Powering positive change

The Hatch H.G. Acres symposium

April 15-16, 2025 | Hotel X, Toronto, Canada

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700~800 kV overhead transmission lines

Adeel Afzal
Global Lead, Transmission Lines, Hatch

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Agenda

1. Why Discuss 700~800 kV Transmission Lines
2. History of 700~800 kV Transmission Lines
3. Comparison with Other Voltage Levels
4. Design Considerations
5. Questions

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Why Discuss 700~800 kV Transmission Lines

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The Need for Discussing 700~800 kV Lines

- Large Projects Planned in this Voltage Range
- Very Limited Global Experience for this Voltage Range
- Competes with HVDC for:
    - Transmitting energy over medium-long distance
    - Interconnecting large isolated systems
- Overlay on existing transmission network

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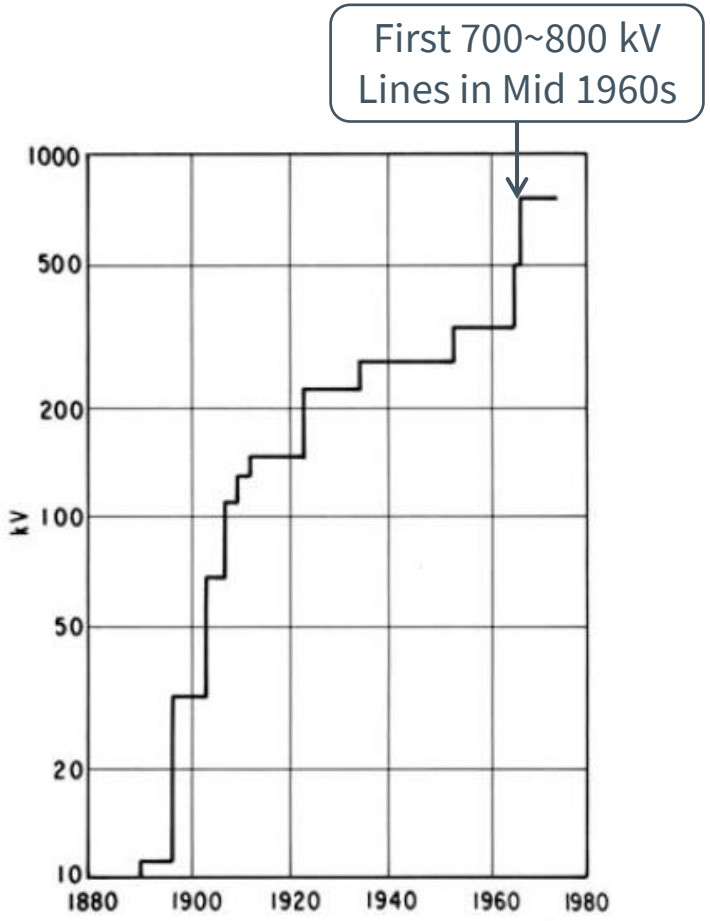
History

History Leading up to 800 kV lines

Hydro Quebec	1st 735 kV Transmission Line in Y1965
AEP	1st 765 kV Transmission Line in Y1969
Brazil	765 kV
Venezuela	765 kV
Russia	787 kV. [1000~1200 kV designed. Operated at 500 kV]
Japan	1000 kV designed. Operated at 500 kV
South Africa	765 kV
South Korea	765 kV
India	1st 765 kV in Y2007
Pakistan	765 kV [under construction]
China	750 kV



Highest AC transmission voltages in North America (EPRI 1982)

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Very few 765 kV Lines in US

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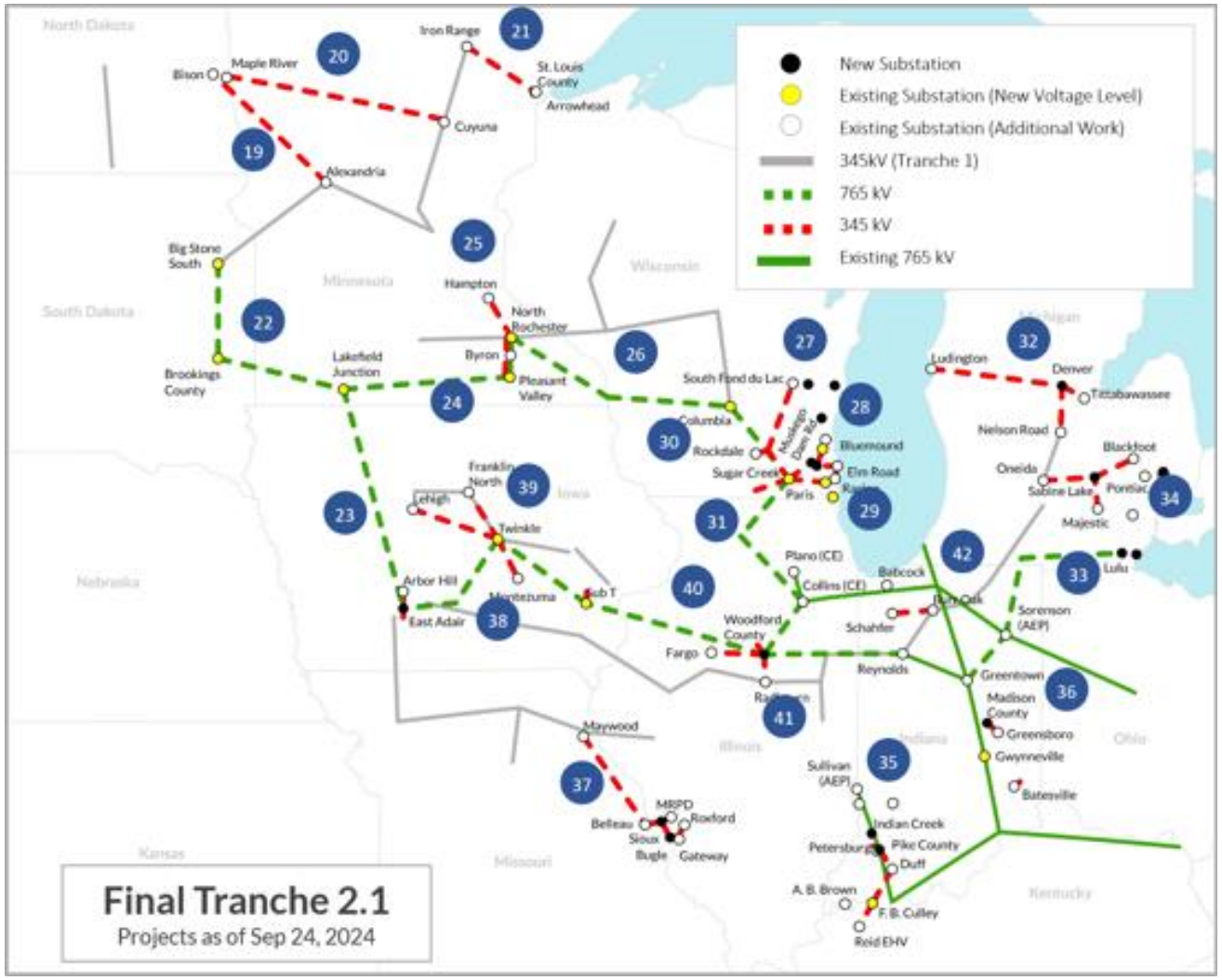
MISO Tranche 2.1



765 kV [Planned]

765 kV [Existing]

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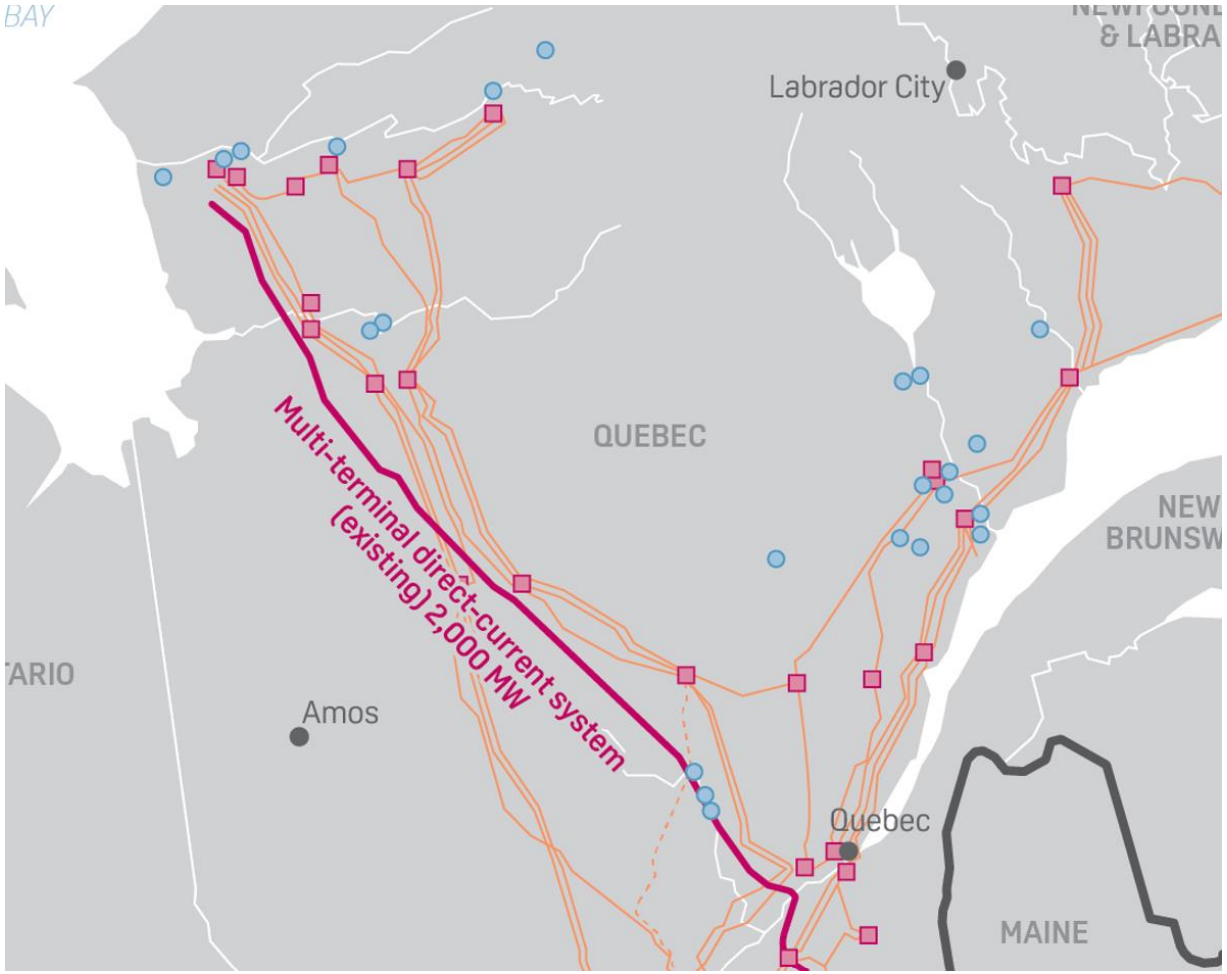
Very few 735 kV Lines in Canada [HQ]



