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EX CCS 4.16
Example Illustrating Need to Derate Minimum Capacity and Adjust Heat Rates

Scenario 1 - No Minimum Loading Constraint
Probabilistic Example

Case	Comb. Prob.	Prob Hunter	Prob Gadsby	State Hunter	mW Hunter	Avg Cost Hunter	Total Cost Hunter	State Gadsby	mW Gadsby	Inc. Cost Gadsby	Avg Cost Gadsby	Total Cost Gadsby	Purchase or Sale mW	Cost/mWh	Total Cost Purchase	Load = Combined mW	Tot. Cost	$/mWh	Error
1	78.2609%	86.9565%	90.0000%	Up	460	11.85	5449	Up	70	67.99	75.88	5311	-30	67.99	(2,039.75)	500	8,721	17.44	
2	8.6957%	86.9565%	10.0000%	Up	460	11.85	5449	Down	0	0	0	0	40	67.99	2,719.66	500	8,169	16.34	
3	11.7391%	13.0435%	90.0000%	Down	0	0	0	Up	70	67.99	75.88	5311	430	67.99	29,236.37	500	34,548	69.10	
4	1.3043%	13.0435%	10.0000%	Down	0	0	0	Down	0	0	0	0	500	67.99	33,995.78	500	33,996	67.99	
Probablity Wtd.	100.0000%				400.0		4,738		63.0		75.88	4,780	37.0		2,516	500	12,034	24.07	0
Derate Method - Unadjusted Heat Rates				Up	400	11.87	4749	Up	70	67.99	75.88	5311	30	67.99	2,039.75	500	12,100	24.20	66
Derate Method - Correct Heat Rates				UP	400	11.85	4738	Up	63	67.99	75.88	4780	37	67.99	2,515.69	500	12,034	24.07	0

Scenario 1 - Minimum Loading Constraint is Binding
Probabilistic Example

Case	Comb. Prob.	Prob Hunter	Prob Gadsby	State Hunter	mW Hunter	Avg Cost Hunter	Total Cost Hunter	State Gadsby	mW Gadsby	Inc. Cost Gadsby	Avg Cost Gadsby	Total Cost Gadsby	Purchase or Sale mW	Cost/mWh	Total Cost Purchase	Load = Combined mW	Tot. Cost	$/mWh	Error
1	90.0000%	100.0000%	90.0000%	Up	360	11.91	4288	Up	40	67.44	82.00	3280	0	67.99	-	400	7,568	18.92	
2	10.0000%	100.0000%	10.0000%	Up	400	11.87	4749	Down	0	0	0	0	0	67.99	-	400	4,749	11.87	
3	0.0000%	0.0000%	90.0000%	Down	0	0	0	Up	40	67.44	82.00	3280	360	67.99	24,476.96	400	27,757	69.39	
4	0.0000%	0.0000%	10.0000%	Down	0	0	0	Down	0	0	0	0	400	67.99	27,196.62	400	27,197	67.99	
Probablity Wtd.	100.0000%				364.0	11.9	4,334.3		36.0		73.8	2,952.0	0.0	#DIV/0!	0.0	400.0	7,286.3	18.2	0
Derate Method - Unadjusted Heat Rates				Up	360	11.91	4288	Up	40	67.44	82.00	3280	0	67.99	-	400	7,568	18.92	282
Derate Method - Correct Heat Rates				UP	364.00	11.91	4334	Up	36.0	67.44	82.00	2952	0	67.99	-	400	7,286	18.22	(0)

RMP DATA REQUEST 8.5:

Excel spreadsheet ex16 appears to be calculating the adjusted heat rate factors based on the derate method. Is this correct? If so please provide this work paper with footnotes to explain how each of the numbers are calculated and where the source documents reside.

