

BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

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In the Matter of the Voluntary Request of	)	
Rocky Mountain Power for Approval of	)	
Resource Decision to Construct Selective	)	Docket No. 12-035-92
Catalytic Reduction Systems on Jim	)	
Bridger Units 3 and 4	)	DPU Exhibit 2.0 Dir
	)	

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PRE-FILED DIRECT TESTIMONY

GEORGE W. EVANS

ON BEHALF OF THE

UTAH DIVISION OF PUBLIC UTILITIES

November 30, 2012

**REDACTED**

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3 DIVISION OF PUBLIC UTILITIES

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5 **INTRODUCTION**

6

7 **Q. Please state your name, business address, employer, and current position or**  
8 **title for the record.**

9 A. My name is George W. Evans, and my business address is 358 Cross Creek Trail,  
10 Robbinsville, North Carolina 28771. I am the President of Evans Power  
11 Consulting, Inc.

12 **Q. For whom are you providing testimony in this case?**

13 A. I am providing testimony on behalf of the Utah Division of Public Utilities (DPU  
14 or Division).

15 **Q. Please describe your education and work experience.**

16 A. I received a Bachelor of Science in Applied Mathematics from the Georgia  
17 Institute of Technology in 1974. In 1976, I received a Master of Science in  
18 Applied Mathematics, also from the Georgia Institute of Technology. My area of  
19 concentration was probability and statistics. In 1980 I joined Energy  
20 Management Associates, Inc. (EMA), the company responsible for the  
21 development of the premier electric utility modeling tools, PROMOD<sup>®</sup>,  
22 PROSCREEN<sup>®</sup>, PROVIEW<sup>®</sup> and MAINPLAN<sup>®</sup>. While at EMA, I worked with  
23 some fifty (50) major electric utilities in the United States and Canada in the

24 application of these modeling tools for generation expansion planning, the  
25 development of net power costs, fuel budgeting, the analysis of power purchases  
26 and the development of optimal maintenance schedules for generating units.

27 In 1989 I left EMA to join GDS Associates, Inc., a consulting firm located in  
28 Marietta, Georgia. At GDS I was a principal and the Manager of System  
29 Modeling. In this position I was primarily responsible for performing analyses  
30 and presenting expert testimony concerning integrated resource planning, the  
31 forecasting of system production costs, developing estimates of the likelihood of  
32 service interruptions, developing estimates of replacement power costs and related  
33 activities.

34 In August of 1997 I left GDS to join Slater Consulting as a Vice President. In  
35 December of 2011, I left Slater Consulting to form Evans Power Consulting, Inc.

36 **Q. Where have you testified before?**

37 **A.** I have provided expert testimony on 41 previous occasions, before the public  
38 utility commissions in Pennsylvania, Georgia, Michigan, Arkansas, South Dakota,  
39 Colorado, Illinois, Mississippi, Alabama, Delaware, South Carolina and  
40 Oklahoma; and also before the FERC (Federal Energy Regulatory Commission),  
41 and in state court and federal court. A complete list of the proceedings that I have  
42 testified in is included in DPU Exhibit 2.1.

43 **Q. Have you appeared before the Public Service Commission of Utah (the**  
44 **Commission) in the past?**

45 **A.** Yes, I have. I presented testimony on behalf of the DPU in the last three Rocky  
46 Mountain Power Company (the Company) general rate cases – Docket Nos. 09-  
47 035-23, 10-035-124, and 11-035-200, and also served as the DPU’s consultant on  
48 net power cost issues in the Company’s two 2010 major plant addition cases.

49 **PURPOSE OF TESTIMONY**

50 **Q. What is the purpose of your testimony in this proceeding?**

51 **A.** The purpose of my testimony is to present my findings on the validity of the  
52 Company’s analyses supporting its decision to construct selective catalytic  
53 reduction systems (SCRs) for two of the Company’s coal-fired generating units –  
54 Jim Bridger 3 and 4.

55 **Q. Can you please summarize your findings?**

56 **A.** The Company’s analyses presented in the direct testimony of Mr. Rick T. Link  
57 are flawed and cannot be solely relied upon to support the Company’s request for  
58 approval of the construction of the SCRs for Jim Bridger units 3 and 4. Mr. Link’s  
59 analyses rely on the Company’s System Optimizer model (SO Model), and results  
60 produced using the Company’s SO Model. In my testimony, I discuss the  
61 following problems concerning the Company’s analyses:

- 62 • The Company’s SO Model results do not reflect the actual operations  
63 of the PacifiCorp system.

