Monitoring Analytics

REPORT TO THE NORTH CAROLINA UTILITIES COMMISSION

Congestion in the Dominion Service Territory in North Carolina:

May 1, 2009 through April 30, 2011

The Independent Market Monitor for PJM

July 15, 2011

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Overview of Congestion Calculations

This report provides details of congestion associated with Dominion's service territory within the state of North Carolina for the periods May 1, 2009, through April 30, 2010 (2009/2010), and May 1, 2010, through April 30, 2011 (2009/2010). Congestion calculations are for the entire territory and not for any specific organization. The total congestion is the sum of all congestion for the organizations with market activity in the area. The report also includes congestion event hours for the constraints which had the largest impact on congestion charges in Dominion, either positive or negative, and the congestion charges associated with each constraint. [1]

Total congestion costs equal net congestion costs plus explicit congestion costs. Net congestion costs equal load congestion payments minus generation congestion credits.[2] Explicit congestion costs are the net congestion costs associated with point-to-point energy transactions. Each of these categories of congestion costs is comprised of day-ahead and balancing congestion costs. Day-ahead congestion costs are based on day-ahead MWh while balancing congestion costs are based on deviations between day-ahead and real-time MWh priced at the congestion price in the Real-Time Energy Market. [3]

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1 Congestion event hours are hours in which a transmission constraint is binding. In day ahead, an interval equals one hour. In real time, an interval equals five minutes. In order to have a consistent metric for day-ahead and real-time congestion frequency, real-time congestion frequency is measured using the convention that an hour is constrained if any one of its component five-minute intervals is constrained.

2 Prior to June 1, 2007, PJM Congestion Accounting methods included implicit congestion costs, spot congestion costs, and explicit congestion costs. After June 1, 2007, PJM no longer calculates spot congestion costs. Implicit congestion costs are now equal to the difference between load congestion payments and generation congestion credits, i.e. net congestion. Explicit congestion costs remained the same after June 1, 2007.

3 See Table 10, "Congestion Definitions," for a summary of relevant definitions.

Table 1 and Table 2 provide a summary of the total congestion charges in the North Carolina portion of Dominion.

Table 1 shows a summary of the congestion costs associated with the North Carolina portion of the Dominion service territory starting May 2009. Table 2 shows a monthly breakdown of congestion costs.

Table 1 Total Dominion North Carolina congestion costs (Dollars (Millions)): May 1, 2009 through April 30, 2011

	Congestion Costs	Percent Change
2009/2010	$8.4	NA
2010/2011	$16.2	92%
Total	$24.6	

Table 2 Monthly Dominion North Carolina congestion costs (Dollars (Millions)): May 1, 2009 through April 30, 2011

	Total Congestion Costs		
	2009	2010	2011
Jan		$3.8	$2.4
Feb		$0.8	$0.9
Mar		$0.1	$0.0
Apr		$0.1	$0.9
May	$0.4	$0.7	
Jun	$0.7	$3.2	
Jul	$0.4	$1.7	
Aug	$0.8	$1.5	
Sept	$0.3	$0.8	
Oct	$0.1	$0.6	
Nov	$0.3	$0.5	
Dec	$0.8	$2.8	

Congestion charges can be both positive and negative. When a constraint binds, the price effects of that constraint vary. The system marginal price (SMP) is uniform for all areas, while the congestion components of Locational Marginal Price (LMP) will either be positive or negative in a specific area, meaning that actual LMPs are above or below the SMP.[4] The area affected by a constraint will have increased prices and the

[4] The SMP is the price of the distributed load reference bus. The price at the reference bus is equivalent to the five minute real-time or hourly day-ahead load weighted PJM LMP.

unconstrained area will have lower prices. If an area is located downstream from the constrained element, the area will experience positive congestion costs. If an area is located upstream from the constrained element, the area will experience negative congestion costs (lower prices).

