idaho Public Utilities Commission, by and through its Attorney of record, Scott Woodbury, Deputy Attorney General, and in response to the Notice of Additional Comment Period issued on November 9, 2007, submits the following comments in Case No. IPC-E-07-15.

Pursuant to the Public Utility Regulatory Policies Act of 1978 (PURPA) and the implementing regulations of the Federal Energy Regulatory Commission (FERC), the Idaho Public Utilities Commission (Commission) has approved a methodology for calculation of the avoided cost rates paid to PURPA qualifying cogeneration and small power production facilities (QFs) by Idaho Power Company, Avista Corporation and PacifiCorp. Avoided cost rates are the purchase price paid to QFs for purchases of QF capacity and energy.

On September 10, 2007, Idaho Power Company (Idaho Power; Company) filed a Petition with the Commission to modify the methodology for determining fuel costs used to establish published rates for PURPA QFs. Idaho Power contends that use of the current method to set the

fuel cost component in the surrogate avoided resource (SAR) methodology will result in published avoided cost rates that are not representative of the costs Idaho Power is likely to avoid by purchasing energy from QFs.

On September 27, 2007, the Commission issued a Notice of Petition and Modified Procedure in Case No. IPC-E-07-15 establishing a comment deadline of October 23, 2007. Comments were filed by Idaho Windfarms LLC, Intermountain Wind LLC, Exergy Development Group, Commission Staff, Avista Corporation, PacifiCorp dba Rocky Mountain Power, INL Engineers, and other interested parties. On November 5, 2007, Idaho Power filed reply comments. On November 9, 2007, the Commission issued a Notice of Additional Comment Period with a deadline for additional comments of November 26, 2007.

## BACKGROUND

In Order No. 29124 issued September 26, 2002 in Case No. GNR-E-02-1, the Commission established the methodology currently used to compute the fuel cost component of the surrogate avoided resource (SAR) methodology. For QF projects generating less than 10 aMW, the avoided cost rates determined by the SAR methodology are commonly referred to as the published rates. The current SAR is a natural gas-fired combined cycle combustion turbine (CCCT). In accordance with Order No. 29124, the release of a new forecast by the Northwest Power and Conservation Council (NWPCC; Council) triggers a recomputation of the published avoided cost rates.

The method the Commission adopted in Order No. 29124 to calculate the fuel cost component in the SAR methodology starts with an arithmetic average of the nominal prices for natural gas for the first 3 years of the Council's median 20-year forecast of natural gas prices. These three years consist of the current year's forecasted price, plus the previous two years' forecasted prices. The SAR methodology then escalates that 3-year average natural gas price at a uniform percent per year over 20 years. The escalation rate is also calculated from the NWPCC 20-year natural gas forecast.

## STAFF ANALYSIS

Staff believes that there are three issues in this case:

1. Adoption of the Northwest Power and Conservation Council's September 11, 2007 fuel price forecast,

2. Whether to change the methodology used to compute the fuel-related component of the published avoided cost rates, and
3. Whether the generic Surrogate Avoided Resource variables used in computing avoided cost rates should be reviewed and adjusted.

**Adoption of the Council's New Fuel Price Forecast**

In Order No. 29124, the Commission adopted use of the medium natural gas price forecast of the Northwest Power and Conservation Council as the source for the fuel prices used in the computation of avoided cost rates. The Commission acknowledged that the Council's forecast would not be updated on a regular basis; consequently, avoided cost rates would no longer be updated on an annual basis as they had been previously. In its Order, the Commission stated "Natural gas prices can be updated when a new NWPPC forecast becomes available." Since Order No. 29124 was issued in 2002, avoided cost rates have been updated once in 2004 following release of a new forecast by the Council (Reference Order No. 29646).

Staff's interpretation of Order No. 29124 has always been that release of a new fuel price forecast by the Council automatically triggers a recomputation of the published avoided cost rates. An automatic recomputation would insure that the published avoided cost rates would be updated as natural gas prices change, even though the updates would not occur at regular intervals as they had in the past. In addition, Staff believed that updates triggered by a new Council forecast would be made without requiring a comment period each time so as to avoid debate over the accuracy and appropriateness of using the Council's forecast and to preserve the integrity and independence of the Council's figures. Staff continues to believe that updates using new fuel price forecasts should be automatic.

If the Commission or other parties wish to reexamine the question of whether the Council's medium forecast is still the most appropriate one to use for avoided cost computations, then Staff recommends that a new docket be opened. A new docket would create a forum for numerous other forecast sources to be considered.

In its comments in this case, Exergy contends that the Council's natural gas price forecast has proven to be extremely conservative. Staff does not dispute this fact, but believes it should be noted that the same could be said for nearly all fuel price forecasts of the past few years. Staff is not aware of any forecasts that accurately predicted the huge price run-up in natural gas prices since 2001.

**Changes in the Avoided Cost Computation Methodology**

Idaho Power proposes that the Commission utilize the average of all 20 years of the Council' s median 20-year forecast. The Commission Staff contends that a better, more straightforward and mathematically sound approach would be to use each year of the Council's entire forecast "as is" rather than the escalated average of the first three years. Avista contends that the Company proposal does not account for the "time value of money." By using an average price across all of the years, it states, they are proposing to pay a higher cost now and a lower cost later, in real dollar terms. Avista and PacifiCorp support Staff's proposed method.

All parties other than the utilities and Staff oppose a change in the methodology. They note that by retaining the current methodology, avoided cost rates will be higher given the shape of the Council's new forecast. However, Staff believes that this will not necessarily always be the case in the future. Staff questions whether wind advocates will support the existing methodology as vigorously in the future when it no longer works in their favor.

Staff believes that its arguments in support of changing the fuel-related computation methodology are clearly laid out in its comments of October 23, 2007; therefore, they will not be repeated here. Staff believes that the question of whether to change the computation methodology is really one of analytical accuracy. It is appropriate, Staff believes, for parties to debate questions of which input variables to use, or even general issues about whether the SAR methodology is best. However, analytical accuracy should be the goal of everyone. In this case, Staff believes that there is only one correct analytical method. No one should object to an analytical method that uses the Council's forecast exactly, as Staff proposes, when the alternative is to mathematically approximate the forecast and always be assured of being either too high or too low. Parties can debate whether the Council's forecast is accurate, but there should be no debate about how that forecast is incorporated in the avoided cost computations.

There is no question that the existing analytical method, while it may have worked well with past fuel price forecasts, now fails badly to replicate the new Council forecast. Staff dismisses totally any notion of some of the parties that Idaho Power's proposal to change the computation methodology is a back door attempt to lower the avoided cost rates. Instead, it is a reasonable response to correct a methodology that no longer works as originally intended.

Idaho Power, in its reply comments, states that the alternative methodology proposed by Staff, Avista and Rocky Mountain is reasonable and is superior to the current methodology. The Company believes, however, that the Staff and utilities' proposal will cause greater swings in the

cash flows of QF developers and may thus impact project financing. Staff does not dispute Idaho Power's contention; however, Staff maintains that the Company's proposed method is analytically incorrect. No input variables, including fuel prices, should be levelized before being used as inputs into the avoided cost model. The swings in cash flows to which Idaho Power refers only occur with non-levelized rates. Levelization has always been performed within the avoided cost model such that a flat stream of avoided cost rates is computed and offered as an alternative to all projects to aid in project financing.

In its reply comments at page 16, Idaho Power also states "In the final analysis, a QF that performs for the full twenty-year term of its contract would receive the same compensation under either Idaho Power's proposal or the proposal of Staff, Avista and Rocky Mountain. Only the shape of the payment stream would be different." These statements are not correct. A 20-year levelized contract with a 2007 online date would be paid $66.88 per MWh under Staff's proposed methodology and $67.77 under Idaho Power's proposed methodology. The difference is due entirely to the difference in analytical methods discussed earlier.

