



North – South Interface Study

MCPS TSTF
January 28, 2020

Executive Summary

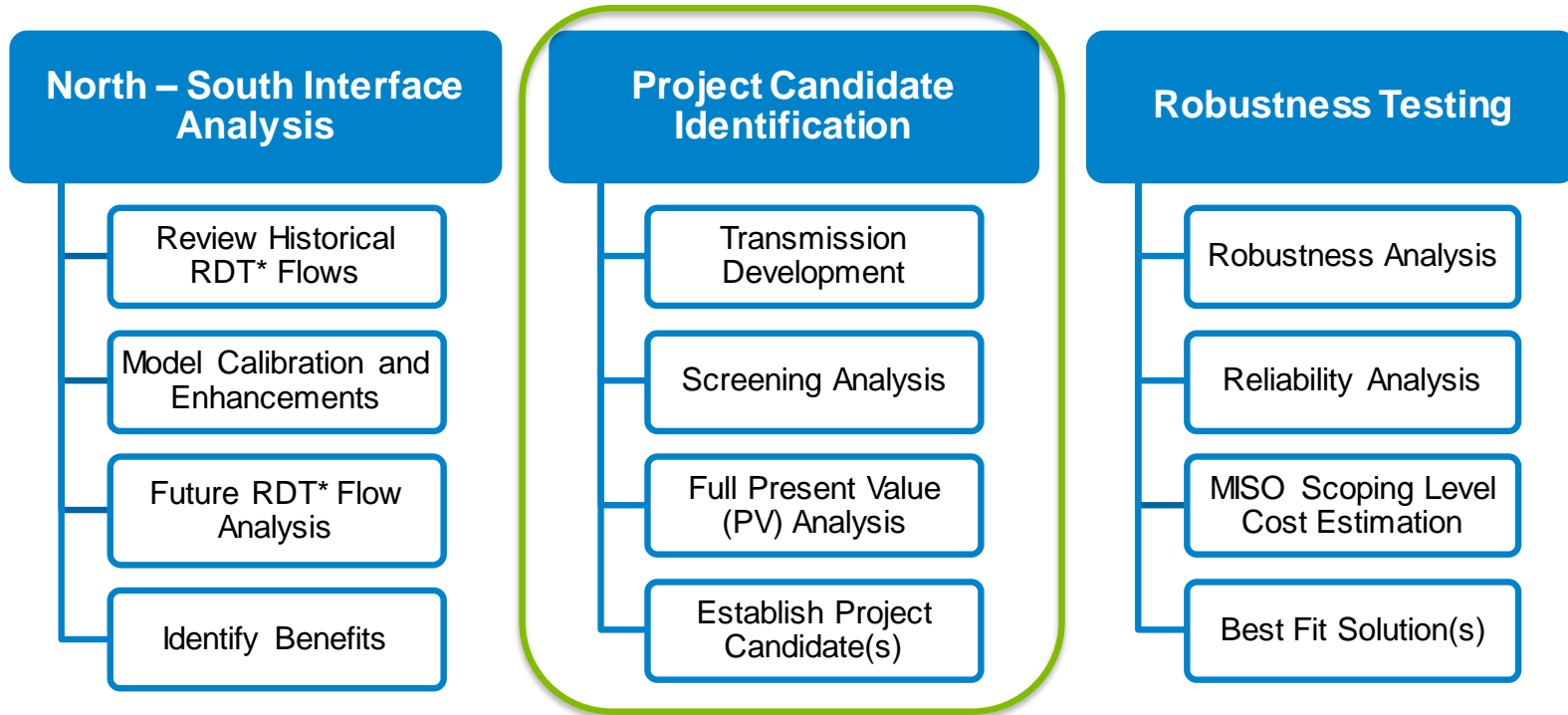


- The North-South Interface Study is an MCPS Focus Area with the objective of improving the firm transmission capacity between MISO's North and South sub-regions
- Three projects surpass the MCPS threshold of a 1.0 Benefit-to-Cost ratio with a 20-year PV benefit analysis and planning-level cost estimates
- Solution refinement, robustness testing and external outreach will be the focus going forward

