

DESCRIPTION OF POTENTIAL HEDGES

Experiment 1:

Equations 1-P and 1-O on page PacifiCorp/32, Cicchetti/4 test the usefulness of using spot Palo Verde prices as hedges for COB at peak (P) and off-peak (O) times. These two geographic markets have correlated prices of .98 (SQRT .969) and .95 (SQRT .917), respectively. This makes them potential hedges. However, their efficiency is high enough that I would have accepted them while also considering other potential hedges.

Experiment 2:

Equations 2-P-C and 2-O-C on page PacifiCorp/32, Cicchetti/5 test the usefulness of using spot natural gas prices at Henry Hub as hedges for spot COB electricity prices. These would be potential hedges.

Equations 2-P-P and 2-O-P on page PacifiCorp/32, Cicchetti/6 test the use of these same Henry Hub spot natural gas prices for Palo Verde spot electricity prices. These both would have been potential hedges for electricity at Palo Verde. However, I would have attempted to find more efficient hedges because these price correlations were just under .6 (SQRT .36).

Experiment 3:

The next category of hedges that I would have analyzed would be futures contracts. Equations 3-P-C on page PacifiCorp/32, Cicchetti/7 and 3-O-C on page PacifiCorp/32, Cicchetti/8 test the efficiency of 12-month futures contracts at COB against monthly spot Peak and Off-Peak prices at COB. These futures

1 contracts have a correlation of about .7 (SQRT .5). Accordingly, I considered
2 other potential hedges.

3 **Experiment 4:**

4 The hedges shown in equations 4-P-P on page PacifiCorp/32, Cicchetti/9
5 and 4-O-P on page PacifiCorp/32, Cicchetti/10 test the efficiency of Palo Verde
6 12-month futures against Palo Verde spot prices. These are both excellent
7 hedges. An R^2 of .85 would mean a correlation of .92; and, therefore reduce price
8 risk to about 8 %. I would have recommended that Wah Chang should consider
9 trading in 12-month futures contracts at Palo Verde to offset the risk it had
10 accepted in its COB electricity contract with PacifiCorp. However, I would have
11 also analyzed some additional direct COB hedges

12 **Experiment 5:**

13 The hedges shown in 5-P-C and 5-O-C on page PacifiCorp/32,
14 Cicchetti/11 test the efficiency of COB futures electricity contracts for delivery on
15 September 1, 2000, the first date of the new pricing terms in the Wah Chang
16 contract. These hedges are efficient and I would, therefore, have also
17 recommended that Wah Chang should have considered these direct COB futures
18 contracts that correspond to the first delivery date as reasonable risk-reducing
19 hedges for the COB spot prices.

20 **Experiment 6:**

21 The hedges shown in 6-P-C and 6-O-C on page PacifiCorp/32,
22 Cicchetti/12 show similar hedges for the September 1, 2000 delivery using futures
23 contracts at Palo Verde as hedges for the COB monthly spot index. The

1 efficiency improves slightly. Therefore, I would have recommended these out-of-
2 market futures contracts as even stronger risk-reducing hedges for Wah Chang.

3 The hedges shown in 6-P-P and 6-O-P on page PacifiCorp/32,
4 Cicchetti/13 are the corresponding Palo Verde Futures hedges for September 1,
5 2000 delivery. These hedges are very efficient and I would have recommended
6 them as well to Wah Chang.

7 **Experiment 7:**

8 Finally, the hedges shown in 7-P-C on page PacifiCorp/32, Cicchetti/14
9 and 7-O-C on page PacifiCorp/32, Cicchetti/15 consider the usefulness of 12-
10 month natural gas futures at Henry Hub for spot electricity prices at COB. These
11 possible hedges do not perform as well as the futures' electricity hedges.
12 Therefore, I would not have recommended them to Wah Chang.

