



MISO Regional Transmission Overlay Study Preliminary Overlays – Indicative Concepts

Economic Planning Users Group (EPUG)

May 25, 2017

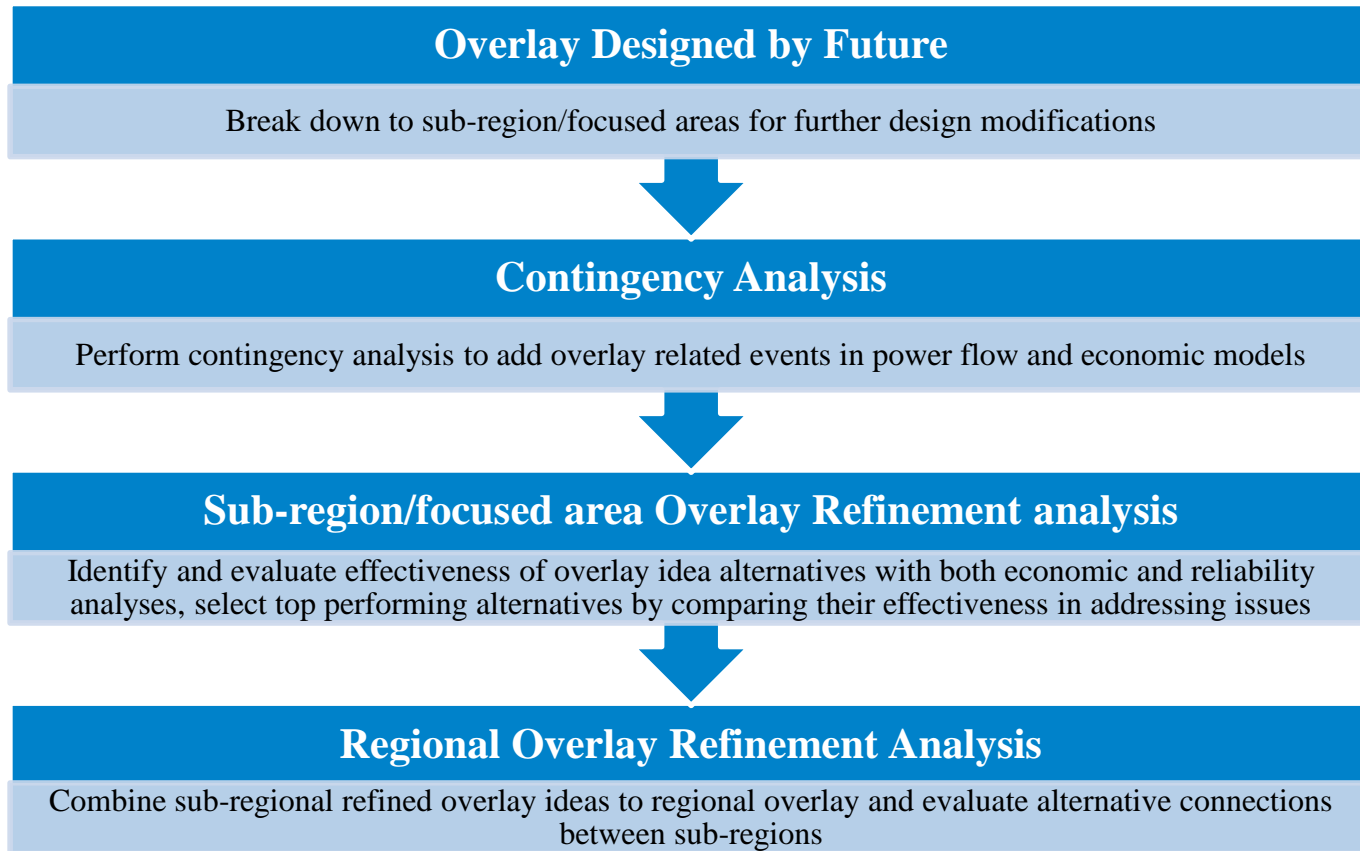
Overview

- The goal is to develop and refine indicative overlay roadmaps collectively with stakeholders
- Present a refreshed set of system drivers identified for each of the MTEP17 futures with/without May 25th overlay iteration
 - Existing Fleet (EF)
 - Policy Regulations (PR)
 - Accelerated Alternative Technologies (AAT)
- Review May 25th iteration of indicative overlays and effectiveness in addressing identified system drivers for further development

Indicative Overlay Roadmap Design Guiding Principles

- The goal is to design long-term overlay roadmaps to collectively address a suite of system drivers
- Indicative overlays are designed and refined through an iterative process, considering the following but not limited to:
 - Effectiveness in addressing identified set of system drivers such as reliability, economic, sub-regional connection, import capability, etc.
 - Realization of synergistic benefits by relieving a group of drivers
 - Utilization of new overlay segments
 - Total benefits accrued against a proper set of value measures
- Different alternatives are considered where applicable
 - Adding/removing/combining segments of overlay ideas
 - Moving terminal locations of overlay ideas