735 kV

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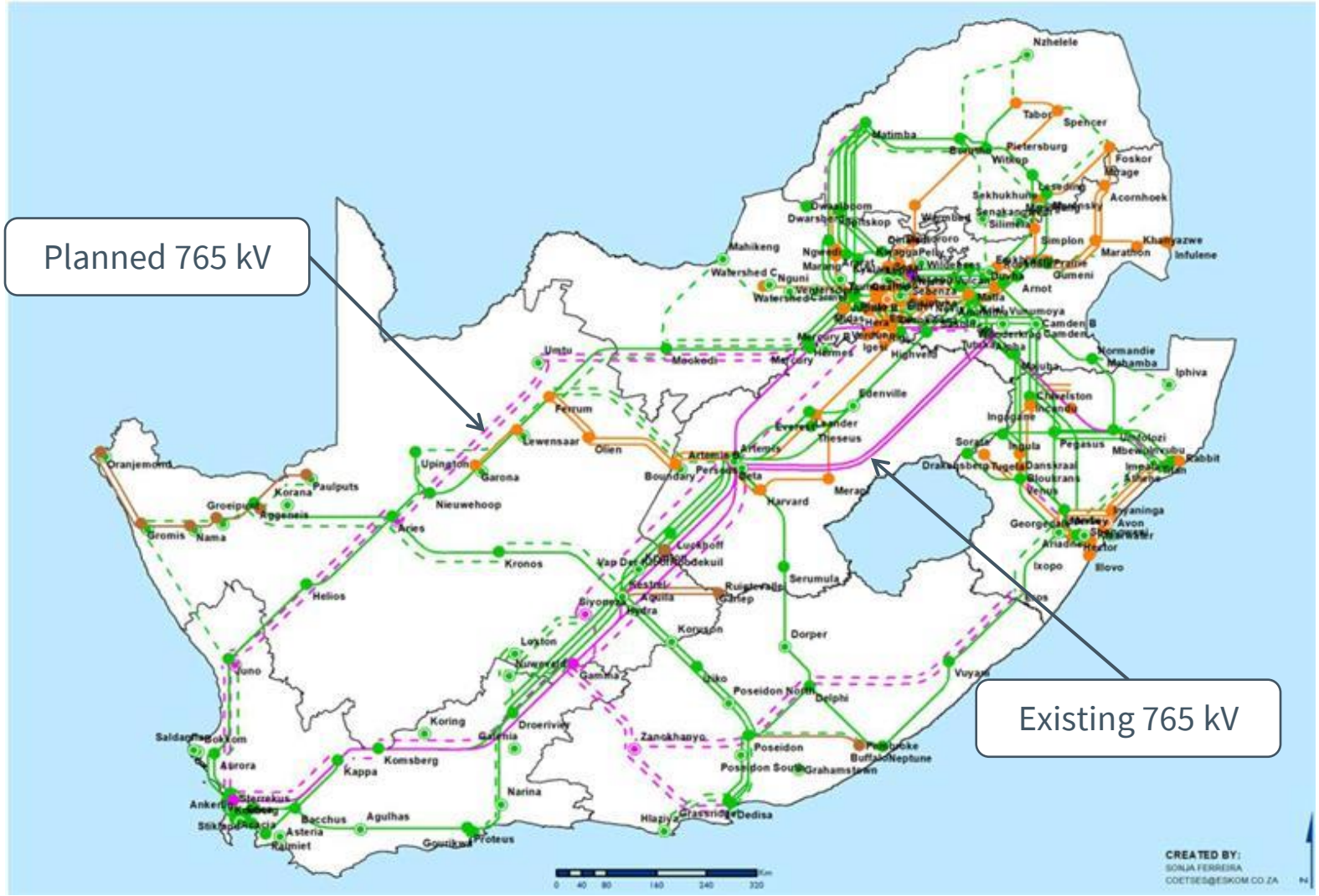
Very few 765 kV Lines in South Africa



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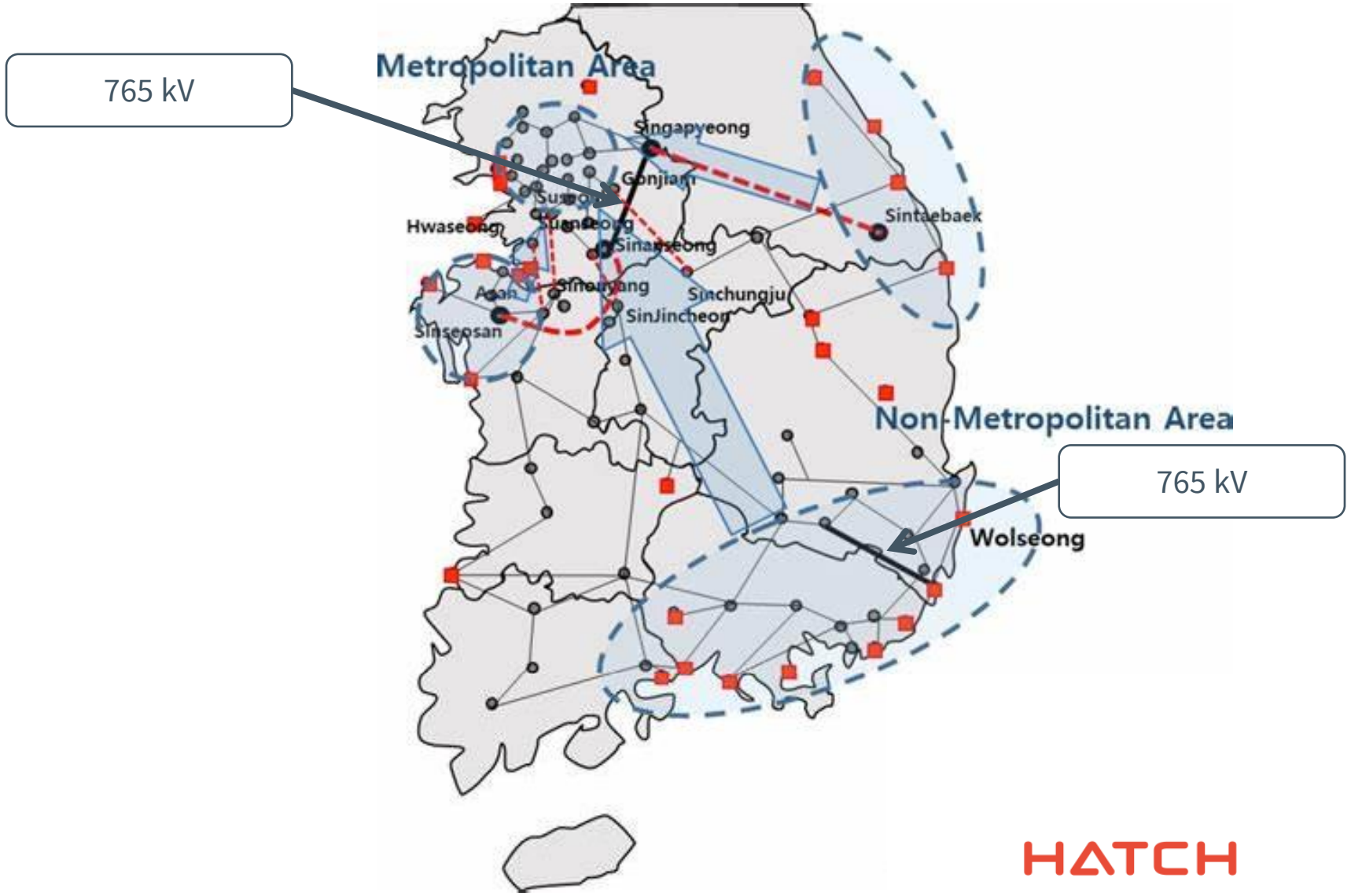
Very few 765 kV Lines in South Korea



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Comparisons

- Right of Way and Heights
- Power Transfer Limits
- Cost and Feasibility
- Overall Pros and Cons

