Application of the Make-Whole Approach and Shortfall Reduction Procedure to the Day-Ahead Market and TCC Auction

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I. OVERVIEW

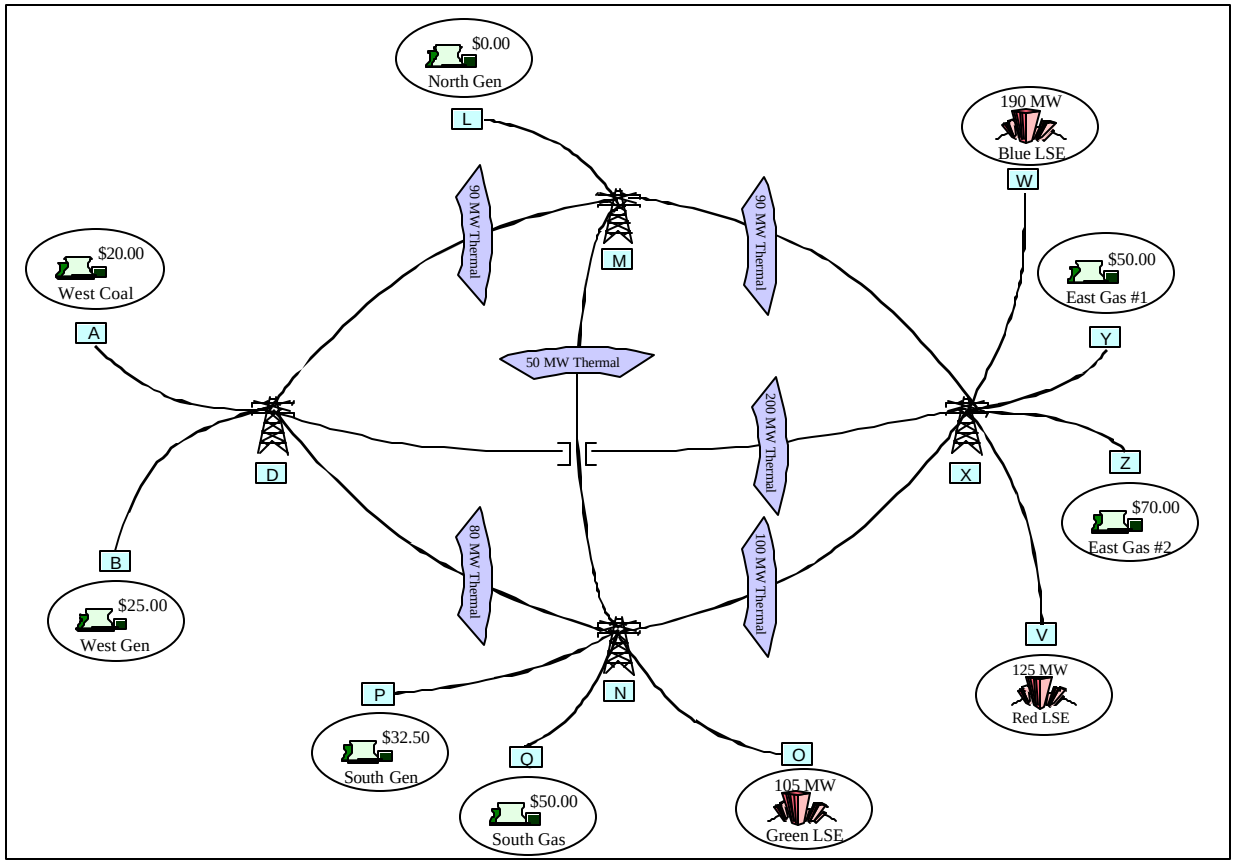
This paper develops a set of examples illustrating the operation and interaction of the Make-Whole approach and the proposed shortfall reduction procedures. In addition to clarifying how these new rules would operate in the context of a simplified example, they are used to illustrate several propositions. First, if TCCs sell at their expected value in the forward auction, and if DAM values correspond to these expected values, then the shortfall reduction rules will not impact either the aggregate total TSC credits nor the level of individual Transmission Owner TSC credits. Thus, the application of the shortfall reduction procedure will not result in cost shifting between the transmission customers of the individual transmission owners. Second if DAM TCC values are higher than those reflected in the TCC forward auction,[1] then the shortfall reduction rules will cushion the impact on the level of the TSC of full funding of TCCs during hours impacted by transmission outages at these higher DAM values. Conversely, however, if DAM TCC values are lower than those reflected in the TCC forward auction, then the shortfall reduction rules will tend to raise the TSC.

[1] As a result, for example, of unanticipated increases in oil and gas prices.

II. EXAMPLE DESCRIPTION

The examples below are based on the simple grid portrayed in Figure 1.[2] There are three transmission owners, Blue, Red and Green serving LSEs at the locations portrayed in the figure. For the purpose of applying the Make-Whole approach, it is assumed that Blue is responsible for the M-X line, Green is responsible for the D-N line and Red is responsible for the N-X line. For simplicity, our example will only analyze outages of these lines. Figure 1 also portrays the generation on the system and the assumed as bid costs at base fuel prices.

Figure 1
Grid Configuration



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

[2] Each line is assumed to have equal reactance and zero resistance.

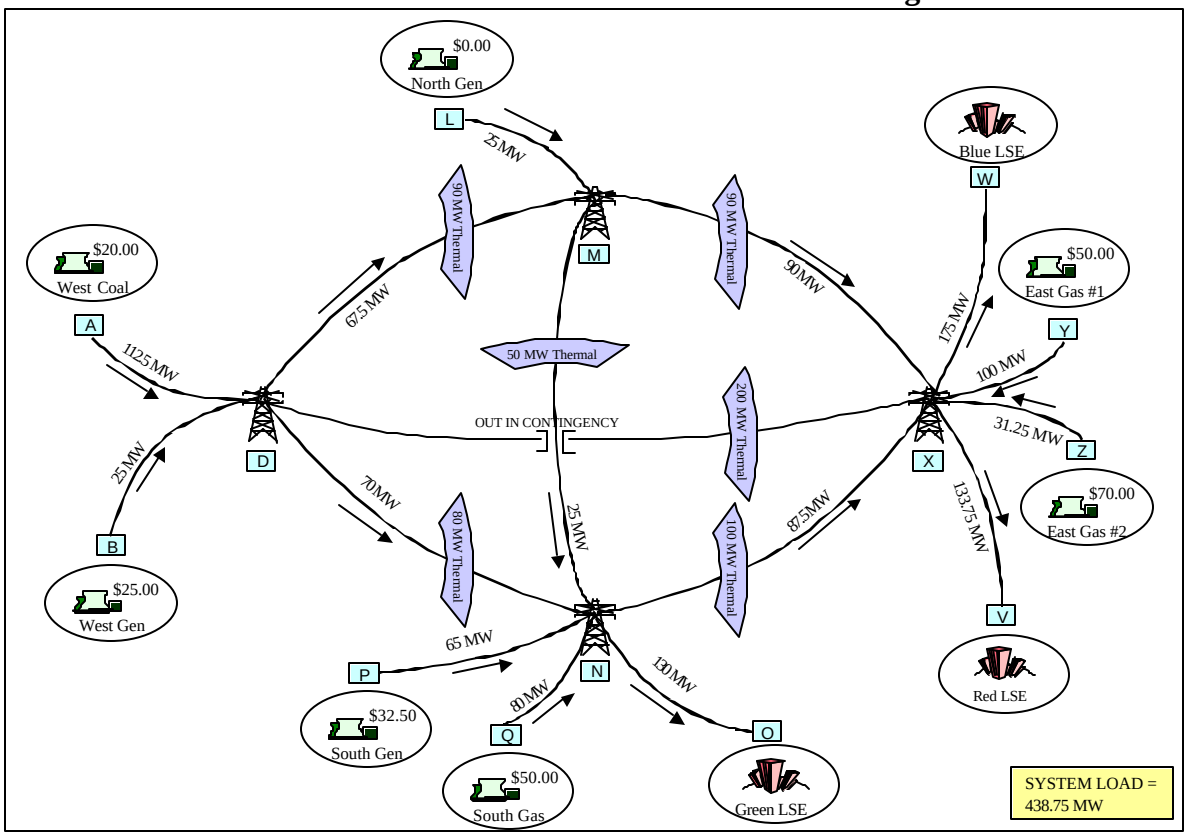
The example further assumes that the Red and Green TOs have been assigned ETCNL as portrayed in Table 2, while customers of the Blue TO have been assigned grandfathered rights in the form of TCCs.

Table 2
Grandfathered Rights

Transmission Owner	Type of Allocation	Inject Node	Withdraw Node	FTR MW
Red TO	ETCNL	P	V	65.00
	ETCNL	A	V	37.50
	ETCNL	Z	V	31.25
Green TO	ETCNL	B	O	25.00
	ETCNL	A	O	25.00
	ETCNL	Q	O	80.00
Blue TO	TCCs	L	W	25.00
	TCCs	A	W	50.00
	TCCs	Y	W	100.00

Figure 3 shows that the grandfathered rights (ETCNL and TCCs) exhaust the capacity of the transmission system, with a binding constraint on M-X.

