## System Impact Study Report

for

PJM Upgrade Request Z2-072

"Indian River-New Church" (Revised)

### **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, an Upgrade 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

TransSource LLC, the Upgrade Customer, has requested the evaluation of the required Network Upgrades to support awarding to the Upgrade Customer IARRs, in the amount of 204.6 MW, having specified a source location of Indian River 26 kV Unit 4 and the sink location as New Church 13 kV CT1.

## **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 requested IARRs associated with the Z2-072 project:

Constraint Name	Contingency Name	MW Impact	Reinforcement	Cost Estimate	Time Estimate	NUN
COSTEN 138 KV COS-KIN Z	BASE	83.9	Rebuild line, replace substation disconnect switches and bus	\$19,430,000	42 months	N4412
COSTEN 138 KV COS-KIN_Z	L138.NewChurch- PineyGrove.13764	169.8	Rebuild line, replace substation disconnect switches and bus	Addressed above	42 months	N4412
COSTEN 138 KV COS-POC_I	BASE	83.9	Rebuild line, replace 138kV breaker, disc. Switch, and substation bus	\$8,495,000	36 months	N4413
COSTEN 138 KV COS-POC_I	L138.NewChurch- PineyGrove.13764	169.8	Rebuild line, replace 138kV breaker, disc. Switch, and substation bus	Addressed above	36 months	N4413
DUPSEAFD69 KV DUP-LAU_I	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	18.1	Rebuild line, replace substation breakers, disc. Switches, and relays	\$5,532,024	30 months	N4414
EDGEWDPL69 KV EDG-NEL_Z	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	36.3	Rebuild line, replace line relays	\$3,244,000	24 months	N4415
EDGEWDPL69 KV EDG-NSA_I	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	36.3	Rebuild line, replace substation breaker & bus	\$5,176,500	30 months	N4416
FRUITLAN69 KV FRT-PEM_Z	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	26.4	Rebuild line, replace substation stranded bus, rigid bus, and disconnect switches	\$5,373,000	36 months	N4417
HEBRON 69 KV HEB-MAR_Z	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	14.8	Rebuild line, replace disconnect switches	\$2,447,000	24 months	N4418
HEBRON 69 KV HEB-ROC_I	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	14.8	Rebuild line, replace disconnect switches and substation bus	\$2,880,000	24 months	N4419
INDIANRI138 KV IND-NEL_I	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	60.3	Rebuild line, replace substation bus	\$24,708,500	48 months	N4420
INDIANRI230 KV IND-PIN_I	BASE	116.6	Rebuild line	\$115,965,000	48 months	N4421

