



33kV Lines Uprating

Overhead Lines Forum
May 2021
Andrew Hindle

**make
everyday
better.**

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Sensitivity: General

Presentation Overview

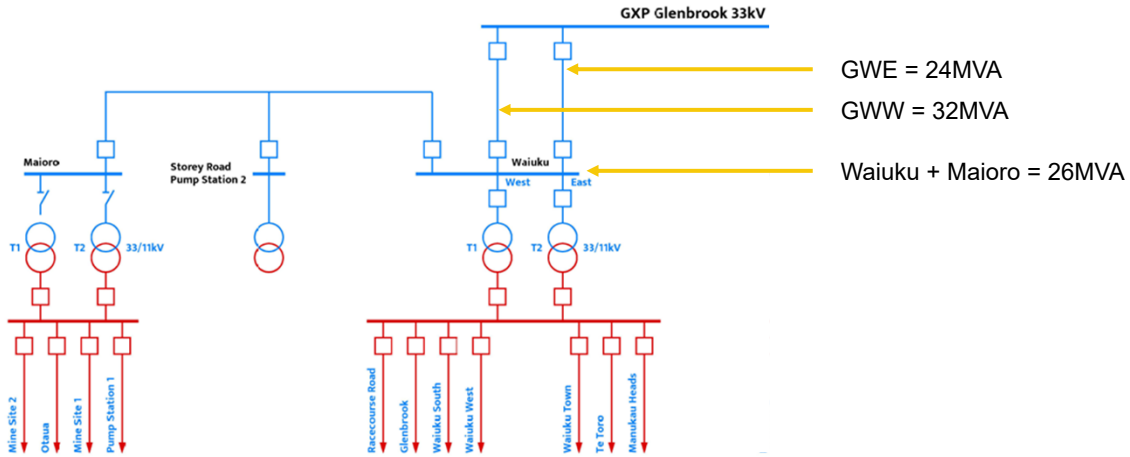
- Introduction to the project
- Uprating methodology
- Line analysis
- Deliverables for cost-benefit Analysis