PC/32
C/4
Revised

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2 reg dep[cobpk] ind[(1) pvpk]
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5 ***** ORDINARY LEAST SQUARES ESTIMATION *****

6 1-P
7 Dependent Variable: cobpk

8	9 Independent Variable	10 Estimated Coefficient	11 Standard Error	12 t-Statistic
12	(1)	-1.75234	1.73706	-1.00830
13	pvpk	0.98366	2.80234e-002	35.10151

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16 Number of Observations 41
17 R-squared 0.96932
18 Corrected R-squared 0.96853
19 Sum of Squared Residuals 2.36356e+003
20 Standard Error of the Regression 7.78487
21 Durbin-Watson Statistic 1.88592
22 Mean of Dependent Variable 41.79659
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34 reg dep[cobopk] ind[(1) pvopk]
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37 ***** ORDINARY LEAST SQUARES ESTIMATION *****

38 1-Q
39 Dependent Variable: cobopk

40	41 Independent Variable	42 Estimated Coefficient	43 Standard Error	44 t-Statistic
44	(1)	-4.62276	1.83021	-2.52581
45	pvopk	1.39939	7.13139e-002	19.62293

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48 Number of Observations 37
49 R-squared 0.91668
50 Corrected R-squared 0.91430
51 Sum of Squared Residuals 1.22473e+003
52 Standard Error of the Regression 5.91544
53 Durbin-Watson Statistic 0.94855
54 Mean of Dependent Variable 25.80189

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1 reg dep[cobpk] ind[(1) hagd] if[per3]

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4 ***** ORDINARY LEAST SQUARES ESTIMATION *****

5 2-P-C

6 Dependent Variable: cobpk

7

8 Independent Variable	Estimated Coefficient	Standard Error	t-Statistic
11 (1)	-82.05551	13.96709	-5.87492
12 hagd	48.64236	5.26860	9.23251

13

14

15 Number of Observations	41
16 R-squared	0.68609
17 Corrected R-squared	0.67804
18 Sum of Squared Residuals	2.41821e+004
19 Standard Error of the Regression	24.90087
20 Durbin-Watson Statistic	1.28074
21 Mean of Dependent Variable	41.79659

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34 reg dep[cobopk] ind[(1) hagd] if[per3]

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37 ***** ORDINARY LEAST SQUARES ESTIMATION *****

38 2-O-C

39 Dependent Variable: cobopk

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41 Independent Variable	Estimated Coefficient	Standard Error	t-Statistic
44 (1)	-29.37706	6.60627	-4.44684
45 hagd	21.41687	2.45674	8.71761

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48 Number of Observations	37
49 R-squared	0.68468
50 Corrected R-squared	0.67567
51 Sum of Squared Residuals	4.63492e+003
52 Standard Error of the Regression	11.50766
53 Durbin-Watson Statistic	0.55412
54 Mean of Dependent Variable	25.80189

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reg dep[pvpk] ind[(1) hhgd] if[per3]

***** ORDINARY LEAST SQUARES ESTIMATION *****

2-P-P

Dependent Variable: pvpk

Independent Variable	Estimated Coefficient	Standard Error	t-Statistic
(1)	-39.35708	14.35717	-2.74128
hhgd	29.46391	5.30472	5.55429

Number of Observations 57
R-squared 0.35935
Corrected R-squared 0.34770
Sum of Squared Residuals 5.47085e+004
Standard Error of the Regression 31.53887
Durbin-Watson Statistic 0.67815
Mean of Dependent Variable 36.93652

reg dep[pvopk] ind[(1) hhgd] if[per3]

***** ORDINARY LEAST SQUARES ESTIMATION *****

2-O-P

Dependent Variable: pvopk

Independent Variable	Estimated Coefficient	Standard Error	t-Statistic
(1)	-6.05617	4.57991	-1.32233
hhgd	9.23616	1.69220	5.45809

Number of Observations 57
R-squared 0.35134
Corrected R-squared 0.33955
Sum of Squared Residuals 5.56713e+003
Standard Error of the Regression 10.06084
Durbin-Watson Statistic 0.48399
Mean of Dependent Variable 17.85986

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***** ORDINARY LEAST SQUARES ESTIMATION *****

3-P-C

Dependent Variable: cobpk

Independent Variable	Estimated Coefficient	Standard Error	t-Statistic
(1)	4.67429	4.10430	1.13888
aveel2	0.82487	0.14152	5.82865

Number of Observations	28
R-squared	0.56647
Corrected R-squared	0.54980
Sum of Squared Residuals	1.05942e+003
Standard Error of the Regression	6.38333
Durbin-Watson Statistic	1.55667
Mean of Dependent Variable	27.54012

Variable: cobpk	Average COB Peak Price		
Mean	27.54012	Standard deviation	9.51358
Minimum	15.79308	Skewness	0.82023
Maximum	51.02846	Kurtosis	2.93199
Valid observations	28		