INDIANRI230 KV IND-PIN I	L138.Loretto-Vienna.13780	153.0	Rebuild line	Addressed above	48 months	N4421
KENNEY 69 KV		16.2	Replace conductor, replace			N4422
KEN-MTO_Z KENNEY 69 KV	BASE L138.NewChurch-		substation disc. switches and bus  Replace conductor, replace	\$5,670,500 Addressed	48 months	
KEN-MTO_Z	PineyGrove.13764	34.8	substation disc. switches and bus	above	48 months	N4422
			Replace conductor, replace			
KENNEY 69 KV	L138.NewChurch-	34.8	substation disc. Switches, bus,	\$10,969,070	10 months	N4423
KEN-STO_I KINGSCRK138	PineyGrove.13764		and breakers  Rebuild line, replace disc.	\$10,868,979	48 months	
KV KIN-LOR_Z	BASE	83.9	Switches	\$21,300,000	48 months	N4424
KINGSCRK138	L138.NewChurch-	169.8	Rebuild line, replace disc.	Addressed		N4424
KV KIN-LOR_Z	PineyGrove.13764	107.0	Switches	above	48 months	111121
LAURELDP69 KV LAU-SHO_I	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	21.3	Rebuild line, replace substation breaker, disc. Switches, and bus	\$4,289,478	30 months	N4425
LORETTO 138 KV	230/138.PineyGrove.AT20+L	560	Rebuild line, replace substation	ψ1,209,170	50 months	N14406
LOR-PIN_I	230.PinyGrve-IndinR.23002	56.9	disc. Switch	\$11,041,500	42 months	N4426
LORETTO 138 KV	L138.NewChurch-	81.1	Rebuild line, replace substation	¢11.041.500	40 4	N4532
LOR-PIN_Z LORETTO 138 KV	PineyGrove.13764 230/138.PineyGrove.AT20+L		disc. Switch  Rebuild line, replace substation	\$11,041,500	42 months	
LOR-VIE_Z	230.PinyGrve-IndinR.23002	128.7	disc. Switches, bus, and relays	\$56,830,000	48 months	N4427
MARDELA 69 KV	230/138.PineyGrove.AT20+L	1.4.0		100,000,000		N14420
MAR-VIE_Z	230.PinyGrve-IndinR.23002	14.8	Rebuild Line	\$7,740,000	36 months	N4428
MTHERMON69	230/138.PineyGrove.AT20+L	49.5	Rebuild line, replace substation	φ5. <b>7</b> 0.6. <b>5</b> 00	26 4	N4429
KV MTH-NSA_Z MTHERMON69	230.PinyGrve-IndinR.23002 230/138.PineyGrove.AT20+L		disc. Switches and bus  Rebuild line, replace substation	\$5,786,500	36 months	
KV MTH-PIN_I	230.PinyGrve-IndinR.23002	49.5	disc. Switches, bus, and relays	\$7,723,000	36 months	N4430
MTOLIVE 69 KV	L138.NewChurch-	34.8	Replace conductor, replace	, ,		N4431
MTO-PIN_Z	PineyGrove.13764	34.6	substation disc. Switches & bus	\$5,670,500	36 months	N4431
NEWCHURC138	L138.NewChurch-	99.1	Rebuild line, replace substation	¢4.715.000	40 41	N4432
KV NEW-OAK_Z NEWCHURC138	PineyGrove.13764		disc. Switch and bus	\$4,715,000	42 months	
KV NEW-	L138.NewChurch-	105.5	Rebuild line, replace substation			N4433
OAK3_Z	PineyGrove.13764		disc. Switch and bus	\$5,102,500	42 months	
NEWCHURC138		104.5				N4434
KV NEW-PIN_Z	BASE L138.KingsCreek-	10.10	Rebuild line & substation bus	\$26,157,974 Addressed	48 months	111101
NEWCHURC138 KV NEW-PIN_Z	Loretto.13713	176.0	Rebuild line & substation bus	above	48 months	N4434
NEWHOPE 69 KV	230/138.PineyGrove.AT20+L	24.0	Rebuild line & replace disconnect	45070	TO MOREIS	NI4425
NEW-OCN_Z	230.PinyGrve-IndinR.23002	24.8	switches	\$6,484,000	24 months	N4435
NEWHOPE 69 KV	230/138.PineyGrove.AT20+L	24.8	Rebuild line, replace disconnect	#12.211.000	26 4	N4436
NEW-WAL_I	230.PinyGrve-IndinR.23002		switches  Rebuild line, replace substation	\$13,211,000	36 months	
NSALISBU69 KV	230/138.PineyGrove.AT20+L	26.4	stranded bus, rigid bus, and			N4437
NSA-PEM_I	230.PinyGrve-IndinR.23002	20	disconnect switches	\$5,769,000	36 months	111.07
			Rebuild line, replace disconnect			
NSALISBU69 KV	230/138.PineyGrove.AT20+L	14.8	switches, circuit breakers, and	¢4.500.000	24 4	N4438
NSA-ROCK_Z	230.PinyGrve-IndinR.23002		substation bus  Rebuild line, replace substation	\$4,590,000	24 months	
NSALISBU69 KV	230/138.PineyGrove.AT20+L	24.8	stranded bus, rigid bus, disc.			N4439
NSA-WAL_Z	230.PinyGrve-IndinR.23002		Switches, and circuit breakers	\$8,725,000	36 months	
OAKHALL 138	D. 455	83.9	Rebuild line, replace substation	425 007 500	40 4	N4440
KV OAK-POC_Z OAKHALL 138	BASE L138.NewChurch-		breakers, disc. Switches, and bus Rebuild line, replace substation	\$36,807,500 Addressed	48 months	
KV OAK-POC_Z	PineyGrove.13764	169.8	breakers, disc. Switches, and bus	above	48 months	N4440
			Rebuild line, replace substation			
		24.8	stranded bus and disconnect			N4441
OCEANPIN69 KV	230/138.PineyGrove.AT20+L	24.0				j l
OCEANPIN69 KV OCN-WOR_Z	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	24.0	switches	\$2,736,000	24 months	
	3		Add 2nd autotransformer,	\$2,736,000	24 months	
	3	116.6		\$2,736,000	24 months	N4442
OCN-WOR_Z	3		Add 2nd autotransformer, terminal position including breakers, bus, disc. Switches, and relays	\$2,736,000 \$8,250,000	24 months 36 months	N4442
OCN-WOR_Z PINEYGRO230	230.PinyGrve-IndinR.23002		Add 2nd autotransformer, terminal position including breakers, bus, disc. Switches, and relays Add 2nd autotransformer,			N4442
OCN-WOR_Z  PINEYGRO230  KV AT20_I	230.PinyGrve-IndinR.23002		Add 2nd autotransformer, terminal position including breakers, bus, disc. Switches, and relays Add 2nd autotransformer, terminal position including	\$8,250,000		N4442
OCN-WOR_Z PINEYGRO230	230.PinyGrve-IndinR.23002	116.6	Add 2nd autotransformer, terminal position including breakers, bus, disc. Switches, and relays Add 2nd autotransformer,			