**Review of the Generic SAR Variables**

Idaho Windfarms, Intermountain Wind, Exergy and INL Engineers suggest that it is inappropriate to consider changes to the gas prices and gas price computation methodology without also considering changes to all of the other variables used to compute avoided cost rates. They characterize the Company proposal to change the fuel cost component methodology as a violation of the policy disfavoring a single-issue rate case, and recommend further proceedings to reestablish new values that more accurately represent current costs and conditions. Adjustment of only one item that makes up an overall rate, without examining all components of the overall rate, Intermountain Wind contends, makes it impossible for the Commission to make the statutorily required public interest finding that the overall rate is "fair, just and reasonable." *Idaho Code* § 61-502.

Avista opposes a revisiting of the non-fuel SAR assumptions. Natural gas, it notes represents approximately 80 percent of the overall cost of the SAR resource. Other cost drivers included in the SAR, on the whole, it contends, remain reasonable, and were they to change would not greatly affect overall published rates.

Generic SAR variables were last updated in Case No. GNR-E-02-01. The final order in that case was issued on September 26, 2002. Staff is certainly not opposed to periodic reviews

of the variables. In fact, we believe that periodic reviews are necessary. However, Staff believes that generic variables should only be changed when they are likely to significantly change the published avoided cost rates. We do not believe that to be the case now.

Attachment A lists all of the variables used in the avoided cost computations. Many of the variables listed are not independent, and instead are simply calculated derivatives of other variables. In addition, some of the variables, such as "base years," simply go along with the costs which they reference. Some variables, such as SAR plant life and SAR capacity factor, have remained the same since when they were first established, and Staff sees no reason why they should change in the future. All of the variables fall into three categories: 1) SAR generic variables; 2) gas price variables; or 3) utility-specific cost of capital variables. The gas price variables are already being addressed in this case as part of the fuel price update. Cost of capital-related variables emerge directly from general rate cases and are specific to each utility. Idaho Power's and PacifiCorp's cost of capital variables, for example, will automatically be adjusted after final orders are issues in their respective general rate cases.[1]

Attachment B lists the generic SAR variables that are independent and that are not addressed either as part of a fuel price adjustment or as part of a general rate case. Each variable is listed along with its source as specified by Order No. 29124. The current value of each variable is listed and, where the source is regularly updated, compared to what the value of the variable would be if it were updated.

Attachment C is a graphical representation of the four components of the avoided cost rate. As is readily apparent, fuel costs comprise the majority of the rates. Capital costs make up the second biggest component. Fixed and variable O & M are small components relative to the others. Small percentage changes in fuel cost will have a large effect on avoided cost rates, while extremely large changes in O & M costs will have relatively minor effects. Changes in variables related to capital costs will have a relatively small effect on avoided cost rates.

Exergy in its comments argued that capital costs of gas-fired combustion turbines have skyrocketed in the last two years. Exergy attached a recent report prepared for the Edison Foundation by the Brattle Group, and quoted the following paragraph from the report:

[1] Note that if the cost of capital figures contained in the Settlement Stipulation of PacifiCorp in Case No. PAC-E-07-05 are accepted, they are lower than current figures and will cause a slight decrease in avoided cost rates for PacifiCorp.

> Steam generation construction costs tracked the general inflation rate fairly well through the 1990s, began to rise modestly in 2001, and increased significantly since 2004. Between January 1, 2004, and January 1, 2007, the cost of constructing steam generating units increased by 25 percent - more than triple the rate of inflation over the same time period. The cost of gas turbo generators (combustion turbines), on the other hand actually fell between 2003 and 2005. However, during 2006, the cost of a new combustion turbine increased by nearly 18 percent - roughly 10 times the rate of general inflation.

The Northwest Power and Conservation Council, as a result of an action item in its Fifth Power Plan, now reviews the assumptions used in the Fifth Power Plan every two years. On October 17, 2006, the Council issued a paper titled *Biennial Assessment of the Fifth Power Plan, Gas Turbine Power Plant Planning Assumptions*. The report is included as Attachment D. Staff believes that two conclusions can be drawn from the report: 1) Combined-cycle gas turbine power plant capital costs, as of October 2006, had not increased from the cost estimates last adopted by the Commission in 2002 (if anything, costs have decreased slightly); and 2) Combined-cycle gas turbine power plant heat rates (i.e., efficiencies) have decreased since 2002. Because the report is now more than a year old, capital costs for combined-cycle plants could have increased in the past year.

Escalation rates for capital and O & M costs are tied to the GDP index as reported by the Energy Information Administration (EIA) in its Annual Energy Outlook. In EIA's most recent report, the GDP index for the period 2005-2030 is reported as 1.9 percent, a decrease from the 2.6 percent now used in the avoided cost computations. Reference Attachment E.

Based on an initial review of the variables, some have increased and others have decreased. Staff performed some preliminary analysis to investigate the effect of changes in variables on the avoided cost rates. By changing only the escalation rates for O & M and by reducing heat rates based on the Council's recent paper, avoided cost rates decreased by approximately $1.85 per MWh. In order for an increase in the SAR capital cost assumption to offset this decrease in rates due to escalation rates and heat rate, capital costs of a combined cycle turbine would have to increase approximately 17 percent. Although the Council's analysis of a year ago showed no overall increase in CCCT costs, if one instead accepts the claim in the Edison Foundation Report cited by Exergy that CCCT costs have increased by 18 percent, avoided cost rates would be virtually unchanged from present rates after changes in all the variables are taken into account.

Attachment F shows the effect of increases in capital cost on the 20-year levelized avoided cost rate. Note that very large percentage increases in capital cost are necessary in order to substantially affect the avoided cost rates.

**Further Proceedings**

Staff does not believe that further proceedings are necessary in order for the Commission to make decisions about any of the issues in this case. Further proceedings, such as a hearing to review and update variables used for avoided cost computations, will only lead to further delays in project developers' abilities to secure contracts. Interim rates have never historically proved workable for developers due to the uncertainty they present for project financing. Furthermore, Staff does not believe that further review of the variables will lead to higher avoided cost rates as seemingly expected by the wind advocates. A decision now on the single issue of gas price would allow immediate update of published rates by incorporating the NWPCC's new gas price forecast.

In addressing the suggestion that perhaps all SAR methodology cost components need to be updated, Idaho Power states in its reply comments that it is agreeable to hosting a meeting no later than March 1, 2008 to identify and quantify necessary updates to the remaining avoided cost methodology components. The Company is hopeful that an agreement can be reached and subsequently filed with the Commission as a consensus document.

Staff, however, is not optimistic that agreement could be reached through a workshop process. Based on recent experience in trying to resolve wind integration issues through a workshop process, with few exceptions, interested parties seem unable to reach consensus. Such a process would be time consuming, contentious and would not likely lead to any better result than if the Commission makes decisions based on the existing record.

**STAFF RECOMMENDATIONS**

Staff recommends the following:

1) That the Commission continue to process this case under Modified Procedure;
2) That the Commission adopt the September 11, 2007 fuel price forecast of the Northwest Power and Conservation Council for use in computing published avoided cost rates;
3) That the Commission issue an Order changing the method for determining the fuel cost component of the SAR methodology to utilize each of the 20 years set out in the

NWPCC's 2007 median forecast of natural gas prices rather than the escalated average of the first 3 years of the same forecast,

4) That the rates computed using the September 11, 2007 Council forecast and the new proposed fuel cost methodology be effective beginning December 15, 2007, and
5) That the Commission not initiate a new docket or order further proceedings in this docket for the purpose of revising non-fuel-related generic variables used in computing avoided cost rates.

Respectfully submitted this 26th day of November 2007.

