PUBLIC VERSION

Pterra Consulting

Report R102-20

LODF-Mile Cost Allocations for Selected Transmission Projects in MISO

Redacted for CEII items

Submitted to

LS Power Midcontinent, LLC

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Pterra CONSULTING

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Executive Summary

Pterra, LLC ("Pterra") was contracted by LS Power Midcontinent, LLC ("LSP") to analyze the beneficiaries of selected transmission projects in the footprint of the Midcontinent Independent System Operator, Inc. ("MISO").

MISO evaluates various types of projects through the MISO Transmission Expansion Plan (MTEP) process. This process is conducted annually and leads to a set of transmission projects that are recommended to MISO's Board of Directors for review and approval. At present, costs are allocated by type of project (Market Efficiency Projects, Multi Value Projects and Baseline Reliability Projects) with a variety of metrics taken into account. For Baseline Reliability Projects, MISO currently applies a non-analytical cost allocation methodology that allocates costs to the geographic zone in which the project is located.

LSP was interested in seeing whether the current geographic-based cost allocation methodology was consistent with the identification of beneficiaries using analytical models. To analyze the accuracy of location-based cost allocation in identifying beneficiaries, Pterra applied the methodology known as the LODF[1]-mile, last applied by MISO to Baseline Reliability Projects in the 2012 MTEP (shortened to "MTEP12"), on a selected set of Baseline Reliability Projects approved in MTEP 2013-2018.

Pterra's process was as follows: (a) develop a procedure for extending the LODF-mile method to transmission projects later than 2012, (b) benchmark the results of the procedure against published cost allocations using the LODF-mile method to identify sensitivities, and (c) apply the procedure to a set of transmission projects in the 2013-2018 MTEP.

Developing a Procedure. Pterra developed a procedure for the LODF-mile method based on published documentation from MISO including implementation rules from April 2019.[2] The procedure was primarily implemented in the TARA[3] software, with exceptions for certain types of projects classified as "complex" projects.

Pterra also obtained copies of MTEP power flow cases for the years 2012 to 2019. These models provided a starting point for applying the procedure. Additional information regarding facility ownership and line lengths necessary to implementing the LODF-mile methodology were collected via public sources, including MISO's Informational Filings with FERC, and via data requests with MISO. Where information was not available or not provided in a timely manner, Pterra applied modeling assumptions. The assumptions were tested for sensitivity as part of the benchmarking stage of the work.

Benchmarking. To benchmark the developed procedure, Pterra compared the results of its LODF-mile procedure for nine projects that were also documented in a MISO Informational Filing with FERC dated 1 August 2016 (modified by MISO on 17 March 2017).

[1] LODF - Line Outage Distribution Factor.
[2] *Appendix J Implementation Rules for LODF Calculation, Transmission Planning Business Practices Manual (BPM-020-r19), effective date April-01, 2019.*
[3] Transmission Analysis and Reliability Assessment, a product of PowerGEM.

The benchmarking shows close matches with the published cost allocations. Some sensitivities were identified that should be noted when applying the procedure to certain types of transmission projects. Table S-1 shows a summary of the largest percent differences for cost allocations to individual transmission companies observed in the benchmarking.

Table S-1: Benchmarking Comparison Showing Largest Difference in Percent Cost Share Between Pterra and MISO-Reported Calculations

Project ID	% Difference
4368	0.02%
7800	2.2%
8020	0.70%
8160	0.15%
8740	0.62%
8113	7.78%
4614	0.04%
7988	0.09%
9482	0.00%

The percent cost allocations for projects 4368, 8020, 8160, 8740, 4614, 7988, and 9482 using the developed procedure were within 0.7% of the percent cost allocations in the Informational Filing for any one Owner. Two of the projects showed higher percent cost differentials. These are:

- Project 7800 is a reconductoring of the Newton-Robinson 138 kV line. The 2015 MISO MTEP power flow model did not accurately represent the project. A correction was assumed and applied to the power flow model. This resulted in a 2.2% percent share difference to the cost allocation to Ameren Illinois Company (91.6% of the total project cost in the Pterra procedure versus 93.8% in the published MISO calculation).
- Project 8113 is a new 230 kV substation in Minot, ND, with a connection to Great River Energy's McHenry Substation. For cost allocation purposes, this is classified as a complex project in that the boundaries that need to be defined using the LODF-mile method are subject to judgment. Pterra applied its best engineering judgment at the boundaries based on the MISO implementation rules. This resulted in a 7.8% share difference to the cost allocation for Great River Energy (68.6% of the total project cost in the Pterra procedure versus 76.4% in the published MISO calculation).

Sensitivity tests for assumptions applied in the calculations where information on line lengths and owners was not readily available showed percent cost differentials as high as 7%.

LODF-Mile Cost Allocations for Selected Transmission Projects

Several transmission projects in MTEP13 through MTEP18 were selected for application of the developed methodology for LODF-mile cost allocation. The resulting cost allocations are presented in Table S-2.

The table highlights the following:

- Projects where the cost allocation percentage is largest for the entity where the project is located
- Projects where the cost allocation percentage is low for the entity where the project is located

- Projects which are classified as "complex" (similar to Project 8113 in the benchmark above) where some judgment is applied to define the boundaries of the project.

Table S-2 Cost Allocations for Initial Set of Transmission Projects

Color Legend	
	% share to owner(s) where the project is located
	% share is higher than the location based owner's share
	Indicates complex project category

Project ID: Project Name (Target Appendix - Project Type) Transmission Owner(s)	LODF Miles	% Share	Cost Allocation
3013: Turkey Hill-Cahokia Reinsulation and Transformer Replacement (A in MTEP13 - BRP)	**156.25**	**100.00%**	**$31,570,000.00**
Ameren Illinois Company			
Ameren Missouri - Area 356	36.73	23.51%	$7,420,612.23
Ameren Illinois Company - Area 357	119.52	76.49%	$24,149,387.77
3339: Pana, North-Taylorville, South Reconductoring (A in MTEP13 - BRP)	**44.45**	**100.00%**	**$7,807,000.00**
Ameren Illinois Company			
Ameren Missouri - Area 356	2.05	4.62%	$360,590.12
Ameren Illinois Company - Area 357	42.40	95.38%	$7,446,409.88
3828: Lore-Turkey River-Stoneman 161 kV Rebuild (A in MTEP13 - BRP)	**119.06**	**100.00%**	**$24,500,000.00**
International Transmission Company Midwest			
American Transmission Company - Area 295	11.75	9.87%	$2,418,591.03
Ameren Missouri - Area 356	0.80	0.67%	$164,228.52
Xcel Energy - Area 600	10.12	8.50%	$2,083,263.10
International Transmission Company Midwest - Area 627	76.79	64.49%	$15,800,751.06
MidAmerican Energy Company - Area 635	4.14	3.48%	$852,554.44
Dairyland Power Cooperative - Area 680	15.46	12.98%	$3,180,611.85
4292: Lenawee 345/138 kV Station (A in MTEP13 - BRP)	**90.05**	**100.00%**	**$25,950,000.00**
Michigan Electric Transmission Company			
Northern Indiana Public Service Company - Area 217	0.06	0.07%	$17,379.11
Michigan Electric Transmission Company - Area 218	55.76	61.91%	$16,066,929.54
International Transmission Company - Area 219	34.24	38.02%	$9,865,691.35
4368: Dresser-Wabash River 138 kV Line (A in MTEP14 - BRP)	**62.90**	**100.00%**	**$14,500,000.00**
Duke Energy Indiana			
Hoosier Energy Rural Electric Cooperative - Area 207	3.95	6.29%	$912,050.00
Duke Energy Indiana - Area 208	58.95	93.71%	$13,587,950.00
4373: Hickory Creek 161 kV Source (A in MTEP13 - BRP)	**49.69**	**100.00%**	**$7,000,000.00**
International Transmission Company Midwest			
American Transmission Company - Area 295	0.38	0.77%	$54,161.69
Xcel Energy - Area 600	1.60	3.23%	$226,028.20
International Transmission Company Midwest - Area 627	44.78	90.12%	$6,308,279.91
MidAmerican Energy Company - Area 635	1.08	2.17%	$152,103.48
Dairyland Power Cooperative - Area 680	1.84	3.71%	$259,426.73
4614: New Franklin-McComb: Build 115 kV Line (A in MTEP14 - BRP)	**123.54**	**100.00%**	**$59,960,000.00**
Entergy Mississippi			
Entergy Arkansas - Area 327	2.70	2.18%	$1,308,881.63
South Mississippi Electric Power Association - Area 349	3.16	2.56%	$1,535,935.00
Entergy Louisiana - Area 351A	115.14	93.20%	$55,884,639.52
Cleco Power - Area 502	2.54	2.05%	$1,230,543.85
7800: Newton-Robinson-1 138 kV Reconductoring (A in MTEP15 - BRP)	**82.08**	**100.00%**	**$19,256,602.00**
Ameren Illinois Company			
Duke Energy Indiana - Area 208	4.65	5.67%	$1,091,849.33
Indianapolis Power & Light Company - Area 216	2.21	2.69%	$518,002.59
Ameren Illinois Company - Area 357	75.21	91.64%	$17,646,750.07

Project ID: Project Name (Target Appendix - Project Type) Transmission Owner(s)	LODF Miles	% Share	Cost Allocation
7988: Terrebone to Bayou Vista 230 kV Line (A in MTEP15 - BRP)	**220.81**	**100.00%**	**$122,000,000.00**
Cleco Power, Entergy Louisiana			
Entergy Mississippi - Area 326	4.34	1.97%	$2,399,383.91
Entergy Arkansas - Area 327	7.11	3.22%	$3,927,128.50
Entergy Louisiana - Area 351A	120.58	54.61%	$66,621,344.27
Cleco Power - Area 502	83.92	38.01%	$46,366,227.89
Lafayette City-Parish Consolidated Government - Area 503	4.86	2.20%	$2,685,915.44
8020: Pleasant Corner-Beacon 161 kV Line & Terminal (A in MTEP15 - BRP)	**76.35**	**100.00%**	**$15,265,000.00**
MidAmerican Energy Company			
Ameren Missouri - Area 356	6.05	7.93%	$1,210,023.54
Ameren Illinois Company - Area 357	0.56	0.74%	$112,204.82
International Transmission Company Midwest - Area 627	40.04	52.44%	$8,004,842.71
Muscatine Power & Water - Area 633	0.20	0.26%	$40,019.28
MidAmerican Energy Company - Area 635	29.50	38.64%	$5,897,909.66
8113: New 230 kV Substation at Minot to Great River Energy McHenry Substation (A in MTEP15 - BRP)	**86.71**	**100.00%**	**$48,916,000.00**
Xcel Energy			
Xcel Energy - Area 600	1.57	1.81%	$885,092.24
Minnesota Power - Area 608	5.95	6.87%	$3,359,220.95
Great River Energy - Area 615	59.49	68.61%	$33,560,617.15
Otter Tail Power Company - Area 620	18.52	21.36%	$10,449,662.21
Montana-Dakota Utilities - Area 661	1.17	1.35%	$661,407.45
8160: Morgan Valley-Beverly 345 kV (A in MTEP15 - BRP)	**82.19**	**100.00%**	**$38,156,592.00**
International Transmission Company Midwest			
Ameren Missouri - Area 356	1.89	2.31%	$881,417.28
International Transmission Company Midwest - Area 627	57.31	69.73%	$26,606,591.60
MidAmerican Energy Company - Area 635	22.98	27.96%	$10,668,583.12
8587: LCTP: Construct New 500 kV Transmission Line from Rhodes to New 500/230 kV Bulk Substaion West of Carlyss (A in MTEP15 - BRP)	**68.08**	**100.00%**	**$49,420,000.00**
Entergy Louisiana			
Entergy Arkansas - Area 327	0.31	0.45%	$224,593.80
Entergy Louisiana - Area 351A	62.46	91.74%	$45,337,895.18
Cleco Power - Area 502	5.31	7.81%	$3,857,511.02
8740: Brooks-Adams County 161 kV Line (A in MTEP15 - BRP)	**88.31**	**100.00%**	**$9,300,000.00**
MidAmerican Energy Company			
Ameren Missouri - Area 356	4.61	5.22%	$485,327.18
International Transmission Company Midwest - Area 627	6.27	7.10%	$660,725.48
MidAmerican Energy Company - Area 635	77.43	87.68%	$8,153,947.34
9482: South Beaumont - New China to Stowell 230 kV Line (A in MTEP15 - BRP)	**110.94**	**100.00%**	**$47,446,558.00**
Entergy Texas			
Entergy Louisiana - Area 351A	110.94	100.00%	$47,446,558.00
9716: Coughlin-Plaisance 138 kV Reconductor (A in MTEP18 - BRP)	**60.44**	**100.00%**	**$12,320,000.00**
Cleco Power			
Entergy Mississippi - Area 326	3.34	5.53%	$681,166.82
Entergy Arkansas - Area 327	0.76	1.26%	$155,401.75
Entergy Louisiana - Area 351A	20.72	34.28%	$4,223,234.29
Entergy New Orleans - Area 351C	0.81	1.34%	$165,295.78
Cleco Power - Area 502	34.37	56.87%	$7,006,083.47
Lafayette City-Parish Consolidated Government - Area 503	0.44	0.72%	$88,817.89
9864: Whiting-Custer 120 kV Rebuild (A in MTEP17 - BRP)	**41.90**	**100.00%**	**$14,300,000.00**
International Transmission Company, Michigan Electric Transmission Company			
Michigan Electric Transmission Company - Area 218	20.84	49.74%	$7,113,344.01
International Transmission Company - Area 219	21.06	50.26%	$7,186,655.99
9925: Tap Stone Lake - Gardner Park 345 kV Line (B in MTEP16 - BRP)	**116.79**	**100.00%**	**$15,000,000.00**
American Transmission Company			
American Transmission Company - Area 295	36.27	31.05%	$4,658,012.63
Xcel Energy - Area 600	70.43	60.31%	$9,045,975.06
International Transmission Company Midwest - Area 627	3.84	3.29%	$492,848.67
Minnesota Power - Area 608	3.59	3.07%	$460,482.72
Great River Energy - Area 615	0.04	0.04%	$5,625.51
MidAmerican Energy Company - Area 635	2.62	2.25%	$337,055.42

