Congestion Analysis Using PROBE

ESPWG Update

September 3, 2003

“What If” Analysis

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Congestion Analysis Using PROBE

- PROBE
  - Software Available at NYISO to Mirror the SCUC
  - Data Fed From Actual Day Ahead Market
  - Assumes Given Unit Commitment
  - Hourly Power Flow Models Available
  - Viewer Mode for Analyzing History
  - Simulator Mode for “What If “ Analysis

Congestion Analysis Using PROBE

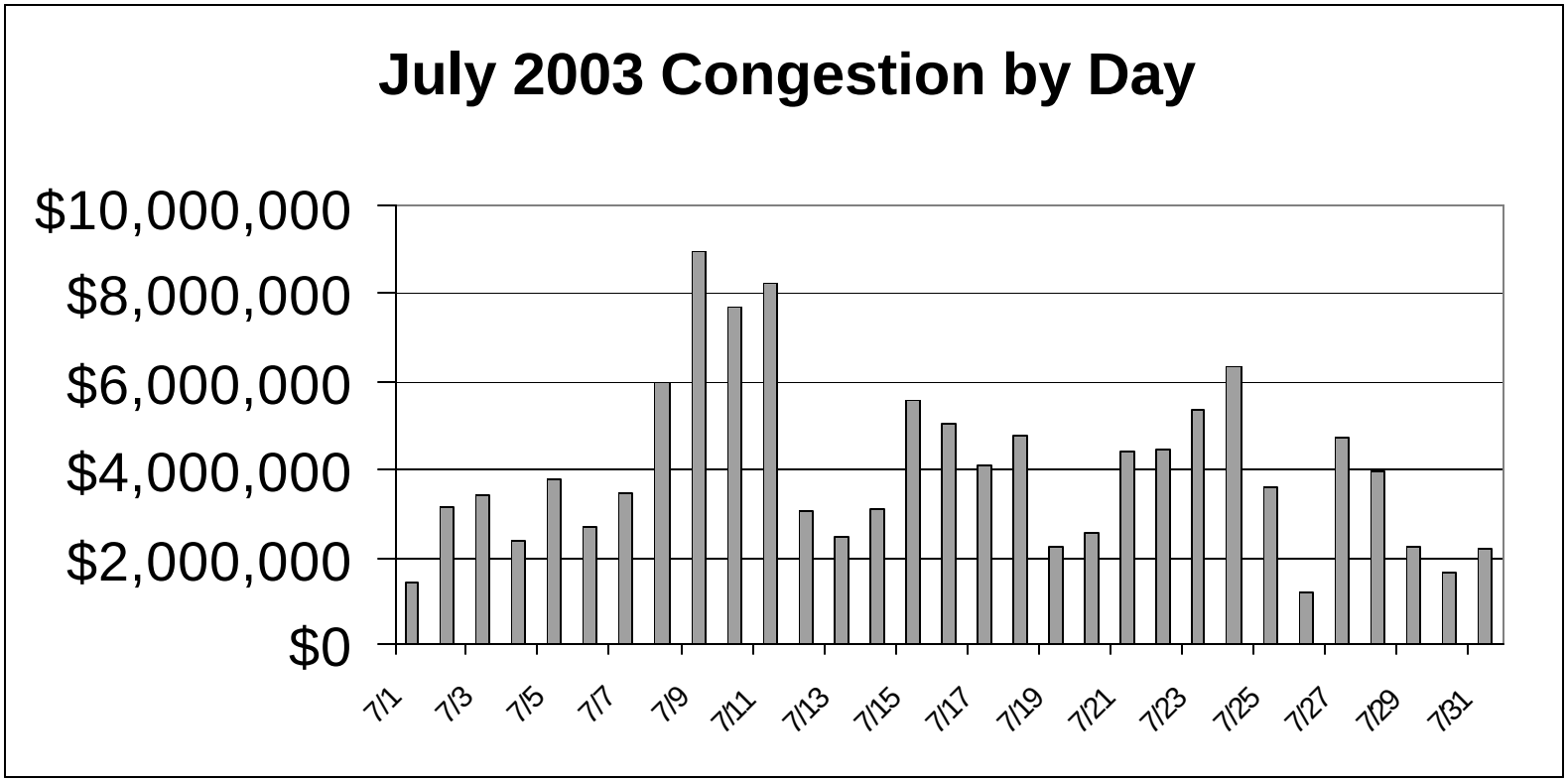
- Idea
  - Use the PROBE Software to Analyze 2003 Congestion Cost and Causes
  - Attribute Congestion Cost to Constraints
  - Adjust Cost to Remove “Unusual Events”
  - Use Results to
    - Define Congestion Cost
    - Establish a Congestion Cost Analysis Procedure
    - Inform Grid Planning
  - Perform Monthly Assessments Going Forward

