Table of Contents		Overview: Section 10, Ancillary Services	
Table of Contents		Overview: Section 11, Congestion and Marginal Losses	78
Preface	i	Overview: Section 12, Generation and Transmission Planning	80
Trefuce	•	Overview: Section 13, FTRs and ARRs	91
SECTION 1 Introduction	1		
2024 Q2 in Review	1	SECTION 2 Recommendations	99
PJM Market Summary Statistics	7	Recommendation Priority	99
PJM Market Background	8	Recommendation Status	99
Conclusions	9	New Recommendations	100
Energy Market Conclusion	10	New Recommendation from Section 9, Interchange Transactions	100
Capacity Market Conclusion	12	New Recommendations from Section 12, Generation and	
Synchronized Reserve Market Conclusion	13	Transmission Planning	100
Nonsynchronized Reserve Market Conclusion	13	Complete List of Current MMU Recommendations	100
Secondary Reserve Market Conclusion	14	Section 3, Energy Market	100
Regulation Market Conclusion	14	Section 4, Energy Uplift	105
FTR Auction Market Conclusion	15	Section 5, Capacity Market	107
Role of MMU	16	Section 6, Demand Response	111
Reporting	16	Section 7, Net Revenue	114
Monitoring	16	Section 8, Environmental and Renewables	114
Market Design	17	Section 9, Interchange Transactions	114
New Recommendations	18	Section 10, Ancillary Services	115
New Recommendation from Section 9, Interchange Transactions	18	Section 11, Congestion and Marginal Losses	117
New Recommendations from Section 12, Generation and		Section 12, Planning	118
Transmission Planning	18	Section 13, FTRs and ARRs	120
Total Price of Wholesale Power	18		
Components of Total Price	18		
Section Overviews	22	SECTION 3 Energy Market	123
Overview: Section 3, Energy Market	22	Overview	125
Overview: Section 4, Energy Uplift	34	Supply and Demand	125
Overview: Section 5, Capacity Market	39	Competitive Assessment	126
Overview: Section 6, Demand Response	52	Recommendations	128
Overview: Section 7, Net Revenue	59	Conclusion	133
Overview: Section 8, Environmental and Renewables	60	Supply and Demand	137
Overview: Section 9, Interchange Transactions	65	110	

137	Balancing Operating Reserve Credits/Balancing Generator Credits	289
153	Lost Opportunity Cost Credits	291
153	Energy Uplift Charges	293
154	Energy Uplift Charges	293
156	Operating Reserve Rates	296
157	Reactive Services Rates	297
163	Uplift Eligibility	298
173	Energy Uplift Issues	299
173	Uplift Resettlement	299
199	Uplift Forfeiture Rule	299
205	Regulation Market Offsets	299
213	Intraday Segments Uplift Settlement	300
217	Concentration of Energy Uplift Credits	301
217	Uplift Credits and Market Power Mitigation	303
220	Fast Start Pricing	304
221	Winter Storm Gerri (January 13 - 22, 2024)	306
231		
231	CECTION - O	
238	SECTION 5 Capacity Market	309
267	Overview	311
274	RPM Capacity Market	311
	Part V Reliability Service (RMR)	313
	Generator Performance	313
277	Recommendations	313
278	Conclusion	317
278	Installed Capacity	325
278	Fuel Diversity	327
279	RPM Capacity Market	328
279	Market Structure	328
280	Market Conduct	344
283	Market Performance	350
284	FRR	355
206	CRF Issue	356
286	CKF ISSUE	))(
	153 154 156 157 163 173 173 199 205 213 217 217 220 221 231 231 238 267 274 278 278 278 278 279 280 283 284	Lost Opportunity Cost Credits Energy Uplift Charges Energy Uplift Charges Operating Reserve Rates Reactive Services Rates Uplift Eligibility Energy Uplift Issues Uplift Eligibility Energy Uplift Issues Uplift Resettlement Uplift Forfeiture Rule Regulation Market Offsets Intraday Segments Uplift Settlement Uplift Credits and Market Power Mitigation Fast Start Pricing Winter Storm Gerri (January 13 – 22, 2024)  SECTION 5 Capacity Market Overview Part V Reliability Service (RMR) Generator Performance Recommendations Conclusion Installed Capacity Fuel Diversity RPM Capacity Market Market Structure Market Structure Market Performance Reseave Market Performance Market Conduct Market Performance Reseave Market Performance Reseave Market Performance Market Performance Market Performance Market Performance Market Performance Reseave Market Performance Market Performance Reseave Reseave Rates Reseave Reseave Market Reseave Rese