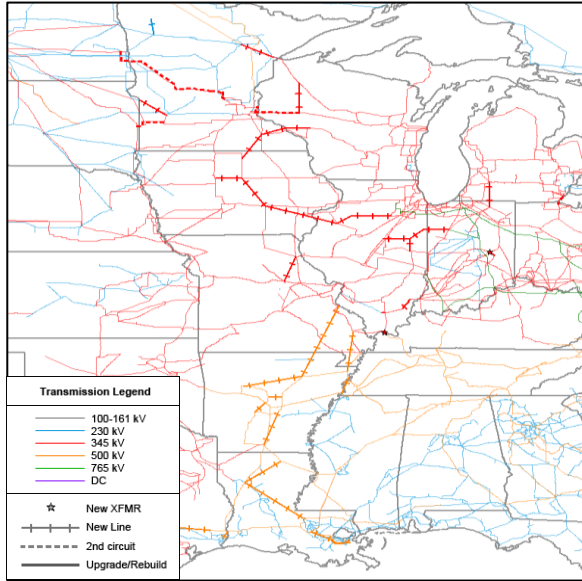
Indicative Overlay Design and Refinement Process



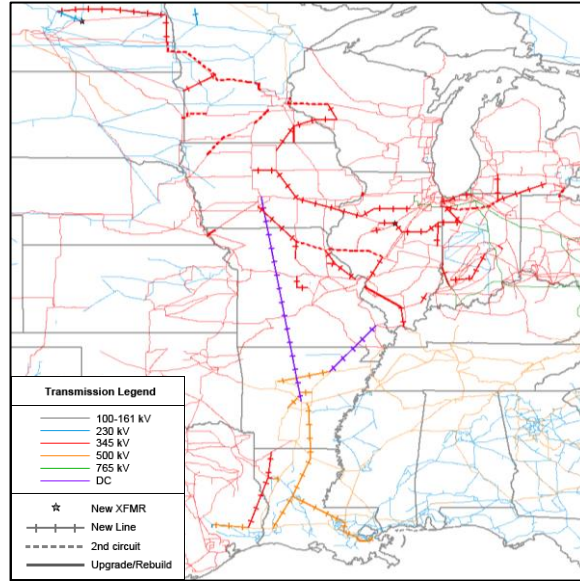
Contingency Analysis Scope

- Contingency analysis was performed to capture additional system impacts caused by indicative overlays
- Reliability Analysis (PSSE/TARA)
 - Create overlay related single contingencies for each future
 - Monitor 100kV and above existing and overlay lines
- Economic Contingency Analysis (PAT Tool)
 1. Create outage list: overlay lines and existing lines $\geq 200\text{kV}$ with $> 25\%$ loading in select hours
 2. Identify monitored lines $\geq 100\text{kV}$ with $> 10\%$ flow changes & $\geq 100\%$ loading as a result of an N-1 outage from 1)
- A selection of overlay related mon/con pairs were consolidated and included in the set of analyses for the May workshop

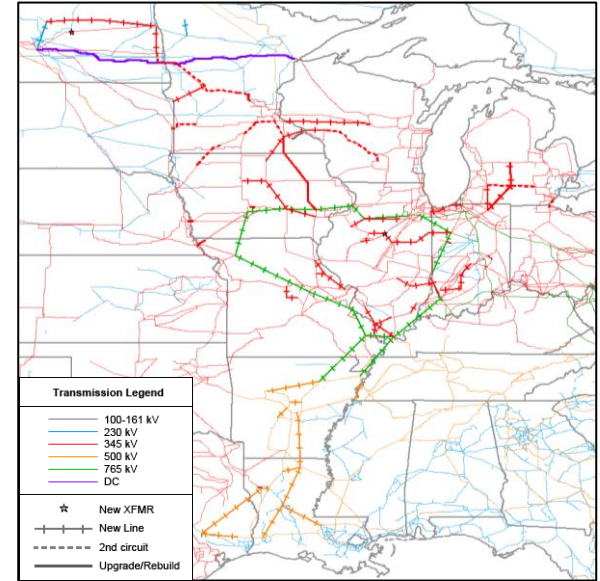
Preliminary Indicative Overlays further analyzed March 17 EPUG Meeting