CCS RESPONSE TO RMP DATA REQUEST 8.5:

Exhibit 16 is a hypothetical example, with data chosen to provide a reasonably realistic set of scenarios. It shows why the deration adjustment to the heat rate is necessary, but it was not used in the actual calculation of any GRID inputs or any adjustment. The Company was provided the same exhibit in the most recent Wyoming case, as Mr. Falkenberg presented the same analysis there. It illustrates why the deration method must be coupled with the minimum loading deration and heat rate adjustment to properly compute production costs.

Attached is Attachment CCS 8.15-1 which is the worksheet used to create Exhibit 16, previously provided as ex16.xls. Tab labeling and shading have been added to assist the Company in understanding this answer.

This scenario considers a two unit system, where each unit has 2 states – up or down. This is an industry standard improvement on the simplistic deration type of model such as GRID, which assumes only one state for each unit (up with derated capacity.)

In this 2 unit, 2 state system, there are four possible combinations of unit availability. For a system of N units, with 2 states each there are 2^N possible states.

The Tab "Example Data" provides the hypothetical input data used in this example. In the example, Hunter has an EFOR (outage rate) of approximately 13%, while Gadsby has an EFOR of 10%. Hypothetical fuel costs, heat rates etc are also assumed in the example, and shown on Tab Example Data.

In the EX16 Tab various calculations are presented. In rows 6-9 (the turquoise shaded area) the four possible scenarios (Hunter+Gadsby Up), (Hunter Up Gadsby Down), (Hunter Down, Gadsby Up), (Hunter+Gadsby Down). The composite probability of each state is the product of the individual generator state probabilities. For example, the probability of both Hunter and Gadsby running is .78, the product of (1-.13) and (1-.1).

The power cost for one hour based on each of the four states is computed in columns H-T of rows 6-11. The system is assumed to have load that is less than could be provided when both units are running, but if both units are not available, purchases are required. In the case when both units can run, the system can sell 30 mW, as is shown

in r6. The total cost of power is developed based on the least cost dispatch of the 2 units (and balancing of market power). In Column W the total cost of each scenario is computed as the sum of the cost of Hunter and Gadsby plus balancing sales or purchases. Each of the four cases is then weighted by its respective probability

(Column C) to derive a total probability weighted power cost in cell W11.

In summary, this analysis computes the system cost of power under the four possible generator outage states. It then weights each state with the proper probability of occurrence to derive the expected value of power costs. This is essentially the same thing as GRID does with hydro scenarios (except that unlike GRID a correct weight for each system state is used, while GRID uses incorrect equal weights for each hydro state.)

On row 14 of the tab EX16 (shaded in yellow) the power cost calculation is performed using the method found in GRID. It is based on using the deration method as applied in GRID [multiplying the plant maximum capacities by (1-EFOR)] but with NO ADJUSTMENT MADE TO THE HEAT RATE CURVES. The cost for the system is then computed using the same least cost dispatch assumptions as in the 4 state example (which parallels that used in GRID.) It can be seen that the total system cost computed under the derate method without any hear rate adjustment exceeds the costs of the probability weight production cost dispatch by comparing the result in cells W14 and W11.

Row 16 (shaded in Green) presents the same capacity deration dispatch as in Row 14, but the heat rate adjustment advocated by Mr. Falkenberg has been applied to compute fuel costs. This is shown on the Example Data tab in the green shaded area in columns X-AA. The adjustment to the heat rate curves for the two units is shown on the Example Tab in the area g8 to m9.This approach uses the same method as the Company currently uses in GRID for the partially owned units. The adjustment used reflects the equations presented in Mr. Falkenberg's direct testimony. The analysis reveals that if the heat rate adjustment is made, the total production cost in the adjusted deration modeling method (w16) <u>is exactly the same as in the probability weighted method</u>, and less than in the unadjusted GRID deration method, as shown in w14 .

Rows 22-36 present substantially the same analysis, but in this case, it is assumed the Gadsby unit is constrained to run at its minimum loading for operational reasons. The analysis shows that unless the minimum capacity state is derated, as advocated by Mr. Falkenberg, the method applied in GRID will, once again, overstate net power costs as compared to the proper probability weighted production cost dispatch.