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Sensitivity: General

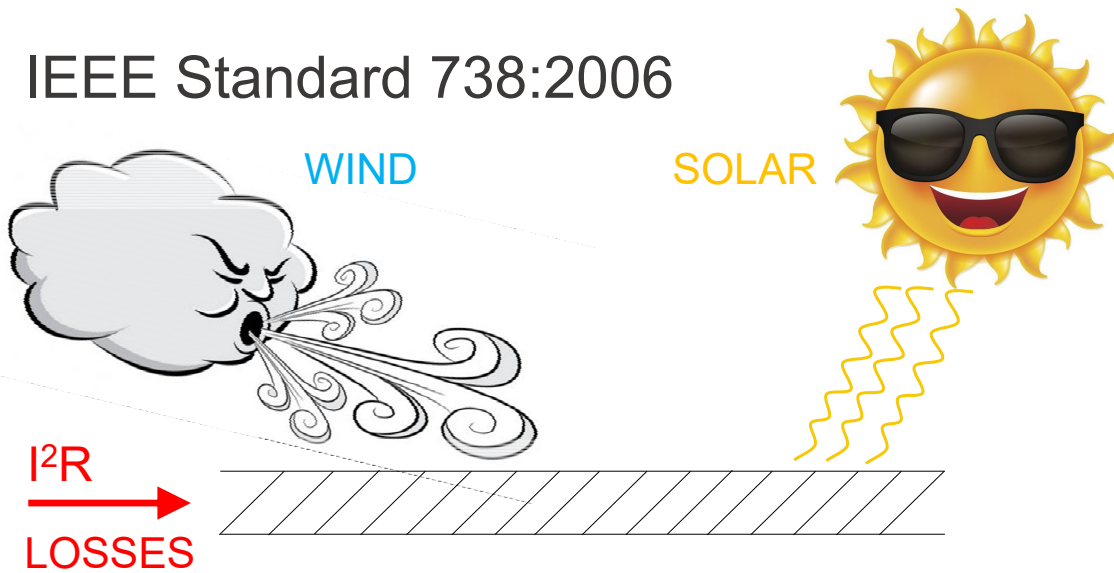
Project Intro – 33kV Line Uprating



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Sensitivity: General

IEEE Standard 738:2006



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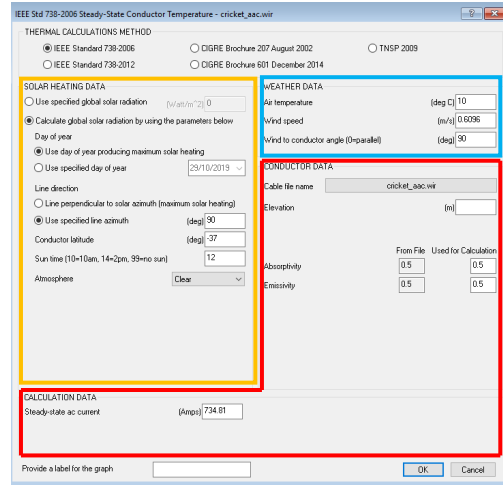
Sensitivity: General

Line Uprating Methodology

- IEEE 738 Method used in PLS-CADD
- Current equation

$$I = \frac{P}{V * \sqrt{3}}$$

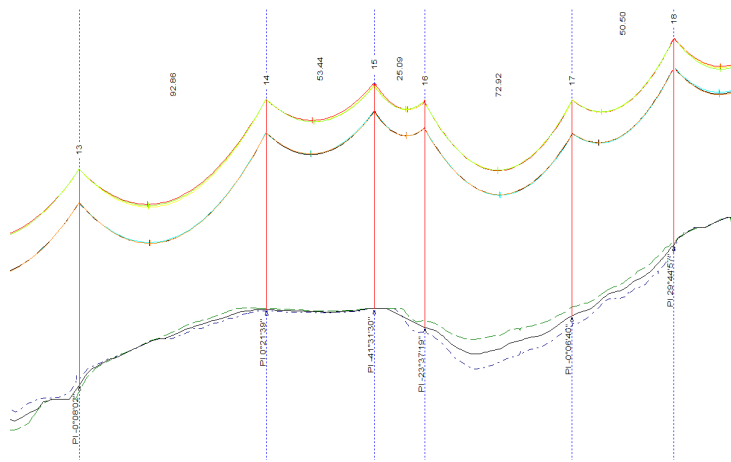
I = Current
P = Rating
V = Voltage
- Output is the maximum operating temperature



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Sensitivity: General

PLS-CADD Analysis & Outputs



- External clearance
- Internal clearance
- Circuit-to-circuit clearance
- Loads



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Sensitivity: General

Cost-Benefit Analysis

Section No.	Pole No.	Pole Number	Ahead Span (m)	Violation in ahead span				Max Violation	Rectification Options - Min. Req. / 26 MVA		
				Winter		Summer					
				Min. Req. 26 MVA	Min. Req. 26 MVA	Min. Req. 26 MVA	Min. Req. 26 MVA		Ground	C2C	Ground
10	91	405755	83m	0.2	-	-0.1	-	-0.1	Pole Replacement	Retension Section (7 spans, 3 of 4 violations rectified)	Pole Replacement
	92	407633	62m	0.2	-	0.1	-	0.1	Pole Replacement		Pole Replacement
	93	406259	86m	0.3	-	0.0	-	0.0			Pole Replacement
	94	408292	85m	-0.6	-	-0.9	-	-0.9	Pole Replacement	Pole Replacement	
	95	407194	73m	0.7	-	0.4	-	0.4		Retension Section	Pole Replacement
11	96	409031	50m	1.3	-	1.2	-	1.2			
	97	409117	60m	1.1	-	0.9	-	0.9			
	98	406035	51m	1.9	-	1.8	-	1.8			
	99	405735	0m	-	-	-	-	-			