Variable: aveel2	Average COB Peak Price		
Mean	27.72068	Standard deviation	8.58060
Minimum	14.88333	Skewness	0.54867
Maximum	48.54545	Kurtosis	2.35051
Valid observations	28		

Correlation and Covariance matrix

	cobpk	aveel2
cobpk	87.27570	59.93616
aveel2	0.75264	72.66171

0.75264
ratio of portfolio variances = 0.247356

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55 ***** ORDINARY LEAST SQUARES ESTIMATION *****

56 3-O-C

57 Dependent Variable: cobopk

58 Independent Variable	59 Estimated Coefficient	60 Standard Error	61 t-Statistic
62 (1)	63 1.16591	64 4.26900	0.27311
avee12	0.61445	0.14045	4.37488

65 Number of Observations	24
66 R-squared	0.46524
67 Corrected R-squared	0.44093
68 Sum of Squared Residuals	6.90613e+002
69 Standard Error of the Regression	5.60281
70 Durbin-Watson Statistic	1.23966
71 Mean of Dependent Variable	19.15958

72 Variable: cobopk	73 Average COB Off-peak Price		
74 Mean	19.15958	75 Standard deviation	7.49828
76 Minimum	4.96808	77 Skewness	0.34420
78 Maximum	38.53346	79 Kurtosis	3.05828
80 Valid observations	24		

81 Variable: avee12	82		
83 Mean	29.28417	84 Standard deviation	8.31804
85 Minimum	18.06750	86 Skewness	0.48358
87 Maximum	48.54545	88 Kurtosis	2.27139
89 Valid observations	24		

90 Correlation and Covariance matrix

91	92 cobopk	93 avee12
94 cobopk	53.80968	40.74234
95 avee12	0.68208	66.30692

96 0.68208
97 ratio of portfolio variances = 0.317918

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1 reg dep[pv_pk] ind[(1) avee$(j)] if[per3]
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4 ***** ORDINARY LEAST SQUARES ESTIMATION *****
5 4-p-p
6 Dependent Variable:      pv_pk
7
8 Independent      Estimated      Standard
9 Variable          Coefficient      Error
10
11      (1)          -4.81930          4.35926
12      avee12       1.28296          9.05998e-002
13
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15 Number of Observations      42
16 R-squared                    0.83370
17 Corrected R-squared         0.82954
18 Sum of Squared Residuals    1.32758e+004
19 Standard Error of the Regression 18.21800
20 Durbin-Watson Statistic     1.30600
21 Mean of Dependent Variable  42.36149
22
23
24 Variable:      pv_pk      Palo Verde Peak Price
25
26 Mean          42.36149      Standard deviation      44.12560
27 Minimum       13.59321      Skewness                 2.69966
28 Maximum       2.21660e+002 Kurtosis                  9.54728
29 Valid observations      42
30
31 Variable:      avee12
32
33 Mean          36.77488      Standard deviation      31.40373
34 Minimum       15.89318      Skewness                 2.72541
35 Maximum       1.64578e+002 Kurtosis                  10.09368
36 Valid observations      42
37
38 Correlation and Covariance matrix
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40      pv_pk      pv_pk      avee12
41      pv_pk      1.90071e+003      1.23513e+003
42      avee12      0.91307      9.62713e+002
43
44      0.91307
45 ratio of portfolio variances = 0.0869291

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1 reg dep[pv_opk] ind[(1) avee${j}] if[per3]
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4 ***** ORDINARY LEAST SQUARES ESTIMATION *****
5 4-O-P
6 Dependent Variable: pv_opk
7
8 Independent      Estimated      Standard      t-
9 Variable          Coefficient   Error         Statistic
10
11      (1)           4.09438      1.18463      3.45624
12      avee12       0.41342      2.46206e-002 16.79159
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15 Number of Observations      42
16 R-squared                    0.87576
17 Corrected R-squared         0.87265
18 Sum of Squared Residuals    9.80400e+002
19 Standard Error of the Regression 4.95076
20 Durbin-Watson Statistic     0.93789
21 Mean of Dependent Variable  19.29773
22
23
24 Variable: pv_opk      Palo Verde Off-Peak Price
25
26 Mean                    19.29773      Standard deviation  13.87321
27 Minimum                 6.67033      Skewness            2.13653
28 Maximum                 67.28065     Kurtosis            6.91645
29 Valid observations      42
30
31 Variable: avee12
32
33 Mean                    36.77488     Standard deviation  31.40373
34 Minimum                 15.89318     Skewness            2.72541
35 Maximum                 1.64578e+002 Kurtosis            10.09368
36 Valid observations      42
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38 Correlation and Covariance matrix
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40      pv_opk      avee12
41      pv_opk      1.87883e+002      3.98002e+002
42      avee12      0.93582        9.62713e+002
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44      0.93582
45 ratio of portfolio variances = 0.0641801