These two examples illustrate that the method applied in GRID is incorrect and will overstate production costs unless the two adjustments proposed by Mr. Falkenberg are made. It is for this reason, that the technique described by Mr. Falkenberg should be applied in the deration model, and has been applied in other applications of the model elsewhere, such as by Portland General Electric in its MONET model. Mr. Falkenberg believes as does Mr. Hayet that this type of adjustment is well accepted within the community of production cost modeling experts.

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VII. MODELING ISSUES DEFERRED FROM DOCKET 07-035-93

Q. DID THE COMMISSION DECIDE ALL GRID RELATED ISSUES IN THE 2007 CASE?

A. No. The Commission invited further analysis of two issues in subsequent cases: the minimum loading and heat rate deration adjustment, and the modeling of duct firing in GRID. Mr. Duvall addressed both of these issues in his testimony. However, I don't agree that the Company has satisfactorily resolved these issues.

Q. EXPLAIN HOW GENERATOR OUTAGES ARE REPRESENTED IN GRID.

A. As discussed earlier, GRID uses what is known as the deration method to model outages. Outage rates are assumed to reduce the available capacity. This means that if a unit has 100 MW of capacity, and a 5% outage rate, the unit is represented in GRID as a 95 MW unit that is available 100% of the time. This is an industry standard technique. In effect, GRID replaces the capacity of each unit with its "expected value." The expected value, MW_e, for a unit is computed as shown below:

$MW_e = MW \times (1\text{-}EFOR)$, where EFOR = the outage rate of the unit, and MW is the maximum capacity of the unit.

The above formula is appropriate because it represents a situation where the unit is fully available (i.e., to MW, the maximum capacity) (1-EFOR)[15] percent of the time, and available at zero MW (because it is on an outage) EFOR[16] percent of the time.

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[15] 95% in the example above.
[16] 5% in the example above.

While it is not immediately obvious, proper use of the deration method also requires other adjustments to unit characteristics be made as well. First of all, the unit's *minimum capacity,* MW(min) should also be derated in the same proportion as the *maximum capacity*. The expected value of the minimum capacity, $MW(min)_e$ is given by the formula below:

$$\mathbf{MW(min)_e = MW(min) \times (1\text{-}EFOR).}$$

The simple and intuitive explanation is that unless this adjustment is made, the unit's *minimum* capacity could exceed its *derated maximum* capacity. While this may seem far fetched, it did occur in GRID simulations the Company filed in July, illustrating a serious problem in the Company's modeling.

Q. CAN YOU PROVIDE A SIMPLE EXAMPLE SHOWING WHY THIS ADJUSTMENT IS NECESSARY IN GRID?

A. Yes. Assume a hypothetical situation where a generator is dispatched at 10 MW for a 100 hour period. In this case, it would generate 1000 MWh. Now assume the unit was on forced outage half of that 100 hour period. In that case, it would only generate 500 MWh and have an outage rate of 50%.

If the unit has a maximum capacity of 10 MW, GRID's duration logic would treat it as a 5 MW unit running for all 100 hours. This is the way in which the derate model works. In that case, GRID would show it producing 500 MWh, and it would produce a result that matches with actual operation.

Now, however, assume that the unit really had a maximum capacity of 50 MW, but still had a minimum capacity of 10 MW and the same 50% outage rate. The same unit, dispatched at minimum for 100 hours, with a 50% outage rate would produce 500 MWh of energy. However, in this scenario, GRID would derate the maximum capacity to 25 MW - but it would still model a minimum capacity of 10 MW. This is because GRID would derate the maximum capacity for outages (50%) but would not do so for the minimum capacity. In this case, GRID would show the unit running at minimum capacity all 100 hours and still producing 1000 MWh, *or twice the correct amount.* Clearly, this problem must be fixed in GRID for results to be realistic.