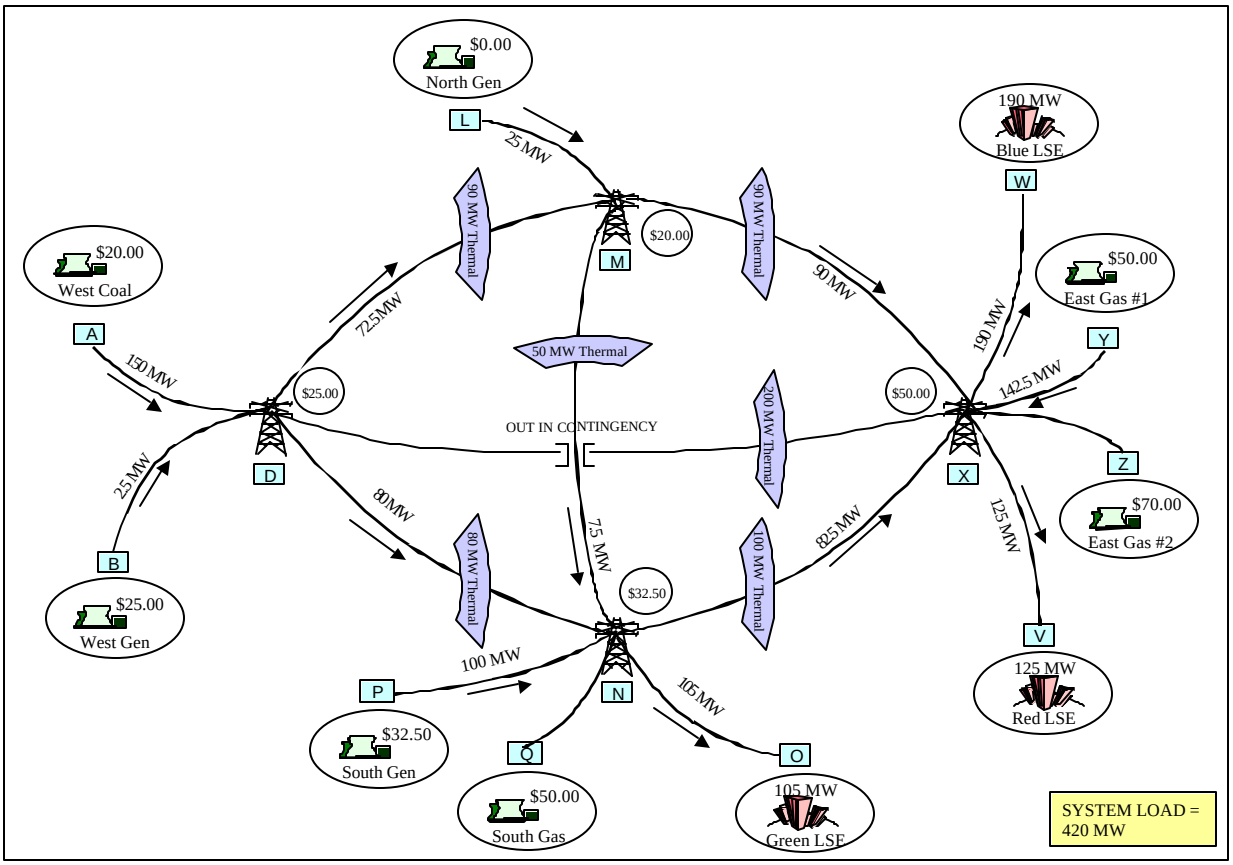
Figure 3
Initial Allocation of ETCNL and Grandfathered Rights



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

The examples further assume that the prices of TCCs sold in the forward TCC auction are determined by expected prices in the day-ahead market. The expected DAM prices are derived by dispatching the transmission system portrayed in Figure 1 to meet an assumed load in four potential grid configurations. The first is the all lines in (pre-contingency) configuration portrayed in Figure 4. In this configuration, the outage of line D-X is the binding contingency, prices in the West are $25/MWh and prices in the East are $50/MWh. We assume that 85 percent of all hours during the six-month period covered by the TCC auction have this grid configuration and DAM dispatch.

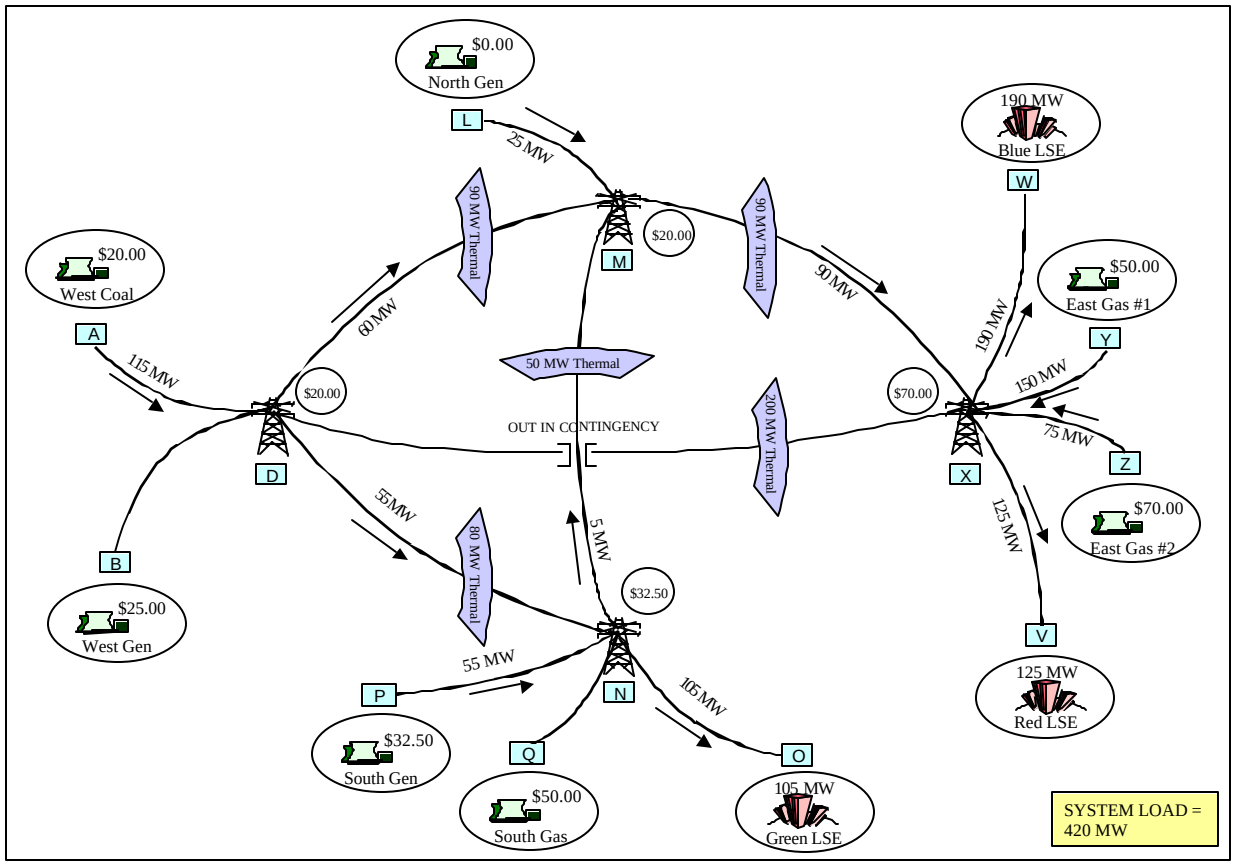
Figure 4
Dispatch and Power Flows in Base Gas Cost Case:
All Lines In



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

In the second configuration, we assume that line N-X is unavailable due to maintenance or forced outage. In this circumstance, the outage of both lines D-X and D-N are binding contingencies in the dispatch.[3] Prices in the West fall to $20/MWh and rise to $70/MWh in the East, as illustrated for the D-X contingency in Figure 5. It is assumed that 5 percent of all hours during the six-month period covered by the TCC auction have this grid configuration.

Figure 5
Dispatch and Power Flows in Base Gas Cost Case:
N-X Out, D-X Contingency