Day-ahead congestion charges and credits are based on MWh and LMP in the Day-Ahead Energy Market. Balancing congestion charges and credits are based on load or generation deviations between the Day-Ahead and Real-Time Energy Markets and LMP in the Real-Time Energy Market. If a participant has real-time generation or load that is greater than its day-ahead generation or load then the deviation will be positive. If there is a positive load deviation at a bus where real-time LMP has a positive congestion component, positive balancing congestion costs will result. Similarly, if there is a positive load deviation at a bus where real-time LMP has a negative congestion component, negative balancing congestion costs will result. If a participant has real-time generation or load that is less than its day-ahead generation or load then the deviation will be negative. If there is a negative load deviation at a bus where real-time LMP has a positive congestion component, negative balancing congestion costs will result. Similarly, if there is a negative load deviation at a bus where real-time LMP has a positive congestion component, negative balancing congestion costs will result.

In order to provide a more detailed explanation of the congestion calculations from which the total congestion charges are derived, each category of congestion is defined and a table of the congestion charges or credits associated with each category is provided.

Net Congestion Bill

The net congestion bill is defined by PJM settlements. The net congestion bill is calculated by subtracting generating congestion credits from load congestion payments. The logic is that increased congestion payments by load are offset by increased congestion revenues to generation for the area analyzed. Whether the net congestion bill is an appropriate measure of congestion for load depends on who pays the load congestion payments and who receives the generation congestion credits. The net congestion bill is an appropriate measure of congestion for a utility that charges load congestion payments to load and credits generation congestion credits to load. The net congestion bill is not an appropriate measure of congestion in situations where load pays the load congestion payments but does not receive the generation credits as an offset.

Load congestion payments are netted against generation congestion credits on an hourly basis, by participant, and then summed for the given period. Generation credits result either from the direct ownership of generation or from the purchase of supply from another entity via a bilateral transaction.

Both day-ahead and balancing load congestion payments and generation congestion credits are calculated.

- **Day-ahead Load Congestion Payments.** Day-ahead load congestion payments are calculated for all cleared demand, decrement bids, and day-ahead energy sale transactions. (Decrement bids and energy sales can be thought of as scheduled load.) Day-ahead load congestion payments are calculated using load MWh and the congestion component of LMP (CLMP) for the load bus, decrement bid location, or the source of the sale transaction, as applicable.

- **Day-ahead Generation Congestion Credits.** Day-ahead generation congestion credits are calculated for all cleared generation, increment offers and day-ahead energy purchase transactions. (Increment offers and energy purchases can be thought of as scheduled generation.) Day-ahead generation congestion credits are calculated using generation MWh and the CLMP for the generator bus, increment offer location, or the sink of the purchase transaction, as applicable.

- **Balancing Load Congestion Payments.** Balancing load congestion payments are calculated for all deviations between a PJM participant's real-time load and energy sale transactions and their day-ahead cleared demand, decrement bids, and energy sale transactions. Balancing load congestion payments are calculated using MWh deviations and the real-time CLMP for each bus where a deviation from a member's day-ahead scheduled load exists.

- **Balancing Generation Congestion Credits.** Balancing generation congestion credits are calculated for all deviations between a PJM participant's real-time generation and energy purchase transactions and the day-ahead cleared generation, increment offers and energy purchase transactions. Balancing generation congestion credits are calculated using MWh deviations and the real-time CLMP for each bus where a deviation from a member's day-ahead scheduled generation exists.

Explicit Congestion Costs

Explicit congestion costs are the congestion costs associated with moving energy from one specific point to another across the transmission system. Such point-to-point transactions may be either internal to PJM or be import or export transactions.

- **Internal Purchases.** For internal purchases the explicit congestion costs equal the difference in CLMPs between the sink bus and source bus of the purchase multiplied by the transacted MWh. The buyer pays the congestion costs associated with internal purchases.