iv Table of Contents © 2024 Monitoring Analytics, LLC

360	New Entrant Onshore Wind Installation	430
363	New Entrant Offshore Wind Installation	430
363	New Entrant Solar Installation	431
364	Historical New Entrant CC Revenue Adequacy	431
367	Nuclear Net Revenue Analysis	432
372		
	SECTION 8 Environmental and Renewable Ener	gy
375	Regulations	443
375	Overview	443
376	Federal Environmental Regulation	443
379	State Environmental Regulation	445
382	State Renewable Portfolio Standards	445
383	Emissions Controls in PJM Markets	445
384	Renewable Generation	445
385	Recommendations	446
401	Conclusion	446
410	Federal Environmental Regulation	448
417	CAA: NESHAP/MATS	448
	CAA: NAAQS/CSAPR	449
	CAA: NSR	451
419	CAA: RICE	451
419	CAA: Greenhouse Gas Emissions	452
419	CWA: WOTUS Definition	453
419	CWA: Effluents	454
419	RCRA: Coal Ash	455
420	State Environmental Regulation	457
421	State Coal Ash Regulations	457
422	State Emissions Regulations	458
424	State Renewable Portfolio Standards	467
426	Transco Regional Energy Access Expansion Project	488
427	Mountain Valley Pipeline	488
428	Transco Southeast Supply Enhancement	488
429	<b>Emission Controlled Capacity and Emissions</b>	488
	363 363 364 367 372  375 375 376 379 382 383 384 385 401 410 417  419 419 419 419 419 420 421 422 424 426 427 428	New Entrant Offshore Wind Installation New Entrant Solar Installation Historical New Entrant CC Revenue Adequacy Nuclear Net Revenue Analysis  SECTION 8 Environmental and Renewable Ener Regulations Overview Federal Environmental Regulation State Environmental Regulation State Environmental Regulation State Renewable Portfolio Standards Emissions Controls in PJM Markets Renewable Generation Recommendations Conclusion Federal Environmental Regulation Conclusion Federal Environmental Regulation Conclusion Federal Environmental Regulation CAA: NESHAP/MATS CAA: NAAQS/CSAPR CAA: NSR CAA: RICE CAA: Greenhouse Gas Emissions CWA: WOTUS Definition CWA: Effluents FCRA: Coal Ash State Environmental Regulation Transco Regional Energy Access Expansion Project Mountain Valley Pipeline Transco Southeast Supply Enhancement

Emission Controlled Capacity	488	PJM and TVA/LG&E and KU Joint Reliability Coordination	
Emissions	490	Agreement (JRCA)	538
Renewable Energy Output	493	PJM and Duke Energy Progress, Inc. Joint Operating Agreement	538
Wind and Solar Peak Hour Output	493	PJM and VACAR South Reliability Coordination Agreement	539
Wind Units	494	Balancing Authority Operations Coordination Agreement between	1
Solar Units	496	Wisconsin Electric Power Company (WEC) and PJM	
		Interconnection, LLC	539
		Northeastern ISO-Regional Transmission Organization Planning	
SECTION 9 Interchange Transactions	501	Coordination Protocol	539
Overview	501	Interchange Transaction Issues	539
Interchange Transaction Activity	501	PJM Transmission Loading Relief Procedures (TLRs)	539
Interactions with Bordering Areas	501	Up To Congestion Transactions	540
Recommendations	502	Sham Scheduling	542
Conclusion	503	Elimination of Ontario Interface Pricing Point	543
Interchange Transaction Activity	504	PJM and NYISO Coordinated Interchange Transactions	544
Charges and Credits Applied to Interchange Transactions	504	Reserving Ramp on the PJM/NYISO Interface	548
Aggregate Imports and Exports	505	PJM and MISO Coordinated Interchange Transaction Proposal	549
Real-Time Interface Imports and Exports	507	Willing to Pay Congestion and Not Willing to Pay Congestion	551
Real-Time Interface Pricing Point Imports and Exports	508	Transmission Service Requests	552
Day-Ahead Interface Imports and Exports	511	Spot Imports	553
Day-Ahead Interface Pricing Point Imports and Exports	513	Interchange Optimization	554
Loop Flows	517	Interchange Cap During Emergency Conditions	554
PJM and MISO Interface Prices	523	45 Minute Schedule Duration Rule	555
PJM and NYISO Interface Prices	525	MISO Multi-Value Project Usage Rate (MUR)	555
Summary of Interface Prices between PJM and Organized Markets	527		
Neptune Underwater Transmission Line to Long Island, New York	528	CDOTTON AS A MARKET OF THE STATE OF THE STAT	
Linden Variable Frequency Transformer (VFT) facility	530	SECTION 10 Ancillary Service Markets	557
Hudson Direct Current (DC) Merchant Transmission Line	532	Overview	558
Interchange Activity During High Load Hours	533	Primary Reserve	558
Operating Agreements with Bordering Areas	534	Synchronized Reserve Market	559
PJM and MISO Joint Operating Agreement	535	Nonsynchronized Reserve	560
PJM and New York Independent System Operator Joint Operating		30-Minute Reserve Market	561
Agreement (JOA)	537	Regulation Market	561
		Black Start Service	563