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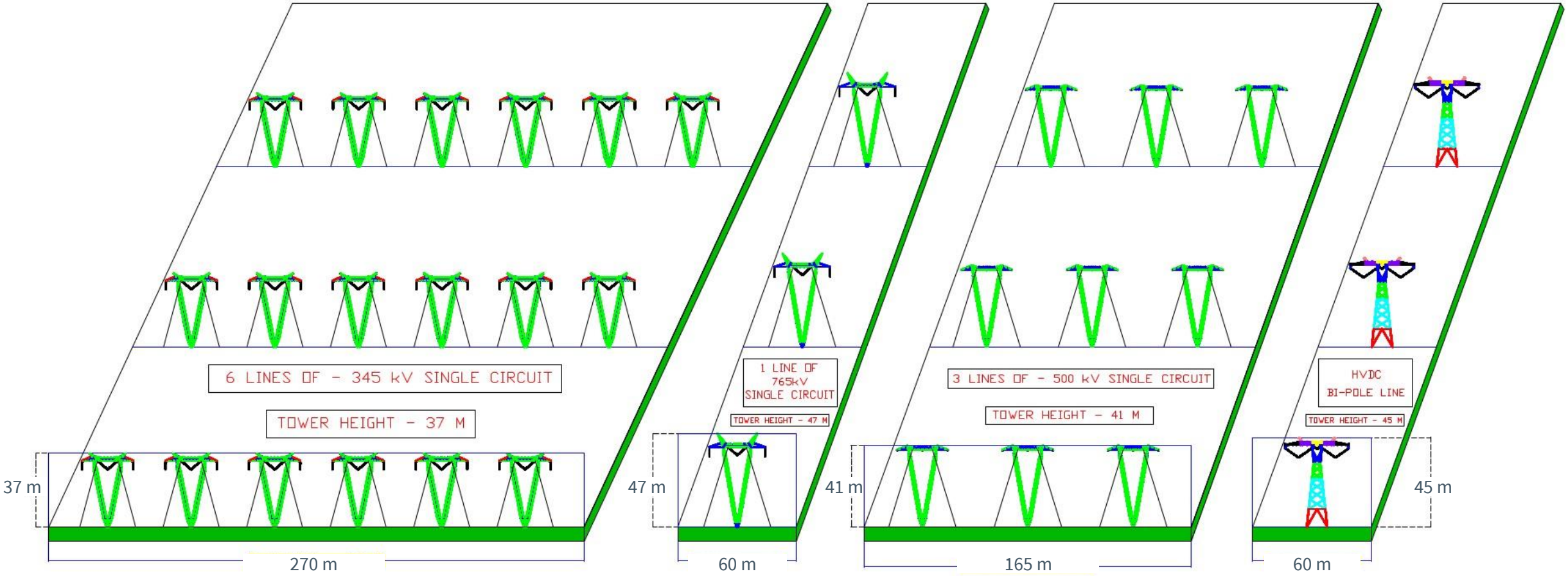
Right of Way Width and Height Comparison-1



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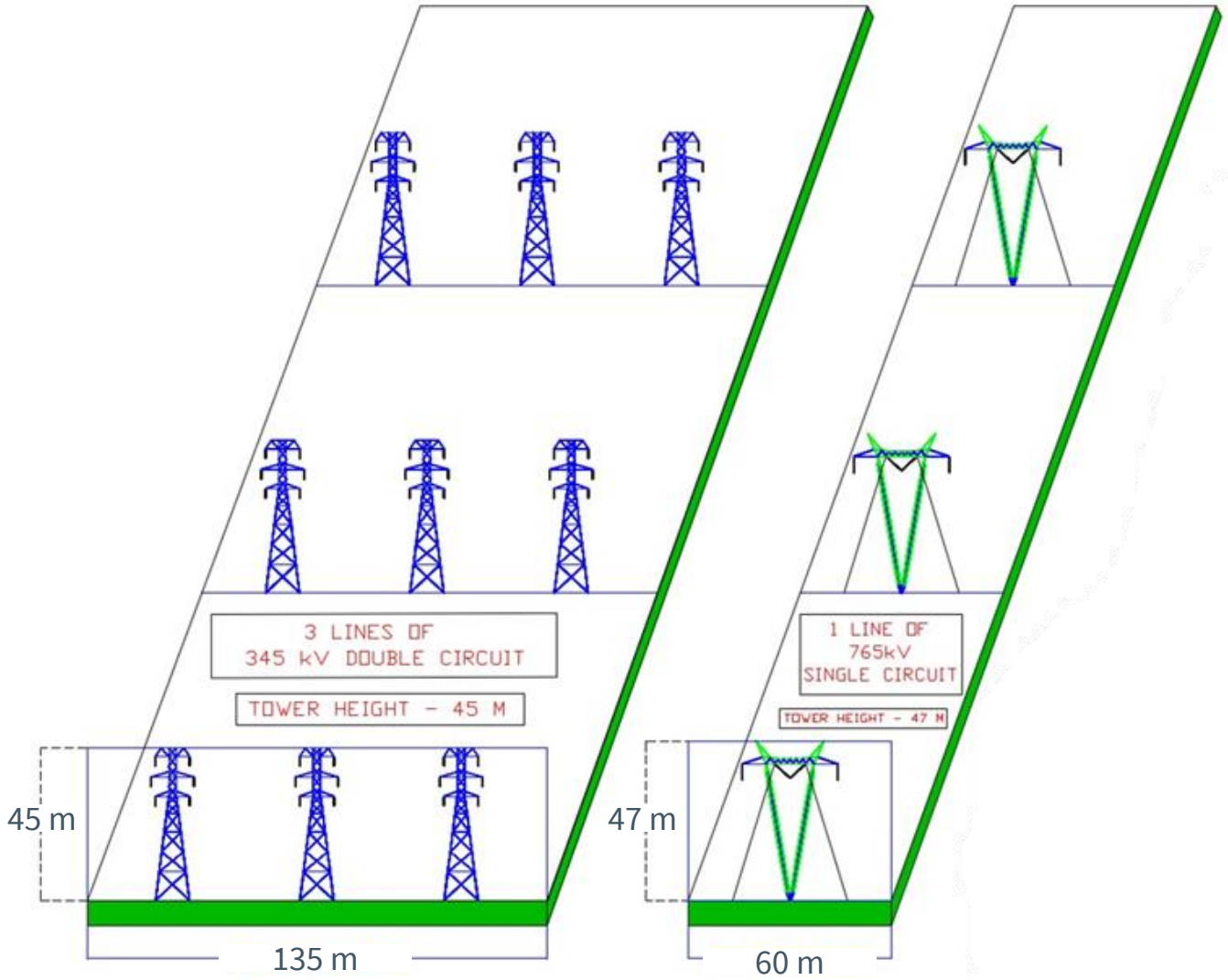
Right of Way Width and Height Comparison-2