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Sensitivity: General

Cost-Benefit Analysis

Section No.	Pole No.	Pole Number	Ahead Span (m)	Violation in ahead span								Max Violation	Rectification Options - 75% / 30 MVA								
				Winter				Summer													
				25% 30 MVA	50% 30 MVA	75% 30 MVA	100% 30 MVA	25% 30 MVA	50% 30 MVA	75% 30 MVA	100% 30 MVA		Ground	C2C	Ground	C2C	Preferred Option	Alternative Option A	Alternative Option B		
1	3	40564	12m	3.5	-	3.5	-	3.5	-	3.5	-	3.5	-	3.5	-	3.5	-				
	4	402303	50m	0.8	-	0.8	-	0.8	-	0.8	-	0.8	-	0.8	-	0.8	-				
	5	40237	10m	0.6	-	0.7	-	0.7	-	0.7	-	0.7	-	0.7	-	0.7	-				
	6	40767	45m	4.2	0.4	4.1	0.6	4.1	0.5	4.0	0.4	4.0	0.6	4.0	0.4	4.0	0.6	4.0	0.5	0.5	0.5
	7	40762	44m	3.9	0.4	3.8	0.5	3.8	0.5	3.7	0.4	3.7	0.6	3.7	0.5	3.6	0.5	0.5	0.5	0.5	
	8	40761	40m	3.9	0.2	3.7	0.2	3.6	0.1	3.5	0.1	3.5	0.1	3.5	0.2	3.4	0.1	3.4	0.2	3.4	0.1
	9	404138	54m	2.3	0.2	2.2	0.1	2.2	0.1	2.1	0.1	2.1	0.2	2.1	0.2	2.0	0.1	2.0	0.1	2.0	0.1
	10	405077	87m	2.8	0.4	2.7	0.4	2.6	0.4	2.5	0.3	2.4	0.4	2.3	0.4	2.3	0.4	2.3	0.4	2.3	0.4
	11	402704	92m	3.5	0.9	3.4	0.9	3.3	0.8	3.2	0.7	3.1	0.9	3.0	0.8	2.9	0.8	2.9	0.9	2.9	0.8
	12	402775	91m	2.4	0.7	2.3	0.6	2.3	0.6	2.2	0.5	2.2	0.7	2.2	0.6	2.1	0.6	2.1	0.6	2.1	0.6
	13	402766	91m	1.1	0.7	1.2	0.7	1.1	0.6	1.0	0.5	1.0	0.7	1.0	0.6	0.9	0.6	0.9	0.6	0.9	0.5
	14	402737	10m	4.2	0.4	4.1	0.5	4.0	0.5	3.9	0.4	3.9	0.6	3.9	0.5	3.8	0.5	3.8	0.5	3.8	0.5
15	402699	24m	1.5	0.5	1.5	0.5	1.4	0.5	1.4	0.5	1.4	0.6	1.4	0.5	1.4	0.5	1.4	0.5	1.4	0.5	
16	402694	74m	2.3	0.3	2.2	0.2	2.2	0.3	2.1	0.1	2.1	0.3	2.1	0.2	2.1	0.2	2.1	0.2	2.1	0.2	
17	402693	10m	1.1	0.5	1.1	0.5	1.1	0.4	1.1	0.4	1.1	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.4	
18	404626	18m	0.9	0.4	0.9	0.3	0.8	0.3	0.8	0.2	0.8	0.4	0.7	0.4	0.7	0.4	0.7	0.4	0.7	0.3	
19	404617	18m	1.2	0.2	1.2	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.0	0.2	1.0	0.2	1.0	0.2	1.0	0.2	
20	402593	10m	1.9	0.7	1.8	0.7	1.8	0.7	1.8	0.7	1.8	0.7	1.8	0.7	1.7	0.7	1.7	0.7	1.7	0.7	
21	402786	47m	2.9	0.6	2.8	0.6	2.8	0.5	2.8	0.4	2.8	0.6	2.7	0.5	2.7	0.5	2.7	0.5	2.7	0.5	
22	404163	50m	3.2	0.7	3.1	0.6	3.0	0.5	3.0	0.5	3.0	0.7	2.9	0.6	2.9	0.5	2.9	0.5	2.9	0.5	
23	402167	54m	2.2	0.7	2.1	0.7	2.0	0.7	2.0	0.7	2.0	0.7	2.0	0.7	1.9	0.7	1.9	0.7	1.9	0.7	
24	404144	10m	1.2	0.7	1.2	0.7	1.2	0.6	1.2	0.7	1.2	0.7	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	
25	402788	10m	1.6	0.8	1.6	0.8	1.5	0.7	1.5	0.6	1.5	0.8	1.5	0.7	1.5	0.7	1.5	0.7	1.5	0.7	