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

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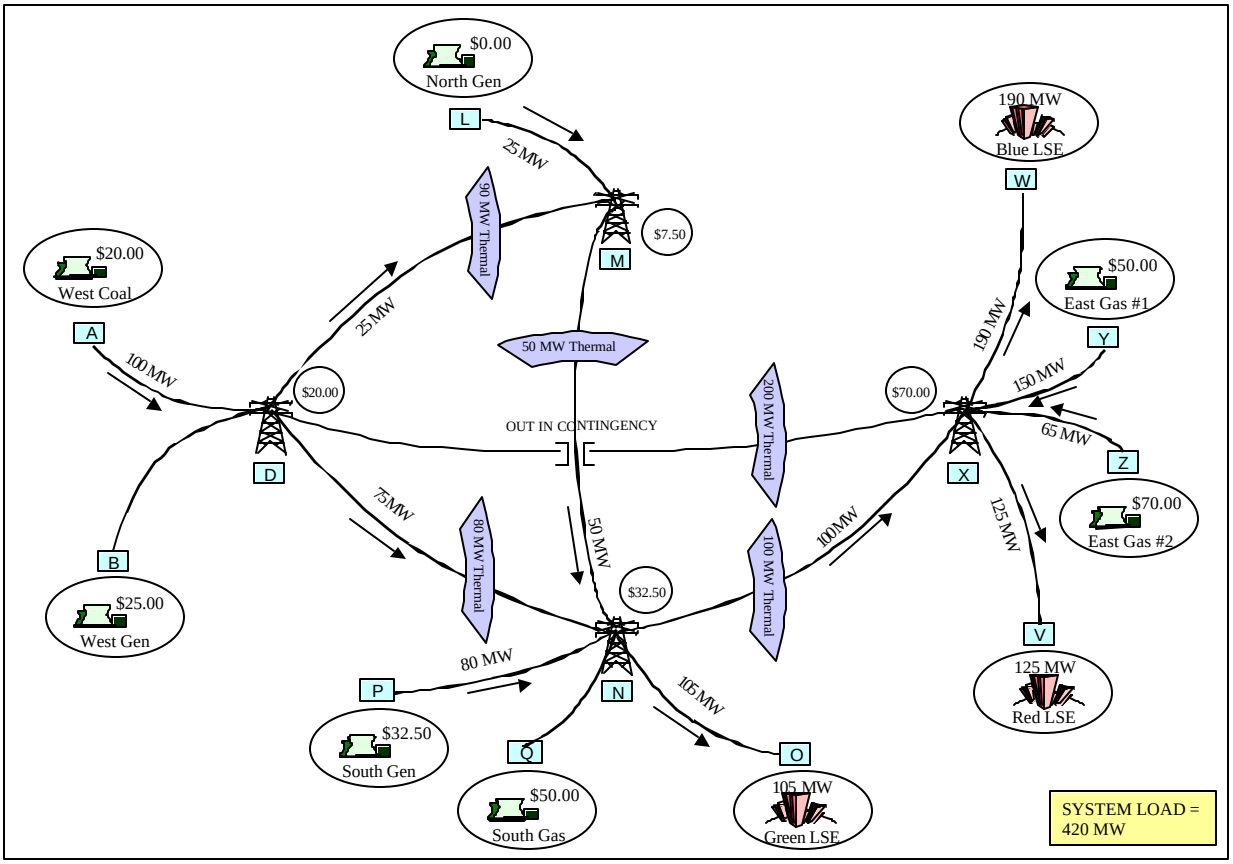
[3] Only the contingency in which D-X is out is portrayed in Figure 5.

In the third configuration, it is assumed that the M-X line is unavailable (on a pre-contingency basis) due to maintenance or forced outage. In this circumstance, the outage of the line D-X is again the binding contingency and prices in the West fall to $20/MWh and rise to $70/MWh in the East, as illustrated in Figure 6. It is assumed that 5 percent of all hours during the six-month period covered by the TCC auction have this grid configuration.

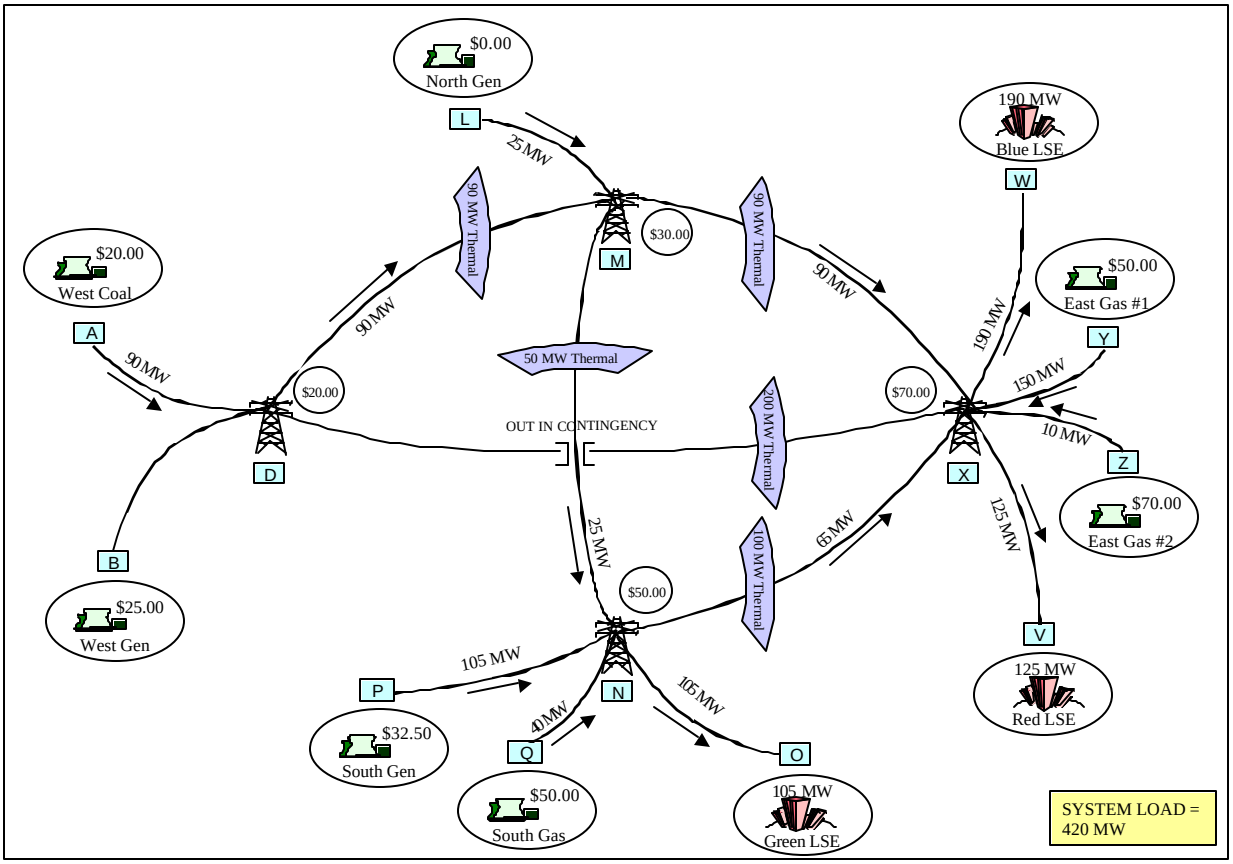
Figure 6
Dispatch and Power Flows in Base Gas Cost Case:
M-X Out, D-X Contingency



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

The final configuration assumes that the D-N line is unavailable (on a pre-contingency basis) due to maintenance or forced outage. In this circumstance, the outage of the line D-X is again the binding contingency and prices in the West fall to $20/MWh and rise to $70/MWh in the East, as illustrated in Figure 7. It is assumed that the remaining 5 percent of all hours during the six-month period covered by the TCC auction have this grid configuration.

Figure 7
Dispatch and Power Flows in Base Gas Cost Case:
D-N Out, D-X Contingency



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

Based on these expected prices from the four grid configurations in the day-ahead market, TCCs are assumed to be sold in a forward TCC auction as portrayed in Table 8.[4] The awards in Table 8 assume that ETCNL is converted to TCCs in the auction based on the 100 percent availability all lines in (pre-contingency) transfer capability of the system. This table portrays the auction revenues absent any modifications under shortfall reduction rules.

Table 8
Expected Prices of 6-Month TCCs
Symmetric Outage Case, Base Expected TCC Price Scenario
100% ETCNL Valued in Auction

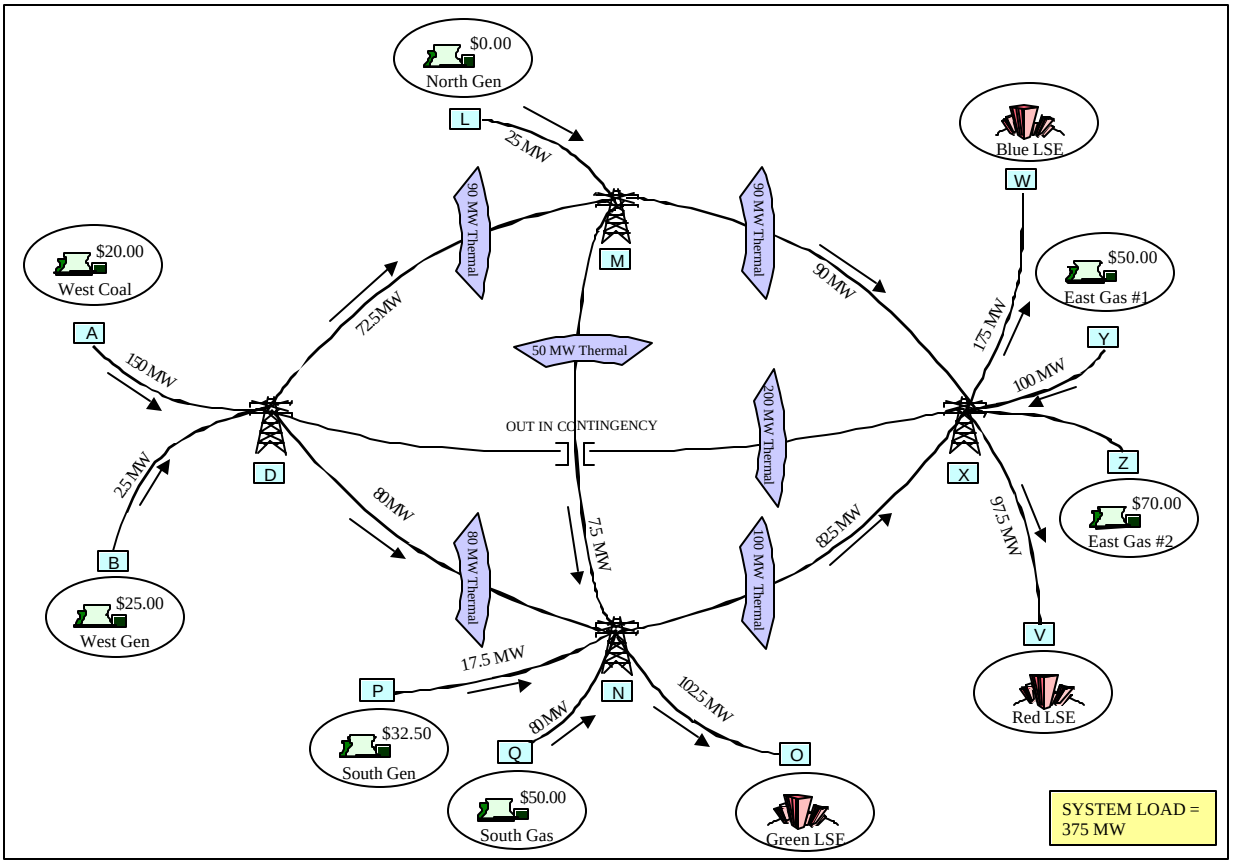
Source	Sink	TCC Award	All Lines In Congestion Price ($/MWh)	Probability	M-X Line Out (Blue) Congestion Price ($/MWh)	Probability	D-N Line Out (Green) Congestion Price ($/MWh)	Probability	N-X Line Out (Red) Congestion Price ($/MWh)	Probability	Expected Hourly TCC Value ($/MW)	Expected 6 month TCC Value ($/MW)
			[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]
TCCs Sold in Auction												
A(D)	O (N)	100	$7.50	85%	$12.50	5%	$30.00	5%	$12.50	5%	$9.125	$39,420.00
B (D)	O (N)	2.5	$7.50	85%	$12.50	5%	$30.00	5%	$12.50	5%	$9.125	$39,420.00
P (N)	V (X)	17.5	$17.50	85%	$37.50	5%	$20.00	5%	$37.50	5%	$19.625	$84,780.00
Q (N)	V (X)	80	$17.50	85%	$37.50	5%	$20.00	5%	$37.50	5%	$19.625	$84,780.00
Grandfathered TCCs												
A (D)	W (X)	50	$25.00	85%	$50.00	5%	$50.00	5%	$50.00	5%	$28.750	$124,200.00
L (M)	W (X)	25	$30.00	85%	$62.50	5%	$40.00	5%	$50.00	5%	$33.125	$143,100.00
Y (X)	W (X)	100	$0.00	85%	$0.00	5%	$0.00	5%	$0.00	5%	$0.000	$0.00