STE-VIE_I	230.PinyGrve-IndinR.23002					
VIENNA 230 KV AT20_I	230/138.PineyGrove.AT20+L 230.PinyGrve-IndinR.23002	78.1	Add 2nd autotransformer, terminal position including breakers, bus, disc. Switches, and relays	\$8,250,000	36 months	N4444
VIENNA 230 KV AT20_I	BASE	34.2	Add 2nd autotransformer, terminal position including breakers, bus, disc. Switches, and relays	Addressed above	36 months	N4444
Total Estimated Cost				\$586,755,830		

NUN: PJM Network Upgrade Number

### **Delmarva Network Upgrade Cost Estimates**

Cost estimates will further be refined as a part of the Facilities Study for this project. TransSource LLC will be responsible for all costs incurred by Delmarva in connection with the Z2-072 project. Such costs may include, but are not limited to, any transmission system assets currently in Delmarva's rate base that are prematurely retired due to the Z2-072 project. PJM shall work with Delmarva to identify these retirement costs and any additional expenses.

Delmarva reserves the right to reassess issues presented in this document and, upon appropriate justification, submit additional costs related to the Z2-072 project.

It is expected that the Upgrade Customer will be responsible for a tax gross up charge for each of these upgrades. This value will be confirmed during the Facilities Study phase.

#### **Incremental Capacity Transfer Rights (ICTRs)**

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:

**29 MWs** into the DPL South Locational Deliverability Area (LDA).

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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## **Network Upgrades**

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Constraint Name	Contingency Name	MW Impact	Reinforcement	Cost Estimate	Time Estimate	NUN
COSTEN 138 KV		83.9	Rebuild line, replace substation			N4412
COS-KIN_Z	BASE	63.9	disconnect switches and bus	\$19,430,000	42 months	
COSTEN 138 KV	L138.NewChurch-	169.8	Rebuild line, replace substation	Addressed		N4412
COS-KIN_Z	PineyGrove.13764	109.8	disconnect switches and bus	above	42 months	
			Rebuild line, replace 138kV			N4413
COSTEN 138 KV		83.9	breaker, disc. Switch, and			
COS-POC_I	BASE		substation bus	\$8,495,000	36 months	
			Rebuild line, replace 138kV			N4413
COSTEN 138 KV	L138.NewChurch-	169.8	breaker, disc. Switch, and	Addressed		
COS-POC_I	PineyGrove.13764		substation bus	above	36 months	
			Rebuild line, replace substation			N4414
DUPSEAFD69 KV	230/138.PineyGrove.AT20+L	18.1	breakers, disc. Switches, and			
DUP-LAU_I	230.PinyGrve-IndinR.23002		relays	\$5,532,024	30 months	
EDGEWDPL69	230/138.PineyGrove.AT20+L	36.3				N4415
KV EDG-NEL_Z	230.PinyGrve-IndinR.23002	30.3	Rebuild line, replace line relays	\$3,244,000	24 months	
EDGEWDPL69	230/138.PineyGrove.AT20+L	36.3	Rebuild line, replace substation			N4416
KV EDG-NSA_I	230.PinyGrve-IndinR.23002	30.3	breaker & bus	\$5,176,500	30 months	
			Rebuild line, replace substation			N4417
FRUITLAN69 KV	230/138.PineyGrove.AT20+L	26.4	stranded bus, rigid bus, and			
FRT-PEM_Z	230.PinyGrve-IndinR.23002		disconnect switches	\$5,373,000	36 months	
HEBRON 69 KV	230/138.PineyGrove.AT20+L	14.8	Rebuild line, replace disconnect			N4418
HEB-MAR_Z	230.PinyGrve-IndinR.23002	14.6	switches	\$2,447,000	24 months	
HEBRON 69 KV	230/138.PineyGrove.AT20+L	14.8	Rebuild line, replace disconnect			N4419
HEB-ROC_I	230.PinyGrve-IndinR.23002	14.8	switches and substation bus	\$2,880,000	24 months	
INDIANRI138 KV	230/138.PineyGrove.AT20+L	60.3	Rebuild line, replace substation			N4420
IND-NEL_I	230.PinyGrve-IndinR.23002	00.3	bus	\$24,708,500	48 months	
INDIANRI230 KV		116.6				N4421
IND-PIN_I	BASE	110.0	Rebuild line	\$115,965,000	48 months	
INDIANRI230 KV		152.0		Addressed		N4421
IND-PIN_I	L138.Loretto-Vienna.13780	153.0	Rebuild line	above	48 months	