Scott Woodbury
Deputy Attorney General

Technical Staff: Rick Sterling

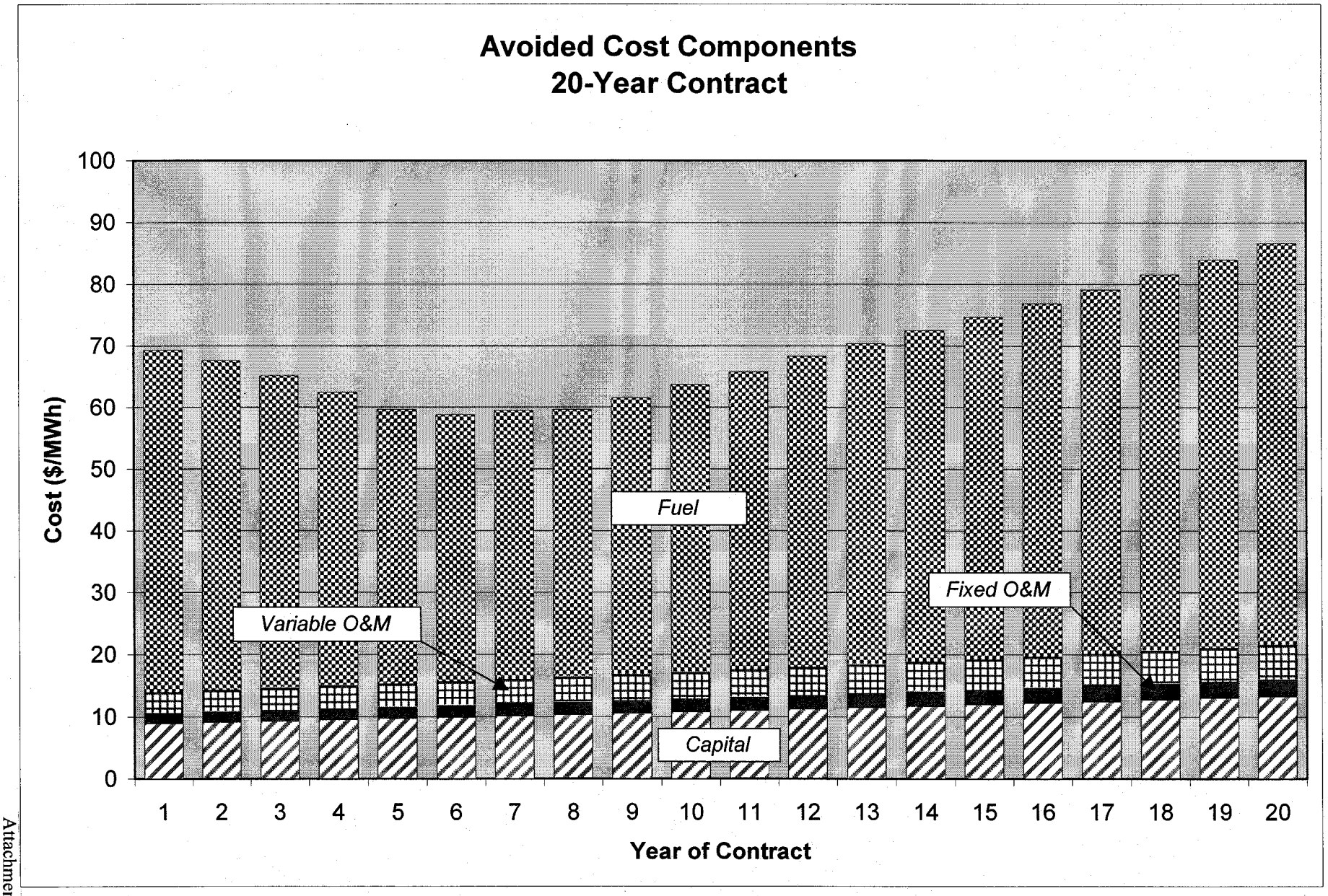
i:/umisc/comments/ipce07.15_2swrps comments

## VARIABLES USED IN THE COMPUTATION OF PUBLISHED AVOIDED COST RATES

| | | |
|---|---|---|
| **SAR GENERIC VARIABLES** | | |
| "SAR" PLANT LIFE (YEARS): | 30 | Established in IPC-E-93-28;WWP-E-93-10; UPL-E-93-3/ PPL-E-93-3, UPL-E-93-7/PPL-E-93-5 |
| "SAR" PLANT COST ($/kW): | $679 | $624 + $55 adder for AFUDC; NWPCC Draft Fifth Power Plan, Generating Resources Advisory Committee |
| BASE YEAR OF "SAR" COST: | 2000 | Based on SAR Plant Cost |
| "SAR" CAPACITY FACTOR (%): | 92% | Established in IPC-E-93-28;WWP-E-93-10; UPL-E-93-3/ PPL-E-93-3, UPL-E-93-7/PPL-E-93-5 |
| HEAT RATE (BTU/kWH): | 7,100 | 6980 w/adjustment for elevation; NWPCC Draft Fifth Power Plan, Generating Resources Advisory Committee |
| "SAR" FIXED O&M ($/kW): | $10.70 | NWPCC Draft Fifth Power Plan, Generating Resources Advisory Committee |
| "SAR" VARIABLE O&M ($/MWh): | 2.80 | NWPCC Draft Fifth Power Plan, Generating Resources Advisory Committee |
| BASE YEAR, O&M EXPENSES: | 2000 | Based on SAR Plant Cost |
| ESCALATION RATE; "SAR" (%): | 2.10% | DOE/EIA Annual Energy Outlook 2002 2.70% inflation adjustment + (0.6%) real decrease in combined cycle costs |
| ESCALATION RATE; O&M (%): | 2.70% | DOE/EIA Annual Energy Outlook 2002 Reference Case Forecast, Table A20, GDP Chain-Type Index, Annual Growth 2000-2020 |
| "TILTING" RATE (%): | 2.10% | DOE/EIA Annual Energy Outlook 2002 2.70% inflation adjustment + (0.6%) real decrease in combined cycle costs |
| **GAS PRICE VARIABLES** | | |
| CURRENT YEAR GAS PRICE ($/MMBTU): | | Current NWPCC Fuel Price Forecast, Medium, East Side Delivered |
| ESCALATION RATE; FUEL (%): | | Computed using Trippel Method from GNR-E-02-01 |
| **UTILITY-SPECIFIC COST OF CAPITAL VARIABLES** | | |
| UTLTY WT'D COST OF CAPITAL (%): | | Based on Cost of Captal from Each Utility's Most Recent General Rate Case |
| RATEPAYER DISCOUNT RATE (%): | | Same as Utility Weighted Cost of Capital |
| CAPITAL CARRYING CHARGE (%): | | Computed Using Utility Weighted Cost of Capital |
| LEVEL CARRYING COST ($/MWh): | | Computed Using Utility Weighted Cost of Capital |

## INDEPENDENT GENERIC SAR VARIABLES USED IN THE COMPUTATION OF PUBLISHED AVOIDED COST RATES

| VARIABLE | CURRENT VALUE | UPDATED VALUE | SOURCE FOR CURRENT VALUE |
|---|---|---|---|
| "SAR" PLANT COST ($/kW): | $679 | | $624 + $55 adder for AFUDC; NWPCC Draft Fifth Power Plan, Generating Resources Advisory Committee |
| HEAT RATE (BTU/kWH): | 7,100 | | 6980 w/adjustment for elevation; NWPCC Draft Fifth Power Plan, Generating Resources Advisory Committee |
| "SAR" FIXED O&M ($/kW): | $10.70 | | NWPCC Draft Fifth Power Plan, Generating Resources Advisory Committee |
| "SAR" VARIABLE O&M ($/MWh): | 2.80 | | NWPCC Draft Fifth Power Plan, Generating Resources Advisory Committee |
| ESCALATION RATE; O&M (%): | 2.70% | 1.90% | DOE/EIA Annual Energy Outlook 2002 Reference Case Forecast, Table A20, GDP Chain-Type Index, Annual Growth 2000-2020 |




Attachment C
Case No. IPC-E-07-15
Staff Comments
11/26/07

# Biennial Assessment of the Fifth Power Plan

## Gas Turbine Power Plant Planning Assumptions

October 17, 2006

Simple- and combined-cycle gas turbine power plants fuelled by natural gas are among the bulk power generating technologies considered in the portfolio analysis of the Fifth Power Plan. The favored bulk power generating technology of the 1990s and early 2000s, natural gas combined-cycle power plants comprise about 11 percent (5914 megawatts) of Northwest generating capacity. Simple-cycle units, valued for provision of system reliability, regulation, load following and in the Northwest, hydro firming, comprise about 3 percent (1654 megawatts) of generating capacity. Most of the combined-cycle capacity was completed between 1995 and 2004 when the combination of low natural gas prices, and reliable, low-emission and efficient gas turbine technology made combined-cycle gas turbine power plants the "resource of choice". Higher natural gas prices since 2001 have reduced the attractiveness of bulk power generation using natural gas. Construction of only one large combined-cycle project has been initiated since 2001. That plant is the Port Westward project, a 399-megawatt project of Portland General Electric, located near Clatskanie, Oregon, scheduled for completion in 2007. That plant employs a higher-efficiency "G-class" gas turbine to help offset high natural gas costs.

