

***PJM Upgrade Request
System Impact Study Report***

For

PJM Upgrade Request Queue Position Z2-069

Bridgewater – Hoboken

June 2015

Preface

The intent of this System Impact Study is to determine a plan, with cost and construction time estimate, for the Network Upgrades necessary to provide the Incremental Auction Revenue Rights (IARRs) associated with the Upgrade Request as provided by the New Service Customer pursuant to Section 7.8 of Schedule 1 of the Operating Agreement and Part VI of the PJM Tariff.

In some instances, a New Service Customer with an associated Upgrade Request may not be responsible for 100% of the identified Network Upgrade cost because other transmission network uses exist. An estimate of the sharing of the Network Upgrade costs will be provided.

General

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Network Upgrades

This Upgrade Request was studied in conjunction with other Upgrade Requests in order to provide the least cost option for all requests. The study resulted in identifying the following required reinforcements in order to grant the IARRs associated with the Z2-069 project:

Constraint Name	Contingency Name	Z2-069 Impact
49STREET230 KV 49T-BER_Z	L230.Hudson-Penhorn-Belville-NBergen-Bergen.X-2250	40.7
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COOKRD 138 KV COO-WCA_Z	L230.CedarGrove-CedarSub-Roseland.Y-2277	5.0
DEANS 230 KV DEA-PIES_I	BASE	9.3
DEANS 230 KV DEA-PIES_I	L230.Roseland-Whippany.A-941	13.4
ESSEX 230 KV ESS-HUD_I	BASE	24.6
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GREENBRO230 KV GRE-MID_Z	BASE	18.1
HUDSON 230 KV HUD-PENT_Z	BASE	9.9
HUDSON 230 KV HUD-PENT_Z	L230.Essex-NJTMeadows.P-2216	13.5
KILMER 230 KV KIL-LAKI_Z	BRUNSWCK-DEANS 230 LINE	17.4
KILMER 230 KV KIL-SAYI_I	BRUNSWCK-DEANS 230 LINE	17.4
KINGSLAN138 KV KIN-TUR_I	BASE	4.1
KINGSLAN138 KV KIN-WCA_Z	BASE	4.1
KINGSLAN138 KV KIN-WCA_Z	L230.CedarGrove-CedarSub-Roseland.Y-2277	5.0
LAKENELS230 KV LAK-MID_Z	BRUNSWCK-DEANS 230 LINE	17.4
MARTINSC230 KV MAR-SIE1_Z	BASE	0.6
MAYWOOD 230 KV MAY-NEW_I	BASE	23.4
MAYWOOD 230 KV MAY-NEW_I	HUDSON-SOUTH WATER FRONT 230 LINE	36.3
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MAYWOOD 230 KV MAY-SAD_Z	HUDSON-SOUTH WATER FRONT 230 LINE	36.3
METUCHEN230 KV MET-PIE_Z	BASE	9.3
METUCHEN230 KV MET-PIE_Z	L230.Roseland-Whippany.A-941	13.4
NORTHWO230 KV NOR-QUA_Z	L500.Branchburg-Hopatcong.5060	1.6
READINGT230 KV REA-ROS_I	BASE	12.2
READINGT230 KV REA-ROS_I	L230.Roseland-Whippany.A-941	17.7
REDOAKA 230 KV REDA-SAY_Z	L230.Roseland-Whippany.A-941	5.4
REDOAKA 230 KV REDA-SRI_I	L230.Roseland-Whippany.A-941	5.4
ROSELAND138 KV ROS-WCAD_I	BASE	4.0
ROSELAND138 KV ROS-WCAD_I	L230.CedarGrove-CedarSub-Roseland.Y-2277	5.0
ROSELAND138 KV ROS-WCAG_I	BASE	4.1
ROSELAND138 KV ROS-WCAG_I	L230.CedarGrove-CedarSub-Roseland.Y-2277	5.0
ROSELAND230 KV ROS-WHI_Z	BASE	31.9
ROSELAND230 KV ROS-WHI_Z	L500.Branchburg-Hopatcong.5060	38.4
ROSELAND230 KV ROS-WILS_I	BASE	23.2
ROSELAND230 KV ROS-WILS_I	L230.CedarGrove-CedarSub-Roseland.Y-2277	38.2
WESCOSVI500 KV 3_I	500/230.SteelCity.T1 (Sctnlz)	1.2