64  
65

- The Company made a series of substantial after-the-fact manual adjustments to the SO Model results.

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- The Company's adjustment for recent changes in natural gas prices and wholesale market prices is not reasonable.

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- The Company admits to two errors identified by the Office of Consumer Services (OCS or Office) in discovery.

70

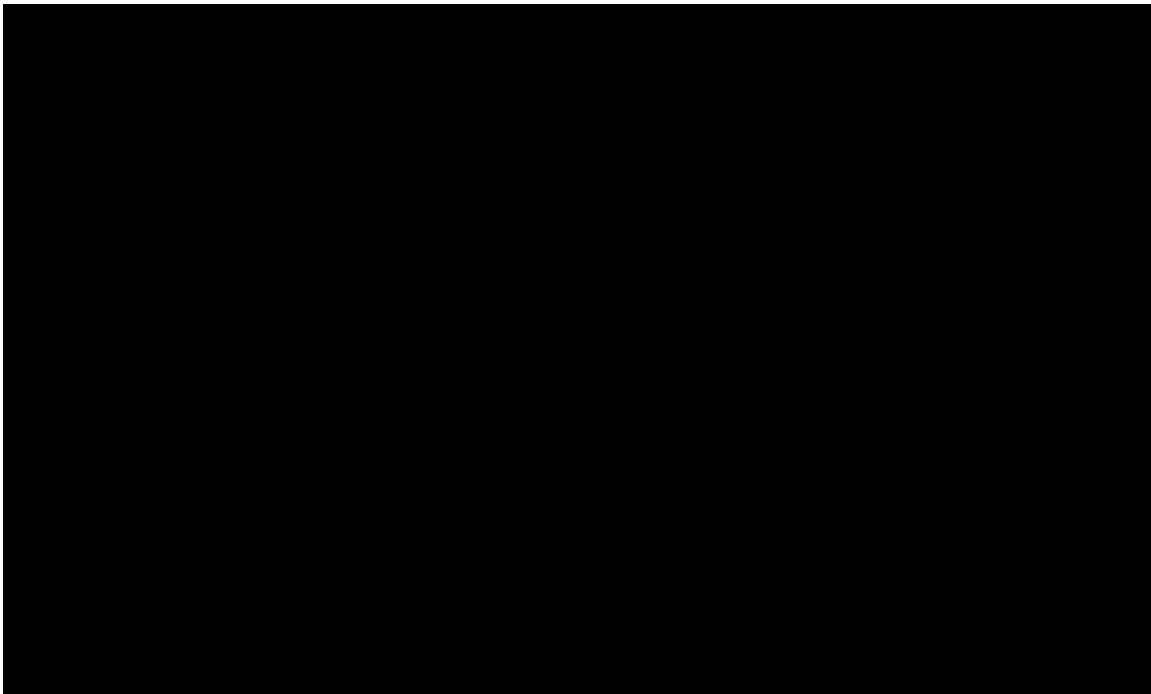
- The Company fails to consider risk in any quantitative manner.

71

72 **ACTUAL OPERATIONS**

73 **Q. Please describe your issues concerning whether the SO Model results reflect**  
74 **actual operations.**

75 A. As with any simulation model, it is extremely important that the model is a  
76 realistic representation of the actual operation of the PacifiCorp system. If the  
77 Company's SO Model does not produce realistic results, then one cannot depend  
78 upon any of the results produced by the Company's SO Model. The most glaring  
79 error in the Company's SO Model is the simulation of the Wyodak coal-fired  
80 plant. The following chart compares the actual Wyodak generation for the years  
81 2006 through 2011 to the Wyodak generation produced by the SO Model in the  
82 years 2011 through 2015.