The resource portfolio of the Fifth Power Plan includes additional gas-fired power plants following 2018. Up to 800 megawatts of additional simple-cycle capacity and 1220 megawatts of combined-cycle capacity may be needed by the end of the planning period. Because of established technology and the relatively short time required to site and permit these types of plants, no actions regarding these resources were called for in the 5-year action plan.

### *Technology and Applications*

The two basic classes of gas turbines are aeroderivative machines and industrial machines (also called "frame" or "heavy duty" turbines). Aeroderivative turbines, as the name suggests, are derived from the gas turbine engines used for aircraft. They are characterized by light weight, relatively high efficiency, quick startup, rapid ramp rates and ease of maintenance. Aeroderivative turbines tend to be more costly than industrial machines because of more severe operating conditions and more expensive materials. Industrial gas turbines are designed for extended high output duty. They are characterized by heavier components, somewhat lower efficiency, slower startup time, slower ramp rates and more complex maintenance procedures.

Gas turbines for electricity generation applications are employed in two principal configurations. Simple-cycle units consist of a gas turbine generator and appurtenant equipment. The hot turbine exhaust is discharged to the atmosphere, limiting the efficiency of these units to about 36 percent. Combined-cycle units include a heat recovery steam generator on the exhaust to recover otherwise wasted energy. Steam from the heat recovery steam generator powers an additional steam turbine, providing extra electric power from the same amount of fuel as a comparable simple-cycle unit. Combined-cycle efficiencies range to about 50 percent. In addition, the steam generator of combined-cycle units can be fitted with fuel burners ("duct firing") to boost peak power output. Most combined-cycle plants employ industrial gas turbines.

Because of their higher efficiency, combined-cycle plants are used for base and intermediate load power generation. Simple-cycle units (and the duct firing section of combined-cycle units) are used to meet peak period loads and to provide ancillary services such as frequency regulation and load following where flexibility is more important than efficiency. Industrial simple-cycle machines are suited to longer duration peaks whereas aeroderivative simple-cycle machines are better suited to short duration peaks, short-term load following and frequency regulation.

A new gas turbine configuration has been introduced to production since development of the Fifth Power Plan. The General Electric 100 megawatt LMS100™ simple-cycle gas turbine incorporates an external intercooler between the low-pressure and high-pressure air compression stages. The intercooler cools and increases the density of air entering the high-pressure compressor, allowing a higher compression ratio to be achieved with less energy. This results in higher thermal efficiency over a wider load range and lower sensitivity to high ambient air temperatures. Basin Electric's Groton Generation Station, the first North American project using the LMS100, was commissioned in July 2006.

Fifth Power Plan planning assumptions for simple- and combined-cycle gas turbine power plants are shown in the following table. Also shown are published data for the intercooled LMS100. The cost of the LMS100 plant is based on the announced cost of the Basin Electric Groton plant. This is a first of a kind installation and may not be representative of future plant costs because of possible first-of-a-kind discounts and potential design and production economies.

| | 5th Plan Aeroderivative Simple-cycle | 5th Plan Industrial Simple-cycle | 5th Plan Combined-cycle[1] | Intercooled Simple-cycle (LMS100™) |
|---|---|---|---|---|
| Unit capacity (MW)[2] | 2x47 | 2x80 | 540/70 | 96 |
| Heat Rate[3] (Btu/kWh) | 9650 | 10240 | 6710/9060 | 8430 |
| Efficiency (%) | 35 | 33 | 51/38 | 41 |
| Cold Startup (min) | 8 | 20 | 180 | 10 |
| Capital cost ($/kW)[4] | $673 | $420 | $586/$250 | $708[5] |

## *Assessment of Cost and Performance Assumptions*

[1] First value is combined-cycle increment; second value is duct firing increment.
[2] ISO, new and clean, derated for inlet and exhaust losses.
[3] ISO, higher heating value, new and clean.
[4] Overnight cost, 2006 dollars for 2006 order.
[5] Estimated overnight cost of Basin Electric Groton plant using Council financing assumptions.

The most significant factors affecting the cost-effectiveness of natural gas power plants are the cost of natural gas (assessed elsewhere), capital cost and thermal efficiency. Capital costs are important for all plants, efficiency is more important for combined-cycle plants.

### *Capital cost of aeroderivative simple-cycle gas turbine power plants*

The Fifth Power Plan cost assumptions for aeroderivative simple-cycle gas turbines are compared in Figure 1 to announced project costs taken from a data base maintained by the Council, as well as budgetary planning estimates published in *Gas Turbine World.* The horizontal axis represents the year of equipment order. The vertical axis represents "overnight" capital cost (2006 dollars). "Overnight" cost is the total construction cost less costs of financing, escalation and interest during construction. The "Aero project" series (triangles) are the estimated overnight costs of projects constructed in the WECC region for which costs have been announced. Announced capital costs are assumed to be total project costs. Overnight costs were calculated from these using the Council's generic financing assumptions for the type of project developer. The single unit project costs were increased by 10 percent for consistency with Fifth Plan assumptions. The cyclical nature of the market is evident. Prices (and number of projects) increased through 2002 (2003 service), as a result of the energy crisis and peak load growth. The market subsequently collapsed and prices and number of projects declined. The higher cost ($737/kW) of the most recent plant suggests the possible effects of recent increases in materials cost.

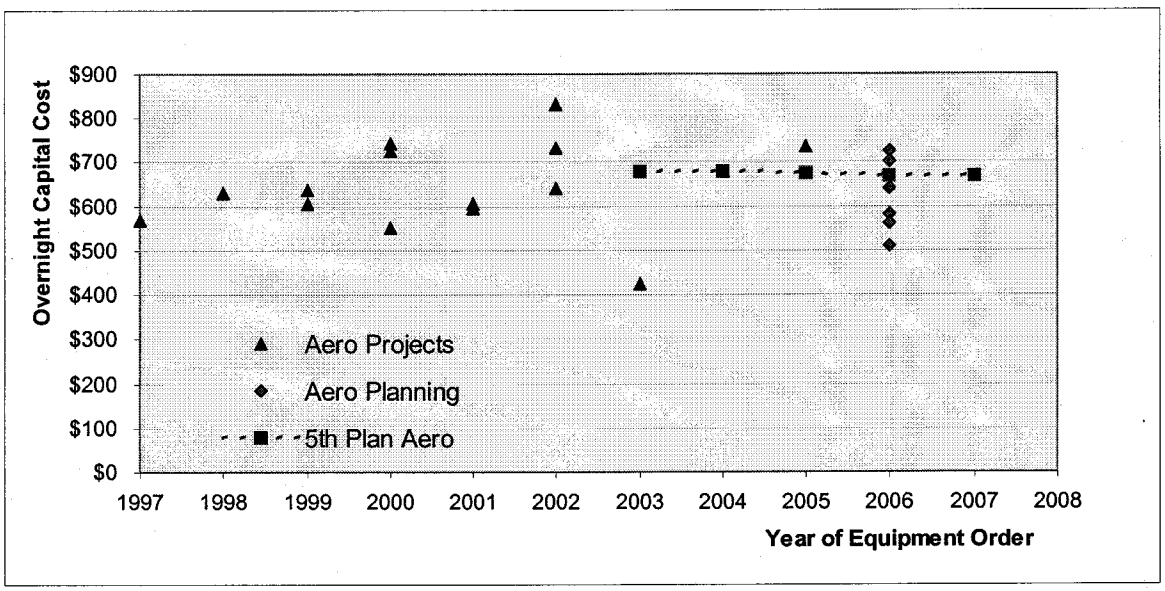



**Figure 1**: Simple-cycle aeroderivative gas turbine power plant capital cost estimates

The "Aero planning" series (diamonds) are based on equipment list prices reported in the *Gas Turbine World 2006 Handbook* and rule-of-thumb balance-of-plant costs. Costs range from $511 to $727/kW.