Required Reinforcements

TO				Estimated Time (Months)	Upgrade Cost	Z2-069 Allocation									
Item		NUN	Proposed Mitigation												
1	PSE&G	n4447	Reconductor 49st - Bergen 230kV line	36	\$ 5,871,748	\$ 5,871,748									
2	PSE&G	n4448	Reconductor 49st - Hoboken 230kV line	36	\$ 17,085,000	\$ 17,085,000									
3	PSE&G	n4450	Reconductor Athenia - Clifton B 230kV line	36	\$ 814,810	\$ 784,407									
			<table border="1"> <thead> <tr> <th>Queue</th> <th>Impact (MW)</th> <th>Cost</th> </tr> </thead> <tbody> <tr> <td>Z2-053</td> <td>1.5</td> <td>\$ 30,403</td> </tr> <tr> <td>Z2-069</td> <td>38.7</td> <td>\$ 784,407</td> </tr> </tbody> </table>	Queue	Impact (MW)	Cost	Z2-053	1.5	\$ 30,403	Z2-069	38.7	\$ 784,407			
Queue	Impact (MW)	Cost													
Z2-053	1.5	\$ 30,403													
Z2-069	38.7	\$ 784,407													
4	PSE&G	n4451	Reconductor Athenia - Clifton K 230kV line	36	\$ 824,561	\$ 793,718									
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Queue	Impact (MW)	Cost													
Z2-053	1.5	\$ 30,843													
Z2-069	38.6	\$ 793,718													
5	PSE&G	n4452	New circuit Athenia - Saddle Brook 230kV line	36	\$ 93,600,000	\$ 89,648,549									
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Queue	Impact (MW)	Cost													
Z2-053	1.6	\$ 3,951,451													
Z2-069	38.6	\$ 89,648,549													
6	JCPL	n4453	Larrabee sub - replace 230kV disconnect switch	7	\$ 125,000	\$ 5,715									
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Queue	Impact (MW)	Cost													
Z2-053	33.4	\$ 119,285													
Z2-069	1.6	\$ 5,715													
7	PSE&G	n4454	Reconductor Bergen - Leonia1 230 kV line	36	\$ 15,249,000	\$ 15,249,000									
8	PSE&G	n4455	Reconductor Bergen - Leonia3 230 kV line	36	\$ 15,045,000	\$ 15,045,000									
9	PSE&G	n4456	Reconductor Bergenfield - Leonia2 230 kV line	36	\$ 21,726,000	\$ 21,726,000									
10	PSE&G	n4457	Reconductor Bergenfield - New Milford 230kV line	36	\$ 13,770,000	\$ 13,770,000									

TO			Proposed Mitigation	Estimated Time (Months)	Upgrade Cost	Z2-069 Allocation		
Item	NUN							
11	JCPL	n4458	At Readington replace 230kV bus tie breaker, affiliated CT's, and disconnects	7	\$ 405,000	\$ 324,358		
			Queue				Impact (MW)	Cost
			Z2-053				9	\$ 80,642
			Z2-069				36.2	\$ 324,358
12	PSE&G	n4459	Reconductor Cedar Grove - Clifton B 230kV line	36	\$ 5,601,382	\$ 5,392,375		
			Queue				Impact (MW)	Cost
			Z2-053				1.5	\$ 209,006
			Z2-069				38.7	\$ 5,392,375
13	PSE&G	n4460	Reconductor Cedar Grove - Clifton K 230kV line	36	\$ 5,577,434	\$ 5,368,802		
			Queue				Impact (MW)	Cost
			Z2-053				1.5	\$ 208,632
			Z2-069				38.6	\$ 5,368,802
14	PSE&G	n4461	Reconductor Cedar Grove - Roseland 230kV line	36	\$ 13,243,604	\$ 12,464,568		
			Queue				Impact (MW)	Cost
			Z2-053				2.4	\$ 779,036
			Z2-069				38.4	\$ 12,464,568
15	PSE&G	n4462	Reconductor Cedar Grove - William 230kV line	36	\$ 13,757,566	\$ 12,976,272		
			Queue				Impact (MW)	Cost
			Z2-053				2.3	\$ 781,294
			Z2-069				38.2	\$ 12,976,272
16	PSE&G	n4463	Reconductor Deans - Pierson Ave 230kV line	36	\$ 27,246,458	\$ 21,994,129		
			Queue				Impact (MW)	Cost
			Z2-053				3.2	\$ 5,252,329
			Z2-069				13.4	\$ 21,994,129
17	PSE&G	n4464	Reconductor Penhorn - Hudson 230kV line	36	\$ 10,922,419	\$ 10,922,419		
18	PPL	n4465	Rebuild Martins Creek – Siegfried 230kV line	60	\$ 104,000,000	\$ 104,000,000		