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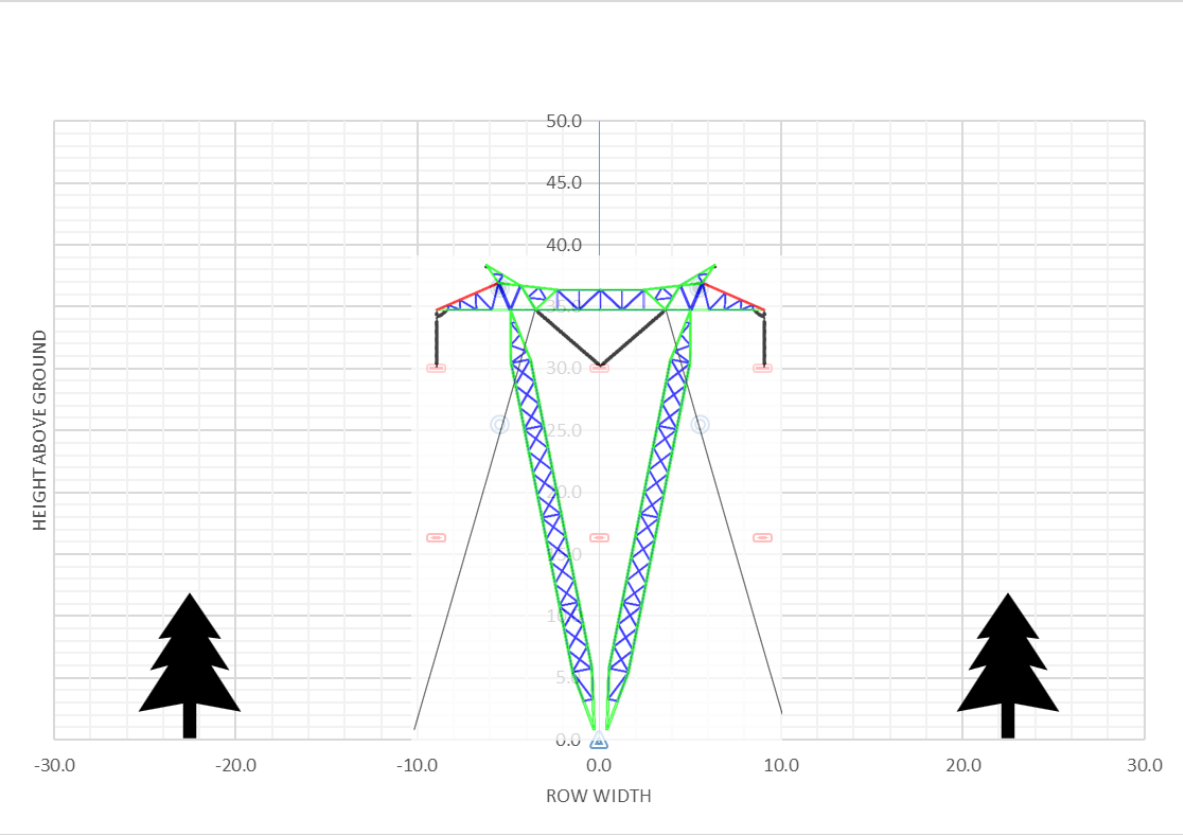
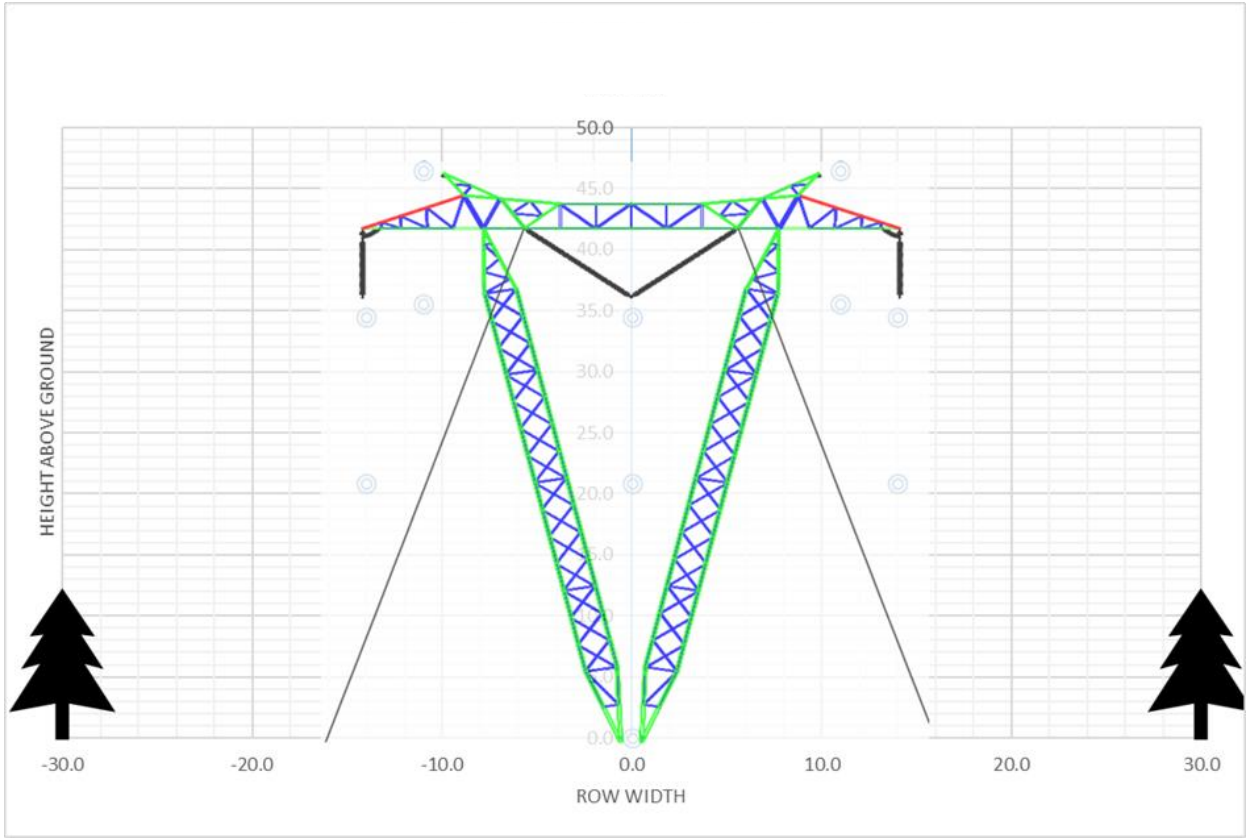
Comparison of Right of Way Width and Tower Height
[345 kV vs 765 kV]



RoW Configuration
345 kV



RoW Configuration
765 kV

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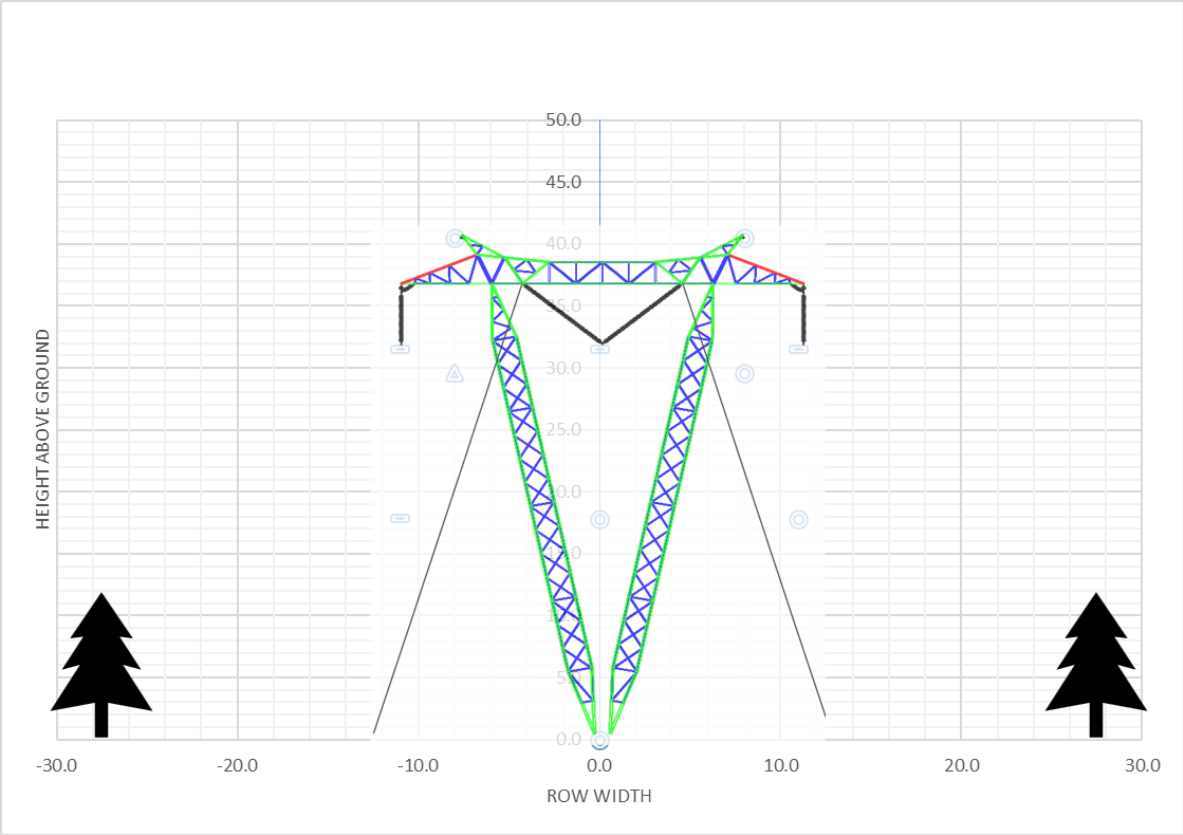
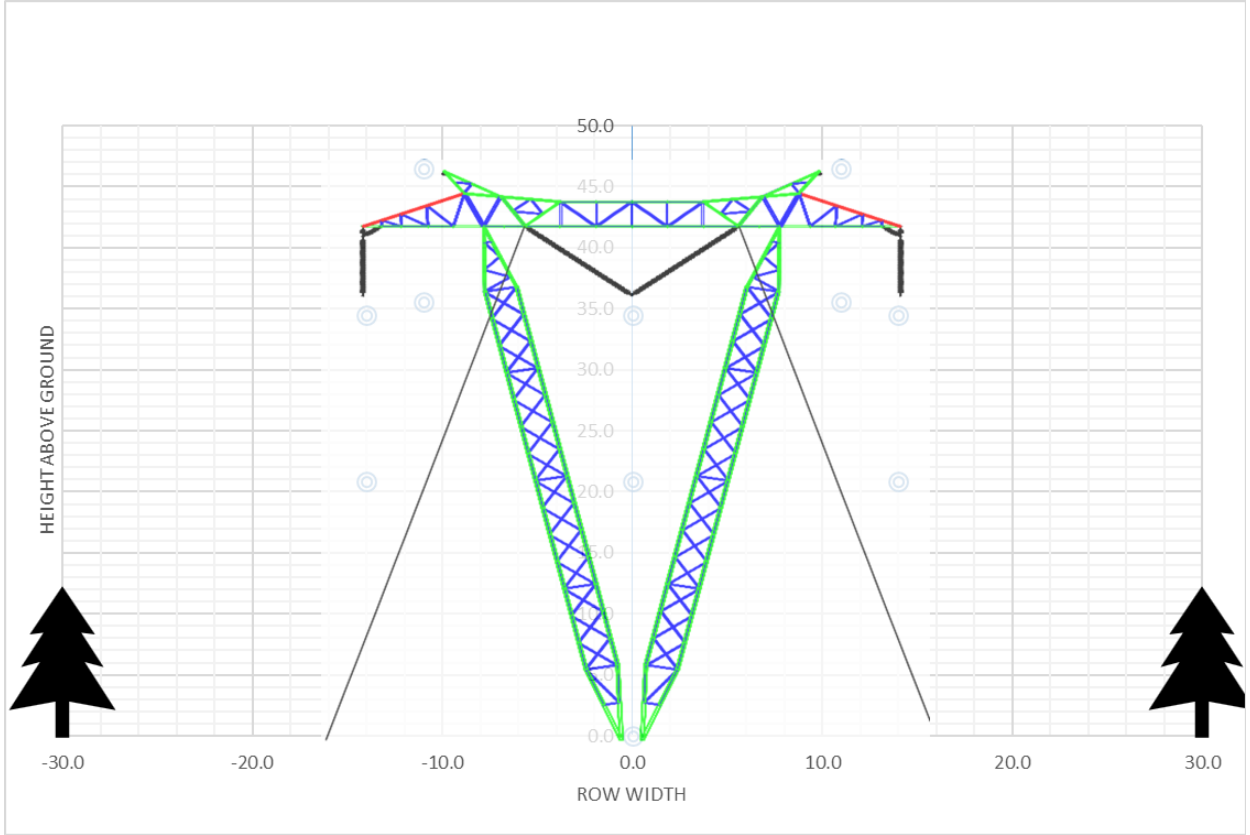
Comparison of Right of Way Width and Tower Height
[500 kV vs 765 kV]