The Fifth Plan cost estimates are shown as box points along the dashed line. They slowly decline in real terms under the assumption that continuing technical development should result in declining capital cost. The Fifth Plan cost is well within the *Gas Turbine World* planning range though slightly lower than the cost of the most recent WECC project. The equipment prices upon which the *Gas Turbine World* series are based are characterized as representing a recovering market, and as such could be expected to be lower than the equilibrium market price estimates of the power plan. The Fifth Plan assumptions appear to remain reasonably representative.

### *Capital cost of industrial simple-cycle gas turbine power plants*

The Fifth Power Plan cost estimates for representative industrial simple-cycle gas turbines are compared in Figure 2 to historical project costs and budgetary planning estimates derived from vendor list prices. As in Figure 1, the horizontal axis represents the year of equipment order and the vertical axis represents overnight capital cost. The "Frame project" series (triangles) are the estimated overnight costs of projects constructed in the WECC region for which costs have been announced. Overnight costs were estimated as described for aeroderivative units. A cyclical market is strongly evident. Unlike the aeroderivative market, the market for industrial turbines appears not to have recovered from the post-energy crisis collapse. Despite rising materials costs, the cost of industrial gas turbine equipment (representing half of the total plant cost, or more) has remained low because of the glut of surplus industrial turbines, many from cancelled combined-cycle projects.

The "Frame planning" series (diamonds) are based on current vendor list prices as reported in the *Gas Turbine World 2006 Handbook* and rule-of-thumb balance-of-plant costs. Estimated overnight project costs range from $360 to $620/kW.

The Fifth Plan assumptions (boxes along the dashed line) are within the *Gas Turbine World* planning range and appear to represent an equilibrium market, as intended. However, because most new capacity, by definition, is developed in a seller's market, consideration might be given in future power plants to correlating capital costs to need for new capacity.

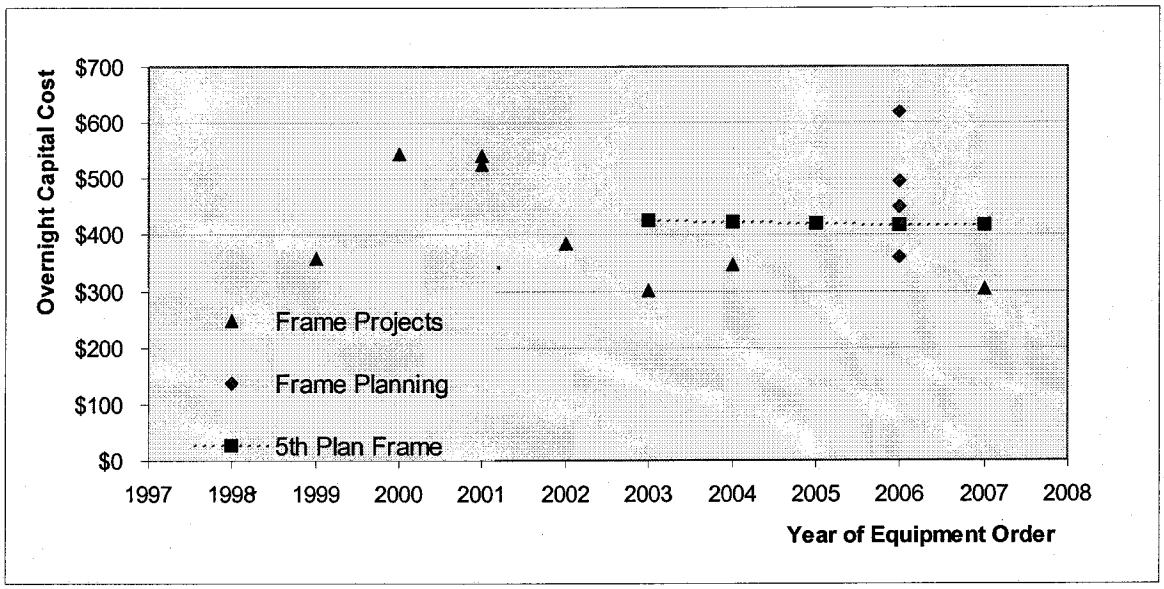



**Figure 2**: Simple-cycle industrial gas turbine power plant capital cost estimates

### *Capital cost of combined-cycle gas turbine power plants*

The Fifth Power Plan cost estimates for representative combined-cycle gas turbine power plants are compared in Figure 3 to historical project costs. *Gas Turbine World* budgetary planning estimates do not appear in this comparison because of the larger sample of available actual project costs, and because of the greater diversity of combined-cycle plant configurations make simple rule-of-thumb estimates of balance-of-plant costs less feasible. As in Figures 1 and 2, the vertical axis represents overnight capital cost. Here, however, the horizontal axis represents the year of service. The "Combined-cycle project" series (triangles) are the estimated overnight costs of combined-cycle projects constructed in the WECC region for which costs have been announced. Overnight costs were estimated as described for simple-cycle units. Unlike simple-cycle power plants, there is no evidence of a post-energy crisis decline in the cost of combined-cycle plants. This may be because few, if any combined-cycle plants have used equipment acquired through the secondary market. Moreover, the increased balance of plant complexity results in greater sensitivity to recent escalation in the prices of steel, copper, concrete and other materials.

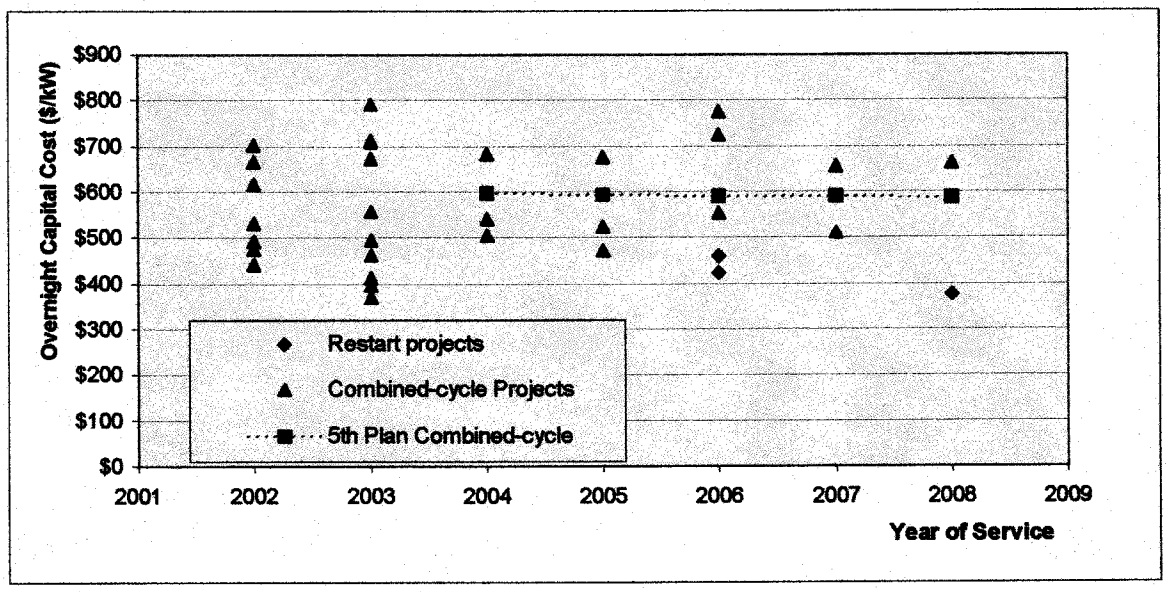



**Figure 3**: Combined-cycle gas turbine power plant capital cost estimates

The Fifth Plan assumptions (box points along the dashed line) slowly decline in real terms under the assumption that continuing technical development should result in declining capital cost. The Fifth Plan cost estimates continue to adequately represent the real-world cost of constructing new combined-cycle plants.