PROBE Test

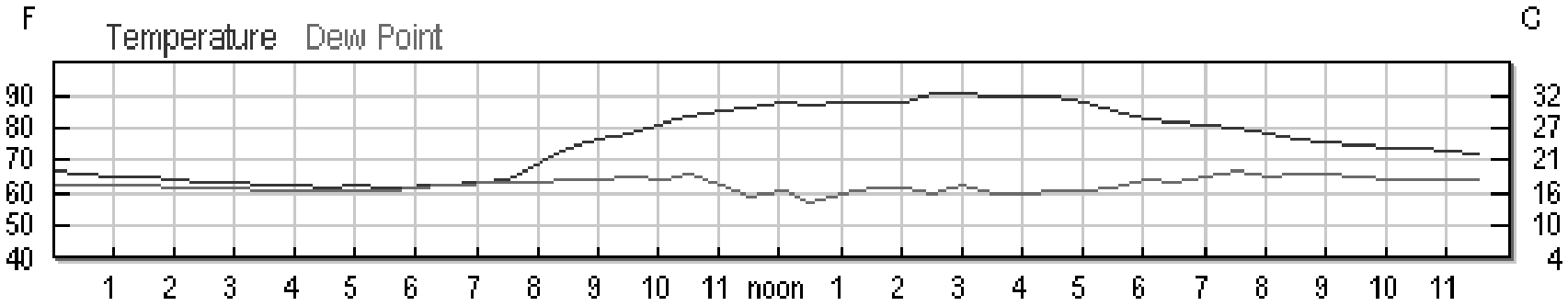
- At the Last (8/19/03) ESPWG Meeting
  - July 2003 Chosen as Test Month
  - Many July 2003 Congestion Statistics from Actual DAM Created
  - One “Unusual” Maintenance Condition Was 29% of Congestion Split
  - “What if” Analysis Just Beginning at 9/19/03 Report
  - Plan
    - Analyze One Day of the Maintenance (MTN) Outage (MTN) (7/15/03)
    - Calculate Congestion Cost Without the MTN Outage
    - Experiment with Unit Commitment Approaches
    - Benchmark to a “No MTN” Maintenance Outage Removed SCUC Run
    - Identify Needed PROBE Enhancements
    - Write Report on Work Done
    - Include TCC Hedging Effect