Q. IS THIS THE ONLY ADJUSTMENT REQUIRED?

A. No. There must also be a corresponding adjustment to the heat rates, which is also not being made in GRID. Generating units are represented in GRID using a polynomial heat rate equation:

$$\textbf{Heat input (hour h)} = \mathbf{A+B \times MWh + C \times MWh^2}$$

This is a non-linear equation that expresses the amount of heat consumed by the generating unit as a function of the capacity level that the unit operates at. A, B, and C reflect coefficients that were originally determined in a curve fitting procedure that was used to create the heat rate equation based on actual data obtained from performing tests on the generating unit. Here MWh is the loading of the unit in hour h.

If, for example, the unit is expected to be running at its maximum capacity, GRID's deration logic will multiply the unit's maximum capacity by its EFOR, as discussed above, and will treat it as a smaller unit running at less than full load. Returning to the original example of a 100 MW unit, GRID treats the 100 MW unit as a 95 MW unit for modeling purposes. Without a corresponding adjustment to the heat rate equation, the heat consumptions using the formula stated above will be incorrect, and will lead to an overstatement of the amount of heat consumed. The reason for this is that generating units are generally most efficient at their full loading point. Without an adjustment to the heat rate curve, GRID's deration logic will therefore overstate fuel costs.

This is again related to the concept of expected value. The proper calculation of the expected value of the heat consumption for the 100 MW unit is as follows:

Heat consumed = (A+B x 100 + C x 100^2) times 95% + 0 times 5%.

In effect, the above equation shows that the expected value of the heat consumed should be computed as (1-EFOR) times the heat input at full loading. GRID, however, would compute the heat input as shown below:

Heat consumed (GRID) = A+B x 95 + C x 95^2

While there appears to be only minor differences in the two formulas in the case when a unit is fully loaded, the small differences can add up. Further, because unit efficiencies typically decline as unit loadings decrease (moving down the heat rate curve), ignoring this adjustment will increase NPC. Even worse, not making an adjustment to the heat rate curve could produce absurd results in some cases.

Q. WHAT ADJUSTMENT TO THE HEAT RATE CURVE DO YOU RECOMMEND?

A. In this case, it is necessary to adjust the heat rate curve so that it produces the same heat consumption at the derated maximum and minimum capacities as the unit would actually experience in normal operation at the maximum and minimum ratings. The proper adjustment to the heat rate curve is as shown below:

Heat Rate Curve Adjusted = A x (1-EFOR)+B x MWh+ C/(1-EFOR) x $\mathbf{MW_h^2}$

Fortunately, the Company already supplies an input to GRID which makes this very adjustment. All one really needs to do is to supply GRID with this input for each resource.

Q. HAVE THESE MODELING TECHNIQUES BEEN APPLIED ELSEWHERE?

A. Yes. In its MONET model, Portland General Electric ("PGE") applies the very type of technique I am proposing. Exhibits CCS 4.7a, 4.7b and 4.7c show data responses from a 2008 PGE case (OPUC Docket No. UE 197), confirming this fact. Further, In Docket No. 07-035-93, CCS witness Philip Hayet also testified that the method I am proposing is well accepted in the community of production cost modeling experts. Finally, I also testified that I applied the method in a production simulation model that enjoyed substantial industry acceptance more than 25 years ago.

Ironically, PacifiCorp itself actually applies both of these techniques (adjusting minimum capacity and heat rate) to fractionally owned units such as Colstrip. From a modeling perspective, fractional ownership is the same thing as capacity duration. There is no reason why the Company should apply the technique for fractionally owned units, while ignoring them for units that are modeled as a fraction of their total capacity. If one thinks of forced outages as a "co-owner" of the resource, that has a call on its output 5 or 10% of the time, it is easy to see why the modeling should in fact, be the same as for fractionally owned units.