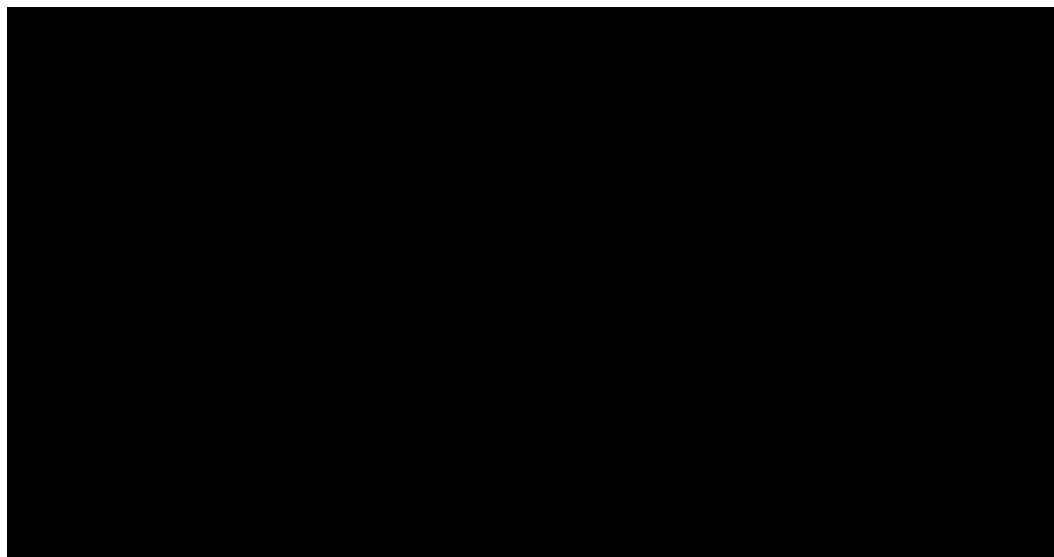
84 Clearly the Company's SO Model greatly exaggerates the generation produced by  
85 the Wyodak plant.

86 **Q. Is the Company's SO Model Wyodak generation even feasible?**

87 A. No, it is not. Even if Wyodak were to operate perfectly, without any planned  
88 outages or forced outages, the maximum annual generation could not exceed  
89 approximately 2,400,000 megawatt-hours. However, according to the SO Model  
90 results produced by the Company, Wyodak can be expected to routinely produce  
91 over [REDACTED] megawatt-hours through the year 2030. In the most recent five  
92 years (2006 through 2011), Wyodak actual annual generation has averaged  
93 slightly more than 2,000,000 megawatt-hours.

94 **Q. What other problems do you see with the Company's SO Model?**

95 A. The SO Model results produced by the Company greatly underestimate the  
96 generation of the Gadsby plant, as shown in the following chart:



97

98 The Company's SO Model predicts [REDACTED] from the Gadsby plant in  
99 2011, and levels of generation in the following years that are [REDACTED] of actual  
100 historic generation levels.

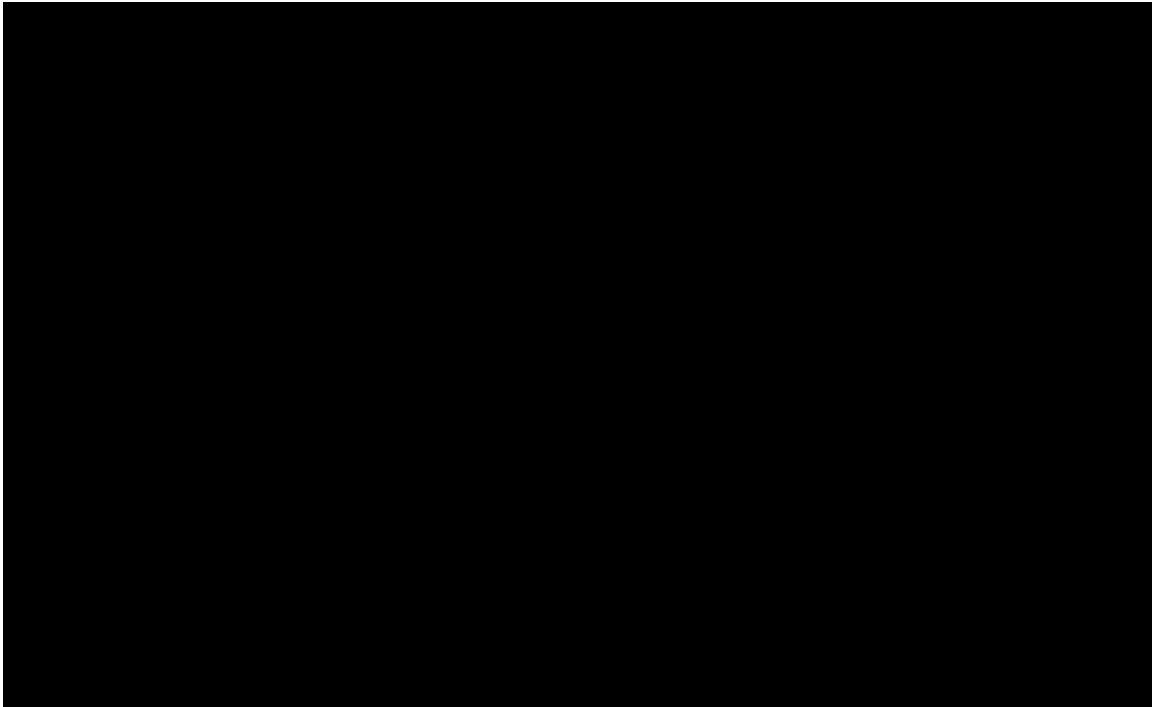
101 **Q. Does the Company contend that certain Gadsby units must operate?**