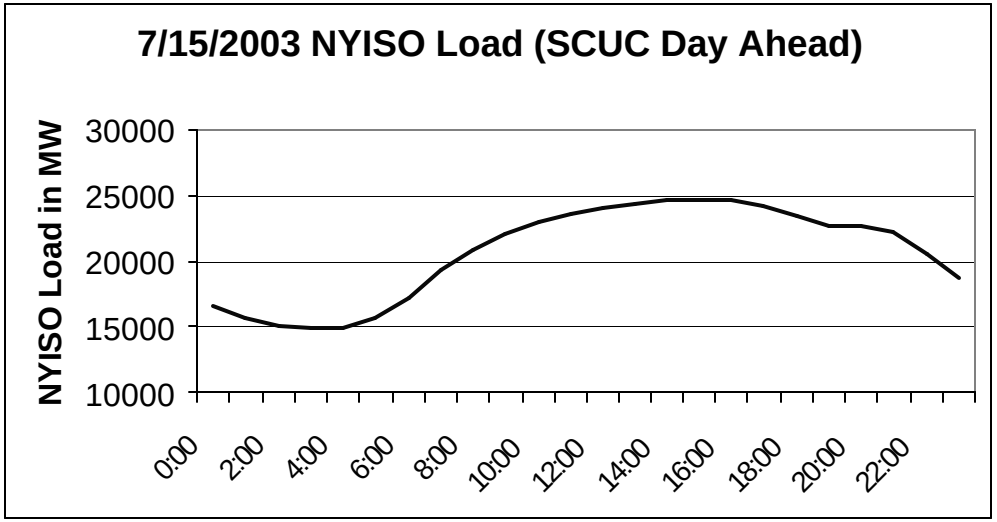
From Previous Analysis

Month Total $124 million



Tuesday, July 15, 2003 NYC Temperature



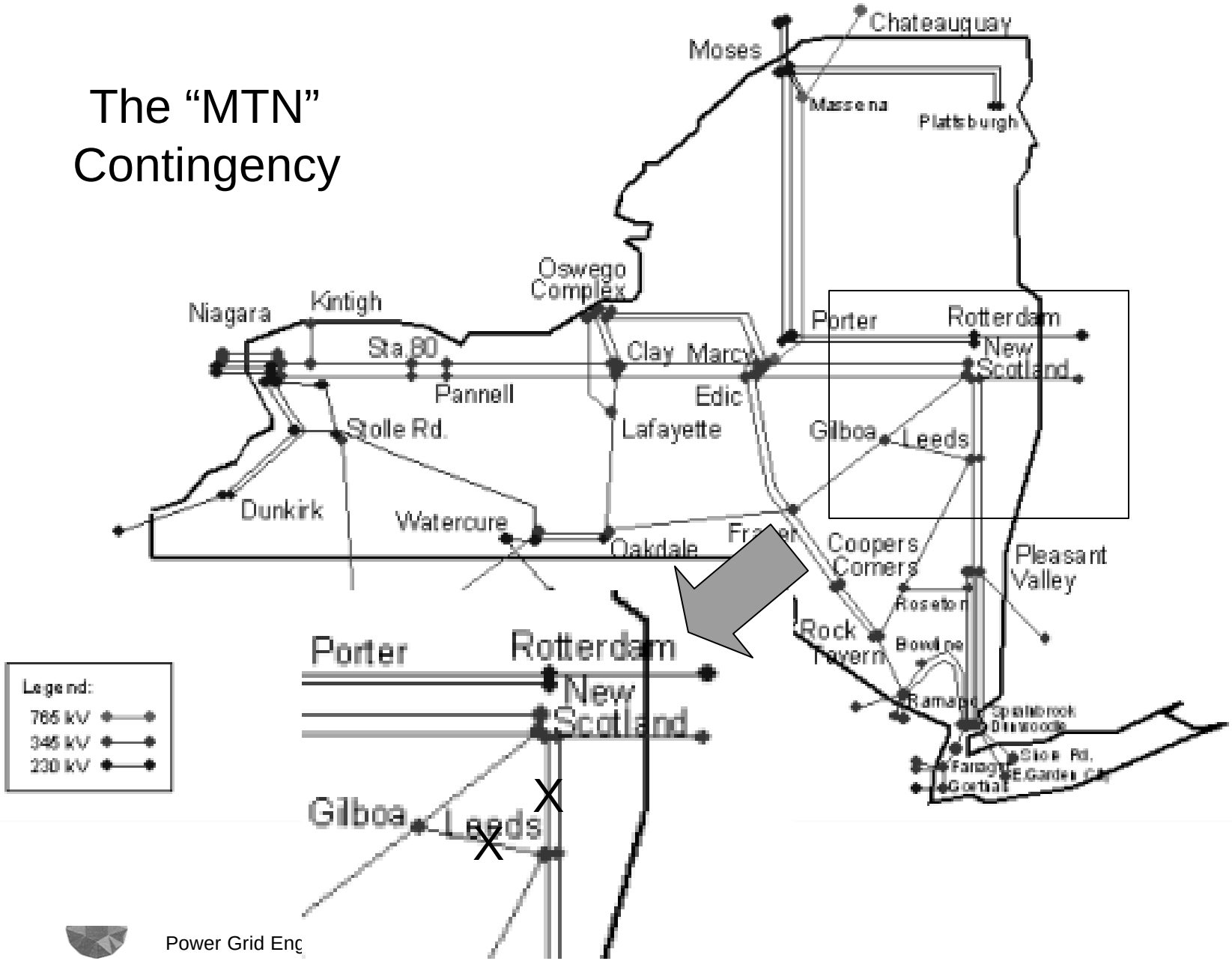


July 15, 2003 Market Summary
Actual SCUC Day Ahead

	Revenue $1000	MWHr
Generation	**$24,421**	**428,641**
Price Capped Load	**$3,175**	**44,460**
Imports	**$4,002**	**94,579**
Exports	**$390**	**9,002**
Wheels	**($6)**	**3,833**
Virtual Load	**$3,040**	**56,903**
Virtual Generation	**$1,758**	**33,689**