Q. CAN YOU PROVIDE AN EXAMPLE ILLUSTRATING THIS PROBLEM?

A. Yes. In the Company's July GRID study, it modeled a monthly outage rate. For May 2009, the Company assumed an outage rate of 50% for Currant Creek. Applying that outage rate in GRID reduced the maximum capacity of the plant to around 210 MW. In the GRID modeling for May, 2008 the Company showed the unit running at 210 MW nearly all of the time. This is far less than the assumed minimum loading for the plant (340 MW), and resulted in an average heat rate for the unit of 9,184 BTU/kWh for the month. This result clearly is far in excess of what would normally occur for the plant in conventional operation (which typically averages 7,300 BTU/kWh.)

This problem stems from the unrealistic modeling of the unit with a large outage rate without making any corresponding adjustment to the minimum loading levels or the units heat rate curve. The Company would have exactly the same issue were it to model fractionally owned units without this adjustment. For this reason, the Company should make both the minimum loading and heat rate duration adjustments for all units which have non zero outage rates.

Q. HAVE YOU PREPARED AN ANALYSIS THAT TESTS THE REASONABLENESS OF THE COMPANY MODELING BASED ON ACTUAL DATA AND EVENTS?

A. Yes. I did several GRID simulations using the July filing, focusing on May 2009, which assumed a 50% outage rate for Currant Creek. This was used because

Currant Creek was off line most of May 2006, and on line nearly all of May 2007, the two years used by the Company to compute the Currant Creek outage rate.

To test the reasonableness of the standard GRID modeling I did one scenario using my proposed method, a scenario where Currant Creek was off line half the time in May 2009 (a logical way to represent a 50% outage rate) and scenarios with the plant on all month and off all month. The latter two scenarios can be averaged to result in a 50% availability case, again comparable to the Company's assumed outage rate.[17] If the GRID modeling is correct, the results from the standard method should be close to those obtained from the scenarios with Currant Creek out half the time, or based on the average of the fully on and fully off scenarios. However, the final results show GRID actually overstated the expected NPC (by \$1.4-\$1.7 million) and Currant Creek heat rates compared to the two logical alternative modeling methods and my proposed method. Further, the actual composite heat rate for Currant Creek for May 2006 and May 2007 was 7,310 BTU/kWh, which compares well with the result under all modeling methods (including mine) except the Company's standard approach. As noted above, the GRID model showed a heat rate for Currant Creek of 9,184 BTU/kWh. I think this demonstrates that the GRID logic is faulty, as its predicted results are the outlier. Exhibit CCS 4.8 shows the results of this analysis.

Q. THE COMPANY USED THE MONTHLY OUTAGE RATES BY MISTAKE IN ITS JULY FILING. HAS THE COMPANY SOLVED THIS PROBLEM BY ELIMINATING THE ERRONEOUS MONTHLY OUTAGE RATES IN ITS SUBSEQUENT FILINGS?

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[17] Note that there were very few durations during May 2006 and 2007, and duration events are uncommon for combined cycle plants in general.

A. No. The problem remains. It is simply *less obvious* because the extremely high May outage rate is now blended in with all the other months. This means that instead of May showing an obviously overstated heat rate in GRID, the heat rate for each individual month is overstated by a less noticeable amount.

Q. IN ITS ORDER IN DOCKET NO. 07-035-93 THE COMMISSION STATED IT WANTED TO EXAMINE THIS ISSUE FURTHER BEFORE ADOPTING IT. HAS THE COMPANY DISCUSSED THE ISSUE IN ITS TESTIMONY?

A. Yes. Mr. Duvall continues to argue that no adjustment is needed. Mr. Duvall has made a number of arguments concerning this issue. Mr. Duvall has made three basic points: 1.) Derating the minimum capacity would allow the model to simulate operation below its actual minimum, which he says the units can never achieve. Mr. Duvall warns this will produce unrealistic results; 2.) The adjustment I propose does not work properly because it ignores partial outages which result in units being derated but not completely out of service; 3.) Comparison of actual heat rates to GRID heat rates shows that no further adjustment is needed.