Item	TO	NUN	Proposed Mitigation	Estimated Time (Months)	Upgrade Cost	Z2-069 Allocation		
19	PSE&G	n4466	Reconductor Maywood - Saddlebrook 230kV line	36	\$ 16,666,500	\$ 15,962,901		
			Queue				Impact (MW)	Cost
			Z2-053				1.6	\$ 703,599
			Z2-069	36.3	\$ 15,962,901			
20	PSE&G	n4467	Reconductor Metuchen - Pierson 230kV line	36	\$ 989,389	\$ 798,644		
			Queue				Impact (MW)	Cost
			Z2-053				3.2	\$ 190,725
			Z2-069	38.2	\$ 798,664			
21	PPL	n4468	Rebuild Northwood – Quarry 230 kV line	60	\$ 33,000,000	\$ 33,000,000		
22	JCPL – PSE&G	n4469	Replace Readington - Roseland 230kV line	36	\$ 142,712,324	\$ 94,607,046		
			Queue				Impact (MW)	Cost
			Z2-053				9	\$ 48,105,278
			Z2-069	17.7	\$ 94,607,046			
23	PSE&G	n4470	Whippany Sub, Roseland terminal - replace disconnects, bus Conductor, primary and backup relaying	7	\$ 343,000	\$ 343,000		
24	PSE&G	n4471	Reconductor Roseland - Williams 230kV line	36	\$ 566,241	\$ 534,084		
			Queue				Impact (MW)	Cost
			Z2-053				2.3	\$ 32,157
			Z2-069	38.2	\$ 534,084			
25	PPL	n4472	Install second Wescoville 500/138kV transformer	60	\$ 60,000,000	\$ 60,000,000		
26	PSE&G	n4526	Reconductor Bridgewater - Middlesex 230kV line	36	\$ 12,976,014	\$ 3,688,966		
			Queue				Impact (MW)	Cost
			Z2-053				93.4	\$ 9,287,048
			Z2-069	37.1	\$ 3,688,966			

TO		Proposed Mitigation			Estimated Time (Months)	Upgrade Cost	Z2-069 Allocation	
Item		NUN						
27	PSE&G	n4527	Reconductor Essex - Hudson 230kV line		36	\$ 12,116,580	\$ 11,764,354	
			Queue	Impact (MW)				Cost
			Z2-053	1				\$ 352,226
			Z2-069	33.4				\$ 11,764,354
28	JCPL	n4528	Reconductor Green Brock - Middlesex 230kV line		36	\$ 6,300,000	\$ 5,877,835	
			Queue	Impact (MW)				Cost
			Z2-053	1.3				\$ 422,165
			Z2-069	18.1				\$ 5,877,835
29	JCPL	n4529	Reconductor Kilmer - Lake Nelson 230kV line		36	\$ 4,800,000	\$ 753,111	
			Queue	Impact (MW)				Cost
			Z2-053	93.5				\$ 4,046,889
			Z2-069	17.4				\$ 753,111
30	JCPL	n4530	Reconductor Kilmer - Raritan River 230kv line		36	\$ 15,300,000	\$ 2,400,541	
			Queue	Impact (MW)				Cost
			Z2-053	93.5				\$ 12,899,459
			Z2-069	17.4				\$ 2,400,541
31	JCPL	n4531	Reconductor Lake Nelson - Middlesex 230kV line		36	\$ 2,900,000	\$ 455,005	
			Queue	Impact (MW)				Cost
			Z2-053	93.5				\$ 2,444,995
			Z2-069	17.4				\$ 455,005
32	PSE&G	n4534	Substation work and reconductor Athenia - East Rutherford 138kV line		36	\$ 20,197,875	\$ 20,197,875	
33	PSE&G	n4535	Substation work and reconductor Athenia - Belleville 230kV line		36	\$ 12,001,625	\$ 12,001,625	
34	PSE&G	n4536	Reconductor BELLEVIL - Penhorn 230kV		36	\$ 13,033,813	\$ 13,033,813	
35	PSE&G	n4541	Reconductor Cook Rd - West Caldwell 138kV line		36	\$ 17,870,730	\$ 17,870,730	
36	PSE&G	n4543	Reconductor Kingland - Turnpike 138kV line		36	\$ 3,913,495	\$ 3,913,495	