RoW Configuration
500 kV



RoW Configuration
765 kV

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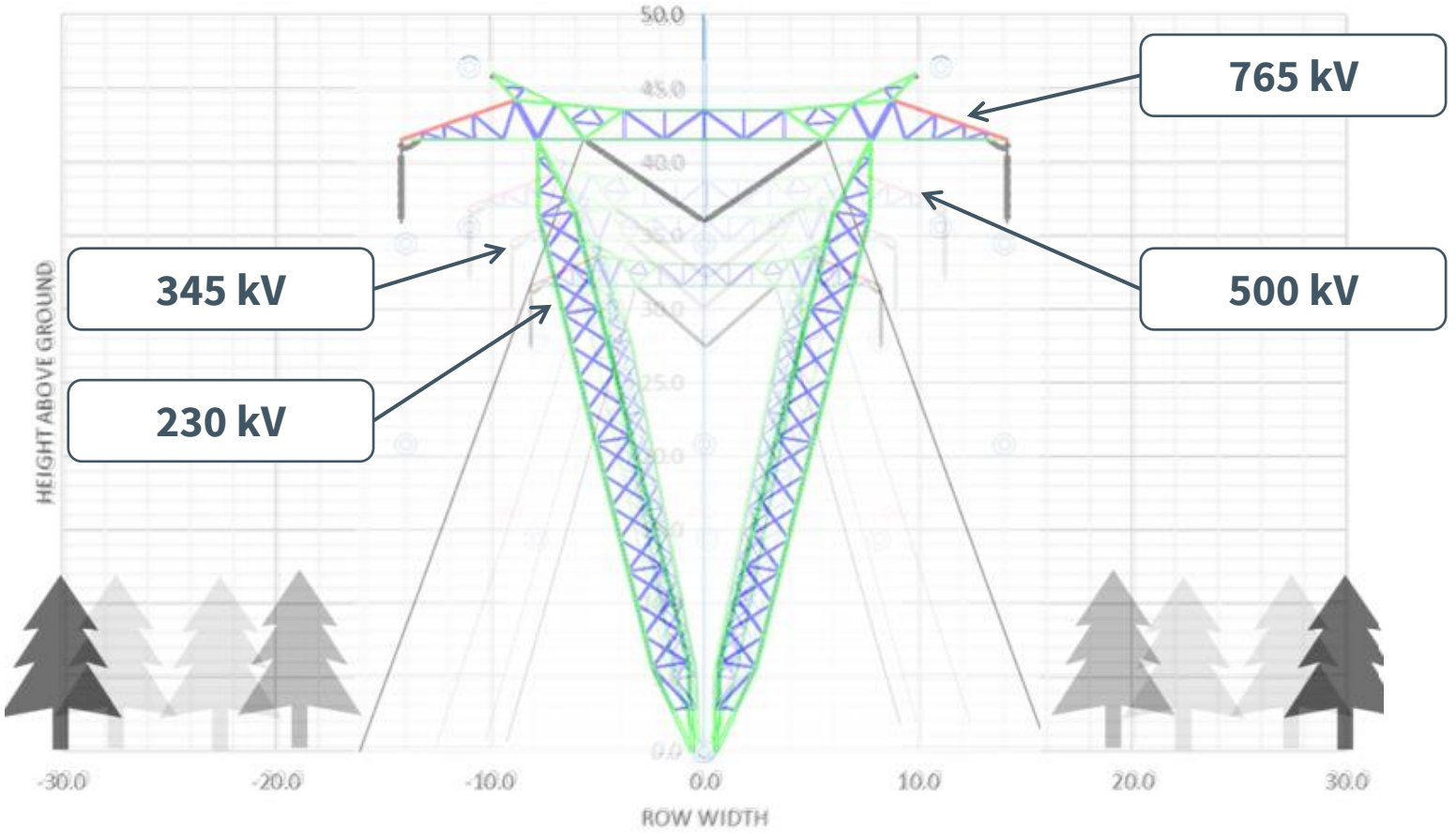
Overlap Comparison View

Right of Way Width vs Tower Height



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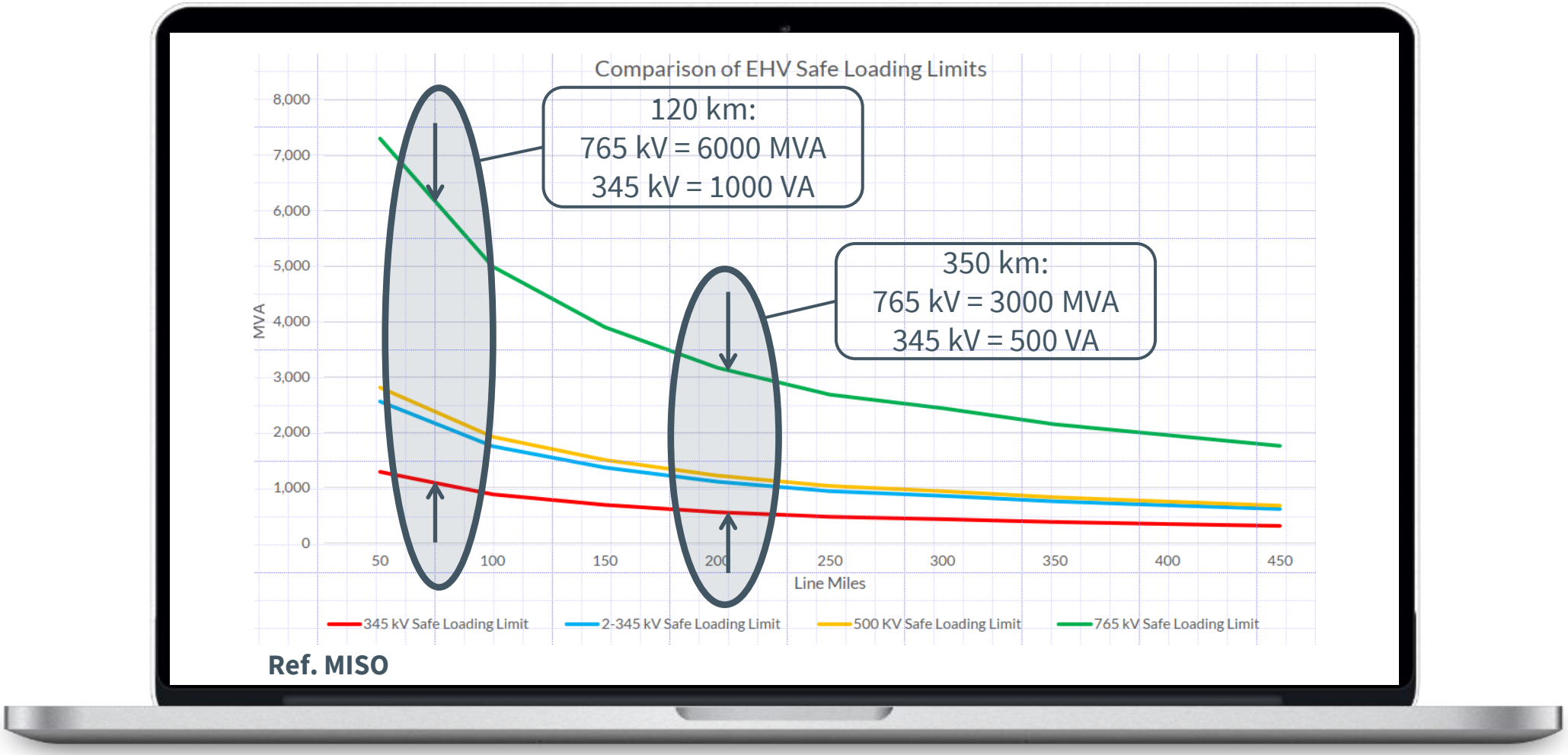
Comparison of Power Transfer Limits