Existing Fleet*



Policy Regulations*

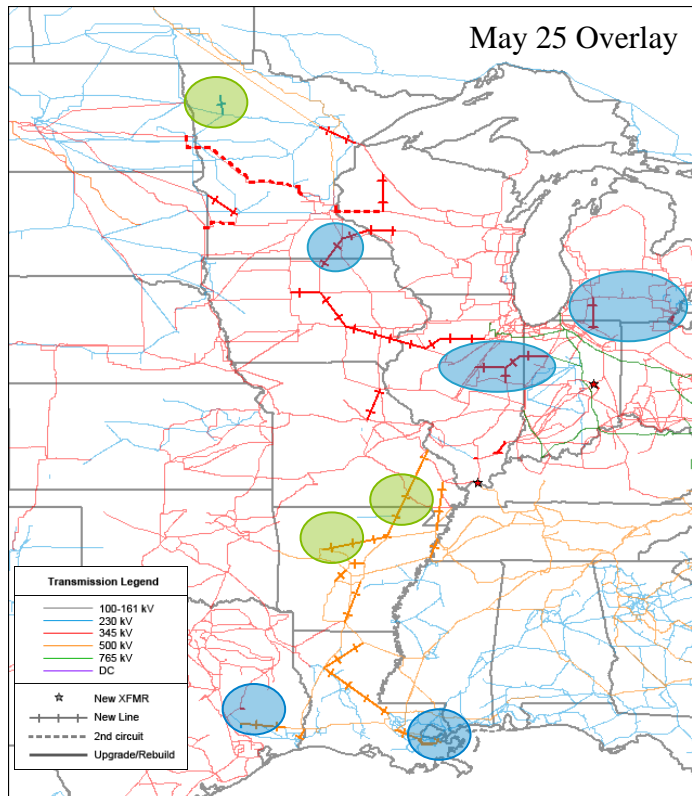
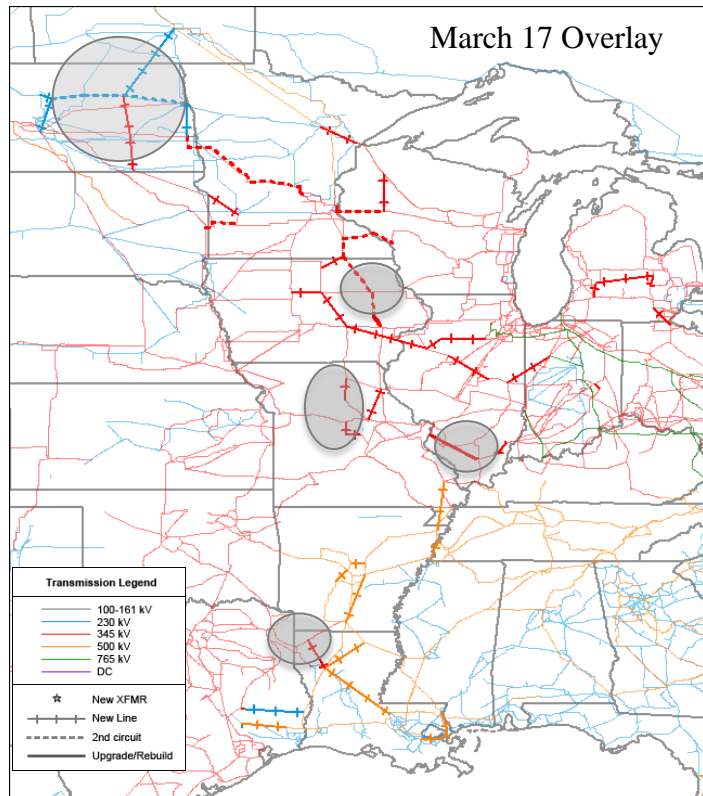


Accelerated Alternative Technologies*

Overlay roadmaps are indicative long-term transmission strategies to help guide and frame near-term regional plan

Preliminary Overlay – Existing Fleet Future (EF)

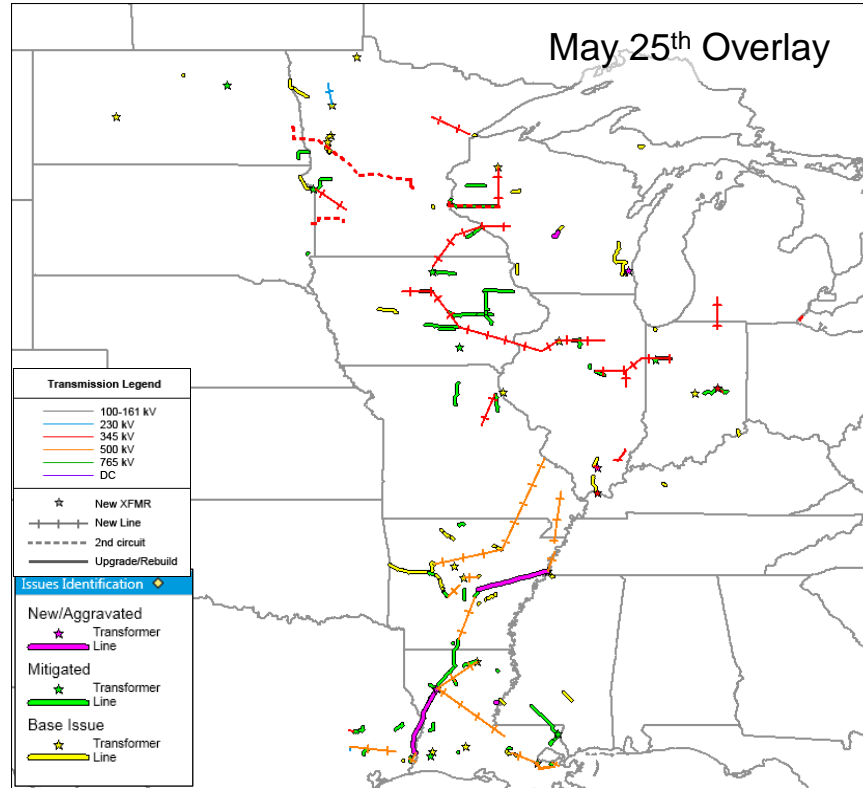
Preliminary Overlay Solicited for Existing Fleet Future *