Topics of previous meetings

- April 2019 – MCPS TSTF 1
 - Began discussion around North-South Study
 - Requested solution ideas from stakeholders
- July 2019 – MCPS TSTF 2
 - Received and screened 35 solutions
 - Nine projects passed initial screening analysis

Current Stage of Study Process



Nine Solution Ideas passed Screening Analysis and were considered in Full Present Value (PV) Analysis

ID	Transmission Solution	Cost Estimate (2019-\$M)	2033 Screening Index					Assumed Contract Path Increase (MVA)
			AFC	CFC	DET	LFC	Weighted	
NS13	New 345kV, 2574MVA line from Jim Hill-Berntie Rebuild 161kV line from Berntie-Stoddard	137	4.07	2.93	2.87	2.33	3.05	2574
NS11	New 345kV, 2574MVA line from Jim Hill-Lutesville	201	2.70	2.02	1.99	1.65	2.09	2574
NS08	New 345kV, 1793MVA line from Jim Hill-Kelso. New 161kV, 509MVA lines from Jim Hill-Berntie. Upgrade existing Stoddard-Berntie, Stoddard-Morley, Oran-Morley and Oran-Kelso lines to 509MVA.	207	2.02	1.68	1.67	1.45	1.71	2302
NS24	New 345kV, 2988MVA line from Jim Hill-Lutesville. Two new 161kV, 837MVA lines from Jim Hill-Dell.	324	2.07	1.36	1.32	1.01	1.44	2988
NS12	New 345kV, 3140MVA line from Dell-Lutesville	357	2.08	1.30	1.25	0.92	1.39	3140
NS25	New 500kV, 4330 MVA line from East Joppa-Dell.	442	2.21	1.25	1.17	0.79	1.36	4330

Nine Solution Ideas passed Screening Analysis and were considered in Full Present Value (PV) Analysis (Cont.)

ID	Transmission Solution	Cost Estimate (2019-\$M)	2033 Screening Index					Assumed Contract Path Increase (MVA)
			AFC	CFC	DET	LFC	Weighted	
NS02	New 161kV, 400MVA line from Jim Hill-Berntie-Richland. Upgrade existing Stoddard-Berntie and Stoddard-Richland lines to 200 MVA.	60	1.36	1.28	1.31	1.29	1.31	400
NS21	New 500kV, 2156MVA line from Dell-Lutesville	312	0.93	0.99	0.99	0.97	0.97	2156
NS09	New 500kV, 2727MVA line from Independence-Lutesville.	534	1.22	0.86	0.84	0.65	0.90	2727

- Solution ideas with a Weighted Screening Index ≥ 0.9 were considered for Full Present Value (PV) analysis

First phase of Full PV Analysis

- Nine Solution Ideas were analyzed using the MTEP19 Economic Model
- Six Solution Ideas had a Weighted B/C Ratio ≥ 1.0
- Results are shown in Appendix Slide 20 & 21