Project ID: Project Name (Target Appendix - Project Type) Transmission Owner(s)	LODF Miles	% Share	Cost Allocation
9994: Custer-Monroe 120 kV Line Rebuild (A in MTEP16 - BRP)	**11.99**	**100.00%**	**$14,500,000.00**
International Transmission Company			
Michigan Electric Transmission Company - Area 218	2.11	17.64%	$2,558,057.64
International Transmission Company - Area 219	9.87	82.36%	$11,941,942.36
10183: Pershing 345 kV Substation (B in MTEP16 - BRP)	**237.57**	**100.00%**	**$14,500,000.00**
American Transmission Company, Xcel Energy			
American Transmission Company - Area 295	122.54	51.58%	$7,479,363.63
Ameren Illinois - Area 357	0.12	0.05%	$7,415.76
Xcel Energy - Area 600	93.08	39.18%	$5,681,222.12
International Transmission Company Midwest - Area 627	6.49	2.73%	$396,361.64
Minnesota Power - Area 608	5.94	2.50%	$362,761.84
Great River Energy - Area 615	0.28	0.12%	$17,248.51
MidAmerican Energy Company - Area 635	1.28	0.54%	$77,996.69
Dairyland Power Cooperative - Area 680	7.83	3.29%	$477,629.81
10269: Lore-Hickory Creek 161 kV Rebuild (A in MTEP16 - BRP)	**44.91**	**100.00%**	**$12,700,847.00**
International Transmission Company Midwest			
American Transmission Company - Area 295	2.65	5.91%	$750,460.44
Xcel Energy - Area 600	1.19	2.65%	$335,944.76
International Transmission Company Midwest - Area 627	35.78	79.66%	$10,116,942.57
MidAmerican Energy Company - Area 635	3.34	7.43%	$943,529.71
Dairyland Power Cooperative - Area 680	1.96	4.36%	$553,969.52
10886: Reconductor South Belleville-Centerville 138 kV Line (A in MTEP17 - BRP)	**20.15**	**100.00%**	**$10,000,000.00**
Ameren Illinois Company			
Ameren Missouri - Area 356	2.59	12.86%	$1,285,822.84
Ameren Illinois Company - Area 357	17.56	87.14%	$8,714,177.16
12037: Montgomery-Cane River 230 kV: New Line (A in MTEP17 - BRP)	**152.11**	**100.00%**	**$37,576,054.00**
Entergy Louisiana			
Entergy Mississippi - Area 326	4.24	2.79%	$1,048,366.31
Entergy Arkansas - Area 327	2.38	1.56%	$587,022.09
Entergy Louisiana - Area 351A	64.75	42.56%	$15,993,989.19
Entergy Texas - Area 351B	6.84	4.50%	$1,689,423.27
Cleco Power - Area 502	73.84	48.54%	$18,240,311.97
Lafayette City-Parish Consolidated Government - Area 503	0.07	0.05%	$16,941.17
12039: Hot Springs - Happy Valley 500 kV: New Line (A in MTEP17 - BRP)	**41.22**	**100.00%**	**$152,531,443.00**
Entergy Arkansas			
Entergy Mississippi - Area 326	0.48	1.18%	$1,792,702.81
Entergy Arkansas - Area 327	39.88	96.74%	$147,552,206.33
Entergy Louisiana - Area 351A	0.86	2.09%	$3,186,533.86
12101: East ALP Project: Lake Peigneur to Cecelia 230 kV: New Line & 230-138 kV Auto (A in MTEP18 - BRP)	**172.54**	**100.00%**	**$105,479,468.00**
Entergy Louisiana			
Entergy Louisiana - Area 351A	124.70	72.27%	$76,232,339.16
Cleco Power - Area 502	37.16	21.53%	$22,714,388.54
Lafayette City-Parish Consolidated Government - Area 503	10.69	6.19%	$6,532,740.31
12105: Fancy Point to Horseshoe 230 kV New 2nd Line (A in MTEP18 - BRP)	**18.94**	**100.00%**	**$24,610,733.00**
Entergy Louisiana			
Entergy Louisiana - Area 351A	18.86	99.53%	$24,495,433.62
Cleco Power - Area 502	0.09	0.47%	$115,299.38
12112: North ALP Project: Cankton 230-138 kV: New Substation & Auto; Cankton to Cecelia 230 kV: New Line & Auto (A in MTEP17 - BRP)	**24.86**	**100.00%**	**$64,982,013.00**
Entergy Louisiana			
Entergy Louisiana - Area 351A	10.47	42.12%	$27,371,488.23
Cleco Power - Area 502	10.46	42.10%	$27,355,751.51
Lafayette City-Parish Consolidated Government - Area 503	3.92	15.78%	$10,254,773.26
12122: Knife Falls 115 kV Project (A in MTEP17 - Other)	**193.73**	**100.00%**	**$968,851.61**
Great River Energy			
American Transmission Company - Area 295	9.00	4.65%	$45,012.29
Xcel Energy - Area 600	87.32	45.07%	$436,670.97
International Transmission Company Midwest - Area 627	35.04	18.09%	$175,224.61
Minnesota Power - Area 608	59.55	30.74%	$297,826.77
Great River Energy - Area 615	0.48	0.25%	$2,415.78
MidAmerican Energy Company - Area 635	2.34	1.21%	$11,701.19

Project ID: Project Name (Target Appendix - Project Type) Transmission Owner(s)	LODF Miles	% Share	Cost Allocation
12138: Robert 230 kV: New Substation (A in MTEP17 - Other)	**348.62**	**100.00%**	**$58,788,807.00**
Cleco Power, Entergy Louisiana			
Entergy Mississippi - Area 326	75.88	21.77%	$12,795,598.59
Entergy Arkansas - Area 327	83.06	23.83%	$14,006,943.76
South Mississippi Electric Power Association - Area 349	3.26	0.94%	$549,872.53
Entergy Louisiana - Area 351A	131.51	37.72%	$22,176,500.22
Entergy Texas - Area 351B	15.27	4.38%	$2,574,492.14
Entergy New Orleans - Area 351C	0.23	0.07%	$38,650.27
Cleco Power - Area 502	39.42	11.31%	$6,646,749.50
12985: Segura to Teche to Bayou Vista 230 kV Line (A in MTEP17 - BRP)	**299.81**	**100.00%**	**$90,000,000.00**
Cleco Power			
Entergy Mississippi - Area 326	9.33	3.11%	$2,799,260.74
Entergy Arkansas - Area 327	4.00	1.33%	$1,200,196.92
Entergy Louisiana - Area 351A	164.38	54.83%	$49,346,529.97
Entergy Texas - Area 351B	6.59	2.20%	$1,977,797.03
Entergy New Orleans - Area 351C	1.48	0.49%	$445,264.07
Cleco Power - Area 502	108.68	36.25%	$32,623,500.18
Lafayette City-Parish Consolidated Government - Area 503	5.35	1.79%	$1,607,451.09
13867: Natchez SES - Red Gum 115 kV: Rebuild Line (A in MTEP18 - BRP)	**66.32**	**100.00%**	**$46,013,706.00**
Entergy Louisiana, Entergy Mississippi			
Entergy Mississippi - Area 326	28.76	43.36%	$19,951,382.18
Entergy Arkansas - Area 327	0.81	1.22%	$561,443.98
Entergy Louisiana - Area 351A	35.21	53.10%	$24,431,138.96
Entergy Texas - Area 351B	0.09	0.14%	$65,774.70
Cleco Power - Area 502	1.45	2.18%	$1,003,966.18

All Projects studied are BRP and MTEP Appendix A projects except for Projects 12122 and 12138 which are classified as MISO Other Reliability Projects, and Projects 10183 and 9925 which are Appendix B projects.

Section 1. Introduction

Pterra, LLC ("Pterra") was contracted by LS Power Midcontinent, LLC ("LSP") to analyze the beneficiaries of selected transmission projects in the footprint of the Midcontinent Independent System Operator, Inc. ("MISO").

MISO evaluates various types of projects through the MISO Transmission Expansion Plan (MTEP) process. This process is conducted annually and leads to a set of transmission projects that are recommended to MISO's Board of Directors for review and approval. At present, costs are allocated by type of project (Market Efficiency Projects, Multi Value Projects, and Baseline Reliability Projects) with a variety of metrics taken into account. For Baseline Reliability Projects, MISO currently applies a non-analytical cost allocation methodology that allocates costs to the geographic zone in which the project is located.

LSP was interested in seeing whether the current geographic-based cost allocation methodology was consistent with the identification of beneficiaries using analytical models. To analyze the accuracy of location-based cost allocation in identifying beneficiaries, Pterra applied the methodology known as the LODF[4]-mile, last applied by MISO to Baseline Reliability Projects in the 2012 MTEP (shortened to "MTEP12"), on a selected set of Baseline Reliability Projects approved in MTEP 2013-2018.

Pterra's process was as follows: (a) develop a procedure for extending the LODF-mile method to transmission projects later than 2012, (b) benchmark the results of the procedure against published cost allocations using the LODF-mile method to identify sensitivities, and (c) apply the procedure to a set of transmission projects selected by LSP.

1.1. Study Projects

The selected MTEP transmission projects for study are listed in Table 1-1.

Table 1-1: Set of Projects Selected for Cost Allocation Using the LODF-Mile Method

Project ID	Target Appendix	Transmission Owner	Project Name	Project Type	Project Cost upon Approval by MISO Board
3013	A in MTEP13	Ameren Illinois Company	Turkey Hill-Cahokia Reinsulation to 345 kV and Cahokia 345/138 kV Transformer Replacement	BRP	$ 31,570,000.00
3339	A in MTEP13	Ameren Illinois Company	Pana, North-Taylorville, South Reconductoring	BRP	$ 7,807,000.00
3828	A in MTEP13	International Transmission Company Midwest	Lore-Turkey River-Stoneman 161kV Rebuild	BRP	$ 24,500,000.00
4292	A in MTEP13	Michigan Electric Transmission Company	Lenawee 345/138 kV station	BRP	$ 25,950,000.00
4373	A in MTEP13	International Transmission Company Midwest	Hickory Creek 161 kV source	BRP	$ 7,000,000.00
4368	A in MTEP14	Duke Energy Indiana	Dresser-Wabash River new 138 kV line	BRP	$ 14,500,000.00

[4] LODF - Line Outage Distribution Factor.

Project ID	Target Appendix	Transmission Owner	Project Name	Project Type	Project Cost upon Approval by MISO Board
4614	A in MTEP14	Entergy Mississippi	New Franklin-McComb: build 115 kV Line	BRP	$ 59,960,000.00
7800	A in MTEP15	Ameren Illinois Company	Newton-Robinson-1 138 kV Reconductoring	BRP	$ 19,256,602.00
8113	A in MTEP15	Xcel Energy	New 230 kV Substation at Minot, ND to Great River Energy McHenry Substation	BRP	$ 48,916,000.00
8020	A in MTEP15	MidAmerican Energy Company	Pleasant Corner-Beacon 161 kV Line & Terminal	BRP	$ 15,265,000.00
8160	A in MTEP15	International Transmission Company Midwest	ITC Midwest LLC Morgan Valley-Beverly 345kV	BRP	$ 38,156,592.00
8740	A in MTEP15	MidAmerican Energy Company	Brooks-Adams County 161 kV Line and remove eight miles of existing 161 kV line from Idaho Avenue Substation (Brooks T5-635038) to Adams County Substation	BRP	$ 9,300,000.00
7988	A in MTEP15	Cleco Power, Entergy Louisiana	Terrebonne to Bayou Vista 230 kV line (Entergy and Cleco Power joint project)	BRP	$122,000,000.00
8587	A in MTEP15	Entergy Louisiana	Construct new 500 kV transmission line (7.5 miles) from Sulphur Lane to the new 500/230 kV Bulk Substation west of Carlyss	BRP	$ 49,420,000.00
9482	A in MTEP15	Entergy Texas	South Beaumont – New China to Stowell 230 kV Line	BRP	$ 47,446,558.00
9994	A in MTEP16	International Transmission Company	Custer - Monroe 120 kV Line Rebuild	BRP	$ 14,500,000.00
10269	A in MTEP16	International Transmission Company Midwest	Lore-Hickory Creek 161kV Rebuild	BRP	$ 12,700,847.00
10183	B in MTEP16	American Transmission Company, Xcel Energy	Pershing 345 kV Substation	BRP	$ 14,500,000.00
9925	B in MTEP16	American Transmission Company	Tap Stone Lake – Gardner Park 345-kV Line	BRP	$ 15,000,000.00
9864	A in MTEP17	International Transmission Company, Michigan Electric Transmission Company	Whiting - Custer 120 kV Rebuild	BRP	$ 14,300,000.00
10886	A in MTEP17	Ameren Illinois Company	Reconductor South Belleville-Centerville 138 kV line (line 1586)	BRP	$ 10,000,000.00
12037	A in MTEP17	Entergy Louisiana	Montgomery - Cane River 230 kV: New line	BRP	$ 37,576,054.00
12112	A in MTEP17	Entergy Louisiana	North ALP Project: Cankton 230-138 kV: New Substation & Auto Cankton to Cecelia 230 kV: New line & Auto	BRP	$ 64,982,013.00
12985	A in MTEP17	Cleco Power	Segura to Teche to Bayou Vista 230 kV line	BRP	$ 90,000,000.00
12122	A in MTEP17	Great River Energy	Build 1.0 mile 115 kV line to new Knife Falls substation	Other	$ 968,851.61
12138	A in MTEP17	Cleco Power, Entergy Louisiana	New Robert 230 kV substation	Other	$ 58,788,807.00

Project ID	Target Appendix	Transmission Owner	Project Name	Project Type	Project Cost upon Approval by MISO Board
12039	A in MTEP17	Entergy Arkansas	Hot Springs – Happy Valley 500 kV: New Line	BRP	$152,531,443.00
9716	A in MTEP18	Cleco Power	Coughlin - Plaisance 138 kV Reconductor	BRP	$ 12,320,000.00
12101	A in MTEP18	Entergy Louisiana	East ALP Project: Lake Peigneur to Cecelia 230 kV: New Line & 230-138 kV Auto	BRP	$105,479,468.00
12105	A in MTEP18	Entergy Louisiana	Fancy Point to Horseshoe 230 kV: New 2nd Line	BRP	$ 24,610,733.00
13867	A in MTEP18	Entergy Louisiana, Entergy Mississippi	Rebuild 115 kV line Natchez to Red Gum	BRP	$ 46,013,706.00

Note: Projects 12122 and 12138 are not BRP Projects but are classified as MISO Other Reliability Projects. Projects 10183 and 9925 are not Appendix A projects but are classified as Appendix B projects.

The selected projects for study are spread out over the footprint of MISO. A geographic overview of the MISO footprint with notes on where various transmission owners operate is provided in Figure 1-1.

Figure 1-1 Geographic Overview of MISO Planning Regions and Transmission Owners[5]

[5] https://www.ferc.gov/market-assessments/mkt-electric/midwest.asp, text overlaid in red fonts by Pterra

1.2. Pricing Zones and Power Flow Modeling

Costs for Baseline Reliability Projects in the MTEP 2012[6] were allocated to pricing zones. However, the power flow models which are used to calculate LODFs do not have a specification for pricing zones. Data in the power flow cases identify transmission elements by the following data classes: Areas, Zones and Owners.

In the LODF calculations, the Area designations are observed. A list of the Area designations is shown in Table 1-2.

[6] The last year when the LODF-mile was used for cost allocation.

Table 1-2: List of Power Flow Area Designations

Transmission Owner	Acronym	Power Flow Area Number[7]
ITC Midwest LLC	ITCM[8]	627
Central Iowa Power Cooperative	CIPCO	627
American Transmission Company, LLC	ATC	295,694,696,697,698[9]
Ameren Illinois Company	AMIL	357
Prairie Power, Inc	PPI	357
Ameren Missouri	AMMO	356
Duke Energy Business Services, LLC for Duke Energy Indiana, Inc	DEI	208
Wabash Valley Power Association, Inc	WVPA	208
Columbia, Missouri, City of (Water & Light Dept	CWLD	333
City of Springfield, Illinois (Office of Public Utilities)	CWLP	360
Great River Energy	GRE	615
Hoosier Energy Rural Electric Cooperative, Inc	HE	207
International Transmission Company (d/b/a ITC Transmission)	ITC	219
Indianapolis Power & Light Company	IPL	216
Consumers Energy Company	CE	218
Michigan Electric Transmission Company, LLC	METC	218
Michigan Electric Transmission Company, LLC (CONS)	METC	218
Michigan Public Power Agency	MPPA	218
Wolverine Power Supply Cooperative, Inc	WPSC	218
ALLETE, Inc. (for its operating division Minnesota Power, Inc., and its wholly-owned subsidiary, Superior Water, Light and Power Company)	MP	608
Montana-Dakota Utilities, Co	MDU	661
Northern States Power Company (Xcel Energy)	XEL	600
Minnesota Municipal Power Agency	MMPA	600
Northern Indiana Public Service Company	NIPS	217
Otter Tail Power Company	OTP	620
Southern Illinois Power Cooperative	SIPC	361
Southern Minnesota Municipal Power Agency	SMMPA	613
City of Rochester, a Minnesota Municipal Corp	RPU	613
Southern Indiana Gas & Electric Company (Vectren)	SIGE	210
MidAmerican Energy Company	MEC	635
Muscatine Power & Water (Board Of Water, Electric & Communications)	MPW	633
Dairyland Power Cooperative	DPC	680
Big Rivers Electric Corporation	BREC	314

[7] Based on MISO MTEP18 power flow case.
[8] An alternate acronym is ALTW for Alliant Energy West.
[9] In the LODF calculations in this report, the contributions from areas 295, 694, 696, 697 and 698 are aggregated and allocated to Area 295.