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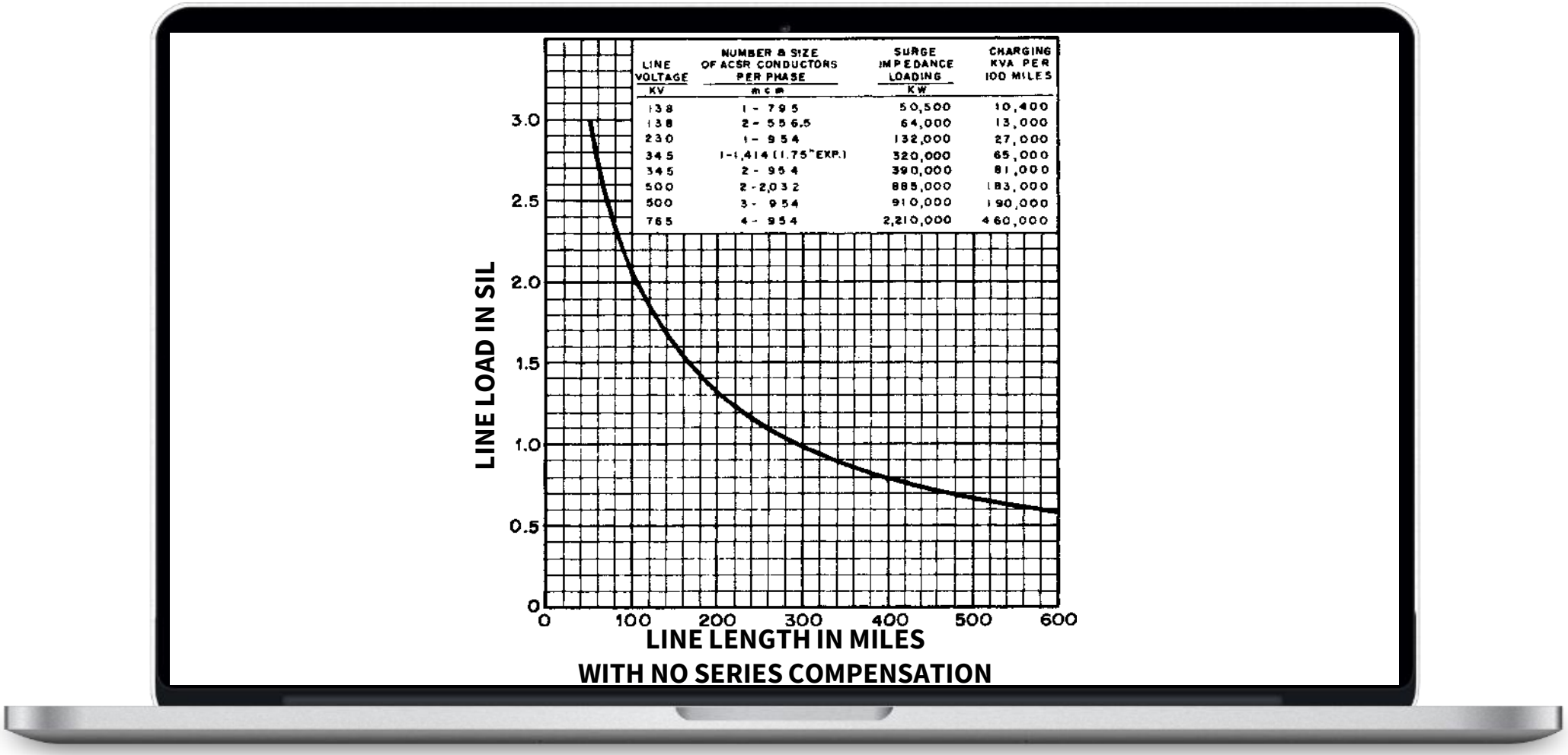
Comparison of Power Transfer Limits

St. Clair Curve



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Comparisons

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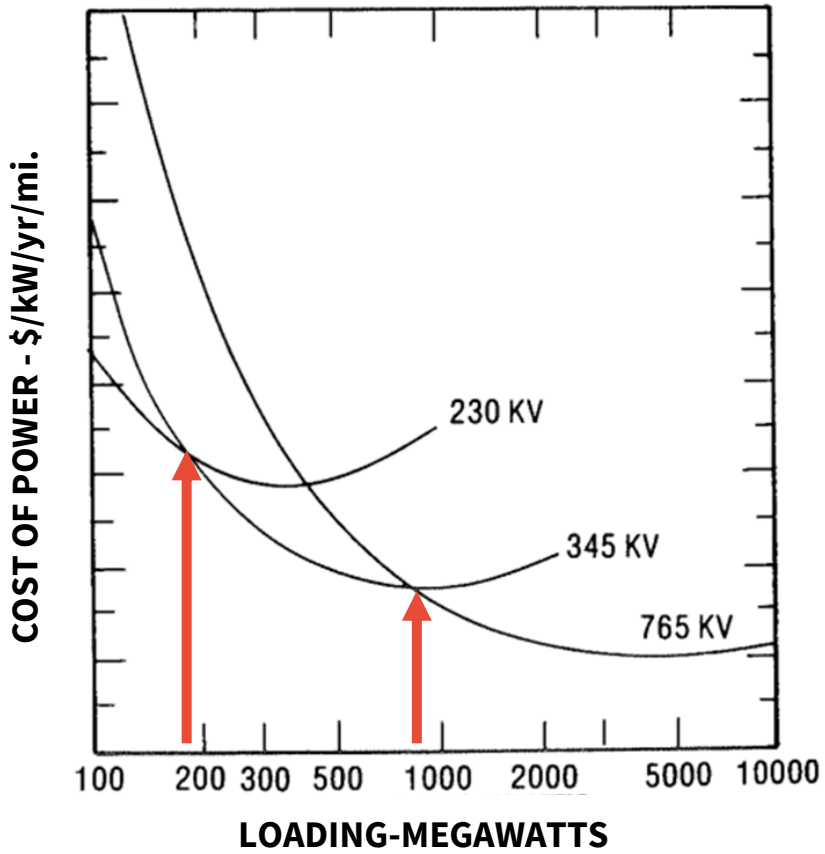
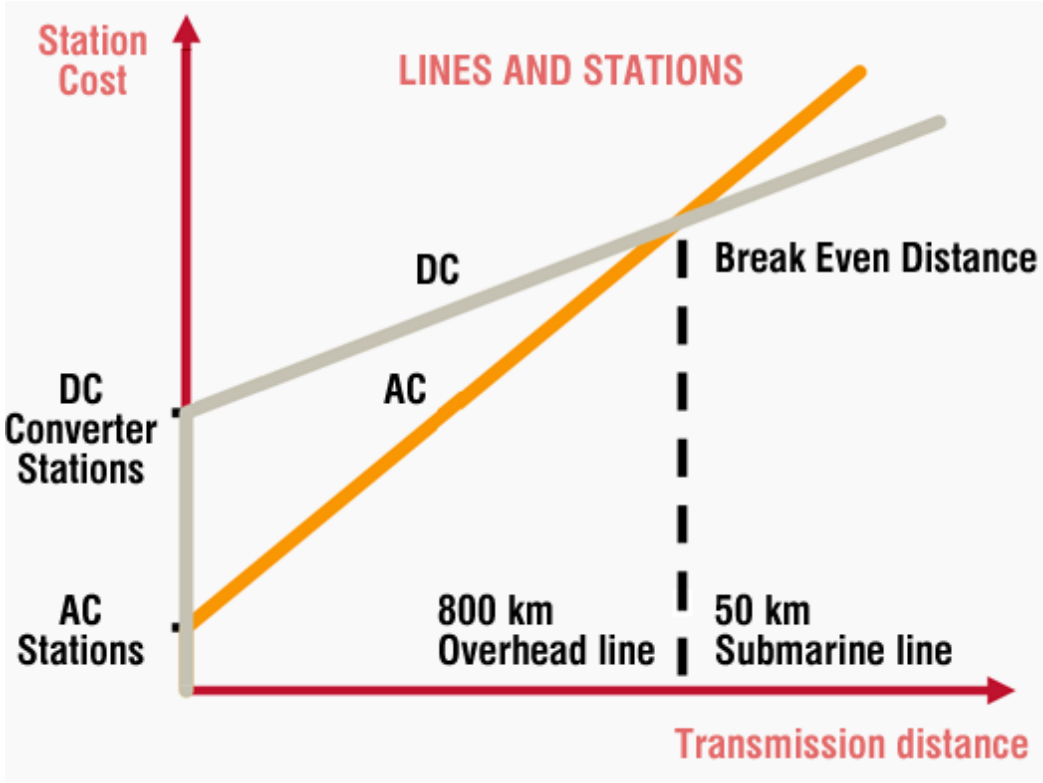
Cost Comparisons - AC/AC and AC/DC



AC vs AC
[Ref. EPRI]



AC vs DC

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Cost Comparisons – When is 800 kV Feasible

Power Flow	Short	Medium	Long	Very Long
High	765 kV	765 kV	765 kV	HVDC
Medium	765 kV 500 kV	765 kV 500 kV	765 kV	HVDC
Low	345 kV	500 kV	765 kV 500 kV	765 kV HVDC

Line Length

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Comparisons

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Overall Pros and Cons

Comparative Factors		Single Circuit Lines			Double Circuit	HVDC Bi-pole
		345 kV x6	500 kV x3	765 kV x1	345 kV x3	+/- 525 kV
Right of Way / Environmental	Width	270	165	60	135	60
	Height	37	41	47	45	45
	Window Impact (Width x Height)					
Cost	Cost (% of 765 kV)	390%	240%	100%	320%	60%
				100%		60%
	Terminal station					
	Thermal losses					
Planning and Operational Factors	N-1 flexibility					
	Growth and interconnections					
	Potential for longer distance					
	Sustained Forced Outages per 100-km-year					
	O&M experience					

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Design Considerations

[Fair warning: Technical Information Ahead!!]