Q. HOW DO YOU RESPOND TO MR. DUVALL'S FIRST ARGUMENT?

A. First, the Company's modeling in GRID already allows a unit to run at a level below its minimum capacity rating, as was shown in the example of Currant Creek above. As long as the outage rate is high enough, GRID will allow units to run below its rated minimum capacity. Mr. Duvall does not seem to view this as a problem, and has proposed no correction for it.[18]

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[18] Correcting this problem would decrease NPC, as it would be equivalent to placing a limit on outage rates.

Second, Mr. Duvall objects to derating the minimum because it allows the model to let a unit run at a level it can never achieve. However, GRID already derates the maximum capacity even though that prevents the unit from *ever* running at a capacity it actually *can achieve*. If derating the minimum is unrealistic, then derating the maximum is as well.

Third, Mr. Duvall explicitly adopts the concept of "expected value" (which he calls a "hair cut") when GRID reduces the *maximum* capacity of resources below their physical limits, but would have the model ignore it for the equally valid issue of applying the minimum capacity. In CCS 29.16 and 29.17, I asked Mr. Duvall regarding the concept of expected value as applied to minimum and maximum capacities. Mr. Duvall did not provide an answer regarding maximum capacity ratings, simply returning to his argument concerning the physical limits for generator minimums. Ultimately, either the Company is correct in using the concept of expected value of capacity in GRID, or it isn't. If it is (and most experts believe it is), then unit minimum capacities should be derated just the same as the unit maximum capacity.

Q. DOES MR. DUVALL HAVE A POINT CONCERNING PARTIAL OUTAGES?

A. Yes. I agree that it is more proper to recognize that when partial outages occur, they are less likely to impact the minimum loading of a unit. As a result, I removed partial outages from my computations in performing this adjustment. This is different from the method I applied in Docket No. 07-035-93, and it serves to reduce the impact of this adjustment. I informed the Company last summer that I would be proposing this refinement.

Q. PLEASE DISCUSS MR. DUVALL'S ARGUMENT CONCERNING THE COMPARISONS TO ACTUAL HEAT RATES SHOWN IN EXHIBIT GND-4SS.

A. There are three important points. First, Mr. Duvall's figures shows the minimum loading and heat rate adjustment has very little impact on coal plants. In fact, the overall change to heat rates is far less than one half of one percent. At best, Mr. Duvall's limited data demonstrate that this issue is a "toss up" for coal units. However, noticeably *absent* from Mr. Duvall's heat rate comparison were the Company's gas units.[19] GRID consistently overpredicts the heat rates of gas units, and the minimum loading and heat rate adjustment really *enhances, rather than diminishes,* the overall accuracy of heat rates results simulated in GRID. Finally, my current method has been refined to more properly recognize partial outages.

The table below shows a comparison of the GRID simulation results and actual heat rates with and without this proposed adjustment. As the table shows, the Company's modeling method is not accurate when applied to gas units, which cycle more often. The Table shows that as concerns coal plants, there is really little basis for choosing between the two methods based on comparison to actual heat rates. However, when gas units are included, the method does produce more realistic results than the Company method. Overall, the use of the derate adjustments improves the system average heat rate results as compared to the current method modeled in GRID. I recommend the Commission adopt this adjustment and the impact is shown on item 21 on Table 1.

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[19] Considering that Mr. Duvall himself has testified that the impact on coal plants is minor because they are us normally "in the money", it's puzzling that he would focus on coal plants for his analysis.

Table 3 – Comparison of Actual to GRID Heat Rates (BTU/kWh)

	Actual Data	Company Method	Derate Method
Coal Average	10,700	10,712	10,688
Coal Weighted	10,609	10,619	10,595
Gas Average	9,063	9,541	9,493
Gas Weigthed	7,387	7,509	7,461
Coal + Gas Avg.	9,882	10,126	10,091
Coal + Gas Wtd.	10,048	10,077	10,050

Q. ARE THERE ANY OTHER PROBLEMS WITH THE MODELING OF COMBINED CYCLE UNITS IN GRID THAT WERE DEFERRED IN DOCKET 07-035-93?