Transmission Owner	Acronym	Power Flow Area Number[7]
Arkansas Electric Cooperative Corporation	AECC	327
Entergy Arkansas, Inc	EES-EAI	327
Entergy Louisiana, LLC	EES	351/351A*
Entergy Mississippi Inc	EES-EMI	326
East Texas Electric Cooperative, Inc	ETEC	351/351D*
Entergy Texas, Inc		351/351B*
Cleco Power LLC	CLEC	502
City of Alexandria, Louisiana	ALEX	502
Lafayette City-Parish Consolidated Government	LUS	503
Entergy New Orleans, Inc	EES	351/351C*

** The first Area number represents the designation for Entergy Louisiana for MTEP13 to MTEP15. The second Area number was created by Pterra to reflect the separation of Entergy Louisiana into Entergy Louisiana (351A), Entergy Texas (351B), and Entergy New Orleans (351C), as well as to separate East Texas Electric Cooperative, Inc (351D) for MTEP16 to MTEP18.*

Section 2. Study Data, Assumptions and Methodology

This section presents data used for the study, assumptions used to facilitate the analysis, and the study methodology.

2.1. Power Flow Models

Pterra received access to related MTEP power flow models from MISO. These models are classified as Critical Energy Infrastructure Information (CEII) and are not publicly available.

From among the power flow models, Pterra selected a specific model to use for the LODF calculation of each study project. The power flow cases selected for each project and the power flow internal bus numbers that identify the project are listed in Table 2-1.

Table 2-1: MTEP Power Flow Models and Specific Bus Numbers Used for Study of Selected Transmission Projects

Project ID	Target Appendix	Power Flow Case Name	Project Related Bus Number
3013	A in MTEP13	(CEII Item)	(CEII Item)
3339	A in MTEP13	(CEII Item)	(CEII Item)
3828	A in MTEP13	(CEII Item)	(CEII Item)
4292	A in MTEP13	(CEII Item)	(CEII Item)
4373	A in MTEP13	(CEII Item)	(CEII Item)
4368	A in MTEP14	(CEII Item)	(CEII Item)
4614	A in MTEP14	(CEII Item)	(CEII Item)
7800	A in MTEP15	(CEII Item)	(CEII Item)
8113	A in MTEP15	(CEII Item)	(CEII Item)
8020	A in MTEP15	(CEII Item)	(CEII Item)
8160	A in MTEP15	(CEII Item)	(CEII Item)
8740	A in MTEP15	(CEII Item)	(CEII Item)
7988	A in MTEP15	(CEII Item)	(CEII Item)
8587	A in MTEP15	(CEII Item)	(CEII Item)
9482	A in MTEP15	(CEII Item)	(CEII Item)
9994	A in MTEP16	(CEII Item)	(CEII Item)
10269	A in MTEP16	(CEII Item)	(CEII Item)

Project ID	Target Appendix	Power Flow Case Name	Project Related Bus Number
10183	B in MTEP16	(CEII Item)	(CEII Item)
9925	B in MTEP16	(CEII Item)	(CEII Item)
9864	A in MTEP17	(CEII Item)	(CEII Item)
10886	A in MTEP17	(CEII Item)	(CEII Item)
12037	A in MTEP17	(CEII Item)	(CEII Item)
12112	A in MTEP17	(CEII Item)	(CEII Item)
12985	A in MTEP17	(CEII Item)	(CEII Item)
12122	A in MTEP17	(CEII Item)	(CEII Item)
12138	A in MTEP17	(CEII Item)	(CEII Item)
12039	A in MTEP17	(CEII Item)	(CEII Item)
9716	A in MTEP18	(CEII Item)	(CEII Item)
12101	A in MTEP18	(CEII Item)	(CEII Item)
12105	A in MTEP18	(CEII Item)	(CEII Item)
13867	A in MTEP18	(CEII Item)	(CEII Item)

2.2. Methodology

The concept of line outage distribution factors (LODF) is well-known, and their calculation is embedded in commercial power flow software such as PSS/E and TARA. LODFs were originally intended for online use to quickly calculate the power flows in a transmission grid following a contingency; hence, the basic components for calculating LODFs are a power flow case, a contingency (or set of contingencies), and a set of participant transmission elements each of which shows some change in electrical flow between the post- and pre-contingency states. For purposes of this report, we shall refer to these participating transmission elements as "contributors" to the specific project's LODF.

MISO adopted the LODF concept in 2006 for its cost allocation methodology, replacing the contingency with the removal of a selected transmission project. LODFs, in this methodology, were calculated based on the change in flow on contributors with and without the study transmission project. For any specific project, there could be hundreds of contributors for each of which an LODF is calculated. The power flow cases used for the methodology were taken from the annual MTEP transmission planning process. In addition, MISO applied a weighting factor to each contributor's LODF in order to distinguish contributors that represent short transmission lines from others that model long transmission lines. This

weighting factor is the length of the line in miles. Thus, the methodology was termed "LODF-mile".

Various power flow software, despite being able to calculate LODF, need to be tweaked and tuned in order to calculate MISO LODF-miles correctly. The developers of the PSS/E software created a specific function known as MWMI which was initially adopted by MISO but later abandoned for an in-house calculation engine. The TARA software also provides a feature to calculate LODFs which can be adapted to be applicable to the MISO methodology.

In its published implementation rules, MISO specified modified approaches to the LODF-mile based on the type of project.[10] These rules, as interpreted by Pterra, were implemented in the TARA software. The project classifications and the associated modeling approach in the TARA software are as follows:

1. New transmission facility (lines or transformers)– Starting from a selected MTEP power flow case, the TARA software setup is configured with auxiliary files to perform the LODF-Mile calculation.
2. Complex projects involving significant system reconfiguration – Where applicable, a detailed auxiliary file for TARA is developed modeling all the system changes implied by the complex project. In some cases, this approach may not be possible with TARA. The alternative is to setup two power flow cases representing the with and without study project models and calculate LODFs manually. This type of project also requires the specification of a Project Boundary, the selection of which may depend on engineering judgment.
3. Project-specific methodology – There are 12 bulleted items in the MISO implementation rules which specify different calculations for certain types of projects. Some require detailed power flow modeling in PSS/E and some may be modeled with a similar setup as in item 1 such as a reconductored line project that is simulated as the original line with a parallel pseudo line. LODF is computed by taking out the parallel line.

As noted earlier, for each transmission project studied, there can be on the order of hundreds of contributors. These contributors take the form of transmission lines and transformers modeled in the MTEP power flows, and each of these in turn may belong to a single owner or may be jointly shared with one or more transmission entities. In the LODF-mile methodology, the sum of LODF-mile contributions from each transmission entity is calculated. The percentage of all the LODF-mile contributions for a project that is allocated to a transmission entity is that entity's percent cost share for the project. For example, consider a transmission project that has a sum of 1000 LODF-miles and that there are five transmission entities that own contributors to the total LODF-mile. If one of the transmission entities contributes 200 LODF-miles, then that entities percent cost share is 20%. This percent cost share may subsequently be converted into a dollar allocation by multiplying with the total project cost. So again, for the same example, if the project total cost is $100 million, then the transmission entity is cost allocated $20 million.

[10] "Appendix J: Implementation Rules for LODF Calculation", 2019 Transmission Planning Business Practices Manual BPM020-r19, MISO. https://www.misoenergy.org/legal/business-practice-manuals/

For this study, the cost allocation is based on 100% of the total project cost.[11]

in calculating the LODF-mile contributions for this study, several considerations and assumptions were applied.

1. As noted in Section 1.2, the MISO LODF-mile methodology allocated costs to pricing zones. However, the power flow models do not have information on pricing zones but rather have class designations such as Area and Owner. All the pricing zones are represented by one or more Areas in the power flow models. For this study, cost allocations are distributed by power flow Area.
    a. If a contributor is designated as belonging to a single Area, then 100% of the LODF-mile contribution is allocated to the Area[12].
    b. If a contributor is designated as belonging to one or more Areas, then an effort is made to obtain information on the breakdown of ownership. In some cases, the information is available from sources such as Information Filings by MISO with FERC. LSP also requested such information from MISO but received limited information. Where no other information was obtainable, the assumption that the ownership is split equally was applied. (The sensitivity to this assumption is discussed in Section 3.4).
2. For the LODF of a contributor:
    a. LODFs are calculated for transmission level contributors. If the contributor has a voltage level of 100 kV or less, the LODF is assumed to be zero.
    b. If the LODF value for a contributor is less than 1%, The LODF is not included in the LODF-mile calculation. A threshold value for LODF of 1% is applied; i.e., if a contributor does not respond by at least 1% to the contingency represented by the project, its impact is not accounted for. This is in accordance with MISO Appendix J on implementation rules for LODF calculation.

       It is thus possible that a transmission entity contributes to the LODF-mile total of a project but the entity's contribution and consequent cost allocation is not considered because of its *de minimus* participation.
3. For the LODF-mile of a contributor:
    a. If the contributor is a transmission line, the length of the line is obtained from the power flow model. If the length is not provided

[11] In the previous implementation of the LODF-mile methodology in MISO, transmission projects 345 kV and higher have 20% of project costs allocated on a system-wide basis to all transmission customers (postage stamp) and 80% allocated sub-regionally to all transmission customers in one or more zones based on LODF analysis. Furthermore, cost sharing was applied where the project cost was greater than $5 million, or the cost was 5% or greater than the constructing Transmission Owner's net transmission plant. For purposes of this report, all transmission projects, including those 345 kV and higher, are 100% allocated using the LODF-mile method.

[12] In some rare cases, the Owner designation may differ from the Area designation in the power flow. In such cases, some research is conducted to determine which is the correct designation, and where no further information is obtained, the Owner designation is selected as the contributor's transmission entity and applied in place of the Area designation.

in the power flow model, the information is obtained from other sources including MISO's Informational Filing with FERC. LSP also requested length information from MISO but received limited information.

b. If the length of a line is not known, the length is estimated based on the impedance of the line with parameters as applied per Table 2-2. (The sensitivity to this assumption is discussed in Section 3.4).

Table 2-2 Per Unit (PU) Impedances Values Applied for Estimating Line Lengths by Voltage Level

kV	Ohms/Mile	PU/Mile Assuming 100 MVA Base
115	0.75	0.00567
120	0.72	0.00500
138	0.72	0.00378
161	0.72	0.00278
230	0.68	0.00129
345	0.6	0.00050
500	0.55	0.00022
765	0.52	0.00009

c. If the contributor is a transformer, a length of 1 mile is assigned. This is in accordance with the MISO Implementation Rules.

Section 3. Analysis and Results from Benchmarking

This section and Section 4 present the analysis undertaken by Pterra to identify cost allocation based on the MISO LODF-Mile methodology for selected MTEP Appendix A projects (listed in Table 1-1).

3.1. Benchmarking the Model

For benchmarking purposes, Pterra utilized the MISO Informational Filing dated 1 August 2016 and modified on 17 March 2017. This document provides cost allocations for selected transmission projects in MTEP14 and MTEP15 using the LODF-mile methodology. Nine of these projects were selected for benchmarking. These are listed in Table 3-1.

3.2. Benchmark Results

Using the MTEP14 and MTEP15 power flow models obtained from MISO, Pterra applied the cost-allocation procedure developed for this study (as described in Section 2.2) for each of the nine projects listed in Table 3-1.

We note that in the MISO calculations, the power flow Area designations were used to aggregate contributions to the LODF-mile.

The following subsections present the results of benchmarking for each project. Result summaries for each benchmark are in Table 3-2 through Table 3-10. Each table shows a comparison of the published MISO percent cost share allocation and Pterra's TARA calculation of the percent cost share. The tables also include the resulting cost allocation based on the two methods' percent cost share and the project cost as approved by the MISO Board for Appendix A projects for the applicable year.

The benchmarked percent cost share values are within 0.7% of the published allocations, except for Projects 7800 and 8113, which have modeling issues in the MISO power flow cases.

Table 3-1 Selected Projects from MISO Information Filing for MTEP-2014/15 Intended for Benchmarking[13]

MTEP Project Number - Area - Name	LODF*Mile	Percent Share	Zone Number
4368-DEI-Dresser - Wabash Riv. New 138kV Line			
DEI	58.94850	93.69%	208
HE	3.96987	6.31%	207
4614-Entergy-MS-Franklin - McComb new 115 kV line			
CLEC	2.53527	2.04%	502
EES	115.88791	93.24%	351
EES-EAI	2.69843	2.17%	327
SMEPA	3.16643	2.55%	349
7800-AMIL-Newton-Robinson-1 138 kV Reconductoring			
AMIL	56.49847	93.82%	357
DEI	2.52106	4.19%	208
IPL	1.19912	1.99%	216
7988-CLECO, Entergy-LA-Schriever to Bayou Vista 230 kV line (Entergy/CLE			
CLEC	84.33066	37.95%	502
EES	121.54689	54.70%	351
EES-EAI	7.10343	3.20%	327
EES-EMI	4.34540	1.96%	326
LAFA	4.89845	2.20%	503
8020-MEC-Pleasant Corner-Beacon 161 kV Line & Terminal			
ALTW	39.99153	52.51%	627
AMIL	0.56165	0.74%	357
AMMO	6.04297	7.93%	356
MEC	29.37494	38.57%	635
MPW	0.19101	0.25%	633
8160-ITCM-ITCM Morgan Valley-Beverly 345kV			
ALTW	57.77406	69.60%	627
AMMO	1.91702	2.31%	356
MEC	23.32350	28.10%	635
8740-MEC-Brooks-Adams County 161 kV Line			
ALTW	5.79802	6.75%	627
AMMO	4.24441	4.94%	356
MEC	75.79220	88.30%	635
9482-Entergy-TX-China to Stowell 230 kV: Construct New Line			
EES	131.95945	100.00%	351
P8113-XEL-Ward Co 230 kV			
GRE	167.25298	76.39%	615
MDU	13.28506	6.07%	661
MP	4.01990	1.84%	608
OTP	30.87482	14.10%	620
XEL	3.51201	1.60%	600

[13] See Table 1-2 for a cross-reference of full names of transmission companies.

3.2.1. Project 4368 Dresser-Wabash River 138 kV Line

A comparison of the cost allocations from Pterra's application of the cost procedure to the allocations reported in MISO's filings is shown in Table 3-2. There are two affected TOs: 207 - Hoosier Energy Rural Electric Cooperative, and 208 - Duke Energy Indiana.

Table 3-2 Benchmark Results for Project 4368 Dresser-Wabash 138 kV project

Cost Allocation for Project ID: 4368 Dresser -Wabash River New 138 kV Line Transmission Owner: Duke Energy Indiana										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
207	Hoosier Energy Rural Electric Cooperative	3.9547	6.29%	$ 912,050	3.9699	6.31%	$ 914,950	-0.01521	-0.02%	-$2,900
208	Duke Energy Indiana	58.9484	93.71%	$13,587,950	58.9485	93.69%	$13,585,050	-0.00009	0.02%	$2,900
Totals:		62.9031	100%	$ 14,500,000	62.9184	100%	$ 14,500,000			

The maximum difference between the MISO and Pterra calculations in percent share allocation is 0.02%.

3.2.2. Project 7800 Newton-Robinson 138 kV Reconductoring

The result of the benchmark comparison is shown in Table **3**-**3**. There are 3 affected Areas.