The "restart project" series (diamonds) in the lower right of Figure 3, ranging from $376 to $457/kW, represent three projects for which construction was restarted after a prolonged period of suspension. While the cost of completing suspended projects will vary depending upon the extent to which the project was completed prior to suspension and other factors, these values provide a sense of the likely cost of completing suspended projects in the Northwest.

### *Efficiency of combined-cycle gas turbine power plants*

The Fifth Power Plan assumptions for the heat rate of combined-cycle gas turbine power plants are compared in Figure 4 to the estimated heat rates of recently constructed combined-cycle plants. The vertical axis represents heat rate (the engineering measure of plant efficiency) in Btu/kWh[6] and the horizontal axis represents the year of service. The "Combined-cycle project" series (triangles) are the estimated heat rates for recently constructed combined-cycle projects in the WECC region. Because the actual heat rates of power plants are rarely published because of proprietary concerns, the heat rates shown in the figure are equipment vendor's published heat rates for the type and configuration of plant equipment. Information regarding equipment is

[6] Heat rate values used here are based on higher fuel heating value consistent with the units used in the Fifth Power Plan.

often available and maintained in the Council's gas turbine power plant database. The heat rates are derated to represent lifecycle values for consistency with Fifth Plan assumptions. Because heat rates vary significantly with plant size, the sample is limited to plants of the same size class (Frame 7) as the plant on which the Fifth Plan assumptions are based The lower value appearing in 2008 is for the Inland Empire power plant in California, first North American application of advanced "H-Class" technology.

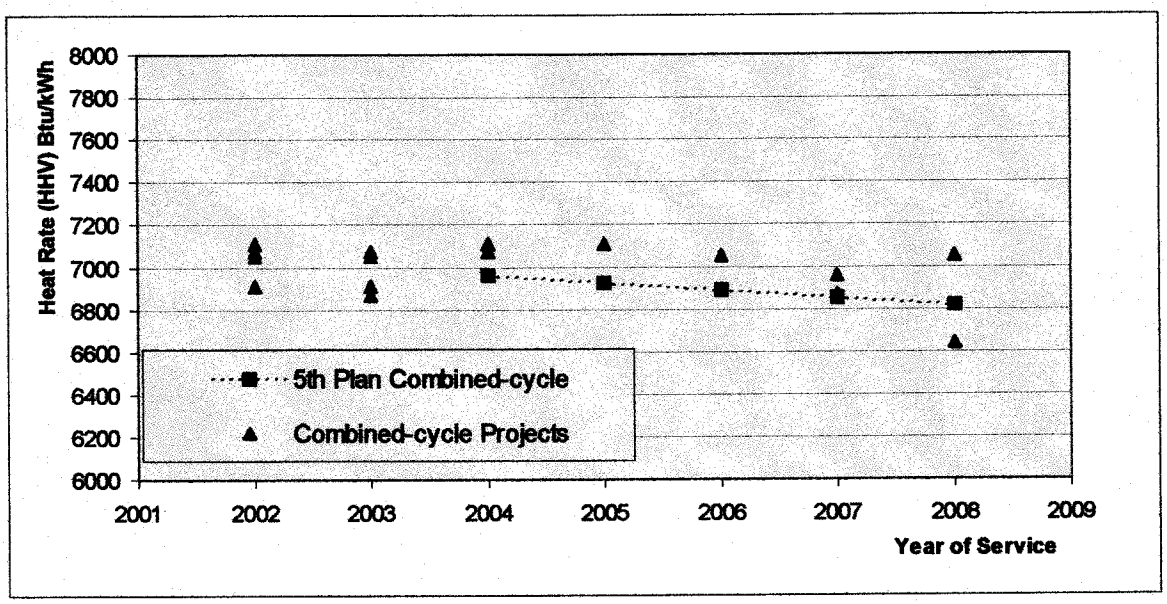



**Figure 4**: Combined-cycle gas turbine power plant efficiency estimates

The Fifth Plan heat rate estimates (boxes along the dashed line) slowly decline under the assumption that continuing technical development should result in improving efficiency (declining heat rate represents improving efficiency). The Fifth Plan estimates appear to adequately represent the efficiency of new combined-cycle plants.

## *Conclusions*

This assessment of the key non-fuel planning assumptions of the Fifth Power Plan regarding new gas turbine power plants indicates these assumptions continue to be representative of real-world experience. This finding, together with the conclusion of the biennial assessment of the natural gas price forecast suggests that the role of natural gas fuelled simple and combined-cycle power plants for bulk power generation in the Fifth Power Plan is unlikely to significantly change.

Because the earliest need for gas turbine plants in the Fifth Power Plan portfolio lies well beyond the period of the action plan, no actions pertaining to the possible bulk power generation role of these resources were included in the action plan. Other factors, however, might result in a need for these resources in the nearer term. These include a possible need for capacity to maintain system reliability and possible need for additional system regulation and load following

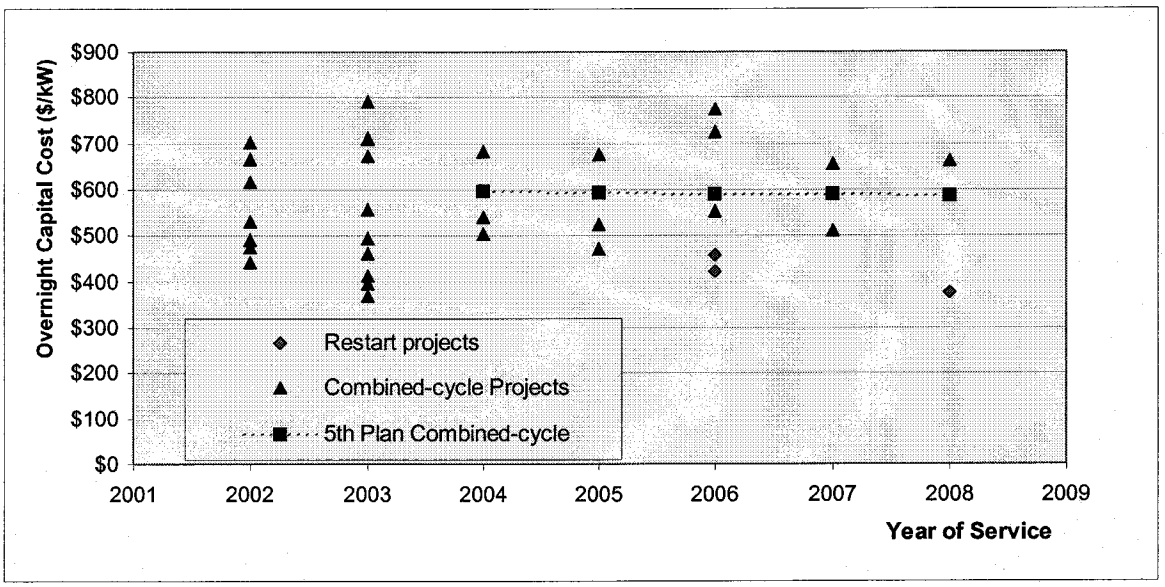



**Figure 3**: Combined-cycle gas turbine power plant capital cost estimates

The Fifth Plan assumptions (box points along the dashed line) slowly decline in real terms under the assumption that continuing technical development should result in declining capital cost. The Fifth Plan cost estimates continue to adequately represent the real-world cost of constructing new combined-cycle plants.

The "restart project" series (diamonds) in the lower right of Figure 3, ranging from $376 to $457/kW, represent three projects for which construction was restarted after a prolonged period of suspension. While the cost of completing suspended projects will vary depending upon the extent to which the project was completed prior to suspension and other factors, these values provide a sense of the likely cost of completing suspended projects in the Northwest.