Constraint	Contingency	TotCong$
=== Energy+Losses		$ 25,493,598
LEEDS___ 345 N.SCTLND 345 1	MTN:SCB1 R391OR R94301 O/S LE	$ 3,588,590
E179THST 138 HELLGT_E 138 1	BASE CASE	$ 838,521
DUNWODIE 345 SHORE_RD 345 1	SPRNBRK_345_EGRDNCTY345CY49___	$ 836,590
HUDS_AVE 138 JAMAICA_ 138 2	BASE CASE	$ 216,671
E179THST 138 HELLGT_E 138 1	BASE CASE	$ 89,388
RAINEY__ 138 VERNON__ 138 1	TWR: 22 21 A2253	$ 66,681
RAINEY__ 345 DUNWODIE 345 2	DUNWODIE345_RAINEY__345_72____	$ 16,718
DUNWODIE 345 SHORE_RD 345 1	BASE CASE	$ 2,419
VALLYSTR 138 EGRDNCTY 138 1	BUS: E F BARRET 292 459 BA	$ 2,399
ELWOOD_W 138 GREENLWN 138 1	NRTHPORT138WELWOOD_E138_681___	$ (18,575)
NRTHPORT 138 PILGRIM_ 138 1	NRTHPORT138EPILGRIM_138A677___	$ (43,272)
	Total Congestion	$ 5,596,130
	Total Market	$ 31,089,728

The “MTN” Contingency



SCUC vs. PROBE Simulator July 15, 2003

July 15, 2003 Actual vs Simulated Comparison

Revenue $1000	SCUC DAM W/MTN	PROBE Simulator W/MTN	Diff	Diff %
Generation	$ 24,421	$ 23,960	($461)	-2%
Price Capped Load	$ 3,175	$ 3,080	($95)	-3%
Imports	$ 4,002	$ 3,986	($16)	0%
Exports	$ 390	$ 386	($4)	-1%
Wheels	$ (6)	$ (5)	$0	-7%
Virtual Load	$ 3,040	$ 3,101	$61	2%
Virtual Generation	$ 1,758	$ 1,770	$11	1%
MWHr				
Generation	428,641	430,116	1,475	0%
Price Capped Load	44,460	44,528	68	0%
Imports	94,579	94,388	(192)	0%
Exports	9,002	8,906	(96)	-1%
Wheels	3,833	3,812	(22)	-1%
Virtual Load	56,903	58,190	1,287	2%
Virtual Generation	33,689	33,717	28	0%
Load Cost $1000				
Energy & Losses	$25,493	$25,783	$290	1%
Congestion	$5,596	$4,633	($963)	-17%
Total Market	$31,089	$30,416	($673)	-2%

SCUC vs. PROBE Simulator
July 15, 2003

Constraints with >2% Cost Difference ($1000)

Constraint	Contingency	SCUC	PROBE Sim	Diff
E179THST 138 HELLGT_E 138 1	BASE CASE	$839	$557	$282
DUNWODIE 345 SHORE_RD 345 1	SPRNBRK_345_EGRDNCTY345CY49_	$837	$335	$502
			Total	$784

- Why ?
  - Need to Verify Assumptions from SCUC Data
    - GT Dispatch
    - PAR Settings
    - Ratings Used
  - A Small Change Makes a Big Congestion Difference Where There is Little Generation Elasticity.
    - Made Worse by Ancillary Service Requirements Assumption (fix under development)
- What to Do About It ?
  - Adjust Model to Identify Different Assumptions
  - Align the SCUC and PROBE Assumptions
  - Optimize Ancillary Service Requirements in PROBE

SCUC vs. PROBE Simulator
July 15, 2003

- Conclusions
  - Fit is Close Enough for Analysis, Especially Outside Zone J and K
    - MTN Constraint is within 0.2% of SCUC Result
  - Zone J and K Flow Matching, Dispatch, and Network Model Needs Tuning Before Analysis of Those Zones

- Next Steps
  - Calculate & Compare Without MTN Contingencies
  - Commit Units & Repeat

July 15, 2003 "What If" Results, No New Unit Commitment

"What if" Test # 1
No MTN
Contingency
Simulator
July 15, 2003

No Unit
Commitment
Change

Revenue $1000	PROBE Simulator W/MTN	w/o MTN No New UC	Diff	Diff %
Generation	$ 23,960	$ 24,054	$95	0%
Price Capped Load	$ 3,080	$ 3,026	($54)	-2%
Imports	$ 3,986	$ 4,607	$621	16%
Exports	$ 386	$ 333	($53)	-14%
Wheels	$ (5)	$ (7)	($2)	35%
Virtual Load	$ 3,101	$ 3,193	$92	3%
Virtual Generation	$ 1,770	$ 1,844	$74	4%
MWHr				
Generation	430,116	423,358	(6,758)	-2%
Price Capped Load	44,528	44,746	218	0%
Imports	94,388	100,000	5,612	6%
Exports	8,906	7,555	(1,351)	-15%
Wheels	3,812	8,334	4,523	119%
Virtual Load	58,190	57,886	(304)	-1%
Virtual Generation	33,717	34,691	974	3%
Load Cost $1000				
Energy & Losses	$25,783	$28,913	$3,130	12%
Congestion	$4,633	$2,216	($2,417)	-52%
Total Market	$30,416	$31,128	$712	2%