[A] LBMP at sink location minus LBMP at source location, All Lines In.
[C] LBMP at sink location minus LBMP at source location, M-X Line Out (Blue)
[E] LBMP at sink location minus LBMP at source location, D-N Line Out (Green)
[G] LBMP at sink location minus LBMP at source location, N-X Line Out (Red)
[I] = (A*B) + (C*D) + (E*F) + (G*H)
[J] = [I] * (6 * 30 days * 24 hours).

[4] For the sake of simplicity we have not made up a set of auction bids; we have simply defined a set of TCCs awarded in the auction that exhausts the capacity of the system. There are many sets of bids that would yield these prices and awards.

The flows associated with the TCCs sold in the auction in combination with the grandfathered TCCs are portrayed in Figure 9. It can be seen that there are binding constraints on the flows on the M-X and D-N lines in the D-X contingency, meaning that no more TCCs impacting these lines could be sold in the auction without violating the revenue adequacy criterion.

Figure 9
Dispatch and Power Flows in TCC Auction



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

Given these TCC auction prices, the crediting of auction revenues to the TSC accounts based on ETCNL would be as shown in Table 10, with the auction prices used to value the ETCNL.

Table 10
Allocation of Auction Revenues to ETCNL

Symmetric Outages, Base Case Gas Prices

Transmission Owner	ETCNL Source	ETCNL Sink	MW Held	Auction Value	ETCNL Value
Red	P	V	65.00	$84,780.00	$5,510,700.00
	A	V	37.50	$124,200.00	$4,657,500.00
	Z	V	31.25	$0.00	$0.00
Red Subtotal					$10,168,200.00
Green	B	O	25.00	$39,420.00	$985,500.00
	A	O	25.00	$39,420.00	$985,500.00
	Q	O	80.00	$0.00	$0.00
Green Subtotal					$1,971,000.00
Total					$12,139,200.00

Alternatively, it is assumed that a shortfall reduction program is implemented, and that the ETCNL converted to TCCs in the auction is reduced to reflect a 5 percent expected outage/ revenue shortfall rate. For simplicity, a perfectly elastic demand for TCCs at the expected value of the TCCs has been assumed so TCC prices are unchanged, but the awards are as portrayed in Table 11.

Table 11
Expected Prices of 6-Month TCCs
Symmetric Outage Case, Base Expected TCC Price Scenario
95% ETCNL Valued in Auction

Source	Sink	TCC Award	All Lines In Congestion Price ($/MWh) [A]	Probability [B]	M-X Line Out (Blue) Congestion Price ($/MWh) [C]	Probability [D]	D-N Line Out (Green) Congestion Price ($/MWh) [E]	Probability [F]	N-X Line Out (Red) Congestion Price ($/MWh) [G]	Probability [H]	Expected Hourly TCC Value ($/MW) [I]	Expected 6 month TCC Value ($/MW) [J]
TCCs Sold in Auction												
A(D)	O (N)	96	$7.50	85%	$12.50	5%	$30.00	5%	$12.50	5%	$9.125	$39,420.00
A (D)	V (X)	0.875	$25.00	85%	$50.00	5%	$50.00	5%	$50.00	5%	$28.750	$124,200.00
B (D)	V (X)	1.25	$25.00	85%	$50.00	5%	$50.00	5%	$50.00	5%	$28.750	$124,200.00
P (N)	V (X)	14.25	$17.50	85%	$37.50	5%	$20.00	5%	$37.50	5%	$19.625	$84,780.00
Q (N)	V (X)	76	$17.50	85%	$37.50	5%	$20.00	5%	$37.50	5%	$19.625	$84,780.00
Grandfathered TCCs												
A (D)	W (X)	50	$25.00	85%	$50.00	5%	$50.00	5%	$50.00	5%	$28.750	$124,200.00
L (M)	W (X)	25	$30.00	85%	$62.50	5%	$40.00	5%	$50.00	5%	$33.125	$143,100.00
Y (X)	W (X)	100	$0.00	85%	$0.00	5%	$0.00	5%	$0.00	5%	$0.000	$0.00

[A] LBMP at sink location minus LBMP at source location, All Lines In.
[C] LBMP at sink location minus LBMP at source location, M-X Line Out (Blue)
[E] LBMP at sink location minus LBMP at source location, D-N Line Out (Green)
[G] LBMP at sink location minus LBMP at source location, N-X Line Out (Red)
[I] = (A*B) + (C*D) + (E*F) + (G*H)
[J] = [I] * (6 * 30 days * 24 hours).

It should be noted that the TCCs awarded in Table 11 are not simply 95 percent of the TCCs awarded in Table 8. This is because valuing 95 percent rather than 100 percent of the ETCNL in the auction does not simply reduce the TCCs sold in the auction by 5 percent. The simultaneous feasibility test is applied jointly to the TCCs sold in the auction, the grandfathered TCCs that are unaffected by the shortfall reduction program, and the 5 percent ETCNL. The 5

percent ETCNL may have different constraint impacts than the TCCs awarded in the auction. In essence, the ETCNL and the TCCs sold in the auction produce differing counterflows. This possibility potentially causes the valuing of ETCNL in the DAM to change the mix of TCCs sold in the auction.[5]

The flows on the binding constraints associated with the TCCs portrayed in Table 11, in combination with the grandfathered TCCs and the 5 percent of ETCNL not valued in the auction are the same as those portrayed in Figure 9 and the awards are limited by the revenue adequacy criterion. Since the TCC prices in Table 11 are the same as in Table 8, the value of the ETCNL sold in the long-term auction under the shortfall reduction program would be 95 percent of the value in Table 10 above.

III. PERFECT EXPECTATIONS

The operation of the Make-Whole approach is now illustrated for the TCC allocations specified above, under the assumption that outages and fuel costs in the day-ahead market are exactly the same as those that determined expected prices in the TCC auctions. We begin by applying the Make-Whole approach if all ETCNL is valued in the TCC auction (Make-Whole only) and then apply the Make-Whole approach in combination with the proposed shortfall reduction procedure.

A. Make-Whole Approach

The Make-Whole approach does not affect settlements in the all lines in case, so we need not apply it to this case. Table 12 shows the DAM settlements for the all lines in case and the settlements are exactly balanced, with no congestion rent surplus or shortfall.

Table 12
Hourly DAM Settlement – Net Excess or Shortfall
All Lines In

Load Receipts	$19,162.50
Generator Payments	($14,687.50)
TCC Payments	($4,475.00)
Net	$0.00
Make Whole Receipts	$0.00
Net	$0.00

See Table A-1, Appendix A.

[5] This outcome is in part attributable to the way we have applied the shortfall reduction procedure. An alternative approach would be to run the TCC auction without withholding any ETCNL and then award 95 percent of the TCCs sold. This approach would not work, however, if some of the holders of grandfathered TCCs were offering them for sale or market participants were offering counterflow TCCs in the auction.

We then consider the DAM settlements for the cases in which the M-X, D-N or N-X lines are out on a pre-contingency basis. Table 13 derives the Make-Whole payment by Blue for the hours in which M-X is outaged. There are two binding constraints in this case, N-X and N-M. Table 13 shows the flows over these constraints in the DAM and the flows that would result from the dispatch of the outstanding TCCs on the DAM grid, as well as the constraint shadow prices in the DAM.[6] The Make-Whole approach entails payments by the responsible transmission owner corresponding to the TCCs that are infeasible in the day-ahead market as a result of transmission outages. This cost is determined by calculating the flows on the binding constraints in the day-ahead market that would be caused by applying the outstanding TCCs to the transmission grid used to clear the day-ahead market. The cost of the outage is the shadow price of each constraint in the day-ahead market (the cost of the redispatch required to compensate for the reduction in transfer capability) times the flows on that constraint in excess of the limit that would be required to maintain revenue adequacy for the outstanding TCCs. Applying this methodology to the M-X outage yields a Make-Whole payment by Blue of $3,375.