### *Efficiency of combined-cycle gas turbine power plants*

The Fifth Power Plan assumptions for the heat rate of combined-cycle gas turbine power plants are compared in Figure 4 to the estimated heat rates of recently constructed combined-cycle plants. The vertical axis represents heat rate (the engineering measure of plant efficiency) in Btu/kWh[6] and the horizontal axis represents the year of service. The "Combined-cycle project" series (triangles) are the estimated heat rates for recently constructed combined-cycle projects in the WECC region. Because the actual heat rates of power plants are rarely published because of proprietary concerns, the heat rates shown in the figure are equipment vendor's published heat rates for the type and configuration of plant equipment. Information regarding equipment is

[6] Heat rate values used here are based on higher fuel heating value consistent with the units used in the Fifth Power Plan.

often available and maintained in the Council's gas turbine power plant database. The heat rates are derated to represent lifecycle values for consistency with Fifth Plan assumptions. Because heat rates vary significantly with plant size, the sample is limited to plants of the same size class (Frame 7) as the plant on which the Fifth Plan assumptions are based The lower value appearing in 2008 is for the Inland Empire power plant in California, first North American application of advanced "H-Class" technology.

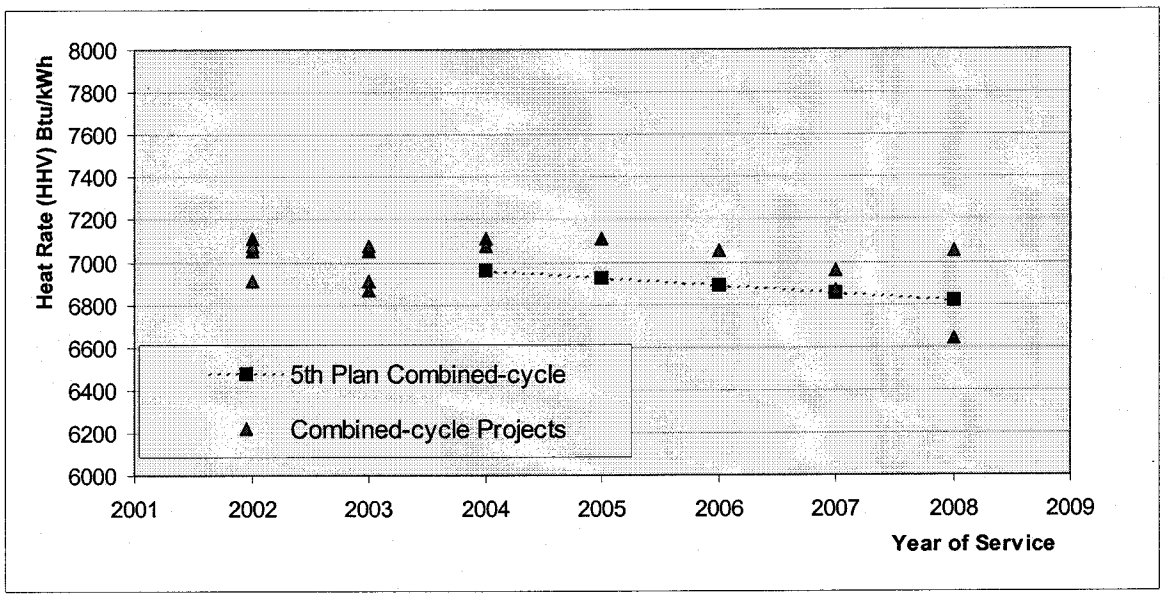



**Figure 4**: Combined-cycle gas turbine power plant efficiency estimates

The Fifth Plan heat rate estimates (boxes along the dashed line) slowly decline under the assumption that continuing technical development should result in improving efficiency (declining heat rate represents improving efficiency). The Fifth Plan estimates appear to adequately represent the efficiency of new combined-cycle plants.

## *Conclusions*

This assessment of the key non-fuel planning assumptions of the Fifth Power Plan regarding new gas turbine power plants indicates these assumptions continue to be representative of real-world experience. This finding, together with the conclusion of the biennial assessment of the natural gas price forecast suggests that the role of natural gas fuelled simple and combined-cycle power plants for bulk power generation in the Fifth Power Plan is unlikely to significantly change.

Because the earliest need for gas turbine plants in the Fifth Power Plan portfolio lies well beyond the period of the action plan, no actions pertaining to the possible bulk power generation role of these resources were included in the action plan. Other factors, however, might result in a need for these resources in the nearer term. These include a possible need for capacity to maintain system reliability and possible need for additional system regulation and load following

capability for the integration of wind power. The former will be better understood once system reliability criteria are established; the latter is being addressed in the regional wind integration project.

Another factor that might affect the real-world role of gas-fired gas turbine power plants in the Northwest is the presence of over 900 megawatts of combined-cycle plant on which construction was suspended following the collapse of power prices subsequent to the 2000-01 energy crisis. Recent experience in California indicates that these projects might be completed at two-thirds to three-quarters the cost of a greenfield plant. This would reduce the cost of energy from a new combined cycle by about 5%, possibly enough to make completion of one of these projects attractive in the face of the cost increases being experienced for other new generating resources.

A final conclusion results from cyclical market evident here for simple-cycle units and observed for windpower and other generating resources. The generating resource capital cost assumptions of the Fifth Power Plan and earlier plans are based on equilibrium market conditions - neither a buyer's nor a seller's market. Historically, however, most generating capacity is acquired during buyer's market conditions, resulting in higher costs than those forecast for equilibrium markets. The cost-effectiveness values of different resources are not equally sensitive to these fluctuations. Future portfolio analyses might consider possible correlations between electricity market activity and resource capital costs.

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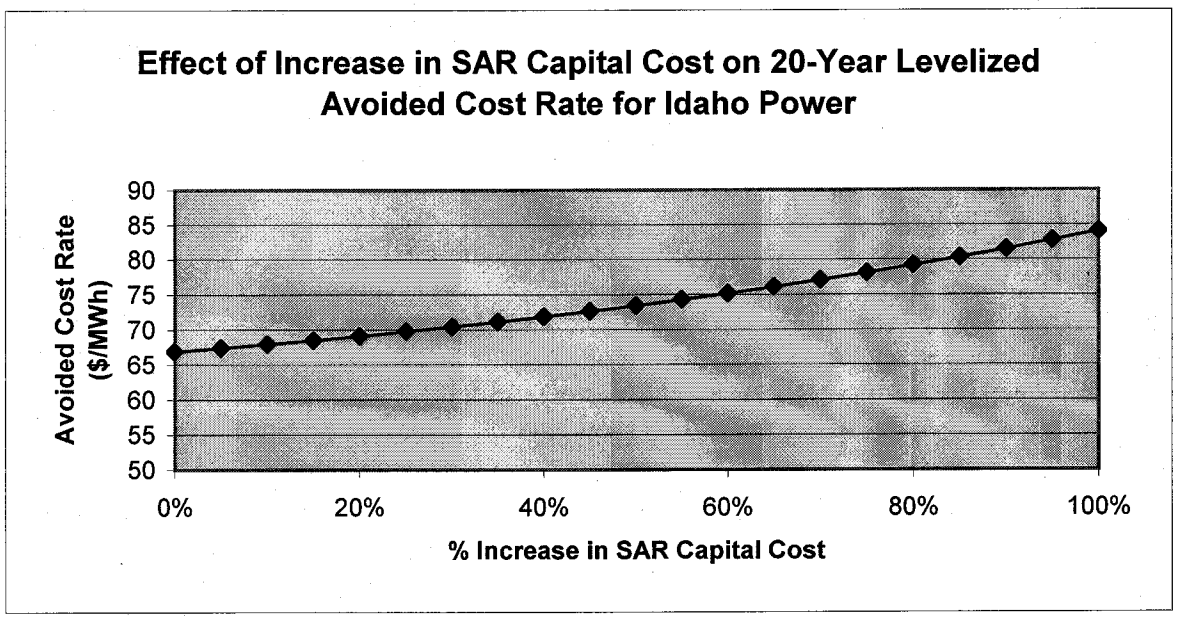
## Table A19. Macroeconomic Indicators
(Billion 2000 Chain-Weighted Dollars, Unless Otherwise Noted)