Unit Commitment Changes

- Identify Generators
  - Unit Has Bid In
  - MW Are Available (after ancillary services)
  - Min Bid < LMP @ Generator
  - Sum of Min Bid MW Savings > Startup Cost for Day
- Make Identified Generators Available for Dispatch
- New Generation by NYISO Zone

Zone	New MW Comitted (Max)	New MW Dispatched (Max)
CENTRL	153	64
CAPITL	872	536
GENESE	62	0

Constraints with MTN Outage Removed
New Unit Commitment

Constraint	Contingency	TotCong$
=== Energy+Losses		$ 28,293,318
E179THST 138 HELLGT_E 138 1	Base Case	$ 1,137,194
DUNWODIE 345 SHORE_RD 345 1	SPRNBRK_345_EGRDNCTY345CY49___	$ 749,207
RAINEY__ 138 VERNON__ 138 1	Base Case	$ 297,085
HUDS_AVE 138 JAMAICA_ 138 2	Base Case	$ 153,935
RAINEY__ 345 DUNWODIE 345 2	DUNWODIE345_RAINEY__345_72____	$ 127,830
RAINEY__ 138 VERNON__ 138 1	TWR: 22 21 A2253	$ 47,407
DUNWODIE 345 SHORE_RD 345 1	Base Case	$ 39,177
VERNON__ 138 KENTAVE_ 138 1	Base Case	$ 29,320
VALLYSTR 138 EGRDNCTY 138 1	Base Case	$ 15,687
VALLYSTR 138 EGRDNCTY 138 1	BUS: E F BARRET 292 459 BA	$ 9,634
CENTRAL EAST - VC	Base Case	$ 8,665
ELWOOD_W 138 GREENLWN 138 1	NRTHPORT138WELWOOD_E138_681___	$ (1,757)
FRESHKLS 138 WILLWBRK 138 1	Base Case	$ (2,918)
NIAGARA_ 345 ROCHESTR 345 1	KINTIGH_345_ROCHESTR345_SR-1__	$ (50,014)

“What if” Test # 2
No MTN
Contingency
Simulator
July 15, 2003

With Unit
Commitment
Change

July 15, 2003 "What If" Results, With New Unit Commitment

Revenue $1000	PROBE Simulator W/MTN	w/o MTN With New UC	Diff	Diff %
Generation	$ 23,960	$ 23,757	($203)	-1%
Price Capped Load	$ 3,080	$ 3,021	($60)	-2%
Imports	$ 3,986	$ 4,514	$529	13%
Exports	$ 386	$ 342	($44)	-11%
Wheels	$ (5)	$ (7)	($2)	35%
Virtual Load	$ 3,101	$ 3,162	$62	2%
Virtual Generation	$ 1,770	$ 1,805	$36	2%
MWHr				
Generation	430,116	424,008	(6,108)	-1%
Price Capped Load	44,528	44,948	420	1%
Imports	94,388	100,000	5,612	6%
Exports	8,906	7,827	(1,079)	-12%
Wheels	3,812	8,334	4,523	119%
Virtual Load	58,190	58,006	(184)	0%
Virtual Generation	33,717	34,670	953	3%
Load Cost $1000				
Energy & Losses	$25,783	$28,293	$2,510	10%
Congestion	$4,633	$2,560	($2,073)	-45%
Total Market	$30,416	$30,854	$438	1%

"What if" Test # 2
No MTN
Contingency
Simulator
July 15, 2003

With Unit
Commitment
Change

Effect of UC Change

July 15, 2003 New Unit Commitment Effect

Revenue $1000	w/o MTN No New UC	w/o MTN With New UC	Diff	Diff %
Generation	$ 24,054	$ 23,757	($298)	-1%
Price Capped Load	$ 3,026	$ 3,021	($5)	0%
Imports	$ 4,607	$ 4,514	($93)	-2%
Exports	$ 333	$ 342	$9	3%
Wheels	$ (7)	$ (7)	$0	0%
Virtual Load	$ 3,193	$ 3,162	($31)	-1%
Virtual Generation	$ 1,844	$ 1,805	($38)	-2%