- **Import and Export Transactions.** For point-to-point and network secondary transmission customers, the Explicit Congestion costs equal the difference in CLMPs

between the sink bus and source bus multiplied by the transacted MWh. The transmission customer pays the congestion costs associated with an import or export transaction.

The explicit congestion costs calculated for the North Carolina portion of Dominion represent the costs associated with point to point transactions that sink in the North Carolina portion of Dominion. For example, if a transaction is sourced in Pennsylvania and sinks in Dominion North Carolina, the charges would be based on the MWh of the transaction multiplied by the difference between the sink CLMP and the source CLMP. The resulting congestion costs are allocated to the zone and state of the sink location, in this case Dominion North Carolina. The sink location is the buyer's location and reflects the cost to the buyer of the internal purchase or external transaction.

Table 3 shows the combined day-ahead and balancing load congestion payments, generation congestion credits, and explicit congestion costs for the Dominion North Carolina service territory for May 1, 2009 through April 30, 2011. Table 4 shows the congestion costs categories separated by day-ahead and balancing to show the contributions from both the Day-Ahead and Real-Time Markets.

Table 3 Total Dominion North Carolina congestion costs by category: May 1, 2009 through April 30, 2011

Congestion Costs (Millions)					
	Load Payments	Generation Credits	Net Congestion Bill	Explicit	Grand Total
2009/2010	$9.6	$1.2	$8.3	$0.1	$8.4
2010/2011	$16.3	$0.3	$16.0	$0.1	$16.2

Table 4 Total day-ahead and balancing Dominion North Carolina congestion costs by category: May 1, 2009 through April 30, 2011

Congestion Costs (Millions)									
	Day Ahead				Balancing				
	Load Payments	Generation Credits	Explicit	Total	Load Payments	Generation Credits	Explicit	Total	Grand Total
2009/2010	$11.3	$1.5	$0.3	$10.1	($1.7)	($0.2)	($0.2)	($1.7)	$8.4
2010/2011	$19.6	$0.1	$0.7	$20.1	($3.2)	$0.1	($0.6)	($4.0)	$16.2

Table 5 lists the top 15 constraints affecting Dominion North Carolina congestion costs for the period from May 1, 2010 through April 30, 2011. Table 5 provides the type of constraint (Line, Transformer, or Interface), the location of the constraint and the congestion event hours for the period analyzed.

Table 5 Top 15 constraints affecting Dominion North Carolina congestion costs: May 1, 2010 through April 30, 2011

				Event Hours	
No.	Constraint	Type	Location	Day Ahead	Real Time
1	AP South	Interface	500	4,712	1,247
2	Bedington - Black Oak	Interface	500	2,238	192
3	Danville - East Danville	Line	Dominion	1,057	164
4	AEP-DOM	Interface	500	513	196
5	Crete - St Johns Tap	Flowgate	Midwest ISO	2,902	1,243
6	West	Interface	500	386	40
7	Cloverdale - Lexington	Line	AEP	1,246	791
8	Beechwood - Kerr Dam	Line	Dominion	617	263
9	Danville - East Danville	Line	AEP	937	0
10	Brandon Shores - Riverside	Line	BGE	354	147
11	Clover	Transformer	Dominion	769	295
12	5004/5005 Interface	Interface	500	1,242	550
13	Graceton - Raphael Road	Line	BGE	554	295
14	Wylie Ridge	Transformer	AP	2,322	1,015
15	Pleasantville - Ashburn	Line	Dominion	94	35

Table 6 shows the congestion cost details of the top 15 constraints affecting Dominion North Carolina for the period from May 1, 2010, through April 30, 2011. The AP South interface had the largest impact on congestion costs with a total of $7.7 million or 48 percent of total congestion costs.

