

Candidate MVP Reliability Analysis Appendix CMVP TSTF

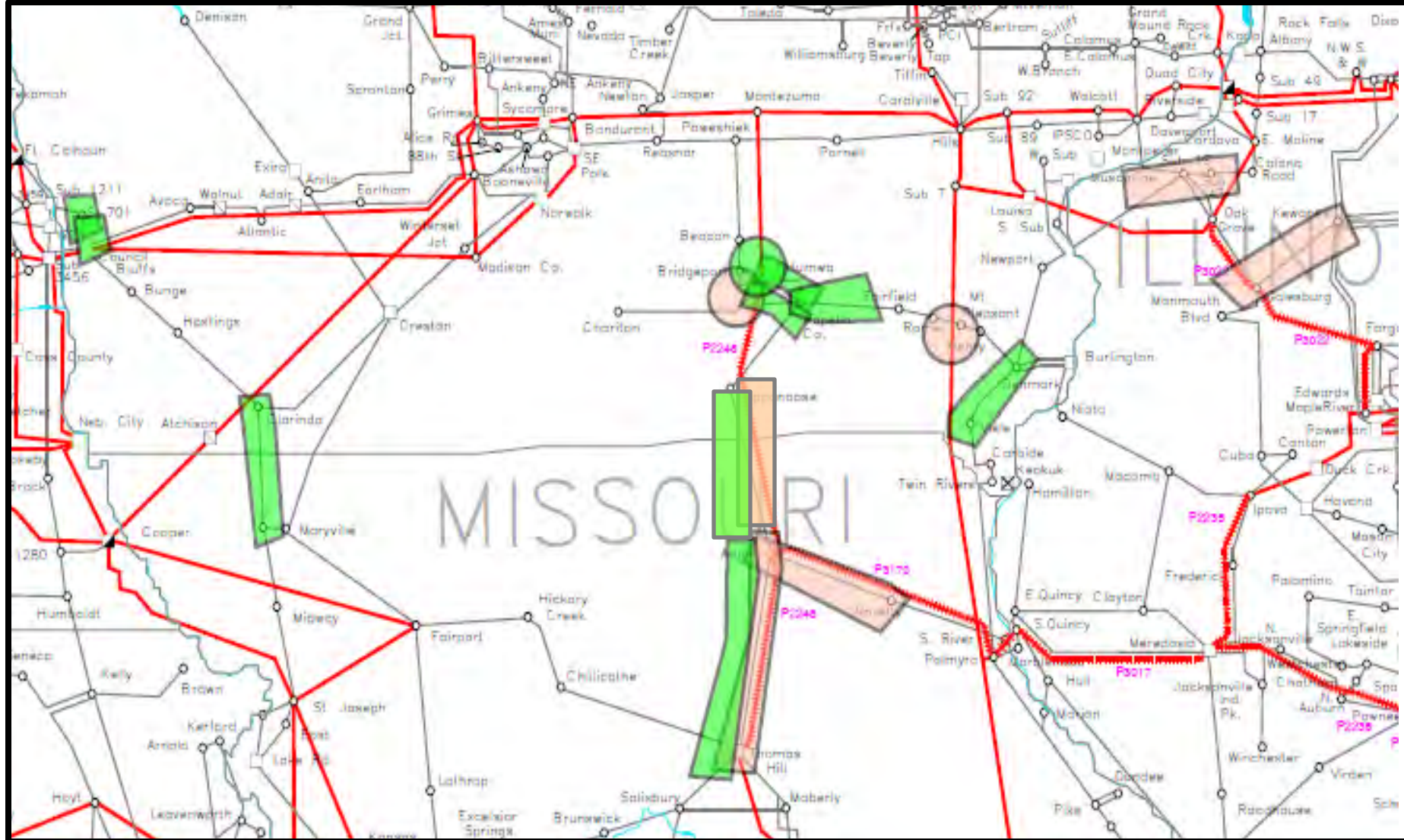
July 28th, 2011

*See pages 97 -
Ottumwa-Adair-Palmyra-Thomas Hill Constraints
Mitigated Map*

Appendix

- **Reliability Analysis Justification of Brookings MVP in Shoulder and Summer Cases**
- **Reliability Analysis Justification of all other MVPs in Shoulder Case**
- **Wind Curtailment Calculations**