102 A. Yes it does. The Company states that the Gadsby combustion turbines (units 4, 5  
103 and 6) are required to operate – see the Company's response to OCS Data Request  
104 1.30, attached as DPU Exhibit 2.2. It appears that this requirement has not been  
105 included in the Company's SO Model.

106 **Q. Are there other generating units that are required to operate, according to**  
107 **the Company?**

108 A. Yes – the Company also states that the Currant Creek gas plant is required to  
109 operate, based on the results of the 2010 Wind Integration Study (see DPU  
110 Exhibit 2.2). However, as with the Gadsby plant, the Company's SO Model  
111 results do not conform with this requirement, as shown in the following chart:

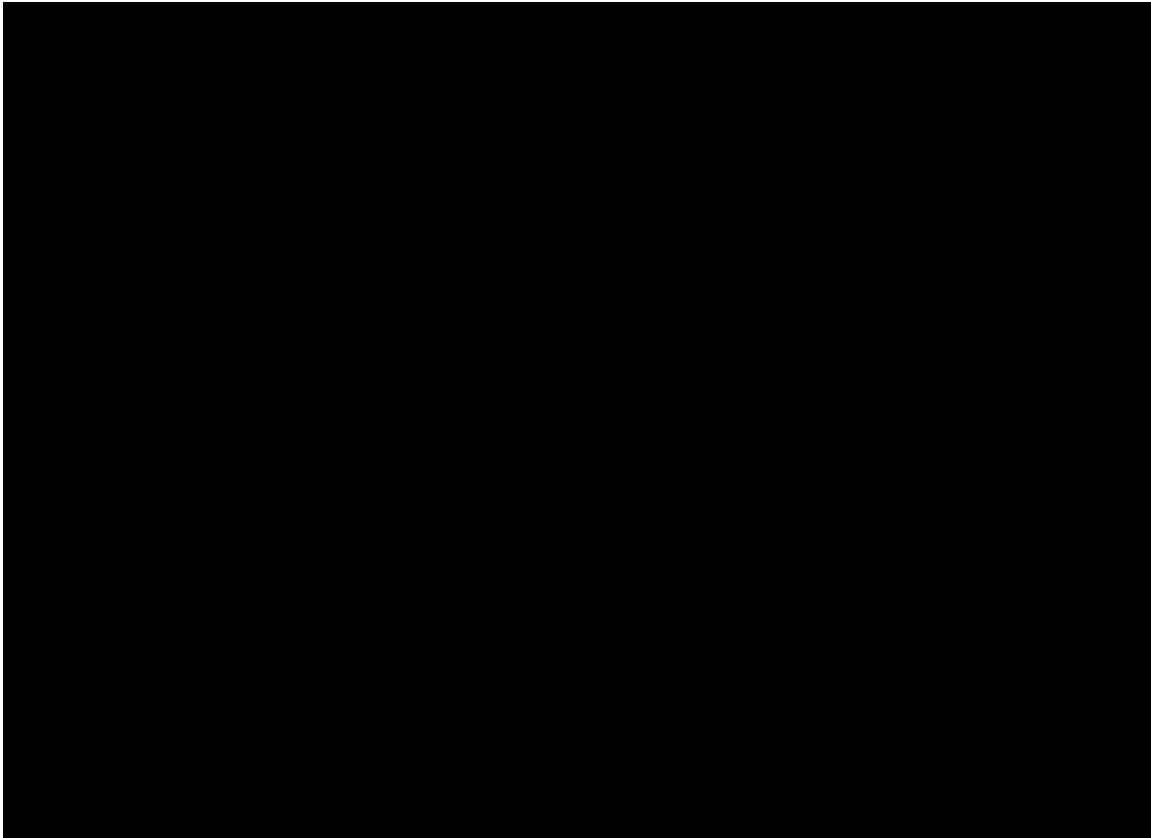




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113 **Q. Does the Company's SO Model produce reasonable fuel costs?**

114 A. No, it does not. For the calendar year 2011, actual natural gas fuel costs  
115 (according to the Company's 2011 FERC Form 1) totaled \$377 million. Yet in the  
116 Company's SO Model, the amount is only \$█ million. So the total 2011 natural  
117 gas costs estimated by the Company's SO Model represent only █ of the actual  
118 natural gas costs. In addition, for three of the Company's coal plants (including  
119 the Bridger plant), the 2011 average fuel costs vary substantially from actual  
120 average fuel costs, as illustrated in the following chart:



121

122 **Q. Does the Company agree that it is important that SO Model results be**  
123 **reasonable when compared to actual results?**

124 A. Yes. As shown in the Company’s response to DPU Data Request 7.1 (attached as  
125 DPU Exhibit 2.3), the Company states that “A routine validation step for System  
126 Optimizer studies is to review plant generation and capacity factors for  
127 reasonableness based on the input assumptions and resource expansion options  
128 used for specific model runs.” So the Company apparently believes it is a “routine  
129 validation” to ensure that SO Model results are reasonable when compared to  
130 actual results.

131 **Q. Did the Company accomplish this routine validation?**

132 A. No. As shown above, the Company did not ensure that the SO Model results were  
