ATTACHMENT B: AN ANALYSIS OF THE DSM COST-EFFECTIVENESS TEST

PacifiCorp's least-cost, IRP portfolio calls for some 90 MWs of Class 1 DSM (entailing direct load control by the utility), and about 150 MWs of Class 2 DSM. The Class 1 DSM involves an inducement to customers to reduce their consumption of electricity during high use periods. PacifiCorp projects the potential for another 300 MWs of load reduction via Class 2 DSM program. Prospective DSM programs must pass through a cost-effectiveness screening to be approved for cost recovery by the Utah Commission. The purpose of this attachment is to demonstrate that the cost-effectiveness test that PacifiCorp proposes to model the appropriate level for Class 2 DSM programs may not be appropriate. It appears possible to pass the IRP test even though the subject DSM program would raise general rates. Conversely, a DSM program that would lower general rates could be rejected because it inappropriately failed a cost-effectiveness test.

Two guides seem to be used to accept or reject potential DSM programs. They are both found in "Appendix G. Demand Side Management." One threshold (pages 305 – 309) is that the levelized costs of a DSM program must be less than $39 per avoided MWh to be considered, at least on the first round. Separately, the PacifiCorp IRP document states (on page 304) that for a DSM program to be cost effective, the direct DSM costs must be equal to or below the avoided electricity production costs. That test fails on intuitive grounds. If, for example, DSM program costs precisely equaled the avoided electricity production costs, then the gross revenue requirement will not have changed, although the sales volume will have been reduced by the DSM decrement. This translates to increased average utility costs and, therefore, increased average rates.

The following presentation will demonstrate that in order to avoid an increase in average costs (which translate directly to average rates), DSM program costs, D (see definitions below), must be equal to or less than *not just* the avoided electricity production costs, C, *but* those production costs *minus* Y*[P/M], or the amount that production costs would have been reduced. This is true since the avoided sales or production, Y, will carry the same unit costs as the system average, P/M before the DSM programs were implemented. This analysis places a much more exacting threshold for DSM program cost-effectiveness and more closely matches the tests required by the PSC for approval of DSM programs. We have provided a demonstration -- including a numerical example -- that justifiable DSM program costs must be much lower than contemplated in the IRP. Following this explanation we will derive other formulations of cost-effectiveness criteria.

Included within these demonstrations will be a discussion to the effect that a DSM program's cost could well exceed the apparent IRP threshold of $39 per avoided MWh and still be cost effective.

<u>Algebraic Demonstrations:</u>

Formulation #1

Objective: Prove that to avoid a cost, or general rates, increase...

(1) $D \leq C - Y*[P/M]$ as expressed in the immediately preceding paragraph (versus $D \leq C$, i.e., the IRP's suggested cost-effectiveness test).

Where:

M ≡ Status quo sales volumes in MWh's
P ≡ Status quo revenue requirement in $
Y ≡ Reduction in sales volumes due to DSM (in MWh's)
C ≡ Reduction in production costs dues to DSM (in $)
D ≡ DSM program costs (in $)

By definition:

P / M : Average costs under the status quo
(P - C + D) / (M - Y) : Average costs given the DSM program

DSM cost-effectiveness test (i.e., to avoid a cost/rate increase solely due to DSM):

Average costs given the DSM program ≤ Average costs under the status quo

i.e.,

Requirement:

(0) $(P - C + D) / (M - Y) \leq P / M$

Proof of (1) as an implication of (0):

Cross-multiplying within (0):

$M * (P - C + D) \leq P * (M - Y)$

Expanding:

$M*P - M*C + M*D \leq P*M - P*Y$

Rearranging and noting that M*P = P*M:

$M*D \leq M*C - P*Y$

Dividing both sides by M:

(1) $D \leq C - Y*[P/M]$ **QED (As was to be shown**)

Numerical Example:

Let:

M = 333,333 MWh's
P = $10,000,000
Y = 30,000 MWh's
C = $1,100,000
D(1) = $505,000

Note: Since the DSM program costs, D(1), are less than half the avoided production costs, C, the indicated DSM program would be deemed cost-effective according to the PacifiCorp criterion.