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Item		NUN	Proposed Mitigation			
37	PSE&G	n4544	Reconductor Kingland - West Caldwell 138kV line	36	\$ 23,953,137	\$ 23,953,137
38	PSE&G	n4546	New parallel Maywood - New Milford 230kV underground circuit	60	\$ 86,970,000	\$ 86,970,000
39	JCPL	n4548	Reconductor Red Oak - Raritan River 230kV line	36	\$ 7,300,000	\$ 7,300,000
40	JCPL	n4549	Reconductor Red Oak - R11 - South River 230kV line	36	\$ 3,500,000	\$ 3,500,000
41	PSE&G	n4550	Reconductor Roseland - West Caldwell A 138kV line	36	\$ 5,614,234	\$ 5,614,234
42	PSE&G	n4554	Reconductor Roseland - West Caldwell B 138kV line	36	\$ 5,886,147	\$ 5,886,147
Total Estimated Cost						\$ 783,848,603

Note: The customer will be responsible for a tax gross up charge for each of these upgrades. This value will be confirmed in the Facilities Study phase.

Final ICTRs Granted

ICTRs were calculated using the 2018 RPM case. Pursuant to Section 234 of the PJM Tariff, New Service Customer shall have Incremental Capacity Transfer Rights in the following quantities into the indicated Locational Deliverability Area:

Z2-069:	PS	PS NORTH	JCPL
	0	0	0

New Service Customer's rights as described above shall become effective upon the completion of the Network Upgrades, Local Upgrades, or Merchant Network Upgrades identified in the above table.

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CEDARGRO230 KV CED-CLIK_I	L230.CedarGrove-Clifton-Athenia.B-2228	38.6
CEDARSUB230 KV CED-CEDF_I	L230.CedarGrove-CedarSub-Roseland.Y-2277	38.2
CEDARSUB230 KV CED-CEDY_I	BASE	23.5
CEDARSUB230 KV CED-CEDY_I	L230.CedarGrove-CedarSub-William.F-2206	38.4
CEDARSUB230 KV CED-ROSY_Z	BASE	23.5
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GREENBRO230 KV GRE-MID_Z	BASE	18.1
HUDSON 230 KV HUD-PENT_Z	BASE	9.9
HUDSON 230 KV HUD-PENT_Z	L230.Essex-NJTMeadows.P-2216	13.5
KILMER 230 KV KIL-LAKI_Z	BRUNSWCK-DEANS 230 LINE	17.4
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KINGSLAN138 KV KIN-TUR_I	BASE	4.1
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MAYWOOD 230 KV MAY-SAD_Z	BASE	23.4
MAYWOOD 230 KV MAY-SAD_Z	HUDSON-SOUTH WATER FRONT 230 LINE	36.3
METUCHEN230 KV MET-PIE_Z	BASE	9.3
METUCHEN230 KV MET-PIE_Z	L230.Roseland-Whippany.A-941	13.4
NORTHWOO230 KV NOR-QUA_Z	L500.Branchburg-Hopatcong.5060	1.6
READINGT230 KV REA-ROS_I	BASE	12.2
READINGT230 KV REA-ROS_I	L230.Roseland-Whippany.A-941	17.7
REDOAKA 230 KV REDA-SAY_Z	L230.Roseland-Whippany.A-941	5.4
REDOAKA 230 KV REDA-SRI_I	L230.Roseland-Whippany.A-941	5.4
ROSELAND138 KV ROS-WCAD_I	BASE	4.0
ROSELAND138 KV ROS-WCAD_I	L230.CedarGrove-CedarSub-Roseland.Y-2277	5.0
ROSELAND138 KV ROS-WCAG_I	BASE	4.1
ROSELAND138 KV ROS-WCAG_I	L230.CedarGrove-CedarSub-Roseland.Y-2277	5.0
ROSELAND230 KV ROS-WHI_Z	BASE	31.9
ROSELAND230 KV ROS-WHI_Z	L500.Branchburg-Hopatcong.5060	38.4
ROSELAND230 KV ROS-WILS_I	BASE	23.2
ROSELAND230 KV ROS-WILS_I	L230.CedarGrove-CedarSub-Roseland.Y-2277	38.2
WESCOSVI500 KV 3_I	500/230.SteelCity.T1 (Sctnlz)	1.2