- Removed elements
- Added elements
- Modified elements

*Indicative overlay shown is preliminary and subject to change based on stakeholder review

Top Economic and Reliability Indicators for Preliminary Indicative Overlay – EF Future



Updated EF overlay more effectively mitigates issues

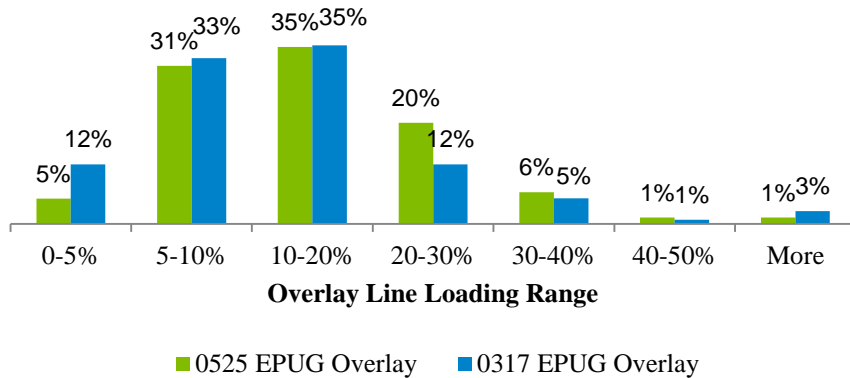
Category	Measure	EF Overlay March 17 th EPUG	EF Overlay May 25 th EPUG
Reliability ¹	# of Elements Mitigated	198	214
	# of Elements Aggravated	25	16
Economics ²	Congestion Relieved (%)	64%	69%
	# of Mitigated Issues	24	29
	# of Helped Issues	7	4
	# of Worsened Issues	3	1
	# of New Issues	2	3

¹ Mitigated - branch loading is <100% and reduced by at least 3% for all contingencies in all cases. Aggravated - branch loading is 100% and increased by at least 3% for at least one contingency in one case.

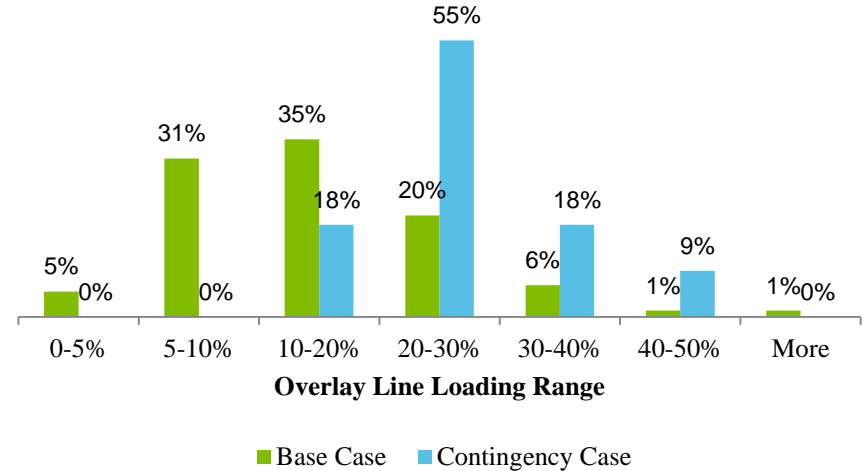
² A Shadow Price (SP) cutoff of 25 k\$/MWh was used. Mitigated issues drop below the cutoff after addition of the overlay. Helped issues see a 50% or more drop in SP, but are still above the cutoff. Worsened issues see a 20% or greater increase in SP.

EF Future Preliminary Overlay Line Utilization comparison for two iterations of overlay refinements

EF Overlay Base Case Loading Distribution Comparison
(Branch Count in Percentage %)