Table 6 Congestion cost details for the top 15 constraints affecting Dominion North Carolina: May 1, 2010 through April 30, 2011

	Congestion Costs (Millions)								
	Day Ahead				Balancing				
Constraint	Load Payments	Generation Credits	Explicit	Total	Load Payments	Generation Credits	Explicit	Total	Grand Total
AP South	$10.0	$0.2	$0.2	$10.1	($2.2)	$0.0	($0.1)	($2.3)	$7.7
Bedington - Black Oak	$2.6	$0.1	$0.1	$2.6	($0.2)	$0.0	($0.0)	($0.2)	$2.4
Danville - East Danville	$1.5	$0.1	$0.0	$1.5	($0.2)	($0.0)	($0.0)	($0.2)	$1.3
AEP-DOM	$1.3	$0.0	$0.0	$1.3	($0.2)	($0.0)	($0.0)	($0.2)	$1.1
Crete - St Johns Tap	$0.8	$0.0	$0.0	$0.8	($0.1)	$0.0	($0.0)	($0.2)	$0.7
West	($0.7)	($0.0)	$0.0	($0.7)	$0.1	$0.0	$0.0	$0.1	($0.6)
Cloverdale - Lexington	$0.8	$0.0	$0.0	$0.8	($0.2)	$0.0	($0.0)	($0.2)	$0.6
Beechwood - Kerr Dam	$1.2	$0.1	$0.0	$1.1	($0.6)	($0.0)	($0.0)	($0.6)	$0.5
Danville - East Danville	$0.5	$0.0	$0.0	$0.5	$0.0	$0.0	$0.0	$0.0	$0.5
Brandon Shores - Riverside	($0.8)	($0.0)	($0.0)	($0.8)	$0.2	($0.0)	$0.0	$0.3	($0.5)
Clover	$0.3	($0.1)	$0.0	$0.5	$0.0	$0.0	($0.0)	$0.0	$0.5
5004/5005 Interface	($1.1)	($0.0)	$0.0	($1.1)	$0.6	($0.0)	$0.0	$0.6	($0.4)
Graceton - Raphael Road	$0.5	$0.0	$0.0	$0.5	($0.1)	$0.0	($0.0)	($0.1)	$0.4
Wylie Ridge	$0.4	$0.0	$0.0	$0.4	($0.1)	($0.0)	($0.0)	($0.1)	$0.3
Pleasantville - Ashburn	$0.3	$0.0	$0.0	$0.4	($0.0)	$0.0	($0.0)	($0.0)	$0.3

Table 7 lists the top 15 constraints affecting Dominion North Carolina congestion costs for the period from May 1, 2009 through April 30, 2010. Table 7 provides the type of constraint (Line, Transformer, or Interface), the location of the constraint and the congestion event hours for the period analyzed.

Table 7 Top 15 constraints affecting Dominion North Carolina congestion costs: May 1, 2009 through April 30, 2010

				Event Hours	
No.	Constraint	Type	Location	Day Ahead	Real Time
1	AP South	Interface	500	3,736	1,194
2	AEP-DOM	Interface	500	700	160
3	Bedington - Black Oak	Interface	500	1,231	32
4	Beechwood - Kerr Dam	Line	Dominion	601	231
5	Kammer	Transformer	500	2,484	778
6	Dunes Acres - Michigan City	Flowgate	Midwest ISO	2,268	522
7	5004/5005 Interface	Interface	500	1,423	392
8	Chuckatuck - Benns Church	Line	Dominion	45	0
9	Danville - East Danville	Line	Dominion	527	69
10	Pleasant View	Transformer	Dominion	14	72
11	Graceton - Raphael Road	Line	BGE	557	174
12	East Frankfort - Crete	Line	ComEd	2,032	988
13	Crete - St Johns Tap	Flowgate	Midwest ISO	1,755	360
14	Hopewell - Chesterfield	Line	Dominion	27	28
15	Baker - Broadford	Line	AEP	10	74

Table 8 shows the congestion cost details of the top 15 constraints affecting Dominion North Carolina for the period from May 1, 2009 through April 30, 2010. The AP South interface had the largest impact on congestion costs with a total of $4.1 million or 49 percent of the total congestion costs.