Ottumwa-Adair-Palmyra-Thomas Hill Constraints Mitigated Map



Ottumwa – Adair – Palmyra – Thomas Hill CMVP

- Project adds 345kV line between MEC's Ottumwa Substation south to Ameren's Adair Substation, east to Palmyra and further south from Adair to Thomas Hill.
- This path provides an outlet for wind generation connected into Adair (500MW max, 450MW dispatched in shoulder case)
- Without this path, the connected wind would overload the 161 kV line from Adair to Novelty in the base case, and during other contingencies overloads the 161 kV lines to the north and south, as well as some nearby transformers
- Any 161 kV bus outages could result in the wind generation at Adair being disconnected from the transmission system
- At 2026 wind levels, the overloads increase in severity along the main outlet from Adair, along with constraints beginning to show up in western Missouri along a parallel path of Ottumwa to Adair

BES Transmission Issues Mitigated by^{PE-19} Ottumwa to Adair to Palmyra to Thomas Hill CMVP (Shoulder Peak) – NERC Cat B

Element	Rating	Maximum Loading %	Minimum Loading %	# of Contingencies
Novelty to Adair 161 kV Line*	167	154.6	93.9	13149
Kewanee South Tap to East Galesburg 138 kV	143	98.8	98.8	1
*Novelty to Adair is a base case overload without the MVP, with the wind connected to the 161kV Bus at Adair				



BES Transmission Issues Mitigated by Ottumwa to Adair to Palmyra to Thomas Hill CMVP (Shoulder Peak) – NERC Cat C

Element	Rating	Maximum Loading %	Minimum Loading %	# of Contingencies
Adair to Apanoose 161kV Line	223	121.0	121.0	1
Thomas Hill to Adair 161kV Line	315	101.2	101.2	1
Sub 18 to Sub 85 161kV Line	248	99.3	99.3	1
Lucas 161/69kV Transformer	96	97.8	97.8	1
Henry 161/69kV Transformer	56	95.8	81.7	1
NOTE: For a 161kV bus fault or any of the three 161 kV breaker faults at Adair station, the outlet for 450MW of wind generation is lost without the MVP				

Non-BES Transmission Issues Mitigated by ^{E-19} Ottumwa to Adair to Palmyra to Thomas Hill CMVP (Shoulder Peak) NERC Cat B and C

Category B				
Element	Rating	Maximum Loading	Minimum Loading	# of Contingencies
Jeff to Fairfield NW Tap 69 kV Line	48	120.6	106.1	2
Mark to Apanose County 69 kV Line	48	118.9	83.7	7
Wooster to Jefferson 69 kV Line	41	96.3	96.1	2

Category C				
Element	Rating	Maximum Loading	Minimum Loading	# of Contingencies
North Centerville to Iowa Steel and Wire 69kV Line	51	101.4	101.4	1
Wooster to Jefferson 69kV Line	41	99.8	99.8	1

New Transmission Issues Resulting From ^{PE-19} Ottumwa to Adair to Palmyra to Thomas Hill CMVP – Shoulder Peak Model

Category B			
Element	Rating	Maximum Loading %	Minimum Loading %
None			
Category C			
Element	Rating	Maximum Loading %	Minimum Loading %
Palmyra 345/161 kV Transformer	370	109.44	109.44
Ottumwa to Montezuma 345 kV Line	478	106.88	106.88
Note: There is a project that would fix the Ottumwa to Montezuma 345kV Line overload that would be implemented with the MVP			

BES Transmission Issues Mitigated by Ottumwa to Adair to Palmyra to Thomas Hill CMVP (Shoulder Peak) – NERC Cat B 2026 Wind Levels