Required Reinforcements

Item	TO	NUN	Proposed Mitigation	Cost
1	PSE&G	n4447	Upgrade the 49 th Street – Bergen 230 kV line by 40.7 MVA	\$ 5,871,748
2	PSE&G	n4448	Upgrade the 49 th Street – Hoboken 230 kV line by 57.8 MVA	\$ 17,085,000
3	PSE&G	n4449	Upgrade the Athenia – East Rutherford 138 kV line by 26.5 MVA	\$ 73,320,000
4	PSE&G	n4450	Upgrade the Athenia – Clifton 230 kV line (B-2228) by 38.7 MVA	\$ 814,811
5	PSE&G	n4451	Upgrade the Athenia – Clifton 230 kV line (K-2263) by 38.6 MVA	\$ 824,562
6	PSE&G	n4452	Upgrade the Athenia – Saddlebrook 230 kV line by 36.3 MVA	\$ 93,600,000
7	JCPL	n4453	Larrabee Substation – Replace the 230 kV disconnect switch on the Atlantic terminal	\$ 125,000
8	PSE&G	n4454	Upgrade the Bergen – Leonia 230 kV line (T-2272) by 20.4 MVA	\$ 15,249,000
9	PSE&G	n4455	Upgrade the Bergen – Leonia 230 kV line (K-2289) by 19.9 MVA	\$ 15,045,000
10	PSE&G	n4456	Upgrade the Bergenfield – Leonia 230 kV line by 51.5 MVA	\$ 21,726,000
11	PSE&G	n4457	Upgrade the Bergenfield – New Milford 230 kV line by 51.6 MVA	\$ 13,770,000
12	JCPL	n4458	Readington Substation – Replace 230 kV bus tie breaker, affiliated CT's and disconnects. This constraint includes a rating external to FE of 996/1145 that is not included in this estimate.	\$ 405,000
13	PSE&G	n4459	Upgrade the Cedar Grove – Clifton 230 kV line (B-2228) by 38.7 MVA	\$ 5,601,383
14	PSE&G	n4460	Upgrade the Cedar Grove – Clifton 230 kV line (K-2263) by 38.2 MVA	\$ 5,577,434
15	PSE&G	n4461	Upgrade the Cedar Grove – Roseland 230 kV line (Y-2277) by 38.4 MVA	\$ 13,243,604
16	PSE&G	n4462	Upgrade the Cedar Grove – Williams 230 kV line (F-2206) by 38.2 MVA	\$ 13,757,566
17	PSE&G	n4463	Upgrade the Deans – Pierson 230 kV line by 13.4 MVA	\$ 27,246,458
18	PSE&G	n4464	Upgrade the Hudson – Penhorn 230 kV line by 13.5 MVA	\$ 10,922,419
19	PPL	n4465	Rebuild 26 miles of the Martins Creek – Siegfried 230 kV line using double 1590 ACSR conductor	\$ 104,000,000
20	PSE&G	n4466	Upgrade the Maywood – Saddlebrook 230 kV line by 36.3 MVA	\$ 16,666,500
21	PSE&G	n4467	Upgrade the Metuchen – Pierson 230 kV line by 13.4 MVA	\$ 989,389
22	FE-PPL	n4468	Rebuild 11 miles of the Northwood – Quarry 230 kV line using single 1590 ACSR	\$ 33,000,000
23	JCPL – PSE&G	n4469	Upgrade the Readington – Roseland 230 kV line by 17.7 MVA	\$ 126,475,793
24	PSE&G-JCPL	n4470	Replace the disconnects, bus conductor, primary and backup relaying on the Roseland terminal at Whippany substation	\$ 343,000
25	PSE&G	n4471	Upgrade the Roseland – Williams 230 kV line by 38.2 MVA	\$ 566,421

Item	TO	NUN	Proposed Mitigation	Cost
26	PPL	n4472	Install second 500-138 kV transformer at Wescoville substation. Significant substation work will be required.	\$ 60,000,000
Total Estimated Cost				\$ 676,226,088

Note: The customer will be responsible for a tax gross up charge for each of these upgrades. This value will be confirmed in the Facilities Study phase.

All upgrades require a minimum of 36 months for construction with the exception of the Athenia – Saddlebrook, Athenia – East Rutherford, and Readington – Roseland upgrades which require 60 months following the execution of a UCSA by all parties.

Some elements will be refined at the Facilities Study and if this results in any changes, a revised System Impact Study will be provided.