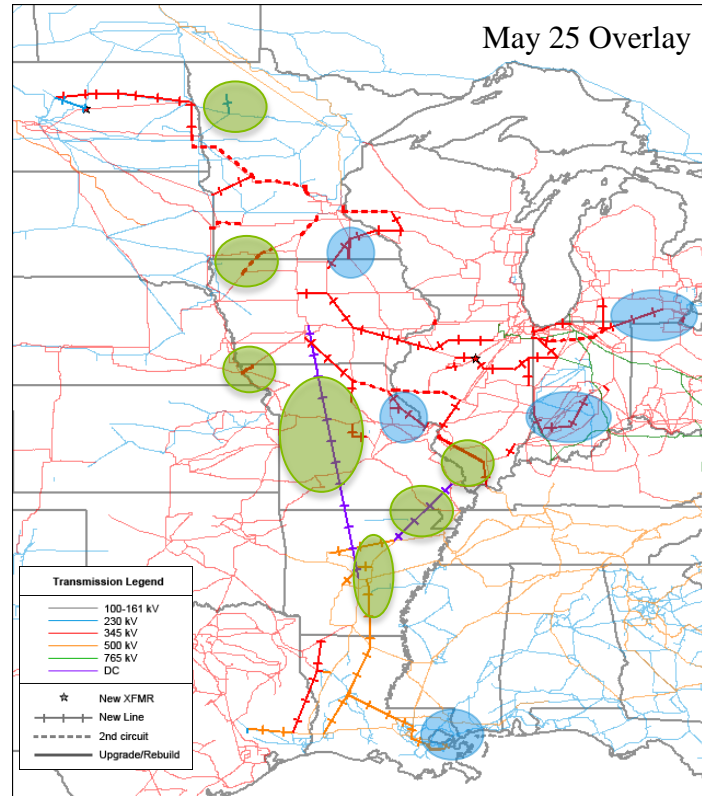
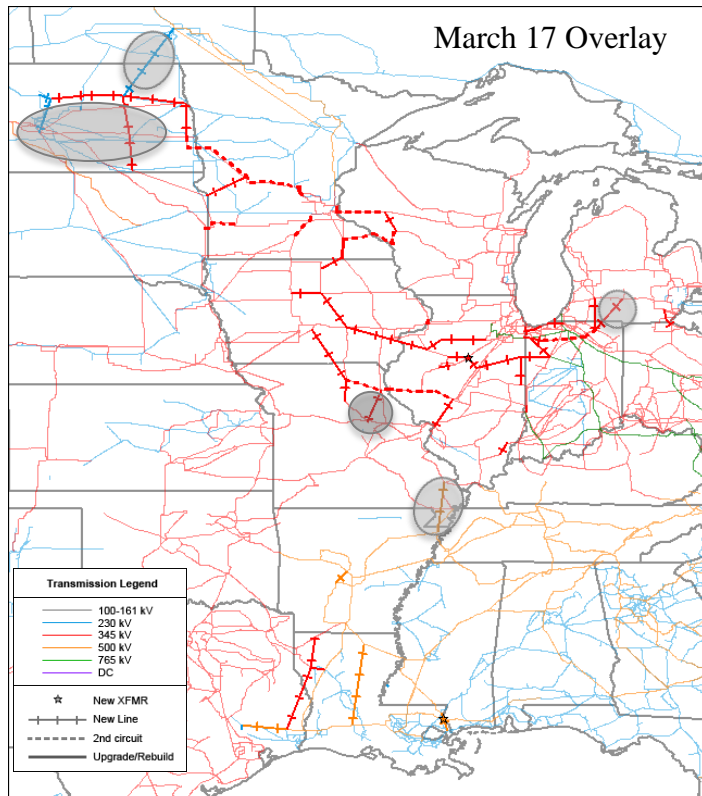
EF Overlay Base Case and Contingency Case Loading Distribution Comparison
(Branch Count in Percentage %)



- The May 25th has significantly increased base case loading for 20-30% loading range
- Contingency case loading on overlay facilities are significantly higher than base case loading

Preliminary Overlay – Policy Regulations Future (PR)

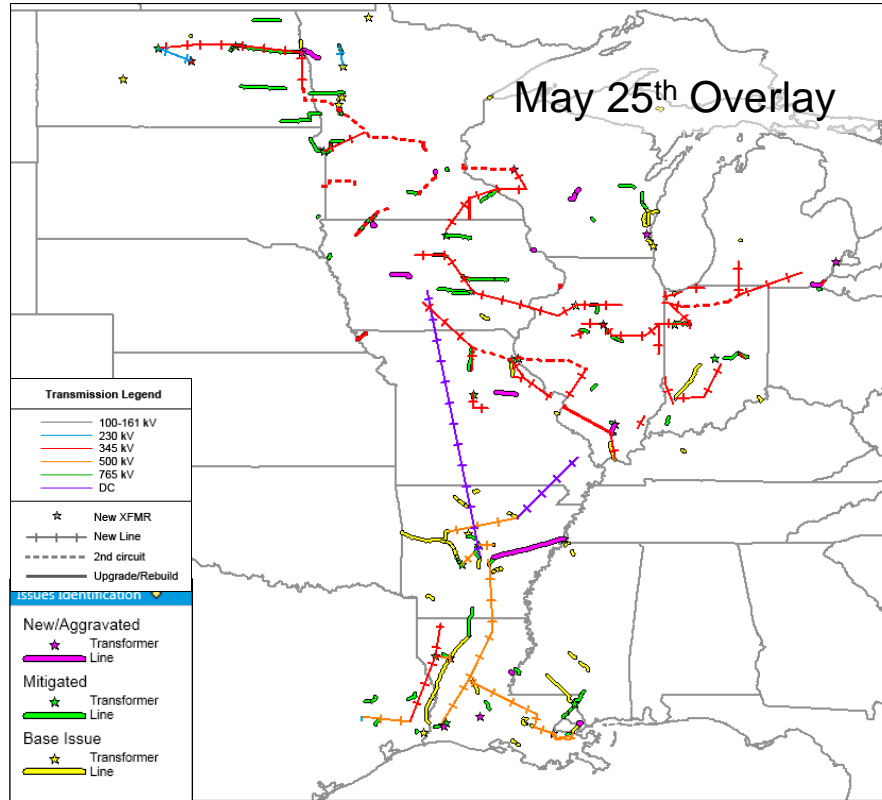
Preliminary Overlay Solicited for PR Future *