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Tower Design Options




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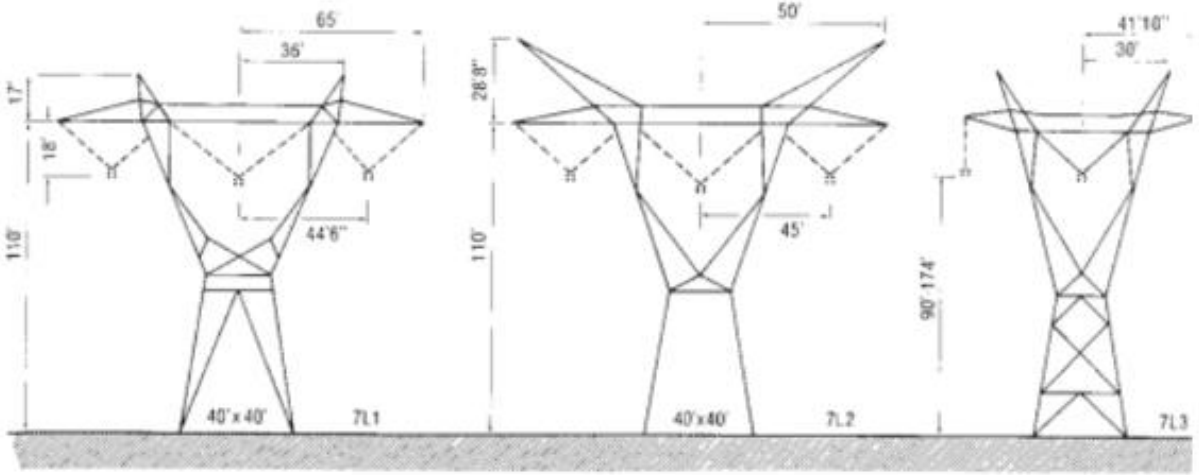
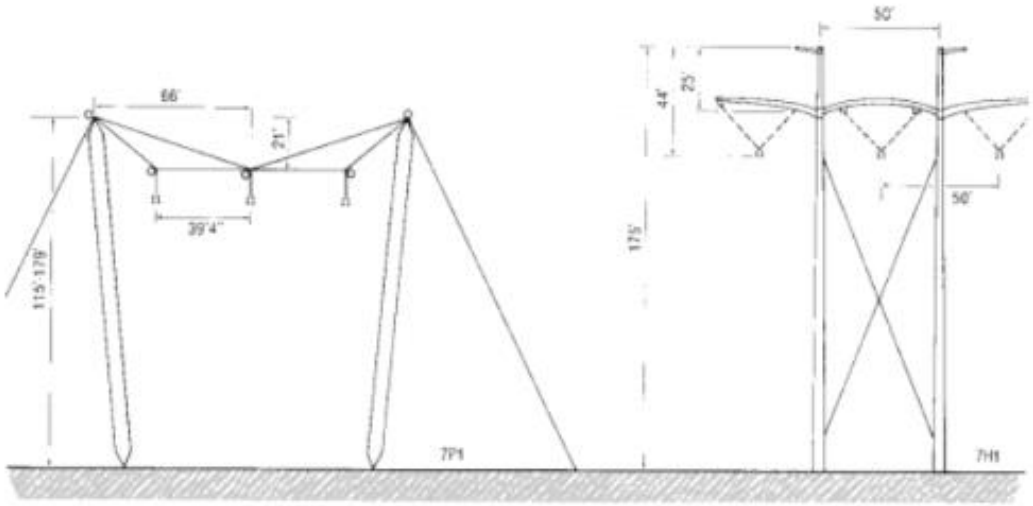
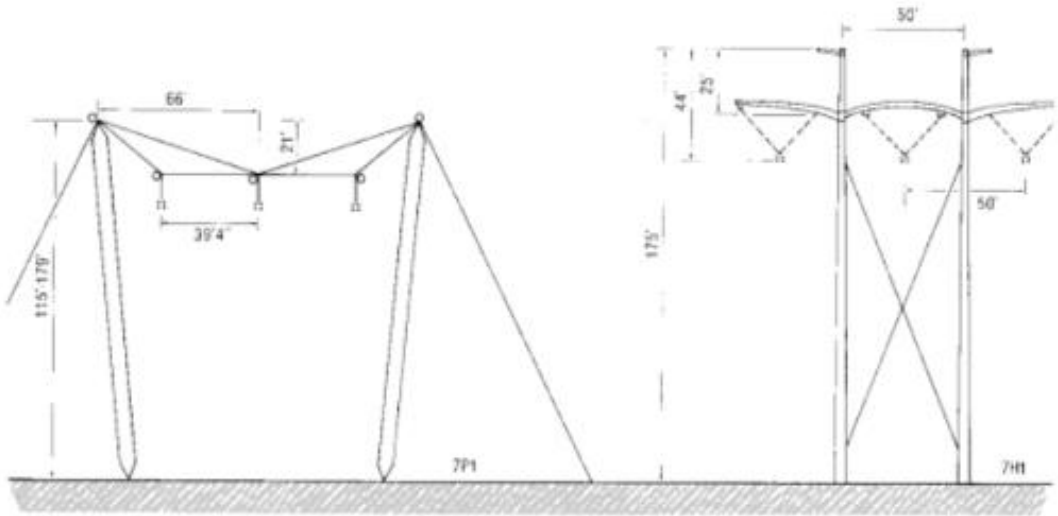
Tower Design Options







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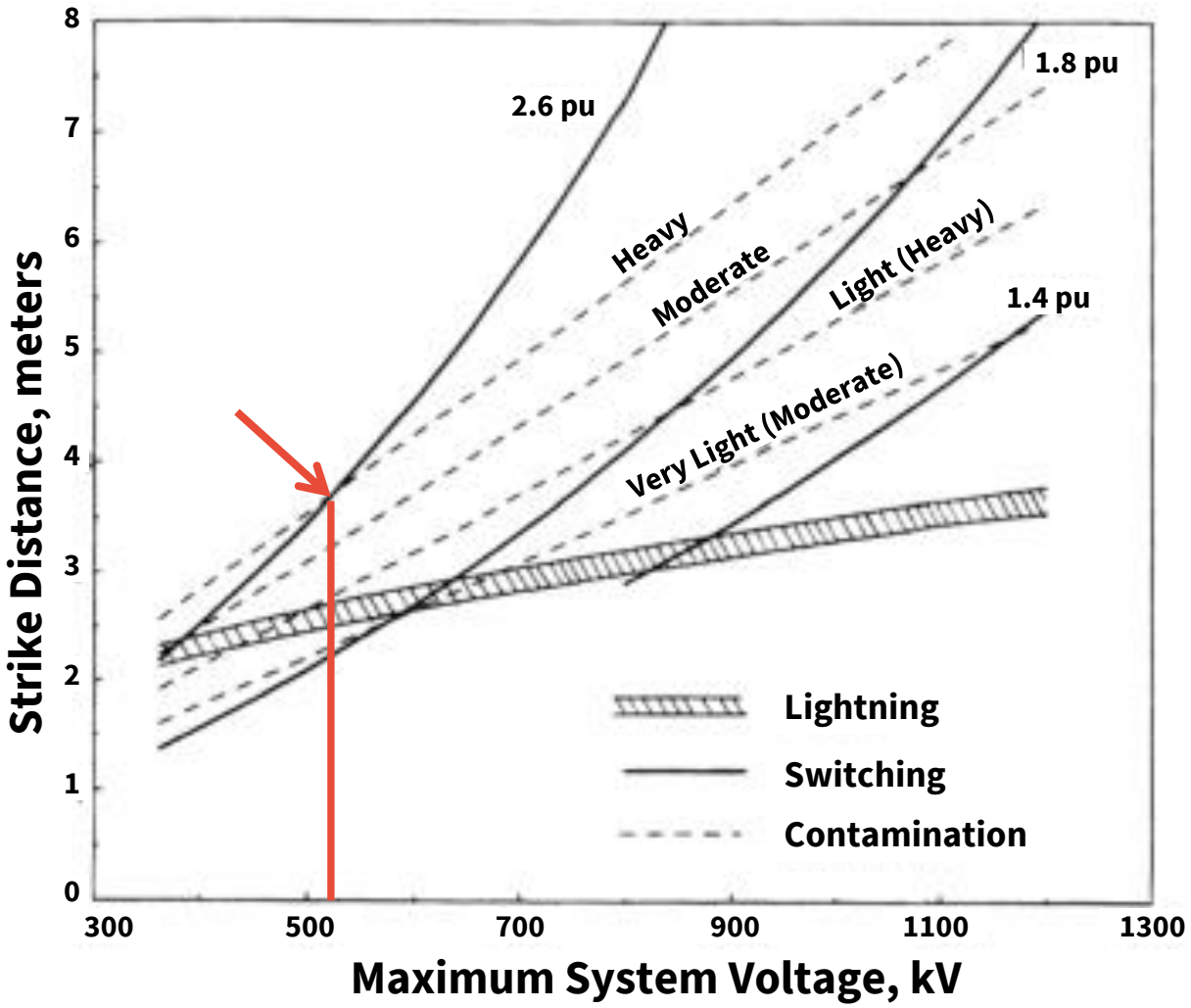
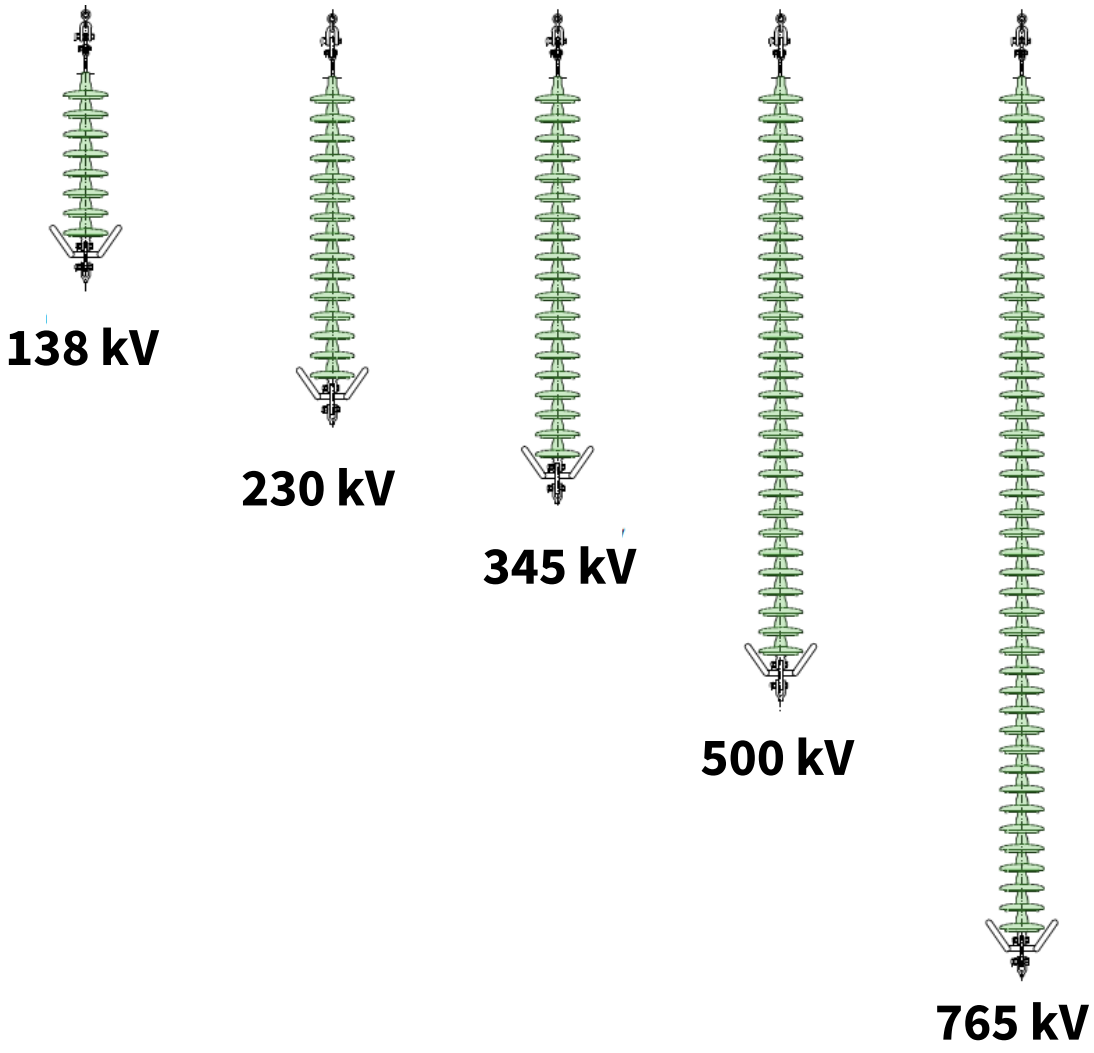
Considerations for Insulation Design