A. Yes. The Commission invited further investigation of this issue in subsequent dockets.

In GRID the Company models the duct firing capabilities of Currant Creek and Lake Side as generation resources that are independent of the underlying Combustion Turbines ("CT") and Heat Recovery Steam Generators ("HRSG"). This has created problems where the duct firing capacity runs at times when the combustion turbines and steam generator are not running.[20] Mr. Duvall testifies that this problem has now been addressed because the plant as a whole uses the same screens.

A more serious problem is that GRID frequently shows duct firing operation of Currant Creek and Lake Side when the CTs and HRSGs of these units are operating at their minimum loading. This is neither an economical nor realistic mode of operation, as duct firing capability has a higher heat rate than the

[20] See the response to CCS 6.41, Docket No. 07-035-93.

This is again, related to the concept of expected value. The expected value of the heat input for the 100 mW unit is as follows:

Heat input = (A+B x 100 + C x 100^2) times 95% + 0 times 5%.

In effect, the above equation shows that the expected value of the heat input should be computed as (1-EFOR) times the heat input at full loading. GRID, however, would compute the heat input as shown below:

Heat Input (GRID) = A+B x 95 + C x 95^2

While it appears to be a rather minor adjustment in the case where a unit is fully loaded, it can be very important in some cases. Further, because unit efficiencies typically decline as unit loadings decrease (moving down the heat rate curve), ignoring this adjustment will increase NVPC. Even worse, not making this type of adjustment can produce absurd results in some cases.

Q. PLEASE EXPLAIN.

A. As discussed earlier, in GRID, it was assumed Gadsby Unit 1 would have a rather large EFOR in June 2008. When the derated capacity of the unit was included in GRID, it amounts to only 574 kW (as compared to its normal minimum capacity in GRID of 27,000 kW). *As a result, in GRID the unit was assumed to have a fuel cost, based on this level of output, of $1288/mWh, or about 129 cents per kWh!* Despite this absurdly high cost, it was assumed in GRID that the unit would be dispatched 147 hours in June 2008. Exhibit RJF-16 shows some of the hourly results for this simulation. Clearly, no real time operator in his right mind would ever dispatch a unit at only a fraction of its minimum loading, and at such a ridiculously high cost. In reality, it never did happen that way, and Confidential Exhibit RJF-15, discussed above, also shows the actual dispatch of Gadsby Unit 1 that occurred during the four year period. While this may seem to be an extreme circumstance it is by no means unique. For example, in the case of Currant Creek, a similar problem is apparent. In the month of May, 2008, when the unit was assumed to be running below its minimum loading (because the maximum was derated below the minimum) the average heat rate for the month was higher than any other month during the year, and 3.6% *higher* than the plant's heat rate at its assumed minimum loading (340 mW) as well.

Q. WHAT SHOULD BE DONE?

A. In this case, it is necessary to adjust the heat rate curve so that it produces the same heat input at the derated maximum and minimum capacities, as the unit would actually experience in normal operation. The proper adjustment to the heat rate curve is as shown below:

Heat Rate Curve Adjusted $= A \times (1\text{-}EFOR) + B \times mW_h + C/(1\text{-}EFOR) \times mW_h^2$

Q. HAVE YOU PREPARED AN EXHIBIT THAT PROVIDES A MORE DETAILED ANALYSIS JUSTIFYING THESE INPUT CHANGES TO GRID?

A. Yes, Exhibit RJF-17 presents an example that further demonstrates why these adjustments are correct and proper. It shows that unless these adjustments are made to GRID it will overstate NVPC using a series of outage scenarios.

Q. HAVE YOU MADE THESE ADJUSTMENTS TO GRID?

A. Yes, the values for these adjustments are shown as Item I.G.18 and 19 on Table 1.