Table 3-3 **Benchmark Results for Project 7800 Newton-Robinson-1 138 kV Reconductoring**

Cost Allocation for Project ID: 7800 Newton-Robinson-1 138 kV Reconductoring Transmission owner: Ameren Illinois Company										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
208	Duke Energy Indiana	4.6541	5.67%	$ 1,091,849	2.5211	4.19%	$ 806,852	2.13304	1.48%	$284,998
216	Indianapolis Power & Light Company	2.2116	2.69%	$ 518,003	1.1991	1.99%	$ 383,206	1.01244	0.70%	$134,796
357	Ameren Illinois Company	75.2137	91.64%	$17,646,750	56.4985	93.82%	$18,066,544	18.71523	-2.18%	-$419,794
Totals:		82.0794	100%	$19,256,602	60.2187	100%	$19,256,602			

Although this project was supposed to be in the 2015 MTEP, the model for the project in the 2015 power flow appeared to be incorrect. This is based on the following observations:

- Before the upgrade (in the MTEP14 power flow case), the impedance of the Newton-Robinson 138 kV line is given as (CEII Item)per unit[14].

[14] These are standard units applied to modeling of transmission line impedances in a power flow model. In this case the applicable assumptions are a 100 MVA base for a 138 kV line.

- Presumably after the upgrade, in MTEP15 power flow case, the Project impedance increases to (CEII Item).
- However, in the MTEP17 and MTEP18 power flow cases, the same line is modeled with an impedance of (CEII Item).

Based on typical data for reconductoring of a 138 kV line, the best model is to use the MTEP17/18 representation of the line and plug this into the MTEP15 power flow case.

After applying the preceding adjustment, the resulting cost allocation shows a maximum difference in percent share allocation between the MISO and Pterra calculations of 2.2%.

3.2.3. Project 8113 New Substation at Minot, ND, to McHenry Substation

Project 8113 is classified as a complex project where the addition of a new 230 kV substation reconfigures the surrounding 230 and 115 kV network. This is illustrated in Figure 3-1. The boundary lines selected by Pterra are identified in the figure. As noted previously, some judgment is applied in the selection of the boundary lines which would have an impact on the resulting cost allocation.

For Project 8113, pre- and post-project power flow models were developed. The change in total boundary flows between the two power flow models is applied as the denominator for the LODF-mile calculation. This approach is consistent with the MISO implementation rules[15].

The result of the benchmark comparison is shown in Table 3-4. There are 5 affected Areas. The maximum difference in percent cost share allocation between the MISO and Pterra calculations is 7.8%. This difference is largely attributable to modeling assumptions applied by Pterra as a best engineering judgment of how MISO modeled the complex project as explained in Section 3.3.

Table 3-4 Benchmark Results for Project 8113 Minot to Great River Energy McHenry Substation

Cost Allocation for Project ID: 8113 New 230 kV Substation at Minot, ND, to GRE McHenry Substation Transmission Owner: Xcel Energy										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
600	Xcel Energy	1.5689	1.81%	$ 885,092	3.5120	1.60%	$ 784,643	1.94311	-0.21%	-$100,449
608	Minnesota Power	5.9545	6.87%	$ 3,359,221	4.0199	1.84%	$ 898,114	-1.93460	-5.03%	-$2,461,107
615	Great River Energy	59.4890	68.61%	$33,560,617	167.2530	76.39%	$37,367,172	107.76398	7.78%	$3,806,554
620	Otter Tail Power Company	18.5229	21.36%	$10,449,662	30.8748	14.10%	$ 6,897,962	12.35192	-7.26%	-$3,551,700
661	Montana-Dakota Utilities	1.1724	1.35%	$ 661,407	13.2851	6.07%	$ 2,968,109	12.11266	4.72%	$2,306,702
Totals:		86.7077	100%	$48,916,000	218.9448	100%	$48,916,000			

[15] *Appendix J Implementation Rules for LODF Calculation, Transmission Planning Business Practices Manual (BPM-020-r19), effective date April-01, 2019*

(CEII Item)

Figure 3-1 Project 8113 Showing New 230 and 115 kV Buses and 9 Boundary Flows Near the Project

3.2.4. Project 8020 Pleasant Corner-Beacon 161 kV

The result of the benchmark comparison for project 8020 is shown in Table 3-5. There are 5 affected Areas. The maximum difference in percent share allocation between the MISO and Pterra calculations is 0.07%.

Table 3-5 Benchmark Results for Project 8020 Pleasant Corner-Beacon 161 kV

Cost Allocation for Project ID: 8020 Pleasant Corner-Beacon 161 kV Line & Terminal Transmission Owner: MidAmerican Energy Company										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
356	Ameren Missouri	6.051799	7.93%	$ 1,210,024	6.04297	7.93%	$ 1,211,179	-0.008829	0.008%	$1,155
357	Ameren Illinois Company	0.56118	0.74%	$ 112,205	0.56165	0.74%	$ 112,570	0.00047	0.002%	$365
627	International Transmission Company Midwest	40.0353362	52.44%	$ 8,004,843	39.99153	52.51%	$ 8,015,413	-0.043806	0.069%	$10,571
633	Muscatine Power & Water	0.200152	0.26%	$ 40,019	0.19101	0.25%	$ 38,284	-0.009142	-0.011%	-$1,736
635	MidAmerican Energy Company	29.4977434	38.64%	$ 5,897,910	29.37494	38.57%	$ 5,887,554	-0.122803	-0.068%	-$10,356
Totals:		76.3462106	100.00%	$15,265,000	76.1621	100.00%	$15,265,000			

3.2.5. Project 8160 ITCM Morgan Valley-Beverly 345 kV

The result of the benchmark comparison for this project is shown in Table 3-6. There are 3 affected Areas. The maximum difference in percent share allocation between the MISO and Pterra calculations is 0.14%.

Table 3-6 Benchmark Results for Project 8160 ITCM Morgan Valley – Beverly 345 kV

Cost Allocation for Project ID: 8160 ITCM Morgan Valley-Beverly 345 kV International Transmission Company Midwest										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
356	Ameren Missouri	1.8950	2.31%	$ 881,417	1.9170	2.31%	$ 881,417	-0.02207	0.00%	$0
627	International Transmission Company Midwest	57.3105	69.73%	$26,606,592	57.7741	69.60%	$26,556,988	-0.46352	0.13%	$49,604
635	MidAmerican Energy Company	22.9833	27.96%	$10,668,583	23.3235	28.10%	$10,722,002	-0.34020	-0.14%	-$53,419
Totals:		82.1888	100%	$38,156,592	83.0146	100%	$38,160,408			

3.2.6. Project 8740 Brooks-Adams County 161 kV Line

MTEP15 describes this Project as follows:

> Brooks substation is located southwest of Des Moines between the Creston and Clarinda 161 kV substations. At present, the Idaho Ave. three-way switching station on the Clarinda-Creston 161 kV line connects to a radial line serving Brooks. The new Adams County 161 kV substation, associated with

generator project J343, will be located on this line as well, between Idaho Ave. and Creston.

Pterra believes that the Idaho Ave Station is bus number (CEII Item) based on the above description. The configuration is shown in Figure 3-2. The power flow modeling is illustrated in Figure 3-3.

The result of the benchmark comparison for this project is shown in Table 3-7. There are 3 affected Areas. The maximum difference in percent cost share allocation between the MISO and Pterra calculations is 0.6%.

Table 3-7 Benchmark results for Project 8740 Brooks-Adams County 161 kV Line

Cost Allocation for Project ID: 8740 Brooks-Adams County 161 kV Line Transmission Owner: MidAmerican Energy Company										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
356	Ameren Missouri	4.6086	5.22%	$ 485,327	4.2444	4.94%	$ 459,873	-0.36414	-0.27%	-$25,454
627	International Transmission Company Midwest	6.2741	7.10%	$ 660,725	5.7980	6.75%	$ 628,203	-0.47607	-0.35%	-$32,522
635	MidAmerican Energy Company	77.4279	87.68%	$ 8,153,947	75.7922	88.30%	$ 8,211,924	-1.63572	0.62%	$57,977
Totals:		88.3106	100%	$ 9,300,000	85.8346	100%	$ 9,300,000			

(CEII Item)

Figure 3-2 Project 8740 – Configuration before the Project (pink line indicates the proposed project)

(CEII Item)

Figure 3-3 Project 8740 – Configuration after the Project (pink line indicates removing Idaho Ave Sub– three-way switching station)

3.2.7. Project 4614 New Franklin-McComb: Build 115 kV Line

The result of the benchmark comparison for this project is shown in Table 3-8. There are 4 affected Areas. The maximum difference in percent share allocation between the MISO and Pterra calculations is 0.04%.

Table 3-8 Benchmark results for Project 4614 New Franklin-McComb: Build 115 kV Line

Cost Allocation for Project Project ID: 4614 New Franklin-McComb: Build 115 kV Line Transmission Owner: Entergy Mississippi										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
327	Entergy Arkansas	2.6967	2.18%	$ 1,308,881.63	2.69843	2.17%	$ 1,301,796	-0.00173	0.01%	$7,086
349	South Mississippi Electric Power Association	3.1645	2.56%	$ 1,535,935.00	3.16643	2.55%	$ 1,527,576	-0.00193	0.01%	$8,359
351A	Entergy Louisiana	115.1396	93.20%	$ 55,884,639.52	115.88791	93.24%	$55,907,542	-0.74831	-0.04%	-$22,903
502	Cleco Power	2.5353	2.05%	$ 1,230,543.85	2.53527	2.04%	$ 1,223,086	0.00003	0.01%	$7,458
Totals:		123.5361	100%	$ 59,960,000	124.2880	100%	$59,960,000			

Although this project was assigned to Entergy Mississippi, both the Pterra and MISO calculations allocated 0% of the cost to that Area. Instead, Entergy Louisiana was assigned the largest value at 93%.

3.2.8. Project 7988 Terrebone to Bayou Vista 230 kV Line

The result of the benchmark comparison for this project is shown in Table 3-9. There are 5 affected Areas. The maximum difference in percent share allocation between the MISO and Pterra calculations is 0.09%.

Note that there are inconsistencies between the project name and the description included with the Informational Filing. For Benchmarking purposes, Pterra used the project as modeled in the MISO load flow case.

Table 3-9 Benchmark results for Project 7988 Terrebone to Bayou Vista 230 kV Line

Cost Allocation for Project Project ID: 7988 Terrebone to Bayou Vista 230 kV Line Transmission Owners: Entergy Louisiana, Cleco Power										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
326	Entergy Mississippi	4.3427	1.97%	$ 2,399,383.91	4.34540	1.96%	$ 2,385,595	-0.00270	0.01%	$13,789
327	Entergy Arkansas	7.1078	3.22%	$ 3,927,128.50	7.10343	3.20%	$ 3,899,738	0.00437	0.02%	$27,390
351A	Entergy Louisiana	120.5795	54.61%	$ 66,621,344.27	121.54689	54.70%	$ 66,728,460	-0.96739	-0.09%	-$107,116
502	Cleco Power	83.9193	38.01%	$ 46,366,227.89	84.33066	37.95%	$ 46,296,987	-0.41136	0.06%	$69,241
503	Lafayette City-Parish Consolidated Government	4.8613	2.20%	$ 2,685,915.44	4.89845	2.20%	$ 2,689,219	-0.03715	0.00%	-$3,304
Totals:		220.8106	100%	$ 122,000,000	222.2248	100%	$ 122,000,000			

3.2.9. Project 9482 South Beaumont – New China to Stowell 230 kV Line

The result of the benchmark comparison for this project is shown in Table 3-10. There is 1 affected Area: Entergy Louisiana. There is no difference in the percent share allocation between the MISO and Pterra calculations, but the LODF-Miles differ by about 21 between the MISO and Pterra calculations.

Table 3-10 Benchmark results for Project 9482 South Beaumont – New China to Stowell 230 kV Line

Cost Allocation for Project Project ID: 9482 South Beaumont - New China to Stowell 230 kV Line Transmission Owner: Entergy Texas										
Area	Owner	*Pterra Calculation*			*MISO Calculation*			*Difference*		
		LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation	LODF Mile	Percent Share	Cost Allocation
351A	Entergy Louisiana	110.9422	100%	$47,446,558.00	131.9595	100%	$47,446,558	-21.01730	0.00%	$0
Totals:		110.9422	100%	$47,446,558.00	131.9595	100%	$47,446,558			

Note: Project ID 9482 is an Appendix A in MTEP15 project. For MTEP 13 through MTEP 15 projects, Entergy Louisiana includes the 3 areas: Entergy Louisiana, Entergy Texas, and Entergy New Orleans.

3.3. Overall Benchmark Results

A list of the largest percent cost share differences between the Pterra and published MISO results is given in Table 3-11.

Table 3-11 Benchmarking Comparison Showing Largest Difference in Percent Cost Share Between Pterra and MISO-Reported Calculations

Project ID	% Difference
4368	0.02%
7800	2.2%
8113	7.78%
8020	0.70%
8160	0.15%
8740	0.62%
4614	0.04%
7988	0.09%
9482	0.00%

The percent cost allocations for projects 4368, 8020, 8160, 8740, 4614, 7988, and 9482 using the developed procedure were within 0.7% of the percent cost allocations in the Informational Filing. Two of the projects showed higher than 0.7% percent cost differentials. These are:

For example:

- Project 7800 is a reconductoring of the Newton-Robinson 138 kV line. The 2015 MISO MTEP power flow model did not accurately represent the project.[16] A correction was assumed and applied to the power flow model. This resulted in a 2.2% percent cost share difference to the cost allocation to Ameren Illinois Company (91.6% of the total project cost in the Pterra procedure versus 93.8% in the published MISO calculation).
- Project 8113 is a new 230 kV substation at Minot, ND with a connection to Great River Energy's McHenry Substation. For cost allocation purposes, this is classified as a complex project in that the boundaries that are needed to be defined using the LODF-mile method are somewhat fuzzy and subject to judgment. Pterra applied its best engineering judgment for the boundaries based on the MISO implementation rules. This assumption resulted in a 7.8% share difference to the percent cost share allocation for Great River Energy (68.6% of the total project cost in the Pterra procedure versus 76.4% in the published MISO calculation).

3.4. Sensitivities to Assumptions in the LODF-Mile Calculations

In the calculation of LODF-mile contributions, two assumptions may impact the results. These are:

1. If a contributor is designated as belonging to one or more Areas, then an effort is made to obtain information on the breakdown of ownership. Where no other information is obtainable, the assumption that the ownership is split equally is applied.
2. If the length of a line is not known, the length is estimated based on the impedance of the line with parameters as applied per Table 2-2.

[16] Since the MTEP cases after MTEP12 were not used for cost allocation, the modeling may have inaccuracies, ignored for MTEP purposes, but are significant enough to affect cost allocation.

For the benchmarked cases, neither of the two assumptions above were applied as all the needed information was available. However, for purposes of determining sensitivity, Pterra tested how the percent allocations would change if the actual information was ignored and the assumptions were applied.

For the sensitivity tests, four of the benchmark projects were considered. These are Projects 4368, 8020, 8160 and 8740. These projects are all non-complex and involved no power flow modeling issues.

Two sensitivity tests were conducted. The first test applied assumption 2 above for any information that was not already included in the power flow cases; i.e., if the power flow case included the length of the line then that value was used, but if it did not, then the line parameters per Table 2-2 were applied. The second test applied both assumptions 1 and 2 such that the assumptions from the first test are used, and in addition, contributor ownership was split equally where there was more than one Owner designated in the power flow model.

The results of the sensitivity tests are summarized in Table 3-12. These results show that:

- If the assumption on line lengths is applied, the largest percent share difference can be as much as 4.5%.
- If both the assumptions on line lengths and ownership are applied, the largest percent share difference can be as much as 7%.

These values represent the maximum percent share differences for a specific Area that contributes LODF-miles to a project.