- Grey circle: Removed elements
- Green circle: Added elements
- Blue circle: Modified elements

*Indicative overlay shown is preliminary and subject to change based on stakeholder review

Top Economic and Reliability Indicators for Preliminary Indicative Overlay – PR Future



Updated PR overlay more effectively mitigates issues

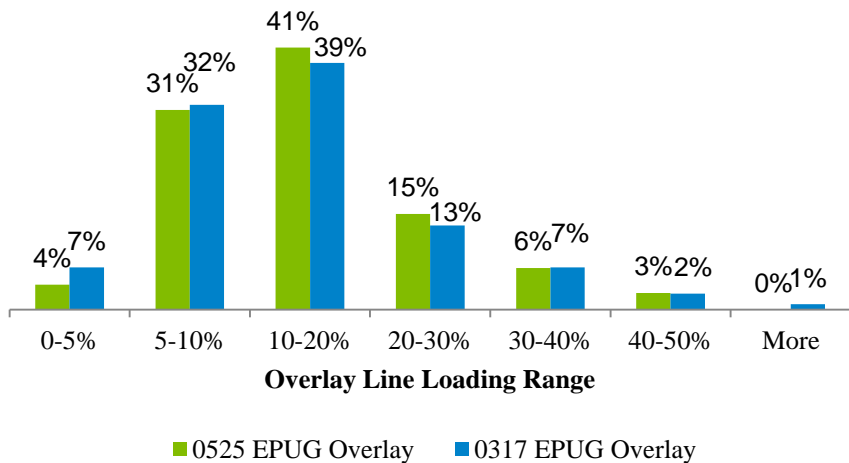
Category	Measure	PR Overlay March 17 th EPUG	PR Overlay May 25 th EPUG
Reliability ¹	# of Elements Mitigated	316	393
	# of Elements Aggravated	41	35
Economics ²	Congestion Relieved (%)	60%	64%
	# of Mitigated Issues	56	52
	# of Helped Issues	9	3
	# of Worsened Issues	4	8
	# of New Issues	6	5

¹ Mitigated - branch loading is <100% and reduced by at least 3% for all contingencies in all cases. Aggravated - branch loading is 100% and increased by at least 3% for at least one contingency in one case.

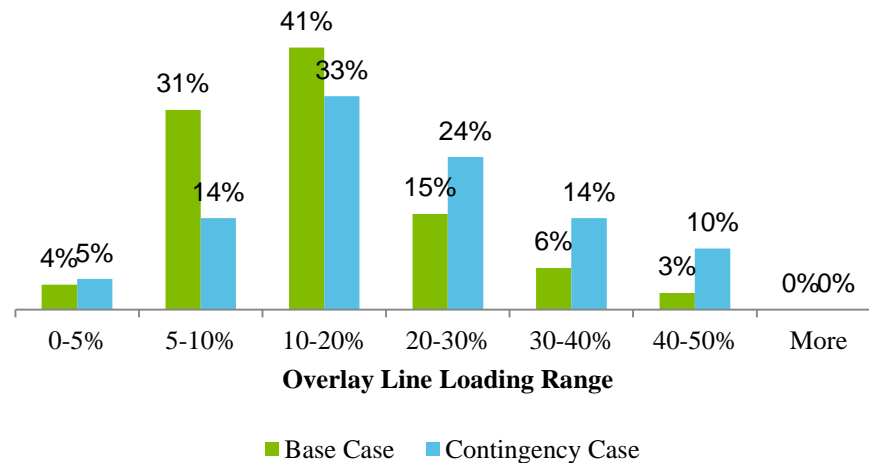
² A Shadow Price (SP) cutoff of 25 k\$/MWh was used. Mitigated issues drop below the cutoff after addition of the overlay. Helped issues see a 50% or more drop in SP, but are still above the cutoff. Worsened issues see a 20% or greater increase in SP.

PR Future Preliminary Overlay Line Utilization comparison for two iterations of overlay roadmaps

PR Overlay Base Case Loading Distribution Comparison (Branch Count in Percentage %)