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reg dep[cobpk] ind[(1) fcob0900a]

***** ORDINARY LEAST SQUARES ESTIMATION *****
5-P-C

Dependent Variable: cobpk

Independent Variable	Estimated Coefficient	Standard Error	t-Statistic
(1)	-95.76035	42.92104	-2.23108
fcob0900	3.35505	0.61657	5.44147
Number of Observations		19	
R-squared		0.63527	
Corrected R-squared		0.61381	
Sum of Squared Residuals		1.09366e+005	
Standard Error of the Regression		79.84022	
Durbin-Watson Statistic		2.18811	
Mean of Dependent Variable		1.15458e+002	

reg dep[cobopk] ind[(1) fcob0900a]

***** ORDINARY LEAST SQUARES ESTIMATION *****
5-O-C

Dependent Variable: cobopk

Independent Variable	Estimated Coefficient	Standard Error	t-Statistic
(1)	-81.41628	19.26114	-4.22697
fcob0900	2.44812	0.27669	8.84785
Number of Observations		19	
R-squared		0.82159	
Corrected R-squared		0.81109	
Sum of Squared Residuals		2.18231e+004	
Standard Error of the Regression		35.82890	
Durbin-Watson Statistic		2.56678	
Mean of Dependent Variable		72.70600	

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1 reg dep[cobpk] ind[(1) fpv0900a]
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4 ***** ORDINARY LEAST SQUARES ESTIMATION *****
5 6-P-C
6 Dependent Variable: cobpk
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8 Independent Estimated Standard
9 Variable Coefficient Error t-
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11 (1) -69.50617 10.73590 -6.47418
12 fpv0900a 1.89525 0.15039 12.60186
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15 Number of Observations 19
16 R-squared 0.90330
17 Corrected R-squared 0.89761
18 Sum of Squared Residuals 5.47901e+003
19 Standard Error of the Regression 17.95256
20 Durbin-Watson Statistic 2.21557
21 Mean of Dependent Variable 55.43453
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36 reg dep[cobopk] ind[(1) fpv0900a]
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39 ***** ORDINARY LEAST SQUARES ESTIMATION *****
40 6-O-C
41 Dependent Variable: cobopk
42
43 Independent Estimated Standard
44 Variable Coefficient Error t-
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46 (1) -15.38033 4.72091 -3.25792
47 fpv0900a 0.68508 6.61331e-002 10.35909
48
49
50 Number of Observations 19
51 R-squared 0.86325
52 Corrected R-squared 0.85520
53 Sum of Squared Residuals 1.05944e+003
54 Standard Error of the Regression 7.89430
55 Durbin-Watson Statistic 0.63073
56 Mean of Dependent Variable 29.78221

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1 reg dep [pvpk] ind[(1) fpv0900a]
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 4 ***** ORDINARY LEAST SQUARES ESTIMATION *****
 5 6-P-P
 6 Dependent Variable: pvpk
 7
 8 Independent Estimated Standard t-
 9 Variable Coefficient Error Statistic
 10
 11 (1) -74.86296 7.36741
 12 fpv0900a 2.00666 0.10321 -10.16137
 13 19.44311
 14
 15 Number of Observations 19
 16 R-squared 0.95697
 17 Corrected R-squared 0.95443
 18 Sum of Squared Residuals 2.58020e+003
 19 Standard Error of the Regression 12.31977
 20 Durbin-Watson Statistic 1.28919
 21 Mean of Dependent Variable 57.42224
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37 reg dep [pvopk] ind[(1) fpv0900a]
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 40 ***** ORDINARY LEAST SQUARES ESTIMATION *****
 41 6-O-P
 42 Dependent Variable: pvopk
 43
 44 Independent Estimated Standard t-
 45 Variable Coefficient Error Statistic
 46
 47 (1) -8.54898 2.72062
 48 fpv0900a 0.52421 3.81120e-002 -3.14229
 49 13.75442
 50
 51 Number of Observations 19
 52 R-squared 0.91755
 53 Corrected R-squared 0.91270
 54 Sum of Squared Residuals 3.51854e+002
 55 Standard Error of the Regression 4.54943
 56 Durbin-Watson Statistic 1.11526
 57 Mean of Dependent Variable 26.00847