133 reasonably close to actual results.

134 **Q. Does the Company agree with your findings in this regard?**

135 A. The Company agrees that the SO Model results for the Wyodak coal plant are  
136 incorrect, as shown in the Company's responses to DPU Data Requests 9.1 and  
137 9.2, which are attached as DPU Exhibit 2.4.

138 **Q. Does the Company agree that the SO Model should be corrected and the**  
139 **analyses redone?**

140 A. No. As shown in the Company's response to DPU Data Request 9.1 in DPU  
141 Exhibit 2.4, the Company claims that the Wyodak error would not significantly  
142 impact the Company's analyses.

143 **Q. Do you agree?**

144 A. No. Correcting this error alone will significantly alter the dispatch of the  
145 PacifiCorp system and impact the levels of wholesale purchases and sales. This in  
146 turn will impact the SO Model's selection of new generating capacity in future  
147 years, further altering the system dispatch and wholesale purchases and sales. If it  
148 were possible to predict the results of the SO Model as easily as the Company  
149 claims, there would be no need to utilize the model.

150 **Q. What can you conclude regarding the Company's SO Model?**

151 A. The Company's SO Model has not been properly tuned to produce reasonable  
152 results. As a result, the Company's claim that the SO Model analyses support the  
153 construction of SCRs at Bridger units 3 and 4 is unsubstantiated.

154 **MANUAL ADJUSTMENTS**

155 **Q. What manual adjustments does the Company make to its SO Model results?**

156 A. The Company made a series of manual adjustments, in a spreadsheet developed  
157 for this purpose, to its SO Model results after completion of all SO Model runs:

- 158 • Increased the cost of coal to the remaining Bridger coal units, should  
159 Bridger 3 and/or 4 be converted to natural gas or retired
- 160 • Modified the Bridger coal mine capital costs for all scenarios
- 161 • Reduced the construction cost of the SCRs
- 162 • Reduced the costs to convert Bridger 3 and 4 to natural gas

163 **Q. What was the impact of all of these manual after-the-fact adjustments?**

164 A. The Company claims that, under base case assumptions, the SO Model shows a  
165 [REDACTED] million savings from the installation of SCRs at Bridger units 3 and 4<sup>1</sup>.