vi Table of Contents © 2024 Monitoring Analytics, LLC

Reactive	563	Frequency Control Definition	647
Frequency Response	563	Primary Frequency Response	647
Market Procurement of Real-Time Ancillary Services	564		
Recommendations	565		
Conclusion	567	SECTION 11 Congestion and Marginal Losses	649
PJM Reserve Markets	568	Overview	651
Implementation of PJM Reserve Markets	571	Congestion Cost	651
Reserve Subzones	575	Marginal Loss Cost	652
Primary Reserve	576	System Energy Cost	652
Market Structure	576	Conclusion	653
Market Performance	578	lssues	653
Synchronized Reserve	579	Artificial Constraints, Closed Loop Interfaces and CT Pricing Logi	c 653
Market Structure	579	Locational Marginal Price (LMP)	654
Market Behavior	581	Components	654
Market Performance	582	Hub Components	659
Synchronized Reserve Performance	586	Congestion	660
Nonsynchronized Reserve	596	Congestion Accounting	660
Market Structure	597	Total Congestion	663
Market Behavior	598	Charges and Credits versus Congestion: Virtual Transactions,	
Market Performance	598	Load and Generation	664
30-Minute Reserve	602	UTCs and Negative Balancing Explicit CLMP Charges	667
Market Structure	602	Zonal and Load Aggregate Congestion	670
Market Behavior	604	Fast Start Pricing Effect on Zonal Congestion	675
Market Performance	604	Monthly Congestion	675
Regulation Market	606	Congested Facilities	676
Market Design	606	Congestion Event Hours	677
Market Structure	624	Congestion by Facility Type and Voltage	680
Market Conduct	629	Constraint Frequency	682
Market Performance	631	Top Constraints	684
Black Start Service	635	Congestion Event Summary: Impact of Changes in UTC Volumes	690
CRF Issues	639	Marginal Losses	691
NERC – CIP	641	Marginal Loss Accounting	691
Reactive Service and Capability	641	Total Marginal Loss Cost	693
Issues with Reactive Capability Market Design	642	System Energy Costs	699
Reactive Costs	645	0 50	

Energy Accounting	699	Long Duration Transmission Facility Outage Requests	792
Total System Energy Costs	699	Transmission Facility Outage Analysis for the FTR Market Transmission Facility Outage Analysis in the Day-Ahead Energy	<b>79</b> 3
SECTION 12 Generation and Transmission Planning	705	Market	801
Overview	705		
Generation Interconnection Planning	705	SECTION 13 Financial Transmission and Auction	
Regional Transmission Expansion Plan (RTEP)	707	Revenue Rights	805
Transmission Facility Outages	708	Overview	809
Recommendations	708	Auction Revenue Rights	809
Conclusion	711	Financial Transmission Rights	810
Generation Interconnection Planning	716	Recommendations	812
Existing Generation Mix	716	Conclusion	813
Generation Retirements	723	Proposed Design	815
Generation Queue	730	Auction Revenue Rights	816
Regional Transmission Expansion Plan (RTEP)	770	Market Design	817
RTEP Process	770	Market Structure	818
Market Efficiency Process	770	Market Performance	818
PJM MISO Interregional Market Efficiency Process (IMEP)	775	1ARRs	825
PJM MISO Targeted Market Efficiency Process (TMEP)	775	Financial Transmission Rights	825
Multi Driver Process	776	Market Performance	831
New Jersey State Agreement Approach for Offshore Wind	777	FTR Revenue Flow	846
Supplemental Transmission Projects	777	Surplus Congestion Revenue	854
Competitive Planning Process Exclusions	781	"Revenue Adequacy"	858
Storage As A Transmission Asset (SATA)	783	Target Allocations and Congestion by Constraint Do Not Match	862
Board Authorized Transmission Upgrades	783	ARRs as an Offset to Congestion for Load	867
Qualifying Transmission Upgrades (QTU)	783	Zonal ARR Congestion Offset	868
Cost Allocation	784	Offset if all ARRs are Held as ARRs	870
Transmission Line Ratings	785	Offset if all ARRs are Self Scheduled	871
Dynamic Line Ratings (DLR) and Grid Enhancing Technology		ARR Allocation and Congestion In and Out of Zone	872
(GETs)	787	Credit	872
Transmission Facility Outages	788	Default Portfolio Considerations	873
Scheduling Transmission Facility Outage Requests	788	FTR Forfeitures	873
Rescheduling Transmission Facility Outage Requests	791		

viii Table of Contents © 2024 Monitoring Analytics, LLC