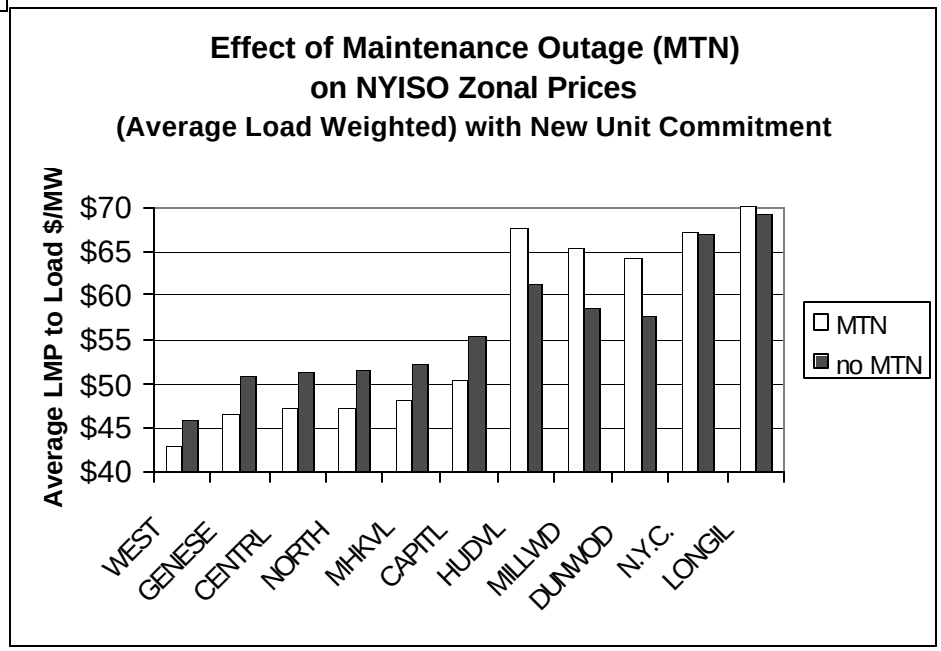
MWHr				
Generation	423,358	424,008	650	0%
Price Capped Load	44,746	44,948	202	0%
Imports	100,000	100,000	-	0%
Exports	7,555	7,827	272	4%
Wheels	8,334	8,334	-	0%
Virtual Load	57,886	58,006	120	0%
Virtual Generation	34,691	34,670	(21)	0%