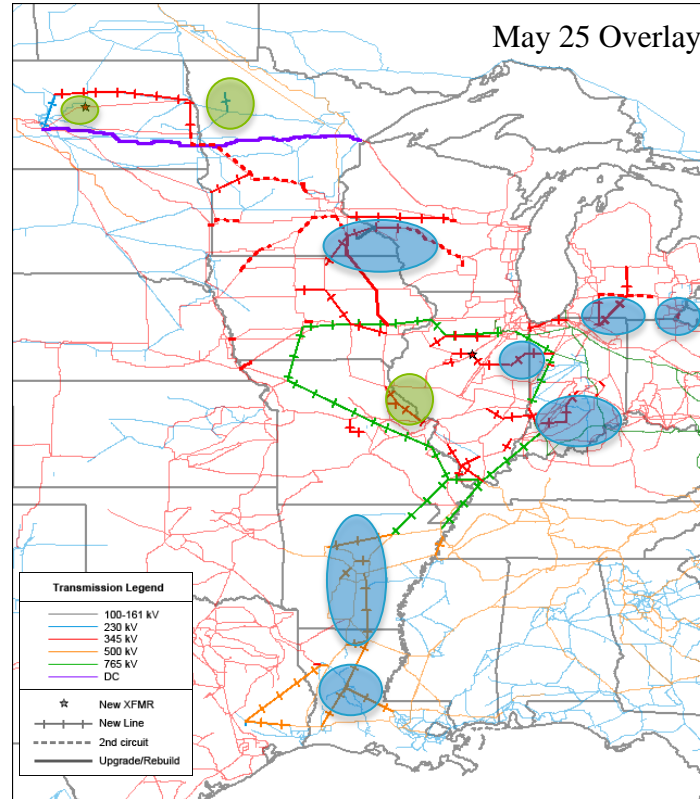
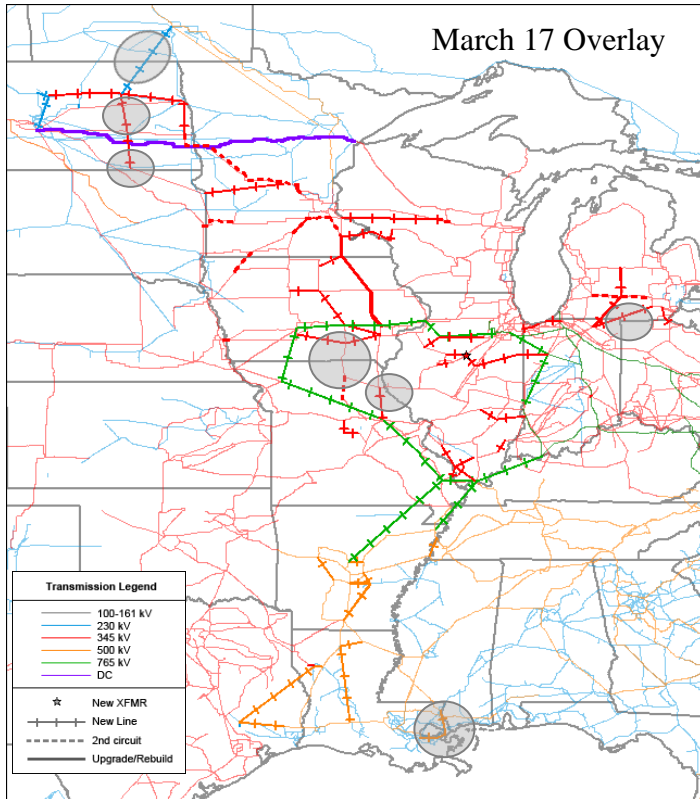
PR Overlay Base Case and Contingency Case Loading Distribution Comparison (Branch Count in Percentage %)



- The May 25th overlay has increased base case loading for higher loading ranges
- Contingency case loading on overlay facilities are significantly higher than base case loading

Preliminary Overlay – Advanced Alternative Technologies Future (AAT)

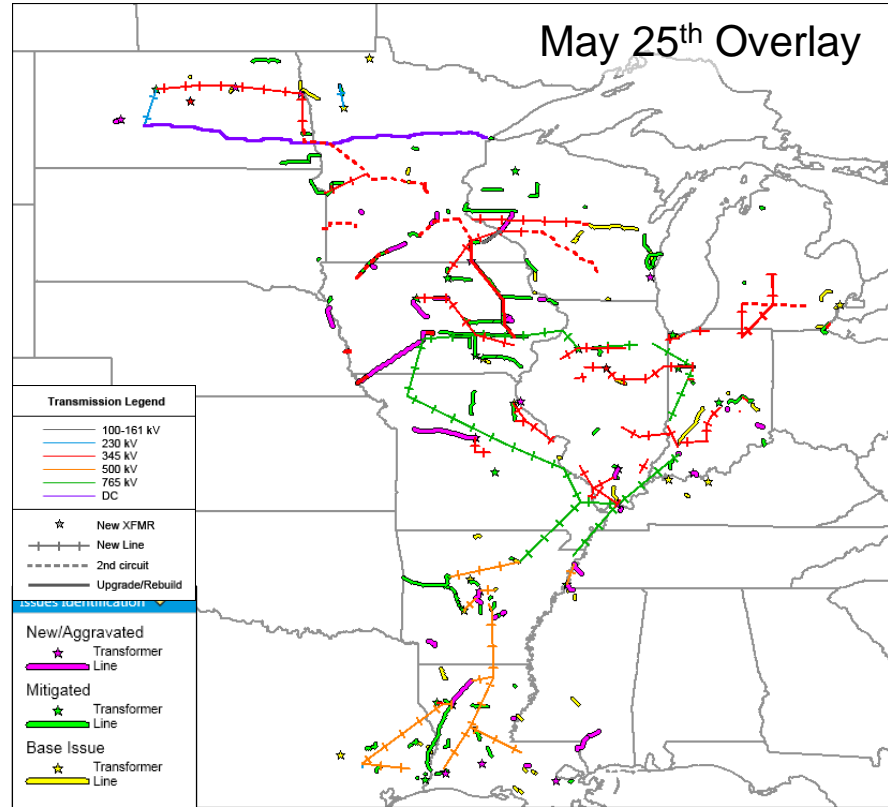
Preliminary Overlay Solicited for AAT Future *