Table 3-12 Results of Sensitivity Tests. Largest Difference in Percent Cost Share Between MISO-Reported Calculations and Three Pterra Calculations

Project #	Maximum % Difference from MISO Calculation		
	Line length & Ownership Known	Sensitivity #1 Some Line lengths not known; Line ownership Known	Sensitivity #2 Some Line length & Ownership not Known
4368	0.02%	4.52%	4.57%
8020	0.70%	2.05%	6.96%
8160	0.15%	2.46%	5.32%
8740	0.62	3.19%	2.62%

Section 4. Analysis and Results for Selected Transmission Projects

After performing benchmarking calculations as described in Section 3, Pterra conducted cost allocation analyses using the MISO LODF-Mile methodology for the remainder of the selected set of transmission projects.

The study results for nine of the selected projects listed in Table 1-1 are reported in Section 3. The remaining projects are discussed in the following sections.

4.1. Project 3013 (MTEP-2013), Turkey Hill-Cahokia 345 kV Project

Table 4-1 Result for Turkey Hill-Cahokia 345 kV Project

Cost Allocation for Project ID: 3013 Turkey Hill-Cahokia Reinsulation to 345 kV and Cahokia 345/138 kV Transformer Replacement Transmission Owner: Ameren Illinois Company				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
356	Ameren Missouri	36.7274	23.51%	$ 7,420,612
357	Ameren Illinois Company	119.5244	76.49%	$ 24,149,388
Totals:		156.2518	100%	$ 31,570,000

The Project is located at Ameren Illinois Company, and about 76% of the cost is allocated to the Area.

4.2. Project 3339 (MTEP-2013), Pana, North – Taylorville, South Reconductoring

Table 4-2 Results for Pana, North-Taylorville, South Reconductoring

Cost Allocation for Project ID: 3339 Pana, North - Taylorville, South Reconductoring Transmission Owner: Ameren Illinois Company				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
356	Ameren Missouri	2.05327	4.62%	$ 360,590.12
357	Ameren Illinois Company	42.4013	95.38%	$ 7,446,409.88
Totals:		44.4546	100%	$ 7,807,000

The Project is located in Ameren Illinois Company, and about 95% of the cost is allocated to the Area.

Assumptions

The following additional assumptions are made for this Project.

- The 2013 MTEP model did not correctly represent the line upgrade/reconductoring. Pterra utilized the 2015 model line parameters and applied it to the 2013 model. The upgrade is modeled with the original line prior to the upgrade in parallel with a pseudo-line of (CEII Item)

4.3. Project 3828 (MTEP-2013), Lore-Turkey River-Stoneman 161 kV Rebuild

Table 4-3 Results for Lore-Turkey River-Stoneman 161 kV Rebuild

Cost Allocation for Project ID: 3828 Lore-Turkey River-Stoneman 161 kV Rebuild Transmission Owner: International Transmission Company Midwest				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
295	American Transmission Company	11.75346	9.87%	$ 2,418,591.03
356	Ameren Missouri	0.79809	0.67%	$ 164,228.52
600	Xcel Energy	10.1239	8.50%	$ 2,083,263.10
627	International Transmission Company Midwest	76.7858	64.49%	$15,800,751.06
635	MidAmerican Energy Company	4.1431	3.48%	$ 852,554.44
680	Dairyland Power Cooperative	15.4566	12.98%	$ 3,180,611.85
Totals:		119.0610	100%	$ 24,500,000

The Project is located in International Transmission Company Midwest, and about 64% of the cost is allocated to the Area.

Assumptions

The following additional assumption was applied for this Project.

- The 2013 model did not seem to correctly represent the line upgrade/reconductoring. Pterra utilized the 2014 model line parameters and applied it to the 2013 model. The upgrade is modeled with the original line prior to the upgrade in parallel with a pseudo line.

4.4. Project 4292 (MTEP-2013), Lenawee 345/138 kV Station

Table 4-4 Results for Lenawee 345/138 kV Station

Cost Allocation for Project ID: 4292 Lenawee 345/138 kV Station Transmission Owner: Michigan Electric Transmission Company				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
217	Northern Indiana Public Service Company	0.06031	0.07%	$ 17,379.11
218	Michigan Electric Transmission Company	55.7564	61.91%	$16,066,929.54
219	International Transmission Company	34.2365	38.02%	$ 9,865,691.35
Totals:		90.0532	100%	$ 25,950,000

The project is located in Michigan Electric Transmission Company, and about 62% of the cost is allocated to the Area.

Assumptions

The project was treated as a complex project with boundary lines as indicated in Figure 4-1. There was a nearby line that also changed between cases, but it was not considered for this project since there was no mention of it in the project description (see cross (X) sign in the figure).

(CEII Item)

Figure 4-1 Project 4292 Showing Boundary Flow for LODF-mile Calculation and Project Buses

The following is an excerpt from MISO Report MTEP-2013 Appendix D1 East:

Project 4292: Lenawee Substation
Transmission Owners: Michigan Electric Transmission Co.
Project Description:
Install a new substation called Lenawee on the Allen Junction portion of the three-ended Milan-Monroe-Allen Junction 345 kV line. Lenawee will be located where the Allen Junction line segment crosses the 138 kV circuits from Whiting to Beecher. A new 345/138 kV transformer will be installed at Lenawee and the existing Beecher-Whiting and Beecher-Samaria 138 kV circuits will be looped into Lenawee Substation. The total estimated cost of this project is $25.95 million. The expected in-service date for this project is April 2015.
The project is shown in Figure P4292-1.

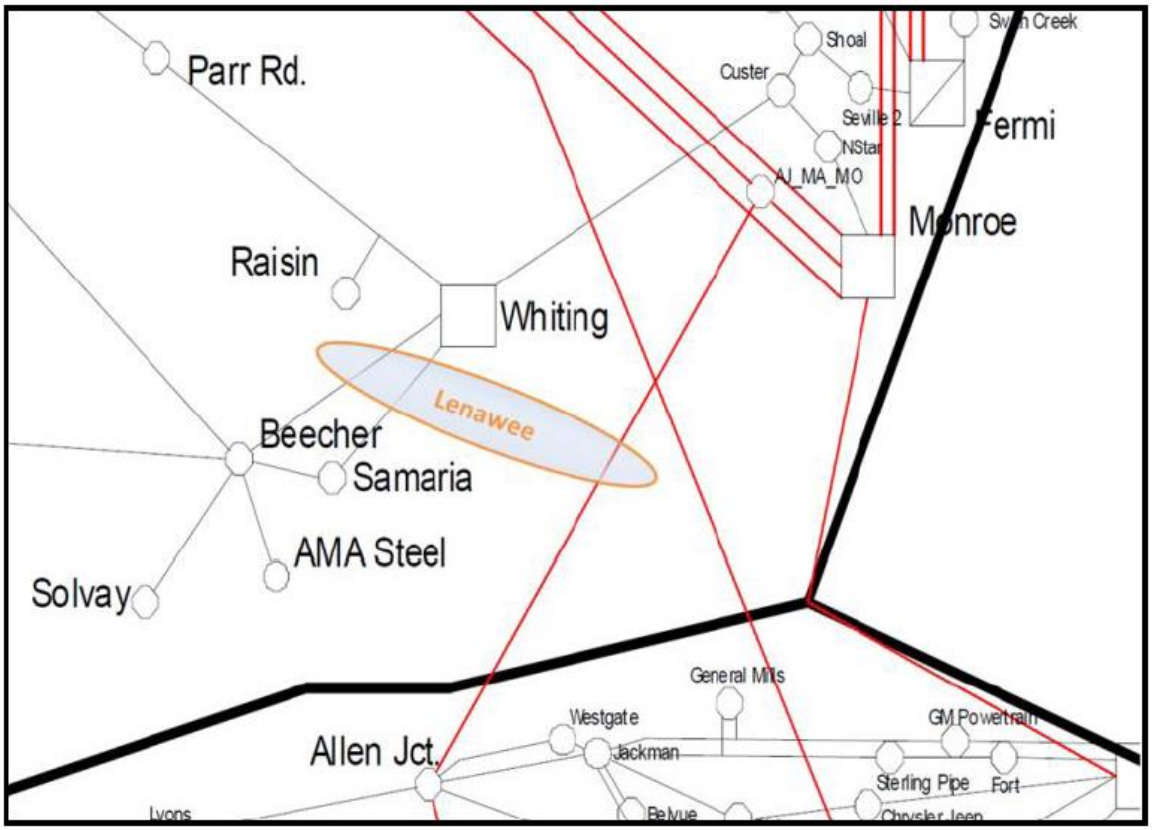


Figure P4292-1: Geographic transmission map of project area
Project

4.5. Project 4373 (MTEP-2013), Hickory Creek 161 kV Source

Table 4-5 Hickory Creek 161 kV Source

Cost Allocation for Project ID: 4373 Hickory Creek 161 kV Source Transmission Owner: International Transmission Company Midwest				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
295	American Transmission Company	0.3845	0.77%	$ 54,161.69
600	Xcel Energy	1.6046	3.23%	$ 226,028.20
627	International Transmission Company Midwest	44.7832	90.12%	$6,308,279.91
635	MidAmerican Energy Company	1.0798	2.17%	$ 152,103.48
680	Dairyland Power Cooperative	1.8417	3.71%	$ 259,426.73
Totals:		49.6938	100%	$ 7,000,000

The Project is located in International Transmission Company Midwest, and about 90% of the cost is allocated to the Area.

The following is an excerpt from the MISO Report MTEP-2013 (MTEP13 Appendices ABC.xls) that describes the project:

> *Add a 345 kV breaker to the Hickory Creek 345 kV ring to allow for the 345/161 kV transformer to a new three terminal 161 kV ring bus. Tap the Liberty-Lore 161 kV line into a new Hickory Creek 161kV ring bus.*

Assumptions

The Project appears in Appendix A of MTEP13, but since the Project is not modeled in the 2013 MTEP power flow case, the project elements from the 2014 MTEP case were inserted into the 2013 model as in Figure 4-2. Additionally, the nearby Eden Bus (693863) was excluded from consideration because there is no mention of it in the project description, and it disappears from the model every other year (2013, 2015 and 2017, as indicated with cross (X) in the figure).

(CEII Item)

Figure 4-2 Project 4373 Showing Project Buses and Boundary Flow for LODF-mile Calculation

4.6. Project 8587 (MTEP-2015), LCTP: Construct New 500 kV Transmission Line from Rhodes to New 500/230 kV Bulk Substation West of Carlyss

Table 4-6 LCTP: Construct New 500 kV Transmission Line from Rhodes to New 500/230 kV Bulk Substation West of Carlyss

Cost Allocation for Project ID: 8587 LCTP: Construct New 500 kV Transmission Line from Rhodes to New 500/230 kV Bulk Substation West of Carlyss Transmission Owner: Entergy Louisiana				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
327	Entergy Arkansas	0.3094	0.45%	$ 224,593.80
351A	Entergy Louisiana	62.4574	91.74%	$ 45,337,895.18
502	Cleco Power	5.3141	7.81%	$ 3,857,511.02
Totals:		68.0809	100%	$49,420,000.00

The Project is located in Entergy Louisiana, and 91% of the cost is allocated to the Area.

4.7. Project 9994 (MTEP-2016), Custer-Monroe 120 kV Line Rebuild

Table 4-7 Custer-Monroe 120 kV Line Rebuild

Cost Allocation for Project ID: 9994 Custer - Monroe 120 kV Line Rebuild Transmission Owner: International Transmission Company				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
218	Michigan Electric Transmission Company	2.1144	17.64%	$ 2,558,057.64
219	International Transmission Company	9.8710	82.36%	$11,941,942.36
Totals:		11.9854	100%	$14,500,000.00

The Project is located at International Transmission Company and about 82% of the cost is allocated to the Area.

4.8. Project 10269 (MTEP-2016), Lore-Hickory Creek 161 kV Rebuild

Table 4-8 Lore-Hickory Creek 161 kV Rebuild

Cost Allocation for Project ID: 10269 Lore-Hickory Creek 161 kV Rebuild Transmission Owner: International Transmission Company Midwest				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
295	American Transmission Company	2.6539	5.91%	$ 750,460
600	Xcel Energy	1.1880	2.65%	$ 335,945
627	International Transmission Company Midwest	35.7765	79.66%	$ 10,116,943
635	MidAmerican Energy Company	3.3366	7.43%	$ 943,530
680	Dairyland Power Cooperative	1.959	4.36%	$ 553,970
Totals:		44.9140	100%	$ 12,700,847

The Project is located at International Transmission Company Midwest, and about 80% of the cost is allocated to that Area.

Assumptions and Modeling Approach:

The following assumptions were applied for this Project.

1) The project is modeled in the 2016 MTEP model with an impedance of (CEII Item)with a line length of 13.03 miles.
2) For the prior upgrade model, Pterra used the 2015 impedance model assuming line length of 13.03 miles instead of 6.81 miles. Thus, the impedance values of the case prior to the upgrade will make more engineering sense (impedance after the upgrade is lower than impedance before the upgrade).

The upgrade is modeled with the line prior to the upgrade in parallel with a pseudo line as follows: (CEII Item)

Table 4-9 Lore-Hickory Creek MTEP Modeling Summary from 2013 through 2018

(CEII Item)

4.9. Project 10183 (MTEP-2016), Pershing 345 kV Substation

Table 4-10 Pershing 345 kV Substation

Cost Allocation for Project ID: 10183 Pershing 345 kV Substation Transmission Owners: American Transmission Company & Xcel Energy				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
295	American Transmission Company	122.5421	51.58%	$ 7,479,363.63
357	Ameren Illinois Company	0.1215	0.05%	$ 7,415.76
600	Xcel Energy	93.0813	39.18%	$ 5,681,222.12
608	Minnesota Power	5.9435	2.50%	$ 362,761.84
615	Great River Energy	0.2826	0.12%	$ 17,248.51
627	International Transmission Company Midwest	6.494	2.73%	$ 396,361.64
635	MidAmerican Energy Company	1.2779	0.54%	$ 77,996.69
680	Dairyland Power Cooperative	7.8255	3.29%	$ 477,629.81
Totals:		237.5684	100%	$14,500,000.00

Note: this project is a target Appendix B project in MTEP 2016

The project builds a new 345/115 kV substation on the Stone Lake to Gardner Park 345 kV Line near the existing Sheldon Pump station. The lines between Sheldon Pump, Stone Lake, and Gardner Park are rerouted through the new substation. Substation ownership is split between the two owning companies.

The Project is located between American Transmission Company and Xcel Energy. About 51% of the cost is allocated to American Transmission Company, and about 39% of the cost is allocated to Xcel Energy.

4.10. Project 9925 (MTEP-2016), Tap Stone Lake – Gardner Park 345 kV Line

Table 4-11 Tap Stone Lake – Gardner Park 345 kV Line

Cost Allocation for Project Project ID: 9925 Tap Stone Lake - Gardner Park 345 kV Line Transmission Owner: American Transmission Company				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
295	American Transmission Company	36.2671	31.05%	$ 4,658,012.63
600	Xcel Energy	70.4316	60.31%	$ 9,045,975.06
608	Minnesota Power	3.5853	3.07%	$ 460,482.72
615	Great River Energy	0.0438	0.04%	$ 5,625.51
627	International Transmission Company Midwest	3.8373	3.29%	$ 492,848.67
635	MidAmerican Energy Company	2.6243	2.25%	$ 337,055.42
Totals:		116.7894	100%	$15,000,000.00

Note: this project is a target Appendix B project in MTEP 2016

The Project is located in American Transmission Company, but only 31% of the cost is allocated to the area while 60% of the cost is allocated to Xcel Energy.