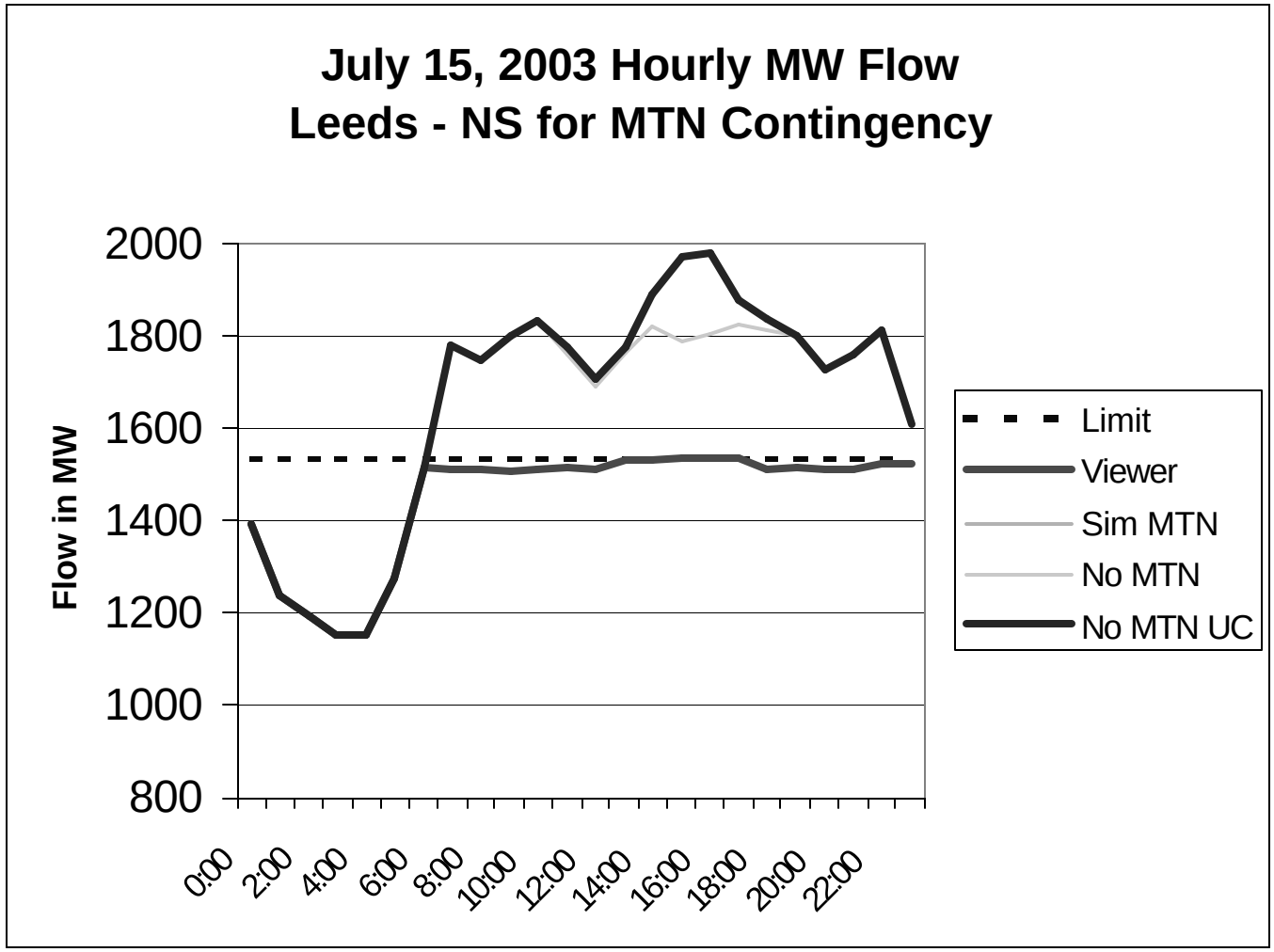
Load Cost $1000				
Energy & Losses	$28,913	$28,293	($620)	-2%
Congestion	$2,216	$2,560	$344	16%
Total Market	$31,128	$30,854	($274)	-1%

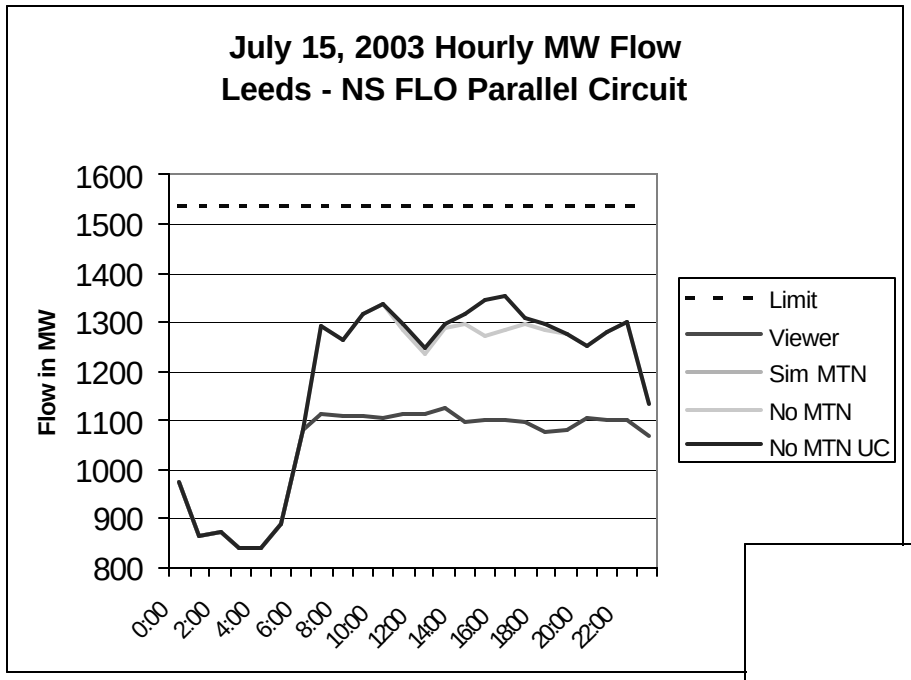
Zonal Load Cost Change With No Maintenance Outage
Zone Cost to Load $1000