Table 13
Calculation of Blue Hourly Make-Whole Charge, M-X Out
Base Case DAM Prices

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-X Out	N-X	100	172.5	72.5	37.5	$2,718.75
D-X Out	N-M	-50	-67.5	-17.5	-37.5	$656.25
				Total Make Whole Charge		$3,375.00

[6] The constraint shadow prices are determined in the day-ahead market. The flows for outstanding TCCs are determined by applying the net injections and withdrawals of outstanding TCCs to the grid configuration used in the day-ahead market.

Table 14 derives the DAM settlements for the M-X out case. Payments by energy customers are $25,462.5, payments to generators are $19,837.50, and payments to TCC holders are $9,000. This produces a DAM shortfall of $3,375, which is exactly made up by the Make-Whole payments.

Table 14
Hourly DAM Settlement –Net Excess or Shortfall, M-X Out
No Shortfall Reduction

Load Receipts	$25,462.50
Generator Payments	($19,837.50)
TCC Payments	($9,000.00)
Net	($3,375.00)
Make Whole Receipts	$3,375.00
Net	$0.00

See Table A-2, Appendix A.

Similarly, Table 15 derives the payments under the Make-Whole approach by Green in the D-N outage case, which amount to $2,225.

Table 15
Calculation of Green Hourly Make-Whole Charge, D-N Out
Base Case DAM Prices

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-X Out	D-M	90	152.5	62.5	10	$625.00
D-X Out	M-X	90	116.67	26.67	60	$1,600.00
				Total Make Whole Charge		$2,225.00

Table 16 then derives the DAM settlements for this outage case, showing that there is a shortfall in the DAM market of $2,225, which is again exactly made up by the Make-Whole payment.

Table 16
Hourly DAM Settlement – Net Excess or Shortfall, D-N Out
No Shortfall Reduction

Load Receipts	$27,300.00
Generator Payments	($21,000.00)
TCC Payments	($8,525.00)
Net	($2,225.00)
Make Whole Receipts	$2,225.00
Net	($0.00)

See Table A-3, Appendix A.

Finally, Table 17 derives the payments under the Make-Whole approach by Red in the N-X outage case, which amount to $3,562.5.

Table 17
Calculation of Hourly Red Make-Whole Charge, N-X Out
Base Case DAM Prices

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-N Out	N-M	-50	-5	45	-12.5	($562.50)
D-X Out	M-X	90	172.5	82.5	50	$4,125.00
				Total Make Whole Charge		$3,562.50

Table 18 then derives the DAM settlements for this outage case, showing that there is a shortfall in the DAM market of $3,562.5, which is again exactly made up by the Make-Whole payment.

Table 18
Hourly DAM Settlement – Net Excess or Shortfall, N-X Out
No Shortfall Reduction

Load Receipts	$25,462.50
Generator Payments	($20,337.50)
TCC Payments	($8,687.50)
Net	($3,562.50)
Make Whole Receipts	$3,562.50
Net	$0.00

See Table A-4, Appendix A.

Table 19 portrays the TSC impacts of the Make-Whole approach with perfect expectations. First, it is assumed that the customers receiving grandfathered TCCs are making payments that are credited against Blue's embedded costs.[7] Second, the auction revenues attributed to the ETCNL are taken from Table 10 above. Third, the Make-Whole deduction is derived from Tables 13, 15 and 17 above, multiplied by 216 (.05 * 24 hours per day * 30 days per month * 6 months per capability period) to reflect capability period charges. Finally, the DAM residual is zero, as shown in Tables 12, 14, 16, and 18 above.

The application of the Make-Whole approach does not directly impact the overall level of TSC credits but eliminates the DAM congestion rent shortfall attributable to transmission outages, and thereby shifts the cost impact across transmission owners to align the cost impact with responsibility. This alignment of incentives may ultimately produce improved outage scheduling that decreases the overall TSC.

Table 19
Capability Period TSC Credits – Base Case Prices
All ETCNL Valued in Auction

	Blue	Red	Green	Total
Grandfathered Rights Payments	$5,000,000.00			$5,000,000.00
Auction Revenues	$0.00	$10,168,200.00	$1,971,000.00	$12,139,200.00
Make Whole Deductions	($729,000.00)	($769,500.00)	($480,600.00)	($1,979,100.00)
DAM Residual	$0.00	$0.00	$0.00	$0.00
Net TSC Credit	$4,271,000.00	$9,398,700.00	$1,490,400.00	$15,160,100.00

[7] The $5 million value of these payments is simply assumed. This figure depends on the terms of past contracts and is not derived in these examples.

B. Make-Whole Approach with Shortfall Reduction

The discussion of the Make-Whole approach combined with shortfall reduction assumes that 95 percent of the ETCNL is valued in the forward TCC auction and thus that 5 percent of the ETCNL is not valued in that auction. The Make-Whole approach is then applied to the total flows in the forward TCC auction, including the ETCNL that was not valued in the forward auction.

The 5 percent of ETCNL that was not valued in the forward auction is then valued at DAM prices and accounted for TSC purposes in the same manner as ETCNL that is valued in the auction. Thus, under this approach the value of the ETCNL always flows to the customers of the transmission owner to whom the ETCNL was assigned, the only difference is whether the ETCNL is all valued in the forward auction or some is valued in the DAM.

Table 20 derives the Make-Whole payment by Blue under the shortfall reduction procedure for the hours in which M-X is outaged. There are two binding constraints in this case, N-X and N-M and Table 20 shows the change in flows over these constraints for the DAM (including the ETCNL flows that were reserved but not valued in the TCC auction) and for outstanding TCCs, as well as the constraint shadow prices in the DAM. All of these flows are calculated for the grid configuration used in the DAM. The Make-Whole approach yields a Make-Whole payment by Blue of $3,375 just as in the case without the shortfall reduction adjustment.

Table 20
Calculation of Blue Hourly Make-Whole Charge, M-X Out
Base Case DAM Prices, Shortfall Reduction

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-X Out	N-X	100	172.5	72.5	37.5	$2,718.75
D-X Out	N-M	-50	-67.5	-17.5	-37.5	$656.25
				Total Make Whole Charge		$3,375.00

Similarly, Table 21 derives the payments by Green with the Make-Whole approach applied to all flows in the D-N outage case, which amount to $2,225.

Table 21
Calculation of Green Hourly Make-Whole Charge, D-N Out
Base Case DAM Prices, Shortfall Reduction

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-X Out	D-M	90	152.5	62.5	10	$625.00
D-X Out	M-X	90	116.67	26.67	60	$1,600.00
				Total Make Whole Charge		$2,225.00

Finally, Table 22 derives the payments by Red with the Make-Whole approach applied to all flows in the N-X outage case, which amount to $3562.5.

Table 22
Calculation of Red Hourly Make-Whole Charge, N-X Out
Base Case DAM Prices, Shortfall Reduction Procedure

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-N Out	N-M	-50	-5	45	-12.5	($562.50)
D-X Out	M-X	90	172.5	82.5	50	$4,125.00
				Total Make Whole Charge		$3,562.50

The DAM settlements would then be as portrayed in Table 23. There is no DAM residual, because the credits for the ETCNL valued at DAM prices would exhaust the DAM revenues. It can be seen that the impact of the shortfall reduction procedure is to reduce payments to TCC holders, offset by the payments to ETCNL valued in the DAM.

Table 23
Hourly DAM Settlements – High Gas Prices
Make-Whole Approach with Shortfall Reduction

	All Lines In	M-X Out	D-N Out	N-X Out
Load Receipts	$19,162.50	$25,462.50	$27,300.00	$25,462.50
Generator Payments	($14,687.50)	($19,837.50)	($21,000.00)	($20,337.50)
TCC Payments	($4,352.50)	($8,753.13)	($8,291.25)	($8,440.63)
ETCNL Value	($122.50)	($246.88)	($233.75)	($246.88)
Make Whole Receipts	$0.00	$3,375.00	$2,225.00	$3,562.50
Net DAM Residual	$0.00	$0.00	($0.00)	$0.00

See Tables B-1, B-2, B-3 and B-4, Appendix B.

Table 24 then portrays the overall derivation of TSC credits under the shortfall reduction procedure, while Table 25 compares the TSC credit with and without the shortfall reduction procedure.. It is noteworthy that the application of the shortfall reduction procedure results in exactly the same allocation of TSC credits as the Make-Whole approach without shortfall reduction. Thus, in the case in which DAM prices are the same on average as the prices in the TSC auction, this approach has no impact on the distribution of the TSC credit across the transmission customers of the three transmission owners. This implies an absence of cost shifting.