KENNEY 69 KV		16.2	Replace conductor, replace	1	ĺ	N4422
KEN-MTO_Z	BASE	10.2	substation disc. switches and bus	\$5,670,500	48 months	
KENNEY 69 KV	L138.NewChurch-	34.8	Replace conductor, replace	Addressed		N4422
KEN-MTO_Z	PineyGrove.13764	34.6	substation disc. switches and bus	above	48 months	
			Replace conductor, replace			N4423
KENNEY 69 KV	L138.NewChurch-	34.8	substation disc. Switches, bus,			
KEN-STO_I	PineyGrove.13764		and breakers	\$10,868,979	48 months	
KINGSCRK138		83.9	Rebuild line, replace disc.			N4424
KV KIN-LOR_Z	BASE	63.9	Switches	\$21,300,000	48 months	
KINGSCRK138	L138.NewChurch-	1.00.0	Rebuild line, replace disc.	Addressed		N4424
KV KIN-LOR_Z	PineyGrove.13764	169.8	Switches	above	48 months	
LAURELDP69 KV	230/138.PineyGrove.AT20+L	21.2	Rebuild line, replace substation			N4425
LAU-SHO_I	230.PinyGrve-IndinR.23002	21.3	breaker, disc. Switches, and bus	\$4,289,478	30 months	
LORETTO 138 KV	230/138.PineyGrove.AT20+L	<b>7</b> - 0	Rebuild line, replace substation			N4426
LOR-PIN_I	230.PinyGrve-IndinR.23002	56.9	disc. Switch	\$11,041,500	42 months	
LORETTO 138 KV	L138.NewChurch-		Rebuild line, replace substation	Addressed		N4426
LOR-PIN_Z	PineyGrove.13764	81.1	disc. Switch	above	42 months	111.20
LORETTO 138 KV	230/138.PineyGrove.AT20+L		Rebuild line, replace substation			N4427
LOR-VIE_Z	230.PinyGrve-IndinR.23002	128.7	disc. Switches, bus, and relays	\$56,830,000	48 months	111127
MARDELA 69 KV	230/138.PineyGrove.AT20+L		disc. 5 witches, bus, and relays	ψ50,050,000	10 months	N4428
MAR-VIE_Z	230.PinyGrve-IndinR.23002	14.8	Rebuild Line	\$7,740,000	36 months	117720
MTHERMON69	230/138.PineyGrove.AT20+L		Rebuild line, replace substation	\$7,740,000	30 months	N4429
KV MTH-NSA_Z	230.PinyGrve-IndinR.23002	49.5	disc. Switches and bus	\$5,786,500	36 months	114429
MTHERMON69	230/138.PineyGrove.AT20+L		Rebuild line, replace substation	\$5,780,500	30 months	N4430
		49.5		\$7.722.000	36 months	114430
KV MTH-PIN_I MTOLIVE 69 KV	230.PinyGrve-IndinR.23002 L138.NewChurch-		disc. Switches, bus, and relays	\$7,723,000	56 monus	N14421
		34.8	Replace conductor, replace	¢5 (70 500	26	N4431
MTO-PIN_Z NEWCHURC138	PineyGrove.13764 L138.NewChurch-		substation disc. Switches & bus	\$5,670,500	36 months	NI 4 4 2 2
		99.1	Rebuild line, replace substation	#4.71.7.000.00	40 .1	N4432
KV NEW-OAK_Z	PineyGrove.13764		disc. Switch and bus	\$4,715,000.00	42 months	274422
NEWCHURC138		405.5				N4433
KV NEW-	L138.NewChurch-	105.5	Rebuild line, replace substation			
OAK3_Z	PineyGrove.13764		disc. Switch and bus	\$5,102,500.00	42 months	
NEWCHURC138		104.5				N4434
KV NEW-PIN_Z	BASE	10 110	Rebuild line & substation bus	\$26,157,974	48 months	
NEWCHURC138	L138.KingsCreek-	176.0		Addressed		N4434
KV NEW-PIN_Z	Loretto.13713	170.0	Rebuild line & substation bus	above	48 months	