However:

System average costs absent DSM = P / M = $10,000,000/333,333MWh's = $30/MWh
System average costs with DSM costs of D(1)
= (P - C + D) / (M - Y)
= ($10,000,000 - $1,100,000 + $505,000) / (333,333 MWh's - 30,000 MWh's)
= $9,405,000 / 303,000 MWh's
= $31/MWh, for an increase of $1/MWh

Conclusion: Since it causes average costs (and, therefore, rates) to escalate by $1/MWh, a DSM program with costs of D(1), or $505,000, is not really cost-effective even though, with costs less than half of avoided production costs, it would pass the IRP test.

We use the same demonstration approach to derive what would be the maximum justifiable DSM program costs in this example:

Maximum justifiable DSM program costs:

(1) D(0) = C - Y*(P/M)
= $1,100,000 - 30,000 MWh's * ($10,000,000/333,333 MWh)
= $1,100,000 - $900,000
= $200,000

System average costs with DSM costs of D(0), or $200,000
= (P - C + D(0))/ (M - Y)
= ($10,000,000 - $1,100,000 + $200,000) / (333,333 MWh's - 30,000 MWh's)
= $9,100,000 / 303,333 MWh's
= $30/MWh, which is the same as the average costs without the DSM program.

The following two formulations provide complementary support for our contention that the IRP test for modeling the appropriate level of DSM is not appropriate.

Formulation #2

Objective: Prove that to avoid a cost, or general rates, increase, DSM program costs per unit of lost production (i.e., D/Y) must be less than or equal to the average avoided production costs (i.e., C/Y) minus the status quo average costs (i.e., P/M).[1]

or,

(2) $D/Y \leq C/Y - P/M$

Proof of (2) as an implication of (0) and (1):

Start with the Requirement (0), and obtain Cost-effectiveness Condition (1):

(1) $D \leq C - Y*[P/M]$

Simply dividing both sides of the inequality by Y yields...

(2) $D/Y \leq C/Y - P/M$ QED

Corollary Discussion:

The discussion on pages 305-309 indicated that primary consideration was given to DSM programs with levelized costs below $39/MWh. Table 7.13 on page 137 in the body of the text showed DSM programs with the potential to reduce system costs by over $200 per avoided MWh. While spending as much as $200/MWh to eliminate loads (i.e., the page 304 criterion) cannot be justified, it is relatively easy in such a circumstance to demonstrate that DSM program costs well in excess of $39/MWh could very well be justified. Using Expression (2) and average production costs (P/M) of $30/MWh, a DSM program that produced, for example, production cost savings (C/Y) of $150/MWh could justify DSM program expenses (D/Y) as high as $120/MWh (or, from (2): $\$120 \leq \$150 - \$30$). That result is clearly well in excess of the $39/MWh that has heretofore been used as a threshold for first-rank DSM consideration. The true test is not whether DSM program costs are beneath $39/MWh but rather by how much those program costs are beneath the difference between avoided and average system production costs.

Formulation #3 Objective:

Prove that to avoid a cost, or general rates, increase, the proportional reduction in the revenue requirement, (C - D)/P,[2] **must be equal to or exceed the proportional reduction in output, Y/M,**

or,

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[1] The IRP's test was merely that the program unit costs were less than the unit costs of incremental purchases, which were a surrogate for avoided costs.

[2] The reduction in the revenue requirement due to the avoided production costs, C, is offset in part by an increase in the revenue requirement due to the DSM direct production costs.

(3) $(C - D)/P \geq Y/M$

Proof of (3) as an implication of (0) and (1):

Start with the Requirement (0), and obtain Cost-effectiveness Condition (1):

(1) $D \leq C - Y*[P/M]$

Simply dividing both sides of the inequality by P yields...

$D/P \leq C/P - Y/M$

Rearranging terms:

$C/P - D/P \geq Y/M$

Recognizing the common denominator on the left side of the inequality:

(3) $(C - D)/P \geq Y/M$

QED

<u>An Alternative Cost-Effectiveness Standard:</u>

The above focused upon reducing average costs, which is equivalent to reducing average rates. There is another, slightly different justification for a DSM program: It is to reduce the average rates *for the load other than the load that is shed*. According to this formulation, average overall rates may go up, but that is okay as long as R(M-Y), the revenues paid by the customers other than those that participate in the DSM program can be reduced. . In other words, those revenues might go down, not because average total costs have declined, but because of an ability to reduce the amount of subsidy (i.e., the difference between costs and revenues) going to the load targeted by the DSM. Accordingly, rates will go down if the cost of the DSM program is less than the amount of subsidy absent the DSM.