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Conductor Surface Gradient Comparison

Configuration	Voltage	Conductor Surface Gradient (kV/cm)	Mitigation
Single bundle	230 kV	17	
Twin bundle	345 kV	18	
Quad bundle	500 kV	17	
	765 kV	24	Increase sub-conductor spacing.
Hex bundle	765 kV	19	

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Electric Field Comparison

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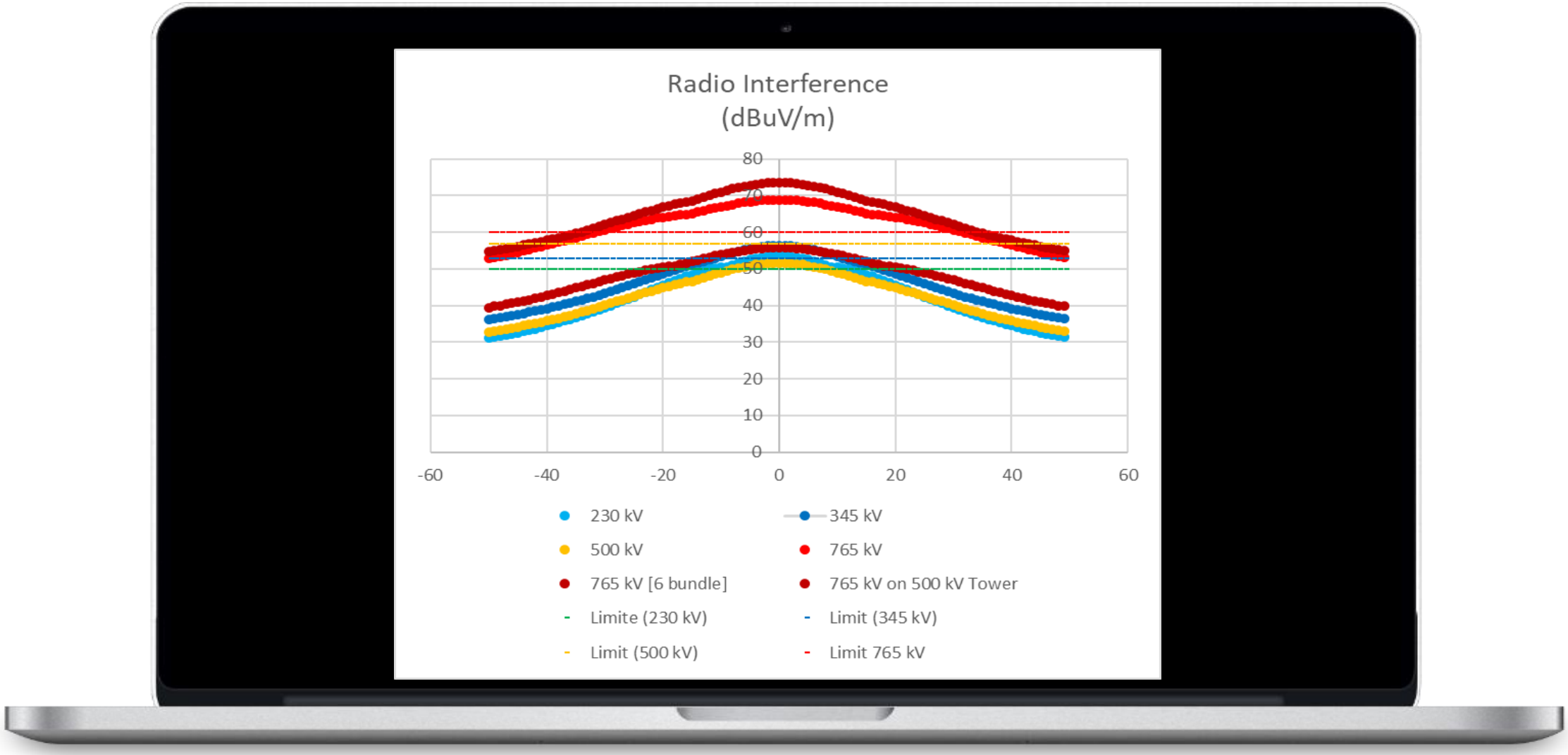
Radio Interference Comparison



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Audible Noise Comparison

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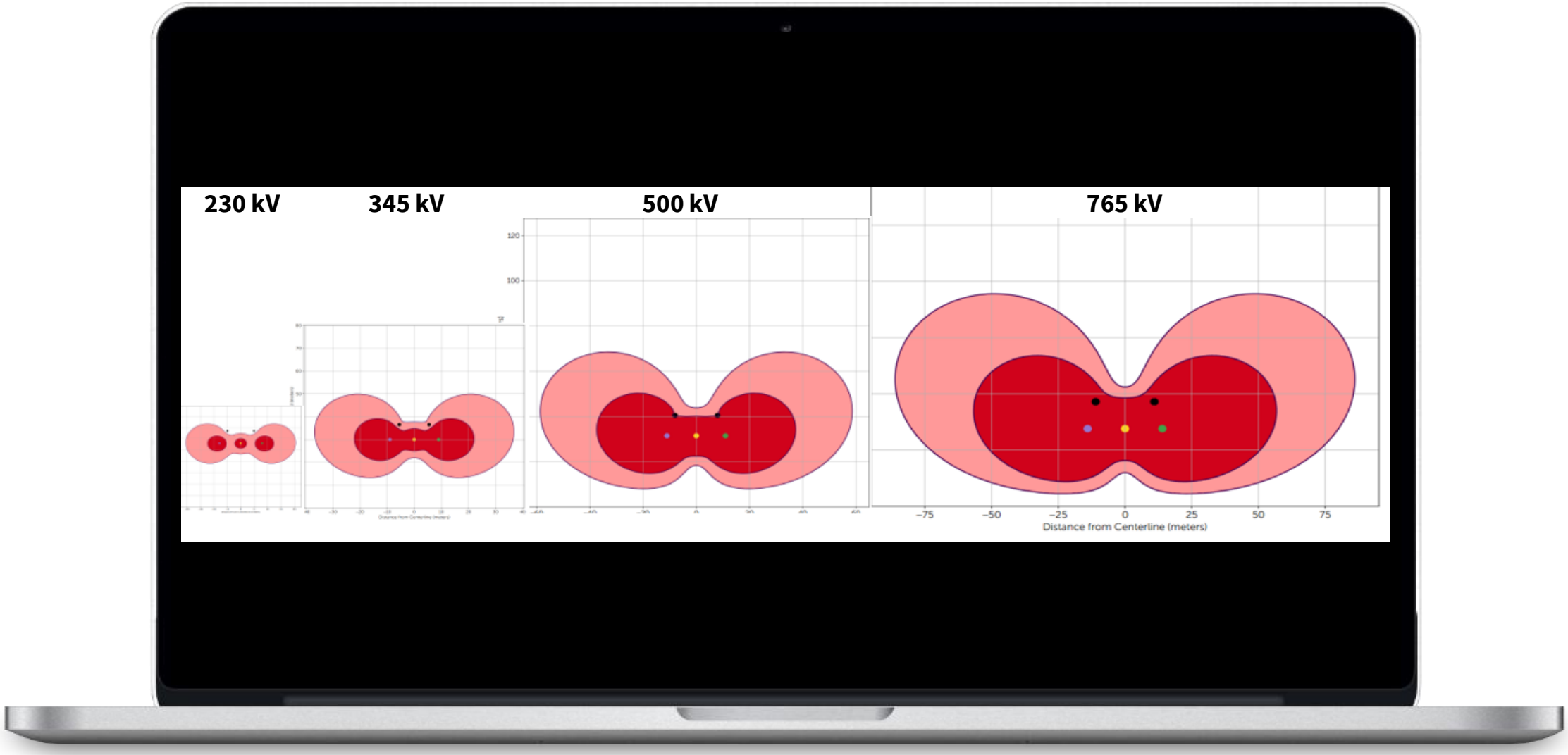
Space Potential Comparison



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Questions

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Thank you.

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