Second Phase of Full PV Analysis

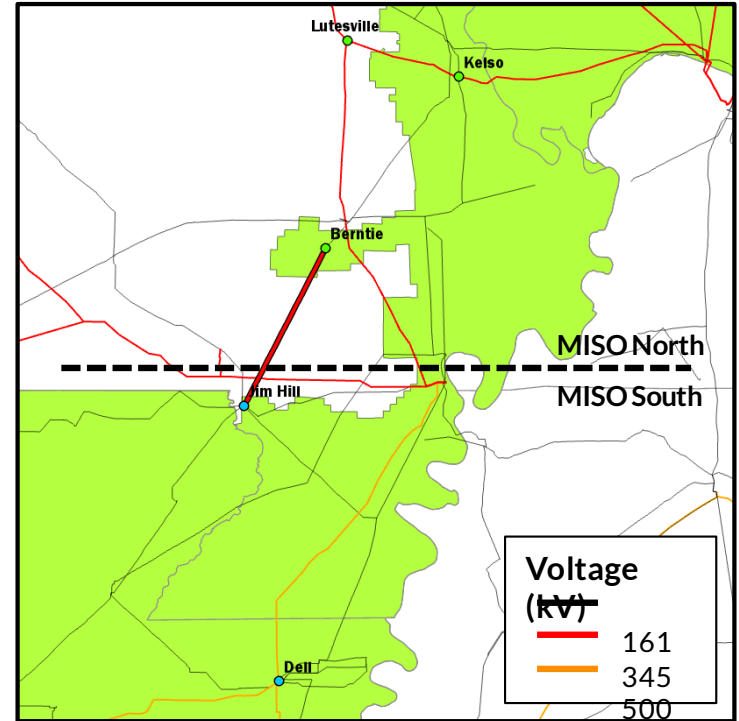
- Six Solution Ideas were analyzed using the MTEP20 Economic Model
 - Up-to-date topology and generation data
 - Enhanced modeling of external constraints
 - Futures identical to MTEP19
- Planning – level cost estimates
- First round contingency analysis

Three transmission solutions have Weighted B/C Ratios \geq 1.0 and will be considered as Project Candidates

ID	Transmission Solution	Cost Estimate (2019-\$M)	20-yr B/C Ratio					Assumed Contract Path Increase (MVA)
			AFC	CFC	DET	LFC	Weighted	
PC-1	New 345kV, 2574MVA line from Jim Hill-Berntie Rebuild 161kV line from Berntie-Stoddard	152	2.33	2.18	1.90	1.75	2.04	2574
PC-2	New 345kV, 2574MVA line from Jim Hill-Lutesville	249	1.43	1.13	1.01	1.08	1.16	2574
PC-3	New 345kV, 1793MVA line from Jim Hill-Kelso. New 161kV, 509MVA lines from Jim Hill-Berntie. Upgrade existing Stoddard-Berntie, Stoddard-Morley, Oran-Morley and Oran-Kelso lines to 509MVA.	262	1.19	1.14	1.04	1.02	1.10	2302
NS24	New 345kV, 2988MVA line from Jim Hill-Lutesville. Two new 161kV, 837MVA lines from Jim Hill-Dell.	382	1.09	1.00	0.82	0.72	0.91	2988
NS12	New 345kV, 3140MVA line from Dell-Lutesville	427	0.97	0.91	0.73	0.64	0.81	3140
NS25	New 500kV, 4330 MVA line from East Joppa-Dell.	539	0.92	0.86	0.64	0.55	0.74	4330

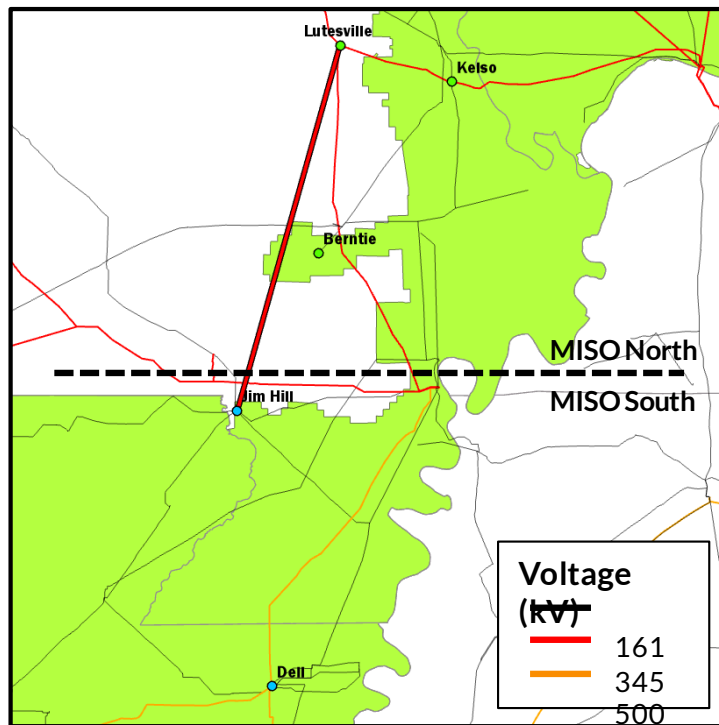
PC-1 – New Jim Hill - Berntie 345 kV line