Let (supplementing the previous terms' definitions):

$R(0|Y) \equiv$ Revenues collected for the avoided sales volumes absent the DSM program ($)

$R(0|M\text{-}Y) \equiv$ Revenues collected from the non-avoided sales absent the DSM program ($)

$R(1|M\text{-}Y) \equiv$ Revenues collected from the non-avoided sales, given the DSM program ($)

Note:

$R(0|M\text{-}Y) = P - R(0|Y);$

i.e., absent DSM, the revenue requirement collected from the (M-Y) portion of total sales equals the total revenue requirement, P, minus the revenues collected from the Y portion of total sales. Also...

$R(1|M\text{-}Y) = (P - C) + D$

i.e., given DSM (and the loss of Y sales), the revenue requirement, which will now be entirely collected from the (M-Y) portion of total sales, will equal the new total direct or production costs (which is the original total revenue requirement, P, minus the production costs avoided by the loss of the Y sales, C) plus the costs of the DSM program itself, D.

DSM cost-effectiveness criterion (i.e., avoiding a rate increase for the non-DSM sales) and its implication:

The revenue requirement for the remaining sales given the DSM program ≤

The revenue requirement for that same block of sales absent the DSM program (i.e., under the status quo)

or,

(5) $R(1| M\text{-}Y) \leq R(0| M\text{-}Y)$

i.e., $(P - C) + D \leq P - R(0| Y)$

Rearranging and eliminating the common term:

(6) $D \leq C - R(0| Y)$

QED (i.e., (6) was shown to be derived from (5))

In words:

To achieve cost-effectiveness, DSM program costs (D) must be less than or equal to the avoided production costs (C, or PacifiCorp's PVRR decrement) *minus* the revenues (R(0| Y)) that would have been collected from the lost, or avoided, output.[1]

Numerical Example:

Let:

M = 333,333 MWh's

P = $10,000,000

Y = 30,000 MWh's

C = $1,100,000

D(1) = $505,000

R(0| Y) = $700,000

Then:

R(0| M-Y) = P - R(0| Y) = $10,000,000 - $700,000 = $9,300,000

R(1| M-Y) = (P - C) + D = ($10,000,000 - $1,100,000) + $505,000 = $9,405,000

Observation: Since it causes an elevation of the revenue requirement to the ratepayers of the non-avoided sales, a DSM program with costs of D(1), or $505,000, again is not really cost-effective -- even though, with costs less than half of avoided production costs, it would pass the IRP test.

Maximum justifiable DSM program costs given the alternative cost-effectiveness criterion:

[3] Note: In order for the IRP's cost effectiveness standard to be true (i.e., that DSM costs must merely be below the avoided production costs), the utility must have been giving away the DSM-avoided sales volumes (i.e., R(0| Y) = 0)

D(0) = C - R(0| Y) = $1,100,000 - $700,000 = $400,000

A continuation of the above numerical illustration:

Revenues collected from the non-DSM sales block given DSM program costs, D, of $300,000:

R(1| M-Y) = (P - C) + D = ($10,000,000 - $1,100,000) + $300,000 = $9,200,000, which is $100,000 less than R(0| M-Y).

Note:

System average costs absent DSM = P / M = $10,000,000/333,333MWh's = $30/MWh

System average costs with DSM costs of D (or $300,000)

= (P - C + D) / (M - Y)

= ($10,000,000 - $1,100,000 + $300,000) / (333,333MWh's – 30,000MWh's)

= $30.363/MWh, which is greater than the average rate prior to or absent DSM.

Observation: The indicated DSM program produces higher average costs, but – due to the reduction in the subsidy to the DSM loads – a lower revenue requirement for the non-DSM loads.

Conclusion: DSM program costs in excess of the maximum consistent with not increasing average costs ($200,000 in the numerical example above) can be justified if the rates charged to the non-DSM customers can be reduced as a result of the DSM program