NEWHOPE 69 KV	230/138.PineyGrove.AT20+L	24.8	Rebuild line & replace disconnect			N4435
NEW-OCN_Z	230.PinyGrve-IndinR.23002	24.0	switches	\$5,050,672	24 months	
NEWHOPE 69 KV	230/138.PineyGrove.AT20+L	24.8	Rebuild line, replace disconnect			N4436
NEW-WAL_I	230.PinyGrve-IndinR.23002	24.0	switches	\$10,258,968	36 months	
			Rebuild line, replace substation			N4437
NSALISBU69 KV	230/138.PineyGrove.AT20+L	26.4	stranded bus, rigid bus, and			
NSA-PEM_I	230.PinyGrve-IndinR.23002		disconnect switches	\$5,769,000	36 months	
			Rebuild line, replace disconnect			N4438
NSALISBU69 KV	230/138.PineyGrove.AT20+L	14.8	switches, circuit breakers, and			
NSA-ROCK_Z	230.PinyGrve-IndinR.23002		substation bus	\$4,590,000	24 months	
			Rebuild line, replace substation			N4439
NSALISBU69 KV	230/138.PineyGrove.AT20+L	24.8	stranded bus, rigid bus, disc.			
NSA-WAL_Z	230.PinyGrve-IndinR.23002		Switches, and circuit breakers	\$6,829,714	36 months	
OAKHALL 138		02.0	Rebuild line, replace substation			N4440
KV OAK-POC_Z	BASE	83.9	breakers, disc. Switches, and bus	\$36,807,500	48 months	
OAKHALL 138	L138.NewChurch-	4	Rebuild line, replace substation	Addressed		N4440
KV OAK-POC_Z	PineyGrove.13764	169.8	breakers, disc. Switches, and bus	above	48 months	
N. O.M.I OC_Z	Timey Grove.13701		Rebuild line, replace substation	usore	10 months	N4441
OCEANPIN69 KV	230/138.PineyGrove.AT20+L	24.8	stranded bus and disconnect			1,1441
OCN-WOR_Z	230.PinyGrve-IndinR.23002	2 1.0	switches	\$2,150,998	24 months	
OCIT WOR_E	250.1 my 61 ve mamr.25002		Add 2nd autotransformer,	Ψ2,130,770	2 i montiis	N4442
			terminal position including			117772
PINEYGRO230		116.6	breakers, bus, disc. Switches, and			
KV AT20_I	BASE		relays	\$8,250,000	36 months	
11 11 11 11 11 11 11 11 11 11 11 11 11	DINE		Add 2nd autotransformer,	Ψ0,230,000	50 monuis	
						N14442
		1500	terminal position including	I		N4442
DINEVCDO220		153.0	I breakers bus diss Critishes and	Addrossed		
PINEYGRO230	1120 Louetto Vi 12700	153.0	breakers, bus, disc. Switches, and	Addressed	26 m =41.	
KV AT20_I	L138.Loretto-Vienna.13780	153.0	breakers, bus, disc. Switches, and relays	Addressed above	36 months	N14442
KV AT20_I STEELE 230 KV	230/138.PineyGrove.AT20+L	78.1	relays	above		N4443
KV AT20_I					36 months 48 months	N4443 N4444

AT20_I		230.PinyGrve-IndinR.23002		terminal position including breakers, bus, disc. Switches, and relays			
VIENN AT20_I	A 230 KV	BASE	34.2	Add 2nd autotransformer, terminal position including breakers, bus, disc. Switches, and relays	Addressed above	36 months	N4444

### NUN: PJM Network Upgrade Number

Note: It is expected that the Upgrade Customer will be responsible for a tax gross up charge for each of these upgrades. This value will be confirmed during the Facilities Study phase.