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***** ORDINARY LEAST SQUARES ESTIMATION *****

7-P-DC

Dependent Variable: cobpk

Independent Variable	Estimated Coefficient	Standard Error	t-Statistic
(1)	78.58252	37.94024	2.07122
avegl2	-3.40856	12.80307	-0.26623

Number of Observations 65
 R-squared 1.12379e-003
 Corrected R-squared -1.47314e-002
 Sum of Squared Residuals 5.96429e+005
 Standard Error of the Regression 97.29919
 Durbin-Watson Statistic 0.45233
 Mean of Dependent Variable 69.00633

Variable: cobpk Average COB Peak Price

Mean	69.00633	Standard deviation	96.59034
Minimum	15.79308	Skewness	2.62266
Maximum	5.31740e+002	Kurtosis	10.29479
Valid observations	65		

Variable: avegl2

Mean	2.80945	Standard deviation	0.94996
Minimum	1.93205	Skewness	1.53327
Maximum	5.79986	Kurtosis	4.35138
Valid observations	65		

Correlation and Covariance matrix

	cobpk	avegl2
cobpk	9.18616e+003	-3.02864
avegl2	-3.35230e-002	0.88854

-3.35230e-002
 ratio of portfolio variances = 1.03352

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1 ***** ORDINARY LEAST SQUARES ESTIMATION *****
2
3 7-0-C
4 Dependent Variable:  cobopk
5
6 Independent      Estimated      Standard      t-
7 Variable         Coefficient   Error         Statistic
8
9      (1)          55.49361     27.52493     2.01612
10     aveg12       -2.61749     9.13051     -0.28657
11
12
13 Number of Observations      61
14 R-squared                    1.39099e-003
15 Corrected R-squared         -1.55346e-002
16 Sum of Squared Residuals    2.71213e+005
17 Standard Error of the Regression  67.79998
18 Durbin-Watson Statistic     0.27573
19 Mean of Dependent Variable  48.00561
20
21
22 Variable:  cobopk      Average COB Off-peak Price
23
24 Mean              48.00561      Standard deviation  67.27942
25 Minimum          4.96808      Skewness           2.49042
26 Maximum          3.29095e+002 Kurtosis           8.58465
27 Valid observations 61
28
29 Variable:  aveg12
30
31 Mean              2.86076      Standard deviation  0.95865
32 Minimum          1.93205      Skewness           1.46760
33 Maximum          5.79986      Kurtosis           4.11032
34 Valid observations 61
35
36 Correlation and Covariance matrix
37
38      cobopk      aveg12
39      cobopk      4.45232e+003      -2.36605
40      aveg12      -3.72959e-002      0.90394
41
42      -3.72959e-002
43 ratio of portfolio variances = 1.0373
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BEFORE THE PUBLIC UTILITY COMMISSION OF OREGON

UM 1002

WAH CHANG,

Petitioner,

v.

PACIFICORP,

Respondent.

CERTIFICATE OF SERVICE

I certify that I have this day served PacifiCorp's Revised Exhibit PacifiCorp/32
Accompanying the Reply Testimony of Charles J. Cicchetti, Ph.D. replacing Exhibit
PacifiCorp/32, upon all parties of record in this proceeding by hand delivery pursuant to OAR
860-013-0070, to the following parties or attorneys of parties:

Richard H. Williams
Milo Petranovich
Lane Powell Spears Lubersky LLP
Suite 2100
601 S.W. Second Avenue
Portland, OR 97204
Email: williamsr@lanepowell.com
petranovichm@lanepowell.com

Paul Graham
Assistant Attorney General
Department of Justice
Regulated Utility & Business Section
1162 Court St. NE
Salem, OR 97301-4096
Email: paul.graham@state.or.us

Natalie Hocken
Vice President and General Counsel
Pacific Power
825 NE Multnomah, #2000
Portland, OR 97232
Email: natalie.hocken@pacificorp.com

DATED: August 7, 2007.

PERKINS COIE LLP

By



James M. Van Nostrand, OSB No. 79428
Christopher L. Garrett, OSB No. 03100
Attorneys for PacifiCorp