26	404172	10m	4.3	0.9	4.2	0.9	4.1	0.8	4.0	0.7	3.9	0.9	3.8	0.8	3.8	0.8	3.8	0.8	3.8	0.8	
27	404177	18m	1.3	0.7	1.3	0.7	1.2	0.6	1.2	0.6	1.2	0.7	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	
28	404173	18m	1.3	0.7	1.3	0.7	1.2	0.6	1.2	0.6	1.2	0.7	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	
29	402677	60m	2.4	0.6	2.4	0.6	2.3	0.5	2.3	0.4	2.3	0.6	2.3	0.5	2.2	0.5	2.2	0.5	2.2	0.5	
30	402674	54m	2.6	0.6	2.5	0.5	2.5	0.4	2.5	0.4	2.5	0.6	2.5	0.5	2.4	0.5	2.4	0.5	2.4	0.5	
31	402706	81m	3.2	0.5	3.1	0.4	3.1	0.3	3.0	0.2	3.0	0.5	3.0	0.4	2.9	0.3	2.9	0.3	2.9	0.3	
32	404154	74m	2.3	0.4	2.3	0.4	2.2	0.3	2.2	0.4	2.2	0.4	2.2	0.3	2.1	0.3	2.1	0.3	2.1	0.3	
33	402526	64m	1.1	-0.1	1.0	-0.1	1.0	-0.1	1.0	-0.1	1.0	-0.1	1.0	-0.1	1.0	-0.1	1.0	-0.1	1.0	-0.1	
34	402677	60m	2.4	0.6	2.4	0.6	2.3	0.5	2.3	0.4	2.3	0.6	2.3	0.5	2.2	0.5	2.2	0.5	2.2	0.5	
35	402788	47m	2.9	0.6	2.8	0.6	2.8	0.5	2.8	0.4	2.8	0.6	2.7	0.5	2.7	0.5	2.7	0.5	2.7	0.5	
36	402793	10m	2.7	0.4	2.6	0.3	2.5	0.2	2.5	0.1	2.5	0.4	2.4	0.4	2.4	0.3	2.4	0.3	2.4	0.3	
37	402626	48m	2.1	0.3	2.0	0.3	2.0	0.2	2.0	0.1	2.0	0.4	2.0	0.3	1.9	0.3	1.9	0.3	1.9	0.3	
38	402122	48m	2.8	0.2	2.7	0.2	2.7	0.1	2.6	0.0	2.6	0.3	2.5	0.2	2.5	0.1	2.5	0.1	2.5	0.1	
39	402677	60m	2.4	0.6	2.4	0.6	2.3	0.5	2.3	0.4	2.3	0.6	2.3	0.5	2.2	0.5	2.2	0.5	2.2	0.5	
40	402677	60m	2.3	0.5	2.3	0.5	2.2	0.4	2.2	0.3	2.2	0.6	2.2	0.5	2.1	0.4	2.1	0.4	2.1	0.4	
41	402714	10m	4.0	0.1	3.9	0.0	3.9	-0.1	3.9	-0.1	3.9	0.2	3.7	0.1	3.7	0.1	3.7	0.1	3.7	0.1	
42	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
43	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
44	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
45	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
46	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
47	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
48	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
49	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
50	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
51	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
52	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
53	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
54	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
55	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	
56	402677	60m	1.9	0.1	1.9	0.0	1.8	-0.1	1.8	-0.1	1.8	0.1	1.7	0.1	1.7	0.1	1.7	0.1	1.7	0.1	



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