4.11. Project 9864 (MTEP-2017), Whiting – Custer 120 kV Rebuild

Table 4-12 Whiting-Custer 120 kV Rebuild

Cost Allocation for Project ID: 9864 Whiting - Custer 120 kV Rebuild Transmission Owners: International Transmission Company & Michigan Electric Transmission Company				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
218	Michigan Electric Transmission Company	20.8417	49.74%	$ 7,113,344
219	International Transmission Company	21.0565	50.26%	$ 7,186,656
Totals:		41.8982	100%	$ 14,300,000

The Project is located in International Transmission Company and Michigan Electric Transmission Company, and the cost is allocated about 50% to each of the two areas.

Assumptions and Modeling Approach:
The following assumptions were applied for this Project:

1) The project is modeled in the 2017 MTEP model with the impedance of (CEII Item)
2) For the prior upgrade model, Pterra used the MTEP 2013 impedance model with a pseudo line to represent the upgrade as follows:
(CEII Item)

Table 4-13 Whiting-Custer MTEP Modeling Summary from 2013 through 2017

(CEII Item)

4.12. Project 10886 (MTEP-2017), Reconductor South Belleville-Centerville 138 kV Line

Table 4-14 Reconductoring South Belleville-Centerville 138 kV Line (Line 1586)

Cost Allocation for Project ID: 10886 Reconductor South Belleville-Centerville 138 kV Line Transmission Owner: Ameren Illinois Company				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
356	Ameren Missouri	2.5906	12.86%	$ 1,285,823
357	Ameren Illinois Company	17.5568	87.14%	$ 8,714,177
Totals:		20.1474	100%	$ 10,000,000

The Project is located at Ameren Illinois Company and about 87% of the cost is allocated to the Area.

4.13. Project 12037 (MTEP-2017), Montgomery – Cane River 230 kV: New Line

Table 4-15 Montgomery-Cane River 230 kV

Cost Allocation for Project ID: 12037 Montgomery - Cane River 230 kV: New Line Transmission Owner: Entergy Louisiana				
Zone	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
326	Entergy Mississippi	4.2439	2.79%	$ 1,048,366.31
327	Entergy Arkansas	2.3763	1.56%	$ 587,022.09
351A	Entergy Louisiana	64.7457	42.56%	$ 15,993,989.19
351B	Entergy Texas	6.8390	4.50%	$ 1,689,423.27
502	Cleco Power	73.8391	48.54%	$ 18,240,311.97
503	Lafayette City-Parish Consolidated Government	0.0686	0.05%	$ 16,941.17
Total:		152.1126	100.00%	$ 37,576,054.00

The Project is located at Entergy Louisiana, but only 43% of the cost is allocated to the Area while 49% of the cost is allocated to Cleco Power.

4.14. Project 12112 (MTEP-2017), North ALP Project: Cankton 230-138 kV: New Substation & Auto; Cankton to Cecelia 230 kV: New Line & Auto

Pterra categorized this project as a complex project due to the addition of new substations that lead to significant reconfiguration on the grid. Pterra calculated the LODFs considering the project boundary flow as shown in Figure 4-3.

Table 4-16 North ALP Project

Cost Allocation for Project ID: 12112 North ALP Project: Cankton 230-138 kV: New Substation & Auto; Cankton to Cecelia 230 kV: New Line & Auto Transmission Owner: Entergy Louisiana				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
351A	Entergy Louisiana	10.47082	42.12%	$ 27,371,488.23
502	Cleco Power	10.4648	42.10%	$ 27,355,751.51
503	Lafayette City-Parish Consolidated Government	3.9229	15.78%	$ 10,254,773.26
Totals:		24.8585	100%	$ 64,982,013

The Project is located in Entergy Louisiana, and about 42% of the cost is allocated to Entergy Louisiana and 42% to Cleco Power.

(CEII Item)

Figure 4-3 Project #12112 Showing Project Buses and Project Boundary Flow for LODF-mile Calculation

The following is an excerpt from MISO report MTEP-2017 Appendix D1 South:

Project 12112 is located in Lafayette Parish Louisiana. The area contains 230, 138 and 69kV networks, as well as 100 MW of generation resources at the Labbe generation plant.
This project will create two new 230/138kV taps in the area. The first new tap point is a new substation called Cankton, which will be constructed at the intersection of the Wells to Labbe 230kV line and the Colton to Bloomfield 138kV line. Both lines will be cut into the new substation. The second tap requires a new 230kV line to be built from Cankton to the existing 138kV Cecelia substation. 230/138kV transformers will be installed at both the Cankton and Cecelia substations. Figure P12112 illustrates the contingency, resultant violations and project to mitigate the reliability concerns. The Project expected in-service date is December 1, 2021.

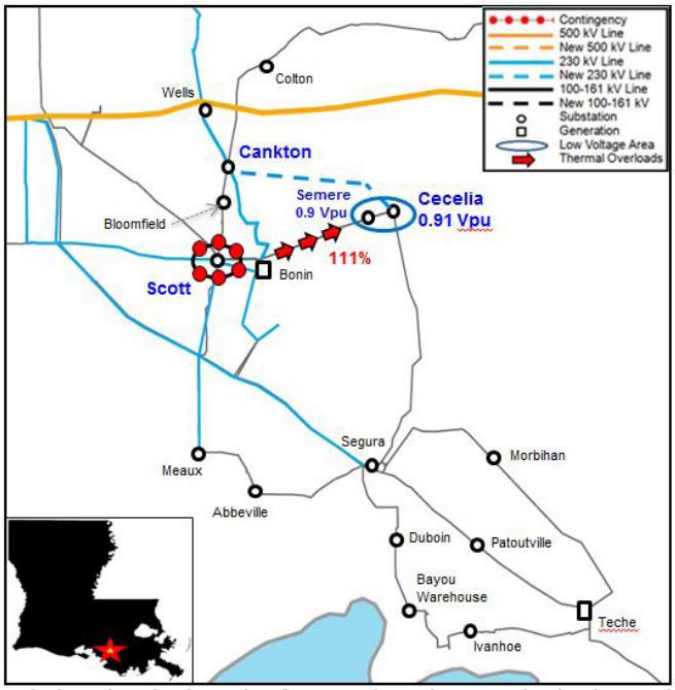


Figure P12112: A bus tie breaker fault at the Scott substation results in thermal overload of the Bonin to Cecelia 138kV line and voltage below criteria threshold at the Cecelia substation

4.15. Project 12985 (MTEP-2017), Segura to Teche to Bayou Vista 230 kV Line

Table 4-17 Segura to Teche to Bayou Vista 230 kV Line

Cost Allocation for Project ID: 12985 Segura to Teche to Bayou Vista 230 kV Line Transmission Owner: Cleco Power				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
326	Entergy Mississippi	9.32500	3.11%	$ 2,799,260.74
327	Entergy Arkansas	3.99814	1.33%	$ 1,200,196.92
351A	Entergy Louisiana	164.38497	54.83%	$ 49,346,529.97
351B	Entergy Texas	6.58851	2.20%	$ 1,977,797.03
351C	Entergy New Orleans	1.48328	0.49%	$ 445,264.07
502	Cleco Power	108.67660	36.25%	$ 32,623,500.18
503	Lafayette City-Parish Consolidated Government	5.35480	1.79%	$ 1,607,451.09
Totals:		299.8113	100%	$ 90,000,000

The Project is located at Cleco Power, but only 36% of the cost is allocated to Cleco Power while about 55% is allocated to Entergy Louisiana.

4.16. Project 12122 (MTEP-2017), Knife Falls 115 kV Project

Table 4-18 Knife Falls 115 kV Project

Cost Allocation for Project ID: 12122 Knife Falls 115 kV Project Transmission Owner: Great River Energy				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
295	American Transmission Company	9.0005	4.65%	$ 45,012.29
600	Xcel Energy	87.3152	45.07%	$ 436,670.97
608	Minnesota Power	59.5524	30.74%	$ 297,826.77
615	Great River Energy	0.48305	0.25%	$ 2,415.78
627	International Transmission Company Midwest	35.0373	18.09%	$ 175,224.61
635	MidAmerican Electric Company	2.33973	1.21%	$ 11,701.19
Totals:		193.7282	100%	$ 968,851.61

Note: Project ID 12122 is not a BRP Project but a MISO Other Reliability Project.

The Project is located in Great River Energy, but only 0.25% is allocated to Great River Energy while about 45% is allocated to Xcel Energy.

Assumptions

1. The project is modeled as a radial line that feeds zero MW load. In order to obtain proper LODF-mile, Pterra assumed the load to be about 75% of the line rating (about 106 MVA) with a 95% power factor.
2. For this Project, the LODF threshold was changed from 0.01 (1%) to 0.1 (10%) to reduce the number of affected branches.

4.17. Project 12138 (MTEP-2017), Robert 230 kV: New Substation

Table 4-19 Robert 230 kV: New Substation

Cost Allocation for Project Project ID: 12138 Robert 230 kV: New Substation Transmission Owner: Cleco Power & Entergy Louisiana				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
326	Entergy Mississippi	75.8792	21.77%	$ 12,795,598.59
327	Entergy Arkansas	83.0626	23.83%	$ 14,006,943.76
349	South Mississippi Electric Power Association	3.2608	0.94%	$ 549,872.53
351A	Entergy Louisiana	131.5089	37.72%	$ 22,176,500.22
351B	Entergy Texas	15.267	4.38%	$ 2,574,492.14
351C	Entergy New Orleans	0.2292	0.07%	$ 38,650.27
502	Cleco Power	39.4159	11.31%	$ 6,646,749.50
Totals:		348.6236	100%	$58,788,807.00

Note: Project ID 12138 is not a BRP Project but a MISO Other Reliability Project.

The Project is located in Cleco Power and Entergy Louisiana with about 11% and 37% allocated to each area, respectively.

4.18. Project 12039 (MTEP-2017), Hot Springs – Happy Valley 500 kV: New Line

Table 4-20 Hot Springs – Happy Valley 500 kV: New Line

Cost Allocation for Project Project ID: 12039 Hot Springs - Happy Valley 500 kV: New Line Transmission Owner: Entergy Arkansas				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
326	Entergy Mississippi	0.4845	1.18%	$ 1,792,702.81
327	Entergy Arkansas	39.8778	96.74%	$ 147,552,206.33
351A	Entergy Louisiana	0.8612	2.09%	$ 3,186,533.86
Totals:		41.2235	100%	$152,531,443.00

The Project is located at Entergy Arkansas, and about 96% of the cost is allocated to that area.

A description and figure for the project taken from Appendix D1 of the 2017 MTEP report appear below:

> This project involves tapping the ANO to Mabelvale and Mayflower to Mabelvale 500 kV lines and constructing a new switching station at this point called Happy Valley. Additionally, a new 35 mile 500 kV line would be constructed between Happy Valley and Hot Springs 500 kV substations. The expected in-service date for this project is June 1, 2021, and it has an estimated cost of $149.31 million. Figure P12039 shows the contingency and resulting thermal violations that drive this project, as well as the proposed project to address the identified reliability concerns.

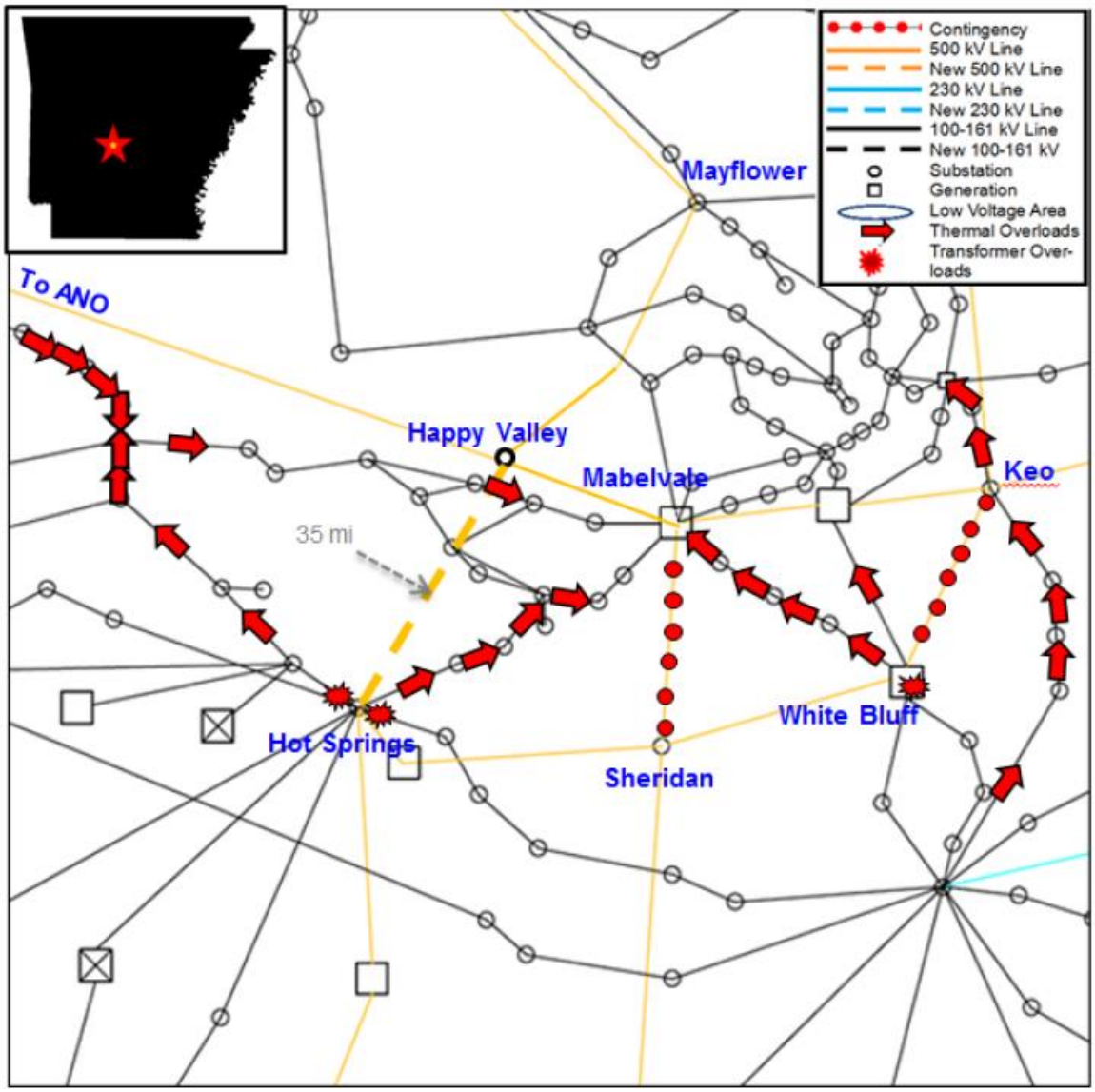


Figure 4-4 Project 12039 Showing Project Location and Surrounding Contingencies

4.19. Project 9716 (MTEP-2018), Coughlin-Plaisance 138 kV Reconductoring

Table 4-21 Coughlin-Plaisance 138 kV Reconductoring

Cost Allocation for Project ID: 9716 Coughlin-Plaisance 138 kV Reconductoring Transmission Owner: Cleco Power				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
326	Entergy Mississippi	3.3418	5.53%	$ 681,167
327	Entergy Arkansas	0.7624	1.26%	$ 155,402
351A	Entergy Louisiana	20.7192	34.28%	$ 4,223,234
351C	Entergy New Orleans	0.8109	1.34%	$ 165,296
502	Cleco Power	34.3718	56.87%	$ 7,006,083
503	Lafayette City-Parish Consolidated Government	0.4357	0.72%	$ 88,818
Totals:		60.4418	100%	$ 12,320,000

The Project is located at Cleco Power and about 57% of the cost is allocated to that Area.