Table 24
Capability Period TSC Impacts – Base Case Prices
Shortfall Reduction

	Blue	Red	Green	Total
Grandfathered Rights Payments	$5,000,000.00			$5,000,000.00
Auction Revenues	$0.00	$9,659,790.00	$1,872,450.00	$11,532,240.00
Make Whole Deductions	($729,000.00)	($769,500.00)	($480,600.00)	($1,979,100.00)
DAM ETCNL Value	$0.00	$508,410.00	$98,550.00	$606,960.00
DAM Residual	$0.00	$0.00	$0.00	$0.00
Net TSC Credit	$4,271,000.00	$9,398,700.00	$1,490,400.00	$15,160,100.00

Table 25
Comparison of Capability Period TSC Credits

	Blue	Red	Green	Total
No Shortfall Reduction	$4,271,000.00	$9,398,700.00	$1,490,400.00	$15,160,100.00
Shortfall Reduction Applied:	$4,271,000.00	$9,398,700.00	$1,490,400.00	$15,160,100.00

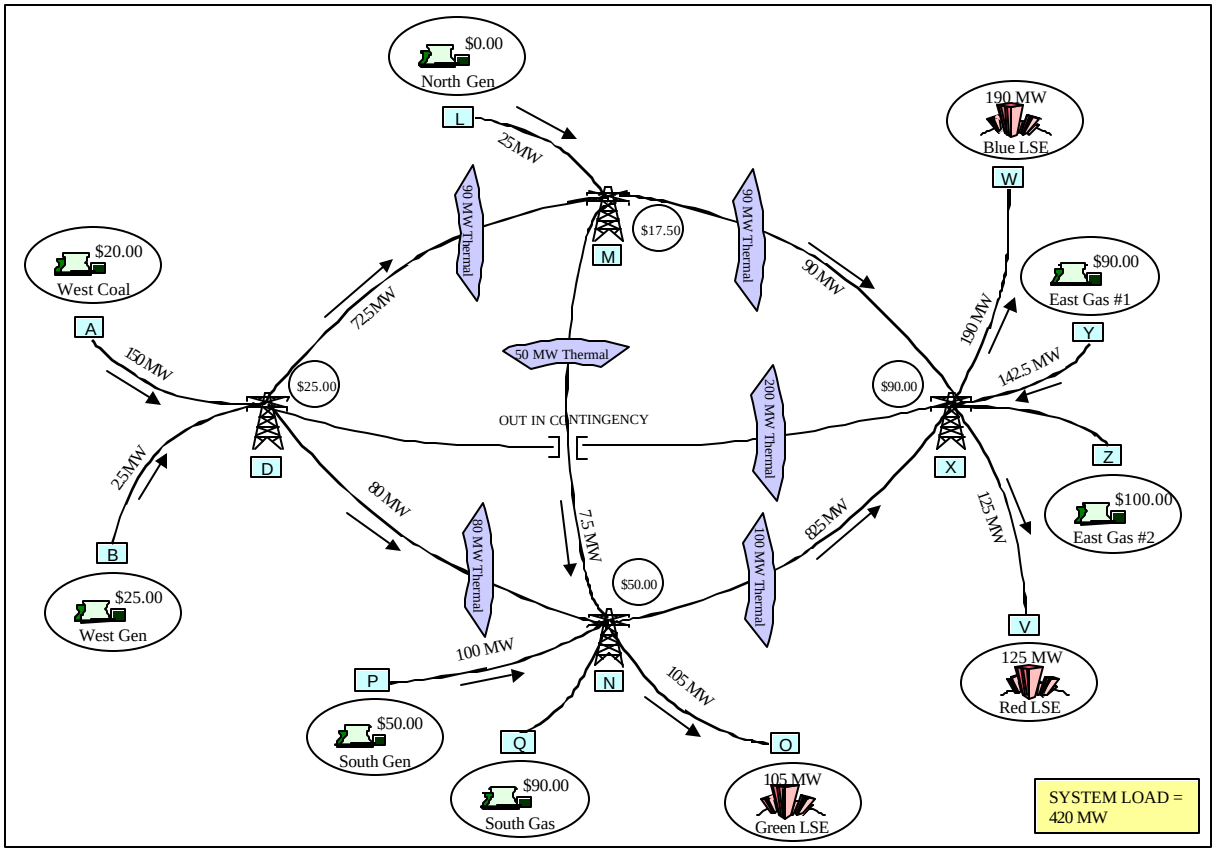
IV. HIGH GAS COST SHOCK

It was seen in the base case example above that absent differences between TCC auction prices and DAM prices, the shortfall reduction methodology will not impact the level of TSC credits. We now illustrate the operation of the Make-Whole approach and shortfall reduction procedure for a case in which gas prices have substantially increased subsequent to the sale of TCCs in the forward TCC auction. In this case, the DAM shortfalls resulting from transmission outages can be large relative to TCC auction revenues and the shortfall reduction procedure tends to cushion the combined impact of the gas price increase and transmission outages on DAM shortfalls. Thus, in this circumstance the shortfall reduction procedure increases the total level of TSC credits. We begin by recalculating the DAM prices for the higher level of gas prices, then apply the Make-Whole approach if all ETCNL is converted to TCCs (Make-Whole only) and then apply the Make-Whole approach in combination with the shortfall reduction procedure.

A. Energy Prices

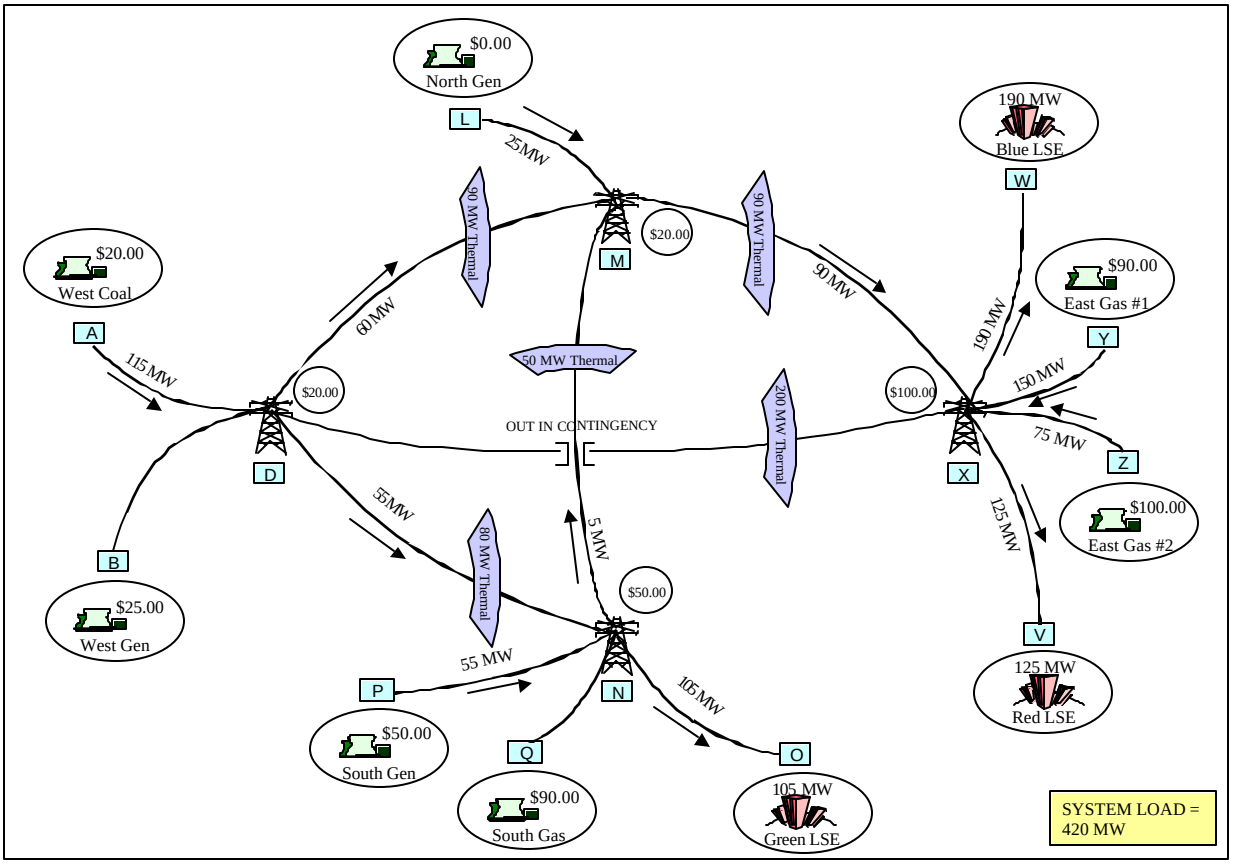
The first DAM market scenario is the all-lines-in (pre-contingency) case portrayed in Figure 26. It can be seen that prices remain $25 in the West, but now rise to $90 in the East.

Figure 26
Dispatch and Power Flows In High Gas Cost Case:
All Lines In



The next scenario is the case in which N-X is out of service pre-contingency, and Western prices fall to $20, with Eastern Prices rising to $100 as shown in Figure 27.