- Two new 161/345kV 675MVA transformers at Jim Hill and Berntie
- Upgrade Berntie-Stoddard 161kV line to 891MVA
- Planning Level Cost Estimate: \$152M
- Settlement Agreement PV Benefit: \$272M
- APC PV Benefit: \$68M
- Contract Path Increase: 2574
- Weighted B/C: 2.04



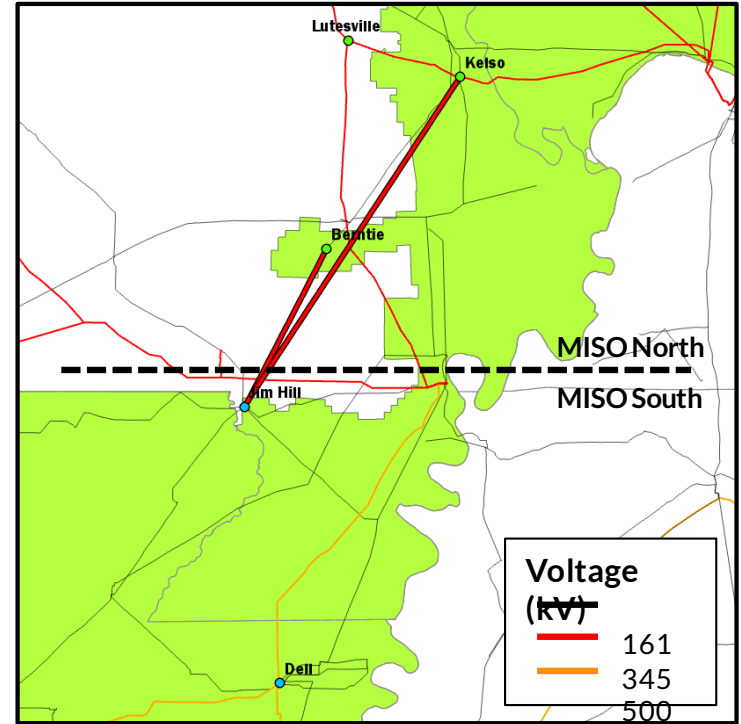
PC-2 – New Jim Hill – Lutesville 345 kV line

- Three 161/345kV 675MVA transformers at Jim Hill
- Planning Level Cost Estimate: \$249M
- Settlement Agreement PV Benefit: \$272M
- APC PV Benefit: \$45M
- Contract Path Increase: 2574
- Weighted B/C: 1.16



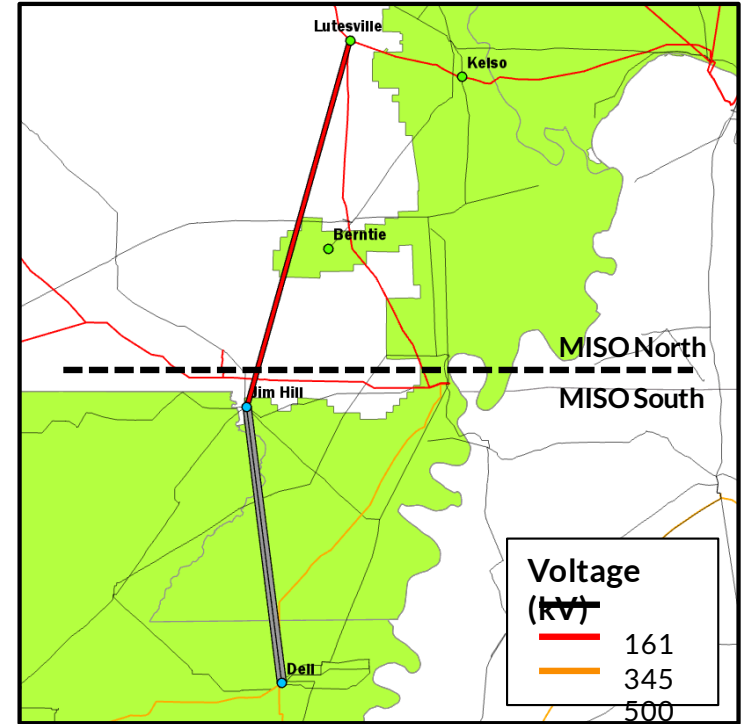
PC-3 – New Jim Hill – Kelso 345 kV line and Jim Hill – Berntie 161kV line