4.20. Project 12101 (MTEP-2018), East ALP Project: Lake Peigneur to Cecelia 230 kV: New Line and 230-138 kV Auto

Table 4-22 East ALP Project: Lake Peigneur to Cecelia 230 kV: New Line and 230-138 kV Auto

Cost Allocation for Project ID: 12101 East ALP Project: Lake Peigneur to Cecelia 230 kV: New Line & 230-138 kV Auto Transmission Owner: Entergy Louisiana				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
351A	Entergy Louisiana	124.7002	72.27%	$ 76,232,339
502	Cleco Power	37.1560	21.53%	$ 22,714,389
503	Lafayette City-Parish Consolidated Government	10.6862	6.19%	$ 6,532,740
Totals:		172.5424	100%	$ 105,479,468

The Project is located at Entergy Louisiana and about 72% of the cost is allocated to that Area.

4.21. Project 12105 (MTEP-2018), Fancy Point to Horseshoe 230 kV: New 2nd Line

Table 4-23 Fancy Point to Horseshoe 230 kV: New 2nd Line

Cost Allocation for Project ID: 12105 Fancy Point to Horseshoe 230 kV: New 2nd Line Transmission Owner: Entergy Louisiana				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
351A	Entergy Louisiana	18.8550	99.53%	$ 24,495,434
502	Cleco Power	0.0888	0.47%	$ 115,299
Totals:		18.9438	100%	$ 24,610,733

The Project is located at Entergy Louisiana and about 99% of the cost is allocated to the Area.

4.22. Project 13867 (MTEP-2018), Natchez SES – Red Gum 115 kV: Rebuild Line

Table 4-24 Rebuild of Natchez-Red Gum 115 kV line

Cost Allocation for Project Project ID: 13867 Natchez SES - Red Gum 115 kV: Rebuild Line Transmission Owner: Entergy Louisiana & Entergy Mississippi				
Area	Owner	*Pterra Calculation*		
		LODF Mile	Percent Share	Cost Allocation
326	Entergy Mississippi	28.7556	43.36%	$ 19,951,382.18
327	Entergy Arkansas	0.8092	1.22%	$ 561,443.98
351A	Entergy Louisiana	35.2122	53.10%	$ 24,431,138.96
351B	Entergy Texas	0.0948	0.14%	$ 65,774.70
502	Cleco Power	1.447	2.18%	$ 1,003,966.18
Totals:		66.3188	100%	$ 46,013,706.00

The project is located in Entergy Louisiana and Entergy Mississippi with about 53% and 43% allocated to each, respectively.

Section 5. Conclusions

Pterra developed parameters with the TARA[17] software in order to model the MISO LODF-mile method. Pterra also obtained copies of the MTEP power flow cases that would have been used for cost allocation. Using the model and power flow cases, Pterra was able to benchmark nine projects that were documented in a MISO Informational Filing with FERC dated 1 August 2016 and modified on 17 March 2017.

The results of the benchmarking are summarized in Table 5-1.

Table 5-1 Benchmarking Comparison Showing Largest Difference in Percent Cost Share Between Pterra and MISO-reported Cost Allocations

Project ID	% Difference
4368	0.02%
7800	2.2%[18] (potential model issue)
8020	0.70%
8160	0.15%
8740	0.62%
8113	7.78% (calculation procedure for complex project category)
4614	0.04%
7988	0.09%
9482	0.00%

The percent cost allocations for projects 4368, 8020, 8160, 8740, 4614, 7988, and 9482 using the developed procedure were within 0.7% of the percent cost allocations in the MISO Informational Filing. Two of the projects showed higher than 0.7% percent cost differentials. These are:

- Project 7800 is a reconductoring of the Newton-Robinson 138 kV line. The 2015 MISO MTEP power flow model did not accurately represent the project. A correction was assumed and applied to the power flow model. This resulted in a 2.2% percent share difference to the cost allocation to Ameren Illinois Company (91.6% of the total project cost in the Pterra procedure versus 93.8% in the published MISO calculation).
- Project 8113 is a new 230 kV substation in Minot, ND, with a connection to Great River Energy's McHenry Substation. For cost allocation purposes, this is classified as a complex project in that the boundaries that need to be defined using the LODF-mile method are subject to judgment. Pterra applied its best engineering judgment at the boundaries based on the MISO implementation rules. This resulted in a 7.8% share difference to the cost allocation for Great

[17] Transmission Analysis and Reliability Assessment, a product of PowerGEM
[18] Project 7800 was missing in the 2015 power flow case for which its cost allocation would have been calculated. Instead, the project is included in the 2017 power flow case.

River Energy (68.6% of the total project cost in the Pterra procedure versus 76.4% in the published MISO calculation).

Sensitivity tests for assumptions applied in the calculations where information on line lengths and owners may not be available showed that percent cost differentials can be as high as 7%.

Several transmission projects identified in MTEP13 through MTEP18 were selected for application of the developed methodology for LODF-mile cost allocation. The cost allocations are presented in Table 5-2.

Table 5-2: Cost Allocations for Selected Transmission Projects

Color Legend	
	% share to owner(s) where the project is located
	% share is higher than the location based owner's share
	Indicates complex project category

Project ID: Project Name (Target Appendix - Project Type) Transmission Owner(s)	LODF Miles	% Share	Cost Allocation
3013: Turkey Hill-Cahokia Reinsulation and Transformer Replacement (A in MTEP13 - BRP)	**156.25**	**100.00%**	**$31,570,000.00**
Ameren Illinois Company			
Ameren Missouri - Area 356	36.73	23.51%	$7,420,612.23
Ameren Illinois Company - Area 357	119.52	76.49%	$24,149,387.77
3339: Pana, North-Taylorville, South Reconductoring (A in MTEP13 - BRP)	**44.45**	**100.00%**	**$7,807,000.00**
Ameren Illinois Company			
Ameren Missouri - Area 356	2.05	4.62%	$360,590.12
Ameren Illinois Company - Area 357	42.40	95.38%	$7,446,409.88
3828: Lore-Turkey River-Stoneman 161 kV Rebuild (A in MTEP13 - BRP)	**119.06**	**100.00%**	**$24,500,000.00**
International Transmission Company Midwest			
American Transmission Company - Area 295	11.75	9.87%	$2,418,591.03
Ameren Missouri - Area 356	0.80	0.67%	$164,228.52
Xcel Energy - Area 600	10.12	8.50%	$2,083,263.10
International Transmission Company Midwest - Area 627	76.79	64.49%	$15,800,751.06
MidAmerican Energy Company - Area 635	4.14	3.48%	$852,554.44
Dairyland Power Cooperative - Area 680	15.46	12.98%	$3,180,611.85
4292: Lenawee 345/138 kV Station (A in MTEP13 - BRP)	**90.05**	**100.00%**	**$25,950,000.00**
Michigan Electric Transmission Company			
Northern Indiana Public Service Company - Area 217	0.06	0.07%	$17,379.11
Michigan Electric Transmission Company - Area 218	55.76	61.91%	$16,066,929.54
International Transmission Company - Area 219	34.24	38.02%	$9,865,691.35
4368: Dresser-Wabash River 138 kV Line (A in MTEP14 - BRP)	**62.90**	**100.00%**	**$14,500,000.00**
Duke Energy Indiana			
Hoosier Energy Rural Electric Cooperative - Area 207	3.95	6.29%	$912,050.00
Duke Energy Indiana - Area 208	58.95	93.71%	$13,587,950.00
4373: Hickory Creek 161 kV Source (A in MTEP13 - BRP)	**49.69**	**100.00%**	**$7,000,000.00**
International Transmission Company Midwest			
American Transmission Company - Area 295	0.38	0.77%	$54,161.69
Xcel Energy - Area 600	1.60	3.23%	$226,028.20
International Transmission Company Midwest - Area 627	44.78	90.12%	$6,308,279.91
MidAmerican Energy Company - Area 635	1.08	2.17%	$152,103.48
Dairyland Power Cooperative - Area 680	1.84	3.71%	$259,426.73
4614: New Franklin-McComb: Build 115 kV Line (A in MTEP14 - BRP)	**123.54**	**100.00%**	**$59,960,000.00**
Entergy Mississippi			
Entergy Arkansas - Area 327	2.70	2.18%	$1,308,881.63
South Mississippi Electric Power Association - Area 349	3.16	2.56%	$1,535,935.00
Entergy Louisiana - Area 351A	115.14	93.20%	$55,884,639.52
Cleco Power - Area 502	2.54	2.05%	$1,230,543.85
7800: Newton-Robinson-1 138 kV Reconductoring (A in MTEP15 - BRP)	**82.08**	**100.00%**	**$19,256,602.00**
Ameren Illinois Company			
Duke Energy Indiana - Area 208	4.65	5.67%	$1,091,849.33
Indianapolis Power & Light Company - Area 216	2.21	2.69%	$518,002.59
Ameren Illinois Company - Area 357	75.21	91.64%	$17,646,750.07
7988: Terrebone to Bayou Vista 230 kV Line (A in MTEP15 - BRP)	**220.81**	**100.00%**	**$122,000,000.00**
Cleco Power, Entergy Louisiana			
Entergy Mississippi - Area 326	4.34	1.97%	$2,399,383.91
Entergy Arkansas - Area 327	7.11	3.22%	$3,927,128.50
Entergy Louisiana - Area 351A	120.58	54.61%	$66,621,344.27
Cleco Power - Area 502	83.92	38.01%	$46,366,227.89
Lafayette City-Parish Consolidated Government - Area 503	4.86	2.20%	$2,685,915.44

Project ID: Project Name (Target Appendix - Project Type) Transmission Owner(s)	LODF Miles	% Share	Cost Allocation
8020: Pleasant Corner-Beacon 161 kV Line & Terminal (A in MTEP15 - BRP)	**76.35**	**100.00%**	**$15,265,000.00**
MidAmerican Energy Company			
Ameren Missouri - Area 356	6.05	7.93%	$1,210,023.54
Ameren Illinois Company - Area 357	0.56	0.74%	$112,204.82
International Transmission Company Midwest - Area 627	40.04	52.44%	$8,004,842.71
Muscatine Power & Water - Area 633	0.20	0.26%	$40,019.28
MidAmerican Energy Company - Area 635	29.50	38.64%	$5,897,909.66
8113: New 230 kV Substation at Minot to Great River Energy McHenry Substation (A in MTEP15 - BRP)	**86.71**	**100.00%**	**$48,916,000.00**
Xcel Energy			
Xcel Energy - Area 600	1.57	1.81%	$885,092.24
Minnesota Power - Area 608	5.95	6.87%	$3,359,220.95
Great River Energy - Area 615	59.49	68.61%	$33,560,617.15
Otter Tail Power Company - Area 620	18.52	21.36%	$10,449,662.21
Montana-Dakota Utilities - Area 661	1.17	1.35%	$661,407.45
8160: Morgan Valley-Beverly 345 kV (A in MTEP15 - BRP)	**82.19**	**100.00%**	**$38,156,592.00**
International Transmission Company Midwest			
Ameren Missouri - Area 356	1.89	2.31%	$881,417.28
International Transmission Company Midwest - Area 627	57.31	69.73%	$26,606,591.60
MidAmerican Energy Company - Area 635	22.98	27.96%	$10,668,583.12
8587: LCTP: Construct New 500 kV Transmission Line from Rhodes to New 500/230 kV Bulk Substaion West of Carlyss (A in MTEP15 - BRP)	**68.08**	**100.00%**	**$49,420,000.00**
Entergy Louisiana			
Entergy Arkansas - Area 327	0.31	0.45%	$224,593.80
Entergy Louisiana - Area 351A	62.46	91.74%	$45,337,895.18
Cleco Power - Area 502	5.31	7.81%	$3,857,511.02
8740: Brooks-Adams County 161 kV Line (A in MTEP15 - BRP)	**88.31**	**100.00%**	**$9,300,000.00**
MidAmerican Energy Company			
Ameren Missouri - Area 356	4.61	5.22%	$485,327.18
International Transmission Company Midwest - Area 627	6.27	7.10%	$660,725.48
MidAmerican Energy Company - Area 635	77.43	87.68%	$8,153,947.34
9482: South Beaumont - New China to Stowell 230 kV Line (A in MTEP15 - BRP)	**110.94**	**100.00%**	**$47,446,558.00**
Entergy Texas			
Entergy Louisiana - Area 351A	110.94	100.00%	$47,446,558.00
9716: Coughlin-Plaisance 138 kV Reconductor (A in MTEP18 - BRP)	**60.44**	**100.00%**	**$12,320,000.00**
Cleco Power			
Entergy Mississippi - Area 326	3.34	5.53%	$681,166.82
Entergy Arkansas - Area 327	0.76	1.26%	$155,401.75
Entergy Louisiana - Area 351A	20.72	34.28%	$4,223,234.29
Entergy New Orleans - Area 351C	0.81	1.34%	$165,295.78
Cleco Power - Area 502	34.37	56.87%	$7,006,083.47
Lafayette City-Parish Consolidated Government - Area 503	0.44	0.72%	$88,817.89
9864: Whiting-Custer 120 kV Rebuild (A in MTEP17 - BRP)	**41.90**	**100.00%**	**$14,300,000.00**
International Transmission Company, Michigan Electric Transmission Company			
Michigan Electric Transmission Company - Area 218	20.84	49.74%	$7,113,344.01
International Transmission Company - Area 219	21.06	50.26%	$7,186,655.99
9925: Tap Stone Lake - Gardner Park 345 kV Line (B in MTEP16 - BRP)	**116.79**	**100.00%**	**$15,000,000.00**
American Transmission Company			
American Transmission Company - Area 295	36.27	31.05%	$4,658,012.63
Xcel Energy - Area 600	70.43	60.31%	$9,045,975.06
International Transmission Company Midwest - Area 627	3.84	3.29%	$492,848.67
Minnesota Power - Area 608	3.59	3.07%	$460,482.72
Great River Energy - Area 615	0.04	0.04%	$5,625.51
MidAmerican Energy Company - Area 635	2.62	2.25%	$337,055.42
9994: Custer-Monroe 120 kV Line Rebuild (A in MTEP16 - BRP)	**11.99**	**100.00%**	**$14,500,000.00**
International Transmission Company			
Michigan Electric Transmission Company - Area 218	2.11	17.64%	$2,558,057.64
International Transmission Company - Area 219	9.87	82.36%	$11,941,942.36