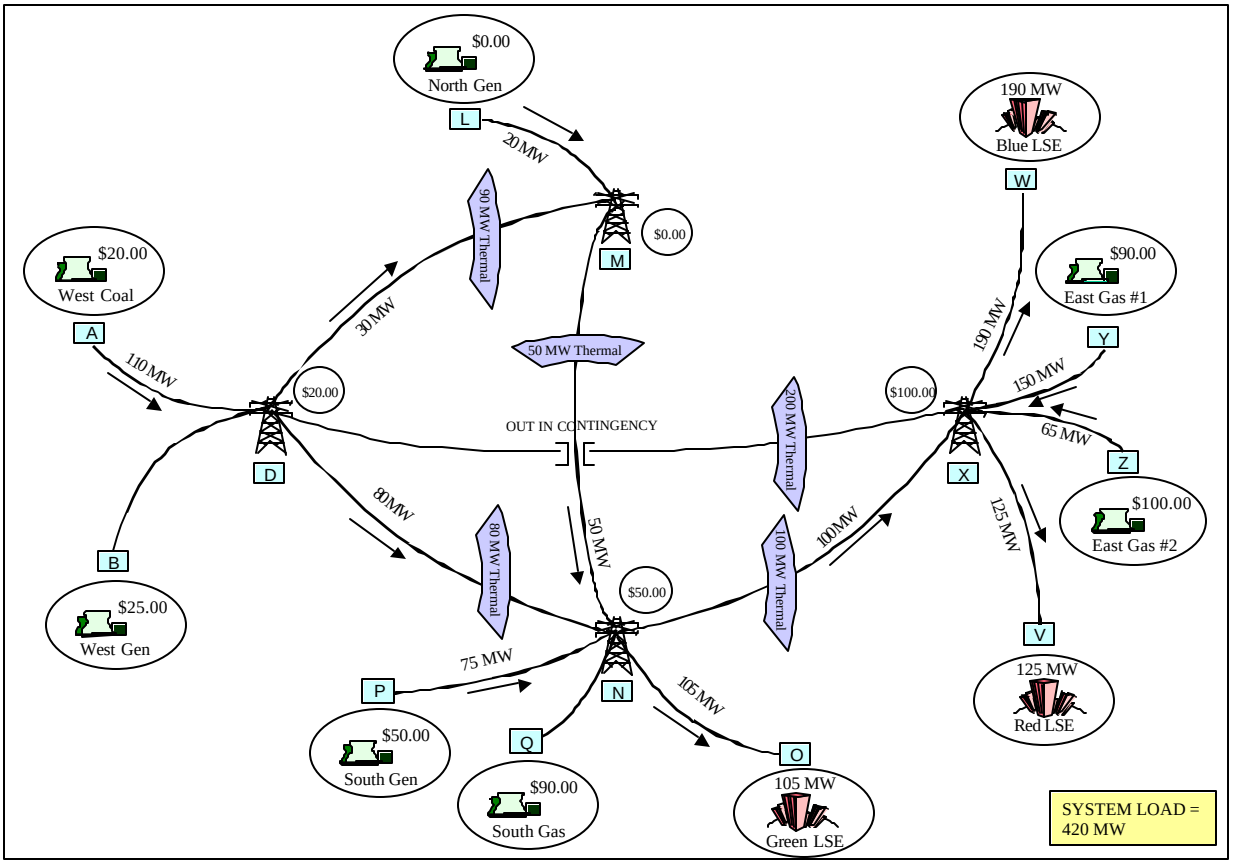
Figure 27
Dispatch and Powe r Flows In High Gas Cost Case:
N-X Out, D-X Contingency



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

The third scenario is the M-X outage case portrayed in Figure 28, and prices again fall to $20 in the West and rise to $100 in the East.

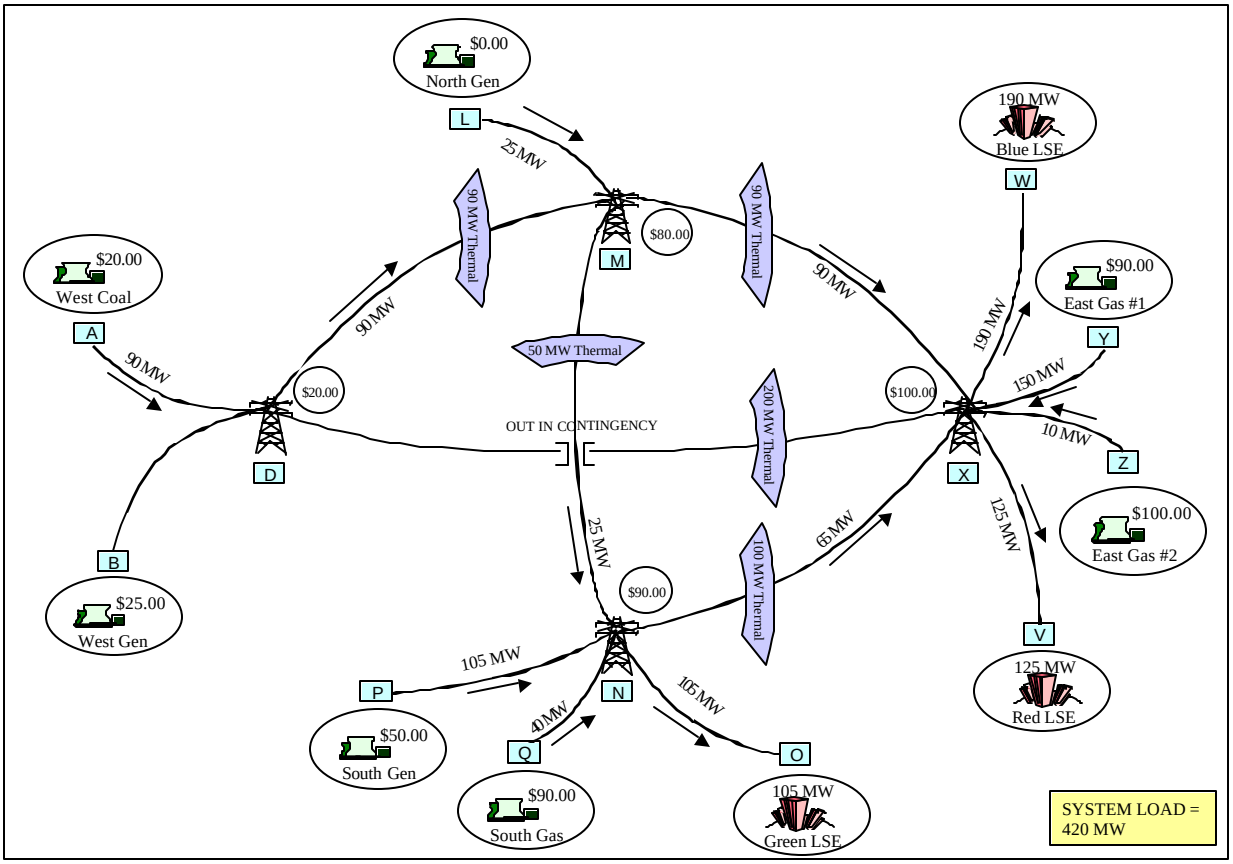
Figure 28
Dispatch and Power Flows In High Gas Cost Case:
M-X Out, D-X Contingency



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

Finally, with D-N out prices in the East and West are similarly affected, but now prices in the South also rise dramatically as shown in Figure 29.

Figure 29
Dispatch and Power Flows In High Gas Cost Case:
D-N Out, D-X Contingency



West Coal 150 MW, West Gen 50 MW, North Gen 25 MW, South Gen 105 MW, South Gas 80 MW, East Gas #1 150 MW, East Gas #2 100 MW

B. Make-Whole Approach

Given these energy prices, the Make-Whole approach would be applied in the same manner as in the base case to derive the payments in each of these outage cases. The derivation of the Make-Whole charges is shown in Table 30. It is seen comparing Table 30 with Tables 13, 15 and 17 that the higher gas prices cause the Make-Whole payments of Blue to rise from $3,375 to $5,150, Green's double from $2,225 to $4,550, and Red's rise from $3,562.5 to $5,250.

Table 30
Calculation of Hourly Make-Whole Charge
No Shortfall Reduction

M-X Out (Blue)

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-X Out	D-N	80	110	30	10	$300.00
D-X Out	N-X	100	172.5	72.5	50	$3,625.00
D-X Out	N-M	-50	-67.5	-17.5	-70	$1,225.00
				Total Make Whole Charge		$5,150.00

D-N Out (Green)

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-X Out	D-M	90	152.5	62.5	60	$3,750.00
D-X Out	M-X	90	116.67	26.67	30	$800.00
				Total Make Whole Charge		$4,550.00

N-X Out (Red)

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-N Out	N-M	-50	-5	45	-30	($1,350.00)
D-X Out	M-X	90	172.5	82.5	80	$6,600.00
				Total Make Whole Charge		$5,250.00

TCC Scenario: Symmetric Outages

The net DAM settlements are then portrayed in Table 31. Table 31 shows that with the Make-Whole payments, the DAM congestion rents are fully funded and there is no shortfall in the DAM settlements.

Table 31
Hourly DAM Settlements – High Gas Prices
No Shortfall Reduction

	All Lines In	M-X Out	D-N Out	N-X Out
Load Receipts	$33,600.00	$36,750.00	$40,950.00	$36,750.00
Generator Payments	($22,075.00)	($27,450.00)	($32,850.00)	($28,050.00)
TCC Payments	($11,525.00)	($14,450.00)	($12,650.00)	($13,950.00)
Net	$0.00	($5,150.00)	($4,550.00)	($5,250.00)
Make Whole Receipts	$0.00	$5,150.00	$4,550.00	$5,250.00
Net	$0.00	$0.00	($0.00)	$0.00

See Tables C-1, C-2, C-3 and C-4, Appendix C.

Finally, Table 32 shows the TSC impacts of the Make-Whole Charges in the High Gas price case. It can be seen that the surprise high gas prices reduce the net TSC credit by more than $1 million, compared to the Base Case (Table 19, above).