| Indicators | Reference Case | | | | | | | Annual Growth 2005-2030 (percent) |
|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | |
| **Real Gross Domestic Product** | **10704** | **11049** | **12790** | **14698** | **17077** | **19666** | **22494** | **2.9%** |
| **Components of Real Gross Domestic Product** | | | | | | | | |
| Real Consumption | 7577 | 7841 | 9111 | 10423 | 12006 | 13731 | 15590 | 2.8% |
| Real Investment | 1771 | 1866 | 2139 | 2478 | 3030 | 3773 | 4735 | 3.8% |
| Real Government Spending | 1941 | 1958 | 2117 | 2242 | 2396 | 2541 | 2709 | 1.3% |
| Real Exports | 1120 | 1196 | 1767 | 2543 | 3584 | 4894 | 6581 | 7.1% |
| Real Imports | 1711 | 1815 | 2321 | 2911 | 3761 | 4963 | 6649 | 5.3% |
| **Energy Intensity (thousand Btu per 2000 dollar of GDP)** | | | | | | | | |
| Delivered Energy | 6.91 | 6.60 | 6.06 | 5.56 | 5.04 | 4.62 | 4.27 | -1.7% |
| Total Energy | 9.41 | 9.07 | 8.33 | 7.64 | 6.92 | 6.33 | 5.83 | -1.8% |
| **Price Indices** | | | | | | | | |
| GDP Chain-type Price Index (2000=1.000) | 1.094 | 1.127 | 1.253 | 1.366 | 1.495 | 1.648 | 1.815 | 1.9% |
| ~~Consumer Price Index (1982-4=1.00)~~ | | | | | | | | |
| All-urban | 1.89 | 1.95 | 2.16 | 2.36 | 2.61 | 2.90 | 3.23 | 2.0% |
| Energy Commodities and Services | 1.51 | 1.77 | 1.93 | 1.94 | 2.19 | 2.48 | 2.80 | 1.8% |
| Wholesale Price Index (1982=1.00) | | | | | | | | |
| All Commodities | 1.47 | 1.57 | 1.68 | 1.72 | 1.82 | 1.94 | 2.06 | 1.1% |
| Fuel and Power | 1.27 | 1.57 | 1.64 | 1.62 | 1.84 | 2.11 | 2.39 | 1.7% |
| **Interest Rates (percent, nominal)** | | | | | | | | |
| Federal Funds Rate | 1.35 | 3.21 | 4.71 | 4.93 | 5.11 | 5.07 | 5.14 | N/A |
| 10-Year Treasury Note | 4.27 | 4.29 | 5.52 | 5.66 | 5.75 | 5.78 | 5.80 | N/A |
| AA Utility Bond Rate | 6.04 | 5.44 | 7.36 | 7.64 | 7.72 | 7.78 | 7.77 | N/A |
| **Value of Shipments (billion 2000 dollars)** | | | | | | | | |
| Total Industrial | 5651 | 5763 | 6298 | 7033 | 7779 | 8585 | 9502 | 2.0% |
| Nonmanufacturing | 1494 | 1538 | 1596 | 1701 | 1846 | 1940 | 2023 | 1.1% |
| Manufacturing | 4157 | 4225 | 4702 | 5332 | 5933 | 6645 | 7478 | 2.3% |
| Energy-Intensive | 1161 | 1160 | 1262 | 1347 | 1426 | 1522 | 1631 | 1.4% |
| Non-energy Intensive | 2996 | 3065 | 3440 | 3985 | 4507 | 5123 | 5848 | 2.6% |
| **Population and Employment (millions)** | | | | | | | | |
| Population, with Armed Forces Overseas | 294.2 | 296.9 | 310.3 | 323.7 | 337.1 | 350.8 | 364.9 | 0.8% |
| Population, aged 16 and over | 229.2 | 231.8 | 244.2 | 254.7 | 265.4 | 276.7 | 288.6 | 0.9% |
| Population, over age 65 | 36.4 | 36.8 | 40.4 | 47.0 | 54.9 | 63.8 | 71.6 | 2.7% |
| Employment, Nonfarm | 131.4 | 133.4 | 141.9 | 147.0 | 154.6 | 162.3 | 169.2 | 1.0% |
| Employment, Manufacturing | 14.3 | 14.2 | 13.8 | 13.7 | 13.4 | 13.0 | 12.5 | -0.5% |
| **Key Labor Indicators** | | | | | | | | |
| Labor Force (millions) | 147.4 | 149.3 | 157.5 | 162.2 | 167.0 | 172.7 | 180.4 | 0.8% |
| Nonfarm Labor Productivity (1992=1.00) | 1.32 | 1.36 | 1.50 | 1.69 | 1.90 | 2.15 | 2.42 | 2.3% |
| Unemployment Rate (percent) | 5.52 | 5.06 | 4.83 | 4.98 | 4.46 | 4.55 | 4.71 | N/A |
| **Key Indicators for Energy Demand** | | | | | | | | |
| Real Disposable Personal Income | 8011 | 8105 | 9568 | 11077 | 13000 | 15172 | 17535 | 3.1% |
| Housing Starts (millions) | 2.08 | 2.22 | 1.94 | 1.91 | 1.90 | 1.85 | 1.80 | -0.8% |
| Commercial Floorspace (billion square feet) | 73.0 | 74.3 | 80.4 | 86.5 | 92.9 | 100.1 | 108.0 | 1.5% |
| Unit Sales of Light-Duty Vehicles (millions) | 16.87 | 16.95 | 17.14 | 18.05 | 19.04 | 20.01 | 21.10 | 0.9% |

GDP = Gross domestic product.
Btu = British thermal unit.
N/A = Not applicable.
**Sources:** 2004 and 2005: Global Insight macroeconomic model CTL0806 and Global Insight industry model, July 2005. **Projections:** Energy Information Administration, AEO2007 National Energy Modeling System run AEO2007.D112106A.

Attachment E
Case No. IPC-E-07-15
Staff Comments
11/26/07

| Percentage Increase in SAR Capital Cost | SAR Capital Cost | 20-year Levelized Avoided Cost Rate | Cumulative Increase in Avoided Cost Rate ($/MWh) | Incremental Increase in Avoided Cost Rate ($/MWh) |
|---|---|---|---|---|
| 0% | 679 | 66.88 | | |
| 5% | 713 | 67.40 | 0.52 | 0.52 |
| 10% | 749 | 67.96 | 1.08 | 0.56 |
| 15% | 786 | 68.52 | 1.64 | 0.56 |
| 20% | 825 | 69.12 | 2.24 | 0.60 |
| 25% | 867 | 69.77 | 2.89 | 0.65 |
| 30% | 910 | 70.43 | 3.55 | 0.66 |
| 35% | 955 | 71.12 | 4.24 | 0.69 |
| 40% | 1003 | 71.86 | 4.98 | 0.74 |
| 45% | 1053 | 72.63 | 5.75 | 0.77 |
| 50% | 1106 | 73.44 | 6.56 | 0.81 |
| 55% | 1161 | 74.29 | 7.41 | 0.85 |
| 60% | 1219 | 75.18 | 8.30 | 0.89 |
| 65% | 1280 | 76.11 | 9.23 | 0.93 |
| 70% | 1344 | 77.10 | 10.22 | 0.99 |
| 75% | 1412 | 78.14 | 11.26 | 1.04 |
| 80% | 1482 | 79.22 | 12.34 | 1.08 |
| 85% | 1556 | 80.35 | 13.47 | 1.13 |
| 90% | 1634 | 81.55 | 14.67 | 1.20 |
| 95% | 1716 | 82.81 | 15.93 | 1.26 |
| 100% | 1802 | 84.13 | 17.25 | 1.32 |




Attachment F
Case No. IPC-E-07-15
Staff Comments
11/26/07

# CERTIFICATE OF SERVICE

I HEREBY CERTIFY THAT I HAVE THIS 26TH DAY OF NOVEMBER 2007, SERVED THE FOREGOING **REPLY COMMENTS OF THE COMMISSION STAFF,** IN CASE NO. IPC-E-07-15, BY MAILING A COPY THEREOF, POSTAGE PREPAID, TO THE FOLLOWING:

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SECRETARY