Table 8 Congestion cost details for the top 15 constraints affecting Dominion North Carolina: May 1, 2009 through April 30, 2010

	Congestion Costs (Millions)								
	Day Ahead				Balancing				
Constraint	Load Payments	Generation Credits	Explicit	Total	Load Payments	Generation Credits	Explicit	Total	Grand Total
AP South	$5.9	$0.7	$0.1	$5.3	($1.2)	($0.1)	($0.0)	($1.2)	$4.1
AEP-DOM	$2.1	$0.4	$0.0	$1.7	($0.1)	$0.0	($0.0)	($0.1)	$1.6
Bedington - Black Oak	$0.9	$0.1	$0.0	$0.8	($0.0)	($0.0)	($0.0)	($0.0)	$0.8
Beechwood - Kerr Dam	$0.8	$0.3	$0.0	$0.6	($0.2)	($0.1)	($0.0)	($0.0)	$0.5
Kammer	$0.4	$0.0	$0.0	$0.4	($0.0)	$0.0	($0.0)	($0.1)	$0.3
Dunes Acres - Michigan Cit	$0.4	$0.0	$0.0	$0.4	($0.1)	$0.0	($0.0)	($0.1)	$0.3
5004/5005 Interface	($0.5)	($0.1)	$0.0	($0.4)	$0.1	$0.0	($0.0)	$0.1	($0.3)
Chuckatuck - Benns Churcl	($0.2)	($0.0)	$0.0	($0.2)	$0.0	$0.0	$0.0	$0.0	($0.2)
Danville - East Danville	$0.4	$0.1	$0.0	$0.3	($0.1)	$0.0	($0.0)	($0.1)	$0.2
Pleasant View	$0.0	$0.0	$0.0	$0.0	($0.2)	$0.0	($0.0)	($0.2)	($0.2)
Graceton - Raphael Road	$0.3	$0.0	$0.0	$0.3	($0.2)	($0.0)	($0.0)	($0.1)	$0.2
East Frankfort - Crete	$0.3	$0.0	$0.0	$0.3	($0.1)	$0.0	($0.0)	($0.1)	$0.2
Crete - St Johns Tap	$0.2	$0.0	$0.0	$0.2	($0.0)	($0.0)	($0.0)	($0.0)	$0.1
Hopewell - Chesterfield	$0.1	$0.0	$0.0	$0.1	$0.0	($0.0)	($0.0)	$0.0	$0.1
Baker - Broadford	$0.0	$0.0	$0.0	$0.0	($0.1)	($0.0)	($0.0)	($0.1)	($0.1)

Table 9 shows the largest deltas by constraint for the period ending April 30, 2011 compared to the period ending April 30, 2010. Congestion costs for the Mount Storm – Pruntytown line had the largest decrease of $4.6 million from the 20098/2010 period to the 2010/2011 period.

Table 9 Top 15 constraint congestion cost deltas from the prior period: May 1, 2010 through April 30, 2011 minus May 1, 2009 through April 30, 2010.