Element	Rating	Maximum Loading %	Minimum Loading %	# of Contingencies
Viele to Denmark 161kV Line	167	100.4	98.1	3
Wapello to Ottumwa 161kV Line #2	335	99.0	97.0	2
Wapello to Ottumwa 161kV Line #1	335	95.7	95.7	1



BES Transmission Issues Mitigated by Ottumwa to Adair to Palmyra & to Thomas Hill CMVP (Shoulder Peak) – NERC Cat C 2026 Wind Levels

Element	Rating	Maximum Loading %	Minimum Loading %	# of Contingencies
Adair to Apanoose 161kV Line	223	122	122	1
Thomas Hill to Adair 161kV Line	315	102.1	102.1	1
Sub 702 to Manawa 161kV Line	335	100.2	100.2	1
Ottumwa 345/161kV Transformer	400	98.6	98.6	1
Viele to Denmark 161kV Line	167	98.1	98.1	1
Council Bluffs to Indian Creek 161kV line	371	97.4	97.4	1
Wapello County to Jefferson 161kV Line	223	97.0	95.8	2
Maryville to Clarinda 161kV Line	153	95.5	95.5	1

Non-BES Transmission Issues Mitigated by Ottumwa to Adair to Palmyra to Thomas Hill CMVP (Shoulder Peak) PE-19

NERC Cat B and C

2026 Wind Levels

Category B				
Element	Rating	Maximum Loading	Minimum Loading	# of Contingencies
Jefferson to Fairfield NW 69kV Line	48	132.5	114.6	2
Mark to Apanoose County 69kV Line	48	125.8	94.9	48
Wooster to Jefferson 69kV Line	41	105.8	103.9	3
Arlington to Green Isle 69kV Line	34.25	103.2	103.2	1
Henry County 161/69kV Transformer	56	99.3	99.3	1
Wapello to Eldon 69kV Line	69	96.9	96.9	1
Category C				
Element	Rating	Maximum Loading	Minimum Loading	# of Contingencies
Venice 138/69kV Transformer	143	103.0	103.0	1
North Centeville to Iowa Steel and Wire 69kV Line	51	111.4	111.4	1
Wooster to Jefferson 69kV Line	41	108.0	108.0	1
Henry County 161/69kV Transformer	56	100.7	100.7	1
Wapello County to Eldon 69kV Line	69	97.5	97.5	1
Lucas County 161/69kV Transformer	96	97.1	97.1	1

New Transmission Issues Resulting From Ottumwa to Adair to Palmyra to Thomas Hill CMVP – Shoulder Peak Model 2026 Wind Levels

Category B			
Element	Rating	Maximum Loading %	Minimum Loading %
Ottumwa to Montezuma 345kV Line	478	110.5	80.3
Jasper 161/69kV Transformer	84	106.4	106.4
Note: There is a project to fix the Ottumwa to Montezuma 345kV line overload that would be implemented with the MVP			
Category C			
Element	Rating	Maximum Loading %	Minimum Loading %
Ottumwa to Montezuma 345kV Line	478	130.7	80.2
Palmyra 345/161kV Transformer	370	120	83
Dahlberg to Stinson 115kV Line	98	103.6	103.6
Grimes to Sycamore 345kV Line	956	99.7	82.8
Granger Tap to 100th and 54th 161kV Line	373	99.2	99.2
Note: There is a project that would fix the Ottumwa to Montezuma 345kV Line overload that would be implemented with the MVP			



Alternative

- Given that existing 500 MW Adair wind zone is connected to three 161 kV lines without adequate capacity to reliably connect wind in base case (without contingent loss of any one of the three outlets) and that existing outlets out of Ottumwa 345 kV station are thermally constrained, it is reasonable to expect new 345 kV connection from Ottumwa and into Adair. This will alleviate base case constraint but not alleviate n-1 contingent loss of the 345 kV connection. Additional outlet from Adair to Palmyra 345 kV provides for reliable n-1 delivery of wind.
- A third 345 kV connection from Adair to Thomas Hill (AECI station) helps improve reliability without improving distribution of benefits into MISO.
- It is therefore recommended that the MVP be limited to Ottumwa to Adair to Palmyra