- Removed elements
- Added elements
- Modified elements

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Top Economic and Reliability Indicators for Preliminary Indicative Overlay – AAT Future



Updated AAT overlay more effectively mitigates issues

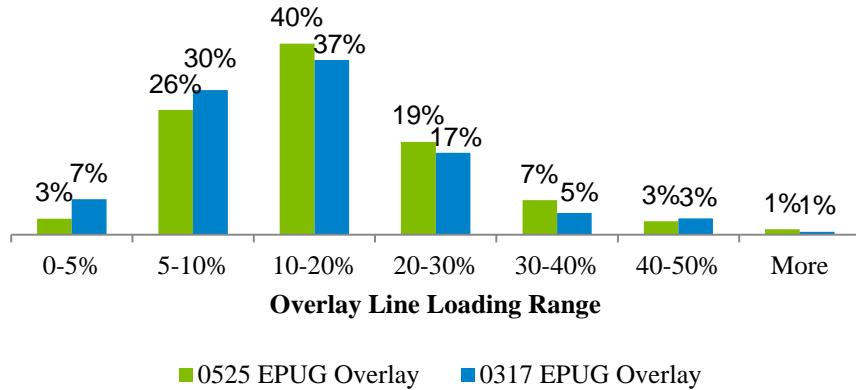
Category	Measure	AAT Overlay March 17 th EPUG	AAT Overlay May 25 th EPUG
Reliability ¹	# of Elements Mitigated	277	287
	# of Elements Aggravated	34	32
Economics ²	Congestion Relieved (%)	38%	50%
	# of Mitigated Issues	82	85
	# of Helped Issues	25	15
	# of Worsened Issues	23	16
	# of New Issues	16	20

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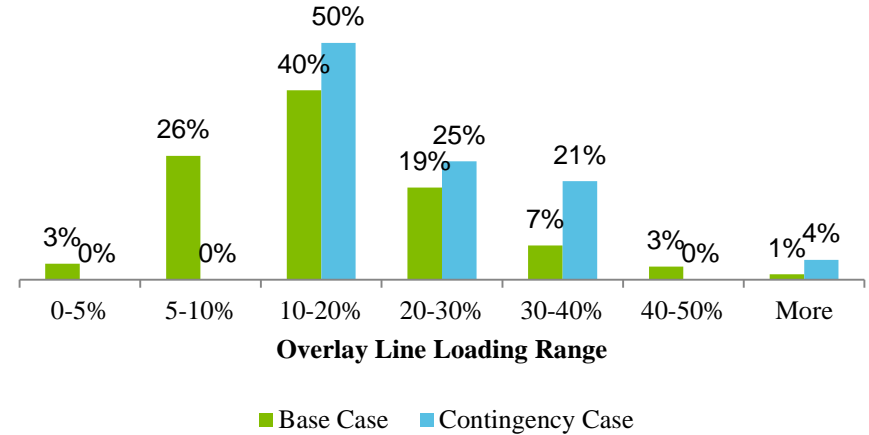
² A Shadow Price (SP) cutoff of 25 k\$/MWh was used. Mitigated issues drop below the cutoff after addition of the overlay. Helped issues see a 50% or more drop in SP, but are still above the cutoff. Worsened issues see a 20% or greater increase in SP.

AAT Future Preliminary Overlay Line Utilization comparison for two iterations of overlay roadmaps

AAT Overlay Base Case Loading Distribution Comparison (Branch Count in Percentage %)



AAT Overlay Base Case and Contingency Case Loading Distribution Comparison (Branch Count in Percentage %)



- The May 25th overlay has increased base case loading for higher loading ranges
- Contingency case loading on overlay facilities are significantly higher than base case loading



Questions?

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Project Team Structure

Project Team Structure	Team Members
North Region	James Slegers
	Rui Bo
	Ling Luo
Central and East Region	Charles Wu
	Ranjit Amgai
	Qun Gao
South Region	Pat Jehring
	Tim Kopp

Preliminary Overlay Roadmaps Solicitation Process

- A stakeholder inclusive process to develop and refine indicative overlays
- Preliminary overlays were solicited based on a large variety of overlay ideas received from stakeholders or generated internally
 - Proposed at the January EPUG overlay design workshop
 - Submitted by stakeholders after the January EPUG meeting
 - Generated by MISO staff internally
 - Proposed from past MISO planning studies, where possible
 - Overlay ideas may be combined or modified as needed
- Alternative overlay ideas were selected for different futures to align with the identified set of system drivers