Table 32
Capability Period TSC Credits – High Gas Cost Case
All ETCNL Valued in Auction

	Blue	Red	Green	Total
Grandfathered Rights Payments	$5,000,000.00			$5,000,000.00
Auction Revenues	$0.00	$10,168,200.00	$1,971,000.00	$12,139,200.00
Make Whole Deductions	($1,112,400.00)	($1,134,000.00)	($982,800.00)	($3,229,200.00)
DAM Residual	($0.00)	($0.00)	($0.00)	($0.00)
Net TSC Credit	$3,887,600.00	$9,034,200.00	$988,200.00	$13,910,000.00

See Tables 10, 30 and 31.

C. Make-Whole Approach with Shortfall Reduction

We now consider the impact of applying the reduction procedure in the high gas price gas. Unlike the base gas price scenario, it is now seen that the application of the shortfall reduction procedure impacts the size of the total TSC charge borne by transmission customers.

Table 33 portrays the Make-Whole payments under the shortfall reduction procedure.

Table 33
Calculation of Hourly Make-Whole Charge
High Gas Case with Shortfall Reduction

M-X Out (Blue)

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-X Out	D-N	80	110	30	10	$300.00
D-X Out	N-X	100	172.5	72.5	50	$3,625.00
D-X Out	N-M	-50	-67.5	-17.5	-70	$1,225.00
				Total Make Whole Charge		$5,150.00

D-N Out (Green)

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-X Out	D-M	90	152.5	62.5	60	$3,750.00
D-X Out	M-X	90	116.67	26.67	30	$800.00
				Total Make Whole Charge		$4,550.00

N-X Out (Red)

Binding Contingencies in Dispatch	Binding Constraint(s) in Contingency	Flow in Dispatch (MWh)	Flow for Outstanding TCCs (MWh)	Difference	Constraint Shadow Price ($/MWh)	Make Whole Charge
D-N Out	N-M	-50	-5	45	-30	($1,350.00)
D-X Out	M-X	90	172.5	82.5	80	$6,600.00
				Total Make Whole Charge		$5,250.00

TCC Scenario: Symmetric Outages

The net DAM settlements under the shortfall reduction procedure are portrayed in Table 34.

Table 34
Hourly DAM Settlements – High Gas Prices
Make-Whole with Shortfall Reduction

	All Lines In	M-X Out	D-N Out	N-X Out
Load Receipts	$33,600.00	$36,750.00	$40,950.00	$36,750.00
Generator Payments	($22,075.00)	($27,450.00)	($32,850.00)	($28,050.00)
TCC Payments	($11,210.63)	($14,062.50)	($12,292.50)	($13,562.50)
ETCNL Value	($314.38)	($387.50)	($357.50)	($387.50)
Make Whole Receipts	$0.00	$5,150.00	$4,550.00	$5,250.00
Net DAM Residual	$0.00	$0.00	($0.00)	$0.00

See Tables D-1, D-2, D-3 and D-4, Appendix D.

Finally, Table 35 shows the TSC impacts of the application of the shortfall reduction procedure.

Table 35
Capability Period TSC Credits – High Gas Cost Case
Shortfall Reduction

	Blue	Red	Green	Total
Grandfathered Rights Payments	$5,000,000.00			$5,000,000.00
Auction Revenues	$0.00	$9,659,790.00	$1,872,450.00	$11,532,240.00
Make Whole Deductions	($1,112,400.00)	($1,134,000.00)	($982,800.00)	($3,229,200.00)
DAM ETCNL Value	$0.00	$1,171,853.39	$227,151.61	$1,399,005.00
DAM Residual	$0.00	$0.00	$0.00	$0.00
Net TSC Credit	$3,887,600.00	$9,697,643.39	$1,116,801.61	$14,702,045.00

See Tables 10, 33 and 34.

Table 36 summarizes the TSC credits in the high gas price scenario with and without shortfall reduction. The total TSC credits summed over the transmission customers of the three transmission owners are affected by the application of the shortfall reduction procedure and it can be seen that there is an increase in TSC credits from the application of the shortfall reduction procedure.

Table 36
Comparison of Capability Period TSC Credits
High Gas Prices

	Blue	Red	Green	Total
No Shortage Reduction	$3,887,600.00	$9,034,200.00	$988,200.00	$13,910,000.00
Shortage Reduction Applied	$3,887,600.00	$9,697,643.39	$1,116,801.61	$14,702,045.00

Another way of looking at the impact of the shortfall reduction procedure is to compare the TSC credits at base gas prices and at high gas prices. Absent shortfall reduction, the TSC credits would be $15,160,100 at base gas prices (Table 19). Absent shortfall reduction at high gas prices, the TSC credit would be $13,910,000 (Table 36), so the impact of outages in combination with high gas prices reduce the TSC credits by $1,250,000. With application of the shortfall reduction procedure to only 5 percent of ETCNL, the TSC credit rises to $14,702,045 so that 64 percent of the reduction arising from outages and high gas prices is eliminated.[8]

V. OUTAGE RATE PERFORMANCE INCENTIVES

The final case shows that the short-fall reduction procedure leaves intact the incentive of each transmission owner to reduce outage costs, because reductions in outages increase the TSC credit. While the short-fall reduction procedure cushions the impact on the TSC credit of differences between the impact of outages at expected DAM prices and actual DAM prices (when DAM prices are higher than expected), the Make-Whole approach assigns the outage

[8] The mix of shortfall reduction benefits and high gas price impacts is different between Red and Green but this is in part an artifact of the example. The base allocation we used gave Red ETCNL that is relatively valuable compared to the outage costs of the line we assigned to Red for outage responsibility.

costs to the TSC of the responsible TO and TSC credits are uniformly increased by improved outage performance.

Table 37 compares the TSC credits from the initial base case in which each transmission owner has a 5 percent outage rate (from Table 25) to a case in which Blue and Red have 5 percent outage rates but Green has a 2.5 percent outage rate.[9] It is apparent that the TSC credit of Green is uniformly and substantially larger with the reduced outage rate under the short-fall reduction procedure. Under the short-fall reduction procedure, the Make-Whole costs assigned to Green fall as a result of the reduced outage rate, and the reduced outage rate (compared to expectations) slightly reduces the value of ETCNL valued in the DAM compared to its value in the auction.

Table 37
Comparison of TSC Credits
Shortfall Reduction Procedure

Symmetric Outages	Blue (5%)	Red (5%)	Green (5%)	Total
No Shortfall Reduction	$4,271,000.00	$9,398,700.00	$1,490,400.00	$15,160,100.00
Shortfall Reduction Applied	$4,271,000.00	$9,398,700.00	$1,490,400.00	$15,160,100.00
Assymetric Outage	Blue (5%)	Red (5%)	Green (2.5%)	Total
No Shortfall Reduction	$4,271,000.00	$9,398,700.00	$1,730,700.00	$15,400,400.00
Shortfall Reduction Applied	$4,271,000.00	$9,388,635.83	$1,728,749.17	$15,388,385.00
Assymetric Outage	Blue (5%)	Red (5%)	Green (7.5%)	Total
No Shortfall Reduction	$4,271,000.00	$9,398,700.00	$1,250,100.00	$14,919,800.00
Shortfall Reduction Applied	$4,271,000.00	$9,408,764.17	$1,252,050.83	$14,931,815.00

See Tables E-1 through E-4, Appendix E, and Table 25.

Table 37 provides the same comparison for the circumstance in which Green's outage rate is unexpectedly high (7.5 percent) relative to expectations, and it is apparent that Green's TSC credit is reduced by the poor outage performance.

[9] The tables deriving the TSC credits for this case are included in Appendix E. The hourly Make-Whole charges and DAM settlements are unchanged from Section III; only the capability period weighting is different.

Similarly, Table 38 compares the TSC credits for the high gas price case in which each transmission owner has a 5 percent outage rate (from Table 36) to a high gas price case in which Blue and Red have 5 percent outage rates but Green has a 2.5 percent outage rate.[10] It is again apparent that the TSC credit of Green is uniformly and substantially larger with the reduced outage rate under the short-fall reduction procedure.

Table 38
Comparison of TSC Credits – High Gas Cost
Shortfall Reduction Procedure

Symmetric Outages	Blue (5%)	Red (5%)	Green (5%)	Total
No Shortfall Reduction	$3,887,600.00	$9,034,200.00	$988,200.00	$13,910,000.00
Shortfall Reduction Applied	$3,887,600.00	$9,697,643.39	$1,116,801.61	$14,702,045.00
Assymetric Outage	Blue (5%)	Red (5%)	Green (2.5%)	
No Shortfall Reduction	$3,887,600.00	$9,034,200.00	$1,479,600.00	$14,401,400.00
Shortfall Reduction Applied	$3,887,600.00	$9,693,742.11	$1,607,445.39	$15,188,787.50
Assymetric Outage	Blue (5%)	Red (5%)	Green (7.5%)	
No Shortfall Reduction	$3,887,600.00	$9,034,200.00	$496,800.00	$13,418,600.00
Shortfall Reduction Applied	$3,887,600.00	$9,701,544.67	$626,157.83	$14,215,302.50

See Tables F-1 through F-4, Appendix F, and Table 25.

Finally, Table 38 also compares the TSC credits from the high gas price case in which each transmission owner has a 5 percent outage rate (from Table 36) to a high gas price case in which Green has a 7.5 percent outage rate in real-time and it is seen that Green's TSC credit is substantially reduced by its high outage rate.

Overall, therefore while the proposed shortfall reduction procedure cushions the impact of changes in day-ahead market prices on outage costs, it does not cushion the impact of higher outage rates on the TSC.

[10] The tables deriving the TSC credits for this case are included in Appendix F. The hourly Make-Whole charges and DAM settlements are the same as in Section IV above.