166 Without the manual after-the-fact adjustments to the SO Model results, the base  
167 case results show a [REDACTED] million savings from the installation of SCRs at Bridger  
168 units 3 and 4. The manual after-the-fact adjustments to the SO Model results  
169 increased the claimed savings by [REDACTED].

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<sup>1</sup> See lines 27-31 on page 2 of Mr. Link's direct testimony.

170 **Q. Is it reasonable to apply these manual adjustments to the SO Model results?**

171 A. No, it is not. In fact, it brings into question the Company's claims concerning its  
172 SO Model results. Mr. Link's testimony presents results (such as the [REDACTED] million  
173 savings) as if the results came directly from the SO Model when in fact, the  
174 claimed savings are the result of substantial manual, after-the-fact adjustments to  
175 the SO Model results.

176 **Q. How should the Company account for these adjustments?**

177 A. The Company should have made additional SO Model runs to properly account  
178 for these adjustments. In particular, the increase in Bridger coal costs when  
179 Bridger 3 and/or 4 are converted to natural gas or retired cannot be correctly taken  
180 into account without re-running the SO Model. The increased Bridger coal cost  
181 will modify the dispatch of all other generating units in the PacifiCorp system and  
182 also impact the system's wholesale power imports and exports. Making such an  
183 adjustment manually through a spreadsheet is not feasible. Other adjustments that  
184 do not impact system dispatch could alter the SO Model's selection of the optimal  
185 alternative concerning Bridger units 3 and 4.

186 **Q. What is the basis for the increased Bridger coal costs?**

187 A. The Company assumed that, in the event Bridger unit 3 and/or unit 4 do not  
188 continue to burn coal, there will be no market for the coal that would have  
189 supplied Bridger units 3 and 4. Therefore the Bridger mine coal that would have  
190 supplied Bridger units 3 and 4 will no longer be mined, surface mining will be

191 halted and the reclamation of the Bridger surface mining operation will need to  
192 begin immediately, driving the costs of the Bridger mine coal upward. On the  
193 other hand, if the Bridger units 3 and 4 continue to operate as coal units, the  
194 surface mining will continue.

195 **Q. What is the impact of this assumption on the SCR analyses?**

196 A. This assumption (according to the Company's analyses) increases the cost of the  
197 conversion of Bridger 3 and 4 to natural gas by [REDACTED] million.

198 **Q. Is the Company's assumption reasonable?**

199 A. It does not appear to be reasonable. The Company's assumption is that, in  
200 essence, if Bridger units 3 and/or 4 do not continue to operate as coal-fired units,  
201 the Bridger coal mine will be forced to abandon the surface mining of Bridger  
202 coal and dramatically reduce recovery of underground coal that would be mined  
203 otherwise.

204 **Q. Has the Company produced sufficient evidence that no market exists for  
205 excess Bridger coal?**

206 A. No. It appears that the Company has not seriously considered the international  
207 market or the possibility that other Company coal plants could utilize the excess  
208 Bridger coal. See the Company's responses to relevant data requests in DPU  
209 Exhibit 2.5. At worst, it appears that the Company could continue to extract small  
210 quantities of coal through surface mining, delaying the immediate need for  
211 reclamation. At best, the Company could potentially find a market, whether local

212 or long distance, for excess Bridger coal. The Company's analysis considered  
213 neither of these possibilities.

214 **FORWARD PRICE CURVE ADJUSTMENT**

215 **Q. How did the Company adjust its results for more recent natural gas and**  
216 **wholesale energy prices?**

217 A. As shown in Exhibit RMP\_\_\_(RTL-6), the Company assumed a linear  
218 relationship exists between the price of natural gas and the net savings of  
219 installing SCRs at Bridger units 3 and 4. Based on this assumed relationship, and  
220 using the Company's June 2012 official forward price curve, the Company  
221 predicts that the savings from the installation of the SCRs will be [REDACTED] million<sup>2</sup>.

222 **Q. Is this a reasonable methodology?**

223 A. No, it is not. Given the complexity of the question before the Commission, it is  
224 not reasonable to base a revised result on such a simplistic assumption.

225 **Q. What method would be reasonable?**

226 A. The Company should produce complete revised SO Model results using the most  
227 recent Company forecast of natural gas prices and wholesale market prices. In  
228 addition, the high and low gas price forecasts should be revised, based on the  
229 Company's most recent forecast.

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<sup>2</sup> See lines 464-468 on page 23 of Mr. Link's direct testimony.