- One 161/345kV 700MVA transformer at Jim Hill
- Upgrade multiple 161kV lines around Berntie and Kelso substations
- Planning Level Cost Estimate: \$262M
- Settlement Agreement PV Benefit: \$259M
- APC PV Benefit: \$42M
- Contract Path Increase: 2302
- Weighted B/C: 1.10



NS24 – New Jim Hill – Lutesville 345kV line and Jim Hill – Dell 161kV double circuit line

- Two 161/345kV 1245MVA transformers at Jim Hill
- Planning Level Cost Estimate: \$382M
- Settlement Agreement PV Benefit: \$259M
- APC PV Benefit: \$104M
- Contract Path Increase: 2988
- Weighted B/C: 0.91



HVDC Project Submissions

- Project costs ranged from \$1.2B - \$3.3B
- HVDC presents many challenges
 - Bulk of HVDC cost due to converter stations
 - Comprehensive changes in economic dispatch
 - Operational assumptions in planning model

HVDC Screening Results

ID	Transmission Solution	Cost Estimate (2019-\$M)	2033 Screening Index					Assumed Contract Path Increase (MVA)
			AFC	CFC	DET	LFC	Weighted	
NS03	New Sheridan (AR) – Brookings County (SD) 600kV DC line	\$3,224	0.46	0.28	0.32	0.16	0.3	2000
NS04	New Sheridan (AR) – Hazelton (IA) 600kV DC line	\$2,738	0.18	0.05	0.07	0.04	0.08	2000
NS05	New Sheridan (AR) – Helena (MN) 600kV DC line	\$3,155	0.22	0.08	0.1	0.04	0.11	2000
NS06	New Franklin (MS) – Raun (IA) 600kV DC line	\$3,292	0.48	0.31	0.3	0.19	0.32	2000
NS07	New Sheridan (AR) – Raun (IA) 600kV DC line	\$2,784	0.66	0.36	0.39	0.23	0.41	2000
NS15	New Dell (AR) – Bland (MO) 500kV DC line	\$1,263	-0.21	-0.17	-0.07	0.03	-0.1	2000
NS18	New Jonesboro (AR) – Bland (MO) 500kV DC line	\$1,254	-0.24	-0.17	-0.07	0.02	-0.11	2000

HVDC Screening Results (Cont.)

ID	Transmission Solution	Cost Estimate (2019-\$M)	2033 Screening Index					Assumed Contract Path Increase (MVA)
			AFC	CFC	DET	LFC	Weighted	
NS20	New Dell (AR) – Lutesville (MO) 500kV DC line New Jonesboro (AR) – Bland (MO) 500kV DC line	\$2,326	0.2	0.12	0.08	0.05	0.11	2000
NS22	New Sheridan (AR) – Montgomery (MO) 500kV DC line	\$1,511	-0.15	-0.16	-0.05	0.01	-0.09	2000
NS23	New Dell (AR) – Bland (MO) 500kV DC line New Sheridan (AR) – Montgomery (MO) 500kV DC line	\$2,774	0.2	0.11	0.08	0.05	0.11	2000

- None of the DC project submissions had a Weighted Screening Index ≥ 0.9

Next Steps for MISO's analysis

- Feedback due on February 21st, 2020
 - Robustness testing for Project Candidates
 - General feedback for the study
 - <https://www.misoenergy.org/stakeholder-engagement/stakeholder-feedback/>
- Additional rounds of contingency analysis
- Scoping cost estimates
- Reliability no-harm testing