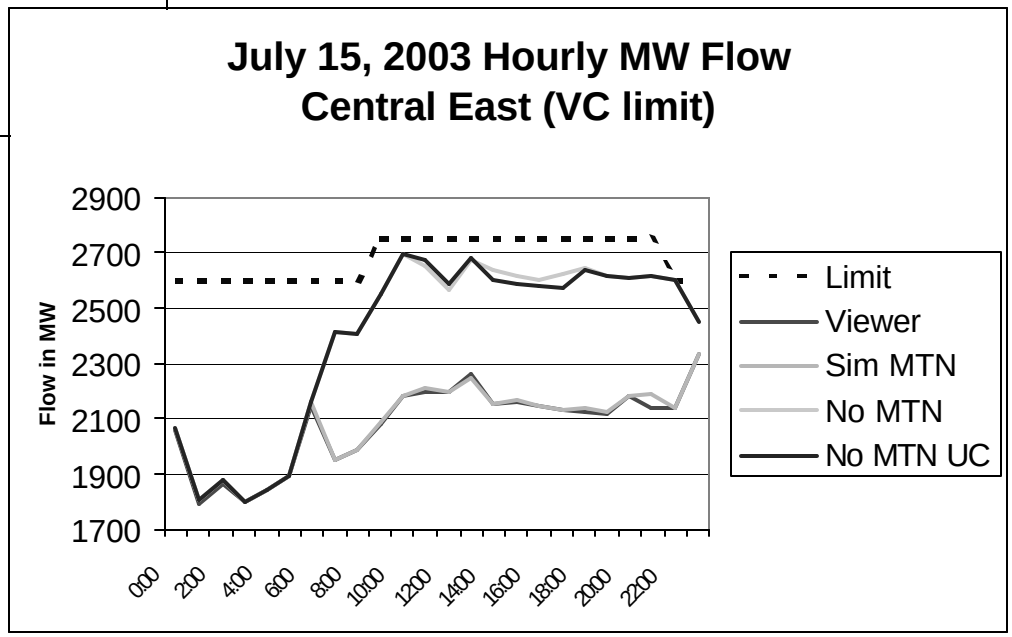
Zone	MTN	No MTN	Change
WEST	$2,695	$2,849	$ 154
GENESE	$1,977	$2,151	$ 174
CENTRL	$1,930	$2,101	$ 171
NORTH	$519	$541	$ 22
MHKVL	$774	$834	$ 60
CAPITL	$1,956	$2,146	$ 191
HUDVL	$960	$901	$ (59)
MILLWD	$535	$478	$ (57)
DUNWOD	$1,137	$1,019	$ (117)
N.Y.C.	$12,222	$12,193	$ (29)
LONGIL	$5,713	$5,640	$ (73)

Effect of Maintenance Outage on Zonal Costs




July 15, 2003 Hourly MW Flow
Leeds - NS for MTN Contingency
Flow in MW
2000
1800
1600
1400
1200
1000
800
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Limit
Viewer
Sim MTN
No MTN
No MTN UC


July 15, 2003 Hourly MW Flow
Leeds - NS FLO Parallel Circuit
Flow in MW
1600
1500
1400
1300
1200
1100
1000
900
800
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Limit
Viewer
Sim MTN
No MTN
No MTN UC


July 15, 2003 Hourly MW Flow
Central East (VC limit)
Flow in MW
2900
2700
2500
2300
2100
1900
1700
000
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Limit
Viewer
Sim MTN
No MTN
No MTN UC

Observations & Conclusions

- Congestion Cost Relief Savings Needs to be Net of Energy & Loss Impact
- Congestion Relief Can Be Offset by Increased and Shifted Costs Elsewhere
- Load Response (Price Capped Load, Virtual Load) Can Respond to Congestion Relief, Affecting the Accounting of Congestion Relief Savings

Congestion Cost and Savings from Congestion Relief Must:

1. Be Carefully Defined
2. Consider All Market Products

PROBE Enhancements

- Automate Multiple Days Viewing and Data Collection
- Add Report by Constraints
- “What If” Analysis
  - Smooth Data Extraction at NYISO
  - Analyze Zone J and K Congestion Discrepancies
  - Simplify Set-up of “What if” Events
  - Simplify Unit Commitment Selection & Changes
- LIPA Suggestions
  - Add Ability to Analyze RT
  - Separate Virtual Load from Calculations
  - Add Ability to Analyze Congestion Based On Bid Cost Differentials
  - Adjust for TCC Revenue
  - Report by Day of Week, Load Level, Typical Week, etc.

Next Work

- Compare with SCUC Run to Check UC Approach
- Write Up Descriptive Report of Work Done
- Look Into Zone J and K Congestion Discrepancies
- Start TCC Revenue Adjustments
- Scope out PROBE Enhancements