231 **OTHER ERRORS**

232 **Q. What other errors in the Company's analyses have been identified?**

233 A. Through the discovery process, the Company has agreed to errors identified by  
234 the Office concerning the Bridger mine capital costs and the inclusion of certain  
235 capital costs in the conversion of the Bridger units to natural gas, as shown in the  
236 Company's responses to OCS data requests in DPU Exhibit 2.6. This admission  
237 adds weight to the need for the Company to perform corrected SO Model  
238 analyses.

239 **RISK**

240 **Q. Did the Company consider risk and uncertainty in its analyses?**

241 A. The Company does perform a series of cases, in which it varies the forecasted  
242 price of natural gas and the forecasted cost of CO2 emissions, but the Company  
243 does not produce a result that is adjusted for risk and uncertainty. The following  
244 table shows the results of the Company's analyses expressed as claimed savings  
245 (in millions of dollars) arising from the installation of the SCRs at Bridger units 3  
246 and 4.

	Low Gas	Base Gas	High Gas
Low CO2		\$402	\$1,337
Base CO2	(\$116)	\$313	\$1,155
High CO2	(\$276)	(\$41)	

247

248 Four of the Company's cases show claimed savings from the SCR installations,  
249 and three cases show claimed losses (costs that exceed the next best option). So  
250 the Company claims that the SCR installations are the preferred option under four  
251 of the seven cases evaluated.

252 **Q. How would you recommend that the Company consider risk and**  
253 **uncertainty?**

254 A. To produce a result that weighs risk and uncertainty, the Company should assign a  
255 probability to each case representing the likelihood that each case will actually  
256 occur, and then multiply the savings from each case by the probability of  
257 occurrence for that case, and add the results. This process produces a risk-  
258 weighted result. In addition, for completeness, the Company should perform the  
259 two missing analyses shown in the table – the Low CO2/Low Gas case and the  
260 High CO2/High Gas case.

261 **Q. Can you provide an example of this process?**

262 A. Yes. The first step would be to assign probabilities to the low, base and high  
263 scenarios for each of the two variables – gas prices and CO2 prices, as in the  
264 following table:

	Low	Base	High
Gas Prices	30%	50%	20%
CO2 Prices	20%	50%	30%

265

266 In this example, I've assumed that the base scenario is the most likely, and that  
267 lower gas prices are more likely than higher gas prices. For CO2, I've assumed  
268 that higher CO2 prices are more likely than lower CO2 prices. The next step is to  
269 use these probabilities to compute the probabilities for each of the nine SO Model  
270 results, by multiplying the probabilities from this table to create the following  
271 table of probabilities:

	Low Gas	Base Gas	High Gas
Low CO2	6%	10%	4%
Base CO2	15%	25%	10%
High CO2	9%	15%	6%

272

273 For example, the probability for the Low CO2/Low Gas case is computed by  
274 multiplying 30% and 20% from the previous table, arriving at 6%. Finally, the  
275 probability in each cell of this table is multiplied by the SO Model result for that  
276 case and the resulting values are summed together. The sample risk-weighted  
277 result, using the Company's values, is \$239 million. Of course, it's important to  
278 have a complete set of SO Model results, rather than the partial set supplied by the  
279 Company.

280

281 **CONCLUSIONS AND RECOMMENDATIONS**

282 **Q. What do you conclude regarding the Company's analyses?**

283 A. The Company's analyses are flawed and cannot be relied upon for a decision  
284 concerning the Bridger SCRs.

285 **Q. What do you recommend?**

286 A. I recommend that the Commission require the Company to perform revised  
287 analyses using the SO Model that include the following:

- 288 • Revisions to the Company's SO Model so that results properly reflect  
289 actual PacifiCorp operations
- 290 • Removal of all after-the-fact manual adjustments to SO Model results
- 291 • Inclusion of the Company's most recent natural gas price forecast and  
292 wholesale market price forecast as the base case price forecast
- 293 • Adjustments to the low and high natural gas forecasts based on the  
294 Company's latest natural gas price forecast
- 295 • Corrections to errors identified by the Office through discovery
- 296 • A complete set of SO model results, for all nine scenarios
- 297 • A quantified risk-weighted result

298 **Q. Does this complete your testimony?**

299 A. Yes it does.