Appendix

Questions / Follow-up

EP@misoenergy.org

Initial PV results for projects which passed screening

ID	Transmission Solution	Cost Estimate (2019-\$M)	20-yr B/C Ratio					Assumed Contract Path Increase (MVA)
			AFC	CFC	DET	LFC	Weighted	
NS02	New 161kV, 400MVA line from Jim Hill-Berntie-Richland. Upgrade existing Stoddard-Berntie and Stoddard-Richland lines to 200 MVA.	60	1.74	0.43	0.47	0.43	0.77	400
NS08	New 345kV, 1793MVA line from Jim Hill-Kelso. New 161kV, 509MVA lines from Jim Hill-Berntie. Upgrade existing Stoddard-Berntie, Stoddard-Morley, Oran-Morley and Oran-Kelso lines to 509MVA.	207	2.28	1.48	1.40	1.22	1.60	2302
NS09	New 500kV, 2727MVA line from Independence-Lutesville.	534	1.11	0.70	0.64	0.50	0.74	2727
NS11	New 345kV, 2574MVA line from Jim Hill-Lutesville	201	2.73	1.73	1.56	1.31	1.83	2574
NS12	New 345kV, 3140MVA line from Dell-Lutesville	357	2.12	1.22	1.05	0.76	1.29	3140
NS13	New 345kV, 2574MVA line from Jim Hill-Berntie Rebuild 161kV line from Berntie-Stoddard	137	4.16	2.53	2.29	1.89	2.72	2574

Initial PV results for projects which passed screening (Cont.)

ID	Transmission Solution	Cost Estimate (2019-\$M)	20-yr B/C Ratio					Assumed Contract Path Increase (MVA)
			AFC	CFC	DET	LFC	Weighted	
NS21	New 500kV, 2156MVA line from Dell-Lutesville	312	1.29	0.91	0.88	0.80	0.97	2156
NS24	New 345kV, 2988MVA line from Jim Hill-Lutesville. Two new 161kV, 837MVA lines from Jim Hill-Dell.	324	2.16	1.26	1.11	0.84	1.34	2988
NS25	New 500kV, 4330 MVA line from East Joppa-Dell.	442	2.19	1.20	0.98	0.66	1.26	4330

Project Candidate Identification: Present Value Analysis

Project Candidate Identification

Transmission Development

Screening Analysis

Present Value (PV) Analysis

Establish Project Candidate(s)

- Present Value (PV) Analysis
 - Determine benefit-to-cost (B/C) ratio for each future using the present value (PV) of benefits for the first 20 years of project life with a maximum planning horizon of 25 years from the approval year for each individual future
 - $Weighted\ B/C\ Ratio = \sum(Future\ Weight \times B/C\ Ratio\ in\ that\ future)$
- Transmission solutions with a weighted benefit-to-cost (B/C) ratio greater than 1.0 are selected as project candidates
- Planning Level cost estimate was developed by MISO for all projects selected as Project Candidates
 - The MISO Planning level cost estimate will be utilized going forward for Robustness Testing

Scenario 2 Full PV Results – Settlement Agreement is not renewed; MISO defaults to 1000 MW Contract Path between North-South

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NS08	New 345kV, 1793MVA line from Jim Hill-Kelso. New 161kV, 509MVA lines from Jim Hill-Berntie. Upgrade existing Stoddard-Berntie, Stoddard-Morley, Oran-Morley and Oran-Kelso lines to 509MVA.	262	3.11	2.35	1.35	0.68	1.87	2302
NS24	New 345kV, 2988MVA line from Jim Hill-Lutesville. Two new 161kV, 837MVA lines from Jim Hill-Dell.	382	2.4	1.83	1.03	0.48	1.44	2988
NS12	New 345kV, 3140MVA line from Dell-Lutesville	427	2.15	1.66	0.92	0.43	1.29	3140
NS25	New 500kV, 4330 MVA line from East Joppa-Dell.	539	1.85	1.45	0.79	0.38	1.12	4330