	Congestion Cost Deltas (Millions)								
	Day Ahead				Balancing				
Constraint	Load Payments	Generation Credits	Explicit	Total	Load Payments	Generation Credits	Explicit	Total	Grand Total
AP South	$4.1	($0.5)	$0.1	$4.8	($1.0)	$0.1	($0.1)	($1.2)	$3.6
Bedington - Black Oak	$1.7	($0.0)	$0.1	$1.8	($0.2)	$0.0	($0.0)	($0.2)	$1.6
Danville - East Danville	$1.2	($0.0)	$0.0	$1.2	($0.1)	($0.0)	($0.0)	($0.1)	$1.1
West	($0.6)	($0.0)	$0.0	($0.6)	($0.0)	($0.0)	$0.0	$0.0	($0.6)
AEP-DOM	($0.8)	($0.3)	($0.0)	($0.5)	($0.1)	($0.0)	($0.0)	($0.1)	($0.6)
Cloverdale - Lexington	$0.6	$0.0	$0.0	$0.7	($0.1)	($0.0)	($0.0)	($0.1)	$0.6
Crete - St Johns Tap	$0.7	($0.0)	($0.0)	$0.7	($0.1)	$0.0	$0.0	($0.1)	$0.6
Danville - East Danville	$0.5	$0.0	$0.0	$0.5	$0.0	$0.0	$0.0	$0.0	$0.5
Brandon Shores - Riverside	($0.7)	($0.0)	($0.0)	($0.7)	$0.2	($0.0)	$0.0	$0.2	($0.5)
Clover	$0.3	($0.1)	$0.0	$0.4	$0.0	$0.0	($0.0)	$0.0	$0.5
Kammer	($0.4)	($0.0)	($0.0)	($0.4)	$0.0	($0.0)	$0.0	$0.1	($0.3)
Wylie Ridge	$0.4	$0.0	$0.0	$0.4	($0.1)	($0.0)	($0.0)	($0.1)	$0.3
Dunes Acres - Michigan City	($0.4)	($0.0)	($0.0)	($0.4)	$0.0	($0.0)	$0.0	$0.1	($0.3)
Pleasantville - Ashburn	$0.3	$0.0	$0.0	$0.3	($0.0)	$0.0	($0.0)	($0.0)	$0.3
Greenwich - Elizabeth River	$0.3	$0.0	$0.0	$0.3	($0.0)	$0.0	($0.0)	($0.0)	$0.3

Conclusion

Congestion costs in the Dominion service territory of North Carolina increased from the 2009/2010 period to 2010/2011 period by $7.7 million or 92 percent. Load congestion payments increased by $6.8 million from 2009/2010 to 2010/2011, while generation congestion credits decreased by $1.0 million from 2009/2010 to 2010/2011. Explicit congestion costs remained approximately the same between the periods.

Congestion Definitions

Table 10 Congestion Definitions

Congestion Category	Calculation
Day-Ahead Load Congestion Payments	Day-Ahead Demand MWh * Day-Ahead CLMP
Day-Ahead Generation Congestion Credits	Day-Ahead Supply MWh * Day-Ahead CLMP
Day-Ahead Net Congestion Bill	Day-Ahead Load Congestion Payments - Day-Ahead Generation Congestion Credits
Day-Ahead Explicit Congestion Costs	Day-Ahead Transaction MW * (Day-Ahead Sink CLMP - Day-Ahead Source CLMP)
Day-Ahead Total Congestion Costs	Day-Ahead Load Congestion Payments - Day-Ahead Generation Congestion Credits + Day-Ahead Explicit Congestion Costs
Balancing Load Congestion Payments	Balancing Demand MWh * Real-Time CLMP
Balancing Generation Congestion Credits	Balancing Supply MWh * Real-Time CLMP
Balancing Net Congestion Bill	Balancing Load Congestion Payments - Balancing Generation Congestion Credits
Balancing Explicit Congestion Costs	Balancing Transaction MW * (Real-Time Sink CLMP - Real-Time Source CLMP)
Balancing Total Congestion Costs	Balancing Load Congestion Payments - Balancing Generation Congestion Credits + Balancing Explicit Congestion Costs
Total Congestion Costs	Day-Ahead Total Congestion Costs + Balancing Total Congestion Costs

MWh Category	Definition
Day-Ahead Demand MWh	Cleared Demand, Decrement Bids, Energy Sale Transactions
Day-Ahead Supply MWh	Cleared Generation, Increment Bids, Energy Purchase Transactions
Real-Time Demand MWh	Load and Energy Sale Transactions
Real-Time Supply MWh	Generation and Energy Purchase Transactions
Balancing Demand MWh	Real-Time Demand MWh - Day-Ahead Demand MWh
Balancing Supply MWh	Real-Time Supply MWh - Day-Ahead Supply MWh