Project ID: Project Name (Target Appendix - Project Type) Transmission Owner(s)	LODF Miles	% Share	Cost Allocation
10183: Pershing 345 kV Substation (B in MTEP16 - BRP)	**237.57**	**100.00%**	**$14,500,000.00**
American Transmission Company, Xcel Energy			
American Transmission Company - Area 295	122.54	51.58%	$7,479,363.63
Ameren Illinois - Area 357	0.12	0.05%	$7,415.76
Xcel Energy - Area 600	93.08	39.18%	$5,681,222.12
International Transmission Company Midwest - Area 627	6.49	2.73%	$396,361.64
Minnesota Power - Area 608	5.94	2.50%	$362,761.84
Great River Energy - Area 615	0.28	0.12%	$17,248.51
MidAmerican Energy Company - Area 635	1.28	0.54%	$77,996.69
Dairyland Power Cooperative - Area 680	7.83	3.29%	$477,629.81
10269: Lore-Hickory Creek 161 kV Rebuild (A in MTEP16 - BRP)	**44.91**	**100.00%**	**$12,700,847.00**
International Transmission Company Midwest			
American Transmission Company - Area 295	2.65	5.91%	$750,460.44
Xcel Energy - Area 600	1.19	2.65%	$335,944.76
International Transmission Company Midwest - Area 627	35.78	79.66%	$10,116,942.57
MidAmerican Energy Company - Area 635	3.34	7.43%	$943,529.71
Dairyland Power Cooperative - Area 680	1.96	4.36%	$553,969.52
10886: Reconductor South Belleville-Centerville 138 kV Line (A in MTEP17 - BRP)	**20.15**	**100.00%**	**$10,000,000.00**
Ameren Illinois Company			
Ameren Missouri - Area 356	2.59	12.86%	$1,285,822.84
Ameren Illinois Company - Area 357	17.56	87.14%	$8,714,177.16
12037: Montgomery-Cane River 230 kV: New Line (A in MTEP17 - BRP)	**152.11**	**100.00%**	**$37,576,054.00**
Entergy Louisiana			
Entergy Mississippi - Area 326	4.24	2.79%	$1,048,366.31
Entergy Arkansas - Area 327	2.38	1.56%	$587,022.09
Entergy Louisiana - Area 351A	64.75	42.56%	$15,993,989.19
Entergy Texas - Area 351B	6.84	4.50%	$1,689,423.27
Cleco Power - Area 502	73.84	48.54%	$18,240,311.97
Lafayette City-Parish Consolidated Government - Area 503	0.07	0.05%	$16,941.17
12039: Hot Springs - Happy Valley 500 kV: New Line (A in MTEP17 - BRP)	**41.22**	**100.00%**	**$152,531,443.00**
Entergy Arkansas			
Entergy Mississippi - Area 326	0.48	1.18%	$1,792,702.81
Entergy Arkansas - Area 327	39.88	96.74%	$147,552,206.33
Entergy Louisiana - Area 351A	0.86	2.09%	$3,186,533.86
12101: East ALP Project: Lake Peigneur to Cecelia 230 kV: New Line & 230-138 kV Auto (A in MTEP18 - BRP)	**172.54**	**100.00%**	**$105,479,468.00**
Entergy Louisiana			
Entergy Louisiana - Area 351A	124.70	72.27%	$76,232,339.16
Cleco Power - Area 502	37.16	21.53%	$22,714,388.54
Lafayette City-Parish Consolidated Government - Area 503	10.69	6.19%	$6,532,740.31
12105: Fancy Point to Horseshoe 230 kV New 2nd Line (A in MTEP18 - BRP)	**18.94**	**100.00%**	**$24,610,733.00**
Entergy Louisiana			
Entergy Louisiana - Area 351A	18.86	99.53%	$24,495,433.62
Cleco Power - Area 502	0.09	0.47%	$115,299.38
12112: North ALP Project: Cankton 230-138 kV: New Substation & Auto; Cankton to Cecelia 230 kV: New Line & Auto (A in MTEP17 - BRP)	**24.86**	**100.00%**	**$64,982,013.00**
Entergy Louisiana			
Entergy Louisiana - Area 351A	10.47	42.12%	$27,371,488.23
Cleco Power - Area 502	10.46	42.10%	$27,355,751.51
Lafayette City-Parish Consolidated Government - Area 503	3.92	15.78%	$10,254,773.26
12122: Knife Falls 115 kV Project (A in MTEP17 - Other)	**193.73**	**100.00%**	**$968,851.61**
Great River Energy			
American Transmission Company - Area 295	9.00	4.65%	$45,012.29
Xcel Energy - Area 600	87.32	45.07%	$436,670.97
International Transmission Company Midwest - Area 627	35.04	18.09%	$175,224.61
Minnesota Power - Area 608	59.55	30.74%	$297,826.77
Great River Energy - Area 615	0.48	0.25%	$2,415.78
MidAmerican Energy Company - Area 635	2.34	1.21%	$11,701.19
12138: Robert 230 kV: New Substation (A in MTEP17 - Other)	**348.62**	**100.00%**	**$58,788,807.00**
Cleco Power, Entergy Louisiana			
Entergy Mississippi - Area 326	75.88	21.77%	$12,795,598.59
Entergy Arkansas - Area 327	83.06	23.83%	$14,006,943.76
South Mississippi Electric Power Association - Area 349	3.26	0.94%	$549,872.53
Entergy Louisiana - Area 351A	131.51	37.72%	$22,176,500.22
Entergy Texas - Area 351B	15.27	4.38%	$2,574,492.14
Entergy New Orleans - Area 351C	0.23	0.07%	$38,650.27
Cleco Power - Area 502	39.42	11.31%	$6,646,749.50

Project ID: Project Name (Target Appendix - Project Type) Transmission Owner(s)	LODF Miles	% Share	Cost Allocation
12985: Segura to Teche to Bayou Vista 230 kV Line (A in MTEP17 - BRP)	**299.81**	**100.00%**	**$90,000,000.00**
Cleco Power			
Entergy Mississippi - Area 326	9.33	3.11%	$2,799,260.74
Entergy Arkansas - Area 327	4.00	1.33%	$1,200,196.92
Entergy Louisiana - Area 351A	164.38	54.83%	$49,346,529.97
Entergy Texas - Area 351B	6.59	2.20%	$1,977,797.03
Entergy New Orleans - Area 351C	1.48	0.49%	$445,264.07
Cleco Power - Area 502	108.68	36.25%	$32,623,500.18
Lafayette City-Parish Consolidated Government - Area 503	5.35	1.79%	$1,607,451.09
13867: Natchez SES - Red Gum 115 kV: Rebuild Line (A in MTEP18 - BRP)	**66.32**	**100.00%**	**$46,013,706.00**
Entergy Louisiana, Entergy Mississippi			
Entergy Mississippi - Area 326	28.76	43.36%	$19,951,382.18
Entergy Arkansas - Area 327	0.81	1.22%	$561,443.98
Entergy Louisiana - Area 351A	35.21	53.10%	$24,431,138.96
Entergy Texas - Area 351B	0.09	0.14%	$65,774.70
Cleco Power - Area 502	1.45	2.18%	$1,003,966.18

All Projects studied are BRP and MTEP Appendix A projects except for Projects 12122 and 12138 which are classified as MISO Other Reliability Projects, and Projects 10183 and 9925 which are Appendix B projects.

Appendix A. MISO Implementation Rules for LODF Calculation

Effective Date: TBD

Appendix J: Implementation Rules for LODF Calculation

J.1 Line Outage Distribution Factor (LODF)

The LODF method first determines the impact of a new facility planned as part of an expansion project on other, existing components for a defined region. MISO planning staff uses the PSS/E MUST software to calculate the LODF on each facility for outage of new project facility. LODF equals the change in flow on a facility due to the outage of a new project facility and is absolute value of facility flow change divided by flow on new project facility prior to outage. Where a project consists of multiple facilities, each new project facility is outaged for its effect on the MISO system facilities..

As an example, consider an new project facility with a post-project power flow of 100 MW. An existing MISO facility has pre-project flow of 200 MW and a post-project flow of 180 MW. The existing circuit flow change is 20 MW between the cases. The LODF for the existing circuit is 20%, as calculated : ABS(200 MW – 180 MW)/100 MW = 20%.

The MUST software calculates Line Outage Distribution Factor of the proposed expansion project for each existing component within the MISO footprint rated at 100 kV and above. In the event that a component's LODF is less than 1% (e.g., the monitored component's power flow changes by less than one percent with the addition of the proposed expansion project), the component is excluded from further cost allocation calculations.

The LODF is then applied to each affected existing component according to the mileage rating of the component. A cost allocation value, called the "Sum of Absolute Value of LODF-Mile" ("LODF-Mile"), is calculated by multiplying the LODF times the mileage, for each component affected by a given expansion project. Transmission Owners are expected to provide line length (in miles) for all transmission system components. Where the component mileage is not available, MISO planning staff estimates mileage using model impedance values and typical impedance per mile rates for similar components. Transformers are given a designated mileage rating of one mile.

<u>Calculating LODF for Complex Projects</u>

If the project is complex and involves significant system reconfiguration, MUST cannot calculate LODF's for reconfigurations. MUST LODF works well for new lines, transformers, and reconductored lines. When there is a system reconfiguration, a project boundary flow is used to calculate LODFs for the project facilities using Equation 8.1-1 below. The project boundary flow is the equivalent to pre-outage flow for single new project facility. The project boundary flow is

calculated by drawing a boundary around the project area and calculating net flow for pre-project and post-project models. The difference in project boundary flows is the divisor used for LODF calculations. The before and after project case flows difference are calculated for all MISO facilities.

As an example, consider a project with difference in project boundary flows of 100 MW. A MISO facility has pre-project flow of 200 MW and a post-project flow of 180 MW. The existing circuit flow change is 20 MW between the cases. The LODF for the existing circuit is 20%, as calculated : ABS(200 MW – 180 MW)/100 MW = 20%.

J.2 General LODF Methodology and Thresholds

- Use RECB developed “Sum of Absolute value of LODF-Mile” method to develop sub-regional cost allocation percent. LODF values generally determined using MUST LODF function by setting a contingency (outage of the project) and monitored branch lists, or equivalent method. All MISO Transmission Facilities are monitored.
- LODF cutoff rate: 1% (if a monitored branch does not respond by 1% of the project line flow, its impact is ignored)
- Mileage: Line length is reported by Transmission Owner for monitored branches. If not reported, it will be calculated through model impedance and typical values for impedance/mile. Transformers are set to be one mile.
- Only facilities with both terminal 100 kV and above are considered for allocation in the computation
- Tie-lines: Percent ownership as reported by Transmission Owners. Otherwise default owner is control area of non-metered bus terminal in model.
- Where a monitored line is a Remote Line not in the owner’s pricing zone the LODF impacts on the Remote Line will be added to the LODF impacts of all other lines of the pricing zone that the Remote Line is in. (See J.5 below)

J.3 Models and Applicable Topology

- The applicable MTEP planning horizon model is used for all project LODF calculations. For example, if a 2011 model is being used for MTEP, and a project is first identified as a required Generator Interconnection Project from a pricing zone which used LODF cost allocation in that MTEP process, the 2011 model will be used even though the project may have a 2009 service date. This avoids the need to develop many different models for LODF determination, and in any event, such a project will have the LODF calculated under the 2011 topology eventually.

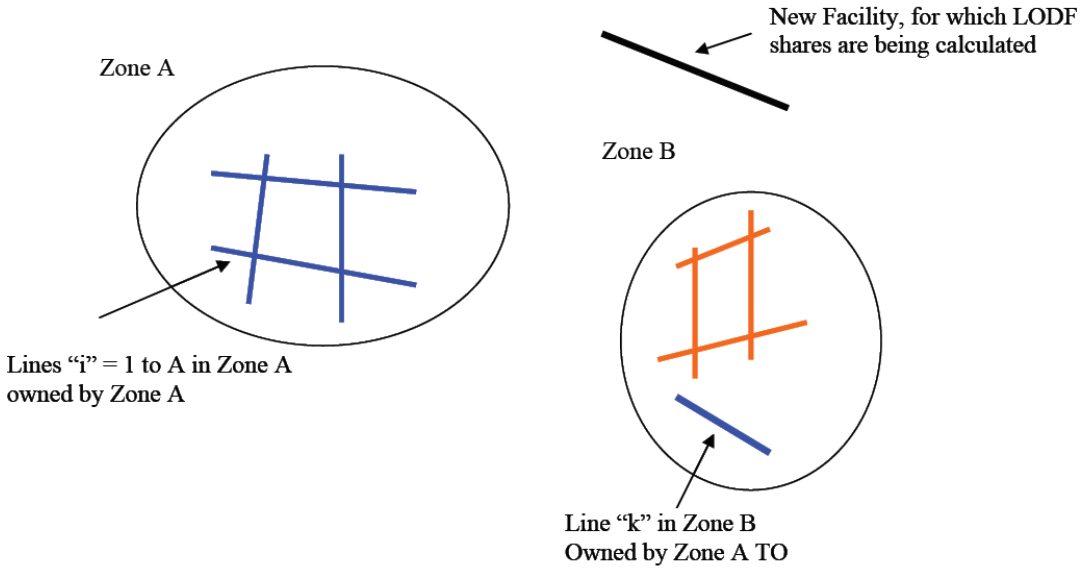
- For each project evaluated, all other Planned and Proposed projects with service dates on or before the MTEP planning horizon year are in the model.
- Both Planned and Proposed Projects that are required to address identified needs will be included in the model. Proposed Projects are included because it is assumed that Proposed Projects or some form of alternative that is not currently known will be required. Proposed Projects to be included in the model are those for which it has been shown that the proposed Project or some alternative is needed to resolve a reliability issue.
- Existing HVDC lines will be modeled as fixed flow with flow controlled to the level set for normal system conditions with the new facility
- Existing Phase Angle Regulators will be modeled as fixed flow with flow controlled to the level set for normal system conditions with the new facility

J.4 Project Specific Methodology

- A reconductored line will be simulated as the original line with a parallel pseudo line. LODF will be computed by taking out the parallel line. Alternatively, comparison of line flows between the base system and the change system will be used to develop LODF values.
- Rebuilds involving conversion (removal) of a low voltage facility to a high voltage facility (addition) will compare line flows between the base system and the change system to develop LODF values.
- A series inductor or capacitor will use the same approach as for reconductored lines.
- New capital investments for replacements, or rebuilds due to aging equipment rehabilitation or replacement will not be cost shared.
- Allocations of costs of looped lines will be treated as any other line. A looped (non-radial) line is a networked extension of an existing line to a new substation.
- Cost of terminal upgrades including bus sections, switches, circuit breakers (CB), protection devices, that are an integral part and necessary to integrate a project involving a line or transformer addition or enhancement are lumped with and allocated as per the allocation percentages for the related branch facilities.
- The LODF for upgrades to existing circuit breakers or other interrupting devices that are needed due to increased interrupting duty or continuous loading capability will be defined as 1.0 for all branches in the pricing zone where the circuit breaker is installed, and 0.0 for all other branches. This will result in the costs of these circuit breakers being allocated based on LODF to be 100% local.
- Cost of shunt connected devices (capacitors, SVCs, reactors) required for load serving steady state voltage control or voltage quality will NOT be shared, unless such devices are also needed to remedy stability or to increase transfer capability for reliability purposes (import capability or generator deliverability). Stability and reliability transfer related shunts

will be shared 10% Postage Stamp with the remaining local for shunts connected to 345 kV and above (LODF = 1 for local branches, 0 for others), and 100% local for below 345 kV.

- LODF for Projects consisting of multiple branch additions or upgrades will be determined by breaking the project up into its separate branches, and determining the LODF allocation for the cost of each branch. This will avoid masking of proximity effects of the new project (which is the principle of the LODF) where individual branches of a project may have counter-impacts that net to a small impact on nearby facilities. When the LODF is calculated for one of the branches of a multiple branch project, each of the other branches of the project is included in the model, however, the LODF contribution on other branches of the new project are not counted.
- Except for new transformer installations with high side voltages of 345 kV or higher and low side voltages of 344 kV or lower, projects consisting of facilities at multiple voltages, each facility will be evaluated for postage stamp eligibility based on its voltage class.
- Costs of 345 kV or higher voltage substation facilities that are installed as a part of a new transformer installation for transformers with high side voltages of 345 kV or higher and low side voltages of 344 kV or lower, and that are needed only to support a new transformer installation shall be lumped with the cost of the transformer and given the same cost allocation treatment as for the transformer. As an example, a new 345 kV bus and circuit breakers needed to install a new 345/138 kV transformer would not be postage stamped, but would be allocated according to the LODF of the transformer serving the 138 kV system. Costs of related 345 kV equipment such as a line extension to the new 345 kV class substation will be treated on a case-by-case basis depending on the intended future plans for additional networked lines to be installed at the substation. Costs of 345 kV bus and circuit breakers related to new line installations at the same time as the transformer installation will be treated as 345 kV facilities and given the postage stamped treatment.
- Projects or facilities driven solely by contingency loss of, or design violations of, facilities of 69 kV and below will not be cost shared.



$$\text{Share}_{\text{Zone B}} = \frac{\sum_{j}^{B} \text{LODF}_j + \text{LODF}_k}{\text{LODF}_{sys}}$$

J.5 Treatment of Monitored Lines Outside of the Owner's Zone

This is the "Location or Load Based" approach. This will include in the Zone B share the flow impacts of all lines